Investigating Methodologies for Evaluating the Effectiveness of Integrated Spatial Information System (ISIS) Implementation in the Valuation Department of the City of Cape Town

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I dedicate this thesis to my girls; Mpho and Princess. May you one day understand why Mummy has never been there to give you attention.

Plagiarism Declaration

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Mphepelo J. Mabesa Leponesa Date: September 2014

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Abstract

The increasing need to develop fully integrated spatial information systems that help improve planning and decision making have led the countries to create partnerships as to facilitate the improved sharing of spatial data and to realise the full potential of spatial data infrastructure. In this process researchers and practitioners use appropriate methods, tools and frameworks to examine, analyse and evaluate the new implemented systems after its implementation. The attempt to find suitable methodologies for evaluating the effectiveness of the system has led to extensive research to develop, identify and test suitable methods and frameworks and to apply these to case studies.

This research investigates the methodologies for evaluating the effectiveness of Integrated Spatial Information Systems (ISIS) implemented in the Valuation Department of the City of Cape Town. The spatial information systems of Valuation Department and the effectiveness of ISIS implementation in this Department are investigated. Theories, methods and tools are employed in this research. The research uses mixed method approaches to develop an in-depth understanding of this spatial information system in the Valuation department, and to examine, analyse and evaluate its effectiveness. The mixed methods approaches used include single case study strategy, Structured System Analysis & Design Methods (SSADM), System Development Life Cycle (SDLC), Business Systems Planning Approach (BSP) and Information System Success Models such as DeLone & McLean Information System Success (D&M) IS, Technology Acceptance Model (TAM) and Integrated Success Model (ISM).

The findings of this study suggest that the implementation of ISIS in the Valuation department is both effective and ineffective. The research findings show that ISIS implementation fails to meet the needs of all users and to improve the Valuation Department business since it is not implemented as it was originally designed. The effectiveness of ISIS results from the fact that ISIS has achieved its main objective of integrating the six business units of property value chains in order to stream line business and Valuation department is not an exemption. The analysis contributes to understanding of the spatial information systems in the City of Cape Town providing property information integrity on Valuation department. It further provides the spatial information system research community with valuable information on the use of system analysis theories, information system success models in spatial information systems.

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Acronyms

SDI:	Spatial data Infrastructure
CCT:	City of Cape Town
GIS:	Geographical Information Systems
LIS:	Land Information Systems
SAP:	Systems, Applications and Products in Data Processing
ERP:	Enterprise Resource Planning
ISU:	Industry specific Solution for Utilities
SIGMA:	Property Management System
ISIS:	Integrated Spatial Information Systems
IS:	Information Systems
D&M:	DeLone & McLean
TAM:	Technology Acceptance Model
ISM:	Integrated Success Model
SSADM:	Structured System Analysis & Design Methods
SDLC:	System Development Life Cycle
BSP:	Business System Planning
NRM:	Natural Resource Management
HLM:	High-level model
FFIEC:	Federal Financial Institutions Examination Council
IT:	Information Technology
ZF:	Zachman Framework
OLAP:	Online Analytical Processing
EIA:	Enterprise Information Architecture
FACTS:	Framework for Analysis, Comparison, and Testing of Standards
AS-IS:	Current information systems
PDSA:	Plan-Do-Study-Act
DSS:	Decision Support Systems
INSPIRE:	Municipalities at the European level
ICT:	Information & Communication Technologies
TRA:	Theory of Reasoned Action
TLIMS:	Tribal Land Information Management Systems
RFID:	Radio Frequency Identification
HRIS:	Human Resources Information Systems Success Assessment
HSM:	Hard System Methodology
LBMS:	Burchett Management Systems
CCTA:	Central Computing and Telecommunications Agency
UK:	United Kingdom
DFD:	Data Flow Diagram
IS:	Information Success
PIR:	Post- implementation Review
U:	Perceived usefulness
EOU:	Perceived ease of use

BI:	Behavioural Intention to use
LUM:	Land Use Management
GRM:	Government Revenue Management
UCT:	University of Cape Town
VSI:	Valuation Infrastructure Support
CAMA:	Computer Assistant Mass Appraisal
PVC:	Property Value Chain
GDP:	Gross Domestic Product
GV:	General Valuation
SV:	Supplementary Valuation
LAN:	Local Area Network
ID:	Identity
ST:	Sectional Title
SG:	Surveyor General
PSRM:	Public Sector Record Management
SAP LUM RE –FIX:	SAP LUM Flexible Real Estate
BPO:	Business Process Owners
IPOS:	Integrated Planning Ordinance System
P&BDM:	Planning & Building Development Management
SAP PI:	SAP Process Integration
IS&T:	Information System &Technology
SII :	Spatial Information Infrastructure
TMD:	Technical Master Data Interface

Chapter 1. Introduction

1.1 Background

Spatial information is essential in "social, economic and political decisions" (McDougall *et al.,* 2007). Due to this role it is regarded as a nationwide resource important for broader social benefits (McDougall *et al.,* 2012). Many governments, business and the overall community depend on spatial information for applied decisions making. Local governments are the custodians of many strategic spatial data sets. As a result, the government must play a critical role in the upgrading of the national spatial data infrastructure (SDIs) that depend severely on the incorporation of spatial data from the lower levels of government (McDougall *et al.,* 2007).

In view of government's role in spatial information, several cooperative partnerships among local and state government have developed. These partnership are created to expedite enhanced allocation of spatial data and to grasp the complete prospective of a spatial data infrastructure (McDougall *et al.,* 2007). In order to achieve maximum benefit from Spatial Data Infrastructure SDIs it is crucial to know the aspects that contribute to the effective and viable operation of these partnerships. As perceived by McDougall *et al.* (2007), there are related issues such as organisational, technical, legal and economic which still obstruct the incorporation of spatial information in varied data distribution environments. On the other hand (Siriba and Hussein, 2006) perceived that SDI development efforts are extremely compelled by both technology or application and are thus doubtful to become full effective and serve the anticipated purposes.

As a result of that, many methods have been utilized for information management, however the current are the e-government strategies. These strategies are meant to improve service delivery, manage information, provide online database of geo-information such as cadastral, geodetic, and topographical by government supports through Spatial Data Infrastructure (SDI) (Siriba and Hussein, 2006). Due to this implemented strategies, SDI now became the governing devices that nations are setting in place to reach their geospatial information management. However, most countries are confronted with complications in designing suitable spatial data infrastructure to support real land administration, and incorporating cadastral data and topographic spatial data particularly in topographic forms. Therefore, it is required to build, design and manage land information systems functions that incorporate

proper spatial data infrastructures. This is because land administration functions are established on and are aided by suitable land information infrastructures (Siriba and Hussein, 2006). Over the last decade, the improvement of the spatial data infrastructure (SDI) has progressed as a crucial strength in the management of spatial information (Williamson, 2005).

South Africa like most of the Southern African developing countries has also struggled to develop a fully integrated land information system so that activities associated with land can be planned effectively. The City of Cape Town in South Africa is one such example. Property information in the City is seen as the foundation of City of Cape Town functions and operations. It is the one that sustain the City's core business of land management. These property data consisted of spatial and attribute. The attribute data stored in the City was composed of land records and ownership details obtained from Deeds Office whereas spatial data was kept in the Corporate GIS and mainly consisted of cadastral data acquired from Surveyor General. It was estimated that spatial data and information constituted 80% or more of the data and information within a municipality (City of Cape Town ISIS project, 2008).

However, a number of problems were identified with the property systems in the City of Cape Town. One of the major problems identified was inaccessibility of data which resulted from the absence of a central database. As a result, the City decided to embark on a project which will fully integrate property information into a single database that contains both attribute and spatial data and to develop and integrate all other systems to source data from this central database (City of Cape Town ISIS project, 2008).

1.2 Statement of the Problem

The City of Cape Town land information systems has for a long time been experiencing many problems in relation to efficiency and effectiveness. It had declared the current integrated land information systems ineffective towards management of property information. The City had different systems and databases that were used to capture, maintain, disseminate and manage spatial (including property) data. Those systems responsible for property data were land information system and Corporate GIS and these different systems lead to ineffective management of property information.

Availability of quality and relevant data and information is a necessary foundation for effective knowledge management in the City of Cape Town (CCT). The spatial information

constitutes a large part of the CCT's information base, it is therefore necessary to have an effective spatial information strategy which will go a long way in building a solid knowledge management base in the City (City of Cape Town ISIS Project, 2008).

Key problems identified in the CCT land information system include unclear custodianship of data, duplication of data, and lack of metadata, limited integration and sharing of data and limited accessibility to information. The absence of an agreed framework and strategy for managing the CCT's spatial information is one of the major key issues that resulted in the key problems identified above. Lack of staffing and skills has also led to ineffective management of information even though there was established GIS infrastructure. Furthermore, lack of investment in spatial information management has also over the years meant a short fall of CCT in terms of effective property management (City of Cape Town ISIS Project, 2008).

The ultimate results of poor land information system in the City were the formation of obstacles to data sharing within a property market that was naturally multifaceted and different. It is clear that many departments in the City were collecting and maintaining the same data elements due to different systems that were used to manage spatial information. Therefore, these departments were not even aware of the data available to other departments and that ignorance and unclear custodianship resulted in duplication of data collection and management (City of Cape Town ISIS Project, 2008).

It is a fact that this duplication have led to an excessive waste of time and funds which could be used to provide for other services. Furthermore, absence of a centralised database makes data not readily available as well as duplications where other business units have to re-update the same data on Geographic Information System (GIS) or Land Information System (LIS). The data that is stored in these several different databases is also kept in a variety of formats and thus makes it to be difficult to access and manipulate the information (City of Cape Town ISIS Project, 2008).

In view of the problems of City of Cape Town land information management and related consequences discussed above, the CCT decided to put into practice Systems, Applications and Products in Data Processing (SAP) Enterprise Resource Planning (ERP) in 2003 which was an interim system until a new fully integrated system was to be developed (City of Cape Town ISIS Project, 2008).

The background information provided in this section indicates that the CCT failed to deliver effective integrated land information systems. SAP ERP was established as a short-term system because it was not able to provide for the property system. SAP ERP system was to function as a warehouse of property information and operate as a linkage between the Town Planning Systems (where properties are created), Industry Specific Solution for Utilities (SAP ISU, billing system) and the property management system of Valuations; SIGMA. The purpose of the system was to link to GIS so that spatial data can be easily displayed. This system was set up to use LIS data and was finally named as the Land Information System. The plan was that LIS would acquire data from various systems such as Planning Systems and Councils allowing SAP to be updated through automated interfaces. This did not however occur as expected because the way data was used and updated caused too many problems (City of Cape Town ISIS Project, 2008).

Consequently, the City of Cape Town embarked on a project ISIS (Integrated Spatial Information System) in 2006 in order to improve integrity of property information. The projects had several objectives such as; to improve productivity and service delivery through streamlining business processes relating to management of property information, to provide accurate information to the public, to eliminate duplication of data, to improve interdepartmental collaboration, to allow easy access to spatial data and to save time (Cape Town ISIS Project, 2008). This project was implemented by the Strategic Development Information and GIS Department in the City. The scope of this project consists of six departments of the City of Cape Town responsible for property value chain.

In order for the City of Cape Town to implement this project, the previous system in these various departments was investigated and identified. First the project went through the analysis phase, the design phase and eventually to an implementation phase. It was implemented on the 25th November 2011 and was implemented in the six departments of CCT responsible for property value chain. The six departments are Valuations, Revenue, Corporate GIS, Property Management, Planning and Built Development and Housing (City of Cape Town ISIS Project, 2008).

This study will therefore evaluate the effectiveness of ISIS project in one of the six integrated business units which is Valuations department. The evaluation of the system is based on the performance of the ISIS project, to see whether ISIS is indeed achieving its goals and objectives towards improving property information integrity.

1.3 Research Objectives

In order to assess whether ISIS is indeed improving the Valuation business in terms of improving property information integrity, this study will therefore aimed at the following:

- To identify suitable model/frameworks which are appropriate in evaluating the effectiveness of spatial information systems such as ISIS in the Valuation Department.
- To describe the current status of spatial information system in the Valuation department and ISIS in a detailed case study narrative.
- To evaluate from a system perspective, ISIS implementation effectiveness in the Valuation Department and identify the performance gaps of ISIS implementation in the department.
- Examine the availability of the basic components of integrated property information system and the ability of ISIS to meet the needs of system users, whether ISIS is indeed improving the Valuation business in terms of providing the necessary data to the department.

1.4 Research Questions

This study seeks to address the following issues:

- In evaluating the effectiveness of ISIS implementation in the Valuation department, what research methodologies are suitable for analyzing and evaluating ISIS?
- What is the status of the spatial information system in the Valuation department?
- Is ISIS effectively implemented in the Valuation department of the City of Cape Town?
- How does ISIS implementation in the Valuation department seek to meet the needs of the users of the systems towards improving Valuation business?

1.5 Scope of the study

This study is limited to the use of appropriate evaluation and analytical methodologies for an analysis in the case of ISIS implementation effectiveness in the Valuation Department of the City of Cape Town. The findings of the evaluation are then summarized. The interventions are outside the scope of this thesis.

1.6 Research Design & Methodology

This study is an investigation at the methodological and practical level. It adds to the knowledge of how to evaluate and analyze the implemented systems and understanding of the integrated information systems. The effectiveness of ISIS implementation in the Valuation department is evaluated using relevant theoretical frameworks, information systems evaluation models and system analysis methodologies that will enable the researcher to achieve the objective of this study. The methods used in this study include single case study strategy, mixed method, structured methodologies and information system evaluation model.

The information systems (IS) evaluation models composed of DeLone and McLean Information Success Model (D&M) IS, Technology Acceptance model (TAM) and Integrated Success Model (ISM) (Zaied, 2012). These three interrelated models will be used to evaluate the effectiveness of ISIS in the Valuation department with focus on the technical and operational aspects of information systems. These systems models are applied in order to analyze performance of the system. The structured methodologies are Structured System Analysis & Design Methodologies (SSADM), System Development Life Cycle (SDLC) and Business System Planning Approach (BSP)/Zachman framework. These methodologies are applied in order to analyze the system implementation of spatial information in the City of Cape Town.

The study also uses single case study strategy (Yin, 2003). This case study is a pragmatic exploration that explores the present phenomenon inside its actual life setting. This occurs particularly while the boundaries between the phenomenon and setting are not clear (Yin, 1994). The single case study strategy adopted in this study implies that the ISIS implementation in the Valuation department of City of Cape Town is investigated in its real and natural setting. In this case study, multiple sources of evidence are used. This expedites a complete view of the occurrence that improves rigour. The use of multiple data sources reinforces the generalizability of the study findings, even though this research is geared to naturalistic generalization (Denzin and Lincoln, 1998). The primary data is from structured questionnaires and semi-structured interviews with the key informants and from participant observation. Secondary data is based on project documentation, reports, journal papers and published books.

The two structured questionnaires were distributed to cover categories of the system users and Valuation Department Managers in order to evaluate the integrity of the system properties to provide necessary data.

In-depth, unstructured and semi-structured interviews with key informants were utilized in the study. The key informants were chosen in this case study since they have sound knowledge of the system and they are unique in this research due to the role they play. For this specific study, key informants are Valuation general staff, Valuation Managers and the ISIS project implementation unit staff.

Participant observation is an essential source of evidence. The researcher has been an employee of the case study. Participant observation may add to bias in this enquiry. Nevertheless, the researcher minimizes this by applying triangulation of evidence from various data sources.

Integrated Success Models (ISM), SSADM, SDLC & BSP are used for analysis and are motivated in chapter 5 of this thesis. In summary, modelling using ISM provides a vigorous gauge of the success of information systems implementation. This is tested by measuring the systems qualities such as system effectiveness, efficiency, flexibility, reliability and appropriateness. SSADM are structured methodologies that are data-driven and emphasize on data modelling and database in a system. SDLC are methodologies used to find the best solution for a clearly defined problem and models the processes (Avison & Taylor, 1997). BSP concentrates on business processes which are obtained from an organization's business mission, objectives and goals (Pant & Hsu 1995). The use of these analytical frameworks adds to the understanding of the spatial information systems in the City of Cape Town from different perspectives.

This research is therefore based on investigating methodologies for evaluating the effectiveness of Spatial Information Systems such as ISIS implementation in the Valuation department of the City of Cape Town.

1.7 Organization of the Document

The research design encompasses the crucial components of examination in the actual problem solving arrangement (Pelto and Pelto, 1978). The chapters in this thesis are organized to guide rationality on one another and report the research objectives and answer the research questions in coherent way. The thesis is composed of ten chapters.

Chapter 1: Introduction; this chapter gives the background and introduces the research problem. It gives research objectives. Research questions and the research methods are engaged to answer the research questions that are established. The design, scope and limitations of the research are discussed and the outline of the thesis is summarized.

Chapter 2: Theoretical Frameworks for Research in Spatial Information System: This chapter discusses the overall analytical, methodological and theoretical frameworks used in information system research and appropriate to this study. It involves single case study strategy, mixed method and system analysis theory (SSADM, SDLC, and BSP).

Chapter 3. Information Systems Evaluation Success Model Theory: This chapter gives a general description of information system evaluation success model which is relevant to this research. This comprises DeLone & McLean Information System (D&M) IS, Integrated Success Model (ISM) and Technology Acceptance Model (TAM).

Chapter 4: Review of Previous Research in Spatial Information System: the chapter reviews prior research in integrated spatial information systems and general information systems that can enlighten this research. It presents the research which has utilized the mixed method approaches, the single case study research strategy, hard system methodologies such as SSADM, SDLC and BSP. It further reports on the use of interrelated Information Systems Success Models such as D&M IS, TAM and ISM.

Chapter 5. Analytical Methodology: the chapter presents the tools, techniques and methodologies that are adopted in this research. It stimulates the benefits of making use of the following in understanding the present spatial information systems implementation in the City of Cape Town: Single case study strategy, mixed method approach, SSADM, SDLC, BSP, ISM, TAM and D&M IS. Table 1.1 gives a summary of these mixed methodologies used in the study together with references sections in which they are addressed.

Table 1.1 A summary of mixed methodology and their reference section

Mixed Methodology Used	**Sections where Mixed Methodology are discussed in the Thesis**
Single Case study Strategy	The description of Case study Strategy is explained in section 2.3. The examples where this is applied are described in section 4.2.1. The suitability of the case study strategy is described in 5.4
Mixed Methodology Approach	This is defined in section 2.2. The examples (literature) are described in section 4.2.2. The suitability of the methodology is described in section 5.3
Information System Methodologies	This is presented in section 2.4. The examples are described in section 4.3. The suitability of the methodology is described in section 5.5.
Information System Evaluation Success Models	This is discussed in section 3.3. The examples are described in section 4.4. The suitability of the Models is described in section 5.6

Chapter 6: The Narrative Description of the Spatial information systems of the City of Cape Town- Valuation Department: the chapter deals with narrative description of the phenomenon of the Valuation. The single case study strategy is applied to lead the process. Various viewpoints of the case are obtained through the interviews with key informants and participant observation (the researcher forms part of the spatial information system as a member of the City government) and documents are broadly castoff. The chapter is critical as it is a foundation for system analysis.

Chapter 7: Narrative Description of ISIS in the City of Cape Town: this chapter gives a narrative description of the implemented spatial information systems in the City of Cape Town. The Valuation department defined in the preceding chapter is part of ISIS, it is hence necessary to describe the implementation of the current system. This chapter uses the single

case study data collection techniques and utilizes various sources of data to have a general sight of the system. The narrative contributes to understanding of the ISIS, and informs the analysis.

Chapter 8: Analysis of the Spatial Information System in the Valuation Department: the chapter is informed by chapter 6 and 7. It evaluates the case from a system angle. The spatial information system of Valuation department is investigated using system analysis methodologies. The detailed analysis of system organizational structure, strategy and information architecture is analyzed using BSP. The analysis of user needs and problems are investigated using SDLC. The documentation of business processes are investigated using SSADM. This assists in identification and analysis of the present system status. The analysis contributes to the understanding of the system from the different perspectives. This chapter is crucial because it gauges performance of the new current spatial information system in the city of Cape Town.

Chapter 9: Analysing the Effectiveness of ISIS implementation in the Valuation Department: this chapter is informed by chapter 7. It evaluates the effectiveness of ISIS implementation in the Valuation department. It assesses the success of the implemented systems in terms of system quality, information quality, service quality, and user satisfaction, perceived ease of use and perceived usefulness. All these assessments are performed using information system success models such as D&M IS, ISM and TAM. Lastly, issues and opportunities with the new system are identified as to see whether ISIS is able to meet the needs of the users toward improving Valuation business. The review results of the evaluation of spatial information system of the Valuation department may be used to strengthen the system and development of system procedure.

Chapter 10: Conclusion & Recommendation: the chapter reveals the conclusions of the investigation of this pragmatic study. Succeeding conclusion, recommendations for more research and improvements to Valuation and ISIS are discussed.

Chapter 2. Theoretical Frameworks for Research in Spatial Information Systems

2.1. Introduction

This chapter discusses the theoretical frameworks, methodologies and analysis frameworks appropriate in spatial information systems research. It is composed of mixed method, single case study strategy, System Development Life Cycle (SDLC), Structured System Analysis & Design Methodology (SSADM) and Business System Planning approach (BSP)/Zachman framework.

2.2 Mixed Methodology Defined

Mixed methodology is a mixture of "quantitative and qualitative data in a single study or series of studies" (Cameron, 2011). It includes using theoretical norms that guide the direction of data collection and analysis. The use of both quantitative and qualitative methods offers a better understanding of research problems that exists alone (Cameron, 2011). It also provides understanding of the world by a theory of procedure in terms of events and interactions. Mixed methodology provides a basis for hypotheses guiding assumptions to contest and give alternatives (Niger, 2012). It also adopts the use of induction, deduction and abduction (Cameron, 2011).

The use of mixed methodology requires an insightful gratitude of the threat to rationality acquired in the approaches being mixed. The social world is perceived to be dynamic. The author emphasized that validating an investigation by replication is misguided because social phenomena do not preserve still and are recursive. He therefore encourages using mixed methodology in research in order to address such problems (Niger, 2012). However, Niger (2012) pointed out that using mixed methodology in complex problems often involves epistemological simplicity and complexity. Nonetheless, the methodology has so far attracted many researchers in different fields of social and behavioural sciences to study social phenomena.

2.2.1 Challenges to the Use of Mixed Methodology

Mixed methodology approach faces challenges which could affect exploration of events. Such challenges include "representation; legitimation; integration and politics" (Collins and Onwuegbuzie, 2007). Representation involves the use of sampling dimensions that are too

small to be detected statistically and also uses non- random samples that avoid effect-size approximations from being generalized to the primary population. Legitimation result from the difficulty in attaining results and or creating inferences that are reliable in a study. Integration challenges forces the mixed method researchers to raise questions about whether it is applicable to triangulate, increase, relate, or combine quantitative data (Collins and Onwuegbuzie, 2007).

Furthermore, political challenges occur due to the tension that emanate beforehand as a consequence of integrating both qualitative and quantitative methods. The tension involves any disputes that arise when various researchers are used for the qualitative and quantitative elements of a study. It also includes the disputations and inconsistencies that arise to the front when qualitative and quantitative data are contrasted. It was further stated that political challenges occurs when the mixed methodology consumers are not encouraged to worth the results obtained from both qualitative and quantitative stages of a study (Collins and Onwuegbuzie, 2007).

2.3 The Case Study Strategy

Case study research strategy is an inquiry of existing phenomena using numerous sources of evidence contained in real life setting (Yin, 2003). It is useful in conducting qualitative and quantitative research together in order to analyse processes in the society (Denzin and Lincoln, 1998) and also to understand the connections between information technologies (IT) related improvements and organisational settings (Darkie *et al.,* 1998). Case study strategy is perceived as a strategy different from other research approaches because of utilizing multiple sources of pragmatic data in a research. Multiple sources of evidence comprise questionnaires, documents, direct observation, interviews, participant observation, archival records and physical objects (Yin, 2003).

It is further stated that the strategy is progressively used to perceive and examine existing problem in the world. As a consequence, its results contribute understanding the individuals, organisation, and social structures (Yin, 2003). Darke *et al.,* (1998) also commended that the strategy has so far fascinated the attention of information systems researcher as a valuable means of exploring the improvement, application and use of information systems in organizations.

Furthermore case study strategy is mostly appropriate when the "how" and "why" questions are raised in research. These questions aim to give reasons and understanding of how and why specific proceedings occur. The strategy is vital also in providing understanding of the problem rather than to offer resolutions to the difficulties that are observed, though it might assists and provide directions to solutions (Yin, 2003).

2.3.1 Single Case Study Strategy

Single case study strategy is normally used to examine an intrinsique, unique case or extreme case (Denzin and Lincoln, 1998, Yin, 2003). They are used to produce a rich narrative of the phenomenon for understanding better and hence contribute to knowledge. This research strategy prefers naturalistic generalisation although, generalisation of results is not emphasized (Denzin and Lincoln, 1998). The strategy can further be utilized to build a new theory and improve on the current ones. The use of single case study in spatial information systems research comprising those of Kurwakumire (2011) and Kurwakumire (2014) are good examples.

Intrinsic Single Case study

Intrinsic single case study is used by the researcher who has genuine interest in the case with the intention to understand the case better. The purpose of the case is not to build theory and to understand some abstract construct or generic phenomenon (Stake, 1995).

Unique Single Case

Unique single case study is built by the physical environment, history, culture and the difficulty of the condition with respect to the political, social and economic aspects (Denzin and Lincoln, 1998, Yin, 2003). For example; a single case study of GIS evaluation in the context of public sector of Uganda in Kurwakumire, (2011) is unique.

Extreme or Critical Single Case Study

This kind of single case study approach explores an important phenomenon in scarce or extreme situations (Denzin and Lincoln, 1998). An instance is the investigation of a contemporary phenomenon of spatial information systems in the public sector by Kurwakumire (2014) and Dessers, *et al.* (2012).

2.3.2 Sources of Evidence in Case Study Strategy

Case study strategy is categorized by various data sources. Every data source substantially adds to the investigator's understanding of the entire phenomenon in the research (Yin, 2003; Baxter and Jack, 2008). Yin (2003) pointed out that a case study database is usually created to enable a sequence of evidence to be sustained. Baxter and Jack (2008) also stated that the use of database improves the consistency of the case study. This is because it lets the investigator to track and arrange data sources stored in a database to easily retrieve in the future. As a consequence, information from these data source is converged through data analysis, instead of handling them individually (Baxter and Jack, 2008).

This convergence enhances strength to the results since the numerous components of data are plaited collectively to promote a better understanding of the event (Baxter and Jack, 2008). Triangulation of results improves construct strength and results into a complete understanding of the case and reinforces the study outcomes while accomplishing a severe case study (Denzin and Lincoln, 1998, Yin, 2003, Baxter and Jack, 2008). Multiples sources of data are discussed below.

Documentation

The case study documentation can be presented in many forms and includes letters, agendas books, administrative documents, reports, journals, memorandums, and newspapers (Denzin and Lincoln, 1998, Yin, 2003). The documents are stable, unobtrusive, exact and cover a broad coverage. However, even though they are useful, they are not always accurate and may report bias, they are also difficult to be retrieved and accessed (Yin, 2009).

Archival Records

This source usually takes the form of computer files and records with records archived in store rooms. It mostly includes service records, personal records, organisational charts, organisational records, maps and client entry records (Yin, 2003). These kinds of records are precise and usually quantitative. However, they are not easily accessible due to privacy (Yin, 2009).

Observations

Observation consists of participant observation and direct observation. These techniques serve as key data sources in case study research strategy motives. Participant observation is a

specific type of observation in which one is not just a passive observer. Thus the observer is insightful into interpersonal behaviour and motives. Participant observer is absorbed in people's lives which could be experienced by staying in the local community (Yin, 2009). Nevertheless, the technique has difficulties connecting to validity and consistency (Yin, 2003). They are biased due to participant observer's manipulation of events, observer effects and absence of checks (Yin, 2003, Yin, 2009).

Direct observations cover events in real time and are contextual (Yin, 2009). They involve the existence of the investigator in the social situation with the drive of perceiving each phase of people activities in a situation (Yin, 2003). Observation repeatedly provides signs around why the present system is not working properly. The technique is worthy for locating bottleneck and inspecting details that have already been noted (Yin, 2003). Furthermore, direct observation is discreet and does not require direct interaction with participants. It is useful for looking at facilities and also for identifying problem situations (Yin, 2003). Thus the observer can take notes as they observe. However, direct observation is limited since they are time consuming, selectivity, reflexivity and are costly (Yin, 2009).

Personal Experience

Personal experience reveals the stream of opinions and values an individual conveys to their instant condition. The technique assumes the outline of a description. However, it is hard to directly study the lived experiences because speech, language and opinions facilitate and explain the know-how the researcher is trying to define (Pelto and Pelto, 1978).

Interviews

Interviews are means of collecting information over verbal quiz by a set of pre-planned core questions (Denzin and Lincoln, 1998). Interviews are divided into three types such as: structured, unstructured and semi-structured interviews. These kinds of interviews give qualitative information and are planned in such a manner that they encompass a broad variety of research objectives. Interviews are very useful as the interviewer could follow particular concerned issues that may results to focussed and positive proposals. Thus some interviewee's response leads to extra questions (Denzin, and Lincoln, 1998). As a result, the style of interviewing permits much freedom for the interviewee to give their individual opinions and involvements connecting to the case (Neuman, 2000). The interviews also provide perceived causal inferences and explanations since they directly focus on case study topics (Yin, 2009).

However, they are limited in the sense that they are bias because of ailing articulated questions and the response; they are also imprecise due to poor recall (Yin, 2009). It was further stated that in qualitative research, the interviewer can simply distract from the aims of the interviewee (Neuman, 2000). Conducting interview is affected through factual features of an interviewer such as class, ethnicity, race, and gender. However, interviews with key informants are exceptional and might reflect life histories (Denzin and Lincoln, 1998).

Structured interviews

Structured interviews allow the interviewer to use a set of prearranged questions that are short and well written. The questions asked in the interview are mostly closed. As a result they need exact responses based on a set of selections recited or written on paper. This kind of interviewing is simple to be conducted and could be standardised since similar questions are questioned to every participant. Structured interviews are applicable if the aim of the study is understood clearly with precise questions (Denzin and Lincoln, 1998).

Semi-structured interviews

Semi-structured interview are composed of structured and unstructured interviews features. They both use closed and open questions and thus contribute to its advantage. In this method, the interviewer design pre-planned basic questions to ensure that same questions are enclosed to every interviewee. This is to allow consistent with all participants. As the interview continues, the interviewer gives the interviewee chance to elaborate or deliver more appropriate information if he or she opts to do so (Denzin and Lincoln, 1998).

Questionnaires

Denzin and Lincoln (1998) defined questionnaire as the active technique of fact-finding that collects a small volume of data from various people. It is a way of confirming data gathered using other methods. It is the base for the question and answer section of a fact-finding interview. Questionnaire approach is effective in the sense that a questionnaire can be send out prior to an interview, and thus allows the interviewee to gather the necessary information before the session and this makes the interview to be more useful (Denzin and Lincoln. 1998).

Questionnaires are appropriate where respondents are situated on a broadly spread geographical location, when data need to be gathered from a large amount of staff, when time

is limited and while a hundred percent coverage is not crucial. Even though questionnaires are a useful tool for fact-finding, it is essential to carefully design the questionnaires. Poor design could imply that the form is hard to complete and this would lead the researcher to receive poor quality of information (Denzin and Lincoln. 1998).

2.3.3 Analysing Case Study Results

Data analysis comprises exploratory, classifying, testing, organizing and recombining both quantitative and qualitative results as to serve the primary proposals of a study. Data collection and analysis emerge concurrently in case study research (Yin, 2003). They both inform and focus on one another in the research process (Neuman, 2000, Yin, 2003). Analysis of data gathered develops understanding of the case, and thus enlightens knowledge about what more data is needed. However, examining case study evidence is not easy since the strategies and techniques have not been properly described (Yin, 2003).

2.3.4 Generalisation in Case Study Research

Case study research approach results are generalised both by naturalistic, statistical or analytic generalisation (Yin, 2003). Nevertheless, generalisation should not be stressed in all research (Denzin and Lincoln, 1998). The researchers must instead carry out case study for understanding purpose. This is because it would cause damage when the researcher is devoted to generalise results or build theory. This would be to the degree that the key features appropriate for understanding the phenomenon itself are overlooked. Moreover, the researcher can choose the amount of information that requires to be understood since it not necessary to understand everything about the case (Denzin and Lincoln, 1998).

Analytical generalisation in case study is used with the aim of the researcher to enlarge and generalise a certain set of results to larger theories (Yin, 2003). Two or more cases are used to test existing theory. This theory is applied as a framework in order to assemble the pragmatic outcomes of the case study. Then replication can be claimed, while more cases seem to support the similar theory Analytic generalisation could be applied in both single case and multiple case studies. This is because research methodology is not perfect, and so, investigators have to use data acquired with multiple methodologies (Yin, 2003). Denzin and Lincoln (2000) also supported the idea that case studies can be generalised, targeting at various actors in multiple situations as it improves generalizability.

Statistical generalisation is created through interpretations prepared about a population on the basis of observed data gathered on a sample. Nonetheless, statistical generalisation must not be regarded as the method of generalising the results of the case study (Yin, 2003).

Naturalistic generalisation is based on a complete case study narrative where the researcher builds an understanding of the case (Yin, 2003). The researchers assess critically if the case study inferences will be relevant to extra cases built on analysis of the narrative case study and understanding more cases. The inferences are simply generalizable to other cases as long as the cases are related. The researcher goal is to generalise the outcomes to larger theory. Narrative styles of writing in enquiry enable next researchers to perceive the case from various perspectives and use naturalistic mode to examine the results of their outcomes (Yin, 2003).

2.3.5 Triangulation in Case study Strategy

Triangulation is a method that uses various bases of data, multiple informants and multiple methods as to collect multiple perceptions on the similar subject in order to achieve a broad understanding of the phenomena (Patton, 2002: Yin, 2003). Triangulation is used to associate data in order to decide whether it validates, and thus to confirm research results (Patton, 2002). Once data is triangulated the findings are maintained by various bases of evidence (Denzin and Lincoln, 1998). Triangulation is a helpful tool that examine data overload, it also allow checks and balances on salience of first impression (Biggerstaff, 2012).

Furthermore, it helps the researcher to evade data fussiness such as being over-confident about a specific sector of data analysis. It also assists the researcher to check main result without taking into account the possible sources of data irregularity (Biggerstaff, 2012). It is further considered useful when using both qualitative and quantitative methods. It is a logical and tactical approach, even when practical on both approaches (Denzin and Lincoln, 1998). Triangulation has four different categories such as data triangulation, triangulation of method, discipline triangulation and triangulation of theory (Biggerstaff, 2012, Denzin and Lincoln, 1998).

Data Triangulation

Data triangulation involves the data that is collected from multiple sources of evidence. As a result, that data is triangulated to produce similar set of facts. Information collected from

other sources can encompass and improve the research process. It was advocated that more than one sources of data increases diversity which leads to a better understanding of the research theme (Biggerstaff, 2012). Moreover, triangulation can be useful when confirmation of data is required especially while conducting action study or ethnography (Banister *et al.,* 2011, Cowman, 1993). Case database is made and a sequence of information that relates the data to the research questions and the inferences derived is sustained (Denzin and Lincoln, 1998).

Triangulation of Method

Triangulation by method utilizes numerous methods to gather data and information about the topic being examined. These methodologies are used to strengthen validity and increase knowledge in research (Denzin and Lincoln, 1998). It combines qualitative mode of research with quantitative styles expending data mixture and triangulation like in mixed method (Denzin and Lincoln, 1998, Biggerstaff, 2012). Methodological approach incorporates either integrating various sorts of data in a research project. This could be achieved by surveying a huge amount of participants, hence attaining quantitative data before passing on to an in-depth interview component which is conducted using a small focused sample as to give more light or justification of the survey findings (Biggerstaff, 2012).

Moreover, the approach assists the researcher to evade difficulties of the research results such as an object of the specific method used. This could aid in resolving matters about some questions of legitimacy or alteration (Biggerstaff, 2012). Most researchers specialize in one style, but a study which uses both is more inclusive (Neuman, 2000). Triangulation of method thus provides diverse information around the research area. The approach is perceived as a logical method that is used to acquire the finest information from the proof available (Biggerstaff, 2012).

Discipline Triangulation

In case study research, theories, concepts, and methodologies adopted are mostly interdisciplinary. Information is obtained from disciplines namely social science, natural science, engineering science, law and philosophy geography. The use of several disciplines enables and reinforces the rich narrative of the case for understanding case better (Denzin and Lincoln, 1998).

Triangulation of Theory

Theoretical triangulation examines, and is informed by, more than one theoretical framework. The goal of the approach is to explore the variety and complexity of the realism of research primarily while scrutinizing human behaviours. This occurs wherever large, multidisciplinary research groups work together on a project like organisational behaviour (Biggerstaff, 2012). Moreover, the approach recognizes, and permits for, the wide choice of theories, difficulty and variety of the actual world, and how diverse theories may be accounted for in research (Kok *et al.,* 2004).

2.3.6 Bias in Case study Research

Bias in case study demoralizes the internal validity of research. It is stated that "selection bias, information bias, and confounding" are existing to some point in all observational study (Grimes and Schulz, 2001). Bias in research indicates deviance from fact. Most observational research is erected in bias and this is the test to the researcher to evaluate how they might have impacted the outcomes and hence simple checklist is required. Selection bias occurs due to lack of comparability among groups being investigated. Information bias on the other hand, stems from incorrect determination of exposure and product. The effects of information bias relies on its type, thus if information is collected differently among the groups, then bias occurs (Grimes and Schulz, 2001).

Furthermore, confounding bias is defined as a mixing of effects, this results when the investigator tries to relay disclosure to the result but in real fact, gauging the effect of a third factor (confounding variable). However, confounding can be managed in numerous means such as constraint, matching, stratification and other sophisticated multivariate methods (Grimes and Schulz, 2001). Bias can be combated by applying correct research tools in the case study research. It can also be reduced by teaching the researcher on specific application of suitable research tools and techniques, methods and theories (Neuman, 2000). Selection, information and confounding are simple checklist for bias that can assist the researcher to interpret research report (Neuman, 2000).

2.4. Information System Methodology

Avison and Fitzgerald (1995:p.10) defined an information systems development methodology "as a system of procedures, techniques, tools and documentation aids, usually based on some philosophical view, which help the system developers in their efforts to implement a new

system." Methodologies may vary in the techniques of each stage but occasionally their variances are more important. Other methodologies focus on human features, technical aspects and pragmatic features of information system. They might vary broadly in their philosophy, objectives and system modelling approaches (Avison and Fitzgerald, 1995).

Furthermore, information system methodology is a framework to establish, program and manage the process of implementing an information system (Yaghini, 2009). Methodologies cannot all be applicable to an organisation. Avison and Fitzgerald (1995) classify information systems methodologies as pertaining to five different types of problem situation; one example is "a well- structured problem situation with a well-defined problem and clear requirements", and System Development Life cycle (SDLC) falls under this.

2.4.1. Information System Methodology Terms and Definition

System

Checkland (1999) defines a system as components that narrate with one another to function as a whole. The portions of the entire system are more than properties of the element parts. Systems replicate the difficulty of the amount of various related features. It involves sub-systems which might be studied in separation; nevertheless, system is the whole which should be the main point of the exploration (Checkland, 1999).

Information System

An information system is defined by (Laudon and Laudon, 2001) as connected elements functioning together to gather, process, store and distributes information to support decision making. It is composed of computer based processing and consists of five parts such as hardware, software, data/information, procedures and people. The fourth component includes manual and computerised procedures and standards for processing data into usable information. The goal of information system is "to process input, maintain data, produce reports, handle queries, handle on line transactions, generate reports and other output" (Hutchinson and Sawyer, 1994).

System Approach

Checkland (1999) defined system approach as an approach that helps to comprehend the real world conditions from general perspectives. System approach considers all features into account while attempting to understand systems. These include soft systems approach and hard systems approach (Jackson, 2003).

2.4.2 Hard Systems Methodology (HSM)

Hard system Methodology (HSM) is suitable in situation where structured problems and objectives of the systems are clear but user requirement are undefined. It stressed on the technical features of information systems. Nonetheless, supposition is not prepared that the requirements are frank and easy to connect to system developers (Avison and Taylor, 1997). Hard system thinkers observe the world systematically. They trust that systems have a specific and defined goal as well as determined boundary. Furthermore, hard systems thinkers observe social phenomenon as stable, predictable and repeatable problems. The methodology is therefore applied in problem situations where behaviour, action, and human aspects are effective factors (Yaghini, 2009).

HSM further focuses on enumerated problems in a system like those relatives to software and hardware development (Checkland, 1999). It has been used successfully at system analysis and design of computer system viewed from technical perspective. As a result, HSM is regarded as efficient and effective information providers. However, there are cases where new information systems were not accepted by the user. There are various kinds of hard system methodologies such as structured, data-oriented, process-oriented, blended and object-oriented methodologies (Avison and Taylor, 1997).

2.4.3. System Development Life Cycle

System Development Life Cycle (SDLC) is appropriate in situations where problems are well-structured with a well-defined problem and clear requirements. The requirements have to be properly identified, understood and easily communicated (Avison and Taylor, 1997). SDLC is defined as “hard” approaches. It is frequently mentioned as “waterfall model” (Avison and Taylor, 1997). Therefore SDLC is regarded as the most plain and general methodology for information system analysis and development. The model provides a structured approach to efficiently examine the system (Zhou, 2004). It attempts to find the best solution for a clearly defined problem.

The method models processes and is appropriate merely to conditions where these processes are fairly firm (Avison and Taylor, 1997). Waterfall model splits the analysis process into various stages and the task for each specific stage is described. Then the results of every phase are documented expending identified methods, and the succeeding phase merely starts when the analyst provides approval for the outcomes of the present phase (Zhou, 2004). The

waterfall model and linear cycle which describes the steps taken in the establishment of information system are shown and elaborated in figure 2.1.

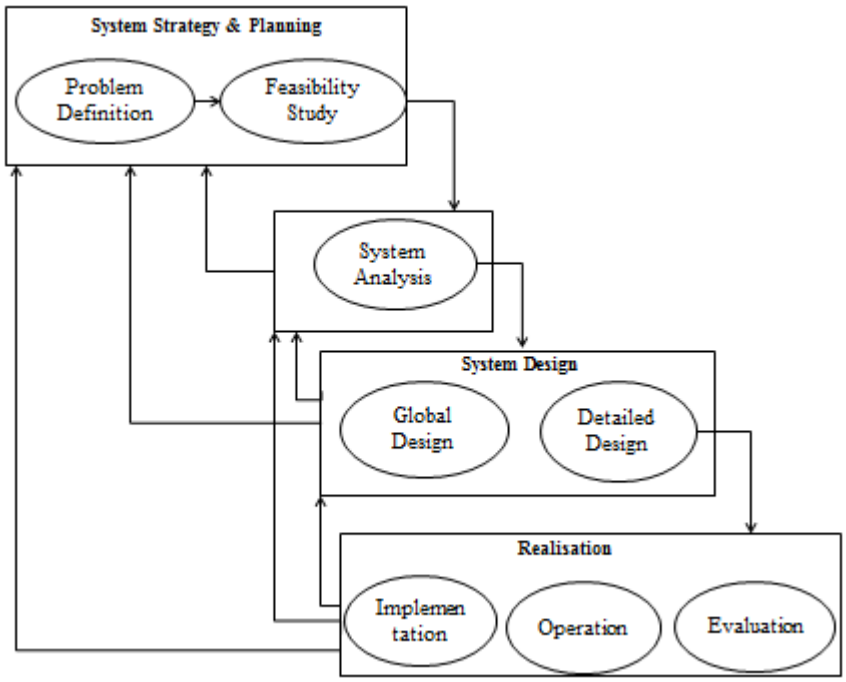


Figure 2.1: System Development Major Phases & Life Cycle (Smit, 2009)

The phases in the waterfall model normally exist in a predefined order with a review at the end of each stage before the next can commence (Hardcastle, 2008). Thus a phase in the cycle can only begin after the preceding phase has been completed and each phase in the cycle often produces one or more models. The models are part of a phase report which states what has been achieved in one phase and drawing up a plan for the next phase. This phase report is used to enlighten the management about the project progress so that management can use the reports to change project route if they are not satisfied with the previous project directions and to allocate resources to the project (Hawryszkiewycz, 2001).

The aim of the waterfall model is to split the development process into sequences of controllable portions that narrate to each other in an organised way (Hardcastle, 2008). The model presents the project guidelines and direction about what should be done as the project continues during a system development project (Hardcastle, 2008, Hawryszkiewycz, 2001). It is integrated into the management process through reports on project status and keeping track of resource needs (Hawryszkiewycz, 2001).

SDLC is further defined as a set of consecutive methods which enable the record and analysis of the present system to produce stated requirements that explain the functional and technical features of the new system (Effenberg, 2001). It is also defined by Dennis *et al.,* (2000) as a process of understanding how an information system can support business needs, design the system, build it and deliver it to its users. Satzinger *et al.,* (2002) indicated that any information system embarks on identifying the main objectives and major activities within each of the first four phases of system development. The four phases are planning phase, system analysis phase, design phase and implementation phase.

The Four Phases of System Development Life Cycle

Planning Phase

The planning phase involves two major activities which are called as problem definition and feasibility study (Satzinger *et al.,* 2002).

Problem definition

Problem definition defines business problem to be solved and then use an ordered set of steps to reach a solution as well as finding the scope of the new system (Hawryszkiewycz, 2001***).*** It occurs when receiving an appeal from the user for systems development and an investigation is then carried out to state the problem to be solved (Alexander, 1979). The first task in this activity is to assess the business needs that first initiated the project (Satzinger *et al.,* 2002). After identifying the needs, the team also creates a list of the expected benefits in more details. The second task identify at high level, the anticipated abilities of the new system. The objective of this task is to define the scope of the problem in terms of the requirements of the information system that can solve the problem (Satzinger *et al.*, 2002).

The investigation on the problem involves definition of system objectives and problems, analysis of characteristics of the organization, definition of system boundaries and their interaction with the environment, definition of solution and their consequences on the organization and existing system. At the end of the investigation of the problem, the deliverable of the project is a problem statement .This problem statement will then be a system scope document consisting of three components such as problem description, the business benefits and the system capabilities (Satzinger *et al.,* 2002).

Feasibility study

This study takes places on the basis of the result of the first study. The main objective of this study is to define clearly the scope and objectives of the systems project, and to identify alternative solutions to the problem defined earlier (Alexander, 1979). In essence the feasibility study tests whether the proposed system functions in such a way that the users become satisfied with its operations. It also defines the processes that would be automated and those that would be manual. Furthermore, the activity defines the inputs, outputs, organizational, technical, operational and economic feasibility of the project (Alexander, 1979). In this activity, the cost and benefits are estimated with greater accuracy. The deliverables of this study is feasibility report (Hawryszkiewycz, 2001). The feasibility study in general is seen as examining key aspects of the proposed system such as follows (Dennis *et al.,* 2000).

- The technical feasibility (Can we build it?)
- The economic feasibility (Will it provide business value?)
- The organizational feasibility (If we build it, will it be used?)

System Analysis Phase

System analysis is viewed as an important activity that occurs when new information systems are being constructed or present ones are changed (Hawryszkiewycz, 2001). It involves investigating the present system and documenting its specifications. The specification contains the understanding of "HOW" the current system operates and "WHAT" it does (Alexander, 1979). System analysis is essential in business to identify clearly the business goals of the new system and to "state how it will be built and how it will work". This comprises gathering the necessary data and developing models and plans for new systems. When developing a new system, many people must be satisfied and clashes must be resolved. System analysts must ensure that several roles are taken to help people to solve their business problems. They can do this by defining what new systems can do to improve ways of doing business (Hawryszkiewycz, 2001).

Moreover, system analysis recommends improvements and indicates business requirements for the solution. It is perceived as a problem solving techniques that break a system into pieces as to study how well those component parts work and interact to achieve their purpose. It focuses on the data, processes and interface building blocks from system user's

perspective. Analysis usually generates a system description and a set of user requests for a new system. These requirements lead to specification for the new system (Whitten *et al.,* 2001).

ODA (1996) defined system analysis as a tool to recognize and get rid of the sources of the present systems failure. It does that by applying methodologies, techniques and modelling tools to design a different information system that satisfy the requests of users, and distribute its service or product on time and within budget. During this phase the current business system is studied and its problems are identified. The processes and requirements for the system are investigated and documented in the form of detailed data flow diagrams (DFDs), data dictionary, logical data structures and miniature specifications (Dennis *et al.,* 2000). Wyatt and Ralphs (2003) described system analysis as procedure that creates a clear picture of existing complex processes within the organisation. It involves identifying the data store of the whole system, how information moves around the organisation and how key work processes are carried out (Wyatt and Ralphs, 2003).

Gathering information

Gathering information is the first activity under system analysis phase. It involves collecting a large amount of data on the available files. The information is obtained from people who are using the system. It is gathered through interviews, questionnaires and by site observations. The other information is acquired by reviewing planning documents and policy statements (Satzinger *et al.,* 2002). Moreover, documentations from current system are also used and studied carefully. Analysts can get more information by observing what other companies have done when faced with the same business need (Satzinger *et al.*, 2002). When investigating the current systems, there two important aspects that the analysts must take into consideration. These are the technical information and software packages. The most important question to be answered when finishing these activities is "do we have all of the information (and insight) we need to define what the system must do?" (Satzinger *et al.,* 2002:109).

Defining System Requirements

This is the second activity of system analysis. It is focusing on incorporating the user requirements and processes in a way that let a system to support various users or functions in

similar areas. This activity allows the analysts to have all the required information collected and recorded (Satzinger *et al*., 2002). The information requirements are classified into technical and functional. The technical information explains details about the required system performance or estimated number of transactions. They are normally developed as a sub-set of the system requirements. They also integrate the current systems and technologies presently used by the organization (Satzinger *et al*., 2002). The functional requirements on the other hand define what the system is expected to do. It involves creating models that would help with recording and communication of the system (Satzinger *et al*., 2002).

The two models developed are logical and physical models. A logical model demonstrates what the system is expected to do in large detail, before technology commitment could be made (Satzinger *et al.,* 2002). The physical model explains how system will be put into practice. This model comprises details about the format (Satzinger *et al.,* 2002). The main output of this activity is a summary document of system requirements that explains what the system should be built to, how data should be processed and what technical or support requirements may exist (U.S House Representative, 1999).

Design Phase

The system design phase defines how the system will work and how the problem will be solved (Hardcastle, 2008). Its purpose is to design the system solution. The design phase is looking at doing the thing right. It does the right thing by using the information obtained during the analysis phase as input in the design (Satzinger *et al.,* 2002). The output of this phase will be specifications of the proposed system. This output will then explain "both WHAT the proposed system will do and HOW it will work" (Alexander, 1979). Moreover, the design phase is aiming at ensuring that the business requirements are content by defining the architecture and structure of a new system (Satzinger *et al.,* 2002). The phase is intended to decide how the system will operate in terms of hardware, software, and network infrastructure (Dennis *et al.,* 2000).

In this design phase, the analysts begin to conceptualize a computer-system solution concentrating on physical model. They determine exactly how the system will function. The phase is categorized into two groups which are the global design and detailed design. The detailed design includes development of an architectural structure for specific software programs and databases design module (Satzinger et *al.,* 2002). The user interface, forms and reports that will be used for proposed system are also selected as well as the operating

environment. Global design involves developing the complete algorithms and structures that are required for program development (Satzinger *et al.,* 2002).

Moreover, the hardware and software apparatus that support the programs and the data are defined in the global design. Data components are collected together to form physical data structures, screens, reports, files and databases (Satzinger *et al.,* 2002). The processes that need to be changed to manual or computerized are stated together with suggesting the best option for physical design. In order for the system to be perfectly designed seven major activities must be followed. These are as follows "design and integrate the network, application architecture, design system user interface, design and integrate database" (Satzinger *et al.,* 2002).

Implementation Phase

This phase is composed of these activities "to procure, receive, configure, and install the new or revised system (U.S. House Representative, 1999). This phase occurs when the new system is build or new packaged software required is bought (Dennis *et al.,* 2000). It is aimed at achieving a reliable, well-working information system. It also ensures that the users are all trained and that the business is gaining from using the system as anticipated (Satzinger *et al.,* 2002). This training is conducted in order for the user to be involved in the integration and system testing activities. All the previous activities have to come together in this phase to culminate in an operational system. The phase is made up of five major activities such as system construction, system testing and evaluation, converting data, training users and documenting the system and system installation (Satzinger, *et al.,* 2002).

Potential Strength of SDLC

SDLC has a numerous aspects to deserve recommendation. It has been successfully tested and applied. It uses standard documentation which assist in ensuring that stipulations are thorough and that they are linked to all involved systems development users (Avison and Fitzgerald, 1995). The approach further makes sure that these involved operators are skilled to use the system. The methodology also encourages the training of users on matters like the overall use of computers and aids to dismiss doubts about the impacts of computers. The model to some extent has the ability to prevent unused cutover dates. It also prevents unpredictably high charges and lower than anticipated benefits (Avison and Fitzgerald, 1995).

Furthermore, the methodology is useful since it gives the users and the technologists an opportunity to review progress at the end of each phase (Avison and Fitzgerald, 1995). The techniques of communication is provided to the users by separating the development of a system into stages, each sub-divided into other controllable tasks, and this enable a better training. The methodology is further commended of providing greater control over the development of computer applications than before (Avison and Fitzgerald, 1995).

This methodology has all the attributes that the methodology must have. Thus, it has sequence of stages beginning with the feasibility study up to review and maintenance. The phases are anticipated to be carried out as a consecutive process. Each phase has sub-phases and the activities to be carried out along with the outputs (or deliverables) of each sub-phase are spelt out in some detail. The model also offers deliverables which include documents, plans or computer programs (Avison and Fitzgerald, 1995).

Potential weakness of SDLC

The approach is limited to routine functioning problem conditions and is not appropriate for backing up management decision making (Avison and Taylor, 1997). The users are not allowed to fully take part in the decision making. The specialists are also not anticipated to inquiry about system development (Avison and Taylor, 1997).

Avison and Fitzgerald, (1995) stated the weaknesses of the system development approach according to the way in which it was applied are as follows: “Failure to meet the needs of management, unambitious systems design, instability, inflexibility, user dissatisfaction, problems with documentation, lack of control, incomplete systems, application backlog, maintenance workload, problems with ideal approach”. Although there are some limitations to the approach, there have been a number of developments since then which make alternative approaches viable and potentially more effective (Avison and Fitzgerald, 1995).

2.4.4 Structured System Analysis and Design Methodology (SSADM)

The Structured Systems Analysis and Design Methodology (SSADM) is defined by (Avison and Fitzgerald, 1995) as a methodology that was initially developed by “United Kingdom (UK) consultants Learmonth and Burchett Management Systems (LBMS) and the central computing and Telecommunications Agency (CCTA)”. These are all accountable for computer teaching and tracing for the UK Civil Service. SSADM has been adopted in many administration applications since 1981. It has also been used obligatory in several Civil

Service applications since 1983 (Avison and Fitzgerald, 1995). The methodology is data-driven approach due to its history and stresses on data modelling and the database by (Avison and Fitzgerald, 1995). SSADM is intended for big scale information systems with high volume business events (Schumacher, 2001).

SSADM is also defined as waterfall model, embedded in the System Development Life Cycle (SDLC). However, it concentrates mostly on the feasibility, analysis and design stage of the SDLC (Schumacher, 2001). It is a thorough method which includes practically all components of the information system (Al-Humaidan and Rossiter, 2001). SSADM stipulates the approaches and techniques that must be adopted in the event of single phases of development. It deals with and combines the three techniques that complement each other within system development cycle. The three techniques are logical data, data flow and entity event modelling. It states the flows and tasks of a development project and creates full records of the project (Schumacher, 2001).

The Strength of SSADM

SSADM is defined as an effective method due to its ability to deal with soft system aspects. It deals with soft aspects through strategic planning stage where the problem that requires solution is acknowledged. The strategic planning is seen as a method that examines the governmental necessities and outlines the business parts that require improvement and stipulates their priorities to the organisation (Al-Humaidan and Rossiter, 2001). Once strategic planning approach has been applied in the system, then the results regarding the system needs are taken over to SSADM. SSADM then begins by reviewing the feasibility of the system to outline its operational, economic, and technical feasibility (Al-Humaidan and Rossiter, 2001).

SSADM is further regarded as a method that supports the user involvement. It supports them through conducting interviews and doing discussions in order to identify the system requirements (Al-Humaidan and Rossiter, 2001). At each stage in the development life cycle the users assess the products with the analyst to detect any flaws in the requirements. Then the organisational structure, goals and policies of the system that need to be investigated are examined in the strategic planning. Consequently, the results are documented in the project initiation document that is used as the starting point in developing the system (Al-Humaidan and Rossiter, 2001).

SSADM is commended of being able to provide timelines in the development project. Thus it permits planning, managing and controlling of a project well. As a result, the product can be delivered on time. The methodology is seen as useful tool due to its ability to emphasize on the investigation of user requirements and while the system model is also developed It is further seen as beneficial method since it is able to reply to deviations in the business setting (Schumacher, 2001).

Thus the record of the project progress is seriously considered, matters such as business purposes and business requirements are taken even though the project is being developed (Schumacher, 2001). It is argued that this provides the chances of the project to modify the planning to the actual needs of the business. SSADM has also been regarded as a useful tool since it provides a better quality of the system, cut costs in the sense that it splits the logical and the physical systems design. It also increases the general production of definite project and the business. It is an effective method that doesn't require very special skills to be practiced in the system (Schumacher, 2001).

The Weakness of SSADM

Although SSADM has successfully been used in many governments department, it however has some limitations. SSADM emphasizes on the investigation of the system and its documentation (Schumacher, 2001). This however leads to danger of making unnecessary analysing that could be time and cost consuming. It is criticized of having many different types of description methods and this prevent consistence checks to be done particularly with big organizations. It uses outline diagram which might also be unclear, because all applicable data flows have to be encompassed (Schumacher, 2001, Bhushan and Parikshit, 2010). SSADM is regarded as a prescriptive, troublesome and difficult methodology to apply. Its structured approach is also stiff and does not reveal the manner in which individuals operate in practice. SSADM also tries to replace methodology for organization and place too much stress on functionality, analysis and design at the cost of individuals and organisational matters (Middleton, 1994). The method tends to stress on formal and technical aspects and overlooks the human, social and organisational aspects (Avison and Fitzgerald, 1995).

Techniques of SSADM

Logical Data Modelling

Logical Data Modelling shows the data structure of the information system. This is a method that is used to identify, investigate, model and record the data requests of the information system (Schumacher, 2001). It provides information on the objects that require to be placed down and on the interactions among these objects. It consists of logical data structure and entity relationship diagrams. The technique is normally conducted in the initial stages of the SSADM. In the feasibility study, a higher Data Flow Diagram and an Entity Relation Diagram are usually formed. Data flow diagrams are used to define the system in diverse levels of concept. They model functionality and display how input changes into output. Entity Relation Diagrams denote entities and their relations. They are used to stem the systems data entities, their attributes and the relationship among them (Schumacher, 2001).

Data Flow Modelling

Data flow modelling is used to detect, model, and record the manner in which data runs around and within information system. The technique produces a joined data flow diagram (DFD) together with suitable supporting documentation. This DFD displays the relationship among different processes in the IS. These are the activities that act on the data (Schumacher, 2001). DFD also models the data store, which is the area where data is stored such as folders, servers, directories, and the way they are accessed. External entities which could be a basis of data flowing into the system, and out of the system are also modelled. The data flows between processes, data stores and external entities are also included in this technique (Schumacher, 2001).

Furthermore, DFDs are created in an organised top-down approach. First a diagram is produced which displays the system's interaction with its setting. This is largely named the context level DFD (level 0) and indicates the setting of the system with its environments (Effenberg, 2001). The context level diagram is broken into a level 1 DFD. This describes the processes of the systems at its next level of detail. Consequently lower level DFDs are created that breaks system processes till the system is defined at the last basic level. The whole set of DFDs is named a levelled set (Effenberg, 2001). Figure 2.2 is the demonstration of notation for data flow diagram

Figure 2.2: Notation for data flow diagram (Effenberg, 2001)

Entity Event Modelling

The technique deals with detecting, demonstrating and recording the business events that have impact on each object and its surrounding (Schumacher, 2001). It consists of Entity Life History diagrams together with suitable supporting documentation. There is a data dictionary for each process, data flow, data store and external entity. Data dictionary is defined as the crucial list of data within an information system. It presents the structure, storage, connections, origin and use of data. Its goal is to provide the opportunity of defining the fundamental in a suitable verbal way (Schumacher, 2001).

2.4.5 Business Systems Planning Approach/ Zachman Framework (BSP)

Business Systems Planning (BSP) is a structured methodology that assists business to create information systems strategy that could satisfy its nearby and long term information requirements (IBM, 1978). BSP involves top-down planning with bottom up implementation. BSP is appropriate in the public sector and industries in the private sector. This is because the requirements for developing information systems are similar irrespective of the business served or the products and services provided (IBM, 1978).

This approach was written by IBM in 1981 and was used internally, it only started working in the early 1970s. However, as time went on, the customers were able to use it and it was recognized as a significant tool for various organizations (Hodges, 2007). Business Systems Planning (BSP) is defined by Zachman (1982:31) as a "method for analysing, defining and designing information architecture of organizations". The approach focuses on "data,

processes, strategies, aims and organizational departments which are interconnected". It brings new approach to design information architecture (Zachman, 1982:31).

The approach diagnoses its business vision, objectives and functions and how these determine its business processes in an organization (Lederer, Katz and Sethi, 1988; Pant & Hsu, 1995). The business processes are investigated to resolve data needs and data classes. These data classes are in turn joined to build up databases (Pant and Hsu, 1995). BSP is further described as a new way to examine the business and to build systems (Business Systems Planning IBM Corporation, n.d.). It has basic building blocks of the architecture since it is designed to define information architecture. These are stated by Business Systems Planning IBM Corporation (n.d) as:

- Data classes which consists of groups of logically related data that are essential to support the business.
- Business processes which contain the categories of logically related decisions and activities needed to control the resources of the business.

The goal of BSP is to (The Pariveda Solutions, n.d)

- "Understand the issues and opportunities with the current applications and technical architecture.
- Develop a future state and migration path for the technology that supports the enterprise
- Provide business executives with a direction and decision making framework for IT capital expenditures
- Provide information system (IS) with a blueprint for development"

Steps in BSP process as defined by Pant and Hsu (1995) are as illustrated in the figure 2.3:

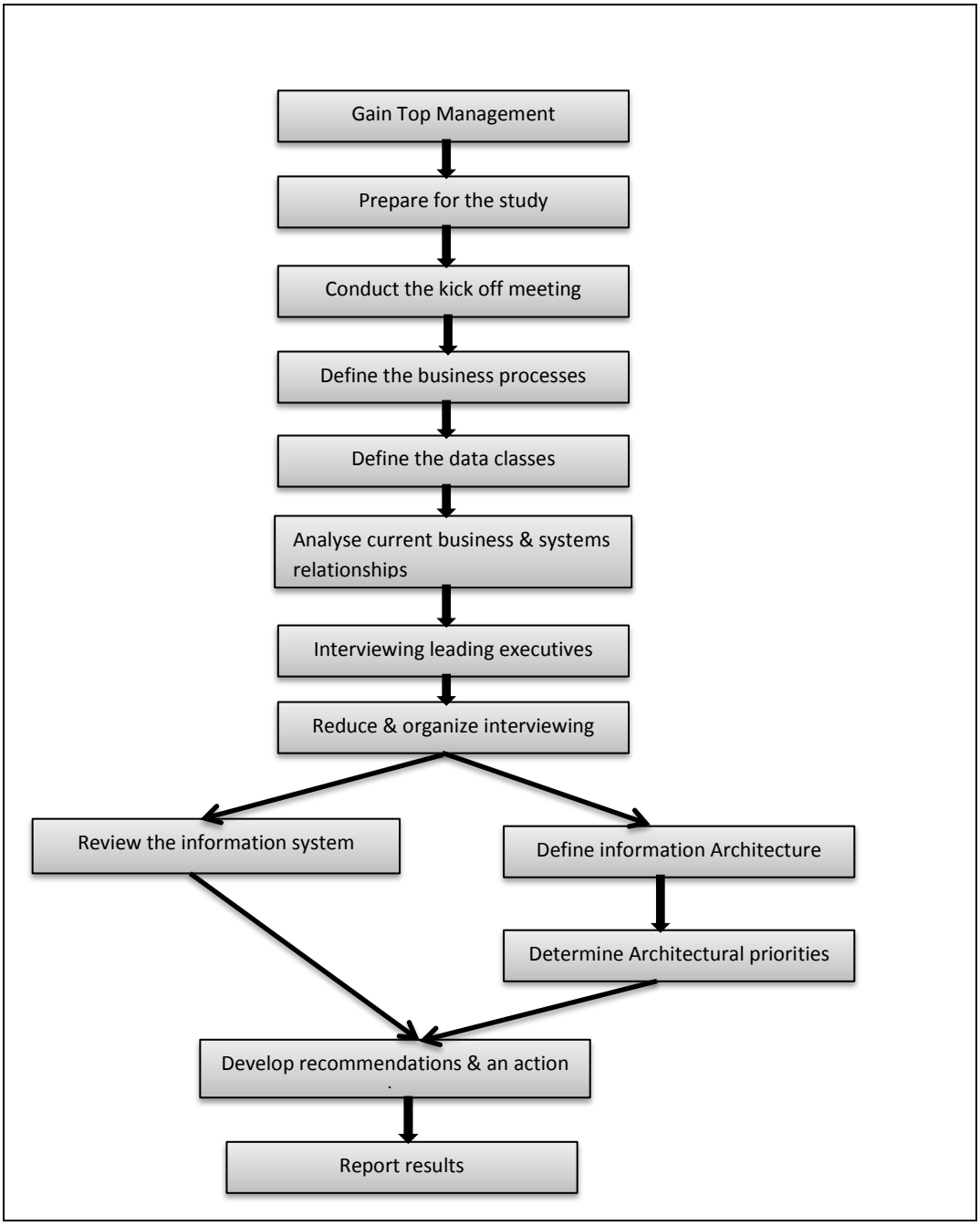


Figure 2.3 BSP Steps (Pant and Hsu, 1995)

The first step of BSP is to gain top management commitment (Pant and Hsu, 1995). Business Systems Planning IBM Corporation (n.d.) described the step as a case where authority to take a study is given to the researcher by the department involved in the research. In this step, there are numerous people who have to agree on the study such as management member, team leader, team members and sponsors (Lederer, Katz and Sethi, 1988).

The second step is to prepare for the study. Hodges (2007) emphasized that this is an instance where the researcher sets time plan and organizes all the required documents to carry out the

research. The researcher selects managers or a person to interview and arranges meetings and place where they can carry out the interviews (Hodges, 2007). In this step, the team members are trained. This is to enable them to collect data on the business operations and current information systems support and yield a work plan (Lederer, *et al.,* 1988).

After preparing for the study, the study now begins by taking kick-off meeting where the researcher presents the aim and the expected results of the study to the key informants (Business Systems Planning IBM Corporation, n.d.). The fourth step is defining the business process. This is where the researcher investigates for the appropriate organizational structure. The current systems of the organizations together with the relationships between the businesses processes are also analysed looking at the business processes and data classes (Pant and Hsu, 1995).

The information architecture is then defined using the data classes and business processes. After defining the information architecture, the researcher has to compare this architecture with the existing systems of the organization under study so as to find out the required or missing systems (Pant and Hsu, 1995). The charts are also created to reflect the relationships between processes and data classes (Lederer, *et al.,* 1988). Analysis of the current system support is another step where the researcher, identify how information system (IS) currently supports the organization. The charts are also created to present organizational processes and the responsible departments (Lederer, *et al.,* 1988).

The next step would require the researcher to interview the senior management about the architecture as to make sure that the architecture defined is correct. Then the researcher would have to make priorities for each of the major systems contained in the architecture. Reviewing the information management is a succeeding step where the researcher evaluates the current IS organisations strengths and weaknesses (Business Systems Planning IBM Corporation, n.d.). After that, the researcher prepares an action plan with proposals about hardware, software, alterations to present systems and approaches of firming IS management (Lederer, *et al.,* 1988).

After completing all the steps, the researcher has to prepare the final study report and present it to the top management (Pant and Hsu, 1995). The report contains the study objective, method, conclusions, recommendations and agreed actions (Lederer, *et al.,* 1988). Then the

top management would have to approve the report and afterwards the researcher could start the architecture construction (Pant and Hsu, 1995).

Business System Planning/Zachman Techniques

The BSP approach comprises six techniques, five matrix-based techniques that emphasis on relations among business processes, data classes, systems, and organizational structures of a company (IBM, 1984). It also focuses on analyzing the business issues met through the development of Information System (IS) architectures. Each of the matrix-based techniques concentrates on showing the relationships between two different object type instances such as business processes and data classes (IBM, 1984). The subsequent framework for a complete explanation is a matrix of five perspectives and six dimensions. Table 2.1 illustrates the Zachman framework as defined by (Effenberg, 2001). This framework was adopted in this study to analyse the spatial information system of the case. However, only the first two perspectives have been adopted and all the six dimensions.

Table 2.1 Framework for information system architecture (Effenberg, 2001)

	Data (what)	Function (How)	Network (where)	Organisation (who)	Schedule (when)	Strategy (why)
Scope/Objective (planner)						
Business Model (owner)						
Information System (designer)						
Technology Model (builder)						
Detailed Models (subcontractor)						

The Zachman Framework in table 2.1 is anticipated to enable explanation and communication of multifaceted administrative thoughts in simple units at the same time broadly and contextually mapping all organisational issues. It provides architecture within which further information analysis and documentation tools and techniques can all be accommodated (Effenberg, 2001).

Dimensions

Table 2.1 shows dimensions represented by columns which build on the theory of breaking down the explanation of an entity. The separation of these explanations and perceptions is essential to the framework to restrain the difficulty of the entity, information system or administration (Effenberg, 2001). The description of the six dimensions is elaborated in table 2.2 as follows:

Table 2.2 Dimensions of the Zachman framework (Effenberg, 2001).

Dimensions	**Focus**	**Purpose**
What	Data	This is the modelling of data in information system
How	Function	This is where the input-process output concept is described and represented diagrammatically.
Where	Network	It concentrates on the relationship between elements of the information system.
Who	Organisation	This focuses on work allocation, authority and responsibility**.**
When	Schedule	This concentrates on the status of data and effects on the level of resource obligation requisite to achieve the short time for precise event cycles.
Why	Strategy	This represents purposes and tactics of the organisation. The guidelines and limits for the setup and design of the system are obtained in this dimension

Perspectives

The rows of the framework in table 2.1 reveal the diverse participants engaged in systems development method and the perception of various explanations of similar entity in realism.

The summary perspectives applied to information systems are provided in table 2.3 as follows (Effenberg, 2001).

Table 2.3: Perspectives of Zachman framework (Effenberg, 2001)

Perspectives	**Purpose**
Scope/Objective	An organisation's direction and business purpose is fully defined.
Business Model	The nature of business is defined through owner's perspective and this leads to models of the company that outline the structure, function and organisation.

The perspective is an important aspect since each carries a various set of restrictions to the system. Thus the designer enforces technology restrictions whereas the owner concentrates on practice and policy limits (Effenberg, 2001).

Cells

The framework cells is required to be loaded with descriptors, models and methods to confirm inclusive recording and understanding and thus enabling effective structure and accurate process (Effenberg, 2001).

Table 2.4 denotes the loading of the Zachman Framework for information system documentation and development as defined by (Effenberg, 2001).

Table 2.4: Zachman Framework for information systems (Effenberg, 2001)

	Data (What)	Function (How)	Network (Where)	Organisation (Who)	Schedule (When)	Strategy (Why)
Objectives /Scope	List of things important to the organisation	List of organisational process	List of sites organisation operation	List of organisational units	Inventory of business events	Inventory of business goals
Models of Business	Entity relationship diagram	Business physical data flow diagram	Logistics network (notes & links	Organisation chart, roles skill sets and security	Business master schedule	Business plan

2.4.6. Zachman Framework and spatial information System modelling

This section re-examines the approaches conferred in this chapter to comprehend how each maps to the Zachman Framework (Effenberg, 2001). This is because it has been contended that, the framework is reliable with other tools and methods and their deliverables could be plotted to the framework (Al-Humaidan and Rossiter, 2000). Zachman framework is different from traditional methodologies since it is an arrangement structure of the methodology deliverables (Effenberg, 2001).

Structured System Analysis & Design Methods (SSADM)/Conceptual model

SSADM/Conceptual models symbolize an outline and sketching of Zachman Framework cells at the same time these cells should be attainable from SSADM. This is because framework cell necessity rule stipulate that all the cell combination in one row institutes a whole model from that perspective (Effenberg, 2001). This denotes mapping of framework cells and conceptual models. The Zachman framework gives an understanding into the content and insufficiencies of conceptual models. Conceptual models for spatial information systems can be investigated looking at complete or incomplete outline of a particular row and whether various perspectives have been incorporated (Effenberg, 2001).

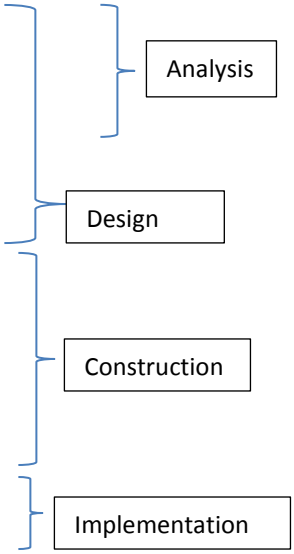
System Development Life Cycle (SDLC)

As defined in section 2.4.3, SDLC is the process of building an information system. It has four phases of development. Therefore plotting of the deliverables from these phases to the Zachman Framework needs the consecutive development down the columns of the framework (Effenberg, 2001). The Zachman Framework for information system in table 2.5

shows this sequential mapping and demonstrates exactly how each of the five perspectives of the Zachman Framework relies on its prototypes, how they also aid a diverse purpose, deliver various products, and are substance to diverse limits. Moreover, SDLC is a system development process that aims at achieving deliverables, the tools and techniques to develop between phases or perspectives. Zachman Framework models the significance of every dimensions of an organisation's system and does not replace the SDLC methodology (Effenberg, 2001).

Table 2.5: Sequential nature of Zachman Framework (Effenberg, 2001)

	What	How	Where	Who	When	Why
Objective/Scope (planner)	information to describe core scope					
Business model (owner)	information about the system and its usage					
Information System (designer)	information about the abstract system					
Technology Model (builder)	information about system building and assembly					
Detailed Models (subcontractor)	information for element building and assembly					



Strengths of Business System Planning/ Zachman Framework

Business System Planning approach is commended of being an integrated method which combines the top down analysis with bottom up implementation. The approach is well known to the top management (Pant and Hsu, 1995). Its main strength is to be able to incorporate all dimensions that must be established in combination with the traditional data and function dimensions of an information system (Effenberg, 2001).

Critique of Business System Planning

BSP has been criticized as a method which relies heavily on top management commitment and executive involvement. Thus top management involvement is observed as significant (Lederer, *et al.,* 1988). The approach is also criticized for producing large volume and a detailed information and thus perceived as time consuming and costly (Pant and Hsu, 1995).

BSP needs a great amount of IT skill within the planning team. It is also regarded as an approach that does not incorporate a software development methodology (Pant and Hsu, 1995).

2.5 Conclusion

This chapter has given a summary of methodologies and theories fundamental to the research in spatial information systems. From the discussion, it is clear that methodologies used focus and inform one another. Description from case study research informs system (SSADM, SDLC and BSP) analysis. These systems methodologies together with case study strategy contribute to knowledge and gives understanding of the case in enquiry before analysis.

Chapter 3. Information System Evaluation Success Model Theory

This chapter discusses a general description of evaluation system success theory. It gives the definitions and concepts used which is relevant to this research. The information system evaluation success model comprises DeLone & McLean Information System (D&M) IS, Integrated Success Model (ISM) and Technology Acceptance Model (TAM).

3.1 Definition and Concepts

There are various definitions and concepts used in this chapter. To avoid any confusion or misunderstanding of terms the following definitions apply:

Information Technology

This is the group of computers systems of an organisation (Turban *et al.,* 2005).

Evaluation

This is the orderly evaluation of the value of an object. It is also defined as the systematic achievement and analysis of information to deliver beneficial response about an object (Trochim, 2006).

A model

A model is based on theoretic fundamentals which normally create its specific set of gauging tools that is applied in the evaluation process (Hattingh, 2005).

Information System Effectiveness

It involves assessing the effectiveness of technological expenditure which is experienced by firms and forms the key ingredient in developing a competitive advantage (Nomdoe, 2007).

Information System Success

It is theorised as an assessment ruling made by an individual, from the point of some shareholder (Seddon, 1997).

3.2. Information System Evaluation

In the information system research, evaluation is regarded as significant topic for study as well as practice (Goran and Jenny, 2012). Evaluation occurs under implementation phase as one of the major events in the system development life cycle (Satzinger, *et al.,* 2002). The purpose of this phase is to ensure that the system executes as users anticipated and in submission with the user necessities. It measures whether the IT solution meets its technical

objectives and to what extent. It also confirms that system incorporation is satisfactory and stress testing is within system stipulations (U.S. House Representative, 1999).

Information system evaluation is described as the methodical gathering of information about the events, features, and results of programs for use by definite people to decrease reservations, advance efficiency, and make decisions with respect to what those programs are doing and affecting. There are two types of evaluation namely formative evaluation and summative evaluation (Frechtling and Sharp, 1997).

Formative Evaluation

The goal of a formative evaluation is to measure preliminary and continuing project actions (Frechtling and Sharp, 1997). It strengthens the object being evaluated. In this evaluation, the supply of the program is examined, the features of the implemented system, the evaluation of the governmental setting, personnel, procedures and inputs are all examined (Trochim, 2006).

Summative Evaluation

The objective of a summative evaluation is to evaluate the feature and effect of a completely implemented project. The other purpose is to evaluate established project's success in attainment of its specified goals. Summative evaluation occurs after the project has been implemented and the timeframe assumed for alteration has transpired (Frechtling and Sharp, 1997). Summative evaluation can also be called as post-implementation review. This is because post implementation phase also occurs after the system has been developed and gone live (Gantley, 2007). Summative evaluation is the one that is adopted in this study.

Post Implementation Review

This phase is perceived as one of the critical stages in the systems development life cycle. It is defined as the process of collecting and evaluating evidence to make sure that all charges and profits are known and analysed as to allow justification for the project. Post-Implementation Review (PIR) is further described as the process that uses quantitative and or qualitative resources, to find the value of Information Systems Technology (IS/IT) projects to the organisation (Gantley, 2007).

PIR offers the organisation with an understanding of what the IS can and cannot do. It also provides benchmark for what is to be achieved in economic, operational or organisational

terms from investment in IT. As a result, the benchmark can then be used to measure the success of the IS project (Gantley, 2007).

Furthermore Post implementation review is used to assess the efficiency of the system progress after the system has been implemented for a period of time (normally 6 months). The purposes are to assess if the system is doing what is intended to do. The other objective is to see if it supports the user as expected in an active and proficient manner. The PIR measure how effective the system is in terms of functionality, performance, and cost versus benefits, as well as to evaluate the efficiency of the life-cycle development activities that made the system (Gantley, 2007).

The results of the review could be exploited to reinforce the system and system development processes (Gantley, 2007). In order to achieve the results of the post implementation review, there are various information system evaluation success models that are used to evaluate the effectiveness performance of information systems in an organisation.

3.3. Information System Evaluation Models & Frameworks

The focus of Information system evaluation has been attempted mostly on system availability and performance. Information System performance evaluation has been investigated from two main perspectives such as IS effectiveness/success/impacts and IS function and service quality evaluation (Rabaai, 2012). As a results a number of IS/IT evaluation models and frameworks were identified in the literature. These include: the DeLone & McLean IS Success model by (DeLone & McLean, 1992: 2003), Technology Acceptance Model (TAM) as introduced by Davis (1985) and Davis *et al.,* (1989), Integrated Success Model (ISM) as introduced by Zaied 2012 where the D&M and TAM model have been integrated together to form one IS model (Rabaai, 2012).

3.3.1 DeLone & McLean Information Systems Success Model (D&M) IS

The IS Success Model (DeLone and McLean, 1992) has delivered an imperative framework for IS efficiency study. For the period 1992 to 2003, closely 300 articles in arbitrated journals have quoted and criticized the IS Success Model (DeLone and McLean, 2003). The attempt to define information system success was found to be ill-defined because of the complexity, inter-reliant, and multi-dimensional situation of IS success (Petter *et al*, 2008). As a result of this difficult, DeLone & McLean (1992) executed an analysis of the research that was printed

in the period 1981–1987. A taxonomy of IS success was also established based on this review. The main purpose of DeLone & McLean article was to synthesis earlier study relating IS success into a further rational form of knowledge and to offer guidance to upcoming investigators (DeLone & McLean, 2003).

DeLone and McLean's (1992) inclusive evaluation of various information system success processes completes with a multidimensional model comprising of six interconnected dimensions of success such as system quality, information quality, use, user satisfaction, individual impact, and organizational impact (Petter *et al,* 2008: DeLone & McLean, 2003).

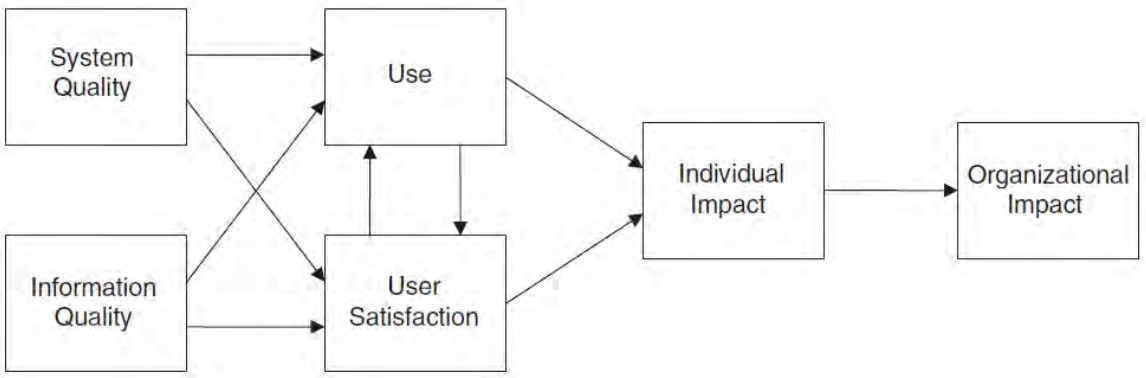


Figure 3.1: DeLone and McLean's of IS Success (DeLone and MacLean, 1992)

A process of understanding of information systems and their effects lead to the creation of the model. As viewed by DeLone and McLean, (2002) their original models were supported by several researchers. This is evidenced by 144 references of the model in the autumn 1999. As seen in the figure 3.1, the system quality and information quality together and independently impact both use and user satisfaction (DeLone & McLean, 1992). The extent of usage of an IS could impact the measure of user satisfaction either negatively or positively or and vice versa. Use and user satisfaction succeed the impact on a user of the system in individual impact. This will eventually impact on the organisation in the organisational impact (Myers *et.al.,* 1997). The model requires further research in order to verify the models validity. As a results of this, Seddon (1997) was the first ones to publish a pragmatic test of the DeLone and McLean of the IS Success dimensions (DeLone & McLean, 1992).

The Updated Model of DeLone & McLean (2003)

Later in 2003, DeLone and McLean re-examined their model and made slight alterations to it (DeLone and McLean, 2002). The contribution made by Seddon (1997) on his pragmatic test of DeLone and McLean model was used to recreate their original IS success model (DeLone and McLean, 2002). He distinct his modified model as: "System quality, Information quality, Service quality, Use, User Satisfaction and Net Benefits" (DeLone and McLean, 2002).

The updated model was addressing the issue of Service quality. The primary difference amongst the original model of D&M (1992) and updated model (2003) involved the adding of services quality to reveal the significance of service and provision in successful e-commerce system (Al-adaileh, 2009). The service quality was perceived as an important construct to the IS effectiveness and if ignored then the IS effectiveness would be miss-measured (DeLone and McLean, 2003).

The other enhancement made to the original model was in relation to '**Use'** construct. There were numerous definitions of use from original model. As a result, **use** was redefined and substituted by **intention to use**, and this depended on whether the use of the system is deliberate or obligatory (DeLone and McLean, 2003). The variable of individual impact and organisational impact from the original success model were combined into one variable called net benefit in the updated model.

The net benefits element implies that the results of the assessment of a system might be either positive or negative on the predefined shareholder (DeLone and McLean, 2003). It also indicates that the net benefits encounter by the organisation will have an influence on the use of the system and eventually on the user satisfaction with the system and vice versa (DeLone and McLean, 2002). Furthermore, absence of optimistic benefits is expected to result into reduced usage and likely discontinuance of the system (DeLone and McLean, 2003).

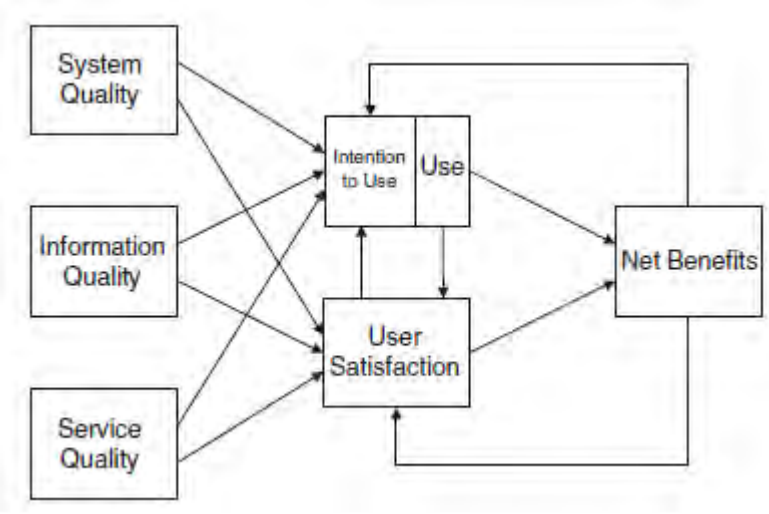


Figure 3.2: Updated D&M IS Success Model (Petter *et al.*, 2008)

DeLone and McLean (2002) in view of their updated model emphasized the significance of a vigilant description of all the dependent dimensions. When model IS is used to assess the achievement of a system; the different amongst settings must be distinguished as well as the condition in which the system being evaluated is used. An example of voluntary versus obligatory use of the system was provided. The model must also be adjusted to be appropriate for the existing condition, for instance, purpose to use against use of the system (DeLone and McLean, 2002).

The definitions of the six dimensions

Table 3.1 give a description of the six dimensions of success adapted from the D & M IS Success Model (2003 & 1992) and defined by Petter *et al.,* (2008), Paltisa. G and Balaban, (2009), Zaied (2012)

Table 3.1 The six dimension of D&M IS (Petter *et al.*, 2008, Paltisa. G and Balaban, 2009, Zaied, 2012)

Success Dimensions	Definition
System Quality	It measures technical success. It focuses on performance features of the system under study. It measures the following elements; ease of use, response time, data accuracy, reliability, completeness, flexibility. performance, portability, usability, adaptability and trust
Information Quality	It measures the required features of the system outputs such as management reports and web pages. It is measured in terms of

	accuracy, timelines, understandability, completeness, currency, relevance and usability.
Service Quality	It measures the provision that the system users obtain from their IT area Staffs. It is assesses how good the service level supplied matches client anticipations. The measurements of service quality include the technical competence, responsiveness, accuracy, functionality, availability, reliability, efficiency
User Satisfaction	This measures the user levels of satisfactions with reports, web sites and support services. The measures include self-efficacy, repeat visits, personalization, perceived risk, enjoyment, response time, accessibility, realization of users demands, correction of mistakes, system documentations and procedures, system flexibility and system compatibility, accuracy of output.
System Use	It measures the amount and way in which staff and clients use the proficiencies of an information system. It measures amount of use, frequency of use, nature of use, appropriateness of use, extent of use, and purpose of use.
Net benefits	The degree at which IS are contributing to the success of individuals, groups, organizations, industries, and nations. It measures improved decision-making, improved productivity, increased sales, cost reductions, improved profits, and market efficiency.

Usefulness of the DeLone & McLean Model

The D&M IS model has been commended to be one of the most widely applied in IS research. The model is able to identify the complexity that surrounds the definition of IS success, and in doing this, it gives valuable contributions to the understanding of IS performance impacts. It also gives a scheme for categorizing the diverse measures of IS. The D&M model is regarded as a valuable model for forming IS success measurements. It has been broadly used by IS investigators for gauging the extents of IS success (Abugabah, *et al.,* 2010). Moreover, each of the variables defining attainment of an information system is constant with one or more of the six major success dimensions of the updated model (Petter *et.al,* 2008).

Critique of the DeLone & McLean Model

D&M IS model has been critiqued by several IS investigators who claimed that the model is incomplete and needs to be extended with other factors like usefulness and the importance of the systems (Abugabah, *et al.,* 2010). It was further argued that although the D&M IS model differentiates among individual effect and organisational effect, the model does not recognise clearly that diverse shareholders in an organisation may genuinely make various assumptions about victory of the same information system (Seddon *et al.,* 1999).

Diverse individuals are probable to assess the significances of IS use in various ways and are essential for gauging IS efficiency in diverse settings (Seddon, 1997, Seddon *et al.,* 1999). However, the logical mixture of six diverse kinds of measures as recommended by DeLone and McLean (1992) would not work. This is because the users of an information system have to interpret success in their situations and in contradiction with their own expectations (Seddon *et al.,* 1999).

3.3.2. Technology Acceptance Model (TAM)

There have been many attempts to propose a model that describe and calculate the use of a system and the Technology Acceptance Model TAM tend to be the only one which has attracted more attention of the information system community. The interest of many researchers arose due to the rising technology requirements in the 1970 and increasing failures of system adoption in organization, predicting system use (Chuttur, 2009). The TAM was then proposed in order to give a description of the factors that affect computer acceptance. Davis (1985) in his model proposed that system usage is a reaction that can be described or prophesied by user inspiration, which in turn, is directly influenced by an external impetus comprising of the real systems characteristics and proficiencies (Chuttur, 2009). The main goal of TAM is to deliver a foundation for finding the effect of external features on internal beliefs, attitudes and intentions (Davis *et.al.,* 1989). It was conveyed in an effort to attain these aims by finding a small number of major variables (Davis *et.al.,* 1989).

In this model TAM suggested that there are two specific beliefs namely perceived usefulness and perceived ease of use that are significant for computer acceptance behaviours (Zaied, 2009). Perceived usefulness (U) is based on an individual opinion that use of technology will enhance performance within an organisation context. The elements of measuring this are

"performance, effectiveness, productivity, risk perception and trust" (Zaied, 2009, pg. 817). Perceived ease of use (EOU) indicates the extent to which a prospective user trusts that learning to adopt a technology requires little effort (Zaied, 2009, Davis *et.al.,* 1989). The perceived ease of use is measured in terms of "easy to learn, easy to manage, self-efficiency, simplicity and compatibility trust" (Zaied, 2009). These two believes were the only ones adopted in the study under investigation.

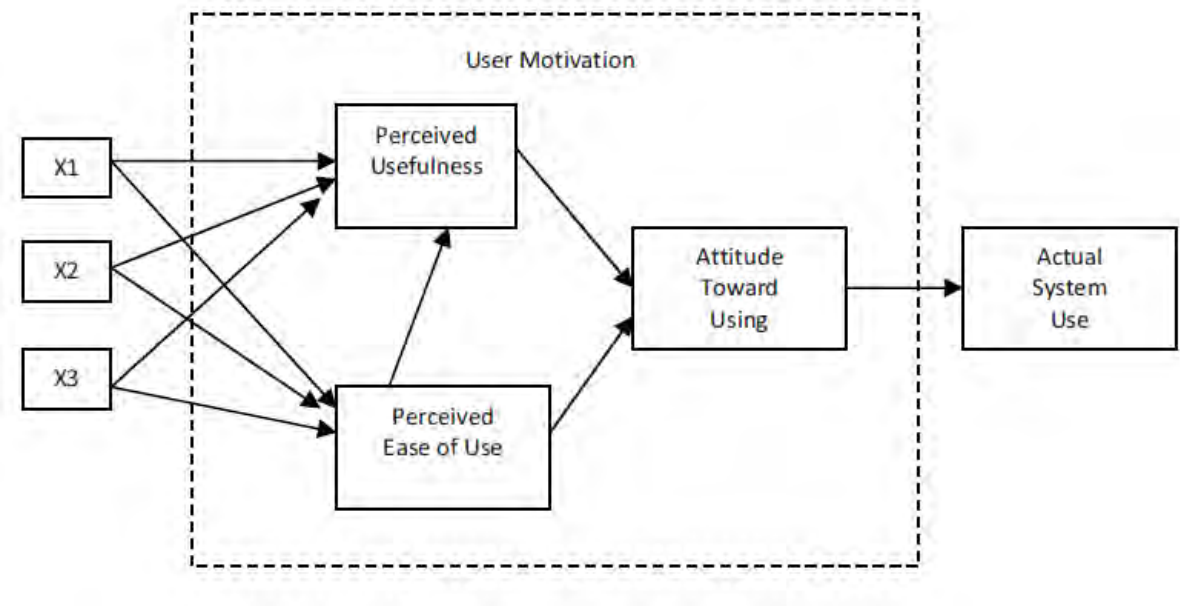


Figure 3.3: Original TAM (Chuttur, 2009)

Many studied were conducted on user acceptance and it was found that variables similar to Perceived usefulness (U) and Perceived ease of use (EOU) must be related to attitudes and usage (Chuttur, 2009). TAM hypothesizes that the use of a computer is influenced by Behavioural Intention to use (BI). However, BI is regarded as being mutually determined by person's attitude toward using the system (A) and perceived usefulness (U), with comparative weights projected by regression (Davis *et.al.,* 1989). Davis (1985) assumed that the attitude of user to a system is a major determining factor of whether the user will essentially utilize or discard the system. The attitude of the user, in turn was regarded to be affected by two major beliefs: perceived usefulness and perceived ease of use. Lastly, the two beliefs were imagined to be directly impacted by the system design features, represented (Chuttur, 2009).

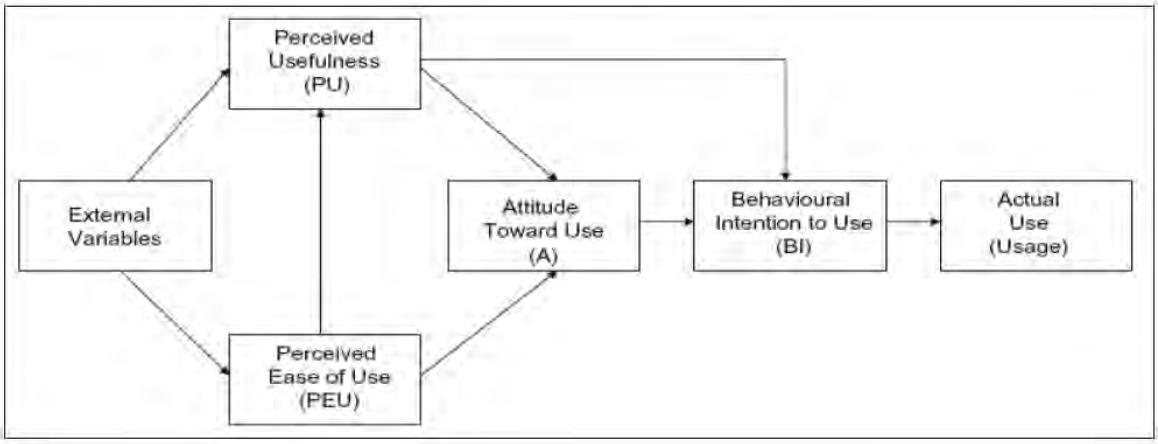


Figure 3.4: Original Technology Acceptance Model (Zaied, 2012)

Critique of TAM model

TAM is perceived as a well-respected model of IT acceptance that has been designed to explain computer usage. It has been broadly engaged in IS research, but has been critiqued of lacking task deliberation. It is not able to report how other elements impact core TAM variables, such as usefulness. It relies too much on assumptions on the use of voluntary system. It has clear recognition that recurrent use of a system might not result to higher user's performance and insufficient systems may be assessed positively by users because of factors such as accessibility, and personal characteristics (Abugabah, *et al.,* 2010).

Al-adaileh (2009) criticized the TAM by stating that it is not evident how perceptive reaction could be conveyed and how personal features may affect this reaction. He argued that this model adopts the rationality in the human actions through stressing the significance of perceived usefulness. This statement might be accurate while individuals have same level of expertise that allows them to understand and assess the effectiveness of the target system, however, individuals who lack knowledge to grasp the returns of this system might be inspired by the ease of system use.

Due to the criticism of TAM, some researchers examined the two models, the D&M IS and TAM and see how they can modify them in order to use both of them for evaluating IS. This is because both the models have the strengths and weaknesses in terms of evaluating the success of information systems. As a result of this, the two models were integrated together since they are the two most respected models in IS (Wang and Wu, 2006).

3.3.3. Integrated Success Model (ISM)

The Integrated Success Model was proposed by Zaied, (2012) by relating the theories of Technology Acceptance Model and DeLone and McLean updated model. The dimensions of the TAM and D&M IS success models were modified and the two success dimensions were added to the proposed model. As a result, ten dimensions were proposed for measuring information system success (Zaied, 2012). The ten dimensions proposed in the model are demonstrated in figure 3.5. Management support and training are the new success dimensions but will not be adopted in the study. Information quality, service quality, system quality, user satisfaction, net benefits, perceived ease of use and perceived usefulness will be adopted.

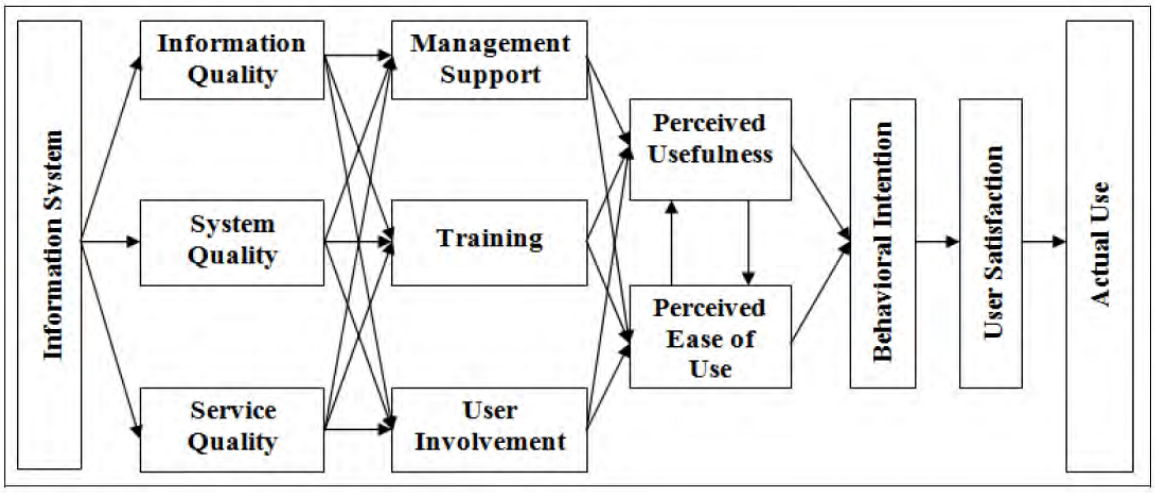


Figure 3.5: Integrated Success Model (ISM) (Zaied, 2012)

The model undertakes that information quality, system quality and service quality are related to management support; training and user involvement and eventually influence perceived usefulness and perceived ease of use which impact on behavior intention and user satisfaction (Zaied, 2012).

The ISM was also supported by Wang and Wu, (2006) who stated that by combining the two concepts of TAM and D&M IS, further inclusive and firm model for assessing IS success model will be extended as these model are corresponding to each other in particular way. In support of the model, the three variables; system quality, information quality and service quality, in D&M IS success model were adopted as the replacement for exterior variables in TAM. This was with a view that they are the most imperative three external variables for

assessing system usage. The ISM on the other hand adopted the notion of TAM since TAM has more inclusive concept linked to it (Wang and Wu, 2006).

In the proposed model, these variables were adopted; perceived usefulness and perceived ease of use. Including the two variables, the emphasis is that user perception is on usefulness and ease of use, instead of system quality, information quality, and service quality which have direct influence on system usage, while system quality, information quality, and service quality serve as the most important variables that affect perceived ease of use and perceived usefulness (Wang and Wu, 2006). Moreover, intention to use in the D&M updated IS model was replaced with the three elements that are proposed in TAM for evaluating system usage which are attitude toward using, behavioural intention to use and actual system usage in a sequential order (Wang and Wu, 2006).

3.4 Conclusion

This chapter has demonstrated the information system models that are used to evaluate the effectiveness, success and impact of the IS implementation. In particular, the DeLone & McLean IS, TAM and ISM as IS success models for information systems are described. Based on these models, methodology for evaluating the effectiveness of ISIS implementation in the Valuation department is facilitated.

Chapter 4. Review of Previous Research in Spatial Information System

4.1 Introduction

This chapter identifies current literature in spatial information systems and information systems in general. It presents the findings of prior research which identified appropriate methodologies/frameworks for spatial information system and information system research. The approaches comprises of single case study research strategy, mixed method approach, information system success models including DeLone and McLean Information System Success Model (D&M) IS of 1992 and 2002:, Technology Acceptance Model (TAM) as introduced by Davis and Davis *et al*. (1989).

Furthermore, the Integrated Success Model (ISM) as introduced by Zaied (2012) where the D&M IS and TAM model have been integrated together to form ISM model will also be reviewed. It also includes hard system approach for analysing the implementation of ISIS in the Valuation department such as System Development Life cycle (SDLC), Structured System Analysis and Design Methodology (SSADM) and Business System Planning Approach (BSP)/Zachman framework. This also reports research findings related to spatial information systems evaluations in particular the use of D&M IS success model, TAM and Integrated Success Model (ISM).

4.2 Approaches to Spatial Information Systems Research

As indicated in section 1.1 spatial information is necessary in social, environmental, economic and political decisions (McDougall, 2012). Due to this, the researchers and practitioners are engaged in general investigation with a perception to apply appropriate, frameworks, methodologies and approaches which lead the design of real spatial information systems. The section discusses the outcomes on the use of single case study research strategy, mixed method approach, hard systems approach and information system success model in spatial information systems.

4.2.1 Case study Research Strategy in Spatial Information Systems

Case study research strategy has been used broadly in the domain of spatial information systems research (Kurwakumire, 2011, Kurwakumire, 2014, McDougall *et al.* 2013, Williamson *et al.,* 2007 and Dessers *et al.,* 2012). There has been curiosity in the information

systems research community in administrative and social matters linked with the improvement and application of computer-based information systems (Darke, Shanks and Broadbent, 1998). This has stemmed in mindfulness of the requisite to utilize case study which focus on understanding social phenomena in their regular situation and racial context. The case study research method is broadly used in qualitative research method in information systems research. It enables understanding the connections between information technology related advances and administrative settings. This case study research strategy is valuable in studying information systems development, implementation and usage in the field (Darke *et al.,* 1998).

Kurwakumire (2011) and Kurwakumire (2014) used case study research strategy to investigate the ill-defined system cases. For instance, the authors used case study to evaluate the current Geographical Information System (GIS) practices in the context of public sector of Uganda. Kurwakumire (2011) applied case study strategy to study "what and" "how" GIS evaluation practices are being carried out in the public sector of Uganda and found that GIS evaluation in the setting of public sector of Uganda is still a new concept under development. In both studies, single case study tools have been successfully employed as the study has covered what to evaluate and how to identify the benefit to be evaluated.

Kurwakumire (2014) and Dessers, *et al.* (2012) found case study strategy useful in analysing a contemporary phenomenon in their cases. The phenomenon under study was GIS which was viewed as both information system and technology and therefore multifaceted (Kurwakumire, 2014). Multiple sources of data such as questionnaires, interviews, observations, photographs and a focus group discussion were used and are also desirable in contributing to the description of the case and are thus recommended by (Yin 1988: Yin 2003).

On the other hand, Desserts, *et al* (2012) used case study strategy to examine the impact of the process configuration on the spatial enablement of concrete public sector processes, and investigated the evolution of framework used in the business of spatial technology. He emphasized that a case is an intensive examination of one or more cases taking into consideration the context, the complexity of reality, and the multiple issues that might have an impact on the subject studied.

Furthermore, Kurwakumire (2011) study demonstrated that single case study is suitable for building theory and improving on the existing ones. He indicated that lack of GIS evaluation studies calls for developing frameworks for monitoring and evaluating government programs. He emphasized that case study strategy is suitable for this study because the part of the system which is evaluated is ill defined and the instruments for carrying out the actual assessment are not properly defined. He put forward his argument by stating that evaluation practices in Uganda still reflect that there is difficulty in identifying the part of the GIS to evaluate or the benefits to measure. This therefore confirms theory in the information systems domain in which the boundary of the system being evaluated is often difficult to identify. As a result of this study, Kurwakumire (2011) found that there is a need for a more formalised or holistic approach to evaluation.

Moreover, Kurwakumire (2014) and McDougall *et al.* (2013) found case study strategy research appropriate for its capability to give for understanding of spatial information systems through its investigation, rather than delivering a resolution to the problems recognized. Kurwakumire (2014) pointed out that through learning and understanding current problems and successes of GIS, it would then be possible to provide a tailor solution for public sector GIS evaluation for Uganda.

Kurwakumire (2014) and Williamson *et al.* (2007) found case study strategy useful in studying information systems in their natural situations. They also found the strategy useful in providing the chance to study from the state of the art, and generate theories from practice. Kurwakumire (2014) carried out this study in order to learn from other GIS implementations of Uganda public sector so that organisations with grass roots systems could improve on the implementation and adoption process. Williamson *et al.* (2007), used case study strategy to examine the data sharing partnership models for a range of reasons. The strategy was used to investigate the "how" and "why" research questions, especially the natural and complication of spatial data sharing partnerships to be analysed. He emphasized that case study approach could offer appropriate basis for analysis and classification of partnership models as well as a high level of data currency and data reliability (Williamson *et al.,* 2007).

Although case study strategy is recommended for use in spatial information systems, it has limitations. For instance, Williamson *et al.* (2007) argued that qualitative methods such as case studies have been regarded as lower to quantitative methods. He found that case studies

are appropriate mainly for stand-alone explanations of phenomena or as empirical study initial to the actual research of producing theories and testing them statistically (Williamson *et al.,* 2007). However, he argued that even though related comments were popular in initial case study approaches, there is now framework which provides both rigorous (Yin, 1994) and scientific approach for the development of case studies (Williamson *et al.* (2007).

4.2.2 Mixed -Methodology Approach in Spatial Information Systems Research

Mixed methodology is an approach in which a researcher applies various approaches to gather, analyse, mix, and draw interpretations from both quantitative and qualitative data in a single study or a program of inquiry (Mingers, 2006).

Williamson *et al.* (2007) explored and adopted a suitable suite of methodology to use for spatial information systems research and found mixed methodology approach a perfect framework. He found that a mixed methodology approach accommodates the combination of both qualitative and quantitative method using a case study strategy. He used the methodology for examining existing data sharing partnerships for Spatial Data Infrastructure (SDI) development. Williamson *et al* (2007) emphasized that the integration of quantitative element inside the case studies through the usage of a questionnaire reinforces the case study approach. The strength of this element lies in the capability to efficiently encompass a large number of participants. It also delivered the possibility to help in identification of key factors, correlations and likely trends which will be helpful in defining a better partnership model.

Furthermore, mixed methodology approach relies largely on using triangulation of present theory, case studies, and survey results which inform the final model. As a result, the internal strength of the model must, in theory, be greater to each of the singular approaches (Williamson *et al.,* 2007). However, the author indicated that caution should continually be applied in early theoretical development and design, as in addition to the possible for complementarity, the risk of conflicting results exists (Williamson *et al.,* 2007).

McDougall *et al.* (2013) found mixed method approach useful for its ability to allow both the survey and case study to be gathered and analysed consecutively. He used the approach to explore the current status of spatial information access and sharing in Australia. He also used the method to explore the spatial data infrastructure SDI development activities in the Natural Resource Management (NRM) sector in Australia (McDougall *et al.,* 2013). In his study he used this strategy to collect and analyse both qualitative and quantitative data in a research

study and merging them (McDougall *et al.,* 2013). McDougall *et al.,* (2013) pointed out that using mixed methodology in this investigation has contributed to the current body of knowledge by exploring the spatial information sharing arrangements in natural resource management areas and formulating strategies to facilitate spatial information sharing between NRM communities and government agencies.

Steenis (2011) used mixed methodology approach to answer the research questions which were difficult to answer through single methodology. He pointed out that the first three questions in his study have a more qualitative nature and seek to explain the nature of Spatial Data Infrastructure. As a result he found mixed-methodology research appropriate to this study since it can integrate techniques from both the qualitative and the quantitative research approaches in a unique composition to respond to research questions that cannot be solved in alternative way. The approach gives better inferences and also provides the chance for offering a better diversity of views (Steenis, 2011).

4.3. Information System Methodology as Applied in Spatial Information Systems Research

There are different methodologies used for information system development which apply to an organisation. It is therefore essential for organisations to select an appropriate and efficient methodology as to enable the implementation process of information systems in the organisation (Yaghini, 2009). Various information system methodologies are explored in this section as models and tools of analysis which facilitate understanding of spatial information systems. However, it should be noted that there is little research done on spatial information systems and therefore literature on system analysis methodologies applied in spatial information is very rare. This means that the literature will also focus on the application of system analysis theory within the general domain of information system research.

4.3.1 Structured System Analysis & Design Methodology (SSADM) in Spatial Information System Research

Structured System Analysis & Design Method (SSADM) was used by Jahromi & Manteghi (2013) in analysing and designing an information system. It was shown to be a useful modelling technique that uses diagrams to illustrate a more (structured) and coherent definition to developers and users (Jahromi & Manteghi, 2013). The method breaks down the system into smaller portions and determines the order and the communication among

activities. The main strengths of these three techniques were seen in its ability to determine information system viability. When these three techniques are given the model is more precise and completed (Jahromi and Manteghi, 2013). Due to this, Jahromi and Manteghi (2013) used the method for analysing various sub- systems of financial information systems for Fars Power Generation Management Company. Jahromi & Manteghi (2013) further revealed that SSADM allows for studying, identifying and documenting the present system problems during analysis stage.

Sukkri (2007) found SSADM useful in analysing and designing a GIS Based Crime Analysis System. SSADM was found suitable for analysing this crime system due to its ability to use engineering approach which improves the quality of the system produced. It was used to analyse the crime data and problem in filing system for law enforcement. SSADM was further found suitable in providing path that allows the researcher to return to previous phase even if not all phase has been completed (Sukkri, 2007). The method is suitable for projects that have clear and stable requirements. As a result this model was applied in providing a pattern into which approaches for analysis, design, coding, testing and support could be employed (Sukkri, 2007).

SSDAM was adopted by Faith *et al.* (2012) as a technique tool for the systematic study and design of a practical collaborative planning system for a National Planning Commission in Nigeria. SSADM was used as a hybrid methodology resulting from the blend of Prototyping. The methodology was deemed suitable to their case study due to its ability to have investigative phases which were deployed as a model for systematic study. This was adopted in order to acquire information on the current trends in research area of computer supported collaborative systems (Faith *et al.,* 2012).

The authors emphasized that the information obtained from investigations compelled the description of a high-level model (HLM) for collaborative planning which is suitable for a developing economy like Nigeria's (Faith *et al.,* 2012). The selection of SSADM was based on its high accessibility for system study and initial design and execution. Due to this, SSADM was seen as suitable for providing a system approach to analysis and design of information system Faith *et al,* 2012).

Even though SSADM has been deemed suitable for analysing information systems in most cases presented, it has some limitations. The weakness of SSADM was found to be its

inability to take a great deal of time to analyse the project and thus becomes hard to build the information system by an anticipated end date (Jahromi and Manteghi, 2013). It was further stated that there is a big delay between the start of the project and the delivery of the system For instance, if any workers of a company are not trained in the SSADM techniques, the company would have to dedicate extra time and money training them in this difficult system (Jahromi and Manteghi, 2013). However, the authors indicated that when analysing the system using SSADM there is a greatly reduced chance of any information being misinterpreted at the commencement stages of the project. The use of familiar process avoids the need to train new staff and saves time and money (Jahromi and Manteghi, 2013).

4.3.2 System Development Life Cycle in Spatial information systems (SDLC)

Within a general domain of information system research, SDLC was found to be a technique worthy of attention. Al-Zahrani (2006) used SDLC to develop a theoretical basis for improving the present status of industrial accidents control in Saudi Arabia. The ability of SDLC methodology to allow the researcher to explore a "well-structured problem situation with a well-defined problems and clear requirements" was found as the major advantage of the methodology (Al-Zahrani, 2006). The method was used to design an information management system model to deal with processes in emergency management. The SDLC methodology was found appropriate since it allowed an understanding of the business issues; it also led to the provision of a proposed system to improve the current situation. As a consequence of this conceptual model, a new information management system model was successfully proposed (Al-Zahrani, 2006).

SDLC was also used by (Khaleel and Suleiman, 2013) together with prototyping approach and the application software package for successful implementation of Enterprise Resource Planning (ERP) system in Malaysian. This is because ERP was viewed by the authors as a unique system and therefore cannot be modelled using one of the single methodology mentioned. SDLC is appropriate during analysis phase for its ability to allow documenting business processes (Khaleel and Suleiman, 2013). As a result of this, a better understanding of the operating business process of Malaysian system could be achieved before a business process can be re-engineered. SDLC was also found useful in the study since through analysis phase, the current ERP functions of employees were determined and the gaps between the current and future states were also identified. The design phase was also found useful in incorporating direction setting information from the initial phase and baseline

information from the analysis phase to build new designs for a preferred ERP system (Khaleel and Suleiman, 2013).

Moreover, within this general domain of systems research SDLC has been used by (McMurtrey, 2013) in analyzing a real-world heath care setting. The ability of the health care centers to operate within regular changing setups and paradigms moves relating to the construction or purchasing of software, was analyzed using SDLC. The four stages of SDLC were followed in analyzing the health care center and as a result an operative software product was identified, chosen and executed in a real-world environment. SDLC was found to be a useful tool for robust in its tried-and-true deployment in business, industry, and government (McMurtrey, 2013). It was also found to be an important part of Management Information System (MIS) world in both practice and academia. Due to this, the SDLC has been selected as one of the two main systems development methodologies, together with prototyping (McMurtrey, 2013).

Abraham, Junglas, and Willis (2010) also successfully employed SDLC for analysing and designing Service Oriented Architecture Projects at the Federal Financial Institutions Examination Council (FFIEC). The method was applied in the project because FFIEC recognized inadequacies in the information concerning supply chain that includes the transmission of information about operational processes to the several shareholders expedited by information systems and technology. As a result of this the method was found of great value because it has been applied successfully through a varied range of industries and IT projects (Abraham *et al.,* 2010).

4.3.3 Business System Planning/Zachman Framework Approach in Spatial information Systems

Price, Tapamo, Blakeway and Ahmed (2009) used Zachman framework (ZF) to analyse forest plantation from an information system perspective. The Zachman framework was castoff to build the semi-formal models to describe the plantation forest domain based on South African experience. Entity-Relationship diagrams, Business Process diagrams and State Charts were used as semi-formal methods and were appropriate in the analysis of the domain. The interviews were also used as semi -formal models and were found useful for verification in the study. The authors stated that the study was deemed suitable since it contributed towards an understanding of plantation forest domain (Price, *et al.,* 2009). It was

found that the use of the Zachman framework for increasing the semi-formal models of the domain was valuable. The authors stated that this is because the framework allowed the models to be cross-checked. Moreover, they argued that shortages emphasised when evolving one model could then be adjusted in others (Price, *et al.,* 2009).

Kozmina and Niedrite (2010) described Zachman framework as an ontology that enable defining an arbitrary entity from diverse viewpoints. The authors apply the framework theory to provide thorough features of data warehouse user interaction with the system environment in the Online Analytical Processing (OLAP) personalization. The framework was found suitable to cover different aspects of personalization. This framework was further found useful in identifying and developing profile of the following questions: "*who*, *what*, *how*, *when*, *where* and *why"* (Kozmina & Niedrite, 2010).

Sousa *et al.,* (2011) used dimensions derived from Zachman framework and found them useful for modelling business processes activities. The framework was used to model the Distributed and Collaborative Process Design and Planning foundation of the Digital Enterprise Technology framework. This is because the framework is able to give details of how various and sovereign investors can design a reliable process Blueprint. It was further stated that the framework uses a matrix-like structure for categorizing and establishing the representations of an enterprise (Sousa *et al.,* 2011). As a result, the Zachman framework was deemed suitable since it is recurrent and could be applied to further state the subjects of each cell. It can also accomplish its purpose if each cell is defined with the adequate level of facts (Sousa *et al.,* 2011).

Furthermore, (Sousa *et al.,* 2011) found that the framework has a rule for classifying business process events and this can be recommended by analysis of the six Zachman framework dimensions. The findings of the results revealed that various outlines were formed for similar business process and decided that the modellers have considered diverse urgencies in what concerns to these six dimensions (Sousa *et al.,* 2011).

Radwan and Aarabi (2011) used the framework to model information systems for collective planning activities within the manufacturing enterprises. The six dimensions of the framework such as "*who*, *what*, *how*, *when*, *where* and *why"* were used to analyse aggregate planning information systems. The framework was found appropriate due to its

comprehensiveness and its simplicity to be understood. It was also stated that the framework is one of the renowned framework (Radwan and Aarabi, 2011).

The Zachman Framework (ZF) was further selected as a guide to evaluate the present practice of Enterprise Information Architecture EIA in Malaysian organizations (Radwan and Aarabi, 2011). Ten organizations from public and private sectors were selected as case studies analysis. This study discovered a poor knowledge and understanding of Enterprise Information Architecture among the organizations even though there had been efforts at implementing EIA. The study also revealed gaps in the existing practice and lack of the knowledge about the frameworks at all context (Radwan and Aarabi, 2011).

Moreover, the Zachman framework was used by Witherell, Rachuri, Narayanan & Lee (2013) as a foundation to develop framework for Analysis, Comparison, and Testing of Standards (FACTS) in the Health industry. The framework was used to deal with different views of stakeholders to classify healthcare information system standards based on informatics. This framework was found useful in assisting the development of a more elaborate analysis, comparison, and testing environment. It consists of a two dimensional, 6*6 matric. Each cell of the matrix models a discrete portion of the enterprise and can therefore be integrated to realize an enterprise as a whole. Due to its capability of using cell matrix, it was then found useful in decomposing and analysing any system that is complex (Witherell, *et al.,* 2013).

Furthermore, this framework was commended by the authors as framework that provides a holistic view of any system while maintaining tractability through the careful separation of concerns (Witherell, *et al.,* 2013). The value of any methodology based on this framework lies in the dimensions in which the problem can be decomposed. This framework further allows stakeholders to analytically define and reason about various disparate issues encountered when coping with standards (Witherell, *et al.,* (2013).

Radwan and Aarabi (2011) used the framework to model the information systems for manufacturing enterprise aggregate planning and found that the framework has a number of limitations even though it was successfully used. It was found that the framework uses a large amount of documentations, and does not have any consideration to the current information systems (AS-IS). It only considers creating a new architecture for information systems of

enterprise without considering the prior system. Zachman framework (ZF) does not have thorough concern to all potential shareholders in enterprises. Moreover, ZF was criticised of lacking deliberation to Evaluation and Control for each perspective. The framework also does not have any consideration to continuous development of information systems (Radwan and Aarabi, 2011).

4.4. Approaches to Spatial Information Systems Evaluation Research

This section explores the findings on evaluating information systems within the general domain of information systems research using different Information System success model IS. Al-adaileh, (2009) stated that the use of advanced sophisticated information technologies and information systems in existing organization is developing in a phenomenon way. As a result, their products are the main aspects that validate their substantial use in every kind of organization. Al-adaileh, (2009) further pointed out that it is important for both the researcher and practitioner to evaluate Information System effectiveness.

This has been found as one of the most critical issues in the Information System field and has resulted in several conceptual and empirical studies. Some Researchers have established many IS success models to aid managers assess their performance. It was emphasized that it is important to have a post implementation review after every new system is implemented. This will determine the success of the new system (Al-adaileh, 2009).

4.4.1 DeLone & McLean Information Systems Success Model in Information Systems Evaluation Research.

This section explores the finding on evaluating information systems within the spatial and the general domain of information systems research using DeLone and McLean Information System Success Model (D&M) IS. The model is presented as a framework and model for gauging the multifaceted reliant variable in IS research (DeLone and McLean, 2003).

DeLone and McLean (1992; 2003) model of information system success model (D&M) IS was used to examine the information systems success and failure of e-government projects in Egyptian local governments (Abdelsalam, Reddick and ElKadi, 2012). The survey data of real users of a local e-government asset project was used to examine the success and the failure of e-government. The results confirmed that aspects found in the information systems success model were applicable to Egyptian e-government project management. Therefore,

management was found to be a critical factor for the development of e-government projects in Egypt (Abdelsalam, *et al.,* 2012).

Based on the results of the findings Abdelsalam, *et al.,* (2012) the D&M IS model was found appropriate since it was able to assess that information system success is associated with systems quality. As a result, recommendations were made to the managers to establish a system and test it before its implementation. This will ensure that the information system is adequately addressed through testing. It was also found that information success is interrelated to the net benefit of the organization and user satisfaction (Abdelsalam, *et al.,* 2012).

Due to this, the authors emphasized that increasing user satisfaction of the system would explain e-government project success (Abdelsalam, *et al.,* 2012). The model was further found useful since it was able to assess that use and user satisfaction are associated with the perceived net benefits. As a result it was found vital for public managers to provide enough training program to the users of the system. The authors supported their argument by stating that it is sensible to have a system where the experienced system users could be able to train other new system users (Abdelsalam, *et al.,* 2012).

Wang and Lia (2008) found DeLone & McLean IS model suitable for assessing e-government success. The model was useful for defining an evaluation framework for assessing the victory of Government to Citizen Information systems. This model was deemed suitable since it enables synthesizing prior research including IS success into a more logical body of knowledge It also provides guidance to future researchers. The model was further found useful for providing a sound evaluation tool (Wang and Lia, 2008).

The D&M IS Success Model was used by Jalal and Al-Debei (2012) as an initial concept to improve a theoretical framework for the success of Web portals in stimulating task invention. This model was found suitable since it has contributed to theory and practice, and a theoretical framework has been successfully established (Jalal and Al-Debei, 2012).

Tona (2009) used D&M IS to evaluate Decision Support Systems (DSS) in the Police organizations. The model was found to be a complete model for assessing the DSS in the

police organization success. This is because the model was able to cover the various perspective of the information system success. The model was found useful to collect both quantitative and qualitative data to measure the interrelated success factors of the model. It was further found that D&M IS model is appropriate for its ability to allow the researcher to assess how the system usage has affected the users in their work and the whole police organization. Tona (2009) indicated that the application of the model showed that the obstacles with the DSS system are not related to the system as such, but rather to the context of the police organization in which the system is functioning.

DeLone & McLean model has been successfully used in evaluating IS domain, however, Al-Khatib (2011) criticised the model by stating that it does not predict system usage. Wang and Liao (2008) also criticised the model by pointing out that it is difficult to implement the model since data are collected from direct surveys. They also mentioned that some important project management assessment dimensions such as project organization and project processes are not included in the framework (Wang and Liao, 2008).

4.4.2. Technology Acceptance Model (TAM) in Information Systems Evaluation

This section explores the findings on evaluating information systems within the spatial and the general domain of information systems research using Technology Acceptance Model (TAM). The acceptance use of technology has been an imperative field of research for over two eras. As a result, many models have been recommended to clarify and envisage the use of a system; however, TAM attracted the interest of most researchers (Chuttur, 2009).

Technology Acceptance Model TAM was adopted by Kurvers (2007) to assess Spatial Data Infrastructure (SDI) from an organizational perspective. The TAM was used to determine whether the Municipalities at the European level, (INSPIRE) are eager and capable to execute a spatial data infrastructure. The model was based on proposition that future technology use relies on someone's behaviour intention. Therefore, Kurvers (2007) used this model to determine the behavioural intention on willingness of the municipalities to implement and use SDI. The willingness was measured in terms of the Perceived Usefulness, Perceived Ease of Use and Attitude towards Use.

As a result, the model was able to predict that the Perceived Usefulness was directly impacted by the Perceived Ease of Use and that the Perceived Usefulness envisages the anticipated Attitude towards Use. The findings of the model show that four municipalities out of five were adequately eager to implement and use SDI's (Kurvers, 2007). As stated by Kurves (2007), it was found that the main impediments when implementing a Spatial Data Infrastructure appeared to be of an organisational rather than of a technological nature. Finance and culture were also found to be the determining factors that inhibit the successfully implementation of SDI. It was also found that the municipalities in this context had inadequate knowledge of SDI and its significant role in the municipalities (Kurves, 2007).

Smienk (2007) used TAM to find the best suitable model to implement Information and Communication Technologies (ICT). He found TAM to be appropriate when determining the behavioral approach to the ICT implementation. Smienk (2007) commended the model and stated that TAM has been tested worldwide and has empirically proven to be a powerful tool in measuring the behavior of potential users. He found that the ability of the model to measure the perceived usefulness, the perceived ease of use, the attitude towards the use and the behavioral intention to use give an indication of whether or not the user is actually going to use the technology or not. Therefore, this was regarded as the merits of the model by the author. Moreover, Smienk (2007) pointed out that the model was chosen since it is quite universal, brief and ICT minded. The model was further found appropriate as it is regarded as having a couple of validated constructs that empower the professional to do continuation research which is very convenient to measure effect over a longer period of time (Smienk, 2007).

Steenis (2011) used the TAM to measure the GIS end Users acceptance of the new technology implemented in the geospatial information management within Defence. The TAM was commended for its ability to measure the behaviour of potential users. Steenis (2011) further regarded the model as effective measurement model for the implementation, the acceptance and use of ICT systems. The TAM was broadly used in ICT and was found robust and validated model that predicts and explains the behaviour of users (Steenis, 2011).

Steenis (2011) further found that TAM is sufficient enough since it gave an impression of the user's perspective. He emphasized his statement by saying that "good" information system that is observed by its users as a "poor" system is a poor system (Steenis, 2011). This

statement served as a fundament for the theory that user satisfaction is a key aspect for information systems development and in the support of decision-making (Steenis, 2011).

Moeketsi and Leonard (2013) used TAM to build a theoretical understanding of technology adoption in the Mogoditsanee Sub-Land Board. The TAM was chosen as the best theory to explain usage of Tribal Land Information Management Systems (TLIMS). The model is further considered as a good approach for studying user acceptance of ICT and is widely used. The authors emphasized that using this TAM helps clarify how technology adopters come to accept or reject the use of ICT. In the application of model, TAM was found suitable for measuring the perceived usefulness of ICT, the perceived ease of ICT use and the attitudes towards use of ICT (Moeketsi & Leonard, 2013).

As a result, Moeketsi and Leonard, (2013) stated that ICT would be regarded as effective if the following criteria exist in the ICT: "if users perceive an ICT to be useful, then the users will have a positive attitude towards ICT. If users perceive an ICT to be easy to use they will have a positive attitude towards it". Upon the application of TAM, Moeketsi and Leonard, (2013) presented the results which revealed that external variables have a bearing on user's intention to use an ICT. Perceived ease of use affects perception of usefulness of an ICT. It was further found there is a relationship between an individual's indicated inclination to perform and the way they behave (Moeketsi and Leonard, 2013). The authors pointed out that external variables and perceived usefulness and perceive ease of use was also found to have bearing on the usage of an ICT and this was also supported by (Davis, 1989).

Moreover, the investigation of the results revealed that given the perceptions of users about the ease of use and usefulness of the system, it was found that the Mogoditshane Sub-Land Board was not using the LIS at 100% even though it has been available for eleven years. The main issue raised was that performing some functions with the information system was complex which according to the theoretical framework can affect usage. Therefore, Moeketsi and Leonard, (2013) recommended that there is need for the functionality of the system to be improved as the system that is in place is not enabling users to improve efficiency which was the initial goal. The authors stated that using TAM in this study contributed to the research on information Systems in Developing Countries (Moeketsi and Leonard, 2013).

TAM has been successfully applied in IS domain, in explaining user acceptance to a certain technology. However, Al-Khatib (2011) found that there are some major limitations of the TAM especially in e-Government contexts. He found that TAM has a propensity to inspect only one information system with a similar group of subjects on a single task. He also found that despite the nature of e-Government being still totally voluntary, the task of government's agencies remains mandatory (Al-Khatib, 2011).

4.4.3 Integrated Success Model in Information System Evaluation

This section explores the findings on evaluating information systems within the general domain of information systems research using Integrated Success Model (ISM). Zaied (2012) came up with the proposal of integrating the two model, DeLone & McLean (D&M) IS and Technology Acceptance Model (TAM) together and use them to evaluate information systems success. The model was created by applying the concepts of both TAM and D&M update IS success model theories (Zaied, 2012). This research under study has also adopted Integrated Success Model by Zaied adopting the five dimensions from D&M IS and two concepts from TAM to evaluate the effectiveness of ISIS implementation in the Valuation department.

Zaied (2012) used ISM to evaluate information systems success. The model was found suitable in assessing the acute success aspects affecting information systems in the public sector in Egypt. It was used to exhibit how ISM can be useful in supporting the decision makers in assessing and developing the information systems (Zaied, 2012). This was investigated by distributing structured questionnaires designed based on ISM. The eleven elements of ISM were used to assess the information system success in this context. The findings of the results indicated that information quality had a strong significant influence on information system success and the least one was user involvement. It was stated that ISM and its elements were found useful since it was seen as a valuable tool for decision makers in organizations on assessing the application of information systems (Zaied, 2012).

Wu (2013) adopted ISM to explore Taiwanese university students' intention to use the Digital Museum of Sports Literature. The ISM was used as the theoretical basis to explore the influence of external variables like system quality, information quality and service quality on perceived usefulness and perceived ease of use, and attitude toward using on behavioural intention. The questionnaire survey and convenience sampling on university students were

used as a research subject. The questionnaires were graded based on the Likert 7-point Scale. The correlation analysis method was adopted to determine the associations between the variables (Wu, 2013).

As a result, it was found that there is strong and weak correlation between the variables. The findings of the results revealed that questionnaires survey was not adequate to explore university students' intention to use the Digital Museum of Sports Literature. As a results of this, Wu (2013) suggested that qualitative interview and observation would be useful to carry out in-depth and in-the-field observations. He emphasized that adopting these data collection methods would assist in understanding how university students think of the research topic and increase the value of the research (Wu, 2013).

Miyamoto, Kudo and Iizuka (2012) used integrated model comprising of TAM, DeLone & McLean IS model and User satisfaction to examine user participation and involvement of Japanese in Enterprise Resource Planning (ERP) adoption. The integrative model was found useful since it provided the theoretical understanding of the variance between object-based beliefs and attitudes and behavioural beliefs and attitudes toward use (Miyamoto, *et al.,* 2012). The integrative model was deemed appropriate since it represented complementary steps in a casual sequence from main features of system design to beliefs and anticipations about results that eventually determine usage (Miyamoto, *et al.,* 2012).

Furthermore, the authors stated that TAM was adopted because of its ability to detect the factors that influence the ERP systems and it was found to be a useful theoretical model in assisting to comprehend and clarify use behaviour in IS implementation (Miyamoto, *et al.,* 2012). DeLone and McLean IS model was considered as appropriate basis for more pragmatic and theoretical research. The findings of the results through using TAM assumed that ERP usage is determined by a behavioural intention to use a system, where the intention to use the system is equally determined by a person's attitudes toward using the system and its perceived usefulness (Miyamoto, *et al.,* 2012). It was further found that the intention of the satisfaction perspective reflects an attitude on the outcome derived from using the system. User satisfaction was shown to increase for ERP when a decision support such as an ERP vendor was provided to assist users in complex situations (Miyamoto, *et al.,* 2012).

Cheng (2013) adopted TAM and used the three dimensions of D&M IS model such as system quality, information quality and service quality as external variables to investigate attitude toward using and behavioural intention to use Radio Frequency Identification (RFID) door security system. The relationships between the three D&M IS dimensions and the TAM variables towards using and their behavioural intention to using an RFID door security system were investigated (Cheng, 2013). This model was then found appropriate for determining the relationships between the variables towards use and users behaviour.

The questionnaires method was used to collect data from 250 consumers of Taipei Arena Ice Land. The results showed that all the variables from D&M IS model were interrelated with the variables from TAM. TAM variables were also interrelated with one another. The integrative model was used with the hope that proposals on how to improve user satisfaction and purpose to use RFID door security system applications could be made (Cheng, 2013).

Al Shibly (2011) used integrative model, Technology Acceptance Model, User Satisfaction and DeLone and McLean IS model to examine the success of Human Resources Information Systems success Assessment (HRIS) in Jordan. TAM has confirmed to be amongst the most real models in the IS literature for envisaging user acceptance and usage behaviour and therefore was found appropriate. Moreover, Al Shibly (2011) pointed out that DeLone and McLean IS model was adopted since it offered a reformulated description of their classic model, considering both the IS nature change and some of the criticisms directed at their 1992 model.

Descriptive statistics analysis and correlation analysis were performed. The descriptive statistics was applied to determine the mean and standard deviation of the variables of TAM and D&M IS (Al Shibly, 2011). The correlation matrix was used to determine the relationships between the variables. The finding on the correlation analysis revealed that information quality is the most important variable affecting user satisfaction. Al Shibly, (2011) further found that there is a weakest correlation between perceived ease of use and user satisfaction. Al Shibly, (2011) study shows that the integrative model has been successfully specified, integrated and validated.

However, Al Shibly (2011) stated that the significance of using traditional IS models like TAM and User Satisfaction in analysing the success of HRIS could be learned from current

research papers which happened to attract attention that research in the IS success is disjointed and criticised for deficiency of theoretical grounding.

4.5 Conclusion

The current literature underlying research in spatial information systems has been discussed in this chapter. The basis for the research's theoretical framework has been placed, therefore one of the research objective which is finding suitable methodologies for this research has been answered.

Chapter 5: Analytical Methodology

5.1. Introduction

This chapter presents the frameworks, methodologies, tools, and techniques chosen in carrying out this study. Chapter 2, 3 & 4 form the basis of this discussion. The research objectives and questions are addressed making use of a set of methodologies and analytical frameworks recognized appropriate in the chapter. The chapter is aimed at providing drivers and explanation behind the suitability of these specific research methods. They are identified as single case study research techniques, structured system approaches and system evaluation success models for information system.

These methods are found as appropriate in reaching the objectives of this study and hence used to perceive and investigates the implementation of the integrated spatial information system (ISIS) in the Valuation Department of the City of Cape Town. Moreover, the chapter shows the research plan and how ISIS case is evaluated applying tools chosen. It should be noted that single case study is utilized to investigate a case of spatial information system in the Valuation department and ISIS in its current forms and evaluation of ISIS effectiveness. Therefore there is only one case, but two scenarios, ISIS implementation and Valuation department in the City of Cape Town.

5.2 The Process of Choosing Methods and Tools

This thesis adopts mixed method approaches used in spatial information systems research. The various methodologies and theoretical frameworks are used to carry out the investigation and evaluation of spatial information systems. This case study is a rounded strategy since it depends on various bases of evidence in investigations. Therefore, it is crucial to holism to choose methods of investigation and analysis in this thesis. An instance is the selection of hard system approaches in this study which advocates analysis and design of computer system viewed from technical perspective. It deals with measured complications in a system such as those relatives to hardware and software development.

Hard System Approach is applied in problem situations where behaviour, action, and human aspects are effective factors (Avison & Fitzgerald, 1995). Moreover, Integrated Success Model is also chosen to assess the effectiveness of the implemented information systems

(ISIS) in a holistic manner. These methodologies are integrated in this thesis in an effort to attain triangulated results. Figure 5.1 demonstrates the research process.

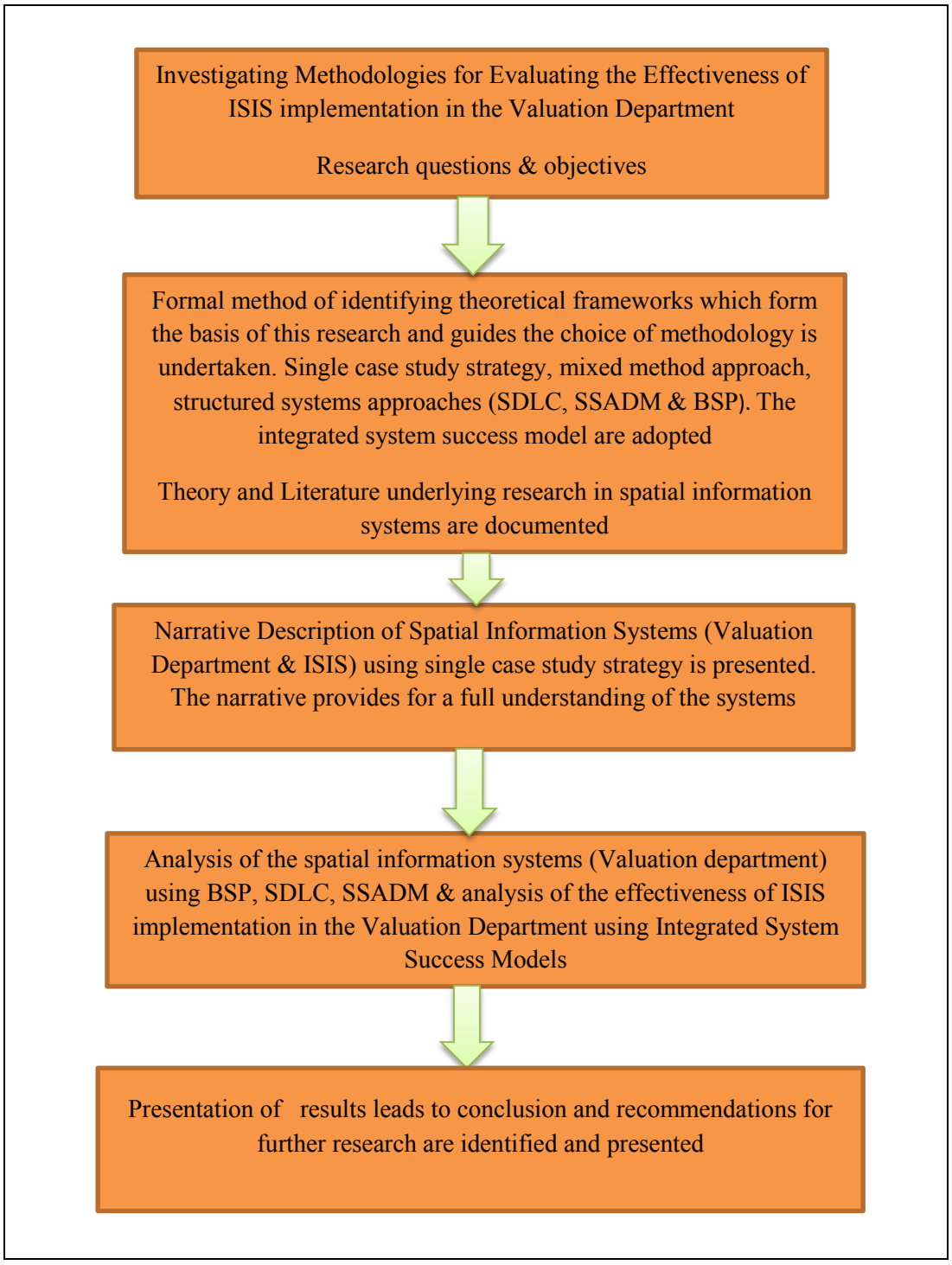


Figure 5.1: The ISIS implementation effectiveness case study research processes

5.3 Suitability of Mixed Method

Chapter four discussed spatial information systems research which has successfully used mixed method (see section 4.2.2), while chapter 2 documented a detailed description of mixed method (see section 2.2). Mixed method is favoured in spatial information system research since it allows the combination of both qualitative and quantitative data in a single study and also enables both the survey and case study to be gathered and evaluated consecutively (Williamson *et al .,* 2007). The integration of numerical measurement in the case studies through the usage of a questionnaire strengthens the case study approach (Williamson *et al.,* 2007). .

The mixed method in this study consisted of mix of methodologies such as case study, hard systems approach and integrated success models. The mixed method was used to collect, analyse and evaluate the existing spatial information systems (ISIS) in the Valuation department. After the investigation the inferences from the questionnaires and interviews were drawn. The correlation between them and the system diagrams were made to see where data issues existed as according to the interview and questionnaires responses from all the responses in the various sections participated. The purpose of the approach is to deliver an understanding of the spatial information system from multiple perspectives domain by a theory of process and correlation in terms of actions and relations (Niger, 2012).

A set of methodologies appropriate for evaluating and analysing the spatial information systems research have been identified in chapter 4. This comprises of case study strategy, structured system analysis and design (SSADM), system development life cycle (SDLC), business system approach (BSP), and integrated success models (ISM). These suites of methodology have been identified based on their merits in analysing and evaluating information systems.

For instance, Business system planning approach was found suitable for modelling business organisational structure, and strategies (Vendeirinho, Caetano, Tribolet *et al.,* 2011). SSADM strength is seen in its ability to use the 3 techniques such as data flow modelling, entity event modelling and logical data modelling to determine information system viability problems. SSADM allows for studying, identifying and documenting the present system problems (Jahromi & Manteghi, 2013). It also involves the use of tools like data flow diagram and data dictionaries to document and describe the real world situation. SDLC method is deemed suitable for its ability to allow the researcher to explore a “well-structured problem situation

with a well-defined problems and clear requirements" (Al-Zahrani, 2006). The Integrated Success Model, ISM was found suitable in assessing the acute success aspects impacting information systems in the public sector. It was regarded as a valuable tool for decision makers in organizations on assessing the application of information systems (Zaied, 2012). A case study strategy and combination of these system methodologies in research reinforces theory validity of information systems research.

5.4 Suitability of Case Study Strategy

Case study strategy is preferred since it is a suitable methodology to gather both primary and secondary data in such cases of analysing and evaluating the spatial information systems research (Kurwakumire, 2014). The case study is suitable to investigate an existing phenomenon by means of various sources of evidence in its real life setting such as those found in spatial information systems (Kurwakumire, 2014, Yin, 1994). In this case study, multiple sources of data such as questionnaires, interviews, observations and documentation were used to collect data. The first three tools are recommended by Yin (2003) as suitable for the case study approach which is used as the basis for data collection in this research.

Furthermore the researcher favours this case strategy because she is able to learn the current problems and success of spatial information from other GIS implementations. Consequently it would then be possible for the researcher to provide a tailor solution for effectiveness of spatial information system implementation.

5.4.1 Motivation for Single Case Study

The single case study strategy is selected because the spatial information system implementation under study is deemed unique. The case is unique in that the integrated spatial information systems has recently been implemented in the City of Cape Town and formal post implementation evaluation has not been done before this research.

The case study is an intrinsic single case study that aimed at offering a rich narrative of the spatial information system (Valuation department and ISIS) over a description for the purpose of understanding instead of building theory (see chapter 6 & &). Moreover, the single case study is favoured for rare cases.

5.4.2 Data Collection in the Case Study of ISIS implementation in the Valuation Department

The empirical data in this research was collected through multiple sources of data documented in section 2.3.2 in order to make sure that rigour is achieved. Questionnaires are used as the best actual method of exploratory that collects a small quantity of data from many people (Denzin and Lincoln, 1998). The information from the system users of ISIS in the Valuation department is collected through the structured questionnaires.

The questionnaires are also used as the base for the question and answer section of exploratory interview (Denzin and Lincoln, 1998). Interviews were limited to the key informants only. Interviews with section Heads in the Valuation department were formally conducted even though the researcher is also a participant in the department but has not been working long enough to have all the experiences from other department sections. The ISIS and Valuation narrative chapters are frequently informed by documents, questionnaires and interviews. The interviews are restricted to the key informants of the ERP Officer, general Valuation staff, Managers and Valuation section Heads. Interviews, Questionnaires, documentary and system diagrams evidence were gathered and reported over a time period of two years (2012-2013). This permitted for modification of the data gathering procedure and data capacity to be reached (Yin, 2003).

Key Informants Described

In this study, the key informants are the general employees of the Valuation department who utilize ISIS on a daily basis, the management employees who manage the department sections, the section Heads who supervise the general staff and use ISIS, and the Enterprise Resource Planning (ERP) officer who was involved in the implementation of ISIS and still responsible for sending /feeding information/data from ISIS Land Use Management (LUM) to Valuation system, Government Revenue Management (GRM). These people are proficient in giving profound perception into the case (Yin, 2003).

The responses obtained from the key informants in this research are referenced in a manner that the identity of the key informants is reserved confidential (i.e, use of key informant interviewee (s) A, B, C, D, E etc.). The researcher just has a common knowledge to know the sections where each key informants works, therefore it is ethically necessary that the researcher make of use of symbols to provide uniqueness to the interviewees. It is for

privacy, safety and esteem of human beings as bases of data in agreement with the University of Cape Town (UCT) Code for Research Ethics (UCT, 2010). Nevertheless the details of the interviewees are contained in the field notes. These are also kept confidentially and are accessible to the researcher and the supervisor.

Questionnaires

The structured questionnaires are used to interview the key informants. The structured questionnaires are preferred source of data collection in this study because it led the key informants to provide the exact responses in the form of a set of choices offered on paper. This type of questionnaire interrogating is simple to conduct, and does not require the interviewer to be present as the key informants are responding to the questions. Thus the interviewer time is saved and the key informants were free of any influence prompting in answering questions. The questionnaires can also be simply standardised since similar questions are addressed to all participants.

The study utilizes two structured questionnaires to collect data, that is, the Users of the ISIS and the Managers in the Valuation department. The questionnaires collected data about the Information Quality, System Quality, Service Quality, Perceived Ease of Use, Perceived Usefulness, User Satisfaction, and Individual and organizational Impact variables (i.e. Net Benefits). The user's questionnaires comprised of 76 statements. The Management questionnaires consisted of 39 statements. The participant were requested to state the extent of their agreement with each element on a six point likert- type scale for both Users and Management, with anchors from "Strongly agree to strongly disagree and not applicable to me.

The general management questionnaire mainly collected data about the net benefits which include the individual and Organizational Impact variables and was distributed to the 4 department Managers. The reason for designing two surveys was that Valuation users interact with ISIS on a regular time, so they have the relevant knowledge to assess elements that are directly linked to ISIS and their productivity. Managers, on the other hand, should have the knowledge about their skills individually and the overall performance of their organization they work at. Managers at this level would be capable to assess whether ISIS have both a positive or negative effect and impact on general net benefits and performance.

In order to get a sample for the study, a list of Valuation staff was provided to the Researcher and there were a total of 136 people on the list. A sum of 114 questionnaires was distributed to the staff. This excludes staff that is not using ISIS such as Finance staff, Secretaries, Valuation Infrastructure Support (VIS) and contract staff. 110 questionnaires were distributed to the users of ISIS and 4 to Management employees and thus form a sample for the study. A covering letter explaining the objective of the study was attached assuring the participants about the confidentiality of their responses and instructions on how to complete the questionnaires.

110 questionnaires as a sample of the study implies that the case study is small and therefore was appropriate for the researcher to distribute the questionnaires by herself going from office to office as well as collecting completed questionnaires. A total of 87 questionnaires (76%) were returned. 84 were users' questionnaires and 3 were management's questionnaires. This made the response rate 73.68% for users. This response rate is regarded as appropriate since it is above 50%, and therefore this makes the study applicable.

Semi-structured interviews with Key Informants

Semi-structured interview were directed specifically to the key informants. This is the favoured interview style in this case study because it allows consistency with all key informants/participants since the interviewer uses a set of pre-planned core questions. The in-depth information about a system is also gained because the style of interviews provides the key informants with opportunity to elaborate and give more relevant information. Then the interviewee's personal and social experience of the ISIS implementation was explored, at the same time giving general knowledge and a shared opinion of the case.

The set of interview was held immediately after conducting and analysing questionnaires. The interview was conducted as to validate the response gained from the survey questionnaires. The summary results of the survey questionnaires were linked to the system diagrams and a form of interview questionnaires was designed as to acquire more or detailed information on some of the questionnaires and to identify if there is a problem with the processes or data flowing in between the processes in the department.

The designed semi-structured interview questionnaires focused more on the overall satisfaction of the information quality that is being provided between the section processes in the department as well as from ISIS Land Use Management (LUM). The interest was to see if

the information/data shown on the data flow diagrams provided by ISIS to Valuation system Government Revenue Management (GRM) is sufficient, accurate, and free from errors, complete, correct, and reliable and real time as expected. In addition; if GRM is also "feeding" the Valuation sections with sufficient, current, complete, accurate, correct, reliable and real time data/information for them to perform their daily work more adequately and efficiently.

In total 5 departmental Section Heads and 1 ERP support Officer were chosen due to their involvement in the Valuation department processes. Interviews were semi-structured and were recorded to cut down on the amount of notes the interviewer had to take, also to increase the precision of data gathering. Eventually recordings were transcribed and the data were structured. The interview questionnaires focused more on the accuracy, completeness, correctness, adequacy, reliability and real time of the data that the Valuation at large receives on a daily basis to perform their task.

The other interest was to establish whether the information/data supplied to Valuation especially CAMA section is sufficient to enhance their model application and whether the department is not limiting itself when it comes to including more variables in their model application. The intention was to find out if there is a gap in data and whether there could be a room for improvement in the model application through more data supply from ISIS to the department.

Observations

Participant observation and direct observation (see section 2.3.2) are the two elements of observation as defined in (Yin, 2009). Both of them need the researcher to be present in the system with the aim of doing the real processes, and also with the purpose of noting each phase of the functions executed in the system (Yin, 2003). Therefore the researcher in this study both acts as participant and direct observer. This section explores a brief explanation of the researcher's position, which might have bearing on the research process.

The researcher remained a public servant of the departmental spatial information system under investigation since January 2011 till September 2013. The implementation of ISIS in the department under study was rolled out on the 25th November 2011 that is 11 months after the researcher became an employee in the department. Therefore the researcher was involved in the final testing of the ISIS system in the Valuation department. The researcher has also

been engaged in the weekly technical meetings of ISIS where the issues related to ISIS were discussed and solved. This weekly technical meeting was created immediately after ISIS implementation so as to assess the impact of a newly implemented system in the six business units of property value chain departments.

The researcher was also appointed as property value chain (PVC) member while an employee in the department and this group requires the researcher to also attend monthly meetings where the issues, risks, problems with the ISIS were discussed and solution proposed. This group was formed as to identify gaps and recommend improvements to the ISIS system. The researcher's main function in the department was to load data/information from ISIS LUM to GRM. As a result the researcher is more familiar with the system quality and data/information quality that the Valuation department was receiving from ISIS on a daily basis.

Another main function of the researcher was property research; this is where the researcher was investigating the property in respect of the queries received from various clients as well as Valuation sections and City departments at large. This therefore allows the researcher to identify issues and gaps of the information quality on a daily basis that the Valuation department provides to the City at large.

The researcher is also familiar with the initial stage of ISIS which is analysis and design phase long before she got employed in the City of Cape Town. First she learned about ISIS through her Honours GIS thesis in 2009 since her thesis required her to research about the system analysis and design of integrated land information system in the Department of Environmental Resource Management of the City of Cape Town. In February 2010, the researcher was then employed in the Water and Sanitation Department of the City of Cape Town where she could still keep track of the two initial stages of ISIS.

The background of the researcher shows that she at least has direct knowledge of the views and insights of the case and its circumstance by the ISIS system users and shareholders. The researcher has witnessed directly the Users responses and frustrations in respect to the information quality and system quality provided by ISIS in the Valuation department. This observation influenced the researcher to conduct this study and used questionnaires, interviews and system diagrams to gain their feelings about the ISIS system and created well-documented evidence. It is possible that the researcher background may influence the

research process as well as the results; however, conducting this research process through the use of rigorous research design will gear towards negating any bias.

Documentation

In this research documentation is the main source of empirical data and information obtained from it is acknowledged in the case study narratives in chapter 6 &7. The studies conducted earlier during the analysis, design and implementation phase of ISIS formed the major data sources in this research. This includes the System Analysis and Logical Design, (2008), City of Cape Town ISIS Project document (2008) which was prepared for the analysis phase of ISIS project. The Project ISIS Master Design Document (2010) created during the design phase of the project. The To-Be Registration Downloads Business Process Definition Version, (2010) and BPD_ISIS_ Valuation (2010) and Project ISIS Go-Live Readiness Assessment Report, (2011) were created in preparation for the ISIS implementation.

The Newsletter for the staff of the City of Cape Town, (2009) and City of Cape Town Council Overview, (2011) were also used as data sources for deriving information about the City of Cape Town organizational structures and their departmental functions. The information obtained from these documents confirms the data from key informants and the participant observer's viewpoints on the case. The triangulation of data is also facilitated as well as ensuring rigour in research.

5.4.3 Reporting the Case study

In this research, two narratives are produced the first one presents the (chapter 6) narrative description of Valuation department the second one presents ISIS narrative (chapter 7). Therefore, the result of the case study is a long report produced from case study narrative and analysis. The statements gathered from the key informants interviews, survey questionnaires, system diagrams, observations and documentations are assembled into a report to define the case and expedites a profound understanding of the case in a complete way.

It should be anticipated that the researcher's work experience in the Valuation department have stance on the research process and reporting. This is because the researcher has some experience of Valuation department after ISIS implementation under conditions of complexity. While translating the data from case study into the narrative case study and analysis, the researcher discloses information which has a stance on the research questions of

the study. This could be slightly subjective process. As a result, the whole thing around the case is not reported and analysed. It is accommodated by methodologies guiding this research (see chapter 2 & 3).

5.4.4 Triangulation in Case Study Research

Both qualitative and quantitative triangulation of results is useful in the case study. These involve methodological triangulation; data triangulation, theoretical and discipline triangulation (see section 2.3.5). As perceived by (Yin, 2003), triangulation escalates validity and reliability of the results in a case study. This means that proof from sources is verified with proof from other sources and results from various tools of analysis support one another which are the advantage of the mixed method approach (Yin, 2003).

5.4.5 Presenting the Case Study Results

The single case study result is presented in the case study narrative through data gathering and explanation structure illustrated in the narrative. This leads to responding to "what and how questions" (Yin, 2003) in chapter one. The Valuation department and ISIS descriptions are produced from multiple sources of data. The results from the questionnaires, interviews are also presented. The data acquired increases understanding of the system and this provides knowledge around what more data is needed. The analysis of the case in case study strategy is informed by narrative descriptions. This facilitated the processing of the single case study through systems tools as explained in Chapters 8 and 9.

5.4.6 Analysing the Case Study Results

The set of methods and tools are used to process and analyse the case study narratives described in section 5.4. This adds to the general understanding of the difficult situation as well as the communications and relationships that occur within the spatial information system. Depending on the definite tool of analysis used, the narratives might be analysed from diverse perceptions and might offer same or diverse results. The several tools are delicate to diverse features of the case study. Triangulation is performed to the analysis results in chapter 8 and chapter 9 to toughen construct validity.

5.4.7 Generalisation of Case Study Results

Analytical generalisation is appropriate in this research. This is because the spatial information system in the City of Cape Town also contains elements of analytical

generalisation in that the case of ISIS and Valuation situation is evaluated and analysed using systems analysis tools. The analytical results contribute to the general understanding of the spatial information of the City of Cape Town.

They also contribute to the applicability of integrated success model in evaluating information systems (ISIS). Denzin and Lincoln (2000) supported the idea that case studies can be generalised, through various actors in multiple situations as it improves generalizability. This therefore implies that, the conclusions drawn from this study would not be generalised for every case without considerations of the findings of more tests performed by the researchers on system analysis as a modelling tool and integrated success model as evaluating tool for assessing information system implementation in their context.

Furthermore, naturalistic generalisation is also applicable. The objective of this research is to understand and evaluate the effectiveness of the integrated spatial information systems (ISIS) in the Valuation department of the City of Cape Town. The case study is intrinsic since it provides explanation of the situation in its settings for the purpose of understanding and knowledge. The curiosity of the researcher is to investigate and evaluate the case and not to generalise the results.

The study further contributes to the understanding of the case. This could eventually results in enhancing the problem situation by recommending changes. Chapter 6 and 7 give a narrative description of the case, and this allow upcoming researcher to apply naturalistic generalisation to analyse the outcomes of the case and relate the results to more cases.

Statistical generalisation is also suitable in this study. The descriptive statistical analysis results of the survey questionnaires obtained from the ISIS system users in the Valuation department are also used as other method of generalisation in this case. Nonetheless, statistical generalisation is not regarded as a single method to generalise the case study results (Yin, 2003).

5.4.8 Observer Bias in this Research

The use of participant and direct observations were used to prevent bias. In this study the researcher's role both as the author and the reporter could pose danger to rigour (Yin, 2004). The personal profile of the investigator may pose bias. However, bias can be contested by applying correct research tools in the case study research (Neuman, 2000). It is therefore

necessary to note that the approaches applied in this study make the researcher to stand on a definite world sight and is inclined by work experiences and perceptions (Mingers, 2006).

5.4.9 Managing Observer Bias

The researcher avoids bias by presenting the case study over the medium of the narrative description and analysing the results. It should be noted that this can be difficult to achieve, since the researcher is involved in this case as participant observer. Nonetheless, the study adopted the use of theoretical frameworks and tools of observation which guided the researcher to ensure rigour as well as aiming to achieve the objectives of the research.

5.5 System Analysis Methodologies in Spatial Information Systems in the City of Cape Town case study

Information systems are significant to an organisations success. A comprehension into the nature and difficulty of spatial information systems as a phenomenon is offered by system approaches in chapter 2 and chapter 4. The application of structured and hard systems methodology such as SSADM, SDLC and BSP are shown to be useful by various authors in chapter 4.

5.5.1. Suitability of Structured System Analysis & Design Methodology (SSADM)

This methodology is chosen to analyse the spatial information system. SSADM is embraced in this study because of its ability to highly recognise the user participation. In the context of this study, different key informants (sections 6.8 & 7.13.2) participated by identifying the problems and constraints of the newly implemented ISIS system in the Valuation department. As a result of these problems, the model leads finding a solution design to the current implemented system. Therefore SSADM was useful in uncovering the underlining problem areas in the spatial information system of Valuation.

Modelling using Structured System Analysis & Design Methodology (SSADM)

SSADM was further deemed suitable to the study since it uses analysis tools such as dataflow diagrams and data dictionaries to document and describe the real situation in spatial information system. These tools are used to document the Valuation processes at large within the different sections, and the data flows between the processes in the department as to understand the spatial information system of Valuation better. The meanings of and the

relationship between the departments processes are described as to understand the processes. This model is appropriate in this study because the study is aiming at assessing whether ISIS is indeed improving the Valuation business. Therefore SSADM is helpful in this case because if problems are identified with the current system, the researcher will be able to go back to the iterative steps to see where the problems lies with the system and if new design is required with the system it would be easy to do or propose some changes. SSADM has iterative steps that allow reviews and changes to be made for improvements if necessary.

5.5.2. Suitability of System Development Life Cycle (SDLC)

SDLC offers a structured approach to investigating the system in an effective way (Zhou, 2004). SDLC is found appropriate for research in information system field as has been broadly discussed in chapter 2 and chapter 4. It is a favoured methodology to find the best solution for a clearly defined problem such as those found in the Valuation department spatial information system. In developing information systems, the purpose is to find best solution to the well-defined problems and clear requirements. SDLC is also favoured in this research because it is a means of gathering an in-depth understanding of the system under investigation; it allows understanding of business issues and documenting of business processes in the analysis phase in order to identify problems areas.

In the context of this thesis, SDLC is used to analyse the spatial information systems of Valuation department and ISIS thereby documenting the business processes so as to provide a better understanding of HOW the current systems (ISIS) operates and WHAT it does. SDLC is further used to analyse the processes and functions, data/information and interface/communication that exist in the Valuation department. The detailed documentation of each business processes are also be documented. This is done in order to identify problems/issues existing in the ISIS system.

5.5.3 Suitability of Business System Planning Approach (BSP)/Zachman framework

BSP is suitable for use in this research as it is a powerful tool for analysing and defining information architecture of organizations. The approach focuses on “data, processes, strategies, aims and organizational departments” that are interrelated (Zachman, 1982). It is therefore used to unfold and analyze the designs of Valuation spatial information systems in the City of Cape Town. This framework is appropriate in this study since it is able to

incorporate the deliverables of other system methodologies applied in the study of information systems research such as SDLC and SSADM (Effenbeg, 2001). The framework permits for structured deliberation of the comprehensive spatial information system during analysis views. It also provides a full documentation of particular dimensions using proper information systems techniques. This makes the framework to provide a comprehensive system narrative and improved understanding of what the approach is trying to achieve (Effenberg, 2001).

Moreover, the steps in BSP processes which have been depicted in chapter 2 sections 2.4.5 were deemed appropriate to the study. These steps allow to effectively collect data in the information system research. The first step of BSP approach which is to gain top management commitment was adopted in this study. First the written proposal to conduct the study in the department was submitted to the Valuation Director stating the goal and objectives of the study. After that the study was prepared through designing questionnaires and meetings were held with four Valuation managers to explain the purpose of the study.

The pilot study was then conducted by distributing the questionnaires to the Valuation Management. This was done in order to test whether the questions asked were relevant and participant (user) involved could be able to answer. The positive feedback from the Management about the relevance of questionnaires was received and the approval was provided to the researcher to continue with the survey. In this way, BSP approach is deemed useful since management commitment was gained and received by the researcher. This management commitment made the researcher to gain the support from the Valuation staff as a whole and made it easy to get large response through the questionnaires and interviews to collect empirical data.

5.6. Integrated Success Model for Evaluating the Case Study

The integrated Success Model is applied using the theories of Technology Acceptance Model (TAM) and DeLone & McLean updated model (D&M) IS (see section 3.3.3). This combination of TAM and D&M IS concepts provide complete and solid model for evaluating IS success. The model is suitable in assessing the critical success aspects impacting information systems in the organizations (see section 4.4.3).

5.6.1 Suitability of Integrated Success Model (ISM)

Integrated Success Model (ISM) is deemed suitable to this study because it has combined the variables of D&M IS and TAM to assess the efficiency of the information system (IS). The models are the two most common models in IS and their combination strengthens rigour in the information systems research hence appropriate for this research.

It is useful in this study since it provides for a comprehensive understanding of the effect of information systems such as ISIS and gives a better explanation on user performance. The five dimensions of D&M IS such as information quality, system quality, service quality, User satisfaction and net benefits are adopted in this study and used to evaluate the ISIS success in terms of the effectiveness and value of the system.

The two concepts of TAM which include perceived ease of use, perceived usefulness will be used. These two variables are useful since they assess the user perception on the usefulness and ease of use of the system (Al Khatib, 2011). The D&M IS and TAM gives a description of dependent variables and metrics for measurement of acceptance or efficiency of the IS on a system level and hence appropriate to the study (Zaied, 2012).

5.7. Correlation between the questionnaire, Interviews and System Diagrams

As mentioned in section 5.3 mixed method approach is suitable for this study since the inferences from both quantitative and qualitative data were drawn and correlation between the two methods of data collection such as interviews and questionnaires with system diagrams were made so as to see where data issues are as according to the interviews and questionnaires responses from all the responses in the various sections participated.

In order to create correlation between these methods of data collection the system diagrams were drawn for the four sections in the Valuation department. The questionnaires from the user of ISIS (Valuation staff) were analysed separately according to the department section, the interviews from the key informants were also analysed. Then the responses (results) from these data collection methods were correlated to the system diagrams separately according to the sections in order to verify if the data flowing in between the Valuation processes in the system diagrams confirm what has been said in the interviews and questionnaires by the key informants.

However, the researcher found it difficult to correlate properly the three methods since most of the responses from the questionnaires were 'on average' and indicated on a mid-range scale value of 4, whereas the interviews from Key Informants stated clearly where the data issues were. In view of this difficulty, the researcher conducted a follow up interview with the Key Informants as to get clarity on the discrepancy of responses and to identify where data/information issues could be, looking at the data flow diagrams of each section. As a result, the follow up interview assisted the researcher since clarity was acquired. The researcher was then able to correlate the interview responses and questionnaires with system diagrams. The results of each section from the system diagrams were demonstrated and analysed.

5.8. Conclusion

The chapter has documented and justified the methodologies chosen in this research. It has successfully shown the appropriateness of single case study strategy and systems analysis methods such as SDLC, SSADM and BSP in spatial information system research. It explained further why and how the mixed methods are used to investigate, analyse and evaluate the spatial information systems of Valuation department and ISIS. The critical goal is to understand the systems thoroughly. The methods used together strengthen rigidity in the study over methodological triangulation.

Chapter 6. Narrative Description of the Spatial Information Systems of the City of Cape Town- Valuation Department

6.1. Introduction

The chapter gives a description of the phenomenon of the implemented spatial information system in the Valuation Department of City of Cape Town in its context from multiple perspectives. The earlier chapters have dealt with the identification of methodologies for such an investigation. Single case study strategy is used to facilitate this description. The narrative presents: the reasons why the Valuation Department was selected as a study area, the geographical context of the case, the background of the spatial information system in the City of Cape Town and a description of the Valuation Department.

6. 2. Valuation department as a selected Case Study

The significance of the Valuation department in the City is one factor that drove the researcher to conduct the study in this department besides the familiarity of the researcher to the department. This is because Valuation plays a major role in impacting on the livelihoods of the public domain by assigning market values to their properties since money is involved, both as a revenue stream to the City and as a direct tax levied upon household. In addition, Valuation department is the one among the other departments in the City which is linked directly to several spatial information systems that disseminate property data in the City, such as System Application & Products (SAP), Land Use Management (LUM), Integrated Spatial Information System (ISIS) and Deeds system. As a result it is vital to ensure that the department provides the current information flows which are appropriate in determining the market value of the public properties.

6.3. Geographical Context of the City of Cape Town Spatial Information System

This section describes the geographical context to facilitate understanding of the spatial information system setting in the City of Cape Town. A case of spatial information systems is best understood in its physical, social, economic, political and organisational contexts.

6.3.1. The Physical Context of the City of Cape Town -Valuation Department

Valuation is one of the departments found in the City of Cape Town Municipality. The City of Cape Town is one of the metropolitan municipalities in South Africa. It covers a geographical area of 2 400 km2 and located on the Southern Peninsula of the Western Cape Province (City of Cape Town Council Overview, 2011). The annual population growth rate of Cape Town is estimated to be 3 %. The estimated population of Cape Town was 3.7 million in year 2010 (City of Cape Town Council Overview, 2011). The City of Cape Town as a unicity municipality is just over ten years old. It became a unicity municipality in 2000 December on the 04th. It first had 58 municipalities which were eventually combined into 7 municipalities on the eve of 1996 local government elections (City of Cape Town Council Overview, 2011). The City of Cape Town is divided into six administrative councils as shown in figure 6.1.

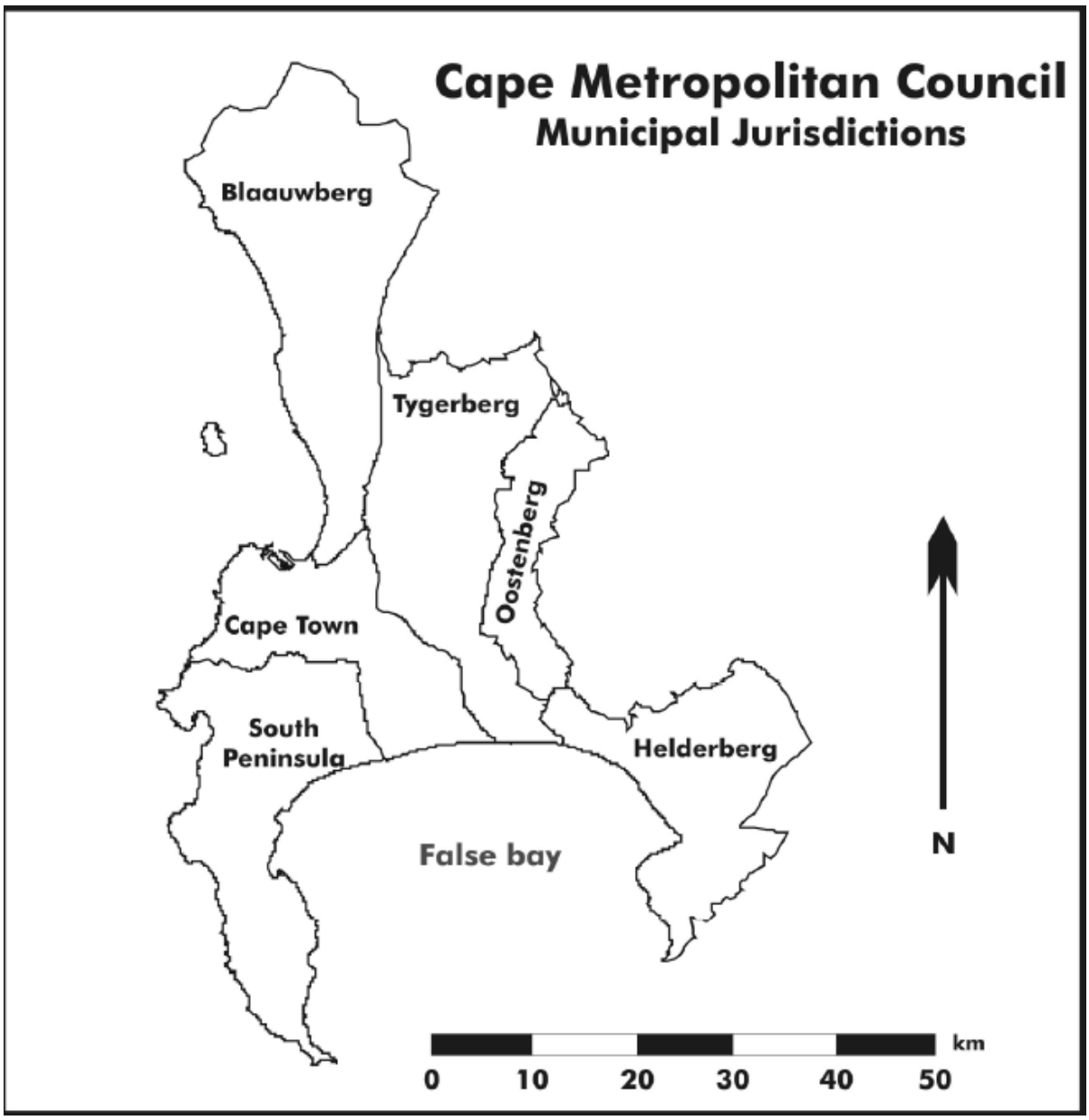


Figure 6.1: Six administrative councils of the City of Cape Town (Whittal, 2008)

The municipality is also distributed into 12 directorates, each directorate has roles and responsibilities (see section 6.3.4). The City of Cape Town employed more than 25 000 staff in 2010 (City of Cape Town Council Overview, 2011).

Pressure of Urbanisation

Like other South African metros, Cape Town is also characterized by a growing population. This is caused by natural birth rate of existing population and urban migration into Cape Town from rural areas and other provinces. Urban migration occurs due to several factors such as better life opportunities offered by urban areas (City of Cape Town Council

Overview, 2011). It is estimated that in the year 2031, the population of Cape Town is predicted to grow to at least 4.3 million (City of Cape Town Council Overview, 2011). However, the number of households in the city is growing at a faster rate than the population. In 2010, the estimated number of households in Cape Town was 1 060 964, and this number is projected to increase to 1.45 million by 2019. Nevertheless, the average household size for all households in Cape Town has decreased from 3.92 people per household in 1996 to 3.72 in 2001 (City of Cape Town Council Overview, 2011). This places additional demand on the provision of housing, as there are an increasing number of households needing shelter. In the City the household is characterised by formal and informal dwelling (City of Cape Town Council Overview, 2011).

A formal dwelling is defined by (City of Cape Town Council Overview, 2011) as a structure built based on approved plans like "house on a separate stand, flat or apartment, townhouse, or a flatlet". An informal dwelling is described as a temporary structure not built according to permitted architectural plans. An example of this is shacks or shanties built in informal settlements (City of Cape Town Council Overview, 2011). The number of households that live in informal dwellings has increased considerably, it was estimated to be 291 826 in 2010. Projections indicate that this trend will continue, unless innovative ways to significantly increase the delivery of low-cost housing are found. The number of households living in informal dwellings is expected to grow to 417 213 by 2019 (City of Cape Town Council Overview, 2011).

6.3.2. Government and Legislative Context

Cape Town is a judicial capital of South Africa. It is the governmental and economic centre of Western Cape Province (City of Cape Town Council Overview, 2011). The City of Cape Town is ruled by 221-member City Council, This City Council nominates the Executive Mayor, Deputy Mayor and Speaker (City of Cape Town Council Overview, 2011). Council is both a judicial and managerial body. It is composed of the constitution which empowers them to make decisions regarding the application of all powers, the performance and the functions of the municipality (City of Cape Town Council Overview, 2011).

The City Manager ran the administration and maintained by an Executive Management Team. The City of Cape Town is subsidized by community money (see section 6.2 & 6.5.1), it is anticipated to apply the highest levels of corporate authority (City of Cape Town Council

Overview, 2011). The governance systems of the City are intended to encounter the highest professional standards (City of Cape Town Council Overview, 2011).

6.3.3. Socio-Economic Context of Cape Town SA

The City of Cape Town is the monetary capital of the Western Cape region (City of Cape Town Council Overview, 2011). It is the third biggest economic hub in Africa. The gross domestic product (GDP) of South Africa is produced by the City at 10.5% and accounts for more than 7% of the Western Cape economic activity (City of Cape Town Council Overview, 2011). The City economy is composed of three biggest sectors such as finance, insurance, property and business services which are driven by tourism. The important drivers of economic growth are tourism, conferences and conventions which provide almost 10% of the province's GDP. Cape Town is the most Africa's visited tourist place and the heritor of various travels and destination awards (City of Cape Town Council Overview, 2011).

Unemployment in Cape Town was at its highest (29. 2%) in 2001 and declined to 15. 1% in 2006, but rose again to 25. 82% in 2010. This was the highest rate since 2001. The indicator of poverty in the city is household income. In Cape Town, 34. 6% of all household have a monthly income of less than R3 500 (City of Cape Town Council Overview, 2011).

6.3.4 The Organisational Context of the Valuation Department

Many departments in the City of Cape Town are involved in the spatial information systems. Therefore Valuation is not an end in itself in spatial information systems. Other departments which fall under the City directorates also deal with property information processes. The City of Cape Town is headed by the Executive Mayor. Under the Mayor there are thirteen Executive Mayoral Committees (Mayco). Each Mayco has its own Executive Management Team. These Management teams (directorates) are managed by Executive Directors. Under each management team, there are various departments that are headed by these Directors. This means that each directorate has its own departments falling under it.

Valuation department is therefore under the City of Cape Town Finance Directorate. Within this directorate, there are only ten departments: Supply Chain Management, Property Management, Treasury, Budget, Valuations, Revenue, Shareholding Management, Expenditure, Housing Finance & Leases and Inter-service Liason. The details of each directorate are illustrated in the City of Cape Town structure in figure 6.2. This structure shows the Executive Mayor on top highlighted in Yellow. The directorates of the City bolded

in black together with their individual departments listed underneath, the Valuation department directorate is shown in purple.

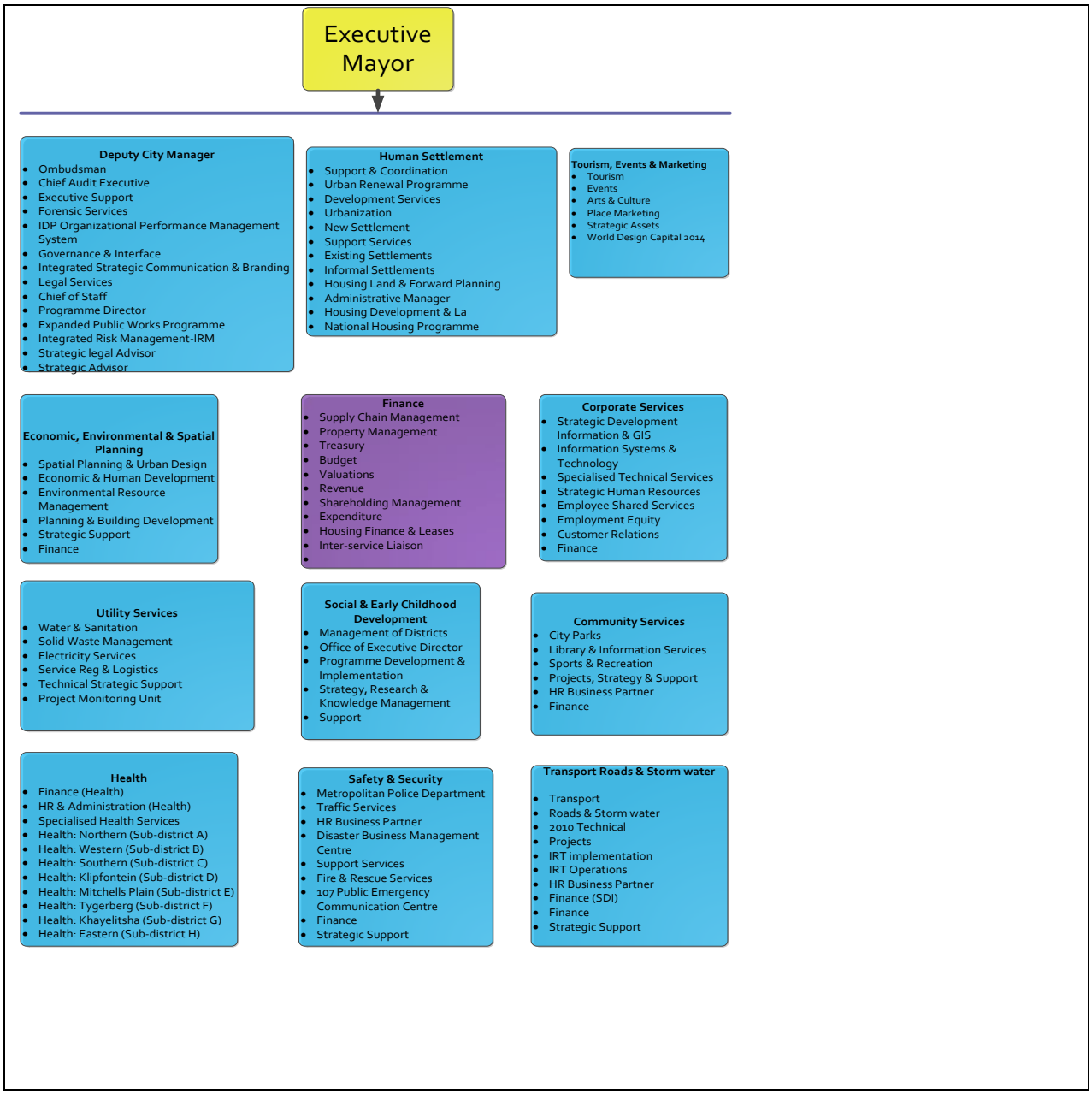


Figure 6.2: The City of Cape Town directorate structures (The Newsletter for the staff of the City of Cape Town, 2009).

6.4. Background of the Valuation Department

The City of Cape Town like other municipalities imposes rates on properties to fund its service delivery programmes. The rates are derived on the market value of the properties as presented in the City's valuation roll in terms of prescribed regulation (key Informants interviewee G, 2013). Therefore, Valuation department is responsible for accurately applying values to properties in order to correctly bill the relevant usage and services on the property. It produces and maintains valuation roll according to approved statute (BPD_ISIS_Valuation, 2010).

Valuation Department vision is to remain the leader of the world in the valuation of property. It is expected to deliver efficient, accurate and clear appraisals to the communities. It does that by improving the systems and processes. Its vision is also to improve the staff ability to assist the City of Cape Town to endure perfect valuation roll. This is done in line with maintaining and sustaining a well-governed municipality. The department is tasked with performing four functions such as: Valuation Operations, Valuation Surveys and Quality, Valuation Data and Business, and Valuation Business Environment (Key Informants interview G, 2013).

6.4.1. The Importance of the Valuation Department in the City of Cape Town

Valuation is a critical department in the City because it produces revenue for the City of Cape Town. It generates revenue by assigning a market value to residential, commercial, agricultural and public infrastructure properties for rating purposes. In order to rate properties, the Valuation undertakes two valuation processes such as a general property valuation (GV) and a supplementary valuation (SV). In the general valuation (GV) of 2009, the department valued more than 780 000 properties (including all property types mentioned above), whereas in GV 2012, the department assigned market value to more than 860 000 properties. As indicated in section 6.3.1, the city of Cape Town has more than 1 million household. However, the 1 million included informal properties and these are immune from taxation. All the residential properties valued at R200 000 and below are rebated for taxation.

A general property valuation is carried out every four years to confirm that the rates levied on properties are rational and reflect current values. This is a necessity for the Local Government Municipal Property Rates Act of 2004 (City of Cape Town Council Overview,

2011). The last two general valuations (GV) were held in 2009 and 2012. Five supplementary valuations (SV) have since been held after 2009 GV and four SV in 2012 GV.

The department uses a Computer Assessment Mass Appraisal (CAMA) Methodology that abides with international valuation practices. This method is a logical process of valuing various properties within a set of time. It uses a geo-spatial data and statistical procedures according to property sales and market situations about the date of valuation. The actual property taxes that property owners pay are based on the property value, and this can be a contentious process (City of Cape Town Council Overview, 2011).

6.4.2. The Organisation Structure of the Valuation Department

The Valuation structure of line management is represented in a standardised organogram in figure 6.3. This chart shows the functional organizational structure of Valuation showing the director, the four branches and the functions performed under each branch.

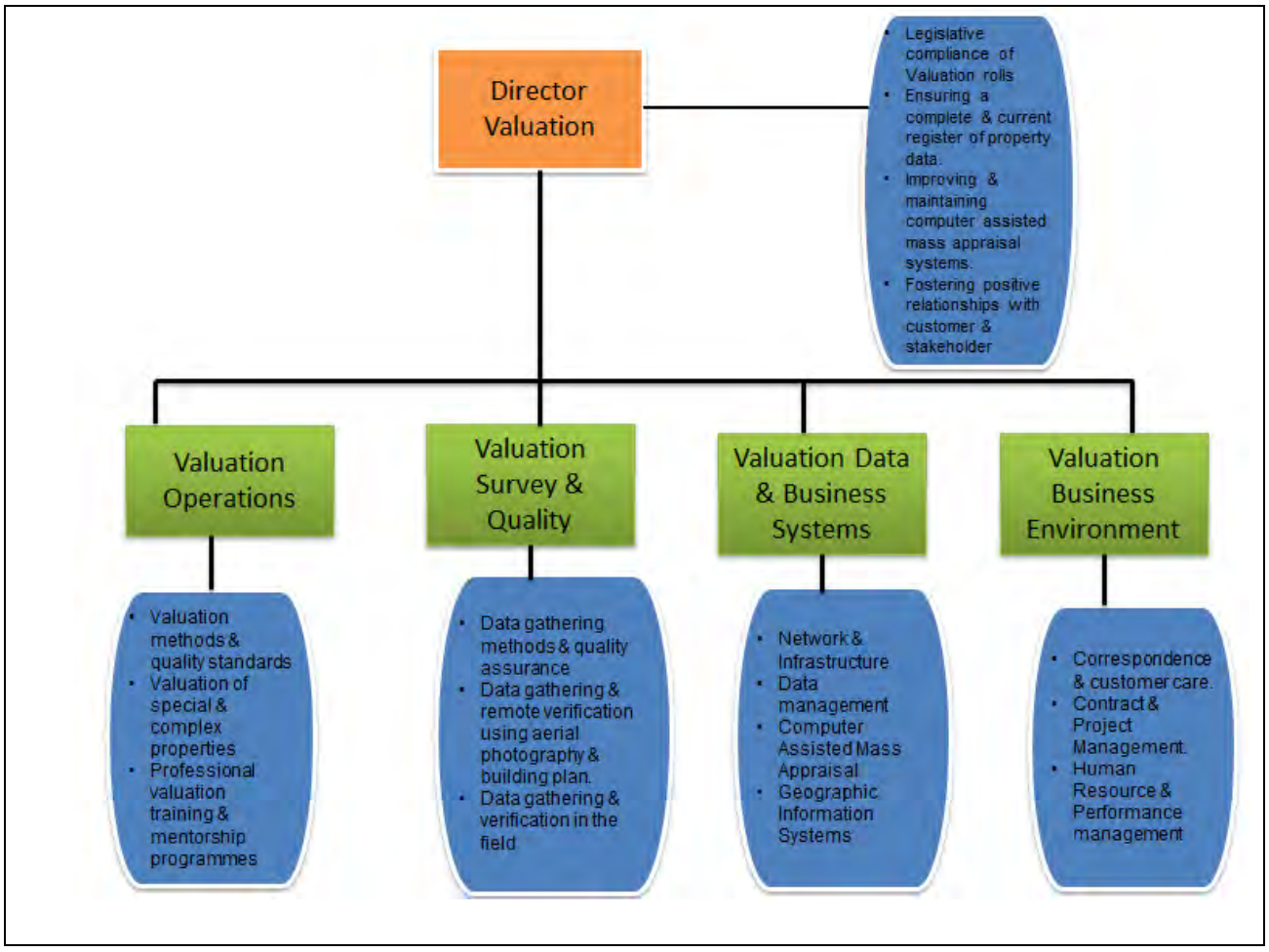


Figure 6.3 Valuation Organizational functional structure (BPD_ISIS_Valuation, 2010).

6.5. The Valuation functional Branches Described

The four functional Branches of Valuation, as stated in section 6.4 are defined in this section. It discusses the processes carried out by these branches.

6.5.1 Valuation Operation Branch Described

The Valuation Operation is divided into three sub-sections. The three sub-sections are divided according to the Valuation department neighbourhoods regions. They are responsible for applying valuation methods in these delineated neighbourhoods regions.

The sections deal with conducting manual valuation, and performing quality standards. Manual valuation is performed by determining the values for properties that would be recorded on SAP LUM. The section is also responsible for processing valuation roll and publishing it to the general public. It conducts data validations on final review and applies exclusion rules to the final review property (BPD_ISIS_Valuation, 2010).

Table 6.1 summarizes the functions/processes, the data sets, software/systems and interface used by this section together with the output of data produced.

Table 6.1 Valuation Operations (BPD_ISIS_Valuation, 2010).

Functions of the Branch		• Valuation methods & quality standards • Valuation of special & complex properties • Professional valuation training & mentorship programmes	
System/s Consists Of:	**Information/Data**	**Functions/Processes**	**Technology**
	Data Sets -Residential properties -Commercial properties -Sectional Title schemes and units -Hanging & holding Properties -Home owner associations properties -Valuation Base data -SG diagrams -Pending Sales -Registered sales -Objections forms Valuation Neighborhoods	**Processes** Conduct manual valuation such as follows: - Collect work packages for the properties to value. -Inspect each property i.e collects data, updates sketch or create a new sketch. -Fill out data collection forms and determine property value. -Complete the work packages by adding the information collected and value determined. - Conduct physical review, checking information on aerial photographs -Capture property review information on GRM -Conduct data validations on final review -Correct capture error for value review -Apply exclusion rules to the final review -Process valuation roll and publish it to the general public (general & Supplementary **Systems/Software Used** GRM (CAMA) Microsoft Excel Microsoft Visio Microsoft Power Point Microsoft Access **Output of data** Override values Finalized values Valuation Roll Objection Values Appeal decision values	**Interfaces** -Corporate ISIS Viewer -Pictometry -ISIS SAP/ LUM -Business Viewer/Valuation layer **User/Clients** -Revenue department -Property Value Chain business units (ISIS) -General Public

6.5.2 Valuation Data and Business Systems Branch Described

Valuation Data and Business System is divided into three sub-sections: Corporate data, CAMA and Valuation Systems Infrastructure (VSI). Corporate Data is responsible for receiving data from the SAP Land Use Management (LUM) and integrating data into Government Revenue Management (GRM). GRM is the system used by Valuation department to manage and maintain property data. The Corporate Data section is divided into three sections which are Geographic Information Systems (GIS), Property Research and Deeds registrations.

The GIS section is responsible for creating valuation maps, confirming property base data, initiating valuation workflow and creation of neighbourhood's delineations. Property Research section deals with conducting property research, maintaining valuation data, loading valuation data into GRM. The Deeds Registration section is responsible for downloading deeds file into LUM. CAMA is responsible for assigning values to properties by running computer assisted models against properties. It also deals with conducting data analysis. VSI deals with the maintenance of Information Technology (IT) of the department. Table 6.2 summarizes the functions/processes, the data sets, software/systems and interface used by this section together with the output of data produced.

Table 6.2 Valuation Data and System (BPD_ISIS_Valuation, 2010).

Functions of the Branch	• Network infrastructure • Data Management • Computer Assisted Mass Appraisal • Geographic Information Systems		
Systems consists of	**Information/Data**	**Functions/Processes**	**Technology**
	Data Sets - Subdivisions --Consolidations -Sectional Title Scheme/Units -Incorporations -Closures -All sales -Building plans -Street addresses -Rezoning & departure -Ownership details -SG diagrams -Objection forms -Vesting advice forms forms)	**Processes** -Conduct data analysis -Apply CAMA model -Confirm property base data -Download deeds file into LUM -Load valuation property data into GRM -Conduct property research -Maintain valuation data -Initiate valuation workflow -Valuation maps creation -Neighbourhoods delineation **Systems/Software Used** -GRM (CAMA) -Modpro -ArcGIS -SAP LUM -LIS -SIGMA -Sectional Title Condo Maintenance -Microsoft Excel -Microsoft Word -Microsoft Visio -Microsoft Access **Output of data** Model Values Sales report Property Base data Property research results Ownership data Various property transactions Neighborhood delineations Valuation spatial data Valuation maps	**Interfaces** -Corporate ISIS view -ISIS SAP LUM -Pictometry -Business viewer/Valuation layer -Windeed -Surveyor General web **User/Clients** -General public -Valuation department -Property Value Chain business units (ISIS)

6.5.3 Valuation Survey and quality Branch Described

This branch is divided into three sub-sections such as Data collection, Field Survey and Remote survey. The Data collection section is responsible for data gathering and capture as well as conducting data collection planning. The Field Survey deals with verification of data in the field and resource balancing. Remote survey is responsible for data gathering through remote verification using aerial photography as well as performing quality assurance control and correcting captured errors.

Table 6.3 summarizes the functions/processes, the data sets, software/systems and interface used by this section together with the output of data produced.

Table 6.3 Valuation Data Collection (BPD_ISIS_Valuation, 2010).

Function of the Branch	Data gathering methods & quality assurance Data gathering remote verification using aerial photography & building plan Data gathering & verification in the field		
System consists of	**Information/Data**	**Function/Processes**	**Technology**
	Data Sets -Registered subdivisions -Registered consolidations -Registered Sectional title schemes /units -Building plans -SG diagrams -DCF (data collection forms)	**Processes** -Conduct data collection planning -Conduct field resource balancing -Conduct data collection & capture -Conduct remote data collect -Perform quality assurance control -Correct captured errors **Systems/Software Used** GRM (CAMA) ArcGIS 9.3 Microsoft Excel Microsoft Word Microsoft Visio Microsoft Access **Output of data** Processed property data Data capture report	**Interfaces** -Corporate ISIS view -ISIS SAP LUM -Pictometry -Business viewer/Valuation layer **User/Clients** -CAMA

6.5.4. Valuation Business Environment Described

Valuation Business Environment is managed by the Manager assisted by three sections heads. The section is divided into four sub-sections such as Objections, Business

Communication, Project Management and Finance. The business communication sub-section is responsible for correspondence and customer care as well as human resource management. This section also deals with creating C3 notification and administration, property investigations and property results excursion. C3 is a process that track, record and report requests and complaints from residents and ratepayers (BPD_ISIS_Valuation, 2010). The C3 notifications are created as a result of the property queries received from the public and the unique number is created for each query so that it can be easily tracked.

Project Management sub section deals with contract and project management, while Objection sub-section is responsible for analysing objection forms. The section capture property information on the objection forms in preparation for facilitating objection process (BPD_ISIS_Valuation, 2010). Table 6.4 summarizes the functions/processes, the data sets, software/systems and interface used by this section together with the output of data produced.

Table 6.4 Valuation Business and Environment (BPD_ISIS_Valuation, 2010).

Functions of the Branch	• Correspondence & customer care • Contract & Project Management • Human Resource & Performance		
System consists of	**Information/Data**	**Functions/Processes**	**Technology**
	Data Sets -Ownership details -Street addresses -Property rating category -SV effective dates	**Processes** C3 Notification creation C3 Notification administration Property investigation Property investigation results Excercusion Closing of C3 Notification **Systems/Software Used** GRM (CAMA) SAP LUM SAP IW58 Microsoft Excel Microsoft Word **Output of data** C3 notification Property investigation results	**Interfaces** -Corporate ISIS view -ISIS SAP LUM -Pictometry -Business viewer/Valuation layer -Surveyor General web **User/Clients** -General public -Revenue -City departments (ISIS)

6.6. The current status of the Spatial Information Systems in the Valuation department

Valuation department achieve its spatial information system by collaborating with the various departments within the City of Cape Town and outside the City. It interacts with other departments in order to achieve its role of accurately applying values to properties. These departments are the five business units integrated into Integrated Spatial Information Systems ISIS of the City of Cape Town as mentioned in section 1.2 and the ISIS narrative in chapter 7 and are called ISIS (Property Value Chain). The department interacts with ISIS and other external organizations by sending and receiving information/data in order to perform its function effectively. Valuation department is the custodian for ownership data and valuation

roll and therefore shares this information with the relevant business units. The business units that work in collaboration with Valuation department are described as follows:

ISIS: This is the integrated spatial information system of the City of Cape Town which houses all the property related information for the property value chain. Each business unit in this spatial information system integration sends their data/information to ISIS as their master centralized database. ISIS interacts with Valuation department by providing it with various data and also by sending data to ISIS as seen in figure 6.4. The data that is being sent from ISIS to Valuation department are called property transactions. Registered deeds and property values (valuation roll) are sent from Valuation to ISIS. Each business unit is the custodians of their own data and shares it with departments integrated into ISIS (see chapter 7).

Surveyor General: This is used specifically for cadastral surveys. The Valuation department relies on this external organization by using surveys diagrams and general plans to confirm the extents of the properties so that the values could be based on the correct extent.

Deeds Office: This is the custodian for ownership details (deeds registrations) and therefore responsible for providing these details as external organization to Valuation department on a daily basis. Once Valuation department receive these deeds data, it processes it and sends it to SAP LUM/ISIS. The department uses these ownership details in order to base their values on the correct ownership properties and keep this record for the purpose of Valuation roll. It also uses Deeds system on a daily basis to confirm the correctness of the ownership details.

Revenue: the department is part of ISIS, it has responsibility for billing the properties appearing in the roll based on the values produced and attached to each property. Thus the property taxes are based on the values produced from valuation roll. Therefore the Valuation department sends this roll to Revenue department straight not through ISIS. The department also interacts with Valuation department individually in terms of sending and receiving property queries as well as vesting advice forms.

Planning and Build Development Management. This department is part of ISIS. It is the custodian for street addresses and building plans. Valuation department interacts with this department individually by sending street address queries as to confirm the correctness of street address data which is used in producing valuation roll.

Public: These are the main clients that the department generates the City of Cape Town revenue from. They interact with spatial information system of Valuation department by lodging the council objections against their properties if valuation attached to their properties is wrong. They also interact with the department to confirm and verify their property information details in the form of queries.

The context diagram in figure 6.4 shows the Valuation department with all other departments within the City and external organizations that interact with it in terms of sending and receiving data as explained above. The data flowing in and out between the departments is also shown.

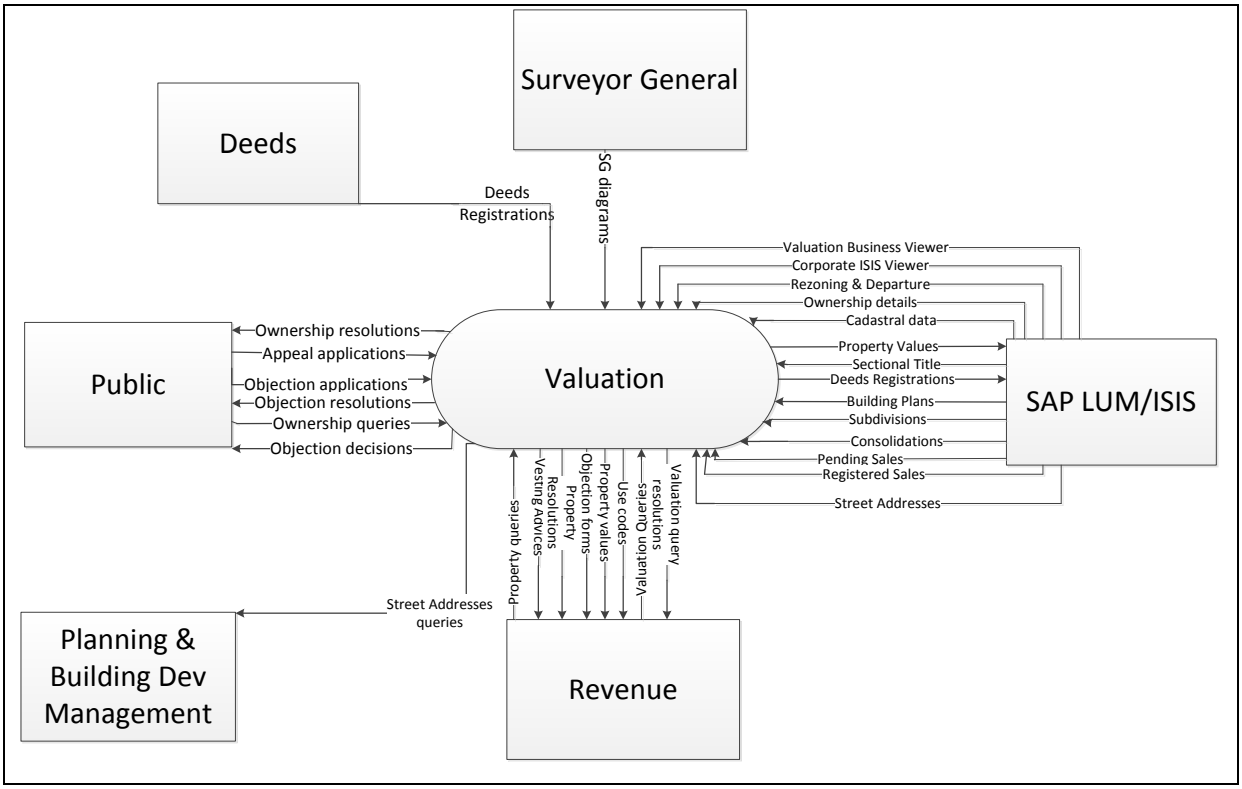


Figure 6.4: Context diagram: current system of Valuation Department (BPD_ISIS_Valuation, 2010)

6.6.1 Processes of Valuation Department

The processes of Valuation department and its four respective sections processes are documented in the top level diagram and high level diagram. The processes, data flows and data stores between the processes have been demonstrated in all these system diagrams of the varying sections in the Valuation department. The data flow shows how information is transferred from one process to another in the Valuation department at high level. Each

section interacts with one another in terms of receiving and sending data. Figure 6.5 shows these processes in a top level diagram.

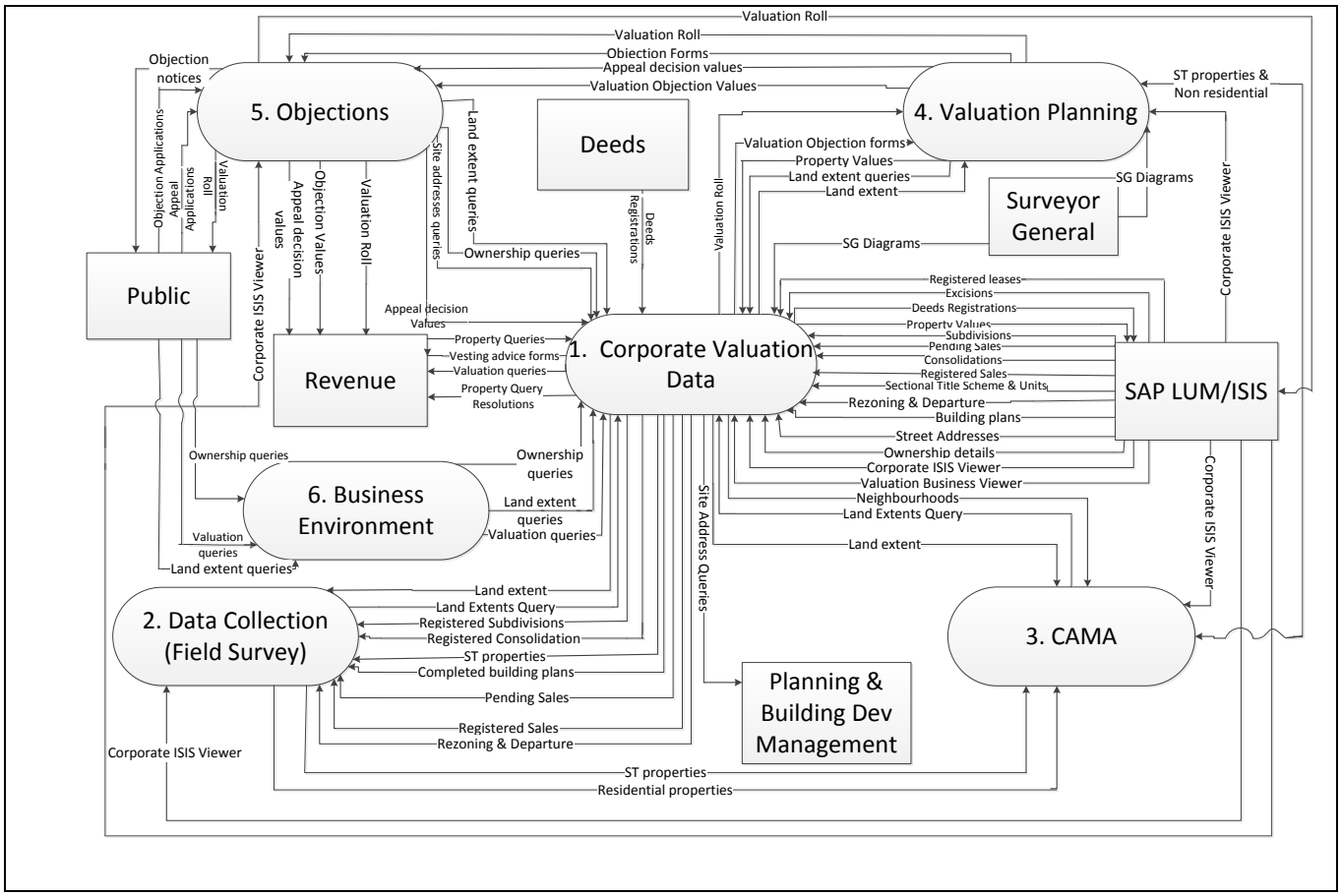


Figure 6.5. Top level diagram: Valuation Department Process (BPD_ISIS_Valuation, 2010)

1. Corporate Data Valuation: this is responsible for receiving data from the SAP LUM/ISIS as shown in the top level diagram above and integrating that into GRM. It is in charge of recording and maintaining property information in the GRM system to enable the Valuation department to initiate property valuation. This process involves task to maintain an accurate property record of all properties within the Cape Municipal area. This core data forms the basis of the valuation processes required for corporate data (BPD_ISIS Valuation, 2010).

2. Data Collection (Field Survey): this is responsible for obtaining data by recording details of properties onsite. This process is initiated when all owner details are captured on SAP LUM/ISIS and property details regarding the field survey are captured on GRM and it is preceded by corporate data Valuation process. The integration points in the process will

ensure efficiency within the process. The process composed of data collection and quality control. Data collection is a process whereby Technical Assistants (field staff) visits clients by either scheduled appointments or cold calls and record details pertaining to that property on GRM. The Quality control functions ensure that the field work is conducted in a professional manner and all information is recorded accurately (BPD_ISIS_Valuation, 2010).

3. CAMA (Computer Assisted Mass Appraisal): it deals with assigning values to properties by running computer assisted models against properties. It is a process that is preceded by the data collection process. Residential and sectional residential properties are put through a series of models that determines property values. These values are applied to sales properties and thereafter applied to all general properties. Once this is conducted the values are sent to the Municipal Valuer (4.Valuation Planning) to make a decision on the values at their disposal. The objective of this process is to ensure that all residential and sectional title residential properties are passed through a model to determine property values (BPD_ISIS_Valuation, 2010).

4. Valuation Planning: The objective of this process is to ensure that the property has been valued and an accurate value is attached to the property. The workflow is conducted within the process to confirm smooth operation and efficiency. This process concludes the property valuation chain. The process occurs when all pertinent data has been verified and captured onto the system. An expert Valuer is tasked to look at values presented to him/her to make an informed decision based on certain criteria. He/she may also use their initiatives and experience to derive a final value for the property. Once a value is attached to a property, the value is put on the Roll, which is made public via the various mediums, that is internet, printed copies and notices are also sent to clients (BPD_ISIS_Valuation, 2010).

5. Objections: this process makes sure that the objections are treated and processed as per legislative requirements (Municipal Property Rates: Act 106 of 2004). A verification process is done by the Municipal Values before a property is certified along with a joint value. The certified document is then submitted to the city in order for it to complete the valuation process. An advert is sent out to all neighbouring properties around the property that has been certified by the Municipal Valuer. The City is then tasked to send out notices to all the names on its database which this property may affect or might be impacted by. Workflow is also performed to allow some functions that were previously manual to be automated. All documents or forms received are scanned and stored on the City LAN and GRM database.

Amended values post objections are stored on the GRM and SAP. This allows other department to view this information (BPD_ISIS_Valuation, 2010).

6. Business Environment: this is a process where correspondence from the public and City departments are held with respect to their property queries. Then C3 notifications are created in respect of direct correspondence received via post, emails (valuation inbox) and the counter. After creating C3 then the investigation is conducted regarding the C3 notification created and the customers are informed of the results of the investigation on their property queries. The property investigation is conducted through Corporate Data process where property queries such as ownership queries, land extent and valuation queries are sent to Corporate Data process to assist with further investigation.

(a) Processes of Corporate Valuation Data

The processes of each section in the Valuation department are further broken down from the top level up to high level. The diagram below shows high level diagram for Corporate Data processes. This shows the processes and the data flow between the processes as well as the data stores between the processes in the Corporate Data section. The data store shows the data that is created by a process and stored through a process. It is represented by open rectangles below.

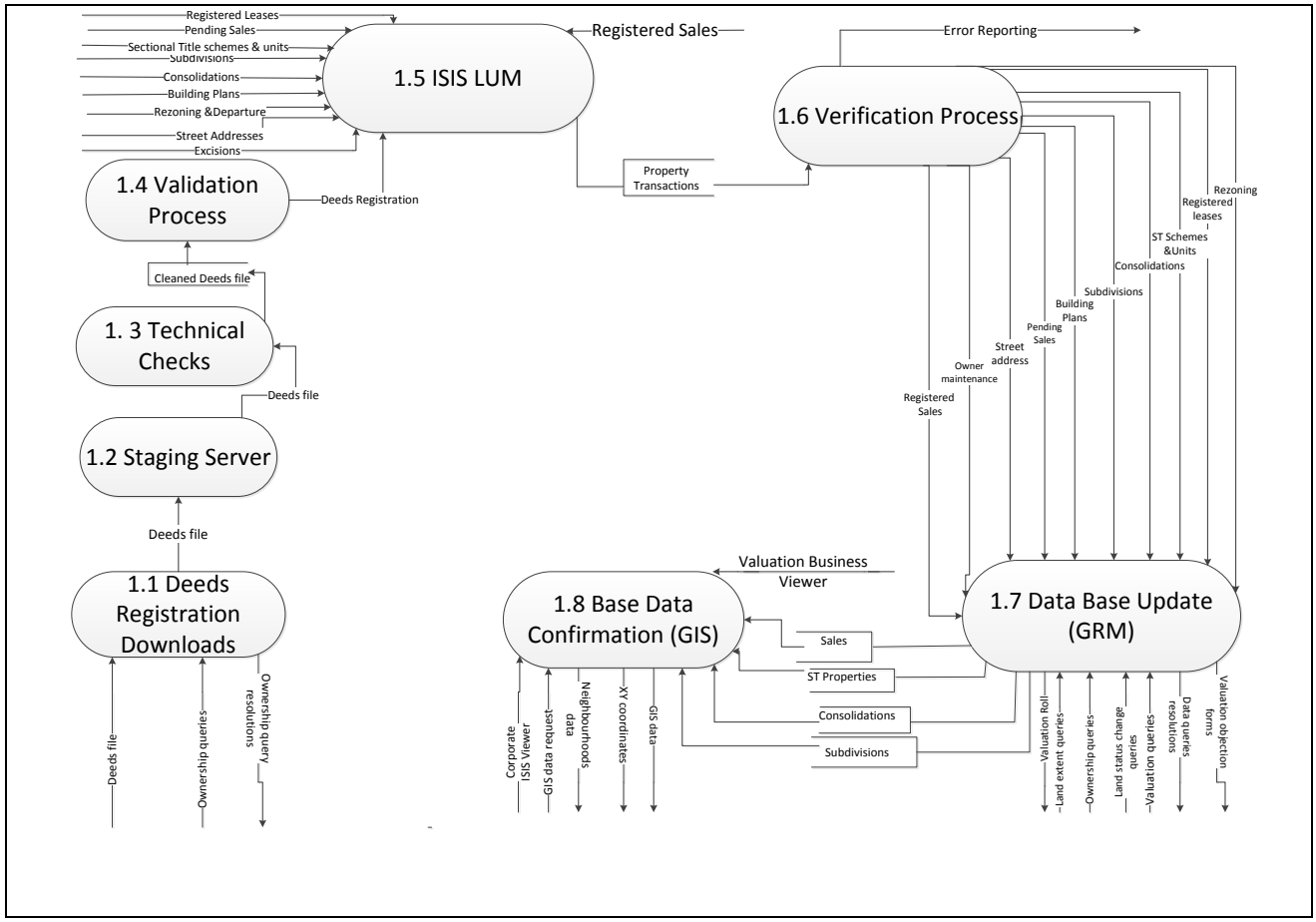


Figure 6.6 High level diagram: Corporate Valuation Data Process (Key Informant interviewee A, 2013)

The descriptions of each process in the Corporate Data are explained as follows:

1.1. Deed Registration Downloads Process: in this process, an email is received daily from Deeds Office informing of all the new registrations to be uploaded in the Valuation department. The process is followed to accurately source and captures the deeds registration information from Deeds office. The purpose of this process is to make sure that deeds registration information is sourced and maintained so that it can be made available to other business units within the City of Cape Town. When the email is received of new registration, a person in charge of the deeds downloads, logs onto the Windeed (Deeds office system) and checks the file type and start uploading the deeds registration file into ISIS LUM. The deeds registration file contains all the registration for the particular day (To-Be Registration Downloads Business Process Definition Version: 2010).

1.2. Staging Server: once the email is received, the attached deeds file is checked and manually copied from the inbox set up to receive the deeds file to staging server. The business unit must ensure that the deeds file transfer to staging server is complete (To-Be Registration Downloads Business Process Definition Version, 2010).

1.3. Technical Check: the deeds file that has been copied into the staging server is processed in order to ensure that the file layout format is correct. This technical check involves a number of predefined checks based on the expected format of the file. The extract tool load (ETL) has been developed to manage the deeds file upload process in terms of the technical and business validation checks together with error handling (To-Be Registration Downloads Business Process Definition, 2010)

1.4. Validation Process: when the technical check has been completed, the cleaned file is automatically validated against business rules on a record by record basis before the record is committed to the Core ISIS SAP_LUM and Master Geodatabase system. The validation involves checking whether Deeds transactions falls within the city administration district. It also includes checking whether the property in the files exists on the core ISIS system. (To-Be Registration Downloads Business Process Definition: 2010).

1.5. ISIS LUM: is a centralized program that houses all non-spatial data. This is an integrated system where all the six business units send and receive their data and is stored. The property information triggered in this process from other business units to Valuations are rezoning, building plans, subdivision, consolidations, sectional title scheme and units, rates clearance pending sales, registered sales, ownership details and street addresses as shown in 6.6 (BPD_ISIS_ Valuation, 2010). In this process new property are created and removed as a result of the registration of a subdivision or consolidation. Other properties are created as a result of a municipal boundary change (inclusion or excision).

1.6. Verification Process: this is a process where various transactions received from SAP/LUM are verified and checked for data error and correctness in Microsoft Access before processing into GRM. In this process, data correctness is done such as filling in the missing data on various transactions and also correcting errors that occurred when processing. Once this data has been verified then the transaction is reprocessed into GRM. These property

transactions are processed via an automated interface called tranerven. The property transactions are given transaction number and type as follows.

Table 6.5 Transaction number and Transaction type

Property Transactions	**Transaction number**	**Transaction type**
Subdivisions	TRANS_SUB 1	Insert, update & cancellation
Consolidations	TRANS_SUB 2	Insert, update & cancellation
Closures	TRANS_SUB 3	Insert, update
Excision	TRANS_SUB 5	Insert, update
Pending sales	TRANS_SUB 6	Insert
Sectional title & units	TRANS_SUB 7	Insert, update & cancellation
Registered Sales	TRANS_SUB 8	Update
Ownership	TRANS_SUB 9	Update
Building plans	TRANS_SUB 10	Update
Street address	TRANS_SUB 12	Update
Rezoning & Departure	TRANS_SUB 13	Update

The meanings of transaction types are provided as follows:

- Insert means the property is supposed to be created on GRM as a new unregistered property.
- Update means the property has already been created on GRM and needs to be updated with a new legal status
- Cancellation means the property that exists in GRM needs to be cancelled and the parcel status need to change to “Dead” and “Inactive”. Meaning the property is not supposed to exist anymore.

1.7. Data Base update /GRM: this is a valuation data base system where all the transactions processed through the interface from ISIS LUM are captured, stored and maintained. The system also maintains property values as well as property information. This is a central repository for valuation department as a whole where property information is utilized by various sections in the department (see figure 6.6).

1.8. Base Data Confirmation (GIS): in this process, data that is captured into the GRM system from SAP/LUM is placed in workflow for it to be confirmed for data correctness. The type of data confirmed is subdivisions, consolidation and sectional title schemes and units. These are placed in the valuation workflow queue called supplementary Valuation (SVA1) where confirmation of base data such as deed extents, ownership and street addresses are checked and confirmed for correctness. In this process, properties are assigned relevant neighbourhoods and X, Y coordinates by using GIS system. If the data is incorrect, then the correction is done by updating in the GRM system. When the confirmation is complete and all amendment made, the GRM is updated, then the data in the workflow is closed from the queue and triggered off the notification to the next queue called (SVB1) Data Collection.

(b) Processes of Data Collection (Field Survey)

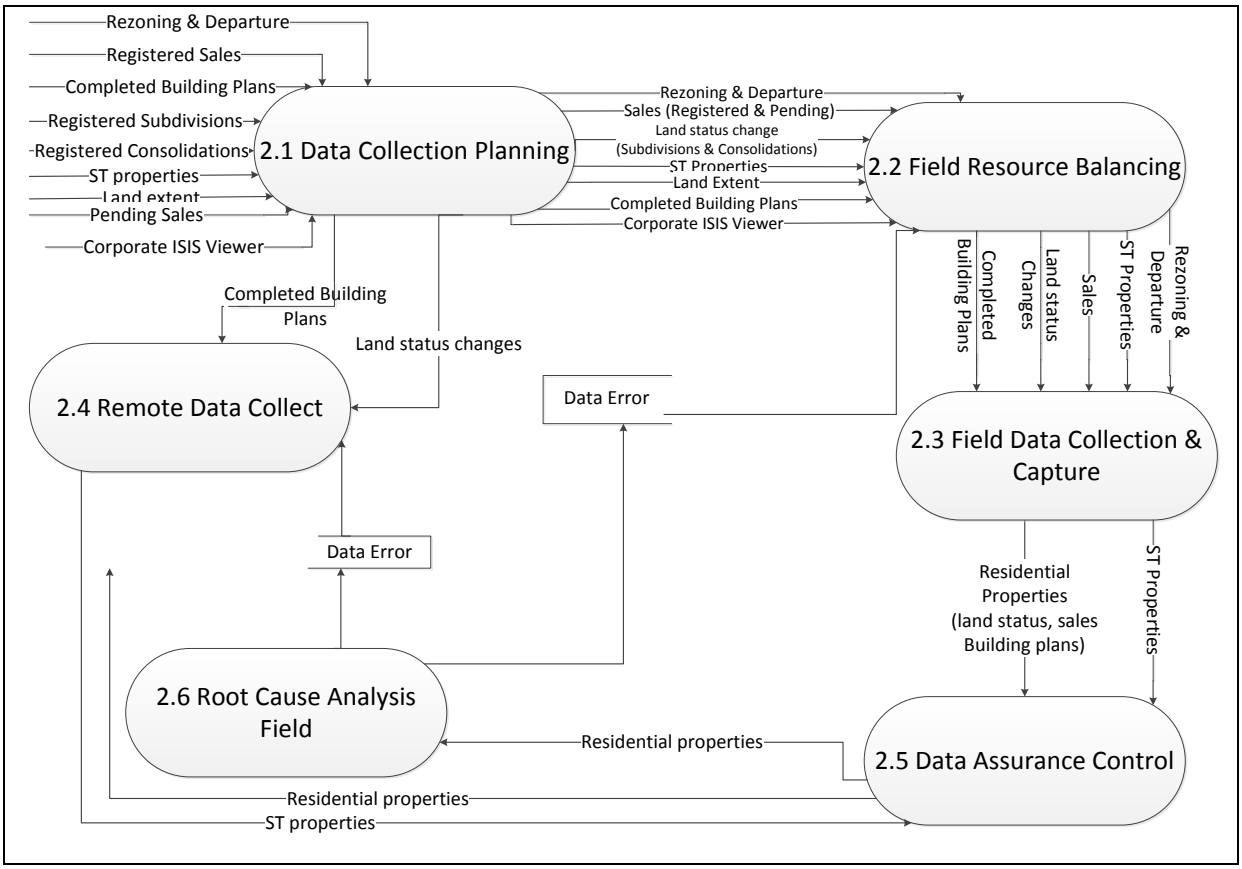


Figure 6.7 High level diagram: Data Collection Process (Key Informant Interviewee C, 2013).

The description of each processes as demonstrated in figure 6.7 are described as follows:

2.1. Data Collection Planning: this is a process that is triggered by the Corporate Data Valuation process. The notification is received from corporate data for land status changes, such as subdivisions, consolidations and sectional title schemes and units. Then the data collection team visits sites to obtain data of the specified property.

2.2 Field Resource Balancing: this is a process where work is allocated to four data collection teams. This is done based on the report that is extracted by the Head of the department from GRM system. The report portrays work that is ready for inspections and is based on the staff capacity (BPD_ISIS_valuation, 2010).

2.3. Field Data Collection & Capture: in this process, staff is allocated work and appointments are scheduled. Once appointments are made, then the team goes into the field to data collect. A collated work package is taken as part of the client visit such as plans and sketches. Then the field data collector has to verify that whatever is listed on the plan is visually seen on the site. All data that collected is recorded on a field data collection sheet. When the data collection is completed the team returns to the office and captures the processed data on GRM. The data from this process also goes for quality assurance.

2.4. Remote Data Collect: the process involves the team collecting data using aerial imagery. Once the data is collected, the team captures the processed data on GRM. The conclusion of this task will produce a data capture report which highlights all the information that was captured onto GRM correctly or incorrectly. When the capturing of the processed data is complete, each individual in the team sends his/her own processed data to quality assurance (BPD_ISIS_valuation, 2010).

2.5. Data Assurance Control: the quality assurance is performed by the quality assurers. The processed data on GRM is checked if it is correctly captured and all errors are fixed. All data is verified and checked against data capture report. When the processed data is checked, a decision is taken with regards to the quality control check being passed or not. If the quality control checks passes, the workflow is triggered reflecting the status update and the work is sent to CAMA for model application. If the quality control fails, then the processed data is sent to Route Cause Analysis process (BPD_ISIS_valuation, 2010).

2.6. Route Cause Analysis Field: the processed data that failed the quality control process is sent on to this process to be fixed. The errors on this process are corrected by individual in the team both from the field resourcing balancing and Remote data collect processes. After the errors have been corrected, the processed data is resubmitted to quality assurance (BPD_ISIS_valuation, 2010).

(c). Processes of CAMA

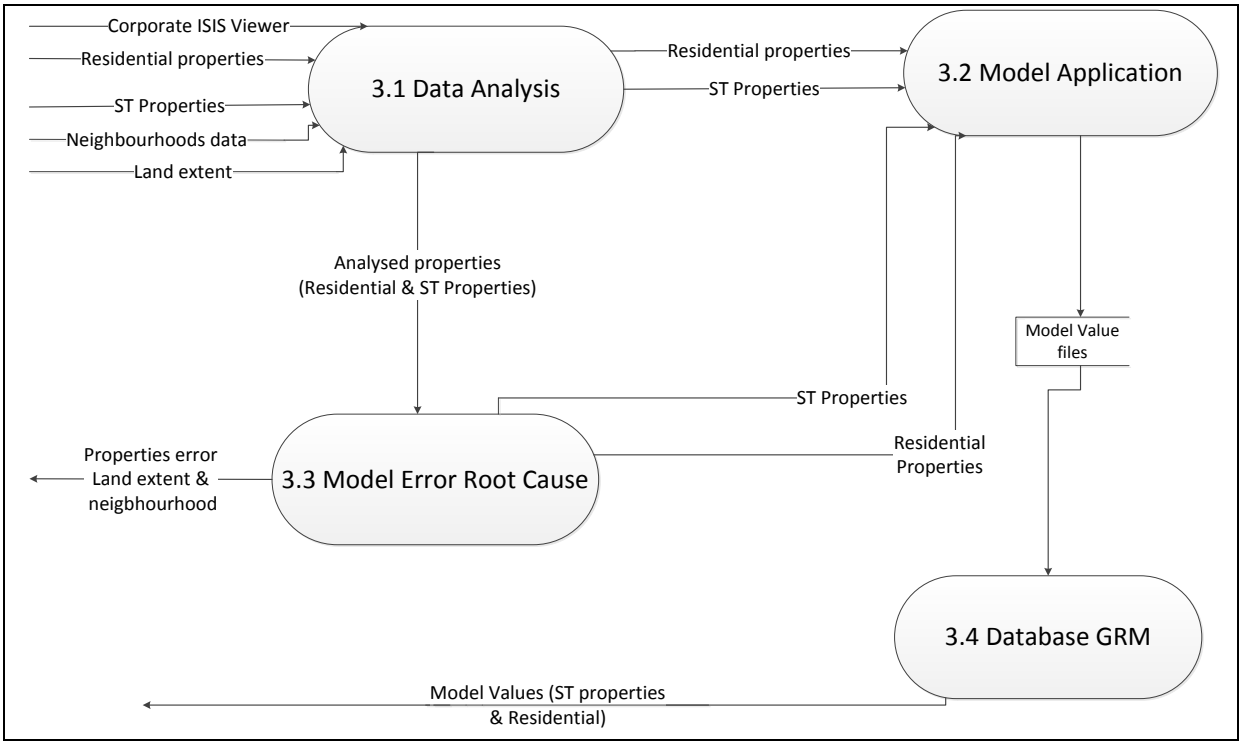


Figure 6.8 High level diagram: CAMA Process (Key Informant Interviewee B, 2013).

The description of each processes as shown in figure 6.8 are elaborated below.

3.1 **Data Analysis:** This process is triggered when receiving notification from data collection process that the data collection has passed the quality assurance and is ready for model application. The analysis process is performed on the sectional title properties and on all the properties once the data collection is completed and GRM is updated with the data collection results. In this process:, data is analysed statistically for consistency, missing data and correct neighbourhoods (BPD_ISIS_valuation, 2010).

3.2 Model Error Route Cause: This is preceded by data analysis process. Once the data has been analysed and the results are produced, the decision is made regarding the correctness based on the results of the analysis. If the analysis is correct, then the properties are sent for

model application. If the analysis is incorrect such as having properties with incorrect or missing data, and if the model application fails then the data is sent to the relevant sections for corrections such as Corporate Data and Data collection sections (BPD_ISIS_valuation, 2010).

3.3 Model Application: When errors have been verified a model is applied to properties. In this process, properties are grouped according to their modelling regions. The market file is also created for model applications. Once these have been done, then the model is applied using model application techniques (BPD_ISIS_valuation, 2010).

3.4 Database GRM: The model values are posted to the GRM database. This provides a view to anyone in the Valuation department that the CAMA model has been developed. Then the CAMA team closes the task in their workflow queue and moves the modelled properties to the Valuers queue (BPD_ISIS_valuation, 2010).

(d). Processes of Valuation Planning

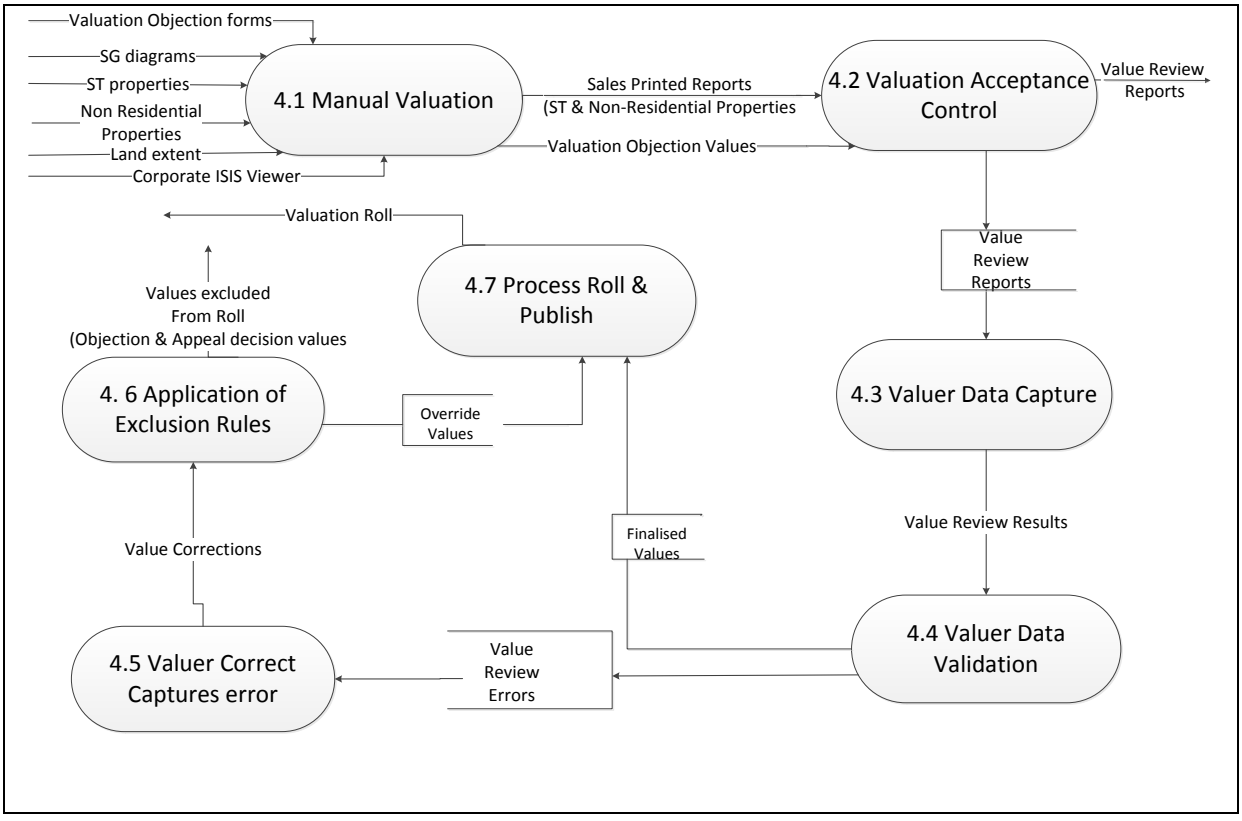


Figure 6.9 High level diagram: Valuation Planning Process (Key Informant Interviewee D, 2013).

The processes of Valuation Planning as shown in figure 6.9 are described as follows:

4.1 Manual Valuation: this process is triggered by CAMA team whereby the Valuers receive notification from CAMA via the workflow that there are properties that require an expert valuation. In this process the sales report is printed and the work is allocated accordingly amongst the regional valuers where a physical review is conducted (BPD_ISIS_valuation, 2010).

4.2. Valuation Acceptance Control: a physical review is conducted by the Valuers. The Valuers either visit client's site or conduct a desktop review. The desktop review is conducted by checking the information on the system and reviewing aerial photographs which is found on Corporate ISIS viewer. Client visits are only conducted where more clarity is required (BPD_ISIS_valuation, 2010).

4.3 Valuer Data Capture: when a thorough review is completed, the results of the value review is captured on GRM by the municipal valuer. These results are also filed for safe keeping and future reference (BPD_ISIS_valuation, 2010).

4.4 Valuer data validation: this process is preceded by data capture, once the final review has been captured onto the system; the check is done to ensure that the results are correct. If there are any issues that are identified from the final review, then the finalized review data is sent to valuer to correct error. If there are no errors or issues with the final review, the data is sent to valuation roll and become published (BPD_ISIS_valuation, 2010).

4.5 Valuer Correct Capture Error: the value review error identified in the data validation is corrected and captured on the system and the correction of values is sent to the process of application of exclusion rules (BPD_ISIS_valuation, 2010).

4.6 Application of Exclusion Rules: After the errors have been corrected and captured in process 4.5 above, the value review correction is then sent to this process. This is a process whereby rules are applied to the final review value results. A decision is made to override the results that had issues in the final review (BPD_ISIS_valuation, 2010).

4.7 Process Roll & Publish: this process occurs when the finalized property values have been updated onto the system. Then upon completion of the value finalization, a work item is sent to the Revenue department as well as SAP LUM for billing purposes. The roll is

published on the web, hard copies of the roll are also printed and notices are sent to clients (BPD_ISIS_valuation, 2010).

(e) Processes of Objection Valuation

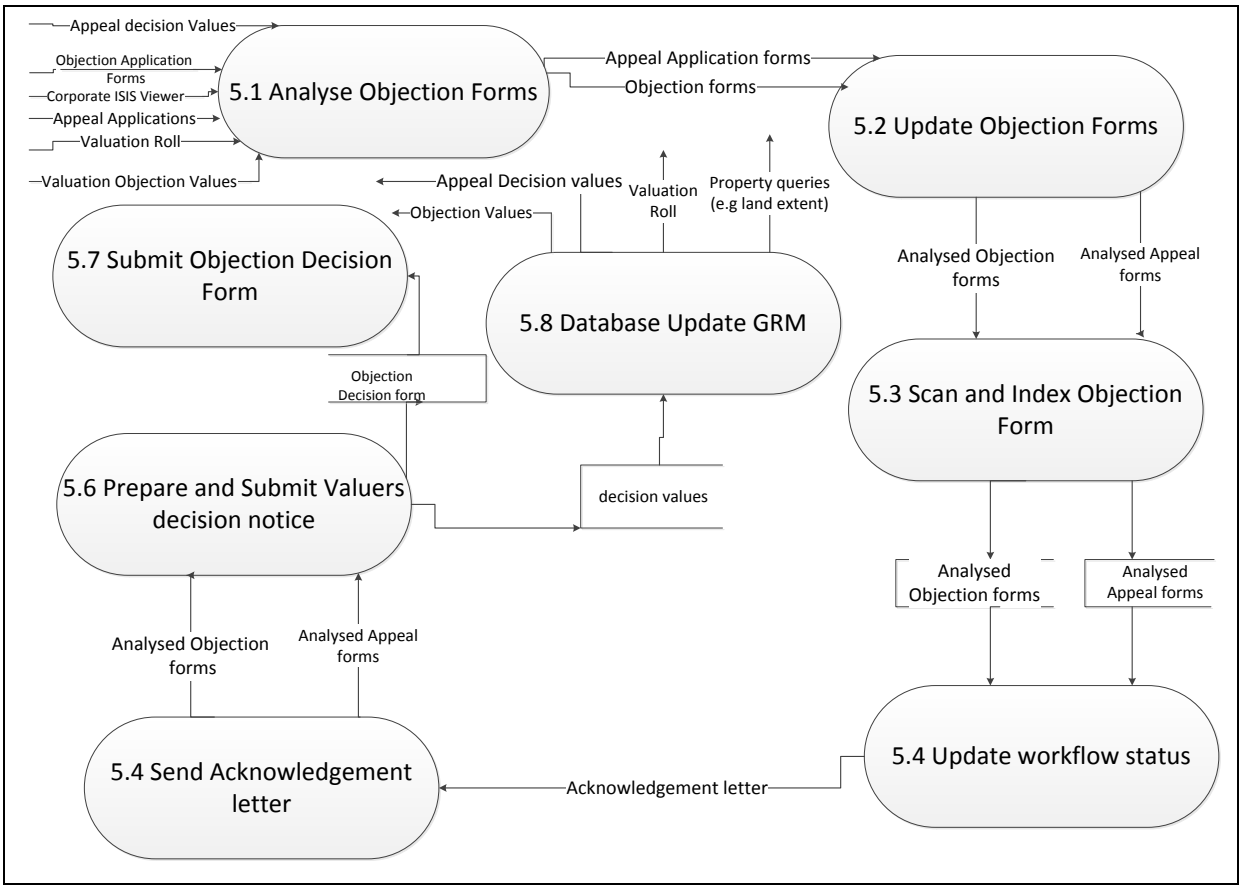


Figure 6.10 High level diagram: Objection Valuation Process (Key Informant Interviewee E, 2013).

The description of each processes as shown in figure 6.10 are described below

5.1 Analyse Objection forms: the objections are made by property owners or council and submit them to Valuation objection process. The property owners complete the forms and sent them to Valuation objection process via fax, post or hand them in physically. Once these objections are received, the administrator manually analyses the objection forms by using the erf numbers (BPD_ISIS_valuation, 2010).

5.2 Update Objection form: once the objection is analysed and the reference is found, the objection form is updated with the valuation reference number which is done by the objection administrator on GRM (BPD_ISIS_valuation, 2010).

5.3 Scan and index Objection form: the objection form is scanned and captured onto GRM. A hard copy of the objection form is filed and indexed for reference purposes (BPD_ISIS_valuation, 2010).

5.4 Update Workflow status: when process 5.3 above is complete, the workflow status is updated and flagged on GRM to notify the relevant sections in the Valuation department and Revenue that there is an objection on a particular property that needs to be attended (BPD_ISIS_valuation, 2010).

5.4 Send Acknowledgement letter: the Administrator uses an application called CAPDBA (Access software) to retrieve a list of names which is used to merge along with Microsoft Word to create the letters of acknowledgement to all the objectors. Then the letter is sent to each of the objectors or objection owners by post (BPD_ISIS_valuation, 2010).

5.5 Prepare and submit Valuer's decision notice: the objection decision form is scanned and indexed as well onto the G:\Drive. A hard copy of the objection decision form is filed for archive. The amended value and the reason for the valuer's decision are captured on to the GRM system (BPD_ISIS_valuation, 2010).

5.6 Submit Objection Decision form: the objection decision form with amended values is submitted to valuation decision board (BPD_ISIS_valuation, 2010).

5.7 Database update GRM: the decision values and reasons for valuers decision are captured onto GRM system and eventually sent to Revenue department to be updated on ISU and LUM (BPD_ISIS_valuation, 2010).

(f) Processes of Valuation Business Environment

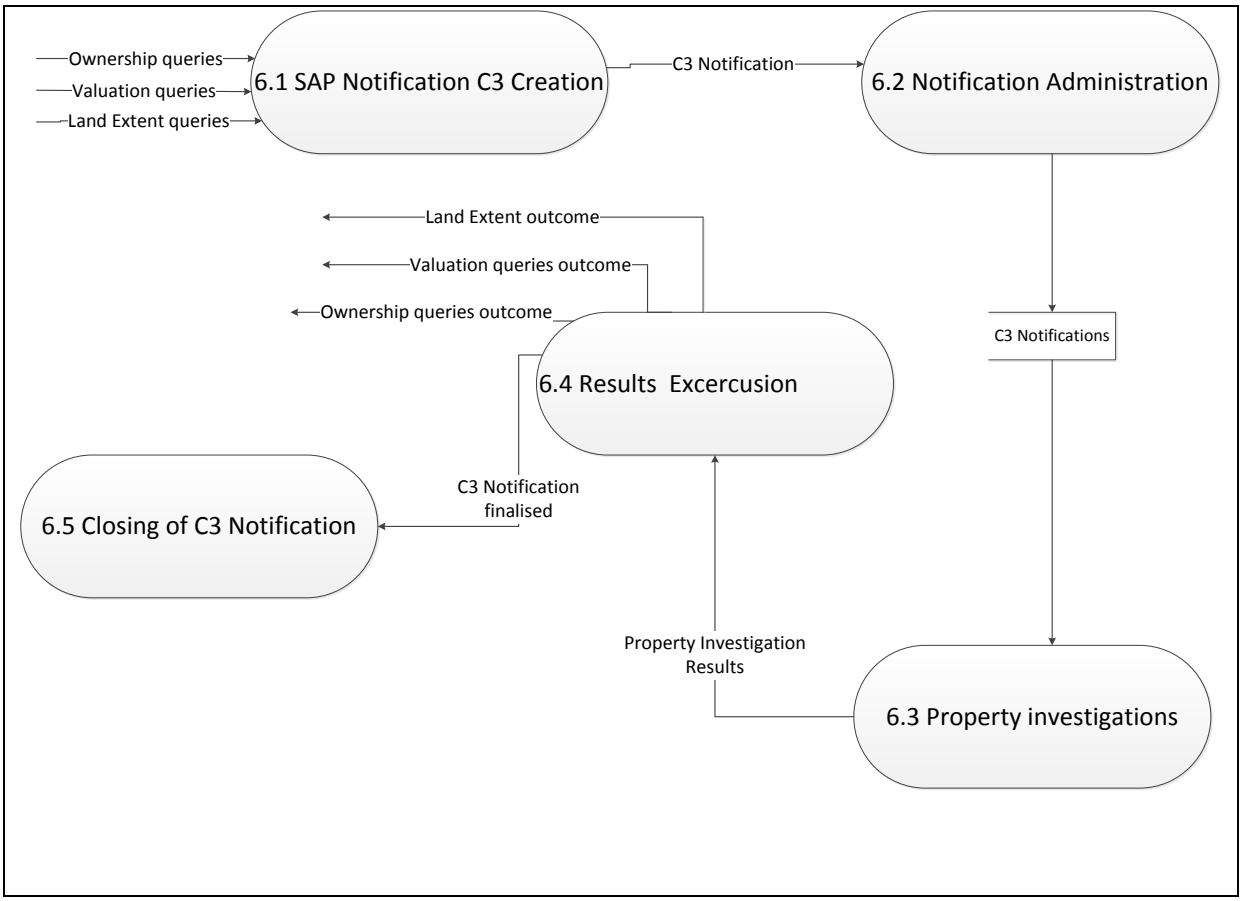


Figure 6.11 High level diagram: Valuation Business Environment Process (Key Informant Interviewee F, 2013).

The description of each processes as shown in figure 6.11 are described as follows:

6.1 SAP Notification Creation: C3 notifications are created in respect of direct correspondence received via post, emails (valuation inbox) and the counter. These notifications are created and placed in the outstanding queue to be attended to. The notifications are also created by city officials outside the Valuation department which are also created and placed in the Valuations outstanding queue

6.2 Notification Administrations: It deals with administration of notifications created on the system SAP as well as assisting in the counter to attend to the client complainant. All notification received via the valuation, the supervisor compiles SAP reports which confirm the current totals that are outstanding, are in process and are closed. The supervisor is also

responsible for compiling individual lists for each check to attend to (Key Informant Interviewee F, 2013).

6.3 Property Investigations: This is where the investigation is conducted regarding the C3 notification that was created as a result of the customer complainant. The C3 notification is read and analysed to identify what the customer are complaining about and the investigations are conducted based on the customer complainant so as to come up with a solution for the customer. If the results of the investigation are not concluded then the comments are added on SAP and manually rerouted to the Valuation section relevant to conclude the investigations and the C3 notification status is placed in process (Key Informant Interviewee F, 2013).

6.4 Results Excercusion: once the investigations have been concluded in process 6.3 above, then the correspondence team sends the results or response to the owner of property to inform them about the outcome of the investigations (Key Informant Interviewee F, 2013).

6.5 Closing of C3 Notifications: the correspondence team closes the C3 notification if investigations have been concluded and the owners of property have been informed of the outcome. They also close the C3 if the investigations received from the relevant Valuation section have been concluded (Key Informant Interviewee F, 2013).

6.7 Challenges/Issues faced by the Valuation Department of the current Spatial Information System

This section presents the challenges and issues faced by the Valuation department with the current spatial information system as viewed by the Participant observer and Key Informants. There was a general feeling from the Key informants that the current spatial information system of Valuations has improved the Valuation business to a certain extent although it still lacks the capacity to provide the needs for current users. This is because of the opinion that the valuation data is still in accurate, unreliable and cannot be trusted by the users of Valuation staff. The general investigations showed that this is due to ISIS sending inaccurate, incomplete and wrong data to Valuations as well as the interface that is being used by the department which is not always reliable as well. There is no doubt that this issues leads to failure to the users as a whole to acquire the necessary data which in turn results in a wrong decision making. The issues identified on this department have been classified into various groups such as processes/functions, data/information and communication/interface.

6.8. Participant Observer's Perspective of the Spatial Information System of Valuation Department

The participant observer holds wealth of experience as the Valuation Data Administrator Officer who served the Valuation Department since January 2011 just before ISIS implementation until September 2013.

Since her operation in the department, she has observed the data/information quality that the Valuation department were receiving from ISIS as she was the one responsible for loading such data from ISIS to the Valuation system on a daily basis (see section 5.4.2). She observed the following with the data/information and processes issues and her observations have also been validated by the key informants.

6.8.1 Participant Observer Perspective with Data/Information Issues

The issues observed with the data/information are that some of the transactions (non-spatial data) such as subdivision and consolidations that are provided by ISIS SAP LUM to GRM system on a daily basis come with missing data such as (MLA indicator). This is a critical data required to process subdivision and consolidations correctly into GRM systems. It indicates the allotment of the property so that the property could be created on GRM with a correct parcel ID. Without this kind of data, the transaction will be processed successfully but with incorrect MLA indicator.

ISIS SAP LUM also provides Valuation department with data that is missing portion role, this is also a critical data that is required for the transaction like subdivision and consolidations to be processed successfully and be created as a new property into the Valuation systems. Without the portion role a property cannot be created and loaded on GRM and the transaction processed results in an error. As a result of this, the data that is expected to be loaded daily in the Valuation system fails to do so and this delays the process of assigning values to the property and thus loss of Revenue. This is because the investigations of such problem takes time and ERP staff normally take long before getting back to Valuation data Administrator with the correct data.

Another issue that exists is that ISIS SAP LUM is not efficient enough as it is supposed to be since the data that is on the system is incomplete. Some of the properties on LUM are indicated as registered whereas there is no registration dates recorded on the system. This

causes inconsistent of data and such data need to be verified from Deeds office to find out if the property is registered or not.

In most cases, these properties are normally found to be unregistered. Data inconsistency makes the SAP LUM system to be unreliable. The incompleteness of this data also poses a problem because it gives false information to the user of the system. The time is also wasted for the property researcher team to investigate the incompleteness of data especially because most of the staff do not have access to Deeds office and have to rely mostly on Deeds Registration staff to get the required information.

More issues observed with data is that ISIS SAP LUM send wrong information to valuation especially cancellation of properties. The transaction especially for subdivisions and sectional title units are received from SAP LUM with the transaction type or command that say the property has to be cancelled on the GRM system. However, when the investigations are carried out based on the transaction type, they normally reveal that properties are not supposed to be cancelled since they are still active and must still exist.

This means that an investigation has to be done before processing that kind of transaction into GRM system:, otherwise such properties would be cancelled on GRM. As a results, this might cause a negative impact on the property since it will not be valued if it has the parcel status of inactive “dead” whereas it was not supposed to be dead. And this therefore results in a loss of revenue. The wrong information on the system normally causes confusion among the Valuation department sections that are responsible for valuing properties or data collecting the properties.

Moreover, data provided by ISIS SAP LUM to the valuation department is not always accurate and clean. For example, most of the sectional title units received from ISIS to Valuation have more than one section LIS ID (LIS ID is the unique identifier for sectional title properties). This poses a big issue since it is often found that a sectional title unit is already created on GRM with one section LIS ID, however when the second transaction for the same unit especially for cancellation of that unit comes, it comes with a new section LIS ID. This leads to transaction being processed with an error. This shows that the data received from ISIS SAP LUM especially for sectional title units are not always reliable and could not be trusted.

Another issue on the sectional title (ST) units in ISIS SAP LUM is that there is duplication of data. Thus the sectional title units in ISIS SAP LUM are recorded twice but with different section LIS ID numbers. It is often found that the other ST units has old section LIS ID number and appear as registered with registration date, the other ST units comes in with legal registration status of surveyor general (SG) approved with another section LIS ID number. This is usually identified when property research is being done to verify data or information on the GRM system. This causes inconsistent of data as well as making SAP LUM unreliable and untrustworthy.

More observation revealed that ownership details in ISIS SAP LUM are not complete due to wrong data migration. Most of the properties on LUM have ownership details as "ISIS placeholder" instead of the real ownership name. This is a big problem since the data on LUM become unreliable and inaccurate. As results of this wrong information, Deeds system has to be regularly used to find the real ownership of such property. This again requires time to be allocated to perform such investigation and thus leads to delay in service delivery. The Deeds system is also not accessible to all the property research team. Some of the property for ownership transaction is received from ISIS SAP LUM to Valuation interface without ownership details. As a results ownership of properties on GRM become a big issue to the Valuation user.

Furthermore, some properties on ISIS/ SAP LUM have a history status, which means that the property is "dead" (does not exist anymore) whereas there is no valid to date which confirm that the property is really "dead". This causes a lot of havoc since the investigations have to be done to confirm the status of such property. This also consumes a lot of time as well as delaying service delivery. Other properties also have a history status and valid to date yet when the research is being done; it reveals that the property is in actual fact still existing. This therefore causes the LUM system to be unreliable and untrustworthy since it provides information which misleads the users.

Key Informants Perspective with Data/Information Issue

The investigation from the key informants revealed that ISIS SAP LUM is not providing Valuation with the information that is supposed to provide on a daily basis. It was stated that the transactions from ISIS SAP LUM sometimes fail to process successfully so that they could be send to Valuations (Key Informant G, 2013). This therefore is proof that Valuation department is not receiving data/information that is supposed to receive in real time and this

would probably affect the revenue since those properties would not be valued timeously. As a result of this, transactions are being sent to Valuations in the form of spreadsheet so that a process could be made to load those properties manually on GRM.

More investigations show that property data on GRM is not synchronized with property data on ISIS SAP LUM. Thus there are more properties on LUM than on GRM. There are also properties on GRM which are not on LUM (Key Informants Interviewees A & G, 2013). Since Go-live of ISIS implementation in the Valuation department, LUM has generated 432 437 records for GRM. However there are some unsent records to GRM. This therefore results in data not being synchronized since all the property records are not always being sent to GRM (Key Informants Interviewees G, 2013).

The other point is that there are properties that are on GRM but not on LUM. This is usually identified when carrying out property research and trying to find information of a certain property on LUM. As a results it become difficult to confirm whether the property is supposed to be "dead" or exist as the reliable source of the property information (LUM) does not have such property records. This also poses a problem especially to Revenue department because the property that appears on the valuation roll could not be found on LUM. As a result it becomes difficult to bill such kind of properties (Key Informants Interviewees A, 2013).

6.8.2 Participant Observer and Key Informants Perspective with Processes/Functions Issues

Many issues associated with the current processes have been identified through participant observations and interviews with key informants. It has been observed that some of the processes in the department depend very much on staff resources to perform them manually and some of the processes rely on manual interfaces. These manual processes are described as follows:

- The valuation roll is being sent to Revenue department with the current defined process. This process is that the file should be an FTP'd and be sent to the Revenue business unit as such. However, this has never been initialised and it is confirmed by Revenue that the valuation file is being sent via e-mail to revenue for loading into SAP ISU (Key informant Interviewee A, 2013).

- Manual process is carried out in order to load data into the system. An example of this is when the interface could not bulk process the registered sales to be loaded into GRM system.
- Manual process is normally caused by the SAP LUM not being able to send some transactions into GRM, as a result of this, the data is being sent via email in a weekly basis in order to be loaded into GRM. This delays the process since the data is not loaded into GRM in real time as expected and also puts pressure on the scarce resources to perform such processes manually.
- Manual process problem occurs when the data/information is being sent from SAP LUM to Valuation with missing and or wrong data. This poses a problem since the investigation has to be carried out before processing such data from SAP LUM to GRM.
- Workflow process that is currently being used in the department is manual. Thus the properties that are placed in the workflow need to be investigated and once the data is confirmed, the routing of such property to another queue is done manually one by one throughout the whole valuation workflow system. This consumes a lot of time since the closing task of a property and routing it to the next queue takes time.
- The base data confirmation by the corporate data (GIS) and Property research team also takes time since each property has to be updated manually on the GRM system once the investigation has been completed. The assigning of neighbourhoods and XY coordinates of a property for a long time has been updated manually on GRM (Key Informant Interviewee A, 2013).

6.8.3 Key Informants Perspective with Interface/communication problems

There are reported communication breakdown on the system. This resulted in failure to transfer data to Valuations. This normally seems to happen with the TRANS_SUB 6 (Pending Sales) which are generated out of Public Sector Record Management (Revenue) and not on LUM. The breakdown has occurred a few times, between the systems and then the records are generated but not sent to GRM (Key Informant Interviewee G, 2013). If these records are not sent then the Registered Sales and ownership details would also not be sent for the unsent Pending Sales which result in records piling up very quickly.

Moreover, the investigation shows that there are times when the link between LUM and GIS were broken and staff were not able to use the GIS tab on LUM. As a result of this no job could be created or completed on ISIS which of course delays the service delivery and caused inconvenience.

Another problem is the bug in the LUM system which sometimes occurs. This bug causes the duplication of data being sent to Valuation business. An examples is subdivision transaction being sent to Valuation with no portion role and some wrong information being sent to Valuation like TRANS_SUB 4 (excisions) while they were not supposed to be sent as TRANS_SUB 4 but as TRANS_SUB 1 (subdivisions) (Key Informants Interviewees A & G, 2013). This kind of transactions, excisions normally process with error and thus not loaded on GRM. This also causes a loss of revenue since the properties that are supposed to be loaded on GRM and be valued are not loaded in real time (Key Informants Interviewees A, 2013).

More interface issue identified is that there is no automated interface between GRM and ISIS SAP LUM. This results in the Valuations department manually sending a file through to the Revenue business unit, which is then loaded onto SAP LUM and to Revenue billing system. This lack of interface is really a problem since it causes the data on GRM and LUM synchronized. This is more of a problem to the Revenue department who depends on the values of properties to bill those properties as to create the Council's revenue. It also puts pressure on the Valuation staff to manually submit the Valuation roll to Revenue (Key Informant Interviewee A, 2013).

Furthermore, corporate data section does not have a reliable interface (Tranerven processor) to process the information that is being provided by ISIS into GRM. Therefore this delays service delivery since data that is required is not received by the user of such data like CAMA people who use the sales to run their model (Key Informant Interviewee A, 2013).

6.9 Conclusion

In this chapter the investigations revealed that there is inefficiency and ineffectiveness in the spatial information system of Valuation department that results from the business processes, data/information and communication/interface that are being used by the department. The interface that is being used by the department was found to be unreliable and results in relying on manual processes most of the time. The data/information used by the department is

also not reliable and accurate and this leads to making wrong decision as well as applying wrong values to the public properties.

This analysis facilitates a complete understanding of the Valuation department in its setting. This chapter informs analysis of the spatial information system in the Valuation Department through system analysis approach as recognised frameworks in spatial information system. Nonetheless, several features of this description appear repeated. This is because the data from various sources and perceptions are compatible, confirming internal validity.

Chapter 7. Narrative Description of ISIS in the City of Cape Town

7.1 Introduction

This chapter presents both narrative description of ISIS and the effectiveness of ISIS in the Valuation Department. Firstly it provides the narrative description of integrated spatial information system in the City of Cape Town in its context from multiple perspectives. It presents the description, design and its implementation. Secondly the effectiveness of ISIS in the Valuation department is described through statistical description. Single case study strategy is used to facilitate this description.

7.2 The ISIS Vision and Objectives

The main aim of the ISIS project is to bring property data, processes and information systems together through property value chain. It had achieved this through centralising the storage of all property data (attribute and spatial data), integrating the current plethora of systems (including SAP) and creating one point of entry and interface. The project was proposed in order to improve productivity and service delivery through streamlining business processes relating to management of property information (see section 1.2). In implementing ISIS, the project aimed at improving revenue generation in the City, enhancing property data quality and automating interfaces between systems. The purpose was that the property data would be stored and sourced from master data and this will facilitate single and consistent property view.

7.3 The ISIS Functions

ISIS is made up of six business units of the City of Cape Town responsible for property value chain. These are Valuation, Planning and Building Development Management, Corporate GIS, Property Management, Housing and Revenue (see section 1.2). These business units are integrated together in terms of their processes, data and interfaces to facilitate and improve the service delivery of ISIS in the City. The project interacts with these six business units in terms of providing and receiving data from them. It also interacts with external departments such as Deeds and Surveyor General. Figure (7.1) demonstrates the scope of ISIS

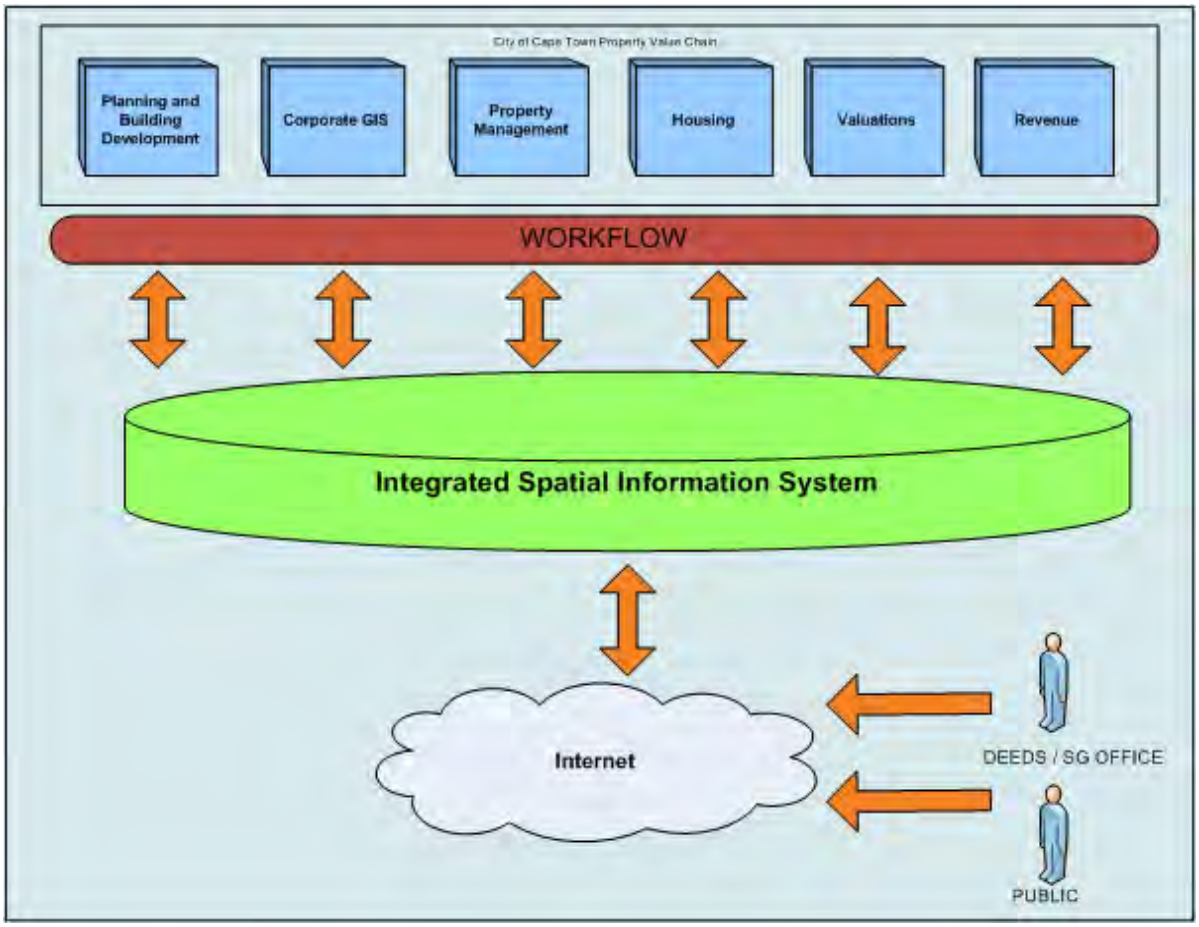


Figure 7.1: Project ISIS Scope (City of Cape Town ISIS Project, 2008)

7. 4 System Design of ISIS

ISIS Management Team came up with twelve principles which were used to guide the project with technical solution design. The first principle that was followed is that property data would be stored and managed in two separate but real-time integrated databases: the ISIS Master Geo-database for spatial Surveyor General-data and attribute data related to spatial data and the SAP LUM (flexible Real Estate) RE-FIX database for attribute data (Deeds information and attribute data related to spatial data). The other principle was that all spatial data together with property data would be kept, prepared and administered from a central location so that the sharing of data across all business units could be permitted (City of Cape Town ISIS Project, 2008). However, several issues which could hinder the solution design were taken into consideration. Those issues were bandwidth, capacity and funding implications (City of Cape Town ISIS Project, 2008).

ISIS Management team further found that most of the processes in the business units were manual; as a result, it came with a proposal that where interfaces between systems are

required, they should be automated and conforms to the City standards. It was also found out that there were no custodians for spatial data; as a result, the project came up with the proposal that all the property data must have a single documented custodian. This entity would be the one in charge of ensuring that spatial data is captured timeously and maintained accurately (City of Cape Town ISIS Project, 2008).

Nevertheless ISIS Team realized that they will have to add other resources in order to facilitate this principle (City of Cape Town ISIS Project, 2008). After realizing that many of these six business units obtain data from various sources, the project recommended that each data component will have one principal source. The ISIS Team further realized that rules should be made and imposed for proper use and protection of property related data (City of Cape Town ISIS Project, 2008).

Further investigation showed that there was no central spatial database in the City, as results the Team came up with the rule that the central spatial database should be applied independently. The attribute database would be application dependent (SAP LUM) and the spatial database will be dependent on the ESRI platform. This could be applied by creating and maintaining a central database for the City. In doing that, performance issues such as bandwidth were again considered. Moreover, it was found that there should be a central property master set and street addresses for the City of Cape Town. This would enable each property to have an exceptional identifier that would be used to locate it from all systems (City of Cape Town ISIS Project, 2008).

The further principles stated that data should not be simulated through manual intervention, if interfaces between systems are necessary, they should be computerized and conform to the City's standards (City of Cape Town ISIS Project, 2008). ISIS Team also brought out the solution that workflow should be integrated across all systems in order to enable the property value chain. The last principle was SAP will be the customer master database (City of Cape Town ISIS Project, 2008).

7.5 Implementing ISIS in the City of Cape Town

ISIS was implemented in the City of Cape Town on the 25th November 2011. This project was implemented in the six business units (see section 7.3) of the property value chain as it was initially planned and designed. In preparation for the implementation of ISIS, data migration, end to end testing and end user training were performed.

End- to end Testing

During this activity, the end to end scenarios were tested and signed off by the business as a validation that the integration of the solution is robust. The scenarios that are applicable to Valuations department and were tested are incorporation; building plans; pending and registered sales; sectional title schemes; consolidation and subdivisions. All these were tested and remarks were indicated (Project ISIS Go-Live Readiness Assessment Report, 2011).

End User Training

The Training Curriculum for project ISIS was produced. This served the purpose of a roadmap when it comes to training the resources within the City of Cape Town. The training was conducted in three phases. This was to ensure that The City of Cape Town's users are adequately trained to operate the SAP system before the Go live date indicated (Project ISIS Go-Live Readiness Assessment Report, 2011). The trainings were as follows;

- Trainees were introduced to SAP and trained to navigate within SAP and recognize the various types of SAP icons and their associated functions.
- Trainees were introduced to ISIS processes.

ISIS training comprised 24 courses based on The City of Cape Town's specific business processes. The courses were focused on training users in performing their job functions using the configured ISIS system. The target audience for each course was nominated by The City of Cape Town project team leaders and Business Process Owners (BPO) (Project ISIS Go-Live Readiness Assessment Report, 2011). The implementation approach was established in order to facilitate efficient implementation. The project was implemented in two phases. Phase one included installing the components/ systems that were part of the implementation process as follows:

- GIS enablement
- SAP LUM for parcel data, zoning and addresses
- SAP Public Sector Record Management (PSRM) for Integrated Planning Ordinance System (IPOS) Case Management

Phase two involves the switching off the land information system (LIS) which was used as the spatial information system before ISIS. The LIS was replaced by SAP Land Use Management. The switch off was done on the 25th November 2011. This is the time when the

LIS stopped to operate. It can only be used for viewing of attribute data not for editing (Project ISIS Go-Live Readiness Assessment Report, 2011).

7.5.1 Implementation of ISIS in the six departments

After implementing the two phases of ISIS, the project was ready to function in the six departments of the City. This means that ISIS is operating within these departments as a centralized master database in terms of sending and providing data to them as demonstrated in figure 7. 2.

7.5.2. ISIS Described

ISIS is an integrated spatial database system where all the six business units send and receive their data. This is a system where the six business units create and trigger the property information to be sent to relevant business units in the property value chain. It is a system where new property are created and removed as a result of the registration of a subdivision or consolidation. Other properties are created as a result of a municipal boundary change (inclusion or excision). The property information triggered from other business units to Valuations are rezoning, building plans, subdivision, consolidations, sectional title scheme and units, rates clearance pending sales, registered sales, ownership details and street addresses (see figures 6.4 & 7.2).

7. 6. Current Systems of ISIS

ISIS is working in collaborating with the six departments within the City of Cape Town and outside the City. It interacts with other departments in order to achieve its role of achieving property integrity in the City of Cape Town. The six business units integrated into ISIS are demonstrated in figure 7.2 and described in details.

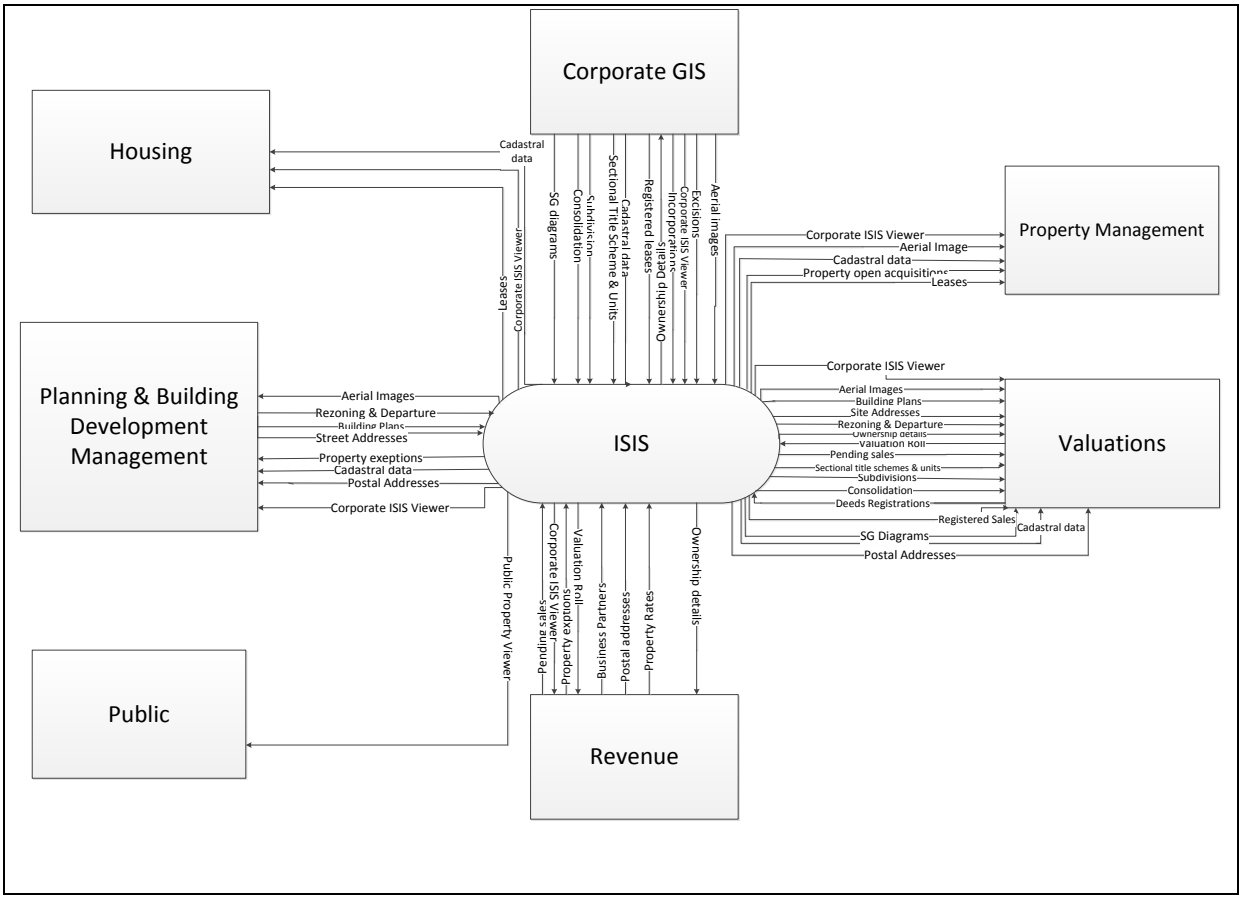


Figure 7.2 Context diagram: current system of City of Cape Town spatial information (Project ISIS Master Design Document, 2010).

Valuation: This is the department in the city responsible for the production and maintenance of the valuation roll in terms of the prescribed legislation. Therefore Valuation department in the integration of ISIS is the one that receive all changes to properties so as to plan and value the properties. ISIS sends and retrieves property data as shown in figure 7.2 from the Valuation GRM system.

Revenue: Revenue department is responsible for rates clearance for properties to be sold and billing. It deals with maintaining postal addresses, updating property values and rates and managing new created properties or consolidated properties on SAP. It also creates and updates owner information on SAP. Therefore, Revenue in this ISIS integration conducts the Rates Clearance process solely in SAP (Project ISIS Master Design Document, 2010).

Corporate GIS: Corporate GIS retrieves SG diagrams from the Survey General Office and capture these diagrams spatially on the Geo-database. A custom GIS program (SG Cadastre Tools) sorts the diagrams and reference open cases that were created from P&BDM. In the

event of consolidations, registered leases, servitudes, a new case is created from GIS which interfaces to SAP and creates the case management. Corporate GIS utilizes ArcGIS desktop (Thick Client) to conduct the spatial capture. Sectional Title schemes and units, property incorporations and excisions are also captured spatially by Corporate GIS and send to ISIS Geo-database. Corporate GIS create the case within the GIS tool which electronically creates the case in Case Management (Project ISIS Master Design Document, 2010).

Planning & Building Development Management (P&BDM): The P&BDM is responsible for capturing Planning and Building Development Application data. The spatial application is enhanced and standardized on the ArcGIS platform and is integrated to the Master Geo-database (see figure 7.3). Sectional Title schemes and units are captured on Integrated Planning Ordinance System (IPOS) Case Management and are sent via interface to SAP Flexible Real Estate (RE-FX) (see figure 7.3). P&BDM utilizes a specialized web mapping application for the capture of council approved properties, addresses and zoning information (Project ISIS Master Design Document, 2010).

Housing: It utilizes the standardized ARCGIS platform and captures the status of the housing projects. A map viewer business unit specific thin client is utilized to capture the Housing Project properties. The acquisitions, disposals and leases processes are captured in SAP Case Management, where open Acquisitions, disposals and lease cases are viewable graphically. ArcGIS Desktop is used to generate PDF's and diagrams. For the demarcation of Informal settlement, they sketch the extent of a new or updated informal settlement and sent request to Corporate GIS for spatial capture via an email message (Project ISIS Master Design Document, 2010).

Property Management: The department of Property Management acts as a Councils estate agent. Its main functions are to research properties and prepare properties for sale such as rezoning, surveying, preparing diagrams and subdivisions. It communicates with all departments for reservations of land future use. The department utilizes SAP LUM Flexible Real Estate (RE-FIX) and case Management to conduct its processes. A map viewer thin client is also utilized, where users access SAP LUM RE-FIX and conduct spatial tasks whilst still within the SAP environment (see figure 7.3) (Project ISIS Master Design Document, 2010).

7.7. Processes of ISIS Described

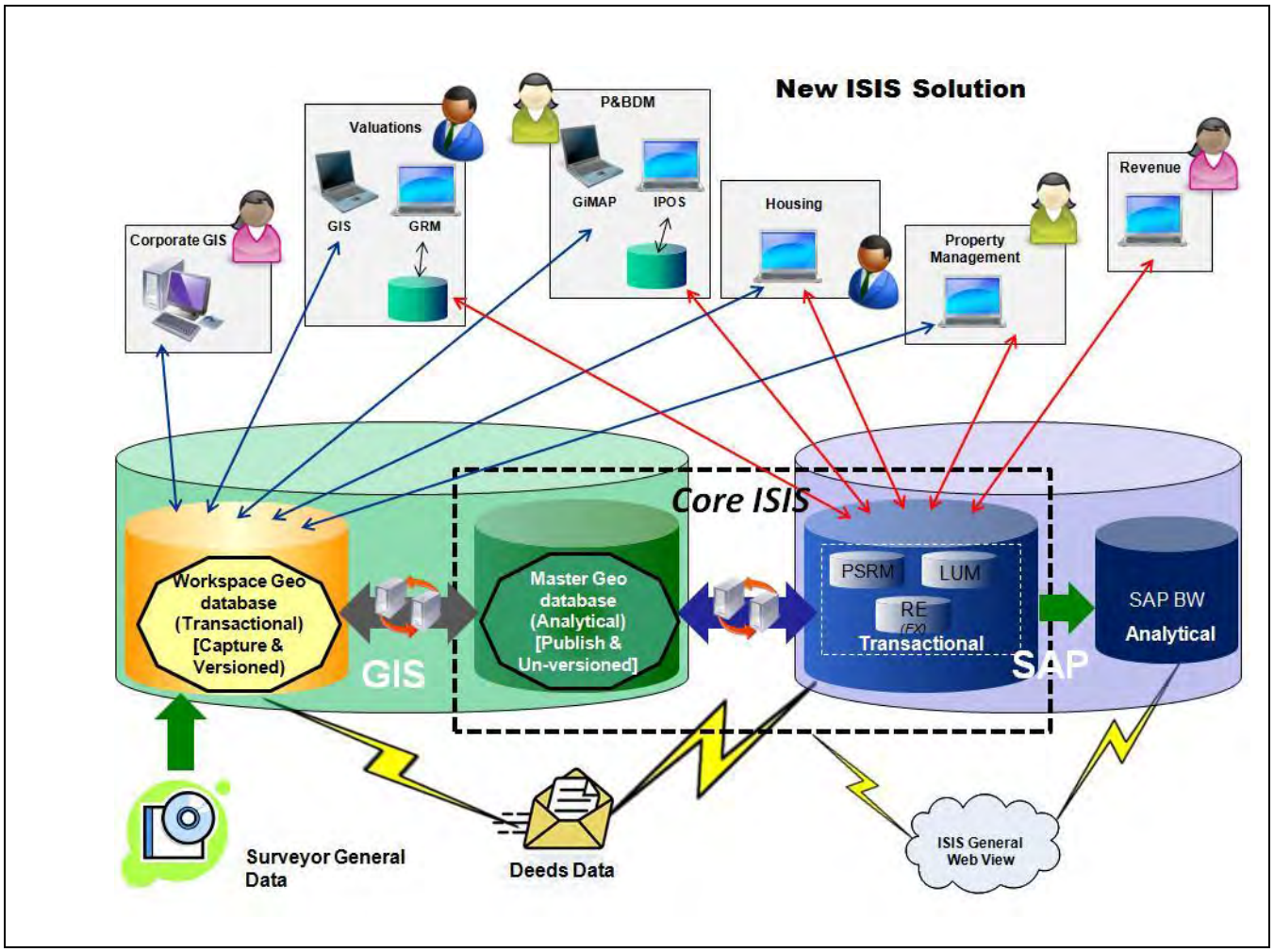


Figure 7.3 Network of Organizational information systems (City of Cape Town, Project ISIS; Database Design specification, 2009)

ISIS is composed of two databases, i.e. SAP-LUM Flexible Real Estate (RE_FIX) and ISIS Master Geo-Database as shown in figure 7.3. Property related data is categorized as non-spatial (attribute) data and is stored in SAP LUM RE_FIX (as the master). The property related data that is purely spatial and spatial critical attribute data is housed in the ISIS Master Geo-database (see figure 7.3). The spatial and non-spatial data integrated between the two systems and data is aligned and synchronized with each other (Project ISIS Master Design Document, 2010).

The data used between the two databases are interfaced and controlled to prevent the data from becoming unsynchronized. ISIS uses standard connectors (vendor provided, such as

SAP to ESRI connectors) or custom built web services (such as Integrated Planning Ordinance System (IPOS) to SAP) (see figure 7.3). Web services are published by the receiving system for the interfacing systems to consume and executive (see figure 7.3). All land parcels and spatial information are created in GIS application. When a parcel is spatially created in the GIS Application, via interfaces, the parcel is created and updated in SAP LUM RE-FX (see figure 7.3).

The interface returns success or failure responses to the database which ensure that the property is updated on both databases. In the case of Deeds data, it is sent via the mediator to both SAP LUM and ISIS workspace database (see figure 7.3). SAP LUM is updated with ownership data while spatial validations are conducted in GIS. Error handling responses is sent to SAP if validation errors occur and thereafter need to be manually corrected by the ISIS support (Project ISIS Master Design Document, 2010).

7.8. Post-implementation of ISIS

ISIS like other systems went through post implementation in order to monitor its implementation, the post implementation support was conducted especially in the first weeks after "Go live". The assumption was that teething problems would certainly arise during the first weeks (Project ISIS Go-Live Readiness Assessment Report, 2011). Therefore the post-implementation support structure was placed to deal with queries and problems that would arise after Go-Live. This support contract was in place with central records management to be onsite for a month after ISIS Go-Live (Project ISIS Go-Live Readiness Assessment Report, 2011).

ISIS Queries were dealt with through the ISIS help desk which was incorporated into the SAP help desk and this support was done before GO-live. The property value chain (PVC) and ISIS technical meetings were established after ISIS Go- live to deal with data and business process issues. Application Support such as GIS, GRM, SAP and IPOS were also setup to support the various interconnect Interfaces and applications that made up ISIS as well as the procedures and confirmation of relevant skill to support each other (Project ISIS Go-Live Readiness Assessment Report, 2011).

7.9. ISIS implementation in the case study-Valuation Department

During the initial stage of ISIS project, it was proposed that Valuation will be integrated into ISIS in such a way that GRM and SAP LUM interface will allow data sets to be transferred

from one application to another. This would be done via SAP Process Integration (PI) for the Valuation data. It was assumed that the interface would allow smooth transfer of data which would result in sharing the current information across all business units within the city of Cape Town. Moreover, the interface would also ensure the transfer of values, use codes, holding references, rateable extent, allocation data, valuation type and year, (these are variables for valuation roll) (Functional Specification-SAP GRM interface, 2009).

It was further stated that the interface between ISIS and Valuation is simulated across various processes, such as manual valuation process and objections process but not restricted to them (see figure 6.5). This interface is required in order to automate certain functions within the current operations of the Valuation business. As a result, it was proposed that the operation of the interface will be determined based on the appointed times of a General and Supplementary Valuation as well as the timing of changes to SAP data which is required within GRM and changes to other data sets within GRM. It was advocated that the interface will be a twofold interface that will run when and as specified (Functional Specification-SAP GRM interface, 2009).

7.9.1 The role of Valuation department in ISIS

Valuation department in the integration of ISIS is the one that receives all changes to properties so as to plan and value the properties. ISIS sends and retrieves property data as seen in the previous section 7.6. A custom table is created in SAP which collects the required data from LUM RE-FIX. GRM have direct access to this custom table and pull the required data (see figures 7.2 & 7.3). Likewise, the various property values and rate categories (valuation roll), use codes is supposed to be pulled from the GRM staging tables into the custom table in SAP, and thereafter updated in ISIS SAP LUM (see figure 7.2). However, this is not currently happening. GRM is only pulling information from SAP LUM such as subdivisions, consolidations, building plans, sectional title, pending sales, registered sales and ownership (see figures 6.6 & 7.2).

There is currently no information that is being sent from Valuation to other property value chain departments through automated interface via ISIS as it was initially designed. This information is being sent manually and gets uploaded to ISIS LUM and Industry Specific solution for Utilities (ISU Revenue billing system) (see figure 7.2) . Moreover, the Valuation department as part of ISIS also deals with the deeds transfer process. Valuation ensures that the deeds data is retrieved from the deeds office every day and is processed via a custom

table. There is a net application that manages the validation of the deeds data, after which SAP Process Integration (PI) sent the data to both SAP and ISIS (see figure 6.6).

7.10. The effectiveness of ISIS implementation in the Valuation Department

The effectiveness of ISIS in the Valuation department was investigated through conducting surveys in the form of structured questionnaires and semi-structured interviews. This section therefore presents the statistical description of ISIS as obtained from the Valuation ISIS users and synthesis of perceived problems, issues and challenges of ISIS as derived from the semi-structured interviews with the key informants.

7.11. The statistical description of ISIS

The section presents the investigation results of the Valuation ISIS User as conducted through the survey structured questionnaires. First the sampling size of the population that participated in the survey is presented and then the survey questionnaires description and reporting.

7.11.1 Population and Sampling

As mentioned in section 5.4.2, the population of this study includes the general employees of Valuation department, the Management and the Valuation Section Heads. A list of Valuation staff was provided to the Researcher and there were a total of 136 people on the list. A sum of 114 questionnaires was distributed to the staff. This excludes staff that is not using ISIS such as Finance staff, Secretaries, Valuation Infrastructure Support (VSI) and contract staff. 110 questionnaires were distributed to the users of ISIS and 4 to Management employees.

7.11.2 Survey Questionnaires description

The questionnaires collected data about variables illustrated in table 7.1. The user's questionnaires comprised of 76 statements. The Management questionnaires consisted of 39 statements The participant were asked to indicate the extent of their agreement with each element on a six point likert- type scale for both Users and Management, with anchors from "Strongly agree to strongly disagree and with 1 scale for "not applicable to me" (see section 5.4.2). The variables that the survey questionnaires were based on are described below.

System quality: It assessed the performance features of the ISIS LUM (Land Use Management System). The technical measures captured under this dimension include: ease of use, accessibility, reliability, flexibility, portability, usability, adaptability and trust of the ISIS system quality.

Information quality: It emphases on the desirable features of ISIS LUM system output. The information quality elements that are measured under this dimension are completeness, sufficiency, content, format, currency, relevance, clear, accurate, precision, reliability, adequacy, timelines, accessibility, comprehensiveness of information quality that is provided by ISIS LUM.

Service quality: this is the support that the users of the ISIS LUM system receive from ISIS ERP support. It measured how well the service level delivered matches Valuation department expectations. The service quality elements that are measured on this include: availability, minimum scroll, speed, safety, understandability, security, flexibility, clear, simplicity, convenience, interaction and completeness of service quality that ISIS LUM is providing to the Valuation users.

User satisfaction: This measures the overall satisfactions that ISIS Users gain from the use of ISIS LUM system and support services. It measures an overall affective response to a perceived performance of ISIS LUM. The overall user satisfaction that was measured was based on the following factors: enjoyment, output precision, personalisation, comfort level, management support (training), user expectations from support of ISIS, overall satisfaction, availability of training materials, system quality, realization of user's demands and output capacity.

Net benefits (individual & organizational impact: It focuses on measuring the extent to which ISIS is contributing to the Valuation staff and organizations as perceived by the Management in the Valuation Department. It also measures the effect of ISIS on task productivity of the department, management support and management control towards ISIS. Management support in this case refers to management approval and continuous support throughout ISIS operational phase

Perceived ease of Use: This measure the amount and way in which the users use the abilities of ISIS LUM. The elements that were measured under this dimension are: ease of use, extent

of use, time of use, frequency of use, number of access, usage pattern and dependency, number of functions used, convenience and characteristics of used computer language (training).

Perceived Usefulness: This is described as an individual's perception that use of technology will improve performance. The elements that were measured under this dimension are as follows: performance, productivity, effectiveness, dependency, and accomplishment, frequency of use, usefulness, trust, risk and routine.

7.11.3 Survey Questionnaires Reporting

The questionnaires were allocated to all staff in the Valuation department and were grouped according to the Valuation department section. A total of 87 questionnaires (76%) were returned. 84 were users' questionnaires and 3 were management's questionnaires. This makes the response rate of 73.68% for users (see section 5.4.2). Table 7.1 & Table 7.2 show the total number of questionnaires count returned for each section and the management.

Table 7.1 Valuation ISIS User Questionnaire count

Valuation Sections	**Questionnaire count**	**Percentage**
Corporate Data	8	9.5
Valuation Operations	30	35.7
Data Collection	29	34.5
CAMA	3	3.6
Business Environment	10	11.9
Objection	4	4.8
Total	**84**	**100**

The Management questionnaires were categorised as follows:

Table 7.2 Management Questionnaire count

Valuation Management	**Questionnaire Count**	**Percentage**
Valuation data & Business Systems	1	33.3
Valuation Operation	1	33.3
Valuation Survey & Quality	1	33.3
Total	**3**	**100**

The returned questionnaires from both users and managers were examined for completeness. After receiving the returned questionnaires, then the questions in the questionnaires were designated to an identification number. The questionnaires were also allocated numbers based on the section in which the respondents work. The second step was to code and type data into an assigned data file utilizing the Statistica for Windows software application. After entering the data into the software, then basic descriptive statistics analysis and correlation coefficient matrix were used to analyse data from the Users. The mean, mode and standard deviation of each of the measured variables such as information quality, System Quality, Service Quality, Perceived Ease of Use, Perceived Usefulness, User Satisfaction, and Individual and organizational Impact variables were calculated.

The analysis on the ISIS User questionnaires was conducted in two ways: first the questionnaires were analysed based on the Valuation department as a whole and secondly, it was analysed separately according to the sections in the department. The results of each section are elaborated.

7.11.4 Interpretation of Questionnaires

As mentioned section 5.4.2, the survey questionnaires were in two forms, the ISIS User and Management questionnaires. The participants were asked to indicate the extent of their agreement with each element on a six point likert- type. The measured scale was as follows for both Users and Management questionnaires;

Table 7.3 Measured scale

Strongly agree	Agree	Average	Disagree	Strongly disagree	Not applicable to me
6	5	4	3	2	1

The interpretation of the measured scale of the questionnaires implies that if the mean and mode of values of the dimension is more than or equal to 4.5, then the level of agreement with the statements gauging a particular dimension is high. If the mean and mode value of the dimension is between 3.5 and 4.49, then the level of agreement with the statements gauging particular dimension is medium. If the mean and mode value of the statement is equal to or less than 3.49, then the level of agreement with the statements gauging a particular dimension

is low. Table 7.4 & 7.5 shows the mean, mode and categories for variables of the Users questionnaires.

Table 7.4 Mean, Mode & STD of the Study Variables for User questionnaires

Variables	Mean	Mode	STD	Mean Category	Mode category
ISIS System Quality	3.91	3.7	0.57	Medium	Medium
ISIS Information Quality	3.91	3.9	0.57	Medium	Medium
ISIS Service Quality	3.90	4.1	0.58	Medium	Medium
ISIS Perceived Ease of Use	4.07	4.2	0.53	Medium	Medium
ISIS Perceived Usefulness	3.92	4.3	0.56	Medium	Medium
ISIS User Satisfaction	3.69	3.4	0.60	Medium	Low

Table 7.5 Mean and std. Deviation of the study variables for Management questionnaires

Variables	Mean	Category
Task productivity	3.1	Low
Management control	3.82	Medium
management support	3.45	Low
perception on individual & organizational benefits	3.5	Medium

7.11.5 Results and discussions of Valuation Department User Questionnaires

As shown in table 7.4, the highest mean score is ISIS Perceived ease of use and the lowest mean score is ISIS User satisfaction.

ISIS Information quality, Service quality & System Quality

As indicated in table 7.4 the findings of the results show the mean value of ISIS information quality as 3.91 and the modal value of 3.9, system quality shows the mean value of 3.91 and the modal value of 3.7. The mean value for ISIS service quality is 3.90 and modal value is 4.1. The mean and modal values for the three dimensions are at medium level as according to

the interpretation described in section 7.11.4 and this could be regarded as a fair response but not satisfactory response.

ISIS Perceived Ease of Use and Perceived Usefulness

The findings of the results on Perceived Ease of Use show the mean value of 4.07 in the overall department and the modal value is 4.2. The two values are both at medium level. The ISIS Perceived Usefulness shows the mean value of 3.92 and the modal value of 4.3. This is a fair response.

ISIS User Satisfaction

The finding of the results in the department at large shows ISIS User Satisfaction as the lowest dimension with mean score of 3.69 which is slightly below the Average "4" and above the instrument scale of "Disagree, 3". This could also be seen from the results analysis of Valuation sections where the ISIS User satisfaction has the lowest mean score among all other seven dimensions such as Valuation Operation with mean 3.64, Data Collection section with mean 3.73, and CAMA section with mean 3.83 (see figure 7.4 & table 7.6). These sections are all the consumers of data/information in the Valuation department. However it seems like their overall satisfaction with the ISIS implementation in the department is not satisfactory and their requirements are not met as they had expected.

When measuring the elements of "Training" under the dimension of User Satisfaction, most of the Users in the department indicated the lowest score on the ISIS training where they were showing their level of disagreement towards the provision of ISIS training by the department.

In order to validate the results of the ISIS User satisfaction in the department at large, the mean for the ISIS User Satisfaction dimension was first calculated and then all the mean value obtained from this dimension was arranged in order starting with the lowest mean number to the highest number. Then the number which appears most often was then selected as the modal value of this dimension and was found to be at the scale of 3.4. This modal value according to the stated interpretation is low.

ISIS Net Benefits

The finding results on the elements of Management control and perception on individual & organizational benefits has a mean value of 3.82 & 3.5 respectively. Both mean value

according to the stated interpretation is medium (see table 7.2). The task productivity and management support has a mean value of 3.1 & 3.45 respectively, which are at low level (see table 7.5).

7.11.6 Valuation Section Questionnaires Results and Interpretation

Figure 7.4 presents the questionnaires results obtained from each section in the Valuation department. As stated in section 7.11.3 the questionnaires were analysed based on the Valuation department as a whole and separately according to the four sections of the department and their sub-sections. The sections presented are the CAMA, Corporate Data, Business Environment, Data Collection and Valuation Operation.

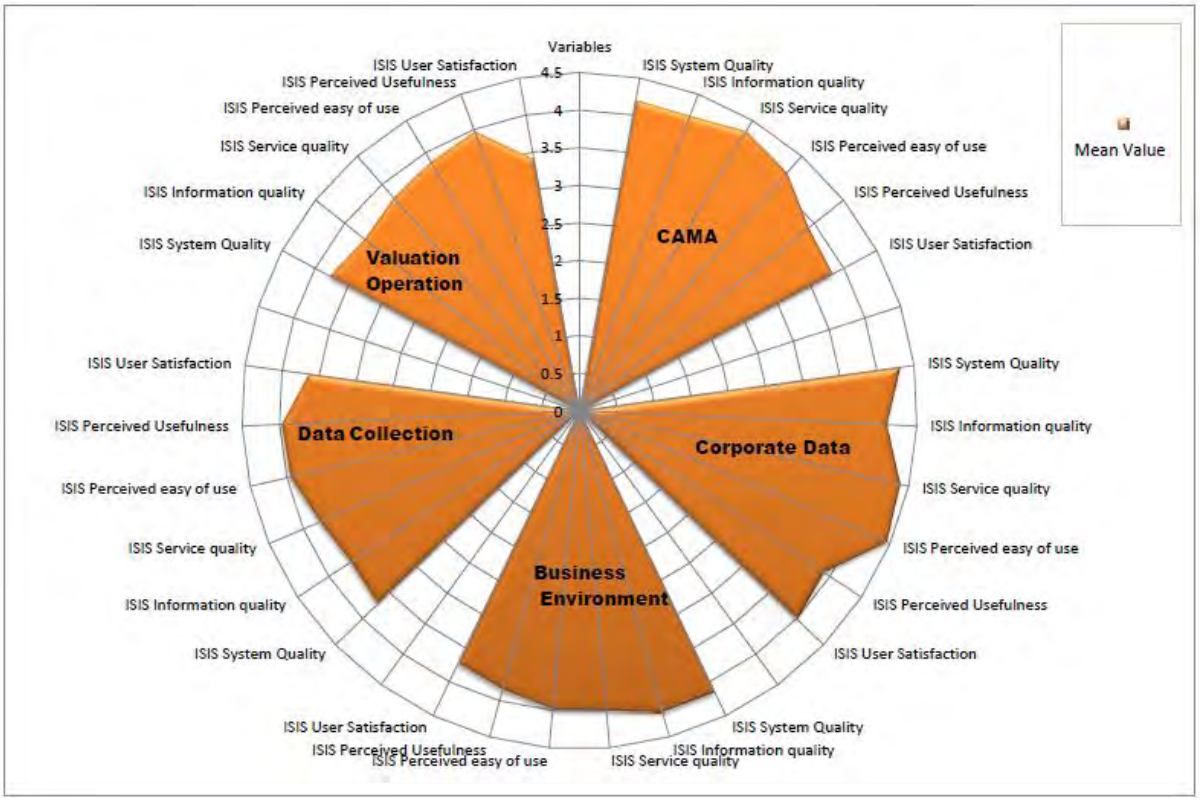


Figure 7.4 The mean value of the variables measured in the Valuation sections

Interpretation of the Results

The six variables inclusive of system quality, information quality, service quality, perceived ease of use, perceived usefulness and user satisfaction were measured for each section as demonstrated in figure 7.4 and the mean value for each variables in each sections were calculated. The mean values for the variables were between 0.5 and 4.5 as seen on the

vertical axis in figure 7.4 even though the maximum measured scale was 6. Table 7.6 presents the interpretation of results as calculated in figure 7.4.

Table 7.6 Interpretation Results

Valuation	Interpretation of Results
CAMA	The highest mean score is ISIS Service Quality. The lowest mean score is ISIS User Satisfaction.
Corporate Data	The highest mean score is ISIS Perceived Ease of Use. The lowest mean score is ISIS Perceived Usefulness.
Data Collection	The highest mean score is ISIS System Quality and ISIS information quality. The lowest mean score is ISIS User Satisfaction.
Valuation Operation	The highest mean score is ISIS Perceived Ease of Use and the lowest mean score is ISIS User Satisfaction.
Business Environment	The highest mean score is ISIS Perceived Usefulness and the lowest mean score is ISIS User Satisfaction.

7.11.7 Correlation Coefficient Matrix

As indicated in section 7.11.3 the ISIS user questionnaires were further analysed using correlation between the measured variables described in section 7.11.2. This is to measure the relationships between two or more variables to see how they relate to one another. In this case, first the ISIS User satisfaction is associated as a dependent variable towards the independent variables such as ISIS system quality, service quality, information quality, perceived ease of use and perceived usefulness. This is because the intention of the user satisfaction perspective reflects an attitude on the outcome derived from using the system (Miyamoto, *et al.,* 2012).

Secondly the two variables of TAM (perceived usefulness & perceived ease of use) are correlated as the dependent variables to system quality, information quality, and service quality. These are the most important variables that affect perceived ease of use and perceived usefulness (Wang & Wu, 2006). The hypothesis is based on the followings:

- ISIS User satisfaction is positively associated with ISIS Service quality and System quality.

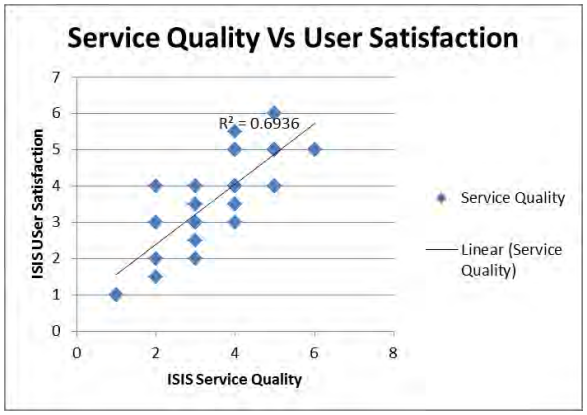


Figure 7.5 ISIS Service quality

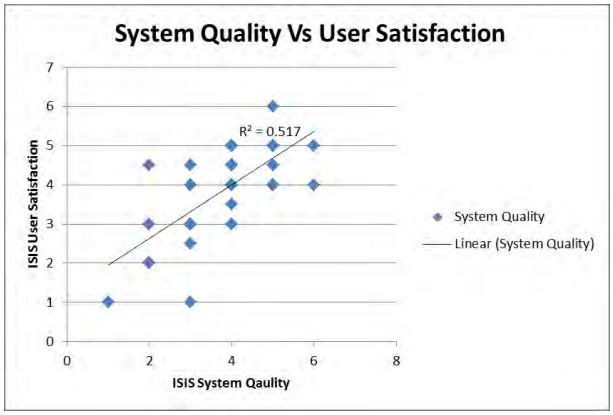


Figure 7.6 ISIS System quality

- ISIS user satisfaction is positively associated with ISIS Information quality and Perceived usefulness

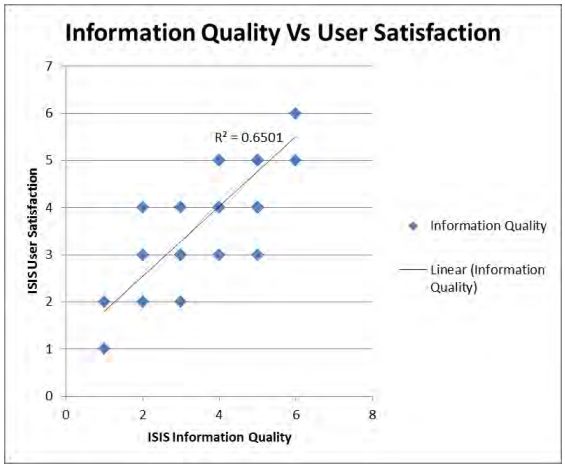


Figure 7.7 ISIS Information quality

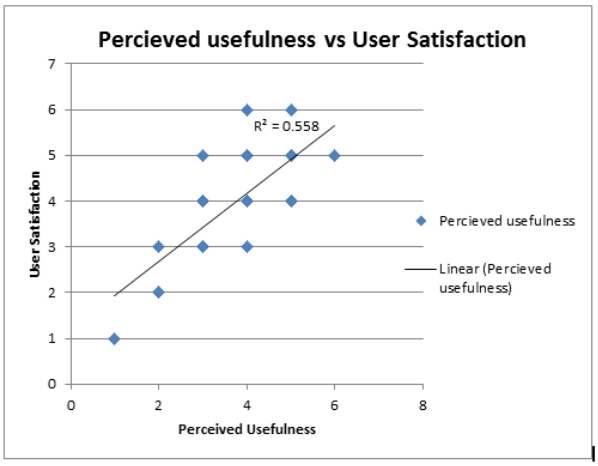


Figure 7.8 ISIS Perceived Usefulness

- ISIS user satisfaction is positively associated with ISIS Perceived ease of use

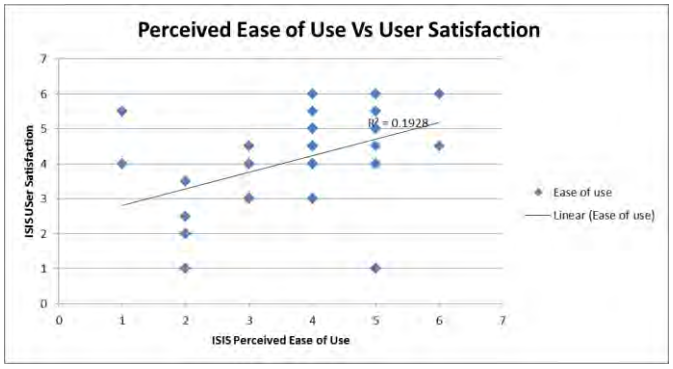


Figure 7.9 ISIS Perceived Ease of Use

- ISIS Perceived Usefulness and ISIS Perceived Ease of Use are positively associated with ISIS Information quality.

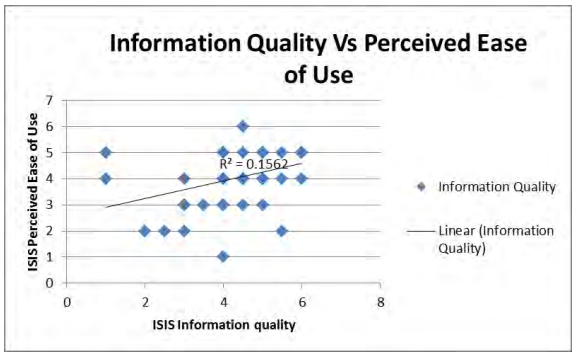


Figure 7.10 Percieved Ease of Use

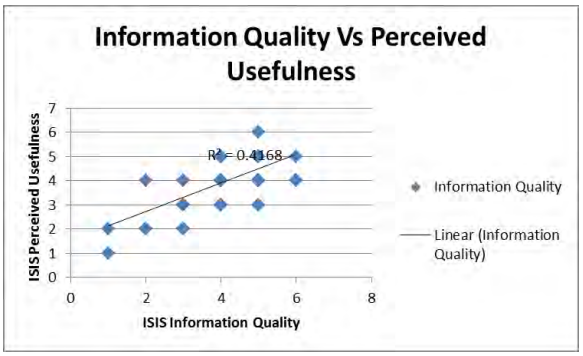


Figure 7.11 Perceived Usefulness

- ISIS Perceived Ease of Use & Perceived Usefulness is positively associated with ISIS Service quality.

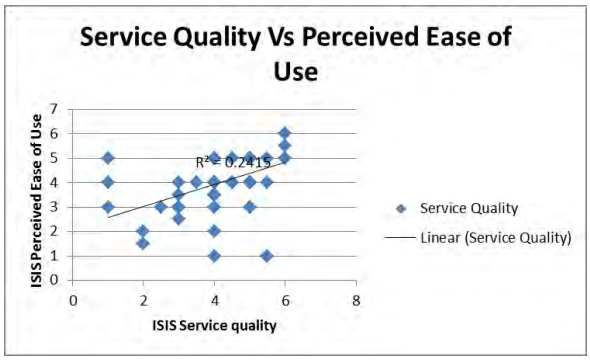


Figure 7.12 Perceived Ease of Use

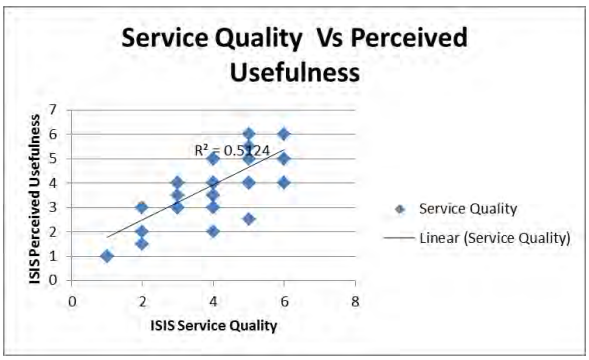


Figure 7.13 Perceived Usefulness

7.12 Key Informants Interviews Reporting

The section discusses a mix of observed problems, issues and challenges as obtained from semi-structured interviews with key informants carried out in 2013.

The researchers conducted the follow up interviews in order to get clarity on some of the questions that were asked in the survey questionnaires especially because most of the dimensions measured showed the results which were mostly on average. Therefore it was difficult for the researcher to draw a conclusion or inferences based on those results. The researcher wanted to identify where the data/information issues could be with ISIS and decided to conduct interview with the Key Informants in the Valuation department and ERP office. These were from CAMA, Data Collection, Valuation Operations and Corporate Data and Business Environment.

Interview Questions Description

The semi-structured interview were based more on the data content, correctness, reliability, sufficiency, completeness, accuracy, real time of data/information that the Valuation department receive from ISIS as well as Use of ISIS. The same questions were asked to the Key Informants. The questions asked in the interview were semi-structured and therefore allowed new ideas to be brought up during the interview from what the interviewee said. As a result the researcher was able to get more details on the issues of data that the section currently had since the interviewees were able to elaborate in details and the interviewer was able to dig more on the point/issues they were raising and was able to identify problems.

7.12.1 Challenges and Problems by Key Informants Synthesised

The findings of the interviews show some dissatisfaction on a lot of data issues that are being experienced in the Valuation department. All the Key Informants had similar views on a lot of data issues. They agreed that there is certainly some data issue going on in their department which means the data quality is not at the level of where it is supposed to be. The further interpretation of the interview results is summarised below:

Data quality: The questions that were related to this measure included data content, correctness, accuracy, reliability, and completeness. The response on this measure in these five sections still shows some dissatisfaction. The question was asked to find out if the data/information supplied by the department is of good quality for them to perform their task

efficiently and effectively. The response on this issue shows that the data quality is not at what is supposed to be. The interviewees stated that data is not satisfying at all due to many data issues (Key Informant Interviewees, A, B, C, D, F, 2013). The interviewees were asked to state those data issues that they are experiencing in their department. Most of them stated that the data is not always up to date, correct and accurate. They pointed out that issues make the data to be unreliable and not trustworthy for them to make informed decisions (Key Informant Interviewees A, B, C, D, F, 2013). The interviewees were asked to summarise the data issues that they have in the department and they stated as below:

- Registered properties still appear as unregistered on GRM and ended up having to alert corporate data to update the parcel status (Key Informant Interviewee C, 2013)
- Incomplete and missing data such as building plans not being there on GRM whereas they are supposed to be (Key Informant Interviewee C, 2013).
- Missing land status changes on GRM (Key Informant Interviewee C, 2013).
- Missing and incorrect base data such as land extents and neighbourhoods (Key Informant Interviewee B & C, 2013)
- Dead properties (properties which doesn't exist anymore) on GRM still active leading to duplication of data (Key Informant Interviewee C, 2013).
- There are a lot of properties on ISIS LUM with registration legal status but with no registration dates. This is a problem because the data itself is misleading and not reliable to be used (Key Informant Interviewee A, 2013).
- Subdivision, consolidation, Sectional Title properties and building plans comes through from ISIS with missing data such as portion role and MLA indicator for subdivision and consolidation (Key Informant Interviewee A, 2013).
- There are lots of properties with owner details as ISIS place holder on ISIS LUM whereas they are supposed to have correct owner details (Key Informant Interviewees A & D, 2013).
- There are 55000 parcels with incorrect legal status (Key Informant Interviewees A & E, 2013).
- There are sectional title schemes properties with duplicate units (Key Informant Interviewees A & G, 2013).

The interviewees were further asked to state the causes of the data quality issues arising in their department and were stated as follows:

- Data capture errors, inconsistency in the way data is captured or re-collected (Key Informant Interviewees B, C & D, 2013).
- People responsible for maintaining data on GRM are not aware of the impact it could cause on them if data is not accurate (Key Informant Interviewees C & D, 2013).
- No urgency to people responsible for maintaining data on GRM. They are not aware of the consequences the data inaccuracy impact on general valuation/ supplementary valuation GV/SV (Key Informant Interviewees C & D, 2013).
- There are sometimes problems with interface that is used to load data from ISIS to GRM which sometimes does not work (Key Informant Interviewees A, B, C & D & F 2013).
- Missing building plans because of IPOS problem. This is a system that planning department (BPDM) uses to process building plans (Key Informants Interviewee A, 2013.
- Lack of quality control on the Corporate Data section site. This is seen by duplicating processes such as placing properties in workflow twice for the same task although placed by different staff in the same section plans (Key Informants Interviewee C, 2013.
- Incorrect legal status and ownership occurred due to incorrect data migration (Key Informants Interviewees A & F 2013).
- Lack of training when it comes to the people who capture sectional title schemes on ISIS LUM. People responsible for capturing ST don't know how to read ST plans and ended up capturing wrong information which leads to duplication of ST units on ISIS LUM (Key Informant Interviewee F, 2013)

Real Time of Data: on this measure, a question asked was to find out if data on GRM is real time for them to perform their daily task effectively. On this issue, Key Informants Interviewees B & D (2013) responded that they do not work real time since their operations do not require them to do so. Therefore they are not even sure whether data on GRM is real time or not since it doesn't really affect them. On the other hand (Key Informant Interviewee C, 2013) stated that data is not real time per say at least 50% is real time. Sometimes they have backlog on their side due to data that was not loaded on GRM on time. This was also seconded by (Key Informant Interviewee A & G, 2013). They stated that data is not in real time as it supposed to be due to some technical issue. The issue of Valuation interface was mentioned as one of the causes of problem since it does not work properly most of the time.

The IPOS which is as system that planning department (BPDM) use to process building plans also causes problem since it sometimes does not work and this delays the building plans to be received by the department and thus affect the Data collection as the main consumer (Key Informant Interviewees A & G, 2013).

The registered sale is one of the data that was mentioned as not real time. This data is not received by Valuation department in real time as it is supposed to be due to technical issue such as simultaneous sales. It is stated that currently registered sales are being downloaded from Deeds to ISIS LUM in the mornings onto GRM; Valuation only receives them later in the evening (Key Informant Interviewees A & G, 2013).

Data Sufficiency/Adequacy: on this measure the question was directed more to the CAMA section. The interviewees were asked if they think that the data that they are currently basing their model on is sufficient to enhance the model application, they responded that it is enough for now but there is always a room for improvement and they would really like to include other factors or variables such as Socio-economic data (census data) showing income level, population distributions and crime rate. They said they believe that these socio-economic factors are somehow incorporated into the neighbourhood variable but they would like to separately include them and test the model on them and see if the results would be different (Key Informant Interviewee B, 2013).

On the same question of data adequacy, they stated that when applying their model they don't consider factors such as proximity to the shopping centres, clinics, schools and recreational facilities. At the moment they are just basing their model on other available variables such as land extent, neighbourhoods, roofing's, walls, views, exterior, sales and environmental noise etc. They pointed out that they believe proximity to amenities would really improve their model since those are property value influencing factors (Key Informant Interviewees B, C 2013).

More questions were to find out if they also include servitudes in their model applications, then they said no, it would be difficult to include servitude in the model since there is no model for servitudes. There is no sufficient data to model servitudes since there are few properties with servitudes. Valuation Planning would be the best people to consider the servitudes when they do value review or manual valuation (Key Informant Interviewees B, 2013). The Valuation Operation section was also interviewed on this issue of servitudes. This

was to find out if they consider servitudes when they do their value review or manual valuation as recommended by CAMA.

The response to this was that they used to look at the servitudes at the City lite map before ISIS implementation but now they don't have access to such data. Valuation Operation is not even sure whether ISIS viewer has provision of such information or not. It was emphasized by both sections that servitudes are also value influencing factors and sometimes the owners of properties object against their property being overvalued. They would recommend for servitudes to be included in order for them to make informed decisions and try to avoid or reduce unnecessary council objections (Key Informant Interviewee B, 2013). On this servitudes issue, (Key Informant Interviewee G, 2013) raised that servitude data is being captured by corporate GIS into ISIS LUM. This means Valuation department needs to request such data to be sent to them.

Furthermore, data sufficiency was also found by the Data Collection section as another issue that they are facing in their operational function. The building plans that they receive on GRM from ISIS does not have all the required information that they need to perform their task effectively such as building plan inspector ID and case number (Key Informant Interviewees A & C, 2013). Moreover, registered leases were identified as one of the data that is insufficient on GRM, this is because this data is currently not being sent to Valuation from ISIS as it was supposed to be since ISIS-go live (Key Informant Interviewees A & D, 2013.

Moreover, data insufficiency has also been identified between two systems ISIS LUM and GRM which are not synchronized with one another as is supposed to be. There are currently 55000 properties on ISIS LUM but not on GRM and 1700 properties on GRM which are not on ISIS LUM. On a daily basis there are some data/records which are not being sent to GRM from ISIS LUM. This therefore also shows that data is not in real time as supposed to be since some of the data is not being received in real time on GRM (Key Informant Interviewees A & G, 2013). It was further mentioned that every day there is always data that is not being sent to GRM due to PI that gets overloaded and end up not sending some of the records since every day there is always records that are not being sent to GRM. Since ISIS-go live there are 549976 records generated for GRM and 2804 have been unsent to GRM (Key Informant Interviewee G, 2013).

Use of ISIS: the question asked in this measure was to find out if the department as a whole makes use of ISIS effectively to perform their task. Three sections from the department out of five section interviewed are not using ISIS effectively as they are supposed to do. Key Informant Interviewee B, (2013) stated that they do not really need to use ISIS for their operational function; they need only 5% of ISIS use. They stated that their source of information is GRM and therefore they assume and expect that all information on GRM is correct. If they have doubt with information on GRM, they consult Corporate Data which is responsible for maintaining the departmental data (Key Informant Interviewee B, 2013).

Key Informant Interviewee C, (2013) stated that they do not use ISIS much as they are expected to use, although their operational work does not depend very much on ISIS. He stated that one of the main reasons they do not utilize ISIS is lack of training. It was stated that the staff in the Data Collection did not have training at all. Those who were trained did not have enough of it and therefore it would be difficult to use ISIS even if it is necessary to use it (Key Informant Interviewee C, 2013).

This was also supported by the Valuation Planning section. This section did not receive enough ISIS training and some people never got chance to go. It was stated that the training sessions was not organized properly and ended up excluding some staff members (Key Informant Interviewee D, 2013). However, the overall response on this was that they do not really have to use ISIS on a regular basis since their source of information is GRM, and GRM has incorporated most of the information that they had to look for from LIS before ISIS. However, there are some instances where they have to confirm data from ISIS and it becomes difficult to do so due to lack of training that they have on the system. As a result, they always refer their data queries to Corporate Data section even when not necessary (Key Informant Interviewees C, D & F 2013).

The Corporate Data section was found to be the only section which maximise the use of ISIS. This is because, the section is responsible for loading data from ISIS LUM to GRM, and therefore ISIS is their source of information. Key Informant Interviewee A (2013) stated that the other sections in the department are not utilizing ISIS as expected. It was pointed out that throughout the experience, every new system is not easily accepted by the users and eventually they will make use of it (Key Informant Interviewee A, 2013).

Another question on the use of ISIS was to find out if ISIS LUM is user friendly and able to return answers to Valuation request very quickly. Key Informant Interviewees A & G (2013)

responded that ISIS LUM is quite sophisticated the first time is being used but once one gets used to it, it's quite friendly. On the issue of returning answers quickly, Key Informant Interviewees A & G (2013) said it depends on the issue logged, when it comes to the issue of lineage query and attributes property queries, they usually response very quick, but when it comes to the issue of attaching title deeds on ownership, it normally takes long.

Valuation better off with ISIS: This was to measure the overall feelings from the sections about the ISIS implementation in their department. The general feeling to this was that the department is better off with ISIS to a certain extent. The reasons they put forward are as follows:

- There is now transparency of data (Key Informant Interviewee A, 2013).
- Real time data is being received which makes the data on GRM up to date (Key Informant Interviewee A, 2013).
- ISIS has brought partnerships between the property value chains (Key Informant Interviewees A, D & F, 2013).
- Spatial references which weren't possible in the past can now be seen. It was stated that they used to check for spatial reference on Valuation layer or City Lite map, but Valuation layer was most of the time not working (Key Informant Interviewee C, 2013).

However, there was also a different feeling about ISIS which states that ISIS implementation has brought a lot of complications since it is not providing them with all the data that they used to receive from LIS such as registered leases. ISIS is also complicated when it comes to searching of ST properties, it was emphasized that it was easy to check ST properties information on LIS but with ISIS is a bit complicated, and this is also caused by lack of training (Key Informant Interviewee D, 2013).

It was further mentioned that due to ISIS implementation, the systems that they were using to view data are no longer available such as City Lite Map which was useful for checking the servitudes on properties (Key Informant Interviewee D, 2013). As a result, the properties with servitudes are being valued like other normal properties. This therefore makes it also difficult to see the merits or effectiveness of ISIS in the department since they are even experiencing more problems than before, yet their expectations with ISIS were high (Key Informant Interviewee D, 2013). The other response to this was ISIS has not brought any difference on

their side since they are not really involved with ISIS and they don't really work in real time. To them life is still normal as before (Key Informant Interviewee B, 2013).

Furthermore, ISIS was criticised to be complicated and not user friendly like LIS even when enough training is being provided. This is because it becomes difficult to check the lineage of properties on ISIS, each portion in the lineage has to be individually opened in order to check their registration dates (Key Informant Interviewees A & F, 2013). An example was given whereby a property might have 200 subdivision portions, and each subdivision has to be opened in order to check its registration dates. This is a hassle since a lot of time is being consumed which results in delay in service delivery dates (Key Informant Interviewee A 2013).

7.13 Data Correlation Method Reporting

As indicated in section 5.7 the survey questionnaires and interviews with key informants were correlated to system diagrams in order to see where data issues were as according to the follow up interviews and questionnaires responses from all the sections in the Valuation department. These correlations are demonstrated on the system diagram. The system diagram in figure 7.14 is drawn to show the processes and the data flow in between the processes and how information is transmitted around in the Valuation department. There are ellipses with different colours on the data flows which show the data quality that is flowing from one processes to another around Valuation system Processes. These are represented using the traffic light approach depicted by "Green", "Red", and "Orange" as shown in the table 7.7. The meaning of these traffic lights in the context of the spatial information flows of Valuation department are defined in table 7.7.

Table 7.7 Traffic lights approach

Color	Definition
Green	Means that the data flowing between one process to another is correct, complete and accurate and can be used.
Red	Means that the data that is flowing between the processes is incomplete, missing, insufficient, and incorrect, not flowing between process as supposed to be. These type of data cannot be used to make informed decision
Orange	Means that the data that is flowing between one process to another still has data error and can be used:, but needs modification.

Valuation Department Processes

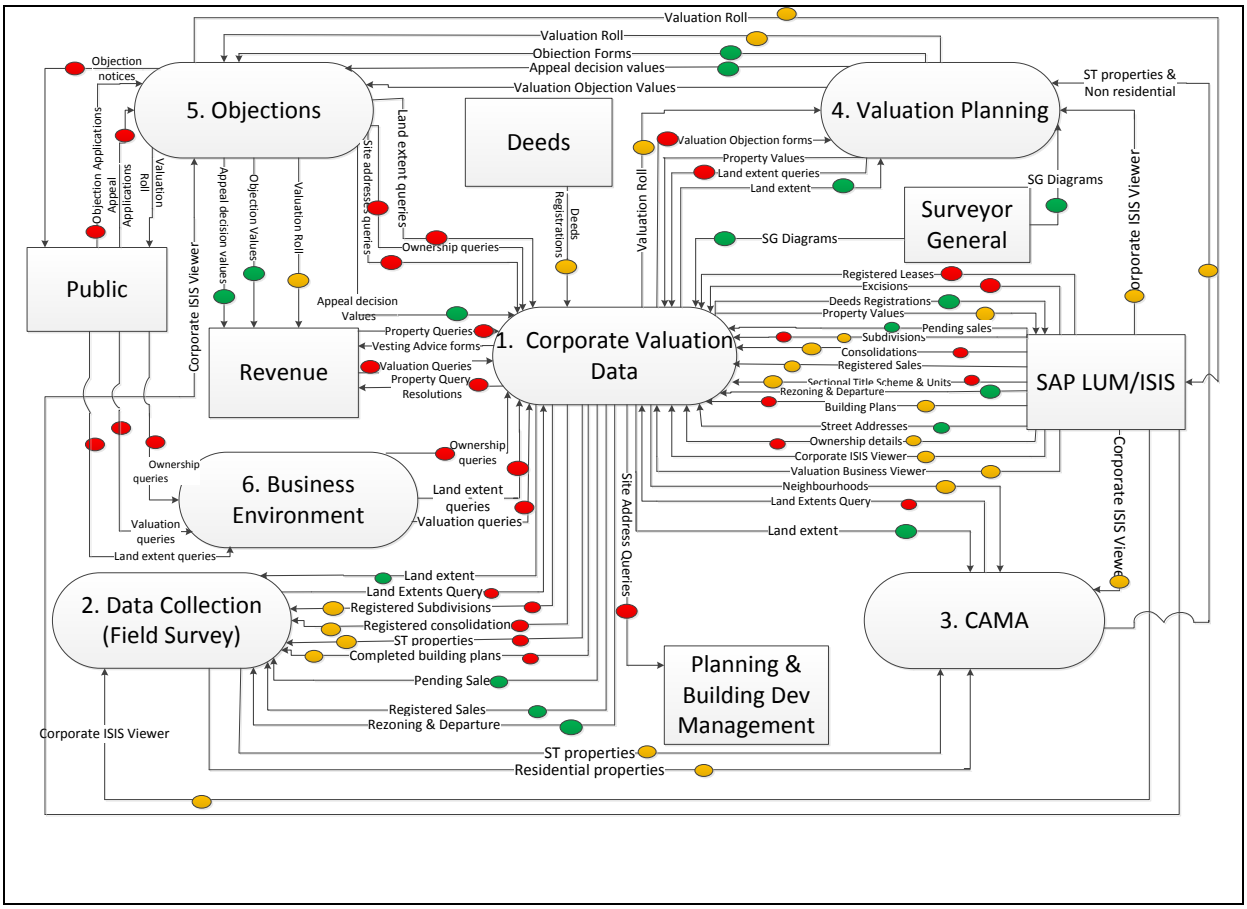


Figure 7.14 Valuation Department Correlation Process

7.14 Conclusion

This chapter give a description of ISIS as seen from multiple perspectives. The investigations in this chapter reveal that ISIS implementation in the Valuation department is both effective and ineffective. The ineffectiveness of ISIS results from ISIS not been able to fulfil the needs of all users as expected and thus the users are not fully satisfied with its implementation. This is because ISIS provides the department with inaccurate, incomplete, incorrect and missing data as well as inadequate data. The effectiveness of ISIS results from ISIS being able to provide Valuation department with real time data and data transparency.

The narrative facilitates a complete understanding of ISIS. This chapter informs analysis of spatial information system of Valuation department through system analysis approach and analysis of the effectiveness of ISIS implementation through information system success models.

Chapter 8. Analysis of the Spatial Information System in the Valuation Department

8.1. Introduction

This chapter uses theoretical and analytical frameworks discussed in chapter 3 and chapter 5 to analyse the current spatial information system in the Valuation department. This is informed by the case study narrative description of the Valuation as presented in chapter 6 and description narrative of ISIS in chapter 7. Nevertheless there are issues documented in chapter 6 which might not be part of this chapter, but were essential in facilitating the understanding of the case in its setting.

The organisational structure and strategy (business mission, objectives and goals) is modelled using BSP/Zachman framework. The business processes/functions, data/information and communication/interfaces are modelled using both BSP and System Development Life Cycle SDLC. Structured System Analysis and Design Methodology, SSADM is used to model documentation of processes through data flow diagrams and data dictionary. The systems tools are utilized to conceptualise the Valuation as observed from various perceptions. This adds to understanding of the system, and assists ascertaining the existing problems in the Valuation with a view to guiding developments, if necessary. The analysis facilitates analytical triangulation. Parts of these analysis tools are accepted due to their appropriateness in addressing the research questions.

8.2 Analysing the Spatial Information System of Valuation Department using Zachman framework

The analysis of the Valuation spatial information system is based on the first two perspectives and the five dimensions of the Zachman Framework inclusive of organisation, strategy, data, function and network. Organisation in this case is the first variable. Figure 8.1 shows basically the analysis stage of SDLC as described in chapter 2.

Table 8.1 Analysis Perspectives of the Zachman Framework (Effenberg, 2001)

	Organisation **Who**	**Strategy** **Why**	**Data** **What**	**Function** **How**	**Network** **Where**
Scope/Objectives	List of organisational units	List of business goals and strategies	List of data essential for spatial information	List of spatial information processes	List of locations where the system functions
Model of the System	Organisation chart showing roles, skills	Show ISIS Strategy	Data Entity Model	System data flow diagrams	Organisational and data links

8.2.1 Valuation department in Business System Planning (BSP)/Zachman framework

The first step in modelling using Zachman framework is to identify and list the organisational units that form part of the spatial information system of Valuation department, their strategies, data, functions and network.

Organisation dimensions

Scope/Objectives Perspectives

The spatial information system of Valuation department is achieved in collaborating with the various departments within the City of Cape Town and outside the City (sees section 6.6). These are listed as follows:

- ISIS
- Planning & Build Development Management
- Revenue
- Deeds Office
- Surveyor General
- Public

Model Perspectives-Organisation Dimension

An organisational chart presented in (section 6.4.3; figure 6.3) and context diagram presented in (section 6.6; Figure 6.4) are used to model this dimension for Valuation business. In trying

to model a group of self-governing business for this perspective, this section will stipulate the skills and roles of organisation in the Valuation spatial information system. The role of Valuation department is to produce and maintain valuation roll in terms of prescribed legislation (See section 6.4). It achieves its roles by applying skills in terms of its four branches and by interacting with other departments within the City of Cape Town and outside. Table 8.2 summarises the model perspectives of organisation.

Table 8.2 The model perspectives of Valuation Department

Organisation	**Skills & Roles**
Valuation Department	Maintain ownership records on SAP-LUM (see section 6.5.2) Produces and maintains the valuation roll on the Valuation System (GRM) (section 6.5.1) Responsible for processing all transactions on the tranerven table to the Valuation System (GRM) (see section 6.5.2)
ISIS (Property Value Chain Business Units)	This is a master database where business units (including Valuation department) store, create and trigger the property information to be sent to relevant business units in the property value chain. (see section 6.6)
Planning & Build Development Management	GIS knowledge to maintain and upgrade street addresses. The street addresses are used by Valuation Department in producing valuation roll (see section 6.6)
Revenue Department	Skills to levy property taxes based on property values. This property values are provided by Valuation Department (see section 6.6).
Surveyor General Deeds Office	Produce survey diagrams, general plans and subdivision plans. (See section 6.6). Provides deeds registration of properties to

	Valuation department (see section 6.5.2 & 6.6)
Public	Assist the City of Cape Town to achieve its goals of generating revenue through paying taxes for their properties based on valuations. (see section 6.6)

Strategy Dimensions

Scope/Objectives Perspective

The strategy dimension at this perspective list the business goals and strategies of each of the organisations as they relate to the spatial element of their business and impact the effectiveness of spatial information system in the Valuation department. Table 8.3 demonstrates the strategy dimension of organisation.

Table 8.3 The strategy dimension of organization.

Organisations	Strategy
Valuation Department	The department has a vision to remain the leader in the valuation of property (see section 6.4) However; it is not able to accurately assign the correct market value to the public properties. This is because of the opinion that the valuation data is still in accurate (see section 6.7).
ISIS (Property Value Chain Business Units)	Its vision is to improve property information integrity (see section 7.2). Besides meeting this requirement, ISIS is unable to fulfil the needs of the spatial information of the Valuation department. (See section 6.7)
Planning & Build Development Management (P&BDM)	Its vision is to comply with capturing planning and build requirements (See section 7.6) Even though the P&BDM meet its requirement, it is providing Valuation

	department with incomplete building plan data (see section 7.12.1)
Revenue Department	Its goal is to correctly bill and collect funds for the city. However, the billing of properties is not always correct due to the wrong values assigned on properties by Valuation department (see section 6.6)
Surveyor General (SG)	Its goal is to be a known world leader in delivering the national cadastral survey management system (See section 6.6). Besides meeting this goal, SG network is not reliable, it is very slow and some days don't return the SG diagrams request.
Deeds Office	Its goal is to provide deeds registration (see section 6.5.2 & 6.6)

Model Perspective - Strategy dimension

In this perspective, the strategy dimension implicates significant justification of the business strategies of the different organisations that influence the effectiveness of the Valuation spatial information. The strategic dimension has a substantial effect on the effectiveness and dissemination of spatial information. In this case ISIS was implemented in the six business units of the City of Cape Town including Valuation department in order to improve integrity of property information through property value chain (see section 7.3). ISIS came up with principles which were used to guide the project with technical solution design and this has already been described in section 7.4. The general objectives of the ISIS Strategy are to maintain property data, improve service delivery, and establish centralized master database (see section 7.2).

Data Dimension

ISIS/SAP-LUM is the major source of the spatial information used by the Valuation department. The data sets that are used by each section in the Valuation department had been identified and documented (see section 6.5.1- 6.5.5). In this section this data is elaborated.

Table 8.4 Data dimension

List of Data for Spatial Information System	Description of Data
Subdivisions	These are new property created from surveyor general plans. It consists of registered and non-registered properties. All registered subdivisions are subject to valuation whereas the unregistered subdivisions do not qualify for valuation.
Consolidations	These are new property created from combining more than one property together to form one property. It consists of both registered and unregistered properties. Only registered consolidations are supposed to be valued.
Property Sales:	This consists of pending and registered sales. The pending sale occurs when the property being sold is not yet fully paid by the buyer. The registered sales occur when the full amount of money is paid to the seller. The pending sales are triggered by the rates clearance process done by the Revenue department. The registered sales are created upon registration of the sales by the Deeds Office. Both registered and pending sales are subject to valuation.
Ownership details	This is composed of the first and second name of the person who owns the property. It also includes the Identity number (ID) and the business partner number of the person.

Sectional Title Scheme/Units	It is a scheme property with sectional title units. The scheme properties are defined by section LIS ID (land information system) as a unique identifier. Within each scheme there are more than one unit. The scheme properties are in two legal statuses, registered and unregistered. Only registered schemes and units are subject to valuation.
Closure	These are properties which result due to roads construction, these are remaining portions and they are normally referred to as road reserves. These properties are not supposed to be valued.
Excision	These are properties created as a result of a municipal boundary change
Building plans	Composed of approval date, completion date and commencement date of the building plans.
Street Addresses	This is usually associated with the property. It is composed of street number, street name and suburb name. Street addresses are used in valuation roll.
Rezoning & Departure	This denotes the zoning of the property such as residential, commercial and agricultural.
Surveyor General Diagram (SG)	This denotes the property boundary and the extent of the property. SG diagrams are used to confirm the correct extents of properties.
Property data	It is composed of different type of properties valued by the Valuation department. These are hanging and holding properties, home owner associations, residential, commercial

	and agricultural properties.
Vesting Advice forms	These are the forms that are prepared by the Valuation department and sent to Revenue department as to inform the department that the properties have property status such as roads, public places and substations and qualify for rebates.
Valuation neighbourhoods	The properties are divided according to the neighbourhoods. This includes residential, commercial, agricultural neighbourhoods. These are used in order to conduct manual valuation.
Objection forms	These are forms used to lodge complains against the public property. The objections are lodged if wrong property market value is assigned; incorrect ownership details and incorrect land extent are associated with property.
Land extent	This is the total area measured against property. This is essential when assigning property market values.
Property values	It's a reflection of what a property would have been sold for in an open market as of particular date
Deeds Registrations	These are the ownership details associated with property, this include the first and last name of the property owners, identity number and business partner.
Valuation roll	This is composed of property market values, use codes, holding references, rateable extent, allocation data, valuation type and

	year

Model Perspective – Data Dimension

The model perspective for data in the form of entity relationship diagram has not be drawn as the purpose of this research is not to design the database but to understand the current spatial information system in the Valuation department.

Function dimension

Scope/Objectives Perspective

As stated in the framework strategies the documentation of function dimension is inventory of the processes related to the Valuation spatial information system. This listing is actually the first stage of expanding the context level diagram DFD for the spatial information system undertaken in (section 6.6; Figure 6.4).

Inside this scope the following is the list of identified processes for the Valuation spatial information system (see section 6.6.1)

- Process Corporate Valuation data
- Conduct Data Collection (field surveys)
- Process Computer Assisted Mass Appraisal (CAMA)
- Process Valuation Planning (Manual Valuation)
- Process Objections
- Process Business communication

Model Perspective-Function Dimension

For the purposes of this research, the descriptions of each process that take place in the Valuation department and its respective sections will be elaborated in terms of the system data flow diagrams and data dictionary to describe the real world situation of spatial information system of Valuation Department. Modelling using data dictionary and data flow diagrams is the powerful technique of Structured System Analysis and Design (SSADM). Therefore, SSADM techniques are used to model these business processes in section 8.4.

Network dimension

Scope/Objectives Perspective

The network dimensions list the locations where the system operates. In the case of spatial information system of Valuation department, the systems will be categorised into two as shown in table 8.5. These systems/technology have been presented in (section 6.5.1- 6.5.5).

Table 8.5 Network dimension- Valuation Department

Primary system (where data is created) by Valuation Department	**Secondary system (where data is stored & used) by Valuation Department**
SAP-Land Use Management (LUM) Government Revenue Management(GRM) Geographic Information System software (ArcGIS) Computer Assisted Mass Appraisal (CAMA)	SAP-ISU ArcGIS (ISIS Viewer) SAP PSRM

Model Perspective-Network Dimension

There is no formal model standard for this cell of the Zachman framework. Section 7.7; figure 7.5 shows the method by which data is transmitted between organisations ratifying the spatial information processes and the sovereign uptake of technology by organisations taking part.

As portrayed in figure 7.5, the following application software read and/or writes data to the Core ISIS database within the City of Cape Town:

- The IPOS application of the Planning and Development Management department
- The GiMAP application of the Planning and Development Management department
- The GRM system of the Valuations department
- ESRI ArcGIS desktop applications of the Corporate GIS department

- Several modules within SAP of the Revenue department
- The ISIS portal to view and, in the case of Housing and Property Management, capture spatial data

Systems external to the City write to the core ISIS database. These include the following:

- Deeds data is received directly from the Deeds Office
- Various different diagrams are received from the Surveyor General Office

A Summary of the Analysis of the Valuation Spatial Information Systems, Revealed through Zachman Framework/BSP

- The Zachman framework in this section has offered a tool for showing Valuation department structures, business mission and its objectives. The framework modelling process featured by the case study data has exposed the primary structures and how these determine its business processes.

- The dimension structure of the Zachman framework has managed to give a complete analysis and documentation of Valuation spatial information system. The descriptions of dimensions have focused on how the current spatial information system of Valuation department operates.

- The framework through its strategy dimension revealed that spatial information system of Valuation department is not able to fulfil the needs of all users.

- The inventory list applied in the case of documenting spatial information system of Valuation department has displayed a lot of detailed than anticipated. This is a result of the need to not only provide a list but to describe each element. However, the list leads to a large documentation which requires a lot of time.

- The framework has proved to be a useful gathering information tool which can feeds into the tools of other structured methodologies. The list analysis of the spatial information system in this case is a crucial stage to continue to graphic analysis using SDLC and SSADM so as to acquire a better understanding of how the system operates and also to diagnose problems with information flows.

8.3. Analysis of Valuation Spatial Information System using System Development Life Cycle (SDLC)

Following a narrative description of Valuation Department in chapter 6 and narrative description of ISIS in chapter 7, this section analyses the spatial information system of Valuation department using SDLC motivated in chapter 4 and chapter 5. SDLC is as a set of consecutive skills that assist the documenting and investigation of the present system to create requirements that describe the functional and technical features of the new system (see section 2.4.3). This facilitates inquiry into the analysis of Valuation spatial information system by documenting its business processes in order to understand how the system operates and what it does.

The four phases of SDLC is followed in order to define a well-structured problem situation with well-defined problems and clear requirements of Valuation system as portrayed in the Valuation narrative (chapter 6). The analysis offers a perception into the proficiency of Valuation department to resolve the issues identified in the Valuation system as to improve the current situation. The SDLC processing of Valuation does not aim to enhance the system but adds to the understanding of the Valuation spatial information system. Enhancement or interference is beyond the scope of this thesis.

8.3.1 Spatial information system of Valuation Department in SDLC Phases

Problem definition

The problem definition component falls under the first step of planning phase in the SDLC. Its task is to define the system objective and problems as well as to define the system boundary and their interaction with environment. It would be difficult to provide a solution to a problem that was not fully defined. The new implemented system, Integrated Spatial Information System (ISIS) forms the spatial information system of Valuation department. This is a system where the six business units create and trigger the property information to be sent to relevant business units in the property value chain (see section 7.5.2). This spatial information system (ISIS) of Valuation department has well-defined objectives with clear requirements of how the system should operate (see section 7.2).

Definition of system objective and problem

The objective of ISIS as described in section 7.2 is to bring property data, processes and information systems together through property value chain. Besides meeting this objective,

ISIS is not able to fully meet the needs of the spatial information of the Valuation department since it still provides inaccurate, incomplete and wrong data to the department. As a result of this problem, Valuation department is also not able to meet its main objectives of accurately assigning the correct market value to the public properties (see section 6.7).

Definition of System Boundary

The Spatial information system in the Valuation department is under the four sections of Valuation department and the six departments within the City of Cape Town and outside. The four sections have been depicted in the organisational structure in (section 6.4.3; figure 6.3) as follows:

- Valuation operations
- Valuation surveys and quality
- Valuation data and business systems
- Valuation business environment

Valuation department achieve its spatial information system by collaborating with the various departments within the City of Cape Town and outside the City. It interacts with other departments in order to achieve its role of accurately applying values to properties. These departments are described in section 6.6 as follows:

- ISIS:
- Deeds Office:
- Revenue:
- Planning and Build Development Management
- Public

Feasibility Study

Feasibility study is the second activity under the first phase of SDLC. It tests whether the proposed system functions in such a way that the users become satisfied with its operations. It test the feasibility based on three activities such as technical, economic and organisational (see chapter 2). Although these feasibilities have been answered before the implementation phase of ISIS, the Valuation users of ISIS are not fully satisfied with ISIS due to several reasons associated with these feasibilities. Table 8.6 demonstrates the technical, economic and operational feasibility in the case of spatial information system of Valuation department.

Table 8.6 Feasibility study of ISIS

Feasibility study	**Spatial Information Systems of Valuation Department**
Technical	System Application & Products (SAP) help desk. All the technical queries experienced with the ISIS LUM are sent to SAP to be solved (see section 7.8). The property value chain (PVC) super user group is formed to deal with data and business process issues of ISIS. (see section 7.8) Application Support such as GIS, GRM, GiMAP, SAP and IPOS are setup to support the various interconnect interfaces (see section 7.8). There was supposed to be an automated interface between GRM and SAP LUM to transfer property values to ISU (Revenue billing system) (see section 7.9) but there is currently no interface (see sections, 6.8.3) Valuation department does not have reliable interface to process the information that is being provided by ISIS LUM into GRM (see section 6.8.3). Communication breakdown between the systems occurs which leads to records generated not being sent to GRM. (See section 6.8.3) There is sometimes bug in ISIS which leads to the wrong information being sent from ISIS to Valuation department. (See section 6.8.3)

Economic	The main ISIS sponsor is the Executive Director of Strategy and Planning (see section 1.2.). However, Valuation department ran out of budget for providing the interface between the GRM and ISIS to ISU (see section 6.8.3)
Organisational	The training curriculum for ISIS was produced. See section 7.5. However, ISIS is not fully utilized in the Valuation department due to lack of training. (See section 7.12.1). ISIS LUM is complicated and not user friendly like Land Information System (LIS) even to staff who receive training (see section 7.12.1). ISIS LUM provides the users with limited data and this discourages the users to use the system (See section 7.12.1). ISIS LUM is not the source of information to all sections in the Valuation department; therefore it is not always necessary for the Valuation users to use it all times (see section 7.12.1) ISIS LUM is fully utilized by the Corporate Data section in the Valuation department as the reliable source of information; however it provides them with missing, incorrect and incomplete data for them to process into GRM system (see section 7.12.1)

	ISIS LUM is not accepted by all users as it is recently implemented in the department. (see section 7.12.1)

System Analysis Phase

System analysis is the second step in the SDLC. As mentioned in chapter 2, it involves investigating the present system and documenting its specifications. The specification contains the understanding of HOW the present system operates and WHAT it does. In order to develop a thorough understanding of how the spatial information system of Valuation department operates and what it does; the two activities of system analysis phase; gather information and define information system requirements is followed in order to collect large amount of data so as to facilitate the understanding of the Valuation spatial information system operations.

Gathering Information

The data gathered from the Valuation system users involves the processes/function, information/data, the software and hardware, communications/interface used in the spatial information system of Valuation. The clients/stakeholders of the system as well as the output produced by each section are also listed. This information was gathered through conducting interviews with key informants and through observations. These are documented according to the four functional sections of Valuation department as described in sections 6.5.1- 6.5.5. Inside each section of the Valuation department, each section performs its own processes/functions however; some of these sections are related to each other in terms of processes. Within these four sections, each one is dealing with both spatial and non-spatial data.

Defining Information System Requirements

Defining information system requirements is another activity of system analysis phase under SDLC. As mentioned in chapter 2, this activity is focusing on incorporating the user requirements and processes in a way that allows a system to support various users or

functions in similar areas. In the case of spatial information system of Valuation department, the technical and functional system requirements of the users in the Valuation department are collected and documented. During the data collection, it was identified that these sections have different system requirements that they need to perform their functions effectively. A set of systems that must provide the information for each information requirements is listed in table 8.7.

Table 8.7 Systems-Information Requirement Matrix

Systems Providing Information	**Information Requirements**
ISIS; Land Use Management (LUM)	Provide Various property transactions: (see section 6.6.1) Registered leases, excisions & servitudes are not currently being sent to Valuation (see section 7.12.1)
Land Information System (LIS)	Old LIS system; used as a reference system to check and confirm the lineage of properties as LUM is not user friendly. (See section 7.12.1)
Tranerven (Automated Interface)	Processes all property transactions (see section 6.6.1). Not all property transactions are being successfully processed into GRM due to interface issues as mentioned in section 6.8.3
Government Revenue Management (GRM)	Maintains and manages various property types mentioned in section 6.5.1, table 6.2); Not all these properties are available on GRM; this is due to unreliable interface used by the Valuation department, as well as ISIS which is providing incomplete and wrong data to GRM. (See sections 6.8.3 & 7.12.1).
Corporate ISIS Viewer	Cadastral data and aerial photographs showing, property information details spatially; location, extent, servitudes, physical address, ownerships ward, council and pictometry.

	Servitudes data is currently not available in ISIS Viewer but was available in City Map Lite (see section 7.12.1)
Valuation Business Viewer	All property sales categorised according to the years and valuation layer.
Windeed (Deeds Office system)	Deeds registrations; ownership details (first name & last name, identity number, business partner). The system is not accessible to all Property Research Team who requires it for their daily operation (See sections 6.8.2 & 7.12.1).
Surveyor General system	Survey diagrams and general plans showing extent of properties and land status change (e.g. subdivisions & consolidations)

System Design Phase

The system design phase is the third phase of SDLC. It defines WHAT the proposed system will do and HOW it will work and how the problem will be solved. In the case of this research, the aim is not to solve the problem but to understand how the system works. This phase will therefore be analysed in the context of spatial information system of Valuation department to see how the system design phase was applied. Table 8.8 summarizes ISIS design in SDLC design phase.

Table 8.8 ISIS design

Major activities in the Design Phase Involves	**ISIS design Involves**
Database design module	Property data is stored and managed in two separate but real-time integrated databases; ISIS Master Geo-database & SAP_LUM/RE-FIX (see section 7.4).

Integrate the network	Bandwidth problem is taken into consideration; Information System &Technology (IS&T) provide support to services and networks and back-ups in terms of daily operations for the ISIS solution (see section 7.4)
Application architecture	The attribute database is application dependent (SAP LUM) and the spatial database is dependent on the ESRI platform (see section 7.4).
Design System & user interface	Interfaces between systems should be automated and conforms to the City standards (see section 7.4). However, Valuation interface is not designed as it was originally proposed. There is no automated interface between GRM and ISIS LUM (see section 6.8.3)

Implementation Phase

This is the fourth phase of SDLC. As indicated in chapter 2, the phase aims at achieving a reliable, well-working information system. It ensures that the users are all trained and that the business is gaining from using the system as anticipated. Valuation users do not all perceive ISIS as a reliable and well working system due to many problems they identified during the interviews (see sections 6.8.1- 6.8.3 & 7.12.1). The phase is made up of these major activities as mentioned in chapter 2. Table 8.9 summarizes ISIS implementation in SDLC implementation phase.

Table 8.9 ISIS implementation Phase

Major Activities of Implementation phase	**ISIS implementation phase**
System testing and evaluation	End to end testing was performed; scenarios that are applicable to Valuations department were tested (see section 7.6).
Convert data	ISIS go-live checks were established and data conversion forms part of the checks. (See section 7.5).After converting data, ownership data was migrated wrongly (see sections 6.8.2 & 7.12.1).

Train users	End user training was conducted in three phases (see section 7.5) However, Valuation ISIS users were not adequately trained and others did not receive training at all (see section 7.12.1).

A summary of the Analysis of the Spatial Information System of Valuation Revealed through SDLC

- SDLC seems to be a very useful technique to facilitate the documenting and analysis of spatial information system in the Valuation department. This facilitated an understanding of how the spatial information system of Valuation department works and what it does. It enabled understanding of a well-structured problem with a well-defined problem and clear requirements situations seen from multiple perspectives.

- The SDLC method allows the identification of business issues through the four phases. It facilitates the identification of system problems in all the phases in the case of the spatial information system of the Valuation department. These identified problems will be used to propose a solution design to improve the system.

- SDLC is useful in the case of the Valuation spatial information system since through analysis phase, an in-depth investigation of the current Valuation system functions, existing information infrastructure, data/information of each section in the Valuation department were determined.
- SDLC has been able to define the system boundary of Valuation department and its interaction with other systems within the City of Cape Town and outside the city.

- SDLC tools of analysis have revealed a number of business issues which have not been revealed using BSP. SDLC through its planning and implementation phase has revealed that Valuation ISIS users lack training with the system (see Tables 8.6 & 8.9). This research thus supports the use of SDLC in spatial information system research.

- SDLC tools do not allow enough participation of the users in all the phases analysed, only technical approach has been followed.

8.4. Analysis of the Spatial Information System of Valuation Department using Structured System Analysis & Design (SSADM)

This section analyses the spatial information system of Valuation department using Structured System Analysis & Design. The SSADM techniques such as data flow diagrams and data dictionary are useful modelling technique to document and describe the spatial information systems of the department. The main strengths of these techniques were seen in their ability to determine information system viability (see section 4.3.1). These techniques are used to model the business processes of the spatial information system in the Valuation department.

8.5. Modelling the Valuation Spatial Information System using SSADM

The spatial information system of Valuation department as presented in the narrative (Chapter 6 & 7) is analysed using SSADM. SSADM has been motivated in sections 2.4.4, 4.3.1 and 5.5.1 and identified as a useful tool for modelling the spatial information system of Valuation department (see section 5.5.1). The data flow diagram (DFD) or context diagram that is used to define the current system of spatial information in the Valuation department did not define the Valuation system in detail (section 6.6; figure 6.4.). This is because of the level at which this DFD is being represented.

However, the business processes of each section in the Valuation department presented in section 6.6.1 have shown the main processes in each section and broke down those processes into smaller process to get a better understanding of the system, the data flowing and data stores between those processes are demonstrated as well. The Zachman framework and SDLC have also documented the processes in the spatial information system of Valuation department but the data flowing and data stores between those processes are not demonstrated. SSADM is therefore a suitable tool to document these business processes as presented in section 6.6.1 so that it can provide system viability and be able to diagnose the problems areas in the data flow.

8.5.1 Modelling Valuation Department Processes using Top level diagram

The processes of Valuation are documented using the top level diagram which is one of the system diagram techniques of SSADM. The top level diagram in figure 6.5 section 6.6.1 is used to zoom into the sub-system of Valuation department and define the major processes. It is made up of processes represented by the rounded rectangles, the data flows shown by arrows and external entities represented by rectangles. The data flow in figure 6.5 shows how information is transmitted around in the Valuation department at high level. The processes that take place in the department are divided into five processes of the department as described in section 6.5. Each section interacts with one another in terms of receiving and sending data. The interaction of data flow between the section and external entities is also illustrated in figure 6.5.

8.5.2 Modelling Valuation Department Processes using Data dictionary

The descriptions of each process that take place in the Valuation department and its respective sections in the top level diagram in figure 6.5 are elaborated in terms of the data dictionary to describe the real world situation of spatial information system of Valuation. In the case of spatial information systems the meanings of and the relationship between the departments processes are described as to understand the processes. Table 8.10 models the Valuation Department processes using data dictionary as described in section 6.6.1.

Table 8.10 Data dictionary for Valuation Department Process

Valuation Department Processes	Data dictionary
1. Corporate Valuation Data	responsible for receiving data from the SAP LUM/ISIS and integrating that into GRM
2. Data Collection (Field Survey)	It is initiated when all owner details are captured on SAP LUM/ISIS and is preceded by Corporate Data Valuation process.
3. CAMA	Assigns values to properties. It is preceded by the data collection process.
4. Valuation Planning	This process concludes the property valuation chain. It occurs when all pertinent data has been verified and captured onto the system.

5. Objections	The objections are treated and processed as per legislative requirements.
6. Business Environment	It conducts property investigation through Corporate Valuation Data process

8.5.3 Modelling Valuation Department Sections using High Level Diagram

The processes of each section in the Valuation department as described in section 6.6.1 are further broken down from the top level diagram in figure 6.5 up to high level. Figures 6.6-6.11 show high level diagrams for the five processes of Valuation department. This shows the processes and the data flow between the processes as well as the data stores between the processes. The data store shows the data that is created by a process and stored through a process. It is represented by open rectangles as shown in the figures 6.6-6.11.

8.5.4 Modelling Valuation Department Sections Processes using Data dictionary

The descriptions of each process that takes place in the five sections in the high level diagram in figures 6.6-6.11 are elaborated in terms of the data dictionary to describe the real situation of spatial information system. The meanings of and the relationship between the processes are described as to understand the processes. The data dictionary for the processes are modelled in table 8.11 below as described in section 6.6.1 and demonstrated in figures 6.6.-6.11.

Table 8.11 Data dictionary for Valuation Department Sections Processes

Valuation Department Sections Processes	**Processes**	**Data Dictionary**
1.Corporate Valuation Data	1.1 Deeds registration downloads	Uploads the deeds file into ISIS LUM
	1.2 Staging Server	Deeds file is checked and manually copied from the inbox set up to receive the deeds file to staging server.
	1.3 Technical Checks	The deeds file is processed in order to ensure that the file layout format is correct.

	1.4 Validation process	The cleaned file is automatically validated against business rules
	1.5 ISIS LUM	This is an integrated system where all the six business units send and receive their data
	1.6 Verification	Transactions received from ISIS/LUM are verified and checked for data error
	1.7 Data Base update	Transactions processed through interface from LUM are captured & maintained.
	1.8 Base data confirmation	Data that is captured into the GRM system from LUM is placed in workflow to be confirmed
2. Data Collection	2.1 Data Collection Planning	It is triggered by Corporate Data process.
	2.2 Field Resource Balancing	Work is allocated to data collection team
	2.3 Field Data Collection	The Teams go into the field to capture data.
	2.4 Remote Data Collect	The team collect data using aerial imagery.
	2.5 Data Assurance Control	The processed data on GRM is checked if it is correctly captured and all errors are fixed.
3.CAMA	3.1 Data analysis	It is triggered when receiving notification from data collection process.
	3.2 Model Application	A model is applied to properties
	3.3 Model Error Root Cause	The decision is made regarding the correctness based on the results of the

		analysis.
	3.4 Data Base GRM	The model values are posted to the GRM database.
4.Valuation Planning	4.1 Manual Valuation	This is triggered by CAMA processes. The sales report is printed.
	4.2.Valuation Acceptance	A physical review is conducted by Valuers.
	4.3.Valuer Data Capture	The results of the value review are captured on GRM.
	4.4 Valuer Data Validation	The check is done to ensure that the results are correct.
	4.5 Valuer Correct Capture	The value review error identified in the data validation is corrected and captured on the system.
	4.6 Application of Exclusion	This is a process whereby rules are applied to the final review value results.
	4.7 Process Roll & Publish	A work item is sent to the Revenue department as well as SAPLUM for billing purposes.
5.Objections	5.1 Analysis objection forms	The property owners complete the forms and sent them to Valuation objection process via fax, post or handed them physically.
	5.2 Update objection forms	The objection form is updated with the valuation reference number
	5.3 Scan & index objection	The objection form is scanned and captured onto GRM.
	5.4 Update workflow status	The workflow status is updated and flagged on GRM
	5.5 Send acknowledgement letter	The letters of acknowledgement is created and sends to all the objectors.

	5.6 Prepare & submit Valuers decision form	The objection decision form is scanned and indexed.
	5.7 Submit objection decision form	The objection decision form with amended values is submitted to valuation decision board
	5.8 Database update GRM	The decision values and reasons for valuers decision are captured onto GRM system.
6.Business Environment	6.1 SAP Notification C3 creation	C3 notifications are created in respect of direct correspondence received.
	6.2 Notification Administration	It deals with administration of notifications created on the system SAP
	6.3 Property investigations	The investigation is conducted regarding the C3 notification.
	6.4 Results Excercusions	Team sends the results to the owner of property to inform them about the outcome of the investigations
	6.5 Closing of C3 Notifications	Team closes the C3 notification if investigations have been concluded.

8.6 Analysing Spatial Information System of Valuation Department using SSADM System Diagram

This section is preceded and informed by the previous sections 8.5.1-8.5.4, which modelled the Valuation business processes in terms of data flows diagrams (Top level & high level) and data dictionary. Figure 8.1 illustrate the relationships between all the DFD used to model the spatial information system of Valuation department as demonstrated in section 6.6.1 and modelled in sections 8.5.1- 8.5.4. This is a decomposition diagram that shows how the DFD in figures 6.5- 6.11 connect with one another.

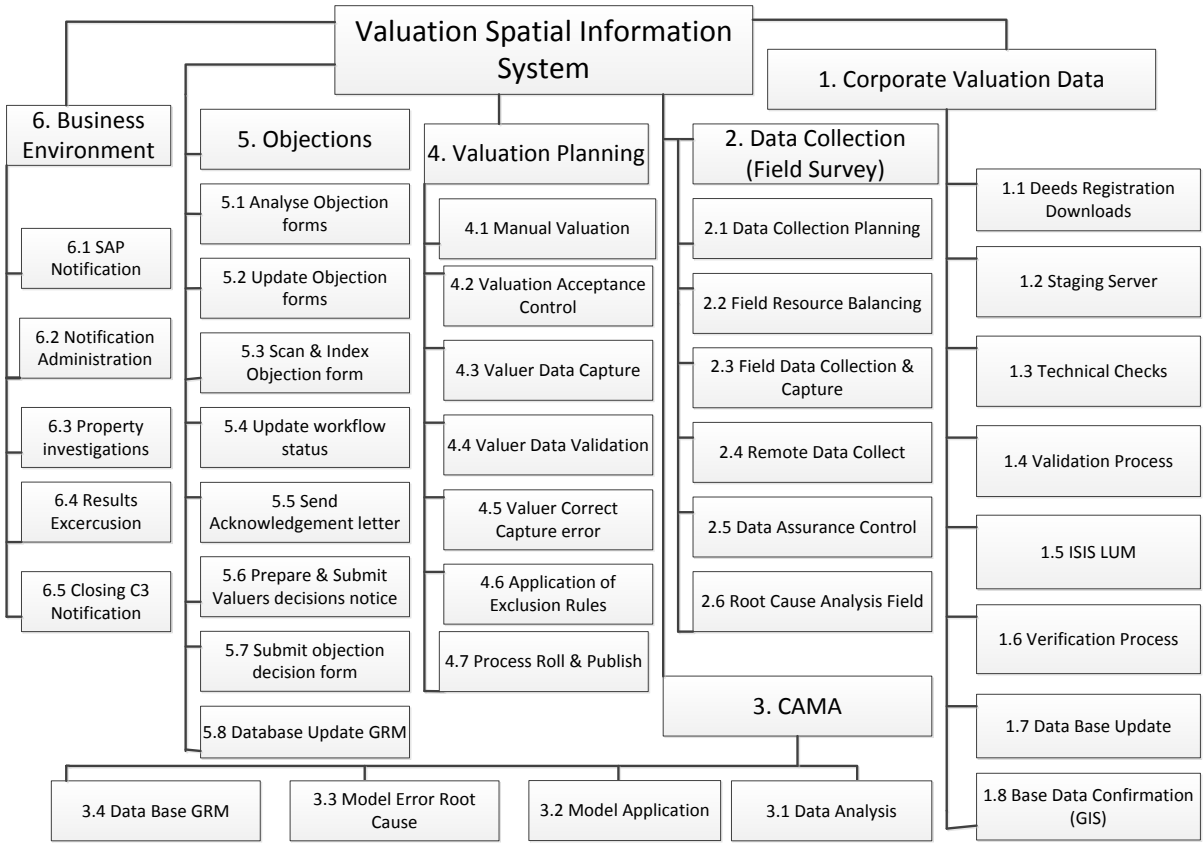


Figure 8.1 Decomposition diagram for Valuation spatial Information system

In order to analyse the information flows of the spatial information system of Valuation Department, the data flow diagram (DFD) which is a powerful technique of SSADM is used in this case to identify problem areas with information flows between the processes in the six processes of the Valuation department as decomposed in figure 8.1. DFD is naturally good for evaluating information flows but does not in itself capture used opinion of the system. In order to establish figure 8.2 other tools such as questionnaires and interviews which are not necessarily part of the SSADM tools/techniques were used (see section 7.13).

Figure 7.14 demonstrates the system diagram with the data flows as demonstrated in section 7.13. There are ellipses with different colours on the data flows which show the data quality that is flowing from one processes to another around Valuation system Processes. As stated in section 7.13, each colour has a meaning in terms of describing the information flow quality that flows from one process to another.

8.6.1 Analysing Corporate Valuation Data Process using system diagram

1. Corporate Valuation Data: Figure 7.14 has depicted the data issues flowing from ISIS to Corporate Data process and vice versa. The diagram correlates with the interview results (See sections 7.12 & 6.8.1) which revealed that, data such as subdivision, consolidation, sectional title properties, ownership details and building plans comes through from ISIS with missing, inaccurate, incomplete and incorrect data and these are represented in red and orange colour in figure 7.14. Registered leases and excision are also shown in red and corresponds with the interview results which stated that this information is not flowing into the corporate data process as it was supposed to be (see sections 7.12 & 6.8.1). Orange colour as explained in section 7.13 means information can be used but needs to be modified. This is the case in the corporate data process where all these data flows shown in orange are being loaded into GRM but investigated at the later stage when property queries are being received regarding those properties. Property values are also flowing from corporate data to ISIS manually (see section 6.8.2) whereas they are supposed to be automated and this are shown in orange. Pending sales, rezoning and departure, street addresses, deeds registration are shown in green colour which means there are no data errors reported.

8.6.2 Analysing Data Collection Process using system diagram

2. Data Collection: As seen from figure 7.14 most of the data flowing into Data Collection process from Corporate Data process are represented in red and orange colour which means that there are errors with data as stated in the interview and as described in section 7.13. This data issues proves what has been said in the interview that data is not satisfying on GRM for Valuation staff to perform their daily duties (section 7.12). This is also proven by the questionnaires results where the response results on the ISIS User Satisfaction showed the lower response with mean 3.73 for the whole section (see section 7.11.5.).

Red colour shows that data such as Subdivisions, consolidations, ST properties, building plans send to Data Collection process have data errors such as wrong legal status (registration status). There are also properties with incorrect land extent that comes to this process. Some of these properties have wrong parcel status; they appear as “Active” whereas they are supposed to be “Dead” (see section 7.12). Building plans depicted in orange in figure 7.14 mean that they are being sent to Data Collection not in real time as expected (see section 7.12).

8.6.3 Analysing CAMA Process using system diagram

3. **CAMA:** When looking at the data that flows between CAMA processes from other processes, it can be seen that CAMA is receiving, ST properties and residential properties shown in (orange) from Data Collection process and it is also receiving neighbourhoods and land extent with (orange and red) from Corporate Data. This means that there is something wrong with the data that is being received by CAMA as it was mentioned in the interview that the quality of data is not correct for them to use (see section 7.12). There is also a data gap when it comes to CAMA process. It was mentioned that, data that they are currently receiving meet their demands for model application, however they recommended to have other data type flowing to their process such as census data (socio-economic data), and proximity to amenities (see section 7.12) which are currently not available.

8.6.4 Analysing Valuation Planning Process using system diagram

4. Valuation Planning: The data issues in the Valuation Planning process has been demonstrated in figure 7.14. Red shows that there is data error with residential, ST, None residential properties and land extent flowing into Valuation Planning. Valuation Roll is being sent to ISIS and Revenue manually whereas it was supposed to be automated which results in delay in service delivery since the manual intervention has to be made (see section 6.8.1). The land extent is also shown in red colour flowing from Valuation Planning to Corporate Data process.

Valuation objections forms and appeal decision values with red colour means that there is an error with data from Corporate Data that leads to objections application. This occurs as results of properties being overvalued, due to properties with servitudes, wrong land extent and wrong legal/parcel status; registrations of properties (see section 7.12). There is also a data gap of servitudes which is not demonstrated in figure 7.14. This was stated in the interview that Valuation Planning process is not receiving this kind of data whereas it was supposed to receive (see section 7.12).

8.6.5 Analysing Objection Process using system diagram

5. Objection: This process as depicted in figure 7.14 sent data represented in red such as ownership, street addresses, and land extents queries to Corporate Data process for it to rectify such data. This is data associated with Valuation roll and this process is normally notified by the public in terms of objection applications.

8.6.6 Analysing Business Environment Process using system diagram

6. Business Environment: the process as depicted in figure 7.14 sends data shown in red such as valuation queries, ownership queries and land extent queries to corporate data for it to rectify. The same data is also being sent by the Public to this process to correct. This means that the public is also realizing the discrepancy with data that they receive from Valuation department.

A summary of the Analysis of the Spatial Information System of Valuation department Revealed through Structured System Analysis & Design Method SSADM

- The SSADM in this section has offered a tool for modelling the Valuation Department processes and evaluate its design in line with integrated system. The SSADM modelling process featured by the case study has exposed the basic processes of the Valuation department.

- SSADM has been able to divide the spatial information system of Valuation department into smaller parts and defines the order and the relationships between activities and processes. This facilitates an in-depth understanding of how the system works.

- The data flow diagrams (Figures 6.5-6.11) seem a very useful tool to determine the means in which data change from one process to another, the data store areas, the entities that transfer data into the system and the paths through data flows. This enables understanding of the relationships between the various processes within the spatial information system of Valuation Department.

- SSADM has been a useful model to complement with BSP in this case since it used data gathered by BSP. As a result, the correlation between the system diagrams and questionnaires was achieved and the problem areas in the information flows were identified.

- The system diagram has managed to locate the problem areas with data flowing in between the six processes in the Valuation department. The data gap in the information flows has also been identified. The system diagram has been a useful tool

in this case since the proposed solution model could be done to combat these data gaps.

- SSADM has proven to be self-documenting in the analysis of this study. This gives guidelines of what should happen with this documentation.

- SSADM tools of analysis have discovered a number of data issues that were not revealed by analysis tools such as BSP. This study therefore accepts supports the use of SSADM in spatial information system research.

8.7 Triangulation of Spatial Information Systems of Valuation Department

The analysis tools of BSP, SDLC and SSADM have looked at various aspects of Valuation spatial information systems effectiveness from different angles. The results of the analysis triangulate and complement each other with respect to the Valuation spatial information system. However, each method/techniques used in this study has both strengths and weakness in viewing the system. Table 8.12 illustrate the strengths and weakness of the methods used.

Table 8.12 The strengths and weakness of the methods used.

Methods/Techniques	Strengths	Weakness
SSADM	The DFD and data dictionary technique used in this study were able to determine the Valuation spatial information system viability.	The method tends to stress on technical aspects and overlooks the human, social and organisational aspects.
	DFD has been powerful for diagnosing information flows bottleneck in the spatial information system.	However, DFD does not in itself capture used opinion of the system.
	SSADM is easily transferable and does not require very special skills to be practiced in the system.	SSADM emphasizes on the analysis of the system and its documentation and this is very time consuming like in this case where the Valuation spatial information system is large.

		SSADM requires the use of diagram to show all relevant data flows and this can become unclear, as all information flows has to be included.
BSP/Zachman framework	The Zachman framework has been able to offer an understanding into the content and shortcomings of SDLC & SSADM. Thus BSP is very powerful as a data gathering technique as it involves interviews with the system users. It is able to deal with soft system aspects.	BSP requires detailed information and this leads to producing large documentation which is time consuming. In this case, the data set that is used by the department had to be described in detail (see section 8.2.1)
	BSP pays much attention to the management, change and validation processes during the analysis of the system.	BSP does not permit a free choice of techniques. It forces documentation even when not necessary.
SDLC	The method is able to give the users an opportunity to review progress at the end of each phase. In the case under study all progress with ISIS was reviewed under each phase (see section 8.3.1)	The model does not allow enough participation of the users and this leads to the method not being able to meet the needs of management.
	SDLC provides guidelines over all phases and it is self-documenting (see section 8.3.1)	SDLC is limited in the view of a system. It is only concerned with the technical aspects of the system ignoring the human aspects
	It emphasizes on the analysis of user needs and provides a better understanding of business issues.	

	It permits free choice of techniques and tools to evaluate the system.	

The methods/tools used in this chapter found that the spatial information system of the Valuation department is not effective enough and thus, unable to fulfil the needs of all users. For example, BSP analysis through its strategy dimensions revealed that ISIS is not able to meet the needs of all users. SSADM and SDLC tools were able to diagnose the problems with information flows and business issues. SDLC tools have revealed a lot of business issues; that the spatial information system of the department is not designed and implemented as it was originally proposed. It has also revealed that ISIS users in the department did not receive training to be able to use the system effectively.

SSADM tools found that the information flows between the processes in the various sections of the Valuation department have missing, inaccurate, incorrect and incomplete data as well as data gaps that is required to enhance the Valuation business. Since the results from a variety of analytical tools converge, construct validity is strengthened and rigour is achieved as has been motivated in chapter 5. In addition the results of the analysis shows that methodological triangulation in this research is achieved.

8.8 Conclusions

Tools for research are useful in the process of analysing the spatial information system. The single case study strategy is found appropriate in reviewing and developing inclusive explanation of the spatial information system in the Valuation department. This supplied the information with which to observe the Valuation from a system perception and model it expending the tools of BSP, SDLC and SSADM.

In this section knowledge and understanding of the spatial information system has been gained through the use of these methodologies. Application of mixed method approach to the investigation of the study has also contributed to theory in the spatial information system.

A further longitudinal study of the spatial information system in the Valuation department of the City of Cape Town will complement to the body of knowledge on integrated spatial information systems in general. The following chapter analyse the effectiveness of the current

spatial information system of Valuation department, ISIS using integrated success models ISM.

Chapter 9. Analysing the Effectiveness of ISIS implementation in the Valuation Department

9.1 Introduction

This chapter evaluate the effectiveness of ISIS implementation in the Valuation department using the Integrated Success Model (ISM) which comprises of DeLone & McLean Information Success updated model (D&M) IS and Technology Acceptance Model (TAM) The five dimensions from D&M IS are adopted as well as the two variables from TAM based on their suitability in addressing the research questions.

The ISIS narrative in chapter 7 facilitates the evaluation of ISIS effectiveness in the Valuation department using Integrated Success Model ISM. The SSADM, SDLC and BSP framework has analysed how the current system in the Valuation department work. The ISM is used to evaluate the ISIS performance and its efficiency to the ISIS Users. In order to apply these models, the study utilizes two structured questionnaires to collect data, thus the Users of the ISIS and the Managers in the Valuation department. The questionnaires collected data about variables such as the Information Quality, System Quality, Service Quality, Perceived Ease of Use, Perceived Usefulness, User Satisfaction, and Individual and organizational Impact variables (i.e. Net Benefits) (see section 7.11.2).

9.2. Modelling ISIS using the five dimension of D&M IS

The five dimensions of D&M IS are used to evaluate the ISIS. These dimensions have been motivated in sections 3.1.5, 4.3.3 and 5.8.2 and have been identified suitable dimensions to evaluate the ISIS success in terms of the effectiveness and quality of the system (see section 5.8.2). This section presents these dimensions in the context of ISIS. Table 9.1 illustrates the D&M IS five dimensions.

Table 9.1 D&M IS dimensions described

D&M IS Dimensions	Description in the Context of ISIS
System quality	It assesses the performance features of the ISIS LUM (Land Use Management System). (See section 7.11.2).
Information quality	It focuses on the desirable characteristics of ISIS LUM system output. (See section 7.11.2).
Service quality	This refers to the support that the users of the ISIS LUM receive from ISIS ERP support. (See section 7.11.2).
User satisfaction	This measures the overall satisfactions that ISIS Users gain from the use of ISIS LUM and support services. (See section 7.11.2).
Net benefits (individual & organizational impact	It measures the extent to which ISIS is contributing to the Valuation staff and organizations as perceived by the Management in the Valuation Department. (See section 7.11.2)

9.3. Modelling ISIS using TAM Variables

The section presents the two variables of TAM such as Perceived ease of use and perceived usefulness in the context of ISIS. The two variables have been motivated in sections, 3.1.4, 4.3.2, & 5.8.2 and are found effective to assess the user perception on the usefulness and ease of use of ISIS. Table 9.2 demonstrates the two variables in ISIS.

Table 9.2 Description of TAM Variables

Variables	Description in the Context of ISIS
Perceived ease of use	This measure the amount and way in which the users use the abilities of ISIS LUM. (see section 7.11.2)
Perceived Usefulness	This is described as an individual's perception that use of technology will improve performance (see section 7.11.2)

9.4 Analysing ISIS using Integrated Success Model ISM

This section is informed by sections 9.2 & 9.3. It analyses the effectiveness of ISIS using the ISM which combines both the D&M IS dimensions and TAM variables as mentioned in section 9.1. This integrative model has been motivated in sections 3.3.3, 4.3.3 & 5.8.2 and was found suitable since it provides for a comprehensive understanding of the impact of information systems such as ISIS and gives a better explanation on user performance. The combination of the two models strengthens rigour in the information systems research hence appropriate for this research (see section 5.8.2). As mentioned in section 7.11.4, ISIS is analysed based on the survey questionnaires conducted in the Valuation department. The results of the questionnaires from ISIS users and Valuation Management were analysed using basic descriptive statistics. Correlation methods were further applied to define the correlation between the independent and dependent dimensions described in section 7.11.2

9.4.1 Descriptive Basic Statistics Analysis

The mean, mode and standard deviation of each of the measured variables as mentioned in sections 7.11.4 were calculated. The analysis on the ISIS User questionnaires was conducted in two ways (see section 7.11.4). The results of the ISIS users are demonstrated in table 7.4, the Management Users in table 7.5 and the Valuation sections in figure 7.4.

Analysing ISIS Information quality, Service quality & System Quality

As indicated in (table 7.4; sections 7.11.4) and based on the results (see section 7.11.5), it appears that the overall ISIS users in the department are somehow satisfied with the output information, the system performance and the system support that they are receiving from ISIS (see section 7.11.2).

Analysing ISIS Perceived Ease of Use and Perceived Usefulness

It appears that ISIS is being fairly utilized in the department and it is somehow improving the user's performance based on the results (see sections 7.11.2 & 7.11.5). On the other hand it seems that given the perceptions of users about the ease of use and usefulness of the system, it seems that the ISIS users in the Valuation department are not using ISIS at 100% based on the results. One of the elements that were measured under perceived ease of use of ISIS was ease of use of ISIS (see section 7.11.2). The results on this shows low score which might mean that performing some functions with ISIS was complex which according to the theoretical framework can affect usage. Low usage of ISIS could also make sense from the researcher perspective since ISIS is a newly implemented system in the department. Therefore, not all the staff in the department would quickly make full use of it. It takes time for the newly implemented system to be fully utilized after its implementation.

Analysing ISIS User Satisfaction

User satisfaction is a major dimension which measures the overall satisfaction that the Users gain from ISIS. Therefore all these dimensions adopted in assessing ISIS affect the overall satisfaction of the ISIS users. This is because it has been shown in the model that the system quality, service quality and information quality together and independently impact the user satisfaction (sections 3.3.1 & 7.11.7). However it appears like their overall satisfaction with the ISIS implementation in the department is not satisfactory and their requirements are not met as they had expected based on the results illustrated in section 7.11.5. As indicated in section 7.11.5, the modal value of this dimension according to the stated interpretation in section 7.11.4 is low. This shows that the Valuation ISIS users are not satisfied with the overall ISIS implementation in the department. It is stated by Steenis (2011) that the system is observed by its user as a "poor" system if the system does not satisfy them. "Good" information system that the users perceived as a "poor" system is then a poor system (See section 4.3.2,

Analysing ISIS Net Benefits

Net benefits was used to measure the degree at which ISIS is contributing to the achievement of Valuation staff and organizations as perceived by the Management in the Valuation Department (see section 7.11.2). Based on the results in section 7.11.5 the net benefits experienced by the Valuation department are supposed to have a positive impact on the usage

of ISIS as well as the user satisfaction with the system (DeLone & McLean, 2002). However, the user's results on the user satisfaction did not indicate the full satisfaction of the users with ISIS (see table 7.6). The findings (see section 7.11.5) on this dimension implies that the management support such as providing training to the ISIS users in the department was not fully provided, Management still lack support to their staff when it comes to ISIS operations.

9.4.2 Correlation Analysis

As indicated in sections 7.11.3 ISIS user questionnaires were further analysed using correlation coefficient matrix. Figures 9.1 & 9.2 summarises the correlation coefficient results obtained in figures 7.5 to 7.13 in section 7.11.7.

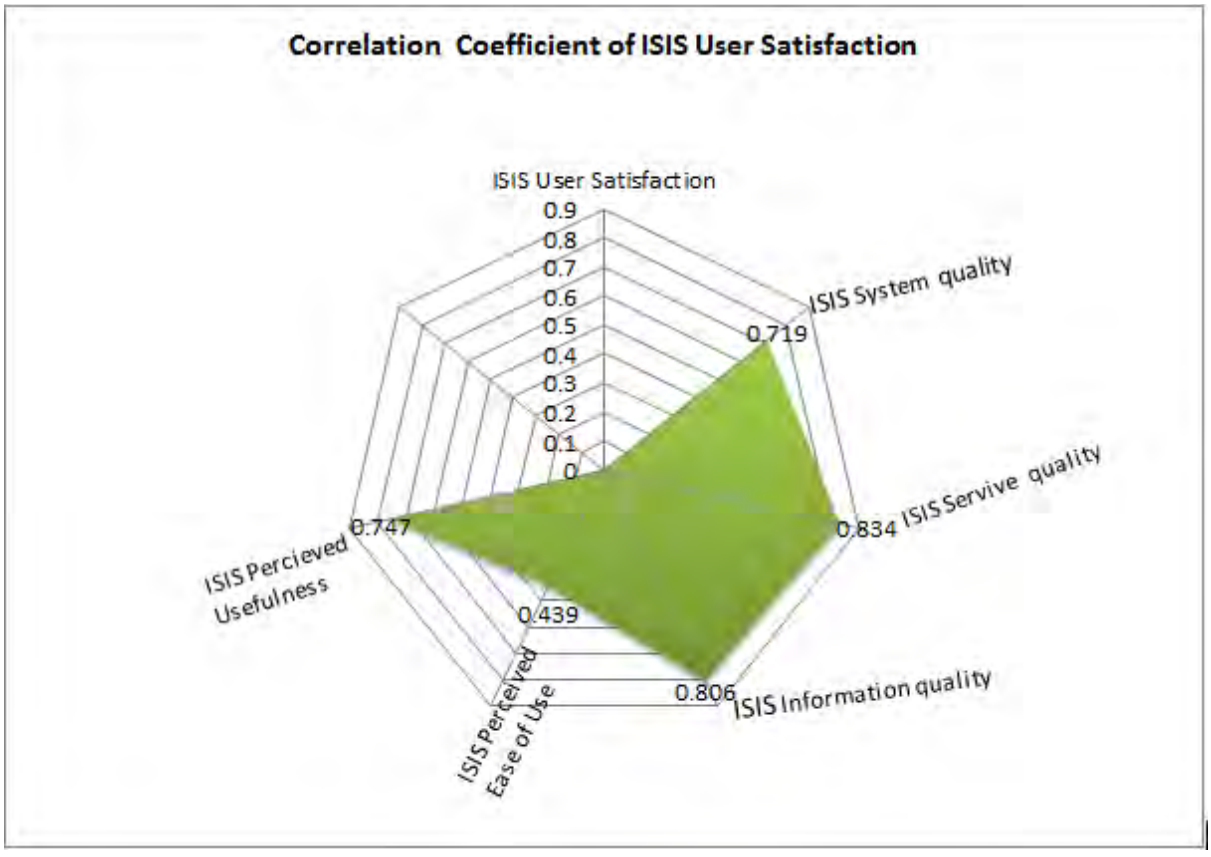


Figure 9.1 Correlation Coefficients of ISIS User Satisfaction

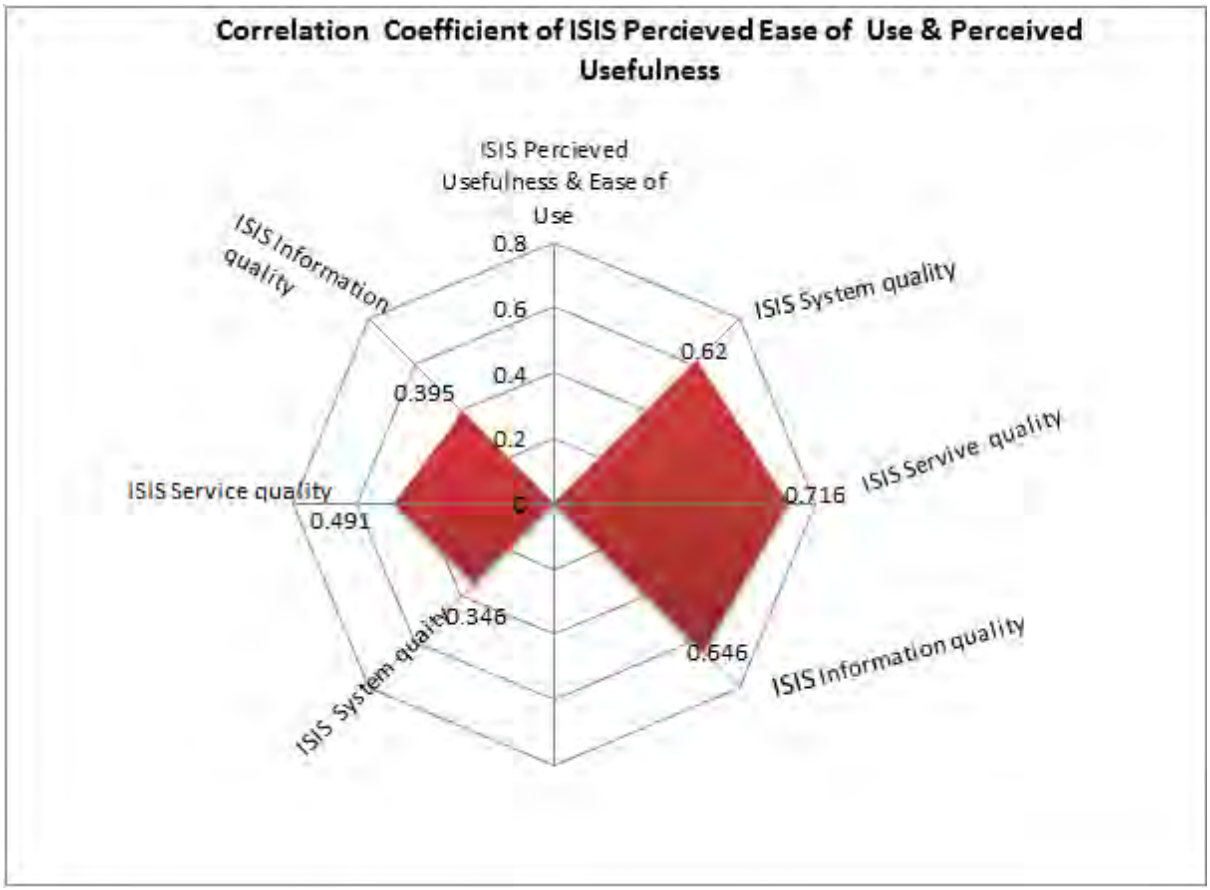


Figure 9.2 Correlation Coefficients of ISIS Perceived Ease of Use and Perceived Usefulness

The implication of the results depicted in figure 9.1 and 9.2 states that if the correlation coefficients are more than 0.7, there is a strong positive correlation between the model dimensions, if the correlation coefficients are equal to 0.7, there is moderate correlation, if less than 0.7, there is a weak correlation.

Figure 9.1 indicate that ISIS service quality and information quality are positively correlated with ISIS user satisfaction. ISIS system quality and ISIS perceived usefulness is moderately correlated with ISIS User satisfaction. The weakest correlation is between ISIS perceived ease of use. These outcomes show that the most significant dimension impacting ISIS user satisfaction is ISIS service quality and ISIS information quality (through the highest scores of correlation, 0.834 & 0.806). The discussions of the correlations are discussed below.

Analysing ISIS Information quality and Service quality on User Satisfaction

It appears from the results in figure 9.1 that high levels of service quality and information quality of ISIS lead to high levels of ISIS user's satisfaction. The outcomes of the study

indicate that ISIS information quality makes ISIS valued by its users in supplying them with up to date, detailed and complete information. This information helps in making decisions and supplying them with information that is easily understandable and is appropriate to their work. This result is consistent with those of (Al Shibly, 2011) who also establish that information quality is the most significant variable that affects user satisfaction and this proves that high levels of information quality causes high levels of satisfaction. The service quality of ISIS make it also valuable to the users in giving them the support that the users require with the system such as availability, flexibility, security and simplicity of the system (see section 7.11.2). These will in turn create a sense of user's satisfaction with ISIS.

Analysing ISIS System quality and ISIS Perceived Usefulness on User Satisfaction

There is a moderate correlation between system quality and perceived usefulness on user satisfaction (see figure 9.1). The results shows that the system quality of ISIS makes it valuable to the users by being reliable, flexible and adaptable for them to use and thus lead to moderate satisfaction of users with ISIS. Moreover, ISIS users believe that ISIS improves their work performance and are therefore moderately satisfied with the implementation of new system (see section 7.11.2).

Analysing ISIS Perceived Ease of Use on User Satisfaction

There is a weak connection between ISIS perceived ease of use and ISIS user satisfaction. Perceived ease of use has a low contribution towards ISIS user satisfaction. There are people who find ISIS as a complicated system to use and therefore are not satisfied with the system. The results are consistent with Al Shibly, (2011) who also found that there is a weakest relationship between the perceived ease of use and user satisfaction. The results presented in section 7.12.1 are also consistent where the key informants stated that ISIS is not easy to use and not user friendly like Land Information System.

Analysing ISIS Information quality on Perceived ease of use and Perceived usefulness

The result in figure 9.2 shows a weak correlation (0.646 & 0.395) between ISIS information quality and perceived ease of use and usefulness. This indicates that Information quality has low contributions towards perceived ease of use and perceived usefulness. It appears that ISIS users believe that ISIS does not allow information to be easily accessed for them to easily use and perform their task effectively (see section 7.11.2). This results on perceived ease of use and information quality is consistent with those of (Wu, 2013) and results

presented in section 7.12.1. Wu (2013) found that information quality has a low significant contribution on perceived ease of use.

Analysing ISIS System quality on Perceived ease of use and Perceived usefulness

There is weak (see figure 9.2) relationship between ISIS system quality and Perceived ease of use and perceived usefulness (0.620 & 0.346). This indicates that system quality has low contributions towards perceived ease of use and perceived usefulness. It seems that ISIS users believe that ISIS is not flexible to adapt to their new work demands and is not easily adaptable for them to perform their work effectively and thus negatively impacting on their performance (see section 7.11.2). This results on perceived usefulness and system quality are consistent with those of (Wu, 2013) quoted in the literature review. Wu (2013) found that system quality has low contribution on perceived usefulness.

Analysing ISIS Service quality on Perceived ease of use and Perceived usefulness

There is a moderate correlation between ISIS service quality and perceived usefulness with a score of 0.716. The weak correlation is between perceived ease of use (see figure 9.2). This means that service quality of ISIS has a moderate significant contribution towards perceived usefulness of ISIS. It seems that the service quality of ISIS makes it valuable to the ISIS users by delivering their service whenever it is necessary and this makes them to perform their work effectively. In contrast, the users believe that ISIS does not provide them with the system support that they are expecting from Enterprise Resource Product ERP for them to frequently and easily use the system (see section 7.11.2).

A summary of the Analysis of ISIS effectiveness Revealed through Integrated Success Model ISM

- The findings of the results revealed that questionnaires survey was not adequate to evaluate the effectiveness of ISIS implementation in the Valuation Department. As a result of this, qualitative interviews and observation were used to carry out in-depth understanding of how ISIS implementation in the department impacts the Valuation department users (see section 7.12).
- The study finds that Integrated Success Model ISM and its elements are useful and beneficial tool for decision makers in organizations on evaluating the implementation of information systems.

- The findings of the results revealed that ISIS users are not fully satisfied with the overall ISIS implementation in the Valuation department.

- The finding results (see section 9.4.1) revealed that the management support such as providing training to the ISIS users in the department was not fully provided. Management still lack support to their staff when it comes to ISIS operation.

- This study found that in the information systems success model, information quality and service quality have a positive significant on user's satisfaction whereas perceived ease of use has low contributions on user's satisfaction.

- The model was found appropriate for determining the relationships between the variables of D&M IS and TAM towards the use of ISIS. The results revealed that there is no strong positive relationship between the dimensions of D&M IS and TAM used in this study.

- The integrative model was found useful since it provided the conceptual understanding of the difference between object-based beliefs and perception toward the use of ISIS.

9.5 Triangulation of ISIS Analysis

The integrative model (D&M IS, TAM) used in this analysis of ISIS are complementary to each other. However, each model used in this section has strengths and weaknesses in terms of evaluating the effectiveness of ISIS. The strengths and weakness of each model are elaborated in the table 9.3.

Table 9.3 Strengths & weaknesses of the Information System Success Model

Models	Strengths	Weakness
DeLone & McLean IS (D&M) IS	The model is able to cover the various perspective of the ISIS success by assessing the system quality, information quality, service quality, net benefits & user satisfaction of ISIS.	It is difficult to implement the model since data are collected from questionnaire surveys (see section 9.4.2). Wang and Liao (2008) also found this.

	Tona (2009) also found this in his study.	
	The model was able to assess that user satisfaction is related to all other D&M IS variables used in this study and all these variable impacts user satisfaction dependently and independently (see sections 9.4.1 & 9.4.2). This is supported by (Miyamoto *et al.,* 2012).	D&M IS model alone does not predict system usage (see section 9.4.1). This is why it is essential to integrate the model dimension. Al-Khatib (2011) also suggested this.
TAM	The ability of the model to measure perceived ease of use and perceived usefulness is a good assessment to see whether ISIS users are using ISIS or not (see sections 9.4.1 & 9.4.2). This is supported by (Smienk, 2007).	TAM seems to be more applicable in predicting the use of the system where it is voluntary. However, in real life settings, like the case of ISIS, Valuation department require users to use ISIS available with little choice for alternatives (Chuttur, 2009)
	TAM helps clarify how Valuation ISIS users came to accept or reject the use of ISIS. This is also supported by (Moeketsi and Leonard 2013)	In assessing ISIS effectiveness, the perceived ease of use appears to have more important effect on system acceptance than perceived usefulness (see section 9.4.2). Chuttur, (2009) also found this in his study.
Integrated Success Model (ISM)	This model manages to determine the relationships between the variables of TAM & D&M IS towards use of ISIS (see section 9.4.2). Cheng (2013) also found this in his study.	ISM uses only questionnaires to assess the effectiveness of ISIS, it was not able to completely reveal the impact of ISIS on the user satisfaction (Wu, 2013)
	ISM has provided a complete solid model for evaluating ISIS effectiveness since the TAM & D&M IS integrated are complementary to each other	

The Integrated Success Model used in this study assesses the effectiveness of ISIS and found that ISIS users are not fully satisfied with its implementation in the Valuation department. ISM shows that ISIS fails to deliver the system quality, information quality and service quality to the Valuation ISIS users based on the survey questionnaires results. On the other hand, ISM revealed that high levels of service quality and information quality of ISIS lead to high levels of Valuation ISIS user's satisfaction. In addition ISM found that in the context where task performance relies on the system such as the example with ISIS, beliefs about the system effectiveness are most dominant in affecting user satisfaction than beliefs about Perceived ease of use (Cheng, 2013). Data triangulation of results from mixed method approaches is thus achieved and construct validity of research is strengthened.

However, ISM revealed that questionnaires survey was not adequate to evaluate the effectiveness of ISIS implementation in the Valuation Department. As a result, this weakness of survey questionnaires has been accommodated through qualitative interviews and observation as suggested by (Wu, 2013).

9.6 Generalisation of ISIS Analysis

The results of the survey found in this analysis show a fair response which is at medium level to all the model dimensions measured. There is however some dissatisfaction with other elements measured from the dimensions. A fair response does not generalise that all staff in the Valuation department are satisfied with ISIS implementation. It is stated that generalisation must not be stressed in the study instead, the researchers should investigate case study for the purpose of understanding (Denzin and Lincoln, 1998). Yin, (2003) also pointed out that statistical generalisation should not be considered to be the method of generalising the results of the case study. As a results of this survey questionnaires results and following what has been stated by these authors, the researcher further apply other method of data collection such as follow up interviews in order to verify the survey questionnaires results as explained in section 7.12.

9.7 Conclusion

The use of mixed method approaches in the study and analysis of ISIS has been explored successfully. Thus offers support to Williamson *et al* (2007) view regarding suitability of mixed methods approach in examining the spatial information systems research, analysis and evaluation.

Chapter 10. Conclusion & Recommendations

10.1 Introduction

The chapter carries the primary conclusions and recommendations of this thesis. This chapter is arranged in line with the research questions as conveyed in chapter 1 (see sections 1.4). Table 10.1 gives a summary of the relationships amongst the research questions together with references sections in which they are addressed.

Table 10.1 The research questions relationships and reference sections addressed

Research Questions	Achievements
In evaluating the effectiveness of ISIS implementation in the Valuation department, what research methodologies are suitable for analyzing and evaluating ISIS?	Appropriate methodologies are identified from literature in chapter 4 and are described in chapter 2 and chapter 3. They are discussed through analytical methodology in chapter 5
What is the status of the spatial information system in the Valuation department?	The status of the spatial information system is established in the Valuation narrative in chapter 6.
How does ISIS implementation in the Valuation department seek to meet the needs of the users of the systems towards improving Valuation business?	The ISIS implementation is developed in chapter 7 in the ISIS narrative.
Is ISIS effectively implemented in the Valuation department of the City of Cape Town?	Modelling and analysis of ISIS effectiveness in the Valuation department is conducted in chapters 8 & 9

10.2 Conclusions

This study investigated methodologies for evaluating the effectiveness of ISIS implementation in the Valuation department of the City of Cape Town and main conclusions are made from the investigations. This section presents the conclusions gained from accepted methodological framework. The conclusions on the effectiveness of the ISIS implementation in the Valuation department are drawn.

10.2.1 Methodological Framework

The mixed method approaches employed in this study supplement one another. They all aid profound understanding of the spatial information system of Valuation department under study. This is because examining the case from a different perspective is enabled. The use of various data sources, together with numerous methods of analysis and modelling (chapter 8 & 9) allows triangulated results, establishing construct validity of this research.

The tools used in the study are individually sensitive to specific features of the system and not to others. Thus application of set of tools is the indications to a complete approach to understanding, analysing and evaluating of Valuation spatial information system. The use of system analysis tools (SSADM, SDLC & BSP) together and Integrated Success Model are examples. These tools supplement one another in that SSADM is strong in using tools like data flow diagrams to diagnose information flows problems, data dictionaries to document and describe the real world situation, while SDLC strength is its ability to provide a better understanding of business issues, HOW the present systems (ISIS) works and WHAT it does.

However, SSADM and SDLC are limited in their view of the system as they are more concerned with the technical aspects of the system ignoring the human aspects. BSP is therefore powerful in combating SSADM and SDLC deficiency by gathering information about the business processes and data and feeding these to SDLC and SSADM. However, BSP tends to require a large volume of documentation.

ISM on the other hand is strong in providing for a comprehensive understanding of the impact of information systems such as ISIS and gives a better explanation on user performance. However, ISM is limited in this case since it uses only questionnaires to assess the effectiveness of ISIS, and this is not enough to reveal the impact of ISIS to the users. The use of all these system analysis tools and ISM in analysing and evaluating this case study strengthen construct validity. They also guided the researcher to ensure objectivity in the investigation and data presentation due to the researcher involvement in the case study department.

Therefore this research has come to a conclusion that the system analysis approach (SSADM, SDLC & BSP) and ISM are appropriate in research involving spatial information systems and in guiding designs of effective spatial information systems. The analysis tools also specified

ways in which the ISIS implementation in the Valuation department might be enhanced as to meet the spatial information integrity.

10.2.2 Frameworks to measure the effectiveness of Spatial Information Systems

The SSADM and SDLC are recognised as the best appropriate model for the analysis of spatial information system. They serve as a base for assessing the effectiveness of actual spatial information system. The outcomes of these analyses disclosed extra features not shown by BSP and ISM alone, and regarded complementary. The success of spatial information system in the Valuation department is linked to its effectiveness in line with meeting the needs of all users and improving its business.

10.2.3 The ISIS Implementation in the Valuation Department -Case study

The research found that ISIS implementation in the Valuation department is both effective and ineffective. The ineffectiveness of ISIS results because of some of the data, processes and interface issues that have been identified in the analysis, as well as the finding results of the ISIS evaluation.

This study concludes that ISIS ineffectiveness in the Valuation department results from lack of training of users on the ISIS (see section 8.3 & 9.4.1). It is known that with every new system implementation, training must be conducted to train the users how to utilize the new system; this is reflected in the SDLC method as one of its last phases, however, most users in the Valuation department lack such training and this leads to them not using the system effectively as they should (see table 8.9).

The implementation of ISIS in the Valuation department is not implemented as it was originally planned and designed. SDLC revealed that the system should be implemented following the specification of the proposed system (see table 8.8). There was supposed to be an interface between GRM and ISIS that send valuation roll to ISIS LUM and then to Revenue department. However, there is currently no such interface and these data is being send manually which result in delay in service delivery.

SSADM has revealed that there is a data gap in the department. The implementation of ISIS shows that registered leases, servitudes and excisions are supposed to be sent from ISIS to Valuation in real time but currently such data is not being received and leads to data gaps in the information flows, even though they require it for their departmental operations (see

section 8.6.1). More data gap is identified where Valuation is not receiving registered sales in real time as it was originally designed by ISIS. This data gap implies that ISIS is not fulfilling the needs of the users as expected since it did not follow all the specification documented during its design.

Moreover, data gap has been identified where ISIS LUM and GRM are not synchronized with one another in terms of data. This implies that ISIS is not implemented effectively in the department since there is still an issue with data migration. The process of data migration as one of the activity in the system implementation under SDLC was not successfully achieved (see table 8.9). This has therefore leads to inconsistency of data between the Valuation systems which results in unreliable systems. Furthermore, one of the objectives of ISIS was to speed service delivery by reducing manual processes; however, there are still a lot of manual processes as mentioned due to ISIS sending incorrect data to the department. This is revealed in SSADM (see section 8.6.2).

The design of ISIS in the Valuation department did not consider all the data requirements that could assist the department in enhancing their model application. There is definitely a data gap in the design of ISIS since the department could make use of some of the data from other departments that are not currently integrated into ISIS. The socio-economic data and proximity to services are value influencing factors which could enhance the model and thus would assist in improving the Valuation business but the departments responsible for such are currently not included. This has been revealed in SSADM analysis (see section 8.6.3).

The effectiveness of ISIS results from the fact that ISIS has achieved its main objective of integrating the six business units of property value chains in order to stream line business and Valuation department is not an exemption. One of the objectives of ISIS in Valuation is to send real time data to the department. Therefore ISIS has fulfilled this objective since the majority of data that is being sent to Valuation from ISIS is real time. However, it is true that sometimes these data is not being received in real time due to some technical challenges as mentioned in the interviews. The ISIS viewer which is developed by ISIS has improved Valuation business since the users are able to locate properties easily. ISIS has also brought data transparency between the six businesses units integrated and Valuation is also part to this.

The stated points about ISIS effectiveness and ineffectiveness shows that ISIS implementation in the Valuation department have both strengths and weaknesses and this

confirms that there is no system development which is perfect to fulfil all its users requirements.

The research has, to a certain degree, addressed its primary objectives and research questions. This research adds to spatial information systems theory and might direct future designs and implementation for effective spatial information systems that are in line with system development procedures, especially in the context of property value chain departments.

10.2.4 Comparative Analysis of the Case Study Results Using Mixed Method

This research has assessed the effectiveness of the spatial information system of Valuation department to supply effective and efficient spatial information service within the accepted tools of system analysis in spatial information systems. Methodological, data and discipline triangulation (see sections 2.3.5 & 5.4.4) is achieved through the analysis of Valuation Spatial information system using a mixed method approach. The use of mixed methods contributes to the rich description and better understanding of the spatial information system from different perspectives.

Table 10.2 shows triangulation of analytical results of the spatial information system effectiveness through the mixed method approaches.

Table 10.2 A comparative analysis of the case study results.

Case study	***SSADM***	***SDLC***	***BSP***	***ISM***
Valuation Spatial information system	Inaccurate, incorrect, incomplete and missing data in the information flows. Inadequate design given the business context.	Not effective to fulfil the needs of all users. Lack of training with ISIS to the users.	Not effective to fulfil the needs of all users	Not user Satisfactory. Users lack training with ISIS.

10.3 Recommendations

The following recommendations are made based on the conclusions drawn from the findings of this research:

10.3.1 Improvements to the ISIS implementation in the Valuation department

As revealed by SDLC in section 10.2.3, the ISIS users in the Valuation department need ISIS training. More training is required to the users who did not receive training at all and to others who received little training. Training is a major requirement for every new system implemented since it enables the users to fully utilize the system. With this ISIS training, all the Users in the Valuation department will be able to make use of the ISIS effectively and this would make their work easier as well as reducing dependency from Corporate Data section in the department. The inadequate use of the system by other users makes these users to rely more on other users who are able to utilize the system unnecessarily. This however, causes unnecessary work load and pressure to these users. This also leads to delay in service delivery by these users with inadequate training since their work performance turned to rely on other users pointlessly.

The automated interface between GRM and ISIS has to be developed so that Valuation business could be improved. The interface would be very necessary because the data type, schemas, naming conventions of Valuation spatial database could be validated to ensure that data is in good format to be stored in ISIS. Currently, there is delay in service delivery as manual process has to be engaged in order to send Valuation roll to ISIS LUM and then to Revenue department. This manual process also consumes a lot of time and depends more on scarce resources to perform such processes. This interface will also assist Revenue department to speed up their operations and thus reducing a lot of human errors as manual processes is prone to such errors. In this way the Revenue department would also be able to generate the correct values towards improving the City of Cape Town business as a whole.

The data gaps that have been identified in the Valuation department due to ISIS implementation should also be reduced; all the causes of data gap should be combated by fixing the technical issues that cause ISIS not to comply with all its design. The servitudes data should be requested from ISIS to be sent to Valuation as it was mentioned that servitudes is already incorporated into ISIS, it is for the department to make a requisition for such data to be send. This servitudes data is a value influencing factors and should be considered when

assigning values to the properties. Inclusion of this data would also assist in reducing a lot of council objections which are lodged due to overvaluing properties with servitudes. In this way, Valuation business would be improved and transparency could also be realized by the public.

10.3.2 The improvement to the Design of ISIS

There is inadequacy of data in the ISIS design which needs to be included in the integration of ISIS so that Valuation business could be improved. This has been revealed by SSADM in section 10.2.3. It is therefore recommended that the design of ISIS must be modified in order to accommodate the inclusion of such data inadequacy. This data inadequacy could be obtained from the department dealing with socio-economic data (census data) showing income levels, population distributions and crime rate; proximity to services such as the shopping centres, clinics, schools and recreational facilities. All these data are value influencing factors which could enhance the Valuation business if considered in the model. At the moment these are not incorporated in the model separately and their influence to the values is not being recognized.

10.3.3 Further Research

Longitudinal Study of the ISIS implementation in the Valuation Department

Once ISIS is completely operational, roughly five years from this study, the study must be prolonged to encompass an investigation of its long term implementation as opposed to its short term operational.

References

Abdelsalam, H., Reddick, C.G., ElKadi, H. (2012), "Success and Failure of Local E-Government Projects: Lessons Learned from Egypt", Online accessible: http://login2egypt.idecision.org/ICEGOV/SuccessandFailureofLocaEGovernmentProjects.pdf, last accessed 10 August 2014.

Abraham C., Junglas, I., Willis, M. (2010), "System Analysis and Design for Service Oriented Architecture Projects: A case study at the Federal Financial Institutions Examinations Council (FFIEC)", *Journal of Emerging Trends in Computing and Information Sciences,* Vol.2, No.1.

Abugabah, A., Sanzogni, L., Alfarraj, O. (2010). "Evaluating the impact of information systems on end user performance: A proposed model". *(IJACSA) International Journal of Advanced Computer Science and Applications,* Vol.1, No.1

Akkermans, J. (2009), *Compliance towards the Belastingdienst,* MSC Thesis. Radboud University Nijmegen.

Al-adaileh, R.M. (2009), "An Evaluation of Information Systems Success: A User Perspective-the Case of Jordan Telecom Group". *European Journal of Scientific Research*, Vol.37, No.2, pp. 226-239.

Alexander, C. (1979). "System Analysis and Design"**,** Online accessible: www.albany.edu/acc/courses/fall97/acc681/ch7.html, Last accessed 02 July 2009.

Al-Humaidan, F., Rossiter, B.N. (2001), "A taxonomy and Evaluation for Systems Analysis Methodologies in a workflow Context: Structured Systems Analysis Design Method (SSADM), Unified Modelling Language (UML), Unified Process, soft systems Methodology (SSM) and Organisation Process Modelling (OPM)", Computing Science. Newcastle University, Online accessible: www.cs.ncl.ac.uk/research/trs/papers/751.pdf, Last accessed 14 August 2014.

Al-Khatib, H., Lee, H. (2011), "E-Government Systems success and User Acceptance in Developing Countries: The role of perceived support quality*", International Journal of e-Business and e-Government studies,* Vol.3, No.2.

Al Shibly, H. (2011), "Human Resources Information Systems Success Assessments: An integrative model". *Australian Journal of Basic and Applied Sciences*, Vol.5, No. 5, 157-169.

Al-Zahrani, S. (2006), "An Information Management System Model for the Industrial Incidents in Saudi Arabia: A Conceptual Framework Based on SDLC Methodology". *Journal of Computer Science*, Vol, 2, No. 5, pp.447-454.

Avison, D.E., Taylor, V. (1997), "Information Systems Development Methodologies: A classification according to problem situation", *Journal of Information Technology*, Vol. 12, pp. 73-81.

Avison, D.E., Fitzgerald, G. (1995), *Information System Development: Methodologies, Techniques and Tools*. 2nd edition, McGraw-Hill, London.

Baxter, P., Jack, S. (2008), *Qualitative Case Study Methodology: Study Design and Implementation for Novice Researchers, the Qualitative Report*, Vol. 13, No. 4, pp.544-559.

Banister, P., Dunn, G., Burman, E., Daniels, J., Duckett, P., Goodley, D., Lawthom, R., Parker,I., Runswick-Cole, K., Sixsmith, J., Smailes, S., Tindall, C.,Whelan, P. (2011), *Qualitative methods in psychology: A research guide. 2nd edition,* Maidenhead, Open University Press, McGraw Hill.

Biggerstaff, D. (2012), *Qualitative Research Methods in Psychology.* University of Warwick, Coventry, UK. May 2, 2012

Bhushan, H. A., Parikshit, G. S. (2010), "System Analysis and Design Flexibility in the Approach Based on the Product Definition", *International Journal of Computer Applications,* Vol. 1, No. 20.

Business Systems Planning (IBM Corporation) (n.d). Prepared for Robinson College of Business, Georgia State University. Unpublished. Online accessible: www.cis.gsu.edu/~emclean/Business%20Systems%20Planning.ppt. Last accessed 04 August 2009.

Cameron, R. (2011), "Mixed Methods Research: The Five Ps Framework", *Electronic Journal of Business Research Methods*, Vol. 9, No. 2.

Checkland, P.B. (1999), *Soft Systems Thinking, Systems Practice: Includes a 30-year Retrospective,* Johns Wiley and Sons, Ltd, Chichester, UK.

Chen, Y., Chen, H.M., Cling, R., Huang, W.W. (2007), "Electronic government implementation: A comparison between developed and developing countries", *International Journal of Electronic Government Research,* Vol.3, No. 2, pp. 45-61.

City of Cape Town (2008), *System Analysis and Logical Design*, Prepared for Integrated Spatial Information System Project (ISIS) of City of Cape Town. Vol. 2.2, 24 November 2008, Unpublished, Internal documentation.

City of Cape Town, (2010), *The Project ISIS Master Design Document*. Prepared for Integrated Spatial Information System Project (ISIS) of City of Cape Town. Vol. 5.5, 19 January 2010. Unpublished, Internal documentation

City of Cape Town, (2010), *To-Be Registration Downloads Business Process Definition, Valuation.* Prepared for Integrated Spatial Information System Project (ISIS) of City of Cape Town, Vol. 1.7, 21 January 2010, Unpublished, Internal documentation.

City of Cape Town, (2010), *BPD_ISIS_ Valuation*. Prepared for Integrated Spatial Information System Project (ISIS) of City of Cape Town. Vol. 1.7, Unpublished, Internal documentation.

City of Cape Town, (2011), *ISIS Go-Live Readiness Assessment Report*. Prepared for Integrated Spatial Information System Project (ISIS) of City of Cape Town. 22 September 2011, Unpublished, Internal documentation.

City of Cape Town, (2009), *Functional Specification-SAP/GRM interface.* Prepared for Integrated Spatial Information System Project (ISIS) of City of Cape Town. Vol. 1.2, 11 October, 2009, Unpublished. Internal documentation.

City of Cape Town, (2009) *Project ISIS Database Design specification,* Prepared for Integrated Spatial Information System Project (ISIS) of City of Cape Town. Vol 1.3, 03 November, 2009, Unpublished. Internal documentation.

City of Cape Town Council Overview, (2011), *A Comprehensive guide to Council's Structures, finance, governance, directorates and planning*. June 2011.

City of Cape Town, (2009), *The Newsletter for the staff of the City of Cape Town*: June/July 2009.

Cheng, K. M. (2013), "An Evaluation of RFID Door Security System at Taipei Arena Ice Land Based on Technology Acceptance Model", *International Journal of Management & Information Systems, 2nd Quarter*, Vol. 17, No. 2, p.117.

Chutter, M.Y. (2009), "Overview of the Technology Acceptance Model: Origins, Developments and Future Directions," Indiana University, USA. *Sprouts Working Papers on Information Systems*, Vol.9, No. 37. Online accessible: http://sprouts.aisnet.org/9-37, Last accessed 10 August 2014.

Collins, K. M. T., Onwuegbuzie, A. J., Jiao Q. G. (2007), "A Mixed Methods Investigation of Mixed Methods Sampling Designs in Social and Health Science Research"**,** *Journal of Mixed Methods Research*, Vol.1, No. 267.

Cowman, S. (1993), "Triangulation: a means of reconciliation in nursing research", *Journal of Advanced Nursing*, Vol.18, pp. 788-792.

Darke, P., Shanks, G., Broadbent, M. (1998), "Successfully Completing Case Study research: Combining rigour, relevance and pragmatism", *Information Systems Journal,* Vol. 8, pp. 273-289.

Davis, F.D., Richard, P., Bagozzi., Warshaw, P.R. (1989), "User Acceptance of Computer Technology: A Comparison of Two Theoretical Models". *Management Science*, Vol. 35, No. 8, August, 1989.

DeLone, W.H., McLean, E.R, (2003), "The DeLone and McLean Model of Information Systems Success: A ten-year Update", *Journal of Management Information Systems*, Vol.19, No.4, pp.9-30, 2003 M.E. Sharpe, Inc.

DeLone, W.H., McLean, E.R. (1992), "Information Systems Success: The Quest for the Dependent Variable", *Information Systems Research*, Vol. 3, No. 1, pp. 60-95.

Dennis, A, Wixom, B.H., Roth, R.M. (2000), "System Analysis and Design". Online available: media.wiley.com/product data/excerpt/87/.../0470074787.pdf. Last accessed 02 July 2009.

Denzin, K.N., Lincoln, Y.S. (Eds) (1998a), *The Landscape of Qualitative Research,* Sage Publications, London.

Denzin, K.N., Lincoln, Y.S. (Eds) (1998b), *Strategies of Qualitative Inquiry*, Sage Publications, London.

Denzin, N.K., Lincoln, Y.S. (2000), *Research Methods, Handbook of Qualitative Research* 2nd ed. Sage Publications, London.

Dessers, E., Crompvoets, J., Vandenbroucke, D., Vancauwenberghe, G., Janssen, K., Vanhaverbeke, L., Hootegem, G.V. (2012), "A multidisciplinary Research Framework for Analysing the Spatial Enablement of Public Sector Processes", *International Journal of Spatial Data Infrastructures Research*, Vol. 7, pp.125-150.

Effenberg, W. (2001), *Spatial Cadastral Information Systems: The maintenance of digital cadastral maps.* PHD Thesis, University of Melbourne.

Elkadi, H. (2013), "Success and failure factors for e-government projects: A case from Egypt", *Egyptian Informatics Journal*, Vol. 14, No. 2, pp.165–173, July 2013.

Ertual, L., Sudarsanam, R. (2005) "Security Planning Using Zachman Framework for Enterprises", *Proceedings of EURO mGOV 2005.* Online accessible: http://6320opensocial.googlecode.com/svn.../Report_Zachman_Row2.docx, Last accessed 10 August 2014.

Faith, C., Oladipo, F., Onyesolu, O., Okechukwu, M. A. (2012), "Implementing a Model of Virtual Collaborative Planning System", *International Journal of Science and Technology*, Vol. 2, No.8, August 2012.

Feuchtwanger, M., Lodwick, G. D. (1987) *Land-related information systems*. Calgary. Department of Surveying Engineering.

Floropoulos, J., Spathis, C., Halvatzis, D., Tsipouridou, M. (2010), "Measuring the success of the Greek Taxation Information System", *International Journal of Information Management*, Vol.30, No.1, pp.47-56.

Frechtling, J., and Sharp, L. (1997). *The User-Friendly Handbook for Mixed-Method Evaluations*. NSF 97-153. Arlington, VA: NSF.

Gasson, S. (1995), "The Role of Methodologies in IT-related Organisational **C**hange"**.** *Proceedings of BCS Specialist Group on ARE Methodologies, 3rd Annual Conference, the Application of Methodologies in Industrial and Business Change*, North East Wales Institute, Wrexham, UK - September 1995. Online accessible: https://idea.library.drexel.edu/bitstream/1860/1968/1/2006175275.pdf, Last accessed 10 August 2014.

Gantley, C. (2007), *Enhancing End User Satisfaction in the Post- Implementation Phase of ISD: An Exploratory Study of a Large Multinational Company*, MSC Thesis, Waterford Institute of Technology, Waterford, Ireland.

Goran, G., Jenny, L. (2012), "Different Roles of Evaluation in Information System Research". *International workshop on IT Artefact Design & Workpractice Intervention, & Workpractice Intervention,* 10 June, 2012, Barcelona. Online accessible: http://www.vits.org/uploads/IT_Artifact/GGJL-ADWI2012_EvaluationResearch.pdf, Last accessed 10 August 2014.

Grimes, D.A., Schulz, K.F. (2002), "Bias and Casual Associations in Observational Research: Epidemiology Series". *The Lancet*, Vol. 359, January 19, 2002.

Hattingh, M.J. (2005), *Instrument to Evaluate to which Extent the Operational Support Information System (OSIS) Adds Value to the South Africa Air Force (SAAF),* MSC Thesis, University of Stellenbosch, Cape Town, South Africa.

Hawryszkiewycz, I.T. (2001) *Introduction to System Analysis and Design*. Australia: Pty Limited.

Hodges, G. R. (2007), "Business Systems Planning (BSP)". Online accessible: books.google.co.za/books?isbn=080188554X**...,**Last accessed 28 September 2009.

Hardcastle, E. (2008), "Business Information Systems".
Online accessible: http://paginas.fe.up.pt/~apm/ESIN/docs/bis.pdf, Last accessed 10 August 2014.

Hutchinson, S.E., Sawyer, S.C (1994), *Computer Essentials*. Burr Ridge: Irwin.

IBM, (1978), "Business Systems Planning: Information Systems Planning Guide", Second Edition, October 1978, Online accessible:
http://books.google.co.za/books/about/Business_systems_planning.html?id=L54SAQAAMAAJ, Last accessed 10 August 2014.

IBM (1984) *Business Systems Planning — Information Systems Planning Guide*.
Application Manual, IBM Corporation, July 1984.

Jackson, M.C. (2003), *Systems Thinking: Creative Holism for Managers,* John Wiley and Sons, Chichester.

Jahromi, S, K., Manteghi, N. (2013), "Designing Financial Information System Using Structured System Analysis and Design Method", *International Journal of Computer Networking and Communication (IJCNAC)*, Vol.1, No. 2, November 2013.

Jalal, E.D., Al-Debei, M. M (2012), "Portals and Task Innovation: A Theoretical Framework Founded on Business Intelligence Thinking". *The Eleventh Annual International Conference on Business Intelligence and Knowledge Economy,* 4th August 2012. Online accessible:
http://arxiv.org/abs/1208.0892, Last accessed 10 August 2014.

Key Informants Interviewees A-G. (2013), Employees of Valuation Department and ERP department, the names of the individuals interviewed and their positions in the organisation cannot be revealed.

Khaleel, Y., Sulaiman, R. (2013) **"**A system development methodology for ERP system in SMEs of Malaysian Manufacturing Sectors", *Journal of Theoretical and Applied Information Technology,* Vol. 47, No.2, 20th January 2013.

Kok, G., Schaalma, H., Ruiter, R. A. C., Van Empelen, R. (2004)," Intervention mapping: a Protocol for applying health psychology theory to prevention programmes", *Journal Of Health Psychology,* Vol. 9, No.1, pp. 85 – 98.

Kozina, M. (2006), "Evaluation of Aris and Zachman Framework as Enterprise Architectures". *Journal of information and organizational sciences,* Vol. 30, No.1.

Kozmina, N., Niedrite, L. (2010), "OLAP Personalizaton with User-describing Profiles." Online accessible: www.lu.lv/.../user.../OLAP%20Personalization%20with%20user-describi..., Last accessed 10 August 2014.

Kurvers, W. (2007), *Implementing local Spatial Information Infrastructures: Are Municipalities INSPIREd?* MSC Thesis, The Manchester Metropolitan University. Manchester.

Kurwakumire, E. (2014) "Toward a Public Sector GIS Evaluation Methodology", *South African Journal of Geomatics,* Vol. 3, No.1, pp 33-52, January 2014.

Kurwakumire, E. (2011), "Evaluating Geographic Information Systems: A case of Uganda Public Sector", Department of Surveying and Geomatics, Midlands State University Gweru, Midlands, Zimbabwe, Online accessible: http://www.iiis.org/CDs2011/CD2011IDI/ICTA_2011/PapersPdf/CT132MZ.pdf, Last accessed 10 August 2014.

Lederer, A. L., Katz, J. M., Sethi, V. (1988), "The implementation of Strategic Information Systems Planning Methodologies", *MIS Quarterly*. September 1988.

Laudon, K.C., Laudon, J.P, (2001), *Management Information Systems,* 7th Ed, Prentice Hall.

Manteghi, N., Jahromi, S.K. (2013), "Designing Financial Information System Using SSADM", *International Journal of Networking and Communication (IJCNAC),* Vol.1, No.2, November 2013.

McDougall, K., Paudyal, D.R., Apan, A. (2012), "Developing Spatial Information Sharing Strategies across Natural Resource Management Communities", Online accessible: www.gsdi.org/gsdiconf/gsdi14/papers/272-Chapter8.pdf, Last accessed 10 August 2014.

McDougall, K., Paudyal, D.R., Apan, A. (2013), "Developing Spatial Information Sharing Strategies across Natural Resource Management Communities. In Spatial Enablement in Support of Economic Development and Poverty Reduction: Research, Development and Education Perspectives". *GSDI Association Press*, Needham. MA. USA, pp. 141-168.

McMurtrey, M. (2013), "A Case Study of the Application of the Systems Development Life Cycle (SDLC) in 21st Century Health Care: Something Old, Something New", *Journal of the Southern Association for Information Systems*, Vol.1, No.1

Middleton, P. (1994), "Euromethod: The Lessons from SSADM", Information Management Division. The Queen's University of Belfast. Belfast BT7 INN, United Kingdom, Online accessible: http://is2.lse.ac.uk/asp/aspecis/19940039.pdf, Last accessed 14 August 2014.

Mingers, J. (2006), *Realising Systems Thinking: Knowledge and Action in Management Science*, Springer.

Miyamoto, M., Kudo, S., Iizuka, K. (2012), "Measuring ERP Success: Integrated Model of User Satisfaction and Technology Acceptance: An Empirical Study in Japan". *Conference Article,* Hong Kong, IACSIT Press. Vol. 57, No. 16, 2012.

Mooketsi, B., Leonard, M., (2013), "Factors influencing the Usage of the Tribal Land Information Management System for Land Management and Administration: The Case of Mogoditshane Subordinate Land board", *The Electronic Journal on Information Systems in Developing Countries EJISDC*, Vol.59, No.5, pp.1-17

Mu-Cheng, Wu. (2013), "A Study on University Students' Intention to Use the Digital Museum of Sports Literature", *The Journal of International Management Studies*, Vol. 8, No 2, August, 2013.

Myers. B. L., Kappelman L. A., & Prybutok. V. R. (1997). "A comprehensive model for assessing the quality and productivity of the information systems function: toward a 163. Theory for information systems assessment". *Information Resources Management Journal,* Vol. 10, No. 2.

Neuman, W. L., (2000), *Social Research Methods: Qualitative and Quantitative Approaches,* Allyn and Bacon, London.

Niger, G. (2012), "Triangulation and Mixed Methods Designs: Data Integration with New Research Technologies", *Journal of Mixed Methods Research.* Online accessible http://mmr.sagepub.com/content/early/2012/03/28/1558689812437101. Last accessed 10 August 2014.

Nomdoe, H. G. (2007), *Evaluating Web-Based Information Systems Effectiveness: An e-Service Quality Multi-Stakeholder Perspective*. MSC Thesis. Cape Peninsula, University of Technology, Cape Town, South Africa.

ODA/CUSP Joint Research Team. (1996), *Computers in Urban Spatial Planning*. Prepared for the Overseas Development Administration, ODA/CUSP.

Oladipo., Onaolapo, F., Onyesolu., Okechukwu, M., Faith, A.C. (2012), "Implementing a Model of Virtual Collaborative Planning System", *International Journal of Science and Technology***,** Vol. 2, No.8, August 2012.

Pant, S., Hsu, C. (1995), "An Integrated Framework for Strategic Information Systems Planning and Development.

Patton, M. (2002) *Qualitative Research & Evaluation Methods*, Sage, Thousand Oakes,

California, R.G.B., Wilson, B.L. (1994), "Numbers and words revisited: Being 'shamelessly eclectic", *Quality and Quantity,* Vol. 28, pp 315-327.

Pelto, J.P., Pelto, G.H. (1978), *Anthropological Research: The Structure of Inquiry,* Second Edition, Cambridge University Press, New York.

Petter, S., DeLone, W., McLean, E. (2008), "Measuring Information Systems Success: models, dimensions, measures, and interrelationships", *European Journal of Information Systems*, Vo.17, pp. 236–263, 2008.

Pick, B. J. (2007), "An Evolutionary Framework for Strategies of Spatial Technologies: Case study Analysis", *IRM International Conference.* University of Redlands, Redlands.

Paltisa, G., Balaban, N. (2009), "Methodological Approaches to Evaluation of Information System Functionality Performances and Importance of Successfulness Factors Analysis", *Management Information Systems*, Vol.4, No. 2, pp.11-17. 24th April 2009.

Price, C.S., Tapamo, J. R., Blakeway, F., Ahmed, F. (2009), "Plantation forestry: an analysis of the domain", *Proceedings of DE@CAiSE' 2009.* University of KwaZulu-Natal.

Rabaai, A. A. (2012), Evaluating *the Success of Large-scale, integrated information systems through the lens of IS-Impact and IS –support*. PHD Thesis, Queensland University of Technology.

Rajabifard, A., Williamson, I. (2002), "Spatial Data Infrastructures: Concept, SDI Hierarchy and Future Direction", *Geomatics' 80 Conference*, Tehran, Iran April 2002.

Radwan, A., Aarabi, M. (2011), "Study of Implementing Zachman Framework for Modelling Information Systems for Manufacturing Enterprises Aggregate Planning", *Proceeding of the 2011 International Conference on Industrial Engineering and Operations Management,* Kuala Lumpur, January 22-24, 2011. Malaysia.

Rauniar, R., Rawski, G., Cates, D. (2011), "Performance Evaluation of Integrated Information System across the Value Chain," *POMS 22nd Annual Conference*, Reno, Nevanda, U.S.A, April 29 to May 2, 2011.

Salie, S., S, A. (2012), A formative evaluation of a staff reward and recognition programme", *SA journal of Human Resource Management*, 10(3), No. 422.

Satzinger, J.W., Burd, D. S., Jackson, B.R (2002), *Systems Analysis and Design in a Changing World.* Canada, Course Technology.

Sebake, M.D., Serena, C. (2012), "Results of three case studies for assessing motivators and barriers of address data sharing in South Africa", *South African Journal of Geomatics*, Vol.1, No.1, pp 32-43, January 2012.

Schumacher, M. (2001), "The use of SSADM as standard methodology on Information systems Projects", *Autumn Semester Report, Term paper, 2001-02, 17 pages*. Computer Science- Theory.

Seddon, P.B., Staples, S., Patnayakuni, R., Bowtell, M. (1999). "Dimensions of information systems success", *Communications of the Association for Information Systems*, Vol. 2, No. 3.

Seddon, P. B. (1997). "A Respecification and Extension of the DeLone and Mclean Model of success", *Information Systems Research,* Vol. 8, No.3, 240-253.
Seddon, P.B., Kiew, M.Y. (2007), "A partial test and development of the DeLone and McLean model of IS success", *Australian Journal of Information Systems,* Vol. 4, No.1.

Shneiderman, B., & Plaisant, C. (2005), *Designing the user interface*. Boston: Pearson/ Addison Wesley.

Siriba, D.N., Hussein, O.F. (2006), "Mainstreaming Spatial Data Infrastructures in Land Management and Administration", Online accessible:
www.gsdi.org/gsdiconf/gsdi10/papers/TS12.1paper.pdf, Last accessed 13 August 2014

Smienk, R. (2006), *Organizational Implementation of ICT: A comparison of different models".* MSC Thesis, Faculty of behavioral sciences**,** Communication Studies**,** ICT and Organizations.

Smit, J. (2009) Advanced GIS, unpublished course notes for APG 4008F, 2009, University of Cape Town.

Sowa, J. F. and Zachman, J. A. (1992), "Extending and Formalizing the Framework for Information Systems Architecture", *IBM Systems Journal.* Vol.31, No.3, pp.590-616.

Sousa, P., Pereira, C., Vendeirinho, R., Caetano, A., Tribolet, J. (2011), "Applying the Zachman Framework Dimensions to Support Business Process Modelling". Online accessible:
www.tud.ttu.ee/material/enn/.../12ProcessMeasurement/Zachman.pdf, Last accessed 14 August 2014

Stacie, P., DeLone, W., McLean, E. (2008), "Measuring Information Systems Success: Models, Dimensions, Measures and Interrelationships", *European Journal of Information Systems,* Vol.17, pp. 236-263, 2008.

Stake, R. E. (1995), *The art of case study research*. Thousand Oaks, CA: Sage

Steenis, W.M. (2011), Developing *a Spatial Data Infrastructure for use in Military, how to assess progress?* MSC Thesis, The Manchester Metropolitan University.

Sukkri, K. H. B. A. (2007), *GIs Based Crime Analysis System***:** MSC Thesis, University of Malaysia, Malaysia.

Taghizadeh, G. (2012)," Evaluating the Impact of Information Systems on Governmental Organizations in IRA: the case of ICT Ministry." *Association Information & Management,* Vol.1, June 2012.

The Pariveda Solutions Business Systems Planning (n.d). "Business Systems Planning": Prepared for Dallas Texas IT Consulting and Business.
Online accessible: www.parivedasolutions.com/.../BusinessSystemsPlanning.aspx - Cached - Similar last accessed 28/09/2009

Tona, O., Skog, L.M., (2009), *The success of DSS in a police organization: An evaluation study*, MSC Thesis, 15 ECTS, Department of Informatics. Lunds University.

Turban, E., Rainer, R., Potter, R. (2005), "Introduction to Information Technology". USA: John Wiley & Sons

University of Cape Town, (2010), *Faculty of Engineering and Build Environment Code for Research Ethics,* UCT, South Africa, Online accessible: www.uct.ac.za, Last accessed 14 August 2014.

U.S. House of Representatives (1999), "Systems Development Life-Cycle Policy: Executive Summary". Online available: www.house.gov/cao-opp/PDFSolicitations/SDLCPOL.pdf, Last accessed 29 June 2009.

Wang, Y., Liao, Y. (2008), "Assessing e-Government systems success: A validation of the DeLone and McLean model of information systems success*", Government Information Quarterly,* Vol. 25, pp. 717–733.

Wang, Y-M., Wu, J-H, (2006), "Measuring KMS Success: A respecification of the DeLone and McLean's Model", *Information & Management,* Vol. 43, pp.728-739.

Williamson, I.P., Grant D., Rajabifard, A. (2005), "Land Administration and Spatial Data Infrastructures", *FIG Working Week 2005 and GSDI-8,* Cairo, Egypt, April 16-21, 2005.

Whittal, J. (2008), *Fiscal Cadastral System Reform, A Case Study of the General Valuation Project in the City of Cape Town,* PHD Thesis, Calgary, Alberta.

Whitten, J.L, Bently, L.D & Dittman, K.C. (2001). *Systems Analysis & Design Methods.* New York. MacGraw Hill Companies.

Williamson, I.P., McDougall, K., Rajabifard, A. (2007), "A Mixed Method Approach for Evaluating Spatial Data Sharing Partnerships for SDI Development". Online accessible: https://minerva-access.unimelb.edu.au/.../117508_mixed_method.pdf, Last accessed 14 August 2014.

Witherell, P., Rachuri, S., Narayanan, A., Lee, J.H. (2013), "FACTS: A Framework for Analysis, Comparison, and Testing of Standards". *National Institute of Standards and Technology*, U.S. Department of Commerce, May 2013.

Wyatt, P. & Ralphs, M. (2003), *GIS in Land and Property Management.* London. Spon Press

Yaghini, M. (2009), "A framework for Selection of Information Systems Development Methodologies", *Computer and Information Science*, Vol.2, No.1, February 2009.

Yin, R.K. (2003), *Case study Research- Design and Methods*, third edition, Applied Social Research Methods Series, Vol. 5, Sage Publications, London

Yin, R. K. (1994), *Case Study Research Design and Methods'*, second edition, Applied Social Research Methods Series, Vol. 5, Sage publications, London.

Yin, R. K. (2009), *Case study Research- Design and Methods*, fourth edition, Applied Social Research Methods Series, Vol. 5, Sage Publications, London.

Yin, R.K. (1988), *Case Study Research: Design and Methods.* SAGE Publications. Newbury Park, California.

Zaied, A.N.H. (2012), "An Integrated Success Model for Evaluating Information System in Public Sectors", *Journal of Emerging Trends in Computing and Information Sciences,* Vol.3, No. 6, July 2012.

Zachman, J. (1982). "Business Systems Planning and Business Information Control study: A comparisment"*, IBM Systems Journal*, Vol. 21, No.3, pp.31-53.

Zachman, J. A. (1987), **"**A Framework for Information Systems Architecture".
IBM Systems Journal, Vol. 26, No. 3, pp.276-292.

Zhou, H, (2004), "Soft Systems Methodology (SSM) in Information System Analysis". Online accessible: www.umsl.edu/~sauter/analysis/6840_f03_papers/zhou/, Last accessed 14 August 2014

Appendix

Valuation User Questionnaires

ISIS LUM/Viewer Efficiency Evaluation

Based on your experience of the ISIS LUM/Viewer, all actions below will ask you to indicate to what extent you agree or disagree with the following statements in terms of the overall use of this ISIS system. There is no right or wrong answer and the main aim is to give the answer that best reflects your opinion. Please indicate in the table provided under the column "Answers" the extent to which you agree or disagree with the statements indicated. For example if you strongly agree with the statement please fill in the number 6 as each number is explained below.

6= strongly agree, 5= Agree, 4= Average, 3= Disagree, 2= strongly disagree,

1=Not Applicable to me

ISIS Evaluation Dimensions	Answers					
ISIS LUM/ Viewer System Quality	**6**	**5**	**4**	**3**	**2**	**1**
1. ISIS allows information to be readily accessible to me						
2. ISIS makes information very accessible						
3. ISIS was easy to use the first time I accessed it						
4. ISIS can flexibly adjust to new demands						
5. ISIS returns answers to my request very quickly						
6. ISIS is versatile in addressing needs as they arise						
7. ISIS is very reliable to use all the time						
8. ISIS is not sophisticated to use						
ISIS LUM/ Viewer Information Quality						
1. ISIS provides sufficient information						
2. Information content provided by ISIS meet my needs						
3. ISIS output is presented in a useful format						
4. ISIS provides reports that seem to be just about exactly what I need						
5. ISIS produces comprehensive information						
6. ISIS provides up to date information						
7. I get from ISIS the information I need in time						
8. ISIS information is clear						
10. The information provided by ISIS is accurate and is free from						

errors						
11. ISIS provide precise information that I need						
12. The output information of ISIS is complete						
13. ISIS allows information to be readily accessible to me						
14. It is always easy to find what I am looking for from ISIS LUM/ Viewer						
	6	**5**	**4**	**3**	**2**	**1**
15. The information that I get from ISIS is very reliable and can be trusted						
16. ISIS is characterised by the frankness and clarity of the services that it offers to the users						
17. The information received from ISIS is adequate for my job performance						
18.There are times when I find that supposedly equivalent data from ISIS LUM is inconsistent from LIS						
19. When it is necessary to compare or consolidate data from two different sources, I find that there may be unexpected or difficult inconsistencies of data from ISIS LUM.						
20. ISIS feeds GRM with all the necessary information that I need to perform my job properly.						
ISIS LUM/ Viewer Service Quality						
1. ISIS is always available all the time						
2. ISIS is very fast in processing transactions						
3. I feel safe in completing transactions while using ISIS LUM/Viewer						
4. Scrolling through ISIS LUM/Viewer is kept to a minimum						
5. ISIS LUM/Viewer provides fast information access						
6. Interacting with ISIS is a clear and understandable process						
7. Overall I trust ISIS security measures						
8. ISIS is simple to use						
9. I find ISIS to be flexible to interact with						
10.I can interact with ISIS and receive the required information						
11. ISIS LUM/Viewer is subject to unexpected or inconvenient down times, which makes it harder to do my job						
12. ISIS LUM/Viewer is subject to frequent system problems and crashes						
ISIS LUM/Viewer Perceived Ease of USE						
1. Learning to operate ISIS was easy for me						
2. I find it easy to get ISIS to do what I want it to do						
3. It is easy for me to become skillful at using ISIS						
4. I find ISIS easy to use and flexible						
5. I always do my job using ISIS when necessary						
6. I am getting the training I need to be able to use ISIS languages, procedures and data effectively						
7. There is not enough training for me to know how to find, understand, access or use ISIS						
8. ISIS is very convenient						
ISIS LUM/ Viewer Perceived Usefulness						
1.My job requires me to use ISIS regularly to verify or view property						

information						
2. My job doesn't necessarily require me to use ISIS to verify or view property data						
3. I use ISIS LUM as a reliable source of property information						
4. I don't feel like using ISIS LUM since I am not well trained to use it						
5. I normally refer my request to Corporate Data to verify or confirm information for me since ISIS LUM is not user friendly						
6. I prefer referring my request to Corporate Data since they know how to navigate through ISIS LUM better than me						
7. I can perform my job tasks at times without using ISIS						
8. I think I don't necessarily need to use ISIS in my job tasks						
9. Using ISIS enables me to accomplish job tasks						
10. Using ISIS enables me to perform work requirements more quickly						
11. Using ISIS improves my job performance						
12. Using ISIS in my job increases my productivity						
13. Using ISIS enhances my effectiveness in the job						
14. Using ISIS makes it easier to do my job						
15. I intend to use ISIS LUM frequently since it is a reliable source of property information						
16. I think it is worthwhile for me to use ISIS routinely in order to make my job easier						
17. I prefer using LIS rather than ISIS LUM since LUM is not easy to use						
ISIS LUM/Viewer User Satisfaction						
1. ISIS meets the Valuation requirements of my area of responsibility						
2. ISIS is of high quality						
3. ISIS has met my expectations						
4. Overall, I'm satisfied with using ISIS						
5. ISIS provides services of what I exactly need						
6. I am satisfied with the training that the Valuation department offered regarding ISIS application and use of it						
7. I don't think I need further training to be able to use ISIS effectively						
8. Training materials were available to me during ISIS training						
9. Overall, I am comfortable with using ISIS LUM/Viewer at all times						
10. I think it is not really necessary to use ISIS LUM at all times since it is not trustworthy						
11. I prefer using LIS rather than ISIS LUM in some instances since LUM is not reliable and trustworthy						

Section 11: Work profile

1. Name of the Section you are working for…….
2. How many years you have been working in the Valuation Department?
   Less than one year
   1-5 years
   6-10 years
   11-15 years

16-20 years
21-25 years
Over 26 years

With many appreciations and thanks

Interview questions directed to the Corporate Data Section

1. **Is the information that you receive from ISIS always accurate and free from errors?**
   ---
2. **Do you always get information from ISIS in real time as expected?**

   ---
3. **Does ISIS always provide you with complete information that you require to successfully process a transaction?**

   ---

4. **Does ISIS provide you with all necessary information that is required by the department as a whole?**
   ---
5. **Do you think the information provided by ISIS keep up with the departmental business requirement?**

---

6. **What other information/data are you supposed to receive from ISIS that you are not currently receiving?**

   ---

7. **Is the information/data on ISIS/ LUM efficient, reliable and trustworthy enough to make an informed decision?**
   ---
8. **Is the data on LUM and GRM currently in synch with one another? Is there a gap?**

---

9. **If not in synch what causes this and by how much do they differ?**

   ---
10. **How does this impact on the Valuation business?**

    ---

11. **Do you think ISIS LUM is fully utilized by other sections in the department as is supposed to be?**

12. **Do you think Corporate Data staff had enough training to be able to navigate through ISIS LUM?**

    ---

13. **How often do you experience the problem with ISIS system?**

    ---

14. **If problem exist with ISIS LUM after how long does the system get fixed?**

    ---

15. **Are you fully satisfied with the information content that you receive from ISIS in a daily basis?**

16. **Are your customers satisfied with the data/information quality that is on GRM?**

    ---

17. **Do you think data/information on GRM is more accurate than before ISIS implementation?**

    ---

18. **What issues do you have in regard to information/data that is on LUM & GRM?**

    ---

19. **What do you think causes the issues mentioned above?**

    ---

20. **When you compare the model application from other countries, do you think the data that the department base their model on is effective enough?**

    ---

21. **What other data/information would you recommend to have in order to enhance the effectiveness of model application?**

Interview question directed to Data Collection (Field Survey)

1. **Are you fully satisfied with the information quality that is on GRM?**

2. **Is the information on GRM/ISIS Viewer always up to date for you to perform your daily task?**

    ---

3. **Do you think information on GRM and ISIS Viewer is reliable and trustworthy enough for you to make an informed decision?**

   ---
4. **Is the information content on GRM and ISIS Viewer meeting your data collection requirements?**
   ---
5. **Is the information on GRM complete enough to perform your daily task?**
   ---
6. **Are you getting information/data in real time on GRM as expected for data collection?**

   ---
7. **What issues do you have in regard to data that is on GRM?**

8. **What do you think causes the issues mentioned above?**

9. **Do you think that the data on GRM is more accurate than it was before ISIS implementation?**
10. **Is the information/data on GRM and ISIS viewer always in synch or corresponding?**
    ---
11. **When you compare the model application from other countries, do you think the data that the department base their model on is effective enough?**

12. **What other data/information would you recommend to have in order to enhance the effectiveness of model application?**

13. **Does your section fully utilise ISIS LUM? If no why?**

14. **How often do you experience the problem with ISIS Viewer system?**
    ---
15. **Do you think Valuation is better off with ISIS implementation?**

Interview questions directed to CAMA section

1. **Are you fully satisfied with the information quality on GRM to effectively perform your model applications?**

2. **Is the information on GRM always up to date for you to perform your model application?**
   ---
3. **Do you think GRM have all necessary data that you require to perform your daily task?**

   ---

4. **Is the information content on GRM meeting your model application requirements?**

   ----
5. **Is the information on GRM complete enough to perform your daily task?**
   ----
6. **Are you getting information/data in real time on GRM as expected for your daily task?**
   ----
7. **What issues do you have in regard to data that is on GRM?**

   ----
8. **What do you think causes the issues mentioned above?**

9. **Do you think that data on GRM is more accurate than it was before ISIS implementation?**
10. **Do you think information on GRM is reliable and trustworthy enough for you to make an informed decision?**

11. **When you compare the model application from other countries, do you think the data that you base your model on is effective enough?**

    ----
12. **What other data/information would you recommend to have in order to enhance the effectiveness of model application?**

13. **Does your section fully utilise ISIS LUM? If no why?**

----

14. **Do you think Valuation is better off with ISIS implementation?**

Interview Questions directed to Valuation Planning

1. **Are you fully satisfied with the information quality on GRM to effectively perform your tasks?**

2. **Is the information on GRM always up to date for you to perform your tasks?**
   ----
3. **Do you think GRM/ISIS Viewer have all necessary data that you require to perform your tasks?**

   ----
4. **Is the information content on GRM/ISIS Viewer meeting your Valuation Planning requirements?**
   ----
5. **Is the information on GRM/ISIS Viewer complete enough to perform your daily task?**
   ----

6. **Are you getting information/data in real time on GRM/ISIS Viewer as expected for your daily task?**

   ----

7. **What issues do you have in regard to data that is on GRM/ISIS Viewer?**

   ----

8. **What do you think causes the issues mentioned above?**

   ----

9. **Do you think that data on GRM is more accurate and complete than it was before ISIS implementation?**

   ----

10. **When you do manual valuation or value review, do you take servitudes into account as a property value influencing factor?**

    ----

11. **What other data/information would you recommend to have in order to enhance the effectiveness of manual valuation?**

    ----

12. **How often do you experience the problem with ISIS Viewer?**

    ----

13. **Does your section fully utilise ISIS LUM? If no why?**

    ----

14. **Do you think Valuation is better off with ISIS implementation?**

Interview questions directed to the ERP Section

1. **Is the information that you receive on ISIS LUM from the PVC always accurate and free from errors?**

   ----

2. **Do you always get information on ISIS LUM in real time as expected?**

   ----

3. **Do you send information/data to Valuation in real time as supposed to be?**

   ----

4. **Does the PVC business unit always provide LUM with complete and correct information that you require to successfully send such information to Valuation GRM?**

5. **Are you able to identify errors on the data that you send to Valuation in a daily basis before sending?**

   ----

6. **Would you say that the information/data that you send to Valuation in a daily basis is accurate and free from errors?**

7. **What information/data are you supposed to receive and send to Valuations that you are not currently receiving and sending?**

8. **Since ISIS go live, how many records have been generated for GRM, and how many have not being sent to date?**

---

9. **Would you say the data on LUM and GRM are currently in synch with one another? Is there a gap?**

10. **If not in synch what causes this and by how much do they differ?**

---

11. **How often do you experience the problem with ISIS system?**

---

12. **If problem exist with ISIS LUM after how long does the system get fixed?**

---

13. **Are you fully satisfied with the information content/quantity that you send to Valuations in a daily basis?**

---

14. **Have you ever come across a problem when sending data to GRM?**

---

15. **How often does the problem occur and after how long are you able to solve such?**

---

16. **What issues do you have in regard to information/data that is being send to Valuation from LUM?**

---

17. **What do you think causes the issues mentioned above?**

---

18. Would you say that ISIS LUM is user friendly?

---

19. Is ISIS LUM flexible enough to adjust to new demands?

---

20. Would you say that ISIS LUM is able to return answers to Valuation request very quickly?

---

21. Do you think ISIS implementation is effective in the City of Cape Town?
