EVALUATING LAND INFORMATION SYSTEM RENOVATION (Case study of the Netherlands, Namibia and Zimbabwe)

Tarias Pinias Masarira
February 2008
EVALUATING LAND INFORMATION SYSTEM RENOVATION
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by

Tarirai Pinias Masarira

Thesis submitted to the International Institute for Geo-information Science and Earth Observation in partial fulfilment of the requirements for the degree of Master of Science in Geo-information Science and Earth Observation, Specialisation: (Geo-Information Management)

Thesis Assessment Board

Chairperson: Professor Ir. Paul van der Molen
Examiner : Drs. M.A. Molendijk

Supervisors

Ir. W.T. de Vries
Ir. C.H.J. Lemmen

INTERNATIONAL INSTITUTE FOR GEO-INFORMATION SCIENCE AND EARTH OBSERVATION
ENSCHEDE, THE NETHERLANDS
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Abstract

Land Information systems as they exist in Land Survey and Land Registration Organisations are highly transactional environments due to the level of interaction they have with their environment and also the criticality of the information that they hold. These systems therefore have to be carefully maintained so that they are constantly available and accessible to the host organisations and the clients. Thus the type of system will play an important part on the type of renovation applicable.

The main objective of the research is to carry out an investigation of the factors and conditions that underpin implementation of different LIS renovations by Land Administration organisations to maintain alignment between their Information Systems and business processes and to make recommendations on the renovation of Land Information Systems in the three study sites. To meet these objectives, the research looks at the impacts of Land Information system evolution on the businesses processes of host and user organisations and the approaches that have been used to renovate land/information systems in general. This is mainly done through expository methods by reviewing literature on systems, software renovation and co-evolution.

To uncover the factors and conditions that impact the renovation of Land Information Systems, fieldwork was done in Namibia and Zimbabwe and a contents analysis of published articles, conference presentations and reports done to get an understanding of the Netherlands case. The factors and conditions pertaining to the different contexts were then derived through an inductive approach following multiple readings of transcripts and interpretations of the findings. The interpretations were based on the dilemmas uncovered from the summaries of fieldwork findings and contents analysis.

Having built a picture of the existing situation with regards to the Land Information systems and the requirements that had to be met by the target systems, the gap between the two was established and suitable approaches of bridging that gap were presented. Each approach varies in terms of the resulting changes, the costs and risks involved. Using portfolio analysis systems can be retired or replaced, reassessed, maintained or modernized. These approaches can be deployed through various methods that include the big bang, parallel running, phased introduction, trials and dissemination and finally incremental evolution. These were then evaluated for feasibility based on the factors and conditions that were existing in each context.

What emerges from this study the renovation of LIS should be approached from a socio-technical perspective. This is because an LIS is much more than computers, programs, databases and networking, but also include investments in skills, data and business processes. All these must co-evolve such that changes can not be made on part of the system without affecting the other parts that interface with it.
Acknowledgements

The thesis period is a one mixed with excitement, anxiety and a lot of uncertainty. To this end finishing the thesis is both a relief and fulfilling experience. In this regard, I would like to express my heart felt gratitude to the people who walked with me during this period.

I thank the Lord God almighty for his sustenance during my stay at ITC and for being a constant help.

I would like to express my sincere and deepest gratitude to my supervisors, Ir. Walter T. de Vries and Ir. Christiaan Lemmen for their patience, advice and constructive comments. I thank all the lecturers who were involved in the course work (Modules), the effort and time especially in giving feedback during the pre-proposal period, the proposal presentations and the mid term presentations. I thank Dr. Erik de Man for his efforts in making everyone’s research a success as the GIM MSc research coordinator. I also want to thank the program Director Mr. Ir. Kees Bronsveld, making life at ITC bearable and comfortable.

I would like to thank my family and my wonderful fiancée Joyce for their constant encouragements, care, support and love. May the Lord bless them all.

My gratitude extends to the Board of Directors for awarding me the chance to come to ITC, by accepting my application to join the GIM program and also by giving me the scholarship that sustained my stay in the Netherlands. I also thank my employer the Surveyor General of Zimbabwe for awarding me the study leave and all my fellow workers for attending to all my requests for information and assistance.

Finally I thank the student body at ITC especially the Zimbabwean students, the SADC community, the ITC Christian Fellowship (for shaking my hand) and the GIM students (both PM and MSc) of the class of 2006. I thank them for sharing their experiences and their thoughts with me and for making my 18 months stay in the Netherlands a memorable experience.

Finally I would like to express my heart felt gratitude to Staff in the Land Management Department at the Polytechnic of Namibia, the Directorate of Surveys and Mapping, the Municipality of Windhoek, the Directorate of Deeds, the Department of the Surveyor General, the Harare City Council (Surveys Division) and members of the survey profession in Namibia and Zimbabwe for assisting me with the information that I required for this research. Staff at the Polytechnic of Namibia thank you so much for all the support you gave me during my stay in Namibia.
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Standardisation offers better chances of system sustainability than customisation

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Government policy influences success of renovation or maintenance activities

Unexpected rises in information quantities strain the system, increasing the risk of failure and the urgency of renovation

Summary of interpretations

Further discussions and conclusion

To recommend renovation alternatives for use by Land Administration Organisations

To investigate the conditions under which Land Administration Organisations implement different renovation approaches to maintain alignment between their land Information Systems and business processes

What are the impacts of land information system evolution on the businesses of Land Administration Organisations?

What approaches have been used to renovate land information systems to continuously align them to changing business needs?

What are the factors that affect the renovation of Land Information systems in Land Administration Organisations?

To recommend renovation alternatives for use by Land Administration Organisations

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List of Abbreviations

DSG  Department of the Surveyor General

DSM  Directorate of Surveys and Mapping

LAO  Land Administration Organisation

DOD  Department of Defence

ICT  Information Communication Technology

GPS  Global Positioning System

LTS  Land Transaction System

LUPA  Land Use Planning and Allocation

LAO  Land Administration Organisation

COTS  Commercial Off The Shelf
1. Introduction

1.1. Background

According to the United Nations, land management involves the implementation of fundamental policy decisions about the nature and extent of investments in land. In this regard, land management should be based on knowledge, knowledge on information, and information on the methods of data collection and the manner in which their results are communicated (Dale and McLaughlin, 1988; UNECE, 1996). Because of its strategic value and cost of acquisition, land-related information is an important and expensive resource that must be carefully managed in order to maximize its potential value (Dale and McLaughlin, 1988; UNECE, 1996; van der Molen and Lemmen, 2003).

A land information system can be defined as a tool for legal, administrative, and economic decision making and an aid for planning and development. It may comprise human and technical resources which together with appropriate organizing procedures are applied to the collection, storage, retrieval, dissemination, and use of land-related information (Dale and McLaughlin, 1988). The real value of such a system lies in the extent to which it benefits the user rather than the producer of the information (UNECE, 1996).

The advancing tide of computerization and digital technology raises, not only the society’s expectations regarding the delivery of information (Jones et al., 1999), which exerts pressure on Land Administration Organizations (Dale and McLaughlin, 1988; Groot and McLaughlin, 2000), but also creates new opportunities for data collection, storage, integration, dissemination as well as service provision (Groot and McLaughlin, 2000). As a result, many agencies responsible for managing national cadastres have or are automating their information systems in response to identified need (Dale and McLaughlin, 1988).

The type and extent of land information systems implemented depends on how the maintenance of the cadastre is organized. In some countries the cadastre and the land register are administered by one public office but in some cases by two different offices. One agency may be responsible for the cadastral records while the other may be responsible for the land register. In such cases it has also been observed that separate information systems will be developed, which may or may not be able to communicate as is the case in most Southern African countries. The information more often exists in either textual or graphical form (Dale and McLaughlin, 1988).

1.2. Legacy Information Systems

Information systems in general and Land Information systems in particular are designed and built to support certain business requirements. As new business requirements and expectations arise, the Information systems are modified, enhanced, partially replaced and new elements are added. These modifications if not well controlled result in very complex systems which may fail to meet future
business needs but end up as legacy systems which are dysfunctional or disjoint with the current business.

Legacy systems evolve over a number of years, and embody substantial corporate knowledge, including requirements, design decisions, and business rules. Legacy systems pose problems related to brittleness, inflexibility, isolation, non-extensibility and lack of openness. In order to effectively use these assets, it is important to develop a systematic strategy for the continued evolution of currently fielded systems in order to meet changing mission, technology and user needs. Managing long-term software evolution is critical, because systems cannot be easily replaced (Brooke and Ramage, 2001; Sommerville, 2001).

However, it is important to note that even as the current Information systems are being transformed, the internal and external business processes they support will need to continue with as little disruption as possible (Brooke and Ramage, 2001; van der Molen and Lemmen, 2003). There is a further need to ensure that the resultant system will be able to support future business processes and not end up being a legacy system itself (Sommerville, 2001).

1.3. Prior work on the renovation of Land Information Systems

The problem of Legacy information systems has been a subject of research for a number of years and notable papers have been presented (Bing et al., 1997b; Chikofsky and Cross, 1990; Cimitile et al., 1997; Jansen and Nielsen, 2005; Ransom et al., 1998; Tilley et al., 2000; van der Molen and Lemmen, 2003). In going through most of the papers that have been produced on the subject of information systems renovation, one is confronted with a lot of different terminology, sometimes referring to the same issue. This has implications for further developmental research in the field as research may end up concentrating on one area instead of building on prior research. Chikofsky and Cross produced a paper in an attempt to standardize the terminology and came up with a taxonomy that in some circles has unfortunately not found widespread use (Chikofsky and Cross, 1990).

Presenters at the FIG symposium on Strategies for renewal of information systems and information technology for land registry and cadastre (van der Molen and Lemmen, 2003) interchangeably used the terms ‘renewal’ and ‘renovation’ of information systems. At the symposium, presenters from 12 European countries discussed the different reasons why they were renovating, the renovation strategies they were using, and the conditions under which they were carrying out the renewal. The papers presented were largely on the renewal of information systems and information technology for land registry and cadastre.

In his MSc research Dorji worked on the development of a strategy for reengineering parcel based information systems in Bhutan. An aim of the research was to ‘reinvent’ the Bhutanese land information system in such a way that it could be developed and maintained with minimal adverse impact on the organization and the country as a whole (Dorji, 1993). To do this he placed emphasis on the needs of the users, the problems and deficiencies of the existing system. The outcome of the project was a proposed strategy for developing the Bhutanese parcel-based information system.
Ochieng in his research on developing structured steps in defining the geological survey of Kenya’s new role to support society devotes part of his work on reengineering the information system and also focuses on the implementation issues (Ochieng, 2002). Among other issues, the research aimed at re-engineering the geological survey’s Information system by proposing a Business Process Reengineering methodology, identifying strategies and actions through a SWOT analysis and finally developing a global design of the new Information System. The research also outlines key implementation issues and business plans to implement some of the changes.

1.4. Research Problem

In renovating Information systems it is important to note that there are several dilemmas that will confront organisations. Legacy systems embody substantial corporate knowledge, including requirements, design decisions, and business rules which stand the risk of being lost during renovation (Sommerville, 2001). On the other hand legacy systems are expensive to replace and to maintain, and renovation also takes place at a time when businesses are operating as normal. Care should be taken because too little renovation may result in a system that is a replica of the original, while too much renovation may strain resources and staff (Sommerville, 2001).

Most of the research on the issue of information system renovation has been focusing much on the technological part with little or surface focus on the other environmental aspects affecting the information systems (Cimitile et al., 1997). Recent research has tended to develop frameworks with focus on renovation from socio-technical perspectives, for which there is no solution blueprint (Mitleton-Kelly and Papaefthimiou, 2001). Brooke and Ramage advocate for a movement away from the notion of optimal solutions and take the view that a set of alternatives based on an evaluation of the strategic implications of legacy land Information system renovation on business may be a more feasible solution for decision makers (Brooke and Ramage, 2001).

This research aims to focus on the renovation of Land Information Systems from a socio technical perspective. The research aims to evaluate the factors and conditions under which Land Administration Organisations struggle to prevent their land information systems from becoming legacy systems in a dynamic and rapidly changing environment. In doing this the research will also borrow from works on co-evolution, software reengineering and evolution theory.
1.5. Objectives

1. To investigate the conditions under which Land Administration Organisations implement different renovation approaches to maintain alignment between their land Information Systems and business processes.
2. To recommend renovation alternatives for use by Land Administration Organisations in the study sites.

1.6. Main Research Questions

1. What are the impacts of land information system evolution on the businesses of Land Administration Organisations?
2. What approaches have been used to renovate land information systems to align them to changing business needs?
3. What are the factors that affect the renovation of Land Information systems in Land Administration Organisations?
4. What are the implications of different renovation approaches on the operational environments of Land Administration Organisation?

1.7. Research Approach

The adopted research approach was as shown in Figure 2 below.

Figure 2: Research Approach
The research comprised the following phases namely the problem definition, development of the conceptual framework, development of field data collection tools, field work, field data interpretation and analysis, development of renovation guidelines and thereafter conclusions and recommendations.

1.8. Research Framework

The research framework to address the research questions raised above included the following:

1.8.1. Development of a conceptual framework

The conceptual framework was developed through the review of literature on Information systems in general and land information systems in particular, legacy systems, existing renovation strategies and frameworks, co-evolution, software reengineering and evolution theory.

1.8.2. Development of field data collection tools

Case study research was used. Data collection was based on multiple data collection methods comprising semi structured interviews, review of organizational reports and publications, archival records, direct observation of organizational environments and physical artifacts. A research protocol and a research guide with structured, semi structured and open ended questions was developed to ensure a systematic elicitation of the relevant information. Interviewees were chosen in accordance to four broad criteria namely users, customers, developers, stakeholders.

1.8.3. Field work

The fieldwork was undertaken in two countries, Namibia and Zimbabwe while the Netherlands case was covered by studying existing documents. The selection of the study sites was based on the ease of logistics and accessibility, the environmental context in which the land information systems were developed (developing and developed country) and finally the progress in dealing with Land Information System renovation (stage of legacy solution).

1.8.4. Field data interpretation and analysis

The study used qualitative methods of data analysis. These included document analysis, behavioral analysis and pattern – matching. This involved the comparison of empirically observed patterns with predicted patterns from literature and employment of natural control situations(Yin, 1989). See also Table 1.

<table>
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<th>Research Questions</th>
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Table 1: Research methods
1.9. Conclusions and recommendations

An understanding of the implications of the evolution of information systems and the strategies that are applicable to the renovation of land information systems was obtained through literature reviews. This was further augmented by fieldwork, whose main thrust was to get an understanding of the conditions prevailing in the study cases. Understanding the operational environments in the three different contexts helped evaluate the applicability of alternative sets of renovation strategies in the context of each of the three Land Administration Organisations. Recommendations on the renovation of land information systems in the three Land Administration Organisations were then made based on the assessments made.

1.10. Research Timeframe

The research timeframe was as shown in Table 2 below

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Table 2: Research Timeframe

1.11. Thesis structure

The structure of this thesis is as follows:

Chapter 1
Dealt with the articulation of the problem statement, the objectives, research questions, research approach and methodology, the research timeframe and the thesis structure.

Chapter 2
The conceptual framework was developed from existing literature on Information systems, Land information systems, systems renovation and legacy, co evolution, software evolution and reengineering and organisational fit was also reviewed. An evaluation of the major factors underpinning the evolution of Land Information Systems in Land Administration Organisations was made.

Chapter 3
The chapter focused on the fieldwork preparation and the methodology used in carrying out the fieldwork. The methods used during the conduct of fieldwork are briefly discussed including the
reasons why they were chosen. A brief background of the study cases is given, why the cases were chosen, how respondents were chosen. Issues of how validation was done and the biases of the research are given. Finally a discussion of some of the problems encountered and the methods used to mitigate the effects is given.

Chapter 4
The chapter focused on the presentation of the data that was gathered during the field work. The presentation of the data was guided by the research objectives, the research questions and most importantly the conceptual framework. It describes the prevailing conditions in the study sites that lead to the current information system condition and how the same conditions will affect efforts to improve and determine the state of the target system.

Chapter 5
This chapter was focused on analyzing and interpretation the fieldwork findings in order to get an understanding of how renovation takes places or is affected in the study sites. Discussions of critical factors for the implementation of renovation strategies as they apply to the three case studies are made by making comparisons between the empirically observed patterns with predicted patterns deduced from theory. Comparisons were also made between observations made in the case studies.

Chapter 6
This chapter focused on the development of recommendations on the way forward in the renovation of the LIS in the three study areas. Based on the current states of the Land Information Systems and the factors emanating from chapter 5, different renovation approaches were evaluated for feasibility by evaluating their implications on the Namibian, Zimbabwean and Netherlands contexts.

Chapter 7
Conclusions were made in respect to how the research objectives were addressed through answers to the research questions. Based on this analysis, recommendations for further research were made.
2. Land Information Systems renovation

2.1. Introduction

Information systems have revolutionized the way business is run in the modern economy. They have been documented to provide organizations with a competitive edge over their competitors (Dale and McLaughlin, 1988). Indeed they have moved from being used for automating process to being indispensable in the mapping of the strategic direction of the organizations in which they have been implemented (Henderson and Venkatraman, 1993).

An understanding of how organizations manage the evolution of their information systems is important because changes have to occur without the organizations and their clients closing shop. This requires sensitivity to the internal and external business processes that depend on the Information Systems. During evolution, the organization also has to balance the amount of change with its capability to handle change, risks aligned to failure, cost and also the future business demands (Sommerville, 2001). This chapter aims to look at the processes, practices and concepts relevant to the formulation of socio technical approaches to the management of Land Information Systems by Land Administration Organisations (LAO) in the face of a dynamic business and technological environment.

According to Chikofsky and Cross (1990) there is considerable confusion on the terminology that is used in both the technical and market place discussions regarding to the enhancement and maintenance of existing systems. In some cases, the terms have been misused and applied in conflicting ways. Accordingly the terms in the Glossary will be adopted and used for this study.

2.2. Information System

Wikipedia defines Information Systems as systems of persons, data records and activities that process the data and information in a given organization and includes manual processes or automated processes. Wikipedia goes on to say that the term information system has different meanings depending on the field of interest. From sociological perspective, information systems are social systems whose behaviour is heavily influenced by the goals, values and beliefs of individuals and groups, as well as the performance of the technology. From a systems theory perspective, an information system is a system, automated or manual, that comprises people, machines, and/or methods organized to collect, process, transmit, and disseminate data that represent user information.

2.3. Land Information Systems

Land Information Systems (LIS) have been defined by the International Federation of Surveyors (FIG) as ‘... a tool for legal, administrative and economic decision-making and an aid for planning and development. A land information system consists, on the one hand, of a database containing spatially
referenced land-related data for a defined area and, on the other, of procedures and techniques for the systematic collection, updating, processing and distribution of the data. The base of a land information system is a uniform spatial referencing system, which also simplifies the linking of data within the system with other land-related data. (Dale and McLaughlin, 1988; UNECE, 1996). This may be represented as in figure 3 below, adapted from (Dale and McLaughlin, 1988).

Figure 3: Land Information system

The usefulness or relevance of a land information system depends on the extent to which it is; up to date, accurate, complete, accessible and beneficial to the user and not just the producer of information (Dale and McLaughlin, 1988). These aspects provide good dimensions for evaluating LIS usefulness to society and it is vital for providers of land related data to constantly evaluate themselves against these dimensions if they are to sustain their relevance to society.

2.4. Role of Land Information Systems in Society

Land is often identified as the primary resource from which wealth is derived. Land information systems have widespread use in land administration. A land administration system provides important information for government, the economy and society at large. Land management, an instrument of Land Administration must be based on knowledge, knowledge on information, and information depends on the methods of data collection and the manner in which their results are communicated (Dale and McLaughlin, 1988; UNECE, 1996).

Land-related information (both textual and graphic) is an important and expensive resource that must be managed efficiently in order to maximize its potential benefits (Dale and McLaughlin, 1988). The information should be viewed as a strategic resource for development and business. Modern Geo-Information Technology offers great potential for the dissemination and use of digital land information to meet society’s demands for rapid access to relevant and reliable information (Dale and McLaughlin, 1988; UNECE, 1996).
The creation and maintenance of an automated cadastre (which will be used synonymously with Land Information system in this research) requires attention not only to technical details, but also to legal, organizational and economic matters. In order to ensure the efficient production and use of Land related information, suitable techniques and organizational arrangements for data exchange must be put in place (Dale and McLaughlin, 1988). There needs to be a “market-place” where data of interest can be checked for content, quality, price and conditions of delivery, and where it is possible to order data via an effective communications network (Dale and McLaughlin, 1988; UNECE, 1996). This can be done by means of a Land Administration Organisation (LAO).

2.5. Administration of Land Information Systems

National differences can be observed in approaches to organizing land administration and establishing offices responsible for the implementation and maintenance of cadastres and registers. Although from an economic and administrative point of view, a single organization would be desirable, in many countries dual systems exist (UNECE, 1996). While in developed economies there is normally one governmental authority responsible for land administration, in developing countries there are often two with cooperation resting more on personalities than on policies (Dale and McLaughlin, 1988; UNECE, 1996).

Dual systems normally comprise a cadastre (administered by a cadastral organization, usually a part of the national mapping and surveying authority, or a special agency that records property boundaries and data for tax authorities) and a legal registration system (administered by the Deeds Registry or the local or regional courts) (Dale and McLaughlin, 1988). This arrangement has been said to suffer from duplication of effort, additional costs, inconsistencies and, hence, inaccuracies in the data posing a danger of confusion and consequently wrong decisions being made (UNECE, 1996). In this research the term Land Administration Organisation shall be taken to represent the single organisation (Dutch Kadaster) and the organisation that administers the cadastre in the dual case (Namibia and Zimbabwe).

2.6. Information systems and business alignment

All business activity takes place within a social environment, thus business is dependent upon society. Correspondingly, society makes demands on business activity. The advancing tide of computerisation and digital technology not only raises expectations on the delivery of information (Jones et al., 1999) but also presents excellent opportunities for automation of cadastres and the creation of cost-effective land administration systems (Groot and McLaughlin, 2000). Customers increasingly require fast responses to requests for products and services and this inevitably caused Land Administration Organizations (LAO) to experience a lot of pressure to automate (Groot and McLaughlin, 2000).

No business can survive in the long run if it fails to address stakeholder interests when formulating its business strategy (Greenway, 2006). To reap the full benefits of ICT, there should be an alignment between LAO business and ICT. Strategic alignment between business and ICT is the process of achieving competitive advantage through developing and sustaining a symbiotic relationship between business and ICT (Henderson and Venkatraman, 1993). Henderson and Venkatraman in their strategic
alignment model (Figure 4) conceptualised and directed the area of strategic management of information technology. The concept is based on two building blocks i.e. strategic fit and functional integration. Strategic fit recognizes that the strategy should be articulated in terms of the external domain (ICT market place positioning) and an internal domain (how the ICT infrastructure should be managed and configured).

In the functional integration dimension, Henderson and Venkatraman (1993) propose two types of integration which consider how choices made in the ICT domain enhance or threaten those made in the business domain and vice versa. Strategic integration is the link between business strategy and ICT policy reflecting the external components. The second type, operational alignment, covers the internal domain and deals with the link between organisational processes and practices and ICT systems.

Henderson and Venkatraman in the Strategic Alignment Model stress that alignment is not a one point in time action (Van Grembergen et al., 2004). The challenge is to ensure the ‘continuous’ assessment of the trends across the four domains and to evolve from one perspective to another based on shifts in the internal and external business environment (Van Grembergen et al., 2004). This implies the necessity for ‘continuous’ learning in organisations.

It has however been pointed out that although the Strategic alignment model recognizes the need for continuous alignment, it does not present a practical framework for implementing this (Van Grembergen et al., 2004). The Organisational Fit Framework (OFF) created by Earl has been cited as one research that has made some progress into providing a practical frameworks, but the realisation has been that achieving alignment in environments of dynamic business strategies and continuously evolving technologies is very difficult to accomplish (Van Grembergen et al., 2004). For this, there is need for close cross domain co-operation between IT personnel and other personnel in organisations since they are all actors in this dynamic environment (Mitleton-Kelly and Papaefthimiou, 2001). In this instance it is important to draw lessons from co evolution Theory to reach the desired state.
2.7. Why Information systems evolve

In Information systems as in any active system, change is inevitable. Lehman’s first and sixth Laws on software evolution, respectively state that an E-type program (a program that is used in a real-world environment) should continually be adapted else it becomes progressively less satisfactory and that the functional content of a program must be continually increased to maintain user satisfaction over its lifetime (Lehman, 1996). According to Yu and Ramaswamy, studying and comparing the internal structures and overall evolution process of biological systems can aid the understanding of software systems from a holistic ‘product-lifecycle’ perspective thereby helping organisations develop software systems with better evolvability traits (Yu and Ramaswamy, 2006). From this it follows that evolution is a natural and necessary stage of a system's life and addresses 2 key issues associated with software systems: the environment in which a system operates is dynamic and software development invariably introduces errors.

Changes that continuously take place around organizations cause them to change in order to survive. To maintain alignment, the internal structures that support them (LIS) also have to change (Yu and Ramaswamy, 2006). Systems need to change and adapt to either a new environment or a new requirement in order to survive, those systems that have high evolvability will survive and those that don’t will be eliminated (Yu and Ramaswamy, 2006). This is reinforced by Lehman’s seventh Law which states that E-type programs will be perceived as of declining quality unless rigorously maintained and adapted to a changing operational environment (Lehman, 1996).

Therefore information systems in supporting critical end-user organisation processes can act either as enablers or disablers of change. They are enablers when they support new types of business processes that would be unmanageable without them. They are disablers when their complexity causes costs of making changes unacceptable, and when they become inflexible such that desirable business process change can not be made fast enough, becomes too expensive or simply unachievable (Henderson, 1999).

Henderson (1999) notes that Information Systems are much more than computers, programs, databases and networking, but that organisations also invest in skills, in data, in business processes and that all these must co-evolve(Brooke and Ramage, 2001). Therefore changes on part of the system can not be made without affecting the other interfacing parts. As systems get older, everything becomes so interconnected due to a lifetime of maintenance, that even apparently small business process changes would require substantial re-engineering work (Henderson, 1999). This is shown more clearly in figures 5 and 6 (both adopted from Sommerville, 2001), below and also appendix D.

<table>
<thead>
<tr>
<th>Layer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business Processes</td>
</tr>
<tr>
<td>Application Software</td>
</tr>
<tr>
<td>Support Software</td>
</tr>
<tr>
<td>Hardware</td>
</tr>
</tbody>
</table>

Figure 5: Layers of a legacy system (adopted from Sommerville, 2001)
Looking at the two figures above, Sommerville says that:
(1) Changing one layer in the system may introduce new facilities, and higher layers in the system may then be changed to take advantage of these facilities;
(2) Changing the software may slow the system down so that new hardware is needed to improve the system performance. The increase in performance from the new hardware may then mean that further software changes which were previously impractical become possible and
(3) it is often impossible to maintain hardware interfaces, especially if a radical change to a new type of hardware is proposed (Sommerville, 2001).

Mitleton-Kelly and Papaefthimiou say that some dilemmas faced by Information Systems in Organisations include:
(i) Rapid technological change and the need to keep up with current technology exert a constant pressure on management, which must be offset against the cost of the investment.
(ii) The existing technological infrastructure, in combination with the increasing obsolescence of technology fails to meet emerging expectations and to keep up with new business requirements.
(iii) Alignment and interfacing between existing and new technology (in terms of new platforms, new hardware, new software and processes) introduce mixed problems contributing to institutional friction (Mitleton-Kelly and Papaefthimiou, 1995).

However, the creation and maintenance of an automated cadastre (synonymous to Land Information system in this research) requires attention not only to technical details, but also to legal, organizational and economic matters. It implies that the manager needs to deal with issues aligned to the organizational structure, investment strategies, skills, responsibilities, recruitment, downsizing, staff development and training, change management, ergonomic factors (to reconcile efficiency with comfort), staff welfare and reassessing the relationship between what is done in the field and what is done in the office and the linkages between them (UNECE, 1996).
2.8. Strategies that have been used to renovate Information Systems

Different approaches have commonly been used to cope with Legacy Information Systems. Each approach varies in terms of changes required and costs and risks involved. Figure 8 (Bisbal et al., 1999a) below shows some of the approaches used.

According to figure 5, redevelopment leads to the most changes (system revolution) and wrapping the least (system evolution)(Bisbal et al., 1999a). Because Bisbal et al., were dealing with Legacy information Systems, a software system that can be maintained within an acceptable budget is usually not considered a legacy information system, they only included maintenance for completeness. However for this study, maintenance will be necessary because some of the LIS studied are not legacy systems and some include legacy components.

**Wrapping**

Wrapping is a non-intrusive approach often serving only as a short-term solution. The approach is applicable in situations where there's no need to change business functionality in the existing platform. The technique builds callable APIs around legacy transactions, providing an integration point with other systems (Seacord, 2003). One example of wrapping commonly used is screen scraping. Screen scraping (often called ‘frontware’) is an option when the intent is to deliver Web access on the current legacy platform. Screen scraping provides Internet access to legacy applications without making any changes to the underlying platform. Because they're non-intrusive, screen scrapers can be deployed in days and sometimes hours.

**Disadvantages**

- is a short-term solution in that it does not address many problems faced by such systems, including overloading, inability to provide new or enhanced functionality, the high cost associated with maintaining a legacy system or finding IT professionals willing to work on obsolete technology,
- Scalability can be an issue because most legacy systems cannot handle nearly as many users as modern Internet-based platforms,
- screen scraping actually compounds an organization’s maintenance problems, as the screen-scraping software will also require maintenance,
Advantages
- EAI vendors advocate wrapping as a way to tap legacy data while avoiding the misery of trying to modify the underlying platform,
- enables integration vendors to focus on the communications and connectivity aspects of their solutions, while avoiding the complexity of legacy systems,
- allows organizations to reuse trusted, well-tested components and to leverage their massive investments in the LIS,
- may actually reduce training costs for new employees and allows an interface to the legacy system to be placed on the desktop,
- provides a “roadmap” to substitute the old system (if that is the aim) incrementally and resource intensive “big-bang” replacement is avoided.

Maintenance
Maintenance is applicable in case a legacy system still functions relatively well. No intrusive changes accompany this strategy, so it is by far the preferred strategy from a cost and risk perspective. It involves nurturing the application without making fundamental changes to the code or breaking its underlying architecture. The strategy basically comes in three variants: adaptive maintenance, corrective maintenance, and perfective maintenance (Warren 1999; Weiderman et al. 1997). Adaptive maintenance pertains to making minor changes in the system’s functionality to ensure that it stays aligned with new business requirements or changing a system so that it operates in a different environment from its initial implementation. Corrective maintenance activities can be directed at correcting deficiencies in the way it meets its requirements e.g., by eliminating errors in the code, and perfective maintenance involves optimizing existing code so it better meets both functional and quality-of-service requirements in a more efficient manner (van den Heuvel, 2006).

Maintenance cost factors
Team stability: the cost is reduced if the same staff is involved in the process for some time.
Contractual responsibility: the developers of a system have no contractual responsibility for maintenance, so they may not have any incentive to develop it with scope for future changes.
Staff skills: maintenance staff are normally inexperienced and with limited domain knowledge.
Program age and structure: as programs age, their structure is degraded and harder to understand and change

Maintenance process

Figure 8: The maintenance process
Migration involves moving an existing, operational system to a new platform, retaining the legacy system’s functionality and causing as little disruption to the existing operational and business environment as possible (Bing et al., 1997a; Bing et al., 1997b; Bisbal et al., 1999a; Brodie and Stonebracker, 1995; Seacord et al., 2003). It forms the best approach when redevelopment is unacceptably risky and wrapping is unsuitable. Its goal is to improve the information systems’ maintainability and adaptability to new business requirements, while retaining the functionality of existing information systems (Chikofsky and Cross, 1990). It involves the following:

1. **Cold Turkey or Big Bang Approach**

   This is a ‘from scratch’ approach to migrating legacy systems. The system is completely redeveloped to a new hardware platform using a modern architecture, tools and databases. The strategy tries to replace the original system with the target IS in one step without intermediate steps. During the development of the modern IS the legacy system is always in use until the cutover. The transition to the modern IS takes place in one single step and this involves a great risk of failure (Bisbal et al., 1999a).

2. **The Database First Approach/forward migration method**

   This approach is only applicable to fully decomposable legacy systems where a clean interface to the legacy database service exists. The legacy data is first migrated to the new environment. After the data migration, the rest of the applications and interfaces are incrementally migrated. This approach involves the use of a Forward Gateway, which enables the legacy applications access the migrated data in the new environment (Bisbal et al., 1999b).

   **Disadvantages**
   - Differences between the source and the target technology and in database structure and constraints can make the construction of the Forward Gateway very difficult,
   - may take a long time during which the legacy system will not be accessible making it unacceptable for critical systems,

   **Advantages**
   - offers a rather simplistic approach,

3. **The Database Last Approach/Reverse Migration Method**

   The approach is suitable only for fully decomposable legacy systems. The legacy applications are first gradually migrated to the new environment but the legacy data remains in the original platform. Legacy data migration is the last phase of the migration process. During migration, the legacy database takes on the role of a database server with the target applications operating as clients and using a Reverse Gateway to access legacy data (Bisbal et al., 1999b).

   **Disadvantages**
   - Features found in relational databases (integrity, consistency constraints, and triggers), may not be found in the legacy database, and hence cannot be exploited by the new application.
Advantages
• regarded as a more commercially viable option compared to the Database First approach as legacy applications can continue to operate normally while being redeveloped.

This approach uses both Forward and Reverse Gateways. The target applications are gradually rebuilt with modern tools and technology. During the migration process the target system accesses legacy data through a reverse gateway and legacy applications access target data through a forward gateway. Sometimes data is duplicated across both databases, which causes problems with data integrity. For this reason a co-ordinator is used. Co-ordinator intercepts all requests and determines what updates have to be made in both databases (Bisbal et al., 1997).

Disadvantages
• may involve data duplicated across both the legacy and the target databases and thus involves very complex strategies to ensure consistency between the legacy and target databases.
• the Reverse Gateway can make target and legacy database schema mapping complex and slow, and this may affect the new applications,
• does not include a testing-step, which is clearly essential and a vital part of the process before retiring the legacy information system,
• In general the approach would pose a big challenge to the migration engineer.

Advantages
• breaks the migration process into a series of well-designed stages.

5. The Butterfly Methodology (Gateway free –approach)
Objective of this methodology is to migrate a mission-critical legacy system to a target system in a simple, fast and safe way. The approach assumes that while the legacy system must remain operable throughout migration, it is not necessary for the legacy and target systems to interoperate during this process. This leads to the elimination of gateways, thus avoiding the complexity they involve. Once data migration commences, the legacy data store is “frozen” to be read-only. The combination of Data-Access-Allocator and Chrysaliser serves as a data migration engine for legacy data migration.

Disadvantages
• Requires a thorough understanding of the legacy and target systems, an accurate and concise sample data store, a fast chrysaliser and the presence of an efficient Data-Access-Allocator.

Advantages
• The period during which the legacy system is inaccessible is minimal and the legacy system does not need to inter-operate with the target system.
• allows target applications to be intensively tested and verified against data held in the Sample Data store.
• Each step of the Butterfly methodology can be completely tested and the legacy database can be rolled back at any stage.
• The legacy system can continue to operate as normal throughout the migration until the last TempStore has reached the predetermined size.

**Retiring the system**
The most extreme evolution strategy is to discontinue the enterprise application. This means that the supporting business process would also cease to exist.

**Replacement by COTS**
Replacement may be applied when the businesses of the organisation must change radically to meet the needs of the market place or when the legacy system has deteriorated beyond reclamation e.g., when the code quality of the original system is so poor that it can't be reused. It can be done using a new system developed from scratch, an Enterprise Resource Planning Software (ERP) system or commercial off-the-shelf (COTS) components externally developed or procured to substitute a legacy system. However, deploying a modern ERP system is not a panacea. An organization either has to customize the software or its business processes. Customizing the software is necessary if the original system was custom-made and provided a critical business advantage. Modern ERP have added tools to help adapt them to customers’ specific needs (Seacord et al., 2003; van den Heuvel, 2006; van der Molen and Lemmen, 2003).

**Disadvantages**
• A packaged system requires retraining of end users whose productivity will slow as they adjust to a new way of doing their jobs.
• IT staff will need training on the new system.
• ERP may require hefty licensing fees that remain throughout the life of the software.
• Customization carries enormous risks that the system won't be able to duplicate a unique set of business processes.

**Advantages**
• Offer a feasible option for those organizations that have limited IT capacity support either internally or in their local environments.
• old, difficult to maintain code is removed,
• the solution is automatically adjusted to new technologies
• Possible out of date work practices, associated with the legacy system, are removed from the organization.

2.9. **Factors affecting Land Information Systems renovation**
The following factors have been cited as influencing the renovation of Land Information Systems:

**Change drivers**

**Hardware changes**
To remain competitive and survive, organisations try to exploit advances in hardware technology (which provide for new capabilities and performance gains) and data storage media (that allow systems to provide rapid on-line access to vast quantities of data) (van der Molen and Lemmen, 2003; Warren, 1999). Where a system's hardware has become obsolete and non-functioning, it may be sensible to replace it. For example VAX/VMS, Sun SPARC/SunOS, even PC/Windows NT are all now end-of-life, non-supported products (Mosley, 2006). Hardware that is no longer serviceable provides a weak foundation which is not recommended when implementing business critical applications. Changing hardware in many cases has extensive side effects, for example propagating changes to software (Warren, 1999). Switching from a VAX to a PC means new software tools (Mosley, 2006). In some cases, the target system may need to change because of other changes in the embedded environment such as the inclusion of new peripheral devices or a faster communication bus (Mosley, 2006).

In embedded hardware and software systems, if the host development system and the development tools are still working and the target system is adequate, there is no need to migrate (Mosley, 2006).

**Software changes**

The software of a system comprises both system software and application software. System software includes operating systems, compilers and 4GLs. These also evolve and new versions are released to customers periodically. New versions either correct errors of earlier ones or provide functional or non-functional enhancements. To encourage customers to acquire new versions, vendors often discontinue support for previous releases (Warren, 1999). In other cases, the software vendor may no longer be available, which means that the software can no longer be supported (Mosley, 2006).

On the other hand, new versions may propagate application software change or may require additional memory or processing capabilities, forcing hardware changes (Warren, 1999). A change in the application might cause a physical constraint of the target processor to be exceeded or some problem aligned to a memory addressability limitation, a processor throughput limitation, or a power consumption limitation to be encountered (Mosley, 2006).

**Changes in user needs**

User needs change over time and may result in change requests that generate functional or non-functional requirements which cannot be satisfied by the system (van der Molen and Lemmen, 2003). At the same time vast quantities of data accumulate to such an extent that at some point the system takes an intolerable period of time to process the data (Warren, 1999). A non-functional requirement for performance enhancement may be generated, resulting in the need to replace the current hardware with faster processors, or by modifying the data structures used to store the data (Warren, 1999).

**Changes to business process**

As already discussed earlier, organisations need to respond to changing marketplaces in order to remain competitive. Changes in business process often generate new requirements which place a corresponding need for change on the supporting information system (van der Molen and Lemmen, 2003; Warren, 1999). Business process reengineering often results in radical changes to the working practices of organizations usually resulting in the supporting software systems being heavily affected. In cases of radical business process reengineering, further evolution of existing software systems may
be inappropriate and new systems must be developed, perhaps with some reuse of existing software (van der Molen and Lemmen, 2003; Warren, 1999).

**Total cost of ownership**

An unusual reason that has been witnessed is that product royalties charged by some software vendors affect the profitability of the system. It is cheaper for the developer to migrate to another set of software tools rather than continue to pay high royalties (Mosley, 2006). One other reason for migration was that the expertise in a product or tool set is lost and the product becomes difficult to maintain (Mosley, 2006; van der Molen and Lemmen, 2003). Staff attrition results in some loss of accumulated knowledge as well. Some software systems have been “patched” repeatedly, and when responsible staff leave, no one knows how to safely make a change to the system. Or the system is written in an old programming language of which there are very few engineers who still program using it (Mosley, 2006; van der Molen and Lemmen, 2003).

**External Environmental factors**

**Political factors**

These arise from central government initiatives aimed at increasing the efficiency and accountability of government departments. Initiatives calling on government departments to modernise their internal information systems and develop electronic services, passing of legislation to increase citizen access to information held by government organisations and the requirements to have interoperable government databases that enable a one stop shop for customers have an influence on a government organisation’s information systems (van der Molen and Lemmen, 2003). Other changes have also lead to levels of land ownership increasing thus increasing the amount of information to be handled by the information systems. Political factors are also related to the level of control that governments exert on the organisations as shown in table 3 below (Lioukas et al., 1993).

<table>
<thead>
<tr>
<th>Area of control</th>
<th>Dimension</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control on human resources</td>
<td>Recruitment policy and hiring of specialists</td>
</tr>
<tr>
<td></td>
<td>Decisions over pay and rewards</td>
</tr>
<tr>
<td></td>
<td>Purchasing policy and contract award decisions</td>
</tr>
<tr>
<td>Control on strategic issues</td>
<td>Decisions affecting the scope of business activity</td>
</tr>
<tr>
<td></td>
<td>Important investments and large projects</td>
</tr>
<tr>
<td>Control on financial issues</td>
<td>Distribution of profits</td>
</tr>
<tr>
<td></td>
<td>Borrowing decisions (sources, limits, conditions)</td>
</tr>
<tr>
<td></td>
<td>Decisions about the use of foreign currency</td>
</tr>
<tr>
<td>Control on purchasing and</td>
<td>Managerial appointments</td>
</tr>
<tr>
<td>appointments</td>
<td>EDP decisions (hardware, software, MIS)</td>
</tr>
<tr>
<td>Control of output decisions</td>
<td>Pricing of products or services</td>
</tr>
</tbody>
</table>

Table 3: Patterns of control adopted from (Lioukas et al., 1993)

An organisation’s autonomy may also be viewed in terms of the statutory and fiscal autonomy of organisations. Statutory autonomy refers to the number of legal mandates imposing limits on the organization’s choices while the fiscal autonomy is a measure of both the mix of resources available to
an organization and the number of restrictions on the use of those resources. Organizations with multiple sources of revenue are less dependent on a single provider of those resources and therefore have greater autonomy. Combining relative measures of fiscal and statutory autonomy on separate axes, it is possible to develop a typology of public organization autonomy (Vinzant and Vinzant, 1996). This may be represented as shown in figure 9 below.

Figure 9: Typology of organisational autonomy (Vinzant and Vinzant, 1996)

Figure 9 presents a way of categorizing organizational autonomy. Limited organizational autonomy prevents an organization from implementing widespread successful change. As the number of constraints increases, the usefulness of strategic management diminishes. Accordingly the return on an investment of effort and resources for implementing strategic management is greatest for organizations in Quadrant II, less so for those in Quadrants I and III, and least of all for those in Quadrant IV. Organizations in Quadrant IV and to a lesser degree those in I and III, because they do not have the autonomy to make the sometimes sweeping changes called for in strategic management, can expect the success and benefits of the approach to be limited accordingly. Further, lack of attention to this problem may result in false expectations and disillusionment (Vinzant and Vinzant, 1996). Although developed for strategic management, it can be applied to renovation of information systems.

Economic factors
Property was observed to be an attractive investment option due to factors aligned to increased personal wealth, interest rate levels and cushion against inflation. To maintain relevance, systems are continually modified, new functionality added and this increases system complexity. This, in addition to aging system development tools and Database Management Systems (DBMS) used, leads to rising maintenance and support costs (Van der Molen and Lemmen, 2003).

Social factors
Because of increased customer awareness, customers are increasingly dictating how services should be customised to meet their requirements. There is also increased demand for information and increased levels of home ownership (Van der Molen and Lemmen, 2003).
Technological factors
Modern society is characterised by growth in the use and ownership of personal computers (Jones et al., 1999). There have also been advances in the communication sector enabling wide information sharing possibilities over the internet. The internet has lead to growth in e-business and provision of online services where the customer can actually be able to create the end product (Lioukas et al., 1993).

Legislative factors
In some cases, the information systems have had to be changed in order to comply with changes in legislation. Changes in legislation may entail a change in the Land administration system processes. Such changes may involve the transfer of the land responsibility from courts to a national Mapping and Cadastre authority (van der Molen and Lemmen, 2003).

Organisational Factors
Organizational structure and volatility
Organizations are forced to continually redesign their structures to accommodate internal and external forces, for instance, new enterprise policies or cuts in funding. Organizational structures may fall into one of five archetypical configurations: machine bureaucracy, professional organization, diversified structure, simple structure (entrepreneurial start-up), and adhocracy. The last two structures are rather unstable and volatile, efflorescing in agile environments, whereas the others flourish in more stable environments. Black-box modernization strategies do not go well with adhocracies or simple structures because the legacy systems underlying the wrappers may not be altered (van den Heuvel, 2006).

Organisational culture
Organisational culture can be defined as the shared values and beliefs which take the form of rules of behaviour in a work group or organisation. At an elementary level, corporate culture can be viewed as ‘the particular way things are done’ in organisations. Culture will be influenced by many variables such as the ‘baggage’ people bring with them from their educational and social background or traditions and myths about the management style of the organisation, reporting structures, etc. It is shaped by numerous pragmatic actions over time based on what does and does not work. These beliefs and assumptions lie within a cultural web which bonds it to the action of organisational life. In some sense it represents the organisation’s social energy and personality and the assumptions and beliefs which it holds. Culture helps to concentrate individual energy in particular directions since the culture bottom line is expected behaviour of organisation members (van den Heuvel, 2006).

According to de Man and van den Toorn (2002), culture plays influences how a social group deals with problems by providing a ‘collective programming of the mind’. They go on further to say that different cultures see problems and thus apply information differently to solve the problems they face. With regards to the introduction and implementation of technologies in organizations, de Man and van den Toorn (2002) highlight two issue as worth noting: (1) the formulation of tasks and the procedures, organisational and institutional settings supporting the execution of the tasks; (2) attitude, and the organization’s focus on the level of competitiveness in its operational environment.
With regards to the second major factor de Man and van den Toorn (2002) say that a competitive environment will compel an organisation to seek and adopt innovative technologies. In a less competitive environment, an organisation will face less market pressure and would tend to be conservative in its organisation and operations.

Political context
Decisions about a strategy to cope with legacy systems must fit within the political context of an organization (van den Heuvel, 2006). Will modernization fit into the current context of heavy budget cuts and layoffs and if modernization is requested now, can the same be requested for other systems two years down the road?

Training
Modernizing legacy systems requires special skills that even the most seasoned software engineer or project leader may not have. The exact nature of these skills depends on the evolution strategy that is adopted. These skills might not be available in the company and could either be outsourced or acquired internally by training information technology staff. Consolidating an upgraded or revitalized legacy system also implies that users need to be trained (van den Heuvel, 2006).

Continuity of software providers
Before embarking on a strategy, companies should assess the continuity of new software and hardware vendors (van den Heuvel, 2006).

2.9.1. Review of international cases on renovation of Land Information Systems

The Hong Kong Land Registry had to transform the Land Registration System to meet the current and future needs of the community from 1999 to 2006. At the core of the transformation was a streamlined business process, supported by an Integrated Registration Information System (IRIS) replacing the existing fragmented computer systems. Upon implementation of the changes, a single, centralised registry and new organisation structure was put in place. The major driving forces for this change were new technology, new legislation, improved facilities and value-added services such as shorter business processing time, fast Internet access, enhanced data security and recovery, one-stop counter service, self-help service and a Chinese language facility for IRIS (Hong Kong Land Registry, 2005).

In May 2003 IT specialists from 12 European countries met in the Netherlands to share experiences on strategies to renew cadastre and land registry hardware and software systems. At that time many of the cadastres and land register authorities in Europe were confronted with the need to renew their information systems (van der Molen and Lemmen, 2003). Although most of the countries were quite content with the performance and reliability of their systems they foresaw the systems unable to meet future requirements like e-commerce, internet solutions and standards. Instead of being pressurised to renew their systems by customer requirements and pace, some authorities decided to do it at their own initiative (van der Molen and Lemmen, 2003).

It was reported, then, that most of the systems were at least 15 to 20 years, had been developed in-house and did not adhere to any international standards. Noting that maturity and advances in technology offered different opportunities at different times, it meant that different solutions could
only be implemented as the right opportunities presented themselves. As a result, there were no technical links between textual and graphical records in most of the information systems. This led to both systems holding redundant data, and a lot of effort being required to update the data and to keep both data sets consistent (van der Molen and Lemmen, 2003).

System maintenance to enhance functionality and to meet user requirements resulted in complex systems which restricted further technical development at reasonable costs. The Dutch Kadastre, for example, found that its system cost six times more to maintain compared to a modern systems. In addition, systems maintenance was no longer guaranteed since the majority of the developers and maintenance staff of the original systems were retiring (van der Molen and Lemmen, 2003).

2.10. Information systems deployment/cut over strategies

**Big bang**
The approach includes designing and building the new system as a whole, followed by instant changeover with simultaneous technological and organizational change. The approach involves great risk; requires substantial planning, preparation for change and extra funding; centrally managed; creates stressful conditions; suitable for applications that need “critical mass” of users (Eason, 1988).

**Parallel running**
Slower process with technological change preceding organizational adjustments; requires careful planning, extra time and funding; may be frustrating to run parallel both systems; problems with lagging organizational change; suitable for applications with “critical mass” of users and for avoiding implementation risks (Eason, 1988).

**Phased introduction**
Slower process with a gradual introduction of both functionality and users; technical issues do not dominate; sequence of system delivery is critical; does not require extensive resources, but appropriate attention should be devoted to each new group; risk is very low; advantageous for tailoring the system to user needs; suitable for independent set of users (Eason, 1988). Also demand construction of adverse interfaces of the old and new tasks, a task that consumes resources and whose products are necessarily discarded at the end of the project. However, it allows the organization to benefit from more time needed to understand and assimilate the new software and business environment.

**Trials and dissemination**
Small scale implementation intended for testing technical systems and for identifying possible problems and needs; does not require a lot of planning and extra resources; risk is low; lessons/experiences are hard to disseminate; solutions are unique for each group (opportunity for local design); suitable for environments with many problems, and where the acceptable pace of change is critical (Eason, 1988).
Incremental evolution
Slow, time consuming process; lacks planning, but requires an overarching policy infrastructure and strong user support; advantageous for local user-led design for professional and managerial groups; ad hoc approach can lead to dead end and difficult transfer of information (Eason, 1988).

2.10.1. Choosing an Ideal Renovation Strategy

Making decisions about the management of a legacy system entails defining a set of decision rules to be applied for discriminating among a variety of alternatives. Depending on the complexity of the problem, this may require that a systematic approach rather than an arbitrary one is followed. The decision model presented in this section provides a structured approach for making decisions during the life-cycle of a legacy system.

The process includes the following steps:
• Goal definition;
• Gap Analysis;
• Portfolio Analysis;
• Alternative definition;
• Conversion strategy definition.

Goal definition
The future objectives of the management about the system are specified taking into consideration the points of view and expectations of different stakeholders within the organization, such as its users, vendors, or maintainers, about the system and quantifying them. A structured approach such as the Goal/Question/Metric (Aversano et al., 2004a) can be used to obtain an expected Quality Profile of the system.

The Gap Analysis
Gap analysis is done to compare the expected against the actual Quality Profile of the system. It requires that the system quality is assessed, and a gap analysis matrix is produced listing the actual and the expected attribute values for each system unit. System assessment can be performed using the operational definitions provided by the assessment model. The units whose attributes will be affected by a gap require a maintenance intervention and are submitted to the next step.

The Hardware condition

Figure 10: Bathtub curve, (Ransom et al., 1998)
Failures in the first period (A) are relatively high dropping down to a low rate for a relatively long period (B). As the component begins to wear, failures increase (C) to the point where the component must be replaced. A low score for a hardware component generally means that the component is in area C of the curve. General characteristics that may be used to assess hardware quality may include vendor/supplier rating, failure rating, maintenance cost, age, ability to perform function and performance (Ransom et al., 1998).

**Software Condition**

With respect to software, it is important that interdependencies between software (support and application) components as well as hardware components be taken into account during the assessment exercise. The general characteristics for assessing software are the same as those for hardware described above, but may also include License costs, Frequency of fixes/patches and Quality of support personnel. To cause minimal disruption, it may be advisable to reengineer or replace only those components of poor quality. Thus individuals performing the assessment should understand the relationships between these software components and their interdependencies with other system software and hardware components (Ransom et al., 1998).

![Bath tub curves for Hardware and software](Software Technology Support Center, 2000)

General applicable characteristics for system applications include Complexity, Data, Documentation, External dependencies, Legality, Maintenance record, Size, Security and Test bed (Ransom et al., 1998). The assessment activities above produce a collection of characteristic-value pairs for hardware, support software and application software. These properties of the legacy system collectively provide a technical perspective of the system. A weighted average assessment value for technical quality can be derived from the technical property values.

**Business Value of the system**

Business value assessment is concerned with assessing the importance of the system to the organisation. It involves identifying business objectives which can be used to determine the importance of the system, within an organisation. These objectives can be: Economics based - such as Market Value or Contribution to Profit, Business based - such as Business Goals satisfied or User Satisfaction or Technical based - such as Data Significance or Level of Usage (Ransom et al., 1998).
In many cases, changes to business processes mean that old systems are now of only peripheral value and there is little point in expending time and effort in modifying these systems. In other cases, however, the systems are business-critical and must be maintained in operation (Ransom et al., 1998).

Portfolio Analysis

Enterprise applications need to be critically assessed and evaluated to ensure they are still aligned with new business process needs and technical requirements. Deciding on an optimal evolution strategy for dealing with an enterprise application may be assisted by portfolio analysis. The most well known portfolio analysis approach is the Nolan, Norton & Co. approach which has also been the basis of a number of other portfolio analysis methods (Aversano et al., 2004a; Bennett et al., 1999; De Lucia et al., 2001).

The approach evaluates applications in a portfolio along two orthogonal dimensions: business value and technical value. Each dimension is demarcated in two segments, one reflecting relatively high values and the other relatively low values. By relating both segmented dimensions a portfolio matrix encompassing four quadrants is created as shown in Figure 11 below.

![Portfolio matrix](image)

The business value depends on how efficiently and effectively the software asset is used in the organization and determines benefits to its stakeholders. Sneed (1991) explains that the contribution of legacy systems to the business value can be derived from their annual revenue accountable and their market value. According to Warren (1999), assessing business value should also take into account business criticality and expected lifetime. The business value assessments should take into account the economic value, data value, utility and the specialization of the system (De Lucia et al., 2001).

The technical value depends on the characteristics of the software components, and on the external technical environment of the system, including hardware, support software and organizational infrastructure. The technical value conveys the quality of a legacy system in terms of technical properties such as flexibility, deterioration (e.g., mounting back-logs and defect rates), and maintainability (e.g., program size and cyclomatic complexity) (Ransom et al., 1998). Faithfully measuring technical attributes requires a coherent quality framework that defines quantifiable
variables for each attribute and includes a solution for computing a weighted average score (Aversano et al., 2004b; Bennett et al., 1999; De Lucia et al., 2001). Each quadrant in figure demarcates a specific evolution strategy.

However the method has found criticism because: it is hard to establish and calibrate threshold values for business value and technical value in the matrix since no guidelines or industry-specific benchmarks currently exist for establishing them; implicitly assumes that individual legacy systems can be treated as autonomous software assets and lastly it fails to take into account future organizational requirements (Heuvel, 2006).

A different approach for selecting a strategy from a variety of options available is presented by Rugaber et al. The authors introduce a conceptual framework for selecting a strategy to move a COBOL system into an environment supporting distributed accesses. The framework includes a variety of options available and a number of selection criteria that are expressed in terms of groups of factors related to the usage of the existing system, the structure and the functionality, the expected evolution of the transited system. They propose an approach for selecting a strategy based on the usage of scenarios to overcome the limitation of obtaining precise evaluations of the different factors (Heuvel, 2006).

A more recent decisional framework proposes a two-phase model to assist organizations in making decisions about legacy systems (Bennett et al., 1999; Brooke and Ramage, 2001). The first phase consists of exploring the purpose and objectives of the organization and producing different business scenarios for its future. In the second step the business strategy is identified which meets the organizational objectives and accordingly a technical solution strategy is defined based on the analysis of the characteristics of the legacy systems, the staff, and the processes (Bennett et al., 1999; Brooke and Ramage, 2001). This approach is very close to business process reengineering that aims to change the processes and information systems of an organization according to new business directions (van den Heuvel, 2006).

**Alternative definition**

Alternative definition entails the definition of every alternative action to be executed on a software unit requiring an extraordinary maintenance intervention. Alternatives can be deduced from the list of action categories described in Table 4, which provides guidelines for selecting extraordinary maintenance interventions on the basis of the attribute requiring a modification. In the table each attribute from the assessment model is cross referenced with the actions that are able to affect it.

<table>
<thead>
<tr>
<th>Attribute / Intervention</th>
<th>Evolution</th>
<th>Massive Adaptive Maintenance</th>
<th>Reverse Engineering</th>
<th>Restructuring and Modularization</th>
<th>Transformation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Economic value</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data Value</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Utility</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Specialization</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maintainability</td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Decomposability</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Deterioration</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Obsolescence</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 4: Attribute versus intervention (De Lucia et al., 2001)
From Table 4 above, an evolutive maintenance intervention is suggested in order to improve the economic value of a software asset, or its utility and specialization degree. The Table however, provides only coarse-grained indications, while each intervention will have to be more precisely specified and designed according to the expertise of the maintenance organization.

**Conversion strategy definition**

The conversion strategy is devoted to evaluating the alternative actions in order to determine the conversion strategy. Factors such as business constraints, risks, costs, and benefits of each alternative will all play a part in the decision, and decision rules will be defined to solve the problem in the most cost effective, beneficial way. The framework provides different examples of decision rules, ranging from the lexicographic ordering to scoring methods, which will be selected depending on various factors, such as the qualifications of the decision maker, the type of preference assessment, and the level of the measurement (van den Heuvel, 2006).

**2.11. Conclusion**

The analysis reveals the need for a systematic approach to renovation of information systems. In section 2.8.5., a number of steps are outlined in choosing a strategy. With regards to the Goal definition, it may not exist with certain organizations. However, a way of going about is given in finding out and evaluating the points of views and expectations of different stakeholders about the system and quantifying them. The dilemma however is how does one quantify subjective issues and will the result warrant official recognition from the organisation’s management?

Defining the gap between the actual and expected Quality profile of the system presents a number of dilemmas. The first dilemma is that the metrics for the quality assessments and even the issues taken into account are not standardized (and would be difficult to standardize). Added to that, the way maintenance is conducted in different organization may mean that the statistics may not be readily available as highlighted, e.g., due to general reluctance, lack of motivation and a perceived lack of time by maintenance staff to record information on their activities. Wade and Laws (1998), highlight two opposing views; one in which some studies reported inconsistencies between programmers’ ranking of software complexity using subjective software metrics and another study which reported the subjective rankings of programmers substantially agreeing with objective rankings. This will obviously depend on familiarity and experiential factors, raising the dilemma that this experience may not be available in all organizations. What happens when all maintenance is outsourced or when documentation is not available? Another dilemma is how big does the gap have to be to trigger an intervention? Can that be standardized or is it subjective?

The dilemmas above therefore also affect the effectiveness of performing a portfolio analysis of the system to come up with an appropriate approach. If it does turn out that portfolio analysis can be done it is worth while to note that portfolio analysis is static in nature and merely gives the status of portfolio components. However, what portfolio analysis gives as an appropriate renovation approach may not end up being the one implemented. This then depends on intervening factors depending on the environment’s constraints and opportunities. This review looks at the renovation strategies that
have been used and at their characteristic and implementation requirements. It also looks at factors
that have been observed to affect the renovation strategies directly or by constraining the
implementing organizations. The question that arises is given the same conditions, will the same
approaches be followed or is application idiosyncratic in nature? The dilemma thus is how best can an
organization implement a successful renovation of its system? The answer maybe that it must choose
an approach that fits its reality, raising the dilemma, how do we come up with that reality?

From the review, what emerges is that in looking at renovation one has to look at the current situation
of the system i.e. to establish the existing quality profile and to accurately predict the expected quality
profile of the target system. One also has to consider the gap that therefore has to be addressed and the
consequences of partially or completely addressing the gap. This comes from considering the possible
renovation approaches (initial set of options coming from portfolio analysis) and evaluation their
feasibility of application and completion based on the complete set of intervening factors some of
which have been described in this review. This can then be represented by the conceptual view in
section 1.4. figure 1.
3. Fieldwork Methodology

3.1. Introduction

This chapter details the data collection methods that were used during field work. It starts by giving a brief description of the key organisations and why these organisations were selected. Focus then turns to the data collection methods that were used, and also on the reasons why these particular methods were chosen ahead of other methods. A brief description of issues of validation and ethics is also made before discussing the issue of respondent categorisation and identification. In this case, justifications are made for the choice of the respondent categories. The chapter also includes a section on the types of documents that were collected and also the types of observations that were made by the interviewer. Before the conclusion of the chapter, a section is dedicated to the problems that were encountered during the field work and the measures that were taken to address them.

Fieldwork was done in order to get an understanding of the quality profile of the information systems currently existing in the different contexts and also to get the expected quality profiles of the target systems. These two aspects would give a picture of the gap to be addressed. This gap between the two gives a clear idea of the effort required and helps in coming up with a list of possible renovation approaches. However the feasible strategy or combination of strategies (determined by the status of different components) to be implemented at the end of the day depends on the factors that either constrain or facilitate systems development, maintenance or renovation activities. Theses factors are best determined by studying the operational environments of the systems through fieldwork especially where there is a little if any documentation available about them (Namibia and Zimbabwe).

3.2. Organisational contexts of the Different countries visited

3.2.1. The Namibian Context

The Directorate of Surveys and Mapping in Namibia is the national survey and mapping authority in Namibia. It provides advice to the government and private individuals and coordinates surveying and mapping activities in the country. Land surveyors submit records of surveys to the Surveyor-General for review and approval before they are registered with the Register of Deeds.

The agencies responsible for land registration and cadastral surveying fall under the Ministry of Lands, Resettlement and Rehabilitation. These include the Surveyor-General that administers the Land Survey Act (Act 33 of 1993) and Registrar of Deeds that administers the Deeds Registry Act (Act 47 of 1937) and the Deeds in Rehoboth Act (Act 93 of 1976), each with its own jurisdiction of administration. Both agencies are organised as Directorates, but while the Directorate of Surveys and Mapping (DSM) has one office located in Windhoek the Directorate of the Deeds Registrar has a second office in the Rehoboth area. The Directorate of Surveys and Mapping was developing a digital cadastral information system while the Directorate of the Deeds Registrar had automated their processes and records for some time.
3.2.2. The Zimbabwean Context

The Department of the Surveyor General (DSG) is the national survey and mapping organization in Zimbabwe and falls under the Ministry of Lands, Land Reform and Resettlement. The department administers the Land Survey Act (Chapter 20:12) which incidentally establishes the duties of the Surveyor General. The ministry controls the policy issues for the smooth running of the Organisation.

The Deeds Registry department is under the Ministry of Justice, Legal and Parliamentary affairs. The Deeds Registry administers the Deeds Registries Act (Chapter 20:05). The Registrar is tasked to examine all deeds or other documents submitted to him for execution or registration. To register, attest, execute documents submitted as appropriate. After that the Registrar is tasked to keep, maintain and supply information on the public records concerning parcel ownership and other rights to parcels and to maintain an efficient system of registration calculated to afford security of title and ready reference to any registered deed. Together the two departments form the agencies responsible for land registration and cadastral surveying.

3.2.3. The Netherlands context

Land registration and cadastral mapping are tasks at national level, assigned by mandate (Civil Code and Cadastre Act) to the Cadastre, Land Registry and Mapping Agency. At its establishment in 1838, the organisation was under the Ministry of Finance, was shifted to the Ministry of Housing, Physical Planning and Environment in 1974 and in 1994 the it was transformed into an independent public body to enable it to undertake land registration and cadastral tasks in a business like way (van der Molen, 2006). The mandate of the Agency is defined by the Cadastre Organisation Act which also prescribes the division of tasks and competencies of the Agency, the Minister, a Supervisory Council, and a User Board (van der Molen, 2006).

Currently, the Agency comprises a head office and 15 regional offices. These offices are responsible for keeping the registers, surveying property boundaries, maintaining maps and disseminating information (van der Molen, 2006).

3.2.4. Why these contexts

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Dutch Kadaster</th>
<th>Namibia</th>
<th>Zimbabwe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information</td>
<td>Operational, already made renovation choice, cadastre and register</td>
<td>Still in the testing phase, only cadastre</td>
<td>Operational, at stage of making renovation choice, only cadastre</td>
</tr>
<tr>
<td>system</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Administration</td>
<td>Government department, limited autonomy, no cost recovery and no profit, dependent on treasury budget</td>
<td>Independent public body, cost recovery, cont make profit, higher autonomy</td>
<td>Government department, retains some income for investing in equipment, limited autonomy, cant recover costs nor make profit</td>
</tr>
</tbody>
</table>
### Table 5 Comparative characteristics of the Study contexts

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Country</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Dutch Kadaster</td>
</tr>
<tr>
<td>Volume of interaction</td>
<td>Over 99% of transactions take place on line</td>
</tr>
</tbody>
</table>

The choice also included logistical and accessibility reasons.

#### 3.3. Data collection

Data was collected through a combination of the fieldwork and some desk study. Relevant literature was reviewed prior to, during and after fieldwork. Data collected from fieldwork was considered as the primary source of information, while the review of organizational records, relevant published material in both hardcopy and electronic format from official organizational and other professional bodies’ websites was considered as a secondary source of information. Findings from these data sources are the basis for chapter 4 and the analyses and discussions in Chapter 5.

Both Primary and secondary data were collected during the Fieldwork. Primary data was collected in three different ways namely; direct (person to person) semi structured interviews (involving individuals and in one case a group), telephone interviews and by email administered semi structured questionnaires. On the other hand, secondary data was obtained through organisations’ official websites (Dutch Kadaster), professional bodies’ conference or workshop publications, organizational reports and minutes of meetings.

#### 3.3.1. Primary data collection

**3.3.1.1. Interviews**

Primary data was mostly collected through person to person semi structured interviews. Different categories of respondents who had some relationship with the National Mapping and Survey Organisation were interviewed. The semi structured interviews were guided by the use of an interview guide (See Appendix A) which had pre defined questions. Semi structured direct interviews allowed the interviewer to address any misconceptions on the interview questions and to follow up on answers from respondents in an effort to get additional insight or further clarification. It gave respondents an opportunity to provide as much detail as possible on some questions even without requests for further clarification.

This technique was very helpful in Namibia because of my limited familiarity with both the environment and the respondents. Following the official channels was very important in dealing with Government Departments and respondents always wanted the assurance that permission had been granted. Interviewing allowed me to reassure respondents by explaining why the interview was being done. Direct contact also formed the basis for sending emails or making telephone calls (to administer
more structured questions) to elicit for further clarifications, in cases where potential respondents could not be interviewed during the field work.

Most of the interviews were with individuals, except for one case where a manager invited relevant heads of units to attend a small group interview. On average each interview took about 25-40 minutes. In Zimbabwe all the interviews were conducted through a combination of the local language and English, while English was used for all interviews except one in Namibia. Interviews started with an introduction of the purpose, reassuring the interviewee about confidentiality and the right to answer only those questions the interviewee preferred to answer and finally the assurance that a transcript of the interview would be sent back to them for verification of the correctness of the contents.

All the interviews took place in the comfort of the interviewees’ offices. This allowed interviewees to feel relaxed and secure. It also allowed them to answer certain questions by using physical artefacts or records in their offices. For examples one respondent demonstrated how users and customers access the cadastral information system (test sample data) by going onto the relevant website and logging in. He also explained the documents that had been automated and what the results of various processes appear like in electronic format through demonstrations on his computer. During each interview recordings were made using a digital voice recorder in cases where the respondent agreed, at the same time brief notes would also be taken and expanded at the end of each day. Note taking was especially important in cases where no recordings were made since the details of responses provided could easily be forgotten.

3.3.1.2. Telephone Interviews

Semi structured interviews were also conducted via telephone. In one case, the respondent agreed to be recorded and this was very helpful for the generation of the interview transcript. In cases where recording was not possible, generation of transcripts had to depend on note taking. Note taking for telephone interviews was found to be very challenging especially in cases where the connection was not very good. Because of the sensitive nature of land issues in both countries, telephone interviews were found to be possible with respondents who knew the interviewer. Interview transcripts from telephone interviews were also forwarded to respondents by email for authentication. Despite taking advantage on the VOIP technology which is cheaper (0.03 Euro per minute to Zimbabwe and free to European landline telephones), interview questions tended to be more directed and less time was taken and thus less cost. Direct recording using the computer was made possible by Digital Wave Player software.

3.3.1.3. Email Administered Questionnaires

The final method used to get primary data was through the use of emailed semi structured questionnaires. This was only possible in cases where respondents had access to email, including easy and reliable connection to the internet. Respondents were asked in advance whether they were willing to respond to email questionnaires if forwarded to them. Thereafter their contact numbers and emails were collected. Email questionnaires were sent to DSG Staff from the Bulawayo office, in the Harare office, to some clients and stakeholders in Zimbabwe and Namibia all of whom I had failed to interview due to time and logistic constraints.
The response rate was however not very good. Of the 22 emails sent (19 in Zimbabwe and 3 in Namibia) only 5 out of 19 emails (26% response rate) sent to Zimbabwe were responded to while none of the emails sent to Namibia were responded to. Of the emails responded to, one follow up email seeking for further clarifications was sent and responded to. The other four gave the assurance that they would respond to further questions related to the research.

3.3.2. Secondary Data Collection

Secondary data was obtained from documents obtained from the organizations, the majority of which are not widely distributed outside the organization or mother ministry. Some of the documents collected were just reports or minutes of meetings, which however hold massive amounts of information on organizational procedures and practices, constraints and opportunities with regards to the development/renovation of information systems. FIG and other conference or workshop publications were also important sources of secondary information especially on the Dutch Kadaster Information System. The Dutch Kadaster official website also had information on the development of the organisation’s information system as well the procedures and practices regarding the development/renovation of its information systems.

3.3.3. Validation and reliability of Information

Transcripts were generated as soon as possible but on the same day on which the interview was conducted. This was done to ensure accuracy. Flexibility, studying transcripts and using different respondent categories aided in validating the authenticity of data collected. Through a snowballing method (Kumar, 2005) respondents directed me to sources they considered more knowledgeable on the subject matter. In such cases, referred respondents would always be made aware of this. It was assumed that this would make these respondents put more thought into what they were saying especially in answer to factual questions.

The fieldwork was also organized to enable different categories of respondents to verify information from within or outside the category. Documents collected also served to validate some of the responses and vice versa. For example, one respondent said that the Deeds registry system had been halted to look at possible integration. A respondent responsible for the system however revealed that the system had crushed, but added that consultants in the Directorate of Surveys and Mapping were working towards incorporating the deeds registry information into the digital cadastral information system’s design.

Further verification of the data collected included sending the interview transcripts back to the respective respondents to verify the authenticity of the transcripts’ contents. Of the verification emails send, only three out of 11 were responded to in Namibia i.e. a 27% response rate. These came with corrections and additional comments. The final means of verifying the information were the interviewer’s personal observations of the organizational and environmental settings and artefacts.
3.3.4. Ethics

Ethical were maintained during this research by considering the following:
- Obtaining the permission of the responsible authorities of the organizations whose staff members were being interviewed,
- Ensuring that the names of the respondents who participated in the interviews were not used in reporting the results of the study and confidentiality was maintained all the time,
- Ensuring that verbal permission was obtained from all the participants,
- Not coercing or intimidating the respondents.

3.4. Respondent categorization and identification

3.4.1. Definition of respondent categories

Respondents were grouped into five categories namely as shown in the table below:

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Users</td>
<td>Internal staff members who use the cadastral information system on a day to day basis, included the cadastral examination personnel and the public counter personnel.</td>
</tr>
<tr>
<td>Clients</td>
<td>Organizations or individuals whose activities or businesses require some products or services from the cadastral information system, included land surveyors and municipalities.</td>
</tr>
<tr>
<td>Developers</td>
<td>Internal members of staff (more likely the IT section and domain experts) and or consultants who are directly responsible for developing the code, implementing and maintaining the system.</td>
</tr>
<tr>
<td>Managers</td>
<td>The management or decision makers in the implementing organizations. These are responsible for making the decisions that map the way forward in the development of the system or the availability of the resources for its current and future development.</td>
</tr>
<tr>
<td>System stakeholders</td>
<td>Groups interested in the development of the information system. These may or may not be direct beneficiaries of the system. These included members of the academia, the deeds registry, the mother ministry etc. (these were sometimes grouped with managers category for this study).</td>
</tr>
</tbody>
</table>

Table 6: Categorisation of respondents

Table 6 shows the categorisation of respondent groups while Table 7 represents the summary of data collection techniques and the type of data that was solicited from each category using different portions from the interview guide in Appendix A.
### Table 7: types of information obtained

<table>
<thead>
<tr>
<th>Level of data collection</th>
<th>Actors</th>
<th>Namibia</th>
<th>Zimbabwe</th>
<th>Netherlands</th>
</tr>
</thead>
<tbody>
<tr>
<td>Users</td>
<td>clients</td>
<td>3</td>
<td>3</td>
<td>Desk study, contents analysis</td>
</tr>
<tr>
<td>Telephone interviews</td>
<td>Developers/IT</td>
<td>2</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Interview topics</td>
<td>Managers/other stakeholders</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

**3.4.2. Field Identification of respondents**

In Namibia, selection of respondents was done with the assistance of pre-identified contact people and as the interviews got underway, respondents were identified by the organizational managers and through a snowballing technique (Kumar, 2005). This involved respondents being asked to identify potential respondents for the next interview. After a period of settling in, observation and some preliminary field analysis, some respondents were independently identified. In all cases the permission of the managers was secured before staff members could be interviewed.

In the DSM, consultants developing the system indicated that it was important for them to ensure that the necessary permissions for an interview were granted by the senior management. They indicated that this was because the organization was paying the full consultancy rates even during the interview and they wanted to be sure they could reveal all the information they had on the organization if requested. Fortunately the management was aware of this and personally introduced me to the consultants.

In Zimbabwe, the respondents were identified prior to the fieldwork. In some cases, like the Land Survey Section in the Harare Municipality, the respondents were identified and invited to join a small group interview by their head of section. By and large, respondents ended up being interviewed based on availability but the choice was more to the discretion of the interviewer. However, in all cases the managers’ approval was secured before staff members could be interviewed.
3.5. Types of documents collected

A number of reports and documents produced within the departments or by researchers focusing on the departments’ Cadastral Information Systems were collected during the fieldwork.

3.5.1. Namibia

From Namibia documents collected included the Ministry of Lands, Resettlement and Rehabilitation annual reports from 2004 – 2006. A hard copy of Swedesurvey’s 2006 pre-study for the Development of a land Information System for Namibia (Draft) was also given to the interviewer. However, since the system is still under development, system specific documents could not be obtained. Additional documents like the Namibia Country report – cadastral template were also downloaded, from the official websites of professional bodies like the FIG.

3.5.2. Zimbabwe

Documents collected from the department of the Surveyor General in Harare included joint DSG and Swedesurvey feasibility study reports on setting up the DSG cadastral database, system studies on cadastral mapping and automation of record keeping, the system’s user and security manuals, system documentation and some procedural documents e.g. on system changes. More recent documents collected from the DSG also include proposals on how the system could be improved and the efforts being made. The documents highlighted the problems that the system was facing.

Additional relevant documents were downloaded from the FIG and OICRF websites. Some documents on plans to commercialise the department were also collected and to collaborate with these, searches were also done and some papers downloaded from the internet. These have data on the conditions the DSG faces in sustaining its information system(s). Contact could not be made with the Deeds office but however, some documents originating from the department were collected.

Other documents of a strategic nature namely minutes of meetings and Public Sector Investment Project (PSIP) documents for 2006 highlighting the need to develop and maintain the DSG information system, were also collected.

3.5.3. The Netherlands

The main source documents on the Netherlands Dutch Kadaster came from the Kadaster’s official website, OICRF and the FIG website. Of particular interest was the FIG Commission 7, symposium on the strategies for renewal of Information Systems and Information Technology for Land Registry and Cadastre that was held in Enschede in May 2003. Contents analysis was used to derive relevant information in the same categories as the other two contexts. This was done manually and included multiple readings of many documents, highlighting and note taking. To verify data, the same exercise was also done using a limited edition of Atlas.ti, version 5.1 software by Thomas Muhr of the Scientific Software Development, Berlin which was downloaded from www.atlasti.com. Using this software, and developing codes based on keywords identifying the themes of interest, relevant quotations were extracted from 10 documents. These were then reread and sorted to build a picture of the Netherlands situation (see Appendix B).
3.6. Observations

Personal observations by the interviewer included observations on the behaviour of staff, the setting and working environment of the organization, the physical artefacts of the organization. Observations were also made on unusual occurrences or practices as well as the reaction of the organisations to these occurrences.

3.7. Difficulties experienced during fieldwork period, and choices made to resolve them

In Zimbabwe, some of the key people could not be interviewed due to changed schedules. Requests were thus made to either send them a questionnaire by email or interview them by phone after getting back to the Netherlands. This applied to key personnel in Zimbabwe’s DSG Bulawayo office who could not be reached due to logistical reasons. However the response rate was very poor as indicated in section 3.3.1.3. On an ethical basis, the interviewer found himself asking the question whether making follow up calls to respondents for which an email had already been sent would not be the same as coercing respondents to respond!

Of the email administered questionnaires send to users in both the DSG and Harare offices, only the IT person responded. To capitalize on the chance a follow up telephone call was made and a more structured question email sent, to which he responded. None of the people in Namibian to whom email interviews were forwarded responded. However, they were all in the customer category for which a number of respondents had been interviewed. One key respondent gave his details and promised to verify and comment on the findings in the Namibian context.

One of the problems encountered during fieldwork was not being able to contact respondents to confirm new interview times if they could not be located at the originally agreed meeting places. The communication networks in Zimbabwe were found to be either congested or malfunctioning. Making cross mobile line network calls was a very big challenge. Due to time constraints, replacement respondents were found. Some key respondents were on leave at the time and opportunities to conduct interviews were presented when they popped into their offices. However because these were quick fix interviews, it was felt that more information could have been obtained from the respondents under different situations. Despite this, some helpful references were given for additional information.

In Namibia, the problems encountered included last moment interview reschedules by respondents and unavailability due to commitments. Due to this reason, an MTN cell phone line was acquired to enable easier communication with respondents. Sometimes an interview with a key respondent would be delayed and inevitably affect that of the next person. At the end of the day, it was realized that a maximum of two interviews a day was ideal. This was also gave me a lot of time to generate interview transcripts since this is a time consuming exercise. However for those cases where respondents did not mind being recorded, the generation of transcripts was easier.

The discovery that the Digital Cadastral Information system in the DSM in Namibia had not yet been commissioned meant that some of the questions on the interview guide became irrelevant. As a result more attention was placed on factors that affected the development/renovation of information systems
from the organizational, personal, environmental and resource perspectives. Opinions and expectations were also solicited on the criticality, benefits and sustainability of the system being developed. In addition, pointers on current customer satisfaction and expectations were looked into.

In Namibia, the fieldwork also occurred at a time when some senior staff were not available in the deeds office meaning that the Registrar of Deeds had to be engaged in a lot of work of an operational nature. This delayed my meeting with him especially to get permission to interview staff members. When he finally became available, and it became possible to interview staff in the deeds registry, it was already the last week of the fieldwork and it was also fully booked. The situation in the registry (that the system was down and was taking time to be resuscitated) was found to be very relevant for this study. Unfortunately permission and time just allowed only one person to be interviewed.

3.8. Conclusions

A combination of expository and multiple case study research was used. Fieldwork was carried out in Namibia and Zimbabwe. An interview guide was used to solicit information from respondents using telephone, individual and group face to face interviews. Interview questionnaires with semi structured questions were also sent to a limited number of respondents, albeit with low turnout. Key people were identified before hand but other respondents were identified during fieldwork using snowballing techniques. Observations on the operational environment were also made in the different context and wherever permissible organisational records and publications were requested.

Multiple data sources were used in order to triangulate information from different sources. This was important in verifying the validity of the information. A low response rate was recorded for verification emails sent to respondents. It was assumed that those who did not reply to the emails were content with the transcripts or simple did not have the time to do so. However it was interesting to note that corrections and additional comments made by those who responded were very helpful and relevant, but did not change the original contents.

From the three cases, various issues can be compared especially with reference to the items raised in table 5. To begin with comparison can be made on the basis of the information systems; their current states and the stage of implementation in the organization. This comparison can be done on the basis of the figures shown in appendix E and figure 7 in section 2.7.1. Turning on the administrative aspects, the different effects of levels of autonomy and resource availability can be considered. From chapter 2 this was also linked to cultural aspects. The level of system to user and customer interaction can also be evaluated based on the urgency with which renovation can actually take place or how changes can actually be implemented i.e., do changes have to take place in runtime environment or at compile time or does the system have to be shut down and for how long. Looking the three cases helps to separate the issues according to how much they can be generalized. The comparisons will help to do two things; test observation against what appears in literature and also to seek common problems and solutions for the benefit of these LAOs and maybe other in similar circumstances.
4. Fieldwork Findings

4.1. Introduction

This chapter presents the fieldwork findings as extracted from fieldwork interview responses, documents collected and personal observations made during the fieldwork. The sections are divided into Technical Issues, Business Value of systems, Organisational issues, information issues and finally institutional and legislative issues. The details covered represent findings addressing issues raised in 2.6., 2.7., 2.9. The findings will address the issues raise in the conclusions to chapter 2 aimed at addressing research questions 3 which corresponds to the environmental factors in the conceptual model (Figure 1). Details of the existing information system situation and that of the desired system will be given to build a case for chapter 6. Discussions of the findings will be made according to the context of the study case to which they refer. Finally the chapter will be concluded with a brief summary of the issues that were under investigation. No interpretation of the findings will be attempted at this stage.

4.2. Technical Issues

4.2.1. Telecommunication networks, network systems and power utilities

**Namibia**

The system being implemented includes an internet solution. The bandwidth was given as a potential problem, but some respondents said most customers only required attribute information which did not require much bandwidth. The provision of broadband service by the national fixed line provider (Telecom Namibia) and the scheduled introduction of 3G (by Mobile Telecommunications Limited – MTC) were expected to provide a solution to the bandwidth problem. The deregulation of the communication sector was introducing competition resulting in more affordable internet access. The municipality of Windhoek was already offering online access to municipal parcel data obtained from the DSM, thus the DSM could follow suit. Respondents said that web based access would make the DSM information available and searchable online.

Going through the offices during interviews it was observed that most respondents had access to the internet and users revealed that all the computers were linked through a LAN. Although the same situation existed in the deeds office in the same building, the two departments and thus their systems were not linking into an integrated system. Computers were observed at the public counters of the DSM, but interviews revealed that customers got photocopies of original documents after paying a search fee at the public counters. During the research period, there was only one power outage for a brief period, interview results showed that these did occur rarely.

**Zimbabwe**

Like in Namibia, the telecommunications sector was deregulated resulting in completion in the sector. It was observed that all the respondents visited had access to the internet in their offices and IT personnel revealed that all network connectivity, domain security and services was established and managed by a system of servers via hubs, switches and cabling. This enabled staff to access data from
the LIS and track or monitor records from their desktops. Interviews results indicated that the DSG system has neither online access nor linkages with any external system and thus customers could only access data from the public counters after paying the necessary search fees. The DSG systems in the Harare and Bulawayo offices were also not linked so staff could only access information on the system in their own office. Power outages (load shedding) are a common occurrence in Zimbabwe especially in winter, while in summer lightning results in electrical faults.

**The Netherlands**
In the Netherlands broadband penetration had reached 29.8 per 100 subscribers (over half of all households) by October 2006. The telecommunication sector was liberalised in 1994 and an independent regulator ensures fair competition in the market and that all players abide by the rules set by the government. Competition lowered pricing drastically from € 74 in 2003 to € 8 in 2006 and improved quality to speeds of 3 Mbits/s by the end of 2005.

Within the Kadastre itself (head office and regional offices) there is a good network which makes it possible for the central server of Kadaster-on-line to provide digital data online and allow users and customers access to products. Kadaster On-line-products accounts for 99.9% of all products provided by Kadaster and is accessible to everyone. Since November 2005, notaries send their deeds to the Kadaster in digital format based on digital handwriting and encryption. All employees also have remote access, with each person’s authorization to access specific resources based on their role. There is reliable power supply and rare power outage except for maintenance purposes. Only one such incident was observed in Enschede for the entire duration of this course (18 months) and this lasted for less than a quarter of an hour towards the end of 2006.

**4.2.2. Software and Hardware**
The three organisations used specialised software which was imported, acquired through supplier agents in the host countries or developed in-house or outsourced.

**Namibia**
The system being implemented was based on ArcCadastre 2.0, ArcSDE 9.1, Oracle Server 9i, ArcIMS 9.0, Windows XP, Windows 2003 and IIS Web Server and would be centralised.

With regards to the hardware, it would consist of the Geodatabase Server, GIS Application Server, Web Server, workstations. The hardware was either acquired or existing hardware was upgraded at the onset of the project in 2006. All servers and workstations were still in good condition.

**Zimbabwe**
The DSG system was based on Watermark Server, SQL Server 6.5, Office 2000, Windows NT4 server, Windows 2000 Server, Windows ME, Windows 95, Windows XP and Windows 98. The current system components in operation were; the attribute database LTS based on Microsoft Access and the image database based on Watermark. The spatial component based on ArcGIS was underdevelopment. The two operational components had not yet been integrated and used separate user interfaces. The figure below shows the schematic relationship of software used for the imaging database.
Two DSG servers were said to be seven years and the other two were nine years of age. Interviews revealed that most of the system hardware was above five years of age. This was confirmed by reports that 84% of the computers, 98% of the printers, 92% of the plotters and all the scanners were above five years old (Nyamhute and Chagweda, 2007). Five years was the expected life span of the hardware according to the DSG IT policy (IT Section, 2000). The server hosting the LTS and Watermark databases was reported to be using a makeshift power supply unit because the correct spare part was not available on the local market. The configurations on the main server managing the Harare domain were not optimal, the servers were constantly breaking down and this affected network resources (Nyamhute and Chagweda, 2007). IT staff also reported that the primary partition had limited space available. Because of the age of the hardware there were problems of compatibility with new software and hardware. IT staff added that upgrading the hardware was also risky as it increased chances of failure.

The average age of the hubs, switches and cabling was eight years and the hub sizes ranged from 8 port, 12 port, 16 port and 24 port (Nyamhute and Chagweda, 2007). Departmental website was hosted by the mother ministry, and respondents said that the DSG needed to change from hubs to switches and thereafter implement a direct link before it can host its own website.

**The Netherlands**

Contents analysis of data on the Kadaster revealed that Microsoft Windows Server 2003, Citrix Access Gateway, Citrix Password Manager, BEA Tuxedo, Windows and open OpenVMS and UNIX were used. The Kadaster still uses heterogeneous systems based on Windows, OpenVMS and UNIX, and still has some legacy systems running on its mainframes. Many applications on these platforms, as well as Web-based applications, have their own security policy, which forces the user to change passwords on a regular basis and forces the use of strong passwords.

In 2000, the agency started migrating completely to virtualized applications and virtualized desktops with Citrix Presentation Server - now running on Microsoft Windows Server 2003 - used respectively on HP ThinPCs and HP thin clients. Citrix Access Gateway was added to enable secure, remote access to all applications over the Web. The latest addition was Citrix Password Manager to enable all...
employees to simplify logging on to password-protected applications. Kadaster also deployed BEA Tuxedo to underpin its portal and backend infrastructure, aimed at streamlining and enhancing the end-to-end property registration and administration process.

4.2.3. Global trends, technological advancements

Respondents highlighted that changes in the existing systems were being fuelled by the need to keeping abreast with changes in technology. This they said enabled compatibility and continued support. The other driver was that aligned to the development of National Data Infrastructure and the introduction of digital lodgement systems.

Namibia

Respondents highlighted the E-Governance concept as a driving factor towards the automation of the cadastral system. Management said they wanted to address two major issues namely the internal (backroom processes) and the external (customer interface). It was said that backroom processes would address the issue of storage space for survey records, their security and the examination processes. The customer interface focus was inspired by the fact that the Namibia Government was embracing the E-Governance concept. In order to be part of that, data conversion was essential.

Zimbabwe

Respondents said there was need to take advantage of the digital equipment being used in the industry e.g., total stations. There was also a great demand to have a completely electronic database from the municipalities, practitioners in the planning, survey and engineering fields, government agencies and also from the financial institutions. The majority of the DSG clients had access to the web and the DSG had the digital data required.

4.3. Business Value of systems

Namibia

System maintenance support

During the development of the system IT infrastructure support was provided by the consultant and the tender specifications included provisions for capacity building to ensure continuity. The consultant considered ESRI and Windows based products to have greater chances of securing local support than user designed or open source products. Open source products were considered to require more expertise to set up and maintain. It was added that the system would also be component based, and thus care was needed during maintenance otherwise the whole system would be affected by simple changes.

Interviews revealed that the DSM did not have in-house IT people, but relied on IT personnel at Ministry level who attended to minor computer problems like installing operating system and application software, antivirus software and networking. Respondents said the DSM needed to develop its staff so that they will have the requisite qualifications to maintain the system in the future, or else assemble resources for outsourcing IT support to a local competent company. One local agent able to support ESRI based products was given as GeoCarta.
**System support**

The automation project was well supported in terms of resources by the government. A respondent said, ‘The consultant was engaged after a government tender for the establishment of a Cadastral Information System was floated. The support from the government was to the tune of N$ 5 Million. The consultant also provided around 2 Million Swedish Crowns for capacity building, and of course this was done by Swedish consultants. There was also great demand for the project from the private sector especially from conveyancers and bankers.’ On the other hand, others said that justifying additional funds for licenses and software upgrades will be major challenge in the face of budget cuts.

**Functional coverage**

The system was designed on the DSM work processes and incumbent laws and regulations and will cater for all the cadastral processes that were being carried out in the DSM. Digital lodgement system will guide users through the examination process and improve turn around time for delivery of approved records. Respondents said the system will make it easier for staff to track records and also make it possible for supervisors to track the progress being made on the jobs and to regulate the workload. Going onto the web will have a great impact on service delivery and customers will be able to access DSM products on line. Unfortunately during my visit the developers were focusing on the web solution so a demonstration could not be done.

**System use**

The system was not yet in use, but was expected to automate all the current manual processes. It was said that internally all cadastral work processes will be carried out through the system, while clients will be able to access their data requirements online reducing the need to visit the office relieving pressure on staff.

**Zimbabwe**

**System maintenance Support**

Interviews revealed a lack of an application development platform, training and finances to acquire relevant hardware, software and documentation. Respondents said, ‘the DSG faced challenges in the provision of the required financial resources and in accessing foreign currency to procure and maintain world class ICT.’ They added that the DSG needed to invest in contingency measures like purchase of power generators and a reliable backup server. Addressing the need for backup, support and resources was said to enable system upgrading and sustenance.

Support for hardware and Microsoft products was not a major problem but Watermark (imaging software), Windows NT4 server and SQL 6.5 were no longer supported. The version of Watermark was also not compatible with later versions of SQL could only run on Windows 98. Developers of the system ceased to support the system in 2000 when NGO and donors started leaving the country. As a result, the phased implementation plan that was being implemented could not be continued due to a lack of programmers. Some respondents said that because the system as only partially computerised it was flexible in that it will not be affected by changes in business processes.

Printflow (a privatized government agency) that oversaw the repair and maintenance of government IT equipment was said to lack the capacity to maintain or prepare contracts and tenders for procurement of DSG services or equipment due to the specialised nature of the software and
equipment used by the DSG. IT respondents said that the existing system could be sustained in its current status for as long as there was someone knowledgeable about its intricacies especially the Watermark server. They added that future changes would require in-depth knowledge of the existing system and the exact parts where a solution was required.

System Support
Some respondents said that they had observed that there was no more real investment in the development and maintenance of the DSG systems. There were mixed feelings about the level of the DSG management’s support. Some respondents said that senior management was unwilling to support the required changes while others saw the support as fair considering the prevailing operational environment characterised by a lack of resources.

Functional coverage
Users said that they started using the LTS from the time survey permits and instructions are issued, when the survey records are lodged, and as they moved within the system during quality assessment until they are approved. After approved, the graphic records are scanned and captured for storage in the imaging database Watermark. The system was also used to track records and to monitor progress.

System use
Cadastral staff said that they interact with the system for every task they carry out. Public counter personnel said they used the system to carry out record searches for the public on a daily basis, but however it was observed and confirmed by interviews that they continued to photocopy original documents rather than print documents for customers from the system. On the 8th of October 2007 there was a fault with the power unit at DSG offices and it was observed that services virtually came to a stop. Customers were being told to return later, and most DSG staff could not be located in their offices because they said they could not work when the system was offline. Without the system some products can not be made available to users and customers. To highlight the importance of the system, the unit had been repaired by midday, when in other situations, under current conditions in Zimbabwe, it would have taken much longer.

The Netherlands
System maintenance Support
The Kadaster in changing had also realised that the supplier of the VAX/VMS system on which the ‘Kadasternetwerk’ was built was expected to gradually stop providing support. Kadasternetwerk also included a client side component which required maintenance thus inconveniencing the client. In 1998, Kadaster deployed an open, standards-based infrastructure – it was believed that an open, interoperable environment would provide the flexibility needed to adapt systems quickly and effectively to meet changing customer needs.

Flexibility and ease of maintenance to support changing business needs was enhance by replacing the IBM mainframe environment with the distributed computing infrastructure. Centralizing administration on the server instead of performing it on the local desktop, made it easier to maintain and upgrade the in-house developed client/server applications. By consolidating the infrastructure, the agency was managing to save the equivalent of €3.5 million every year despite having grown and introduced new services.
System Support
The revenue from the portal is approximately €76 million every year and gives Kadaster the opportunity to extend services across company boundaries. About 600 people work at the head office (including the Information and Communication Technology departments) and structures and procedures allow IT issues to be deliberated at the highest levels of management. In the 2002 the costs of the IT re-engineering programme are about US $80 million and for the entire organisational and social component a balance sheet provision of US $100 million was been made.

Functional coverage
Deeds can be electronically sent (digital signatures are acceptable), or posted, to Kadaster using automated workflow to facilitate the property buying/selling process. An expert system supports the acceptance of notarial deeds and supports staff in the judgement and acceptance of deeds. Field based staff also have remote access to the system. Customers (in this instance mainly the notaries) can use Kadaster’s online environment to look up the original deed in the public registers online, order and download copies of deeds as a pdf files or as a printed documents.

System use
‘Kadaster On-line-products’ accounts for 99.9% of all products provided by Kadaster while only 0.01% is provided offline. Without the system some products and services can not be accessed by users and customers.

4.4. ORGANISATIONAL ISSUES

Namibia
Organisational Structure
The DSM did not have a dedicated IT section to support and look after the needs of the system. A respondent noted that, ‘In the DSM structure there are no posts for IT personnel. Most posts are for personnel from the surveying disciplines since it is the Surveyor General’s department.’ It was added, ‘there is a separate Government Department under the office of the Prime Minister’s office that oversees issues pertaining to computers in Government departments and another at ministry level. In this regard it is very difficult to convince the government that there is need for IT personnel at the departmental level.’

Organisational culture
One respondent said that the professionals who normally run Land Registration Organisations were trained and preferred to retain certain conservative practices e.g., aiming for the highest accuracy possible and not the appropriate accuracy or user needs. He described the professionals as ‘typically traditional and conservative.’ It was added that the information system should be seen as a tool for improving the organization and the organizational culture.

Human capacity and availability
Interviews revealed that there was a lack of properly trained and skilled manpower in the directorate and thus the need to invest in organizational Human resource development. The 2005/06 Ministry of
The DSM was prioritising human capacity development in different specializations. Management said that from experience it was better to train staff to have IT proficiency, however other respondents said that while it was good to have one person with knowledge in many different areas, having specialists was better. To that effect one respondent said, ‘In the IT world it is also a fact that there are different specialties and we really can’t expect one person to be a specialist in every aspect of IT. There is need for people with different specialties who will complement each other.’

**Policies and procedures in LIS implementation**

Respondents said that they preferred running the new system and the existing manual system in parallel for sometime until staff were satisfied that the system was meeting expectations. Evaluation of the new system functionality would be accomplished through demonstrations and tests and these were done before each stage was completed and accepted. Tests were done using sample data and gave the users the opportunity to point out any shortcomings in the system and the data. Testing was said to involve double checking to determine the integrity of the data. At the time of this fieldwork the web access solution was undergoing tests but respondents could not give a demonstration because they failed to log in since it was said to be undergoing repairs by the developers.

**Staff attrition**

Respondents said that the people who were supposed to drive and maintain the system were leaving the organization due to better opportunities elsewhere. The respondent added that, ‘There was also an internal person whom the consultants had worked with for a period of two years, but had recently left. A new person had come to take up his place and assist with the maintenance of the IT infrastructure.’ It was added that in bringing in new people, progress on the system and business would be stalled since they would need training on the procedures and practices.

**Organisational learning**

Some respondents said that a lack of successful implementations of land information systems in Namibia from which to learn was a problem. The City of Windhoek’s information system was given as one example of a successful implementation. The success of which was attributed to a dedicated IT section. In the DSM it was said there was an earlier attempt to implement a cadastral information system. This had failed due to limited user involvement and it was said that not much was learnt from it.

On the other hand, within the Deeds office, respondents said they had learnt from the problems the information system had experienced and in future, ‘they would: make sure that the developer was made aware of what the directorate needed; be able to critically review the product against what would have originally been asked for and would be better positioned to ensure contingency measures were in place to ensure service continuity.’
Cooperation
Management and the developers said that there were extensive consultations with all the different levels of staff in order to capture all the business processes and thus design a relevant system. During the development, consultants continued to involve internal staff since it was envisaged that lack of staff involvement would affect the use and ownership of the system.

Some respondents said that the design of the Cadastral Information system should have provisions for other directorates to bring in their information, but the DSM has to convince the directorates not to go and establish similar systems. Lack of institutional co-operation and a policy on data sharing was said to reduce sharing to a matter of personal relationships. Stakeholders said that the DSM was not keeping them updated on progress and some organisations that had implemented information systems based on the DSM data, said they were concerned that changes to commonly used attributes – parcel identifiers – could lead to negative propagation effects on their systems.

Readiness to change
Respondents said that there should be a willingness of the organisation’s staff to embrace the system. Some staff were said to have argued that everything was working well so why was change needed. In some cases, the effort required tended to conflict with staff interests and could not be linked directly to staff benefit e.g., some staff prioritised completing articleship for registration as licensed land surveyors while others prioritised only the training that would be recognised for promotional purposes by the employer. Respondents said working full time on the system could not be linked to these interests. One respondent said that most of the staff members and some of the old surveyors were inexperienced and uncomfortable with computers and implementation of the system would require them to have a certain level of computer proficiency.

Organisational Readiness
Respondents said there was need for a critical mass of professionals to be available before, during and after the implementation of the system. It was added that the concept of computers and databases was still very foreign to most organizations and thus a greater need to develop IT competence among its technical staff. All this was said to have implications on the budget. It was also revealed that, ‘all the staff members in the DSM were just waiting to see what the final product would look like.’ However in the Deeds office, respondents said, ‘The fact that there was no previous experience with automated systems and that the system generated a lot of excitement among the staff contributed to some of the oversights’ that resulted in system failure.

Customer expectations and recommendation
Respondents expected the DSM to provide products like general plans and diagram copies, coordinates of property beacons, control points, digital attribute spatial information on land parcels, ownership information, address data and property value, data on resettled land, land use planning information and urban land information online. Integrating data from the Ministry of Lands directorates would provide a one stop access to ownership information from the deeds office, address and property value from the Land Valuations department, data on resettlement land from the land resettlement department, land use planning information from LUPA and urban land information from municipalities.
Clients said they required current information and a real-time system, of which digital lodgement would be very critical. It was stressed there was need for the user interface to be customized and simple enough to address different user requirements and that different levels of functionality should be provided for different users. Respondents said there was need to prioritize client confidence and trust in the data. Digital lodgement would reduce the rejection rate of surveys and shorten the new examiner’s learning curve apart from reducing the turn around time for delivery of approved surveys.

Zimbabwe

Organisational Structure
Respondents revealed that proposals to formalize the IT branch on the DSG structure with a range of different specialised posts had been approved by the Public Service Commission (PSC) in 2006 and interviews conducted. There was an informal IT section consisting of two people (1 in Bulawayo and another in Harare) that was maintaining the system. It was highlighted that there was need to capacitate the current IT section in terms of manpower and skills. It was also highlighted that there was need for a Marketing section which would assist the DSG determine the market’s actual demands and preferences leading to the delivery of quality and relevant services and products to the clientele.

Organisational culture
Respondents said that the DSG tended to turn to external consultants with very little regard to internal competence and this affected staff moral. Others added that, ‘unlike in previous years there was very little or no breaking of new ground in terms of innovation.’

Human capacity and availability
Interviews revealed that there was a high staff turnover due to the inability of the department to retain personnel. The DSG was experiencing manpower shortages and available personnel were being strained. It was pointed out that while the department had prioritised the training of survey personnel to become IT proficient, the high staff turn over was eroding the gains made. Interviews revealed that only one staff member was currently familiar with the system and could safely make structural changes to its code. Respondents also added that errors in the system were due to an inadequate number of staff assigned to capturing the data, this led to insufficient checks since staff had to leave other tasks momentarily to capture data – staff were overwhelmed.

Policies and procedures in LIS implementation
Respondents said that the DSG should maintain and upgrade the existing system rather than totally abandon it. They added that it was vital to maintain the originality of the current system that was in place. A total overhaul could entail losing everything that was linked to the current system and starting afresh, users said they would recommend running the new system parallel to the current one till such a time that they were satisfied the new system was functioning well.

Existing procedures with respect to system changes were that users made change requests, management took up the recommendations, IT produced a prototype and organised a demonstration of the prototype after which management would consider approval. Respondents said that it was crucial to test the new system before adoption.
The DSG had an IT policy document that specified the period, conditions and procedures for the replacement of hardware and software. It was highlighted that these measures were no longer being implemented and respondents said there was need for appreciation on the part of senior management of the importance of enforcing and maintaining these practices. Others said that it was difficult to implement the IT policy because of the time it took to receive the required material and financial resources. Backup procedures were also available but likewise were no longer being observed. Users now approached the IT section directly with change requests or recommendations and no longer filled in the required forms.

IT staff reported that not many requests for changes were being brought forth apart from complaints on system failure and difficulties in executing some of the routine processes. Requests for modifications, corrections or additional functionalities used to be recorded in a log over changes book maintained by the cadastral administration section, but respondents signalled that this was no longer the case. Reasons given were that the changes to the Information system were too minor to warrant recording in the log over changes record book, and that there were no structures in IT. Respondents also said that during the early stages of system implementation, all record track data would be deleted from the system after the particular records were approved. This was no longer done and could be a factor contributing to the memory problems faced by the system. Customers said the DSG had weak information communication technology policies and practice and the system was now regarded as being the major source of viruses in the surveying industry.

**Staff attrition**

Respondents said that the originators of the system were no longer with the department. Less than four staff members directly involved in the original development of the system were still with the department.

**Organisational learning**

It was found that the DSG had learnt from the failure of the RAMS project and the Geomedia project (mapping branch), both of which resulted in the loss of large amounts of digital information and severely affected the computerization. Management said that they had learnt how managerial reaction time could adversely affect the continuity of computerisation efforts especially in an environment of rapid technological change.

A respondent highlighted how an elaborate feasibility study was done to customize the Laos Cadastral Information system to the existing Zimbabwean Environment. The last phase in the implementation of the existing system was supposed to lead to the integration of the two system components. Learning was further enhanced by the fact that the system in the Bulawayo office was implemented after the completion of the two components of the system operating in Harare.

**Cooperation**

Some clients said they ‘had experienced problems in accessing the digital data from the DSG due to pricing and communication problems.’ They said there was no institutional framework for sharing information and this affected synergy. Synergy with other institutions was highlighted as being vital for facilitating technological transfers and development and for sharing of a common vision. They
also said that the DSG was not updating stakeholders on progress being made especially in the development of the spatial component of the information system.

Respondents said that the problem in integrating the DSG and Deeds Office Systems was the difference in the way the systems captured the parcel identifier. The problem in the Bulawayo and Harare systems was in the way the survey record numbers were assigned. A change of the parcel identifier or the development of some proxy identifier was recommended to facilitate the linking of the systems that existed in the Bulawayo and Harare offices and finally with the Deeds Registry System. It was noted that the development of the new parcel identifier could be done in cooperation with the deeds office and municipalities. Internally, respondents said senior management should support staff initiatives to solve problems associated with the system.

Readiness to change
Respondents said that the IT section staff had proposed some changes to improve the system but this was met with some resistance by the management. IT staff however said that they did not expect any problems in the case of a system change-over, since ‘compared to banks, the DSG system was quite small.’

Organisational Readiness
Respondents said that the DSG did not yet have the capacity to host its own website. However, they added that the DSG had IT staff members competent enough to maintain and further develop the system. It was reported that the issue of improving the system could actually be handled internally since the DSG had competent staff to make changes to the system. They highlighted that no major change-over problems were expected as long as the relevant personnel and resource – either financial or material – were available.

Customer expectations and recommendation
Respondents said that they expected the DSG to lead by example in terms of innovation and that they regarded it as the torch bearer in terms of the development of Land Information Management systems in Zimbabwe. They expected further development of the spatial component. They noted that the DSG was not developing as expected since it had not migrated to the web by the time this fieldwork was done.

Respondents expected a system where the information was up to date and thus their expectation of the DSG was a computer based development with real time updates. They said the expected online access to spatial cadastral data, image data (legal documents), and parcel and ownership data.

Within the DSG users said they expected the system to include a monitoring component for approved documents, a workflow component, images of large format documents (larger than A3) and spatial data. They wanted a system that would enable access to image data and parcel attribute data from both regional offices through a single user interface. They added that the system should facilitate the introduction of the Digital lodgement system. IT staff were however concerned about the upgrading of the network infrastructure, hardware and software, system security and backup, migrating to modern application development platforms and hosting the DSG website.
The Netherlands

Organisational Structure
During the consolidation process (ongoing) subsidiaries were closed and centralized, system administration and data centers were centralized, and the system workload was consolidated. The Agency was split into a front ‘shop’ and a ‘factory’. The number of subsidiaries was reduced leaving 15 Kadaster-offices. All 15 Kadaster-offices have the same tasks, procedures and processes. A flat hierarchical structure was also implemented (see appendix C).

Organisational culture
The Kadaster is fully dependent on the income that users have and want to pay. In this case it was vital for it to become a customer and market oriented institution with a service-directed attitude. To achieve this, the Kadaster needed to tackle silo-centric, departmental technology focus. A transparent financial and personnel management system was also introduced and a focus on quality saw it being awarded with an ISO certificate.

Human capacity and availability
Kadaster employs about 2200 peoples. 600 (including the Information and Communication Technology departments) are located at the head office and 1600 in the fifteen regional offices. About 250 employees are invoved in other Kadaster duties including contributing to land development projects, and maintaining the national triangulation and GPS-network.

Policies and procedures in LIS implementation
LIS change activities involve a Client survey, where an in-depth survey of the specific requirements and wishes of clients is carried out. The result of this coordination is a document featuring the objectives that have to be met. From there, work on developing the Business Case wherein the global concept is described starts. When the business case is approved, the project is then created. This involves creating a prototype, following whose construction various testing phases are organized. In the case of Kadaster-on-line, project rolled out was done in a pilot involving 15 clients.

Staff attrition
During the restructuring the number of staff was reduced from 3700 to 2200. With regards to system maintenance, it was also realised that staff who were responsible for developing and maintaining the legacy systems was ageing and nearing retirement.

Organisational learning
An expert system supports staff in the judgement and acceptation of deeds. Every deed that is not accepted by the system is further analysed to improve the intelligence of the expert system.

Cooperation
Good contact with users is facilitated by the presence of a user council at national level (comprising representatives of the umbrella organisations of notaries, real estate agents, banks, municipalities, waterboards and consumers) and a system of account and marketing management at regional the level. Client surveys are conducted during various sessions with client groups and provide a clear picture of what new systems are required to provide in terms of user friendliness and functionality.
Online integration of Kadaster's products with clients business processes requires client front-office to Kadaster back-office integration and also the integration of the back-office activities of the Kadaster offices. For this to be successfully done there is need for cooperation from all parties involved. Automatic recognition will improve quality of registration, but there has to be a good definition about standards, interpretation of data, and new workflows between all parties involved. This is seen as a major challenge for the future.

Readiness to change
During the development of new systems, the synchronisation system and the existing systems must be maintained and this places a requirement on the number of specific areas of expertise that need to be sustained. The ICT-organisation must be able to manage the size and level of expertise to be developed and decide on the deployment of internal and external capacity. Another point of attention is the expertise required for testing and building the capacity to support employees after implementation of new systems. All these factors were considered in the choice of the current renovation approach being implemented by the Kadaster.

Organisational Readiness
Kadaster experience revealed that the roll-out of new systems changes the work processes and thus has a huge impact on staff. Good preparation is necessary, and great attention during the roll-out period is required. The capacity of the whole organisation to control and absorb a certain volume of renewal definitely determines the elapse time of the renewal scenario.

Customer expectations and recommendation
Kadaster surveys showed that customers want cadastral data to be delivered in digital form. They want the data to be up-to-date, reliable, complete and rapidly accessible. The data must fit within the customer’s working procedures. In short they want value for money.

4.5. INFORMATION ISSUES

Namibia

Amount of information
It was said that the DSM was running out of the available floor space for the storage of original hard copy documents. This was said to be one of the reasons for automation. Respondents said that as the information increased, the digital system also became larger, and as the systems grew larger, they tended to slow down and become ‘clumsy.’ Respondents said that keeping track of the size of the system was important, because after the deeds office system crashed, they found out that the capacity of the server had become too small to enable the restoration of the backup.

Quality of information
Some customers said that the hard copy information that they received from the DSM was sufficient for their purposes. Others said that what most people require is the attribute data especially plot numbers, whether surveys have been approved, or whether a property has been registered.’ However, the currency and thus quality of the information was affected by the fact that it took six months for surveys to be approved. This was said to have an effect on developers whose return on investment
would be affected. Respondents also added that there was need to disseminate the information to as wide an audience as possible due to its potential for national development.

**Zimbabwe**

**Amount of information**

Respondents said that the data coming into the system was increasing due to the introduction of the 99 year leases and the housing delivery program that was causing cities to expand into peri-urban areas. They added that the ‘DSG was not prepared to handle this huge influx of data.’ They also added that as the amount of information increased so did the amount of memory required for storage and also the amount of information that needed to be searched. As a result the system was becoming slow, and some information was missing because updating was lagging due to limited staff.

**Quality of information**

Respondents said that they had observed that, ‘the DSG was no longer updating its information as often as it used to.’ They added that, ‘there was lack of trust especially in the imaging data base as some images could not be found or were wrongly referenced.’ Staff in the DSG said that because of manpower shortages, reported errors were taking long to correct and inadequate checks were being done during data capture. Some staff members were not updating records, this had become so rampant that a ‘record status committee’ was created to carry out an audit of the records in every office and find out whether the necessary details had been recorded in the system.

Political pressure on the surveying profession to perform was said to have resulted in less accurate surveys being done. This they said had compromised the quality of the information being stored. DSG supervisors said survey work was passing through the examination process without adequate checks and this was affecting quality.

**The Netherlands**

**Amount of information**

In 2002, 410,800 deeds of transfer and 552,500 deeds of mortgage were recorded. Land surveyors also surveyed 98,200 new land parcel boundaries. All cadastral registers and maps in the Kadaster are in digital format.

Governmental organisations can have public restrictions on land and property. The possibility of combinations of these rights causes hundred of input varieties in a cadastral system. Especially when a system is automated, all these possibilities have to be careful analysed.

**Quality of information**

At the moment, Kadaster staff select important parts in deeds and copy and paste them (not automated) into the registration system. Automated recognition will make this process less intensive and enhances the quality of the registration (no mistakes can be made). The type of information that is required is that which is relevant to users’ requirements. So there is need to sort out the legal, financial, organizational and institutional aspects.
4.6. INSTITUTIONAL AND LEGISLATIVE ISSUES

**Namibia**

*Institutional positioning*
The DSM was fully dependent on the government for financial resources and was accountable to government for the pricing of its products and services and for the revenue it generated. The DSM also had to conform to the government procurement regulations which stipulated the amounts that could be handled at different levels of administration.

One respondent said, ‘The other issue is with regards to the hiring, retention and motivation of staff say through reward systems. Not being able to reward hard working staff members is more frustrating that no being able to let go of non performing staff members. With regards to the development of the system, there are also restrictions on the DSM’s ability to create posts that are needed like the IT posts discussed earlier. A post can take more than two years to be approved after initial application.’

*Statutory obligation*
The DSM was mandated to be the custodian of property boundary information in Namibia. Respondents said that the DSM should not relinquish control of cadastral and topographical data or the deeds office ownership information because that is what they were supposed to do according to the law. Developers also said the mandate made it important to design the handling system based on the country’s laws and the accompanying DSM work processes. In response to the DSM proposal to change the property identifiers, some respondents said that the DSM reserved the prerogative to enforce such issues according to the current legislation.

*Government IT policy*
Respondents highlighted the existence of a central IT under the Prime Minister’s office that oversaw issues pertaining to computers in Government departments. They also added that the Ministry also had some IT personnel and this was said to affect the DSM. Respondents said that while the DSM may prefer to outsource the hosting of their website to a private firm, government policy specified that to migrate to the web the DSM would need to go through the central IT in the Prime Minister’s office. With regards to maintenance of equipment, the supplier who gets the tender, where a service to be acquired exceeded N$ 10 000, may not be the one who would have supplied the equipment in the first place.

**Zimbabwe**

*Institutional positioning*
The DSG is fully dependent on the government for financial resources and is accountable to government for the pricing of its products and services and for the revenue it generates. The DSG has to conform to the government procurement regulations which stipulate procurement amounts that can be handled at different levels of administration. Organisational structural changes, staff recruitment and dismissal in the DSG are controlled by the Public Service Commission (PSC). This was said to affect the DSG and respondents pointed out that although interviews for IT personnel had been conducted, the posts had not been filled a year later.
Respondents also said that there was greater regulation on the pricing of DSG products and services by the Attorney General’s legal drafting division which affected the recovery of costs. The Government Tender Board often took their time to deliberate and approve tenders and by the time tenders are awarded, the initially quoted figures would have been overtaken by events. This had resulted in the DSG not being able to procure new servers to replace the old ones. The requirement to conform to government procurement regulations also limited the speed with which the department could react to the changes taking place around it.

**Political context**

Respondents said that the political administration would definitely need to be apprised of developments with regards to the system in case something goes wrong. Some respondents however said that being a government department had no affect on the development of the DSG’s information systems. They said that progress could only be stifled within the DSG and the sanction of higher authorities outside the department was not required. Yet others noted that at a stakeholder conference that was held in 2000, the then Minister of Lands had expressed reservations on having land information accessed by every one via the web, despite Zimbabwe having an open cadastre by law.

It was also noted that political pressure for the delivery of the 99 year farm leases had resulted in less accurate surveys and thus affected the quality of the information.

**Statutory obligation**

The enabling laws (Land survey Act and the Land Survey Regulations) and industrial structure of the cadastral surveying industry needed to be changed to enable innovation and ‘flow’ to benefit consumers. The legal requirement for hard copy products meant that such technologies as total stations which produce digital observation data files that can be downloaded for processing eliminating transcription errors were being under utilised. The registration process still demanded the use of hardcopy legal documents like survey diagrams and dispensation certificates.

The introduction of the 99 year lease had increased the pressure on the survey industry to perform and this had resulted in increased amounts of data. The DSG was ill prepared to handle the sudden influx of data. Respondents also said that the introduction of digital lodgement, as a solution, would have to be discussed in the survey regulations board for incorporation into the regulations.

The current state of the system was said to be flexible. Respondents said that because of this, the system would not be adversely affected by any changes that take place in the actual business processes or changes in legislation.

**Government IT policy**

Respondents pointed out that there existed a government IT department, Printflow (now privatized), that was responsible for overseeing the repair and maintenance of government IT equipment. There was also the Government Central Computing Services (CCS), under the ministry of finance, which was the custodian of the Government IT policy. Respondents added that due to the specialised nature of the software and equipment used by the DSG, the two departments lacked the capacity to maintain or prepare contracts and tenders for procurement of services or equipment. The fact that Printflow
reserved the right of first refusal for the repair of government equipment forced may departments to have annual maintenance contracts with the agency.

**The Netherlands**

**Institutional positioning**
Kadaster since it is a non profit making organization

**Political context**
Though many politicians and policy-makers would agree that a geoinformation infrastructure might be useful, it is hardly hot political news. However there were others who clearly understood the relevance of a well-organized geoinformation infrastructure. The challenge for players in the geoinformation industry was to win over new political converts and systematically involve them in the trajectory. This would entail raising levels of interest, which, in turn, would generate involvement and help policy-makers to understand the relevance of the issue, and reduce the time take to approve relevant legislation.

**Statutory obligation**
Procedures for registration and cadastral mapping are prescribed in the Cadastre Act. Submission and recording of notarial deeds in the registers is a prerequisite to obtain legally recognised ownership. In the Netherlands, only notaries are allowed to create deeds, and these deeds need to be published by Kadaster to let the ownership pass from the seller to the buyer. Also, according to the law the boundary survey is performed by land surveyors of the Agency. The main tasks of Kadaster are Land Registration, Surveying, Mapping (Cadastral map and Topographic maps) and Land Consolidation.

By law, cadastral information is only collected and maintained by Kadaster. i.e. Kadaster is the only organisation in The Netherlands, responsible for this type of information and there is no information coming from other parties. The Dutch Kadaster is obliged to provide information to anyone who asks. Hence, the task of Kadaster is to collect and provide information.

**Government IT policy**
The vision of the Dutch government, states that government and other public organisations in particular must make their products and services available via the Internet. One of the principles of a land registration/cadastral system is that it is open for the public. The programme entitled 'Another Government', aimed at having 65% of services provided by government bodies available via the Internet by 2007. Despite this it can be noted that developments in the field were shaped more by necessity than by the policy intentions of government.

The government bill on the electronic delivery of legal deeds to the Cadastral Agency contains stringent rules to ensure that the deed which is sent is the same as the deed which is registered and stored at the Cadastral Agency.
4.7. Issues arising from findings

Demands to extent functionality to enable higher rates of interaction (on line access) leads to higher dependency, need for higher availability thus higher maintenance levels and low downtimes. This presents a number of dilemmas when the situation is characterised by declining hardware quality, limited resources, limited local skills and poor state of the national telecommunications and utility infrastructure.

Aligned to this, the demand for a one stop shop for information in the face of system that is fragmented due to geographical location of components, different software platforms and standards also poses a dilemma when considering the unreliable state of the national telecommunications and utility infrastructure.

The existence of conditions that maintain the status quo or bring inertia within the organisation versus the need for renovation which results in change presents another dilemma. Such issues as organisational culture, inappropriate IT practices and procedures, lack of relevant expertise and non supportive organisational structure are some issue that can militate against change. On the other hand past IS experiences and organisational learning may have a positive effect on renovation. Government policy shifts may also introduce a dilemma when they cause sudden changes requiring LAOs to meet business needs they had not prepared for and also when the level of organisational autonomy restricts the speed of a rapid corresponding reaction by the organisation to meet the resource requirements to support renovation programs.

Demands for local support and customisation versus standardisation in the face of local skills gaps and the need for licence costs present another dilemma. On one hand standardisation offers greater chances of sustainability but may prove expensive for the LAO in the long run. Another dilemma that is faced by LAOs is that of the demands for extended functionality and e-government services in the face of legal and political conditions that maintain the status quo and take long to change. These dilemmas will be discussed further in Chapter 5.

4.8. Conclusion

From the ensuing discussion, it was found that the main factors that affect the development of Information systems in the Namibian and Zimbabwean context could be categorised into technical, organisational, information, statutory and legal issues. These categories represent the both macro and micro environmental factors that affect organisations implementing cadastral information systems.

One observation with regards to the responses was the relative homogeneity of the responses. There seemed to be an agreement on the responses except in some cases especially in the effect government policies and institutional positioning had on the development of the departments’ information systems. This could be attributed to many reasons such as the prevalence of the perceived organisation, the degree of shared understanding of the problems or most respondents having a similar professional background. The other reason could be that of having a small epistemic community (land surveyors) in both countries who shared a similar culture. A distinguishing feature from the findings was with regards to the degree of impact on the organisational information system environment given the stage of implementation.
5. Addressing the Dilemmas faced by LRO in LIS renovation

5.1. Introduction

The chapter presents the interpretation and discussion of the findings presented in chapter 4. It focuses on the arrows in the conceptual model linking the environmental factors to the current and existing LIS situations i.e., how do the factors influence the states. It however, more emphasis on the arrow towards the renovation approach, i.e., how the factors affect that determine the decision on the choice of a renovation approach. To do this the discussion is guided by the dilemmas presented in section 4.3., of the previous chapter. In the discussion, similarities and differences are drawn between the contexts. The chapter concludes with a summary of issues for consideration in chapter 6.

5.2. Demands to extent functionality versus technical quality

5.2.1. Poor technical quality of a system and its network infrastructure limit: levels of improvements applicable necessitating renovation

From section 4.2.2 the technical quality of the DSG system in terms of the hardware, the operating system and support software is very poor. The degree of obsolescence and incompatibility increases the risk of upgrading thus reinforcing the status quo. Server breakdowns and memory problems combined with the deteriorating network infrastructure reduce the availability of the system both for internal users and for client service. From the Namibian deeds registry, staff learnt that memory problems reduce the possibility of restoring back up in the event of a system failure (section 4.4.). Insufficient installed spare memory (especially on the servers) reduces software supportability. Spare memory permits the incorporation of enhancements and the correction of latent deficiencies (Software Technology Support Center, 2000). From section 2.7.2., hardware that is not longer serviceable provides a weak foundation which is not recommended for implementing business critical information systems. The need to avoid the components’ end-of-life situation and its impacts was also a driver in the Dutch Kadaster’s renovation program (see Appendix B, section B.1.4.3.3). It was also realized that it is not always possible to meet newly demanded functionalities using the existing ICT tools and that frequent modifications and addition of new functionality may not always fit in the existing infrastructure (Appendix B, section B.1.4.3.3). Thus it may be concluded that poor system hardware quality increases the risk of failure and increases the urgency of renovation (involving the replacement of the hardware).

According to Wade and Laws (1998) as summarized in section 2.11 subjective ranking on software quality were found to be in agreement with objective ones. A subjective application of the bathtub curve to the findings from section 4.2.2 and 4.3 will reveal that different DSG software components are in different segments. Most of the DSG support and application software is in segment C of the bathtub curve for software (see Figures 10 and 11). The watermark imaging component of the system displayed section C characteristics while the holding system based on the Microsoft Access DBMS was still in section B of the curve. The software situation compromised the security of the system and
ultimately the security of critical data (see also figure 13). Operating software quality has security implications on the system and the system’s ability to meet projected growth in information flows. Microsoft Access had limited capacity and was predicted to come under increasing pressure from projected data inflows from the 99 year lease surveys and the urban housing delivery program (see sections 2.8.5, 4.2.2 and 4.5.).

The software in the DSM was still in good condition with different components falling in different sections of the software bathtub. The holding system was still being customized to fit the Namibian context and was thus in section A, the mapping component implemented using Arc Cadastre (a proven product) would be in section B (see sections 2.8.5, 4.2.2, 4.3). The Dutch cadastre on the other hand was shown to still have legacy applications running on its mainframes (see section 4.2.2) and these would be in section C. A number of issues arise from this discussion. The demand for new functionality places a requirement for renovation and having different software components entails that LAO may just need to deal with the problem components and leave the rest intact. This however required expertise.

5.2.2. A system’s business value determines the interaction rate and thus the minimum expected downtimes during renovation

The three organisations are the sole custodians of cadastral data in their countries and the data is produced once and for use by all. Current legislation in all the three countries make it illegal to reproduce cadastral data. Without this data no first registration of a property can take place in the deeds registry. Due to the criticality of the information they hold and the level of transactions they handle, the systems assume a very high business value (Heuel et al., 2006).

In the DSG all cadastral business processes, can only take place through interaction with the system. In the Dutch Kadaster, 99.9% of all products are provided on line while notarial deeds are submitted and examined by an expert system in digital format. Because the utility of the systems is very high (section 4.3), system down time should be as low as possible in order to minimise inconveniences to the users and the clients. The higher the degree of the organisation’s dependence on a system the shorter the expected system downtimes especially when there is no fall back system. This has implications on the cutover strategy chosen.

The Namibian system being implemented will be highly customised, support all the cadastral business activities and have very high accessibility due to internet enabled access. Just like the Dutch Kadaster, the system will be expected to have high availability due to the number of interactions by users and clients with the system. This has implications on the level of support that has to be available for the system. Systems critical to business processes or highly interactive systems expect high levels of support and maintenance.

5.2.3. System fragmentation limits renovation

Although the DSM system would be component based, it would be centralised (in Windhoek) and would be using common interfaces. On the other hand the existing DSG system was fragmented both in terms of the components and also in terms of the geographical distribution. The LTS and the
watermark components were not linked and did not use a single user interface (section 4.2.1). The same situation was replicated in Bulawayo. The Harare and Bulawayo components were not linked and did not communicate (4.2.1). This meant that all DSG cadastral data could not be accessed within the same office or a common interface. However, the fragmentation itself would not place limits on renovation were it not for the fact that the watermark component is no longer supported. This last fact would however affect the reusability of the component. In the Dutch Kadaster, kadaster-on-line makes it possible for digital data in the 15 geographically spread kadaster offices to be provided on line using one interface (see section 4.2.1). From this discussion, fragmentation would complicate renovation if integration is to be done in a situation where there are no standards. Online access offers a solution to the problems of fragmentation that make systems unable to meet business needs.

The reported fragmentation in the DSG was also in terms of the different software and hardware platforms in place. This has security implications in that some software can violate the network security protocols implementable. One example was with regards Windows 98 versus the network security protocols implemented using Windows 2000 server. Thus fragmentation in terms of different software and hardware platforms necessitates renovation to prevent compromising system security.

### 5.2.4. Existing national telecommunications and utility infrastructure places limits on extent to which new business requirements can be met.

Findings in section 4.2.1 expressed the intention in both the DSM and the DSG to use the web for wide distribution of their data while for the Dutch Kadastre 99.9% of products are delivered online. However, according to Lu and Farrell (1990) poor communication networks preclude the use of data communication and computer networks in developing nations. ITU figures for September 2007 show that internet penetration is 9.9% and 3.9% for Zimbabwe and Namibia respectively and mainly confined to the urban areas. ITU reports also show that the number of internet cafes is increasing in both contexts and charging from Nam$10/30 min in Namibia and Zim$600000/30 min in Zimbabwe. This presents better opportunities for online access by clients, the majority of whom would need to travel distances in excess of 800 km to Windhoek in Namibia and 500 km to either Harare or Bulawayo in Zimbabwe. Noting that the major clients for the cadastres, the Land Surveyors mainly stay in cities and act on behalf of their clients, access would be greatly enabled by an internet solution and will increase the organisations’ visibility.

Lu and Farrell (1990) also indicate that system availability both at the server and at the client side in developing countries is also affected by unreliable electric power supply. This is reinforced by Heuel et al (2006) who add that a well performing nationwide communication network will not be implemented synchronic to organizational requirements. The state of the national telecommunications and utilities infrastructure in both contexts does not limit the feasibility of renovations targeted at online access of DSG and DSM data.
5.3. Organisational factors determine successful completion of a renovation effort

5.3.1. Addressing the skills gaps in the organisations is a feasible alternative to having a dedicated inhouse IT department

Responses in 4.4 highlighted the need for appropriately staffed IT departments in the DSM and the DSG. The expressed desire to have in-house IT staff taken against a high staff turn-over, a lack of appropriately skilled IT and domain staff poses a dilemma. This however does not apply to the Kadaster since its organizational structure accommodates IT personnel. The preferred solution of training domain staff to be IT proficient poses problems in their placement on the organizational structure. This is because in the public service posts come with job descriptions, responsibilities and salary scales. The IT training afforded to most survey personnel may not entail them to hold and receive the salaries of an IT post designed for an IT trained person. This results in frustration and thus a higher turnover of hybrid personnel. This also explains the reluctance for some personnel to undergo IT related short courses since the public service commission (PSC) does not recognize it for promotion to higher grades in their main areas of expertise. Despite this, Heeks (2002) maintains that such hybrid personnel are better able to integrate the contexts and assumptions of both technical designers and business oriented users. This is also supported by Mitleton-Kelly and Papaefthimiou (2001) who have written that for legacy problems to be reduced, the IS professionals need to understand the business process, and the business users and strategists need to understand the technical potential as well as the limits of the IT systems. Introduction of ‘hybrid’ personnel was one of the attempts made in the past two decades to enable communication between the business and IS domains. From above, it may be realised that inadequate consideration of staff career development in a restrictive environment (bureaucracy) hinders the development of hybrid staff who are important in renovation programs.

In situations of high staff turnover the logical solution would be to outsource. This would be logical given the complexity and size of the systems to be implemented. The other factor aligned to outsourcing is also the expressed preference for local consultants over international consultants. Although in section 4.3 and 4.4, DSG staff expressed the view that renovation activities could actually be handled in-house, there was a possibility that the process would overwhelm the two member IT section. Thus dependency on a limited number of IT staff can not sustain renovation activities that extend over prolonged lengths of time.

Section 4.4 indicates that it is apparently possible to run parallel systems (despite capacity problems!). The question that comes up is, 'which systems can be run in parallel in the two contexts: a manual and electronic system or two electronic systems?' Although this appears to work, according to Namibian responses there is need to clearly define staff roles during implementation. This is to prevent the frustrations on the IS manager that may result from unavailability of staff due to staff not being permanently seconded to the development of the information system. Other statements, which at first appear like truisms, e.g. 'such undertakings should not be approached with little preparation and thought,' and 'it is like doing the same work twice,' reflect the feelings of some of the staff on this arrangement. Running two electronic systems in parallel, has been noted in literature to require more resources and more expertise and may not be a preferred approach for an organization with high resource and staff problems (Eason, 1988). The DSM and the DSG have low capacity of retaining...
the required expertise thus outsourcing is the most feasible solution in regards to renovation. The situation with Dutch Kadaster is however different in the sense that they have the necessary resources to maintain the existing databases, synchronisation and new developed system (sections 4.3 and 4.4).

5.3.2. Lack of appropriate IT practices and procedures brings complexity to IS and make renovation difficult

Regarding the cutover from the existing to a renovated system, two questions arise: ‘what factors determine the switch from the existing system to a renovated one?’ and ‘what factors determine an organisation’s satisfaction with the new system?’ One Zimbabwean response referring to the existing system pointed out that, ‘when a 90% rate of integrity with the old system had been reached, the DSG automatically switched to the new system.’ In this case they were more concerned with the integrity of the data. However, in moving from one electronic to a new electronic system other aspects such as functionality also come into consideration. In the case of Hong Kong, clients complained that the new system did not provide some of the old functionality (www.landreg.gov.hk/index-en.htm). In section 4.2.2.4 a Zimbabwean respondent said ‘it was vital to maintain the originality of the current system.’ Taken in the sense of the following response, ‘it was crucial to test the new system before adoption’, there would appear to be a contradiction. However, taken in combination the statements above appear to imply that satisfaction with a renovated system can only be guaranteed when it retains or exceeds the existing system’s business value and functionality. In the Kadaster case, in section 4.4, the need for testing pilot projects before roll out is highlighted.

Section 4.4 shows that laid down procedures on: software change requests, system backup, log over change reports and track data were no longer being followed in the DSG. One possible cause for this could have been lack of awareness of existing procedures by new staff due or disregard of procedures by all staff. However, the IT section (the custodian of the DSG IT policy document that highlighted these issues) also let the practice continue unabated. It could be that the IT section was informal and had no structures to legally implement organizational procedures and place obligations on other staff members. The fact that these deviations were never questioned by DSG management also points a lack of supervision. Non compliance with procedures could lead to incomplete documentation and limited understanding of code which according to Wade and Laws (1998) may result in maintenance efforts causing increasingly fragile structures which are difficult to understand and dangerous to change.

5.3.3. Experiences with past IS implementation and organisational learning affects future renovation activities

Knowledge is referred to as the perception of the reality of things based on personal experiences and accumulated past knowledge (Realini, 2004). Past experiences in implementing information systems as shown in sections 4.4 is invaluable to the three organizations. Findings interestingly show that important lessons learnt in failed systems and highlight issues to be avoided in future and how personnel can more importantly determine the destiny of their information systems even if their development is outsourced. These were being passed between staff through a process of socialization.
The use of expert systems (section 4.4.) to improve organisational learning as in the case of the Kadaster introduces an interesting dimension on learning.

Literature identifies explicit and tacit knowledge. The former can be coded in writing or symbols and can be shared in data form, scientific formulae, specifications, manuals. The later is deeply rooted in actions, routines, commitment ideals, values and emotions (Realini, 2004). Findings in section 4.4 indicate that despite a high staff turnover there apparently is not much loss in terms of institutional capacity as would be expected. It would thus appear that the people that are left behind and the new staff have to learn and adapt quickly. Knowledge of previous systems and experiences in past and present IS implementation efforts would contribute significantly to renovation project success.

5.3.4. The cadastral industry culture reflected by the LROs introduces inertia to renovation initiatives

Government agencies (Bureaucracies) in most post colonial countries are remnants of systems that were established to control and dominate (Berman and Tettey, 2001). According to Lu and Farrell (1990) most IS activities involve human interaction and are thus affected by cultural differences. They add that culture governs interpersonal behaviour at group level and thus dictates individual behavior in an organizational setting.

Responses in section 4.4 express the view that the DSG and the DSM saw themselves as wielding power over customers due to their regulatory roles (conferred by the respective country’s Land Survey Act) and the criticality of the information they hold. But unlike in the case of the Dutch Kadaster, which administers several authentic registers, the DSM and the DSM are not customer oriented conforming to what (de Man and van den Toorn, 2002) highlighted as some past tendencies of mapping organisations namely: that their information is supply-driven and of a blanket nature and that they collect their data and produce information with respect to demands that are identified and abstracted by themselves (de Man and van den Toorn, 2002).

All the three organisations are monopolies in the cadastral information service sector, and thus they can afford to move at their own pace in the establishment of their information systems. This is in conformance with the assertion by de Man and van den Toorn (2002) that a competitive environment will compel organisations to seek and adopt innovative technologies. Such was the case with the Kadastre which had to adopt a market and customer oriented attitude (section 4.4.). In a less competitive environment, an organisation will face less market pressure and would tend to be conservative in its organisation and operations (de Man and van den Toorn, 2002). Responses in sections 4.4 described the cadastral survey industry in Southern Africa as conservative and traditional. This reinforced the status quo, and was manifest in the outdated survey regulations (see responses in section 4.3), lack of management support for staff innovation (DSG, section 4.3) and slow management reaction times (DSG, section 4.4). However, the findings in sections 4.4 show that some professionals in the cadastral field were changing with the times and their progress was actually being limited by the DSG and the DSM and the out dated regulations.
It can be concluded that in the Namibian and Zimbabwean contexts, organisational culture introduces inertia (with regards to innovation) which militates against renovation initiatives. Monopolies can ‘afford’ to move at their own pace in the establishment and renovation of their information systems, but this can be reactive (DSG and DSM) or active (Dutch Kadaster, (van der Molen and Lemmen, 2003)).

5.4. General environmental factors constrain the extent of adaptation

5.4.1. Extent of system automation (renovation) depends on the existing legal requirements.

The extent of system automation in the DSG is described by the phrases ‘a completely automated system’ as expressed by client groups in section 4.3 and ‘partial computerization’ as expressed by DSG staff in section 4.3. The two statements give the impression that a completely automated system is one that is able to receive input, process it, produce, store and disseminate the output in digital format. However, most clients basically need the end results of LRO processes. According to (Realini, 2004) complete automation of all services is useless and implies insurmountable expenses.

Al-Omari and Al-Omari note that the legal umbrella is a safety valve for all government activities and say that it is prudent to conduct a legal assessment before embarking on electronic initiatives (Al-Omari and Al-Omari, 2006). Such assessments include: legality of conducting electronic business transactions; legality of electronic documents exchanging; legality of sharing application data across organizational boundaries; liability assignment for Internet transactions; legality of notifications, management, physical services delivery and contracts, and verifying identifications, electronic signatures and authentication procedures. In the Kadaster, these aspects have already been addressed and electronic transactions are taking place legally (section 4.2.1. and 4.4.). (Realini, 2004) commenting of the Swiss situation says that in the current administration many (or too many) official documents are still paper-based. In Namibia and Zimbabwe processes linked to land registration require the original hard copy record (survey diagrams, general plans and dispensation certificates), signed by a registered Land surveyor and approved by the Surveyor General. From the points above it may be concluded that the systems need only be automated to the extent that client needs and legal requirements are met.

5.4.2. Standardisation offers better chances of system sustainability than customisation

Namibian responses in sections 4.3 and 4.4 expressed preference for local support, competences and user specifications and yet in practice the DSM was using international software (ESRI and Windows), international vendors and general standards. They were in practice opting for standardization with very little customization. In the DSG the setup of the watermark was highly customized to the DSG requirements that it is difficult to find support for it in the current state. The Kadaster on the other hand preferred an open standard based infrastructure due to reasons of flexibility.
Findings in section 4.3 indicate that standardized products like the ones mentioned above have a better chance of getting local support. This local support came in the form of locally based agents like Geocarta in Namibia for ESRI products. This is supported by Lu and Farrell (1990) who indicated that use of packaged software acts as useful alternatives to dampen the effect of lack of local and in-house expertise. Other findings in the same section suggested the use of open source software. However, respondents also expressed the view that it would require a certain level of competency to set up the software and to maintain it. It may be concluded that the decision for customized or standardized products depends on the quality and availability of relevant resources. Given the resource positions of the Namibian and Zimbabwean organisations, standardisation offers a better chance of system sustainability.

5.4.3. Tying in to government initiatives provides justification for IS renovation

According to section 4.3.1, the change from the manual to the electronic system in the DSM was to address the back office (internal) processes and customer interface (external). The customer interface was said to be inspired by the government’s embrace of the e-Government concept. On the other hand in the Zimbabwean side, the DSG was facing a huge influx of data from surveys targeted at the rationalization of the Land Reform exercise (99 year lease agreements) and urban housing delivery program in the face of a decline in the technical quality of the system. On the Kadaster part, the vision of the government to have public data available on the internet (section 4.6.) coincided with the organisation’s desire to cut costs. Tying in to government initiatives would logically prove the relevance of the departments and legitimize the requests for more resources or existence. However, combining the statements above reveals that it is not so much the government policy that drives the changes, but necessity. In the DSM there is need to improve processes and access and reduce pressure on staff. In the DSG there is need to cope with increased information in the face of impending system failure, and in the Kadaster the need to cut costs.

5.4.4. Government policy influences success of renovation or maintenance activities

Al-Omari and Al-Omari (2006) point out that the relationship between citizens and governments is strictly managed by law; moreover, government agencies may be required by law to share information with other agencies or with the citizens. The statutory obligations placed on the DSG and DSM require them to share their information.

Findings in sections 4.4. and 4.6. indicated that the DSG and the DSM had limited autonomy. According to table 4, they have low control on their human resources (recruitment, pay, rewards), on strategic issues (decisions affecting scope of business activity, purchasing policy and contract award decisions), on financial issues (distribution of profit, purchasing and contract award decisions, borrowing decisions and decisions on use of foreign currency), on purchasing and appointments (managerial appointments, EDP decisions) and on pricing of products or services. Given these controls on the DSM and the DSG it can be concluded that they have very low statutory and financial autonomy thus falling in quadrant IV of the typology of autonomy grid by Vinzant and Vinzant (1996). Although the grid applies to Strategic management, it has great relevance for IS development and renovation as well. The Dutch Kadastre would fall in II of the same grid. It is thus more difficult for the DSM and the DSG to engage in renovation activities than for the Dutch Kadaster. The greater
the autonomy an organisation has, the greater the chance of successful system renovation and maintenance.

5.4.5. Unexpected rises in information quantities strain the system, increasing the risk of failure and the urgency of renovation

The DSG was confronted by the issue of increasing amounts of information in the face of decreasing system technical quality and a lack of resources. Realini (2004) says that to succeed in services, customers have to be granted flawless execution of operations. All the processes have to function without interruptions or delays. There should not be bottle necks in the process flows (Al-Omari and Al-Omari, 2006). Staff attrition versus increased amounts of work coming in meant that the available staff members (in the system administration section) were being overwhelmed since members now had to perform multiple tasks. This was the cause of section 4.5. findings that indicated that the system was not up to date, there were errors in the data, some data was missing and there was work backlog.

Another behaviour reported was that of other cadastral staff members not updating the database due to the issue of trying to meet expected performance targets versus lack of monitoring mechanisms (section 4.5). This resulted in a natural preference for working on less complicated jobs first. To determine less complicated surveys, staff first scanned through the available records, took them to their workplaces without registering the jobs against their names on the system. Unlike the DSM system whose design includes a workflow management system, the DSG system gives examiners great freedom in choosing the records they want to examine rather than their supervisors assigning them work. When a record update committee was constituted, things got back to order, indicating the need to implement better supervision on processes and monitoring of system quality. Lack of staff and proper supervision may lead to counter productive behaviour that poses a risk to renovation in terms of quality, cost, time and ultimately stakeholder confidence in the system, and thus use.

5.4.6. Summary of interpretations

From the discussions it may follows that hardware and software quality are triggers of renovation. They increase the risk of failure especially when they approach their end of life stages necessitating radical methods of renovation to be embarked on with urgency. The demand for new functionality also places a requirement for renovation and having different software components entails that a LAO may just need to deal with the problem components and leave the rest intact. This however requires expertise and knowledge of the interconnections between the components.

System with high criticality and interaction levels expect high levels of support and maintenance. The higher the environment’s dependence on a system the shorter the expected system downtimes during renovation initiatives especially when there is no fall back system. Satisfaction with a renovated system can only be guaranteed when it retains or exceeds the existing system’s business value and functionality.

System fragmentation brings complications to renovation if integration is to be done in a situation where there are no standards. Online access offers a solution to the problems of fragmentation that
make systems unable to meet business needs. The state of the national telecommunications and utilities infrastructure in the Namibian and Zimbabwean contexts does not limit the feasibility of renovations targeted at online access of DSM and DSG data.

Inadequate consideration of staff career development in a restrictive environment (bureaucracy) hinders the development of hybrid staff who are important in renovation programs. Renovation is a resource intensive exercise and thus dependency on a limited number of IT staff can not sustain renovation activities that extend over prolonged lengths of time. The DSM and the DSG have low capacity of retaining the required expertise thus outsourcing is the most feasible solution in regards to renovation. At the same time knowledge of previous systems and experiences in past and present IS implementation efforts would contribute significantly to renovation project success. The decision for customized or standardized products depends on the quality and availability of relevant resources. Given the resource positions of the Namibian and Zimbabwean organisations, standardisation offers a better chance of system sustainability.

Non compliance with maintenance procedures could lead to incomplete documentation and limited understanding of code which lead to maintenance efforts causing increasingly fragile structures which are difficult to understand and dangerous to change. Lack of staff and proper supervision may lead to counter productive behaviour that poses a risk to renovation in terms of quality, cost, time and ultimately stakeholder confidence in the system, and thus use.

The greater the autonomy an organisation has, the greater the chance of successful system renovation and maintenance. Tying in to government initiatives would logically prove the relevance of the departments and legitimize the requests for more resources or existence. However findings indicate that it is not so much the government policy that drives the changes, but necessity. In that respect, systems need only be automated to the extent that client needs and legal requirements are met.

In the Namibian and Zimbabwean contexts, organisational culture introduces inertia (with regards to innovation) which militates against renovation initiatives. Monopolies can ‘afford’ to move at their own pace in the establishment and renovation of their information systems, but this can be reactive (DSG and DSM) or active (Dutch Kadaster)

5.4.7. Further discussions and conclusion

The discussions above show that there are many issues that have a bearing on the final renovation decision. What becomes very clear is that dependencies need to be taken into account. At micro level there are inter dependencies in the software components or application programs themselves. In systems that are component based, making changes to a component requires one to identify and understand the dependencies with other components. If this is not done it may affect the performance of the system. Software components are also inter-related with the operating systems and the hardware platforms, such that changes to one may have implications for the other items. At the same time the existing operating systems and hardware may make it impossible for new software or hardware to be supported due to compatibility reasons. This entails that developing enhanced functionality may thus be restricted. These issues arise from co-evolution theory at the micro level.
Moving from that level to the organisational level the discussions show that changes in business processes impose requirements on the IT infrastructure and vice versa. The lack of skills to maintain the legacy systems also arises from the inability of the organizations to either recruit, develop or retain them. IT and domain experts are required for system design, maintenance, testing and use. The organizations are also not structured to accommodate IT experts and thus have problems retaining hybrid personnel. Yet these are very critical in enabling co-evolution of the IT and Survey domain experts by reducing the communication gap between them. The limited autonomy of the organizations results in inability to retain or train staff, to restructure and to provide the requisite resources for renovation. Maintenance and renovation costs can be reduced by continuity in staff, so staff turnover will have an effect on both, resulting in the erosion of the knowledge base and causing skills problems.

Changes in the business objectives may require the development of a new system or enhancements of the existing systems. Global changes in operations and technology may lead to changing customer expectations with regards to service demands (e.g. online access) which may entail changes to the way information is provided by the current infrastructure. This results in the need for building new interfaces to support the information. Furthermore, the economic climate and the market exert financial pressures that affect the allocation of funds to build or rebuild an application. Issues like changes in legislation have an impact on the types of products and services supported in terms of their format, quantities and systems may have to be adjusted to accommodate the new regulations. These might range from simple code changes to the system itself, changes to other systems that are interfacing with the original system, the development of a new system that will interface with other older systems.

The influence of exogenous institutional factors, like legislation, are part of the feedback process which impact decisions, IT systems and ways of working and also contribute to the legacy problem and indeed the solution. From this discussion it is apparent that understanding renovation exercises in the study sites of this research is greatly aided by co-evolution theory.

From the discussion it also emerges the impact of the factors outlined varies depending on the stage of development of a system. In terms of their electronic systems, three stages can be identified from the contexts as follows pre-maintenance (DSM), at renovation decision level (DSG) and in the renovation stages (Dutch Kadaster). At these stages, the resource demands in different stages of this developmental trajectory within the same context would appear to rise to a peek at the stage of renovation before gradually falling during the renovation stage.
6. LIS Renovation Recommendations

6.1. Introduction
Based on the factors affecting the organisations from chapters 4, 5 and appendix B, this chapter makes recommendations on the way forward with regards to renovation. It focuses on building a picture of the state of the current system and that of the desired system thus establishing the gap between them. This gap is what will determine renovation approaches from section 2.7.1 subject to the interpretations in chapter 5. The implications of the alternative applicable renovation strategies for each context are evaluated.

6.2. Namibia

6.2.1. Summary of technical aspects of the Information system
The system architecture depends on having two main clients connecting to the system. The first client is the Internet Browser which connects to the web application published on the web server. The web application uses the ArcIMS GIS application server to provide the user with all needed GIS functions. The web application also connects to the Oracle Server 9i directly for tabular information. The second client is the ArcCadastre Desktop Application which connects directly to the GIS data stored on the Oracle Server 9i through ArcSDE.

ArcCadastre is considered the interface to edit and handle spatial data within DSM. ArcIMS is responsible for providing map view through the web Applications. RDBMS (Relational Database Management System) is represented by the Oracle solution which will be responsible of storing DSM Data including the spatial data. ArcSDE role is to manage the spatial data stored within the oracle DB and handle requests for spatial data. Internet browser is considered as the client for the intranet web application. All web applications are installed and hosted on the web Server such that it is dedicated to handle http requests sent from the Internet browser

The hardware consisted of a Geodatabase Server (running Windows 2003, ArcSDE 9.1 and Oracle Server 9i), a GIS Application Server (running Windows 2003 and ArcIMS 9.0), a Web Server (running Windows 2003 and IIS Web Server) and workstations (running Windows XP, ArcCadastre 2.0). These were acquired at the onset of the project in 2006, thus are still in good condition.

6.2.2. Expectations with regards to the Target Information system
Stakeholders outside the DSM required on line access to digital data. This data included attribute spatial information on land parcels, ownership information, address data and property value, data on resettled land, land use planning information and urban land information. This entailed a one stop access to ownership information from the deeds office, address and property value from the Land Valuations department, data on resettlement land from the land resettlement department, land use planning information from LUPA and urban land information from municipalities. Since these directorates (save municipalities) were in the ministry as the DSM, it was suggested that the design of the system should make provision for data from other directorates and then allow them to update their
respective portions of data. One reason given was that the ministry had the same set of clients. Stakeholders also required current information and a real time system, of which digital lodgement would be very critical.

The same sentiments were echoed by internal stakeholders. The slightly different concerns included the fact the user interface should be customized and simple enough to address different user requirements. Online access would reduce client pressure on staff and would make work monitoring and record tracking would be easier. Digital lodgement would reduce the rejection rate of surveys and shorten the new examiner’s learning curve apart from reducing the turn around time for surveys. In this regard examiners would require all the information required for a comprehensive survey examination to be captured by the system. Other requirements were with regards to the security and sustainability of the system. Stakeholders also regarded different levels of functionality for different users, client confidence and trust in the data as important.

6.2.3. Approaches to Renovate

Looking at the expectations and the current system being implemented the following recommendation could be made;

6.2.3.1. Perfective Maintenance (extension of initial design)

Since the software is still to be commissioned, but close, preparations for system use and maintenance should begin. It is noted that the product delivered has to first and foremost meet the functional specifications of the tender. That having been said, the facts raised above with regards to the stakeholder requirements of the target system can only be met on the extension of the original terms of reference of the tender. Such an extension will then include provision for inclusion of the data from the other directorates either in the DSM system but updated by remote access or else by modifying the user interface to tap into the datasets of the other directorates in the future. This comes in the form of future proofing i.e. making it possible to add functional components to the system or possible to modify individual components in time as the requirements arise. The DSM could thus consider the inclusion of ‘use them when you want them’ components as extra features of the system. Comparing the current system being implemented and the expected system features, it could be noted that the gap to be addressed is small.

Recommendations for the future

System sustenance

- The DSM has to start considering how best to sustain the system when it becomes operational by building the necessary maintenance expertise or establishing maintenance contracts with competent companies. One consideration is to build an in house IT department,
- The DSM also has to start developing suitable maintenance procedures and practices to making sure that they are followed, and this may entail cultural changes,
- Contingency plans have to be put in place to ensure the continuous availability of the system for internal and client business processes.
6.3. Zimbabwe

6.3.1. Summary of technical aspects of the Information system

The current state of the system shows that the DSG is confronted with an end of life situation with regards to its hardware platforms (the most critical of which are the servers) and to its imaging software component based on Watermark server. These pose an immediate risk of loss of information, thus stressing the urgency with which the renovation exercise should approached.

With regards to the current system, the applications and the data are on separate hardware in a two tier infrastructure. The attribute data is hosted on the LTS server and the image data on the Watermark server, and on the client side, applications to enable access (user interfaces) to both sets of data. Applications are installed on the client side in the current setup, and in this way access to either data is limited to authorized user workstations. The user interfaces are not integrated currently, and users alternate between the two.

The LTS runs on Microsoft Access, which implements relational database technology. The applications are form based but generated through Access modules that use Visual Basic as the programming language. Documentation and user manuals are still available in digital and hardcopy format although their up datedness may now be questionable as reflected by interview results. The watermark server stores the system’s images in the standard formats .jpg and .tiff. The watermark system currently stores the images in directories according to the years the surveys were done and in subdirectories specifying the survey record number. This makes them relatively easy to retrieve and to host in a more modern and supportable platform.

Currently there are about four members of staff who have extensive information on the structure and working of the two components systems to augment the existing documentation. Two of them are working in the IT departments of the Harare and Bulawayo offices have intrinsic knowledge of the coding of both systems. In this way they can make structural changes or fill in the gaps in the system documentation thus reducing the cost of reverse engineering.

6.3.2. Expectations with regards to the Target Information system

Issues of concern from stakeholders outside the DSG included the provision of digital data online. This could be through a web or other remote access to subscribed users. In terms of content stakeholders wanted access to spatial cadastral data, image data (legal documents), and parcel and ownership data. Stakeholders also desired to have real time updates of data. From internal stakeholders, there was a desire for the system to include an approved document monitoring system, workflow system, images of large format documents (larger than A3) and spatial data. The target system should also enable the access of all data through a single user interface. This single user interface would provide access to image data, parcel attribute data and data from both regional offices. The IT section was especially concerned about upgrading the network infrastructure, hardware and software, system security and backup, migrating to modern application development platforms and hosting the DSG website. Domain cadastral survey staff were interested in a system that would facilitate the introduction of the Digital lodgement system.
6.3.3. Possible alternatives for renovation

6.3.3.1. Use COTS

Commercial off the shelf software would be a solution to the DSG woes if a suitable product could be found (See section 2.7.1). Idiosyncrasy is one aspect of Land Administration Organization Information systems that makes it difficult to have COTS available. Various standardized components can however be included to make up different components of the system. However a lot of expertise would be required to design a holding system that would be the main stay of the system responsible for integrating the components as is the case in the development of the Namibian system.

Noting that the systems in Southern Africa are very similar due to the fact that the Land Survey Acts derive from the same source, Lantmäteriet (National Land Survey of Sweden) could take advantage of the vast experience of SwedeSurvey in developing LRO information systems in the region to produce a flexible standardized package. ArcCadastre already incorporates a cadastral component and a workflow management component. However for now it remains a dream. However, COTS may require a huge initial capital outlay, seeing it could not engage local developers to renovate the system in 2006, the DSG could fail to pay for the COTS solution.

6.3.3.2. Scratch the existing system and start everything from scratch

This is feasible but would mean years of investment in terms of data capture and data maintenance will be lost and additional expenses in developing a new system incurred. This may actually be very difficult to justify to all stakeholders especially given that the data is still reusable in its native formats.

6.3.3.3. Maintain existing platform and use wrapping to increase access

Another option would be to keep the current systems on the same platforms, but use wrapping as a solution to enable access to data using a single user interface without having to integrate it first (Section 2.7.1). This approach focuses on the communications and connectivity aspects of the solutions, while avoiding the complexity of legacy systems. To deliver Web access on the current legacy platform, Screen scraping (often called ‘frontware’) can be used. The non-intrusive tools add a graphical user interface to character-based mainframe and minicomputer applications which allows effective leveraging of legacy data and lets users employ common graphical data manipulation tools to input data and process system output.

Advantages
The DSG would be able to tap legacy data while avoiding the misery of trying to modify the underlying platform i.e., intergrating the fragmented databases, LTS and watermark in the two regional offices. It would be able to reuse its existing components and to leverage its massive investments in the LIS. By using screen scrapers, internet access can be deployed in days and sometimes hours.

Constraints
The approach is applicable in situations where there's no need to change business functionality in or the existing platform. The DSG system needs both. The method perpetuates the legacy problem and in addition the screen scrapers also require maintenance, thus increasing the maintenance burden of the DSG. Given the state of the DSG system, scalability can become a problem since more users are handled on modern Internet-based platforms.

6.3.3.4. Migrate system to new platforms

This would involve the assessment and replacement of current hardware to meet the requirements of new software platforms in the target system. This would also require the up scaling of the Microsoft Access database and its associated code to a modern DBMS and development platform that would meet the demands of increased inflows of information and implementation of dissemination methods that enable wider access of information. If the new developmental platforms enable and support image data in a RDBM or object oriented environment this would also make it easier for data integration. Service oriented architecture can be adopted whereby Bulawayo and Harare office data are kept as separate data sources and then accessed via a single user interface via web pages. This may entail that the current two tier architecture may also have to be changed to a three tier architecture composed of PC based imaging application and web based tools at the client side, an enterprise Application server in the middle tier and database servers and other currently existing applications as the back end server.

Constraints

The problem in this case would be on the cost of the hardware and the expertise to implement the solutions. The other risk would also be the issue of the cutover which may necessitate that the current system be made unavailable for a certain period to users. Of major importance is that whilst the new solution is being implemented, the same staff needed on the development will still be expected to undertake routine work.

Recommendations

- Use open source software, license free developmental platforms. Use external expertise i.e., outsources. Develop internal staff.
- Use the Butterfly methodology of migration given in section 2.7.1.
- Deploy systems using the phased introduction method in section 2.7.1
- The DSG to develop the necessary expertise for system sustenance.

6.4. The Netherlands

From the findings in Appendix B, the Dutch Kadaster has already made decisions and has a clear road map of its renovation program. Observing what is happening in the Dutch Kadastre could also be of great importance to the other two organizations. However it is important to highlight that complacency would result in the Dutch Kadaster renovated system being a legacy system by the time of completion! In this regard it is necessary for the Kadaster to be vigilant to changes taking place in the global technology arena and the changing tastes of society. The complete renewal in the step by step approach taken by the Kadaster is complex and the duration of the effort is very long. Obviously during this period two systems will need to be maintained. In this case some of the funds that could
have been used for developing the new system will be used in maintenance activities. Another disadvantage is that an irreversible sequence of steps.

6.5. Conclusion

The DSM would be recommended to start making preparations for the commissioning of its system, its use and most importantly how the system is going to be maintained after the consultant has completed the project.

It is recommended that the DSG adopt migration as the solution to renovation and phased introduction as the deployment method. This would allow enable wider access through an online solution and change the underlying platforms as required. Before cutover, the existing systems would be operational and it also allows reuse of some components of the existing system.

For the Dutch Kadaster there is need to be vigilant to changes taking place in the global technology arena and the changing tastes of society to prevent the renovated system from becoming a legacy system at time of implementation.
7. Conclusions and Recommendations

7.1. Introduction
This chapter presents the main conclusions of the research. The research questions posed and were addressed in the different chapters of the thesis as follows;

7.2. Objective 1: To investigate the conditions under which Land Administration Organisations implement different renovation approaches to maintain alignment between their land Information Systems and business processes.

7.2.1. Research Question 1: What are the impacts of land information system evolution on the businesses of Land Administration Organisations?
It was realised that information systems act either as enablers or disablers of change as they support critical business processes in end-user organisations. They are enablers when they can support new types of business processes that would be unmanageable without them. They are disablers when their complexity makes the cost of making changes unacceptable, and when their inflexible causes desirable business process change unable to occur quickly enough, become too expensive or simply unachievable. Information Systems are much more than computers, programs, databases and networking, but also include investments in skills, data, business processes. All these must co-evolve such that changes can not be made on part of the system without affecting the other parts that interface with it. As systems get older, everything becomes related in some way to everything else. Old systems are so interconnected due to a lifetime of maintenance, that even apparently small business process changes would require substantial work on the supporting systems.

7.2.2. Research Question 2: What approaches have been used to renovate land information systems to continuously align them to changing business needs?
Approaches that have commonly been used to renovate Land Information Systems include redevelopment, wrapping, migration, maintenance and the use of commercial off the shelf applications. Redevelopment leads to the most changes (intrusive) and wrapping the least (non intrusive). Each approach varies in terms of changes required, the costs and risks involved. Choice of the renovation approach could be determined by portfolio analysis based on the technical and business value of the system. Based on this evaluation, systems could be retired or replaced, reassessed, maintained or modernized. Finally it was found out that there are also different ways of deploying renovated systems. These included the big bang, parallel running, phased introduction, trials and dissemination and finally incremental evolution.

7.2.3. Research Question 3: What are the factors that affect the renovation of Land Information systems in Land Administration Organisations?
From Chapter 4 it was found that the main factors that affect the development of Information systems in the Namibian and Zimbabwean context could be categorised into technical, organisational, information, statutory and legal issues. Technical factors comprised communication and networking
infrastructure, software and hardware states, system support, system use, functional coverage and global technological trends. Organisational factors included the organisational structure, organisational culture, human resource capacity and availability, policies and procedures, organisational knowledge, cooperation, resistance, organisational readiness and customer expectations. Factors aligned to information included the amount of information and the quality of information and these were shown to ensue from the institutional and legislative issues. Issues referred to under this category included the institutional positioning, statutory obligations and government policy.

It was found that the degree of impact on the organisational information system environment varied with the stage of implementation.

7.3. Objective 2: To recommend renovation alternatives for use by Land Administration Organisations.

7.3.1. Research Question 4: What are the implications of different renovation approaches on the Land Administration Organisation environments?

From chapters 2 and 6, it was realised that different renovation approaches would make the organisation incur costs in acquiring hardware or software components. Organisations may also be called upon to look for external expertise i.e., to outsource. Some approaches especially where the target and existing systems have to run parallel for some time strain the system in terms of additional maintenance costs and labour. This may require organisation to restructure temporarily or permanently. Certain renovation approaches may mean that the system may not be available to support both internal and client business processes. Renovation implications may also place certain risks on the organisation in that the risk of failure is higher. Some allow staff members time to learn and get acquainted to the target environment while others do not. From the other findings summarised above it is clear that there is no one optimal approach, and a combination of methods may be used. All depends on the prevailing circumstances.

7.4. Recommendations

Because of time constraints, there are certain aspects that this research did not look at. In the first instance, since the research was exploratory, there was need to have extra visits to the same interviewees to seek further clarification of some of their responses. This was because a comprehensive understanding of the contextual situation emerges as all responses are analysed at the same time. Although asking different respondent categories helped, some questions that arose could only be addressed by offering different explanation sets. It was intended to also get the views of the senior government officials, software and hardware support and supplier communities, but this was however impossible due to the schedule. There views would have been invaluable to validating the findings and indeed in defining different solution sets.

It would be interesting to find out how the research would be like or the results would differ if a purely co-evolution theory perspective was used. Some aspects were actually included in this analysis but in a very limited way.
Lastly there is need to determine at a quantitative or other more detailed level the exact effects of some of the propositions tabled in Chapter 5 of this research.
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Glossary of terms

**Reengineering** – Also known as both renovation and reclamation, is the examination and alteration of a subject system to reconstitute it in a new form and the subsequent implementation of the new form. It generally includes some form of reverse engineering followed by some form of forward engineering or restructuring. This may involve modification with respect to new requirements not being met by the original system (Chikofsky and Cross, 1990).

**Reverse engineering** – Is the process of analysing a subject system to: identify the system’s components and their interrelationships and; creating representations of the system in another form at a higher level of abstraction. It does not involve changing the subject system and is a process of examination not change or replication. Starting from the existing implementation, it captures or recreates the design and deciphers the requirements actually implemented by the subject system. Two sub areas of reverse engineering are redocumentation and design recovery (Chikofsky and Cross, 1990).

**Forward engineering** – is the traditional process of moving from high-level abstractions and logical implementation-independent designs to the physical implementation of the system (Chikofsky and Cross, 1990).

**Restructuring** – is the transformation from one representation form to another at the same relative abstraction level, while preserving the subject system’s external behaviour (functionality and semantics) (Chikofsky and Cross, 1990).

**Maintenance** – is the modification of a software product after delivery to correct its faults, to improve performance or other attributes, or to adapt the product to a changing environment (Chikofsky and Cross, 1990).

**Evolution** – the gradual development of a system into a better form (Jönsson, 2006).

**Evolvability** - denotes a software system’s capability to be evolved, and is dependent on product quality, evolution processes and organisational use environment (Jönsson, 2006).
APPENDIX A: INTERVIEW GUIDE

Research question guides

Human Resources
- Availability of a critical mass of domain experts
- Availability of IT personnel with requisite competencies
- Synergy between domain experts
- Support for innovations
- Attitude and reaction to innovations
- Behaviours

Organisational Factors
- Operating policies and procedures of the organisation for introducing technological innovations (what organisations are supposed to do)
- Organisational practices (what organisations actually do in practice)
- Organisational culture
- Organisational readiness for change
- Organisational ability to change
- Driving force behind innovation activities undertaken
- Social construction of technological legacy (the effect of successes or failures of technological innovations)
- Autonomy of organisation
- Quality of interorganisational relationships
- Organisational structure

Maintenance Factors
- Availability of maintenance support (inhouse, local, foreign) for software and hardware infrastructure
- Quality of hardware, software and network infrastructure
- Frequency of maintenance
- Types of problems reported on system functionality
- Points of contact for maintenance
- Change request procedure and practice
- Type of problems reported about system functionality

Policy and institutional issues
- Government IT policies
- Government procurement and expenditure issues
- Government developmental policies
- Organisational statutory obligations and controlling legislation
- Other Government controls

System properties
- Process supported by the system,
Satisfaction with the system’s support to business processes
Impact of system failure on business processes
Current measures to prevent system failure
History of changes to the system
Effect on business if system is stopped to incorporate changes
Current ways in which users accessed information
System design issues
Functional coverage of system
Quality of output
Availability of documentation

System expectation
- Expected system performance,
- Expected future changes to the system
- How changes will affect current business processes
- Hindrance to meeting expectations (current and future)

Other Factors
- Fears regarding the system
- Changes to society in general.
APPENDIX B: Contents analysis of the Netherlands situation

B.1.1 Netherlands policy issues
The vision of the Dutch government, states that governments and other public organisations in particular must make their products and services available via the Internet. The programme entitled 'Another Government', aimed at having 65% of services provided by government bodies available via the Internet by 2007. Kadaster by developing Kadaster-on-line, wanted to demonstrate the progress made in making real estate information availability and accessibility to its clients. For Kadaster this meant products and services could be provided via the Internet at lower cost to the organization and its clients. This was important for the Kadaster since it is a non profit making organization.

Projects like Public Counter 2000 instigated by policy plans (an attempt to integrate electronic services at municipal level) did influence developments in the field did not actually shape them. Developments in the field were shaped more by necessity than by policy intentions of government.

B.1.2 Netherlands political issues
The government and the House of Representatives acknowledge the social importance of a geoinformation infrastructure but seem unable to make the connections with their own policies at a more general level. The fact that a democratic government and a good cadastral system goes hand in hand illustrates the political importance of the cadastral system. Civilised life is based to a large degree on the fact that people know who owns what.

Though many politicians and policy-makers would agree that a geoinformation infrastructure might be useful, it is hardly hot political news. That said, there are many others who clearly understand the relevance of a well-organized geoinformation infrastructure. The field should see it as a challenge to win over new converts and systematically involve them in the trajectory. This would entail raising levels of interest, which, in turn, would generate involvement and help policy-makers to understand the relevance of the issue.

B.1.3 Netherlands legal issues
The Minister of the Interior defines authenticated registration as: "High-quality files, with explicit guarantees to maintain that quality, containing vital and/or multiple information required with regard to the body of legal tasks and for diverse reasons about persons, institutions matters and events, which is designated by the law as the only officially recognized registration of such information and which is used throughout the country by all government bodies and, if possible, private organizations, unless otherwise excluded by substantial reasons such as the protection of privacy” In simple terms: registration systems that hold certain unique information. This information is collected only once for use within all government domains. This is then guaranteed by a government ban on any other efforts to collect the same information.
By law, cadastral information is only collected and maintained by Kadaster. i.e. Kadaster is the only organisation in The Netherlands, responsible for this type of information and there is no information coming from other parties. By law the Dutch Kadaster is obliged to provide information to anyone who asks. Hence, the task of Kadaster is to collect and provide information. Its main tasks are Land Registration, Surveying, Mapping (Cadastral map and Topographic maps) and Land Consolidation. The procedures for registration and cadastral mapping are prescribed in the Cadastre Act. Submission and recording of notarial deeds in the registers is a prerequisite to obtain legally recognised ownership. This -by consequence-constitutes a public monopoly. The mandate to enforce the Cadastre Act is assigned to the Cadastre and Land Registry Agency. According to the law the boundary survey is performed by land surveyors of the Agency. Although there are many private commercial surveying companies in the Netherlands, a system of licensed private cadastral surveyors is not in place.

The government bill on the electronic delivery of legal deeds to the Cadastral Agency contains stringent rules to ensure that the deed which is sent is the same as the deed which is registered and stored at the Cadastral Agency. Governmental organisations can have public restrictions on land and property. The possibility of combinations of these rights causes hundred of input varieties in a cadastral system. Especially when a system is automated, all these possibilities have to be careful analysed. One of the principles of a land registration/cadastral system is that it is open for the public. As a consequence of this the system has to be protected against unauthorized actions. It must be very clear by law who is authorised to update the system.

The public notary can submit notarial deeds as a digital file. The concept is that notary public keeps a paper deed in his/her office as the authentic one, sends a certified true copy electronically to the Agency, which records the document in a digital work process. In the Netherlands, only notaries are allowed to create deeds, and these deeds need to be published by Kadaster to let the ownership pass from the seller to the buyer.

Because the Dutch Kadaster is a legal entity which operates as an independent organisation, an important issue is not making profit. So looking for 'cheap' i.e. effective and efficient ways to provide information on a wide scale was necessary. Doing business efficiently can make the products cheaper for the customer.

### B.1.4 Netherlands Technical issues

#### B.1.4.1 Infrastructure

The organisation of the cadastre is strongly influenced by the introduction of modern information and communication technology (ICT). To begin with, the geoinformation infrastructure has a strong ICT component. By replacing the IBM mainframe environment with the distributed computing infrastructure, Kadaster has the flexibility and ease of maintenance to support the changing business of the business. Through consolidating the infrastructure, the agency is now saving the equivalent of €3.5 million every year despite having grown and introduced new services. The system has the limitless scalability to cope with the growing volume of registry requests. Whenever changes were made to an application, the changes needed to be made to the other applications. In 1998, Kadaster decided to deploy an open, standards-based infrastructure because it was believed that an open,
interoperable environment would provide the flexibility needed to adapt systems quickly and effectively to meet changing customer needs.

**B.1.4.2 On line access**

In 1996 kadaster established 'Kadasternetwerk' which later turned out to be a problem. It experienced stability and reliability problems. The supplier of VAX/VMS, the platform on which the 'Kadasternetwerk' was built was expected to gradually stop providing support and the technical procedure involved was slow. The connections did not always work. Availability and accessibility also depended on the stand-alone software installed by an intermediary at the client side and this also required maintenance. In 2001, 'Kadasternetwerk' was replaced by Kadaster-on-line. In 2003, a public version of Kadaster-on-line called 'Kadaster On-line-products' that can be accessed by anyone without the need for a subscription was introduced. This was because the use of internet technologies and other product formats in the world around Kadaster was increasing and Kadaster started focussing on making real estate information available via the Internet.

**B.1.4.3 Architecture**

**B.1.4.3.1 Current situation**

Kadaster found a solution for reducing IT complexity and centralizing applications, access and security with Citrix, and implemented the new Citrix components in three phases. In 2000, the agency started migrating completely to virtualized applications and virtualized desktops with Citrix Presentation Server -now running on Microsoft Windows Server 2003 - used respectively on HP ThinPCs and HP thin clients. The servers are allocated in two locations to improve application availability in emergencies. Later, Citrix Access Gateway - extended with authentication tokens for additional security - was added to enable secure, remote access to all applications over the Web. The latest addition was Citrix Password Manager to enable all employees to simplify logging on to password-protected applications.

Citrix Presentation Server enables the Kadaster to be very flexible and dynamic in the administration and renewal of applications because management is centralized on the server instead of being performed on the local desktop. The organization’s in-house developed client/server applications are now much easier to maintain and upgrade. In addition, the system has the adaptability, scalability, availability and performance to handle growing business requirements. Kadaster also deployed BEA Tuxedo to underpin its portal and backend infrastructure, aimed at streamlining and enhancing the end-to-end property registration and administration process. This robust solution provides Kadaster with a distributed transaction processing infrastructure, using new and existing skills and application assets, and delivering standards-based interoperability. Tuxedo is at the heart of this service-centric implementation, although the flexible architecture also includes Java-based technologies.

Citrix Access Gateway gives employees secure, remote access to applications running in the Citrix Presentation Server environment via any Web browser. Working from home or from desktops at municipals has become just as easy and secure as working in the office, even on desktops not controlled by the Kadaster. All employees have remote access, with each person’s authorization to access specific resources based on their role. Actions that a user can take when accessing an
application are centrally managed by IT staff using Access Gateway. The combination of Access Gateway and Presentation Server lowers costs, brings location independence into the infrastructure, and enables easy, centralized management of applications.

However, communication among the regional databases is not bi-laterally but organised via the Kadaster portal back-end i.e. Kadaster-on-line functions as a kind of clearing house which forwards and routes the requests to the respective regional authority/database via the zip-code of the requested product (e.g. cadastral map, real estate information). At the portal back-end the information products are organised and packed coming from the regional databases and then delivered to the client.

B.1.4.3.2 Past situation

In 1994, when the agency was exposed to the open market Kadaster needed to build the business around its customers. It was difficult for the newly-formed Customer Teams to co-ordinate the service owing to the silo-centric technology. Dutch Land Registry Office needed to tackle silo-centric, departmental technology focus. Kadaster was faced with multiple connections between overlapping applications and user interfaces. The existing environment with all these connections was so inflexible and expensive to maintain that it became practically impossible to continue.

The 'Kadasternetwerk' was insufficiently flexible to introduce new products onto the market with ease. Kadaster was therefore unable to respond adequately to market demands. There was a risk that third parties would take over Kadaster's role as an information provider. Due to the technology that was used and the knowledge users needed, the 'Kadasternetwerk' imposed limits on the number of clients that could be approached and the products that were to be delivered. The use of new technology makes it possible to serve more clients and deliver more diverse products.

The old 'Kadasternetwerk' had to be replaced by the new web-based Kadaster-on-line system, taking care of the existing databases. Kadastre still uses heterogeneous systems based on Windows, OpenVMS and UNIX, and still has some legacy systems running on its mainframes. Many applications on these platforms, as well as Web-based applications, have their own security policy, which forces the user to change passwords on a regular basis and forces the use of strong passwords.

B.1.4.3.3 Reasons for Renovation

Without doubt meeting user demands was having a huge impact on the existing automated systems. It also meant that maintenance costs are increasing due to the used ICT-components and the more complex structure of systems and programmes. Many important user demands for new functionality could only be realized by drastic renovation of big parts of the existing systems or by the realisation of new systems.

Although there seems to be no immediate risk of components becoming end-of-life, the impact as such of a component which reaches an end-of-life status is very big. Will there be enough time to implement a new component, are enough resources available and can we manage the impact on business demands? The answer to these questions required a strategy that would balance the user demands for new functionality, availability and continuity and the demands on cost management.
(maintenance cost, support cost for aging tools and complex ICT-infrastructure) and manageability of the renewal.

In the years behind, the system is frequently modified and new functionality is added. This didn't always fit in the existing architecture. The complexity of the system increased and as a consequence, together with the also aging system development tools and the used DBMS, maintenance costs kept rising. A benchmark, performed in the year 2000 by an external consulting company, revealed that the maintenance cost are 6 times higher compared to the usage of modern system development tools and DBMS.

Using the current ICT-tools for the newly demanded functionalities neither is option. The productivity of system development simply is too low to meet the current demands with respect to flexibility, timeliness and costs. Modern ICT-tools offer advantages in the area of development and maintenance and have a better fit with new standards.

One should keep in mind that also other necessary ICT-developments must also continuously be facilitated, parallel to the renewal-activities. Another possibility to shorten the elapse time of the renewal is to put more effort in the projects that support the renewal. This pertains to ICT-related capacity as well as for the management effort, employees and the users. Experience reveals also that the roll-out of new systems that change the work processes has a huge impact on our own staff. A very good preparation is necessary, and great attention during the roll-out and period thereafter is required. Summarizing: the capacity of the whole organisation to control and absorb a certain volume of renewal definitely determines the elapse time of the renewal scenario. The availability of more money itself therefore will not automatically result in a faster implementation.

With respect to maintenance it is obvious that during a long period the new developed systems, the synchronisation system and the existing systems must be maintained. The result is an increasing number of specific areas of expertise to be sustained. The ICT-organisation must be able to manage size and level in which expertise must be build up and come to a conscious policy for the deployment of internal and external capacity. Another point of attention is the expertise required for testing and the building of capacity to support the employees after implementation of new systems.

B.1.5 Business processes

An expert system supports the acceptance of notarial deeds. With this expert system the staff is supported in the judgement and acceptance of deeds. Every deed that is not accepted by the system is further analysed to improve the intelligence of the expert system. The system not only shortens the acceptance procedure, but also supports the development of a system on national level. A notary can therefore work in any part of the country, because the digital deeds are presented to a central system. There are still problems in the field of electronic authorisation, data integrity and certification. Offices of notaries, of real estate agents and municipalities will have longer opening hours. Therefore the cadastre will open up its network 24 hours a day providing services at different levels at different moments.
Now, the deeds can be sent electronically (digital signatures are accepted), or still posted, with Kadaster using automated workflow to facilitate the buying/selling process. Since November 2005, notaries send their deeds to the Kadaster in a digital way, based on digital handwriting and encryption. Before, notary employees had to travel to the office to bring them on paper, or had to send them by post. Currently Kadaster staff selects important parts in deeds and copy and paste them (not automated) into the registration system. Automated recognition will make this process less intensive and enhances the quality of the registration (no mistakes can be made). But there has to be a good definition about standards, interpretation of data, and new workflows between all parties involved. This is seen as a major challenge for the next few years.

IT re-engineering causes important changes in the workflow. In almost every re-engineering process the possibility of integrating the administrative databases and digital maps are investigated. This integration process seems to be very difficult and most of the time, the result is only a combination of the two databases at a logical level. The costs of the IT re-engineering programme are about US $80 million and for the entire organisational and social component a balance sheet provision of US $100 million has been made.

**B.1.6 Information**

But an effective and cohesive system of hardware, software, data etcetera is still not enough. You need information – information relevant to your purpose. So, you need to sort out the legal, financial, organizational and institutional aspects. If not, your beautiful technological infrastructure won’t be much use.

**B.1.7 Culture**

A modern cadastral system must develop such an organisational culture that it becomes a customer- and market-oriented institution with a service-directed attitude. The reformulation of strategic business objectives goes hand in hand with the possibilities offered by the information and communication technology (ICT). Such a programme is known as IT re-engineering. Cadastral systems have to become customer- and market oriented with a service-directed attitude.

**B.1.7.1 Governance**

The governance aspect is of importance, ICT-possibilities should be aligned with business strategies with respect to continuity, improvement and renewal. Business strategies should be aware of ICT-solutions to timely prepare for the future

**B.1.8 Netherlands Financial issues**

**B.1.8.1 Revenue**

The revenue from the portal is approximately €210,000 per day—equivalent to €76 million every year—and provides together with the backend a Service-Oriented infrastructure to manage internal business process. It also gives Kadaster the opportunity to extend services across company boundaries. Through consolidating the infrastructure, the agency is now saving the equivalent of €€3.5 million every year despite having grown and introduced new services.
B.1.8.2 Business conducted

The way in which a cadastral system is financed has its influence on the organisation. In the last year 410,800 deeds of transfer were recorded and 552,500 deeds of mortgage. Land surveyors surveyed new boundaries for 98,200 land parcels. All cadastral registers and maps are in digital format. Cadastral registers are kept in the system AKR (Automated Cadastral Registers), the maps in LKI (Land information system): two separated systems with interface connection in order to appropriately coordinate the ongoing updating of the cadastral registers and maps. For all the services must be paid: the Agency is obliged to fully recover its costs. The total business costs in 2002 were about € 207 million.

The Cadastre and Land Registry Agency in the Netherlands fulfils its mission as an independent public organisation, under the principle of 100% cost recovery. During the last ten years organization development took place in which: -the Agency became 100% cost recovering; -the Agency was split in a front 'shop' and a 'factory'; -a flat hierarchical structure was implemented; -a transparent financial and personnel management was introduced; -ISO certificate was awarded; -customer surveys show good client satisfaction; -merger with Topographic Service of the Ministry of Defense as per 1-1-2004 And the number of staff dropped from 3700 to 2200.

B.1.8.3 Customers

Customers (in this instance mainly the notaries) can use Kadaster’s online environment to look up the original deed in the public registers in the browser environment, order a copy of the deeds as a download .pdf file, or as a printed document. The system also acts as an index for the public registers. It provides a clear overview for different customer groups of the rights related to a property, who the owner is, and the purchase price or a cadastral map with the boundaries.

What do users/customers want from a cadastral system? Nowadays they want that the cadastral data are delivered in digital form. They want them up-to-date, reliable, complete and rapid accessible. The data must fit within the customer’s working procedures. In short they want value for money.

Clients of the Kadaster include the government, municipal authorities, water boards and mortgage providers. After its partial privatization, the Kadaster needed to focus on the open market, such as notary practices and real estate agents, because the private sector is requiring more and more services. Some 45,000 users among 12,000 clients use Kadaster-on-line to consult up-to-date real estate information that is crucial for their own work processes. Kadaster-on-line offers clients (including notaries, real estate agencies, local councils and construction companies) greater convenience and accessibility to cadastral products all over Netherlands. Clients can access their information far quicker and cheaper. Every day more than 60,000 products are provided via Kadaster-on-line; equating 99.9% of all products provided by Kadaster (0.01% products provided offline). Standardized workflows had to be defined in such a way that clients could integrate the Kadaster-on-line products in the front-office of their home system.
B.1.8.4 Organisational structure

The cadastral system is an independent administrative body that is no longer part of the personnel and financial organisation of the state service. Under the guidance of an Executive Board the Dutch Cadastre carries out its own entrepreneurial policy. To keep good contact with the users, the Agency has a user council at national level (comprising representatives of the umbrella organisations of notaries, real estate agents, banks, municipalities, waterboards and consumers), and at regional level a system of account- and marketing management for all direct relationships with the users. It is thus more user-oriented, because it is fully dependent of the income that users have and want to pay. The cadastre is not fully privatised, which means that the organisation has some monopolies in cadastral registration. There is no real competition with private companies and is only allowed to sell so-called semi-finished products.

In cases where the cadastre belongs to the governmental organisation, the available budget comes from the responsible ministries and there is not a direct link between income and expenses of the cadastre, there is mostly a very poor understanding of the cost/benefit situation of the system.

During the consolidation process that is still ongoing, subsidiaries were closed and centralized, system administration and data centers were centralized, and the system workload was consolidated. About 2200 peoples are employed, 600 in the headoffice (including the Information and Communication Technology departments) and 1600 in fifteen regional offices. About 250 employees thereof are active in two other tasks of the Agency: contribution to land development projects, and maintaining the national triangulation and GPS-net.

There are 15 Kadaster-offices in The Netherlands, that all have the same tasks, procedures and processes. In these offices all data is being processed, administrative data as well as maps. In these offices also the paper-based archives exist, sometimes with deeds over a hundred years old. These offices make the data digitally available in databases. The central server of Kadaster-on-line makes it possible to provide these data online. The specific requirement to achieve interoperability was to link these geographically spread databases to Kadaster-on-line. Data out of these databases are used to compile information products that are essential for the legal certainty of real estate transactions and which are requested by the clients.

The re-organisation efforts followed by Kadaster are twofold; on the one hand, in order to replace the old 'Kadasternetwerk' by Kadaster-on-line, various databases had to be connected to the new web-based system i.e. the re-organisation capitalises on back-office to back-office processes. On the other hand, online access to the services and integration of Kadaster's products in the front-office of the client requires front-office integration on the client side i.e. front-office to back-office process integration (respectively the other way around) is also in the foreground.

B.1.9 Implementation process

Client survey; an in-depth survey of the specific requirements and wishes of clients was carried out. This survey was conducted during various sessions with client groups and provided a clear picture of
what the new system had to be able to provide in terms of user friendliness and functionality. The result of this coordination is a document featuring the objectives that have to be met.

The Business Case process was next, in which the person responsible for policy first determined the use, necessity and urgency in an application for a business case. After this application has been approved, the writing process for the business case itself started. In this business case, the person responsible for policy and the ICT department agreed on and approved what had to be delivered. The global system concept was also described.

The project was then created, in which the business case was worked out in greater detail. This included a more detailed definition of the proposed solution in relation to all business processes. A description of information and risk analyses was also provided. The global system concept was worked out in detail. The technical development and construction of a prototype as well as the construction of the system itself was also taken care of. This was a time-consuming and complex phase.

The prototype was geared to internal use as well as to clients. It served as a working model and was used to verify whether clients would ultimately appreciate what had been requested.

After various improvements aimed at harmonising the prototype, the project built Kadaster-on-line and all accompanying interfaces. All of this was developed and built within the internal organisation.

After the construction phase, various testing phases were organized (a functional test, which measures whether the system works correctly and is complete with respect to the specified functionalities, an acceptance test, a pre-production test, implementation tests, etc).

Kadaster-on-line was then rolled out during a pilot involving 15 clients.

B.1.10 References used for Dutch Kadaster contents analysis

APPENDIX C: ORGANISATIONAL STRUCTURES

Dutch Cadastre Organogram
APPENDIX D: DRIVERS OF EVOLUTION CHANGE
APPENDIX E: LIFE CYCLE OF AN ENTERPRISE APPLICATION

[Diagram showing the life cycle of an enterprise application with cycles labeled 1, 2, and 3, and stages such as Introduction, Growth, Maturity, Modernization Round, and Decline.]