A PROPOSED FRAMEWORK FOR TECHNOLOGY SELECTION IN ORDER FOR DEVELOPING COUNTRIES TO EXECUTE ELECTION OPERATIONS EFFICIENTLY

By

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ABSTRACT

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Afghanistan in 2004 and the DRC in 2005 are examples of where technology intensive registration solutions have been implemented to support election operations in developing countries with limited success and more importantly the solution had no sustainability, requiring further investment for subsequent elections. This study establishes a framework that defines a set of criteria that can be used to determine what and how technology can be used to enhance and improve election operations in developing countries and assist Electoral Management Bodies in establishing a long-term Information Technology Master Plan.

The framework takes into account the digital divide and the need for Electoral Management Bodies and their staff to grow their capabilities in regards to the application of technology. The framework identifies a range of COTS products and technologies that can be utilised for various election administration and operational activities and assesses the benefits as well as risks associated with the products and technology. The framework is supported by a capability maturity modelling concept that enables an Electoral Management Body's computerisation maturity and technology capabilities to be established and a growth path determined.

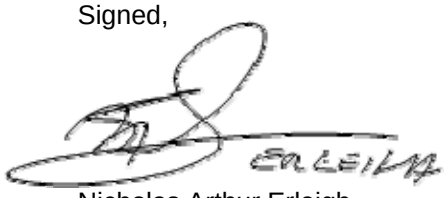
The study found extensive support for the use of technology in general administration activities as well as delimitation, voter registration, candidate management and result reporting. The study proposes that electronic voting technologies only be used in Developing African countries after extensive thought and consultation with stake holders.

DECLARATION

I hereby certify that this dissertation constitutes my own product, that where the language of others is set forth, quotation marks so indicate, and that appropriate credit is given where I have used the language, ideas, expressions, or writings of another.

I declare that the dissertation describes original work that has not previously been presented for the award of any other degree of any institution.

Signed,



Nicholas Arthur Erleigh

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Chapter 1. INTRODUCTION

1.1 Scope

The project sponsor Dr Sisti Paul Cariah of the Tanzanian National Election Commission, Pastor (1999), as well as Altman and Klass (2005) amongst others have indicated that there is no ready research available on the application of technology in the election arena in developing countries. Furthermore information sharing between election management bodies and aid agencies is poor. Lastly vendors tend to promote solutions that maximises their return rather than address long-term needs. This is clearly illustrated by the number of voter registration solutions implemented in Africa that have no sustainability. As a result master planning for technology application in elections tend to focus on the immediate needs of the commission, as well as the election process as applicable at that time.

The project's intent is to propose a framework that will establish a set of criteria that can be used to determine what and how technology can be used to enhance and improve election operations in developing countries.

The study will look at the following areas of election operations:

- General administration
- Procurement and logistic management
- Delimitation
- Voter registration (this includes capturing of voter biometrics)
- Candidate registration
- Ballot casting (voting), counting and result reporting
- Dispute resolution

Within each operational area the study looked at a range of questions as illustrated in Figure 1 below in order to create a framework that can be used for decision making in regard to Information Technology Master Planning in Elections.

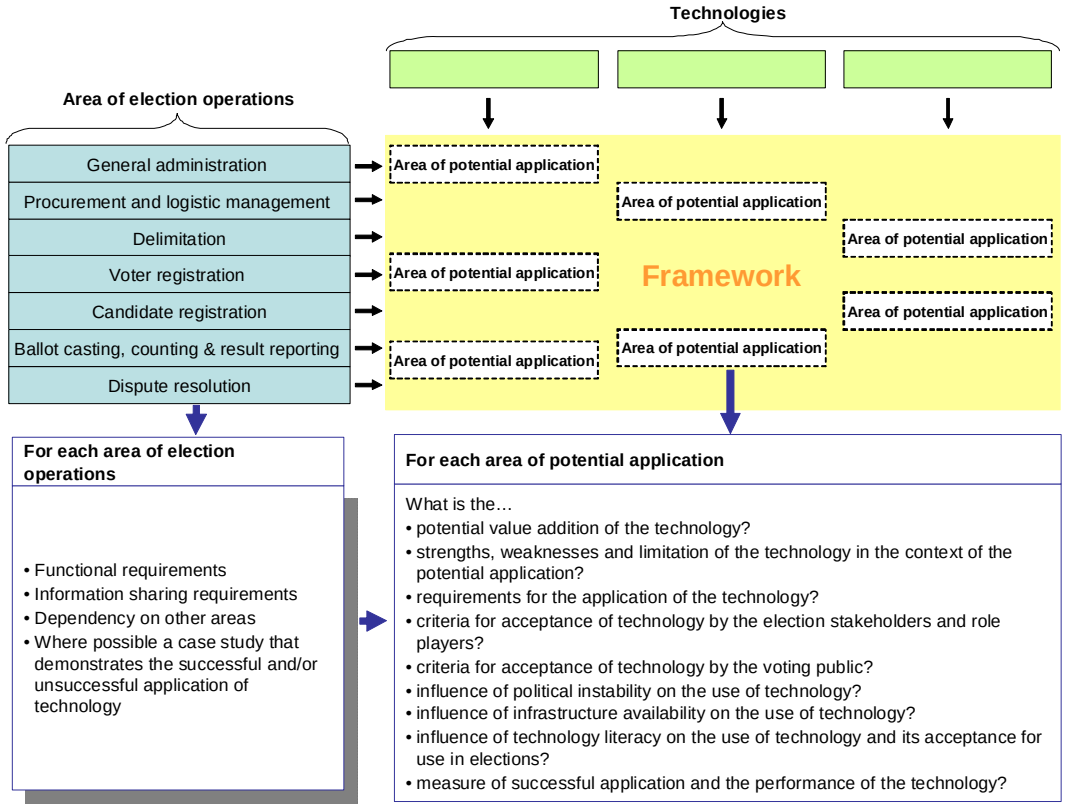


Figure 1: Decision Framework for IT Master Planning

1.2 Problem Statement

Lederer and Sethi (1988) as well as Ahituv and Neumann (1990) propose that the key to the success of the information system function in an organisation lies with having a good planning system and a long-range plan focused on meeting the organisation's present and future information needs. The information needs that are included in the plan are a derivative of the organisation's business goals. Moskowitz (1986), Vitale et al (1986) and Index Systems (1986) as cited in Lederer and Sethi (1988) indicate that the plan should also contain strategic applications and organisation-wide data architecture. In short the master plan should provide a road-map to the organisation's information, technology and

resource requirements together with the growth and support strategy in the short, medium and long-term.

Taking this into account as well as the lack of ready research on the application of technology in elections, one can therefore formulate the problem statement as a need for a framework that an Electoral Management Body (EMB) can use to establish a long-term Information Technology Master Plan. The framework should enable them to:

- Identify areas of potential technology application.
- Understand how the electoral community will respond to the application of technology and what (if any) educational drives the commission should embark on before applying technology.
- Assess the risks associated with applying specific technologies
- Determine a recommended growth path
- Determine the requirements for the application and integration of technologies
- Avoid the mistakes that have already been made by other electoral commissions

1.3 Approach

The framework has been established through:

- The conducting of a literature and product search to identify potential technologies and their application. That includes internet searches, attendance at exhibitions and discussions with designers and election officials.
- The conducting of a literature survey to establish the present viewpoint of researchers as well as norms and standards regarding the application of technology in elections. That includes white papers, conference papers, journal articles, government legislation, published election reports and published books.

- The reviewing of existing case studies where technology has been applied in order to establish a correlation between technology and socio-cultural needs in developing countries.

- The conducting of a survey on election authorities and commissions in various developing African countries in order to explore their views and experiences as electoral administrators as to how technology can be applied to facilitate and/or enhance electoral administration. The results will be correlated to determine if there are common views and/or experiences that can then be extrapolated to form part of the framework.

- The conducting of a survey of political parties, NGO's , International organisations and consultants in various developing African countries in order to explore their view regarding the acceptability of using various technologies in election operation. The results will be correlated to determine if there are common views and/or experiences that can then be extrapolated to form part of the framework.

Yard et al. (2007) consist of a number of papers that address the broader scope of areas where technology can be applied in electoral administration. It is intended to use Yard et al. (2007) as a benchmark and a means to scope and direct the project.

1.4 Outcome

The deliverables of the project consist primarily of a report that is compiled in accordance with the requirements for a dissertation and addresses the objective as described in this proposal. The report will be supported by completed survey questionnaires.

The report will contain:

- A detailed description of the proposed framework.

- A survey report of the results obtained via the questionnaire and the conclusions derived there from.

- An analytical report on the investigated case examples of technology application.

- A summary of the relevant conclusions, recommendations, guidelines and best practices as proposed by existing researchers for technology application

The dissertation will increase the body of knowledge on election administration by expanding our understanding of where and how technology can best be applied by answering the questions raised in the dissertation objective.

By highlighting and addressing the issues that are pertinent to developing countries the study and resultant framework will facilitate the dissemination of electoral administration knowledge between the developed and developing world.

The framework will also enable other scholars to focus research on developing optimum solutions for the election arena.

Chapter 2 explores existing literature and establishes the foundation of the study through a literature survey to identify common views, guiding principles and to establish a list of reference activities that can be used within the framework. This will be further expanded upon in chapter 3 where the founding principles for technology application are established. Chapter 4 describes the design of the study, while chapter 5 describes how it was conducted. Chapter 6 presents the results and findings of the survey, while chapter 7 demonstrates how the framework is applied and concludes the project.

Chapter 2. BACKGROUND AND REVIEW OF LITERATURE

2.1 Related Work

Alvarez and Hall (2008, p99) defined the fundamental purpose of election administration as follows: "*Maintaining the integrity of the electoral process is a fundamental goal of election administrators in democracies around the world. If questions arise about the integrity of an election, the legitimacy of the subsequent governing regime can- and often is -undermined. Thus election administrators have developed systems to monitor and protect the integrity of the democratic electoral process.*"

Extensive research has been done on the conducting of elections and the process of democratisation by a wide range of organisations such as:

- Electoral Institute of Southern Africa (EISA),
  Web Address: http://www.eisa.org.za/

- Institute Democracy and Electoral Assistance (IDEA),
  Web Address: http://www.idea.int/

- International Foundation for Election Systems (IFES),
  Web Address: http://www.ifes.org/home.html

The vast majority of this research has focused on the procedural, political, legal or social science perspectives of elections. For example, although Norris (2004) addressed a broad scope of the world's democracies, the work is focused on party politics, voting behaviour and the electoral system in general, its architecture and rules. On the other hand Powell (2003) explores elections as an instrument of democracy and the relationship between the majoritarian and proportional visions. Very little research has been conducted on how technology can be used to improve and/or enhance electoral operations. Some researchers emphasised technology, but focused largely on voting technologies and more

specifically on developed western democracies. For example Alvarez and Hall (2008) focused their work on voting machines as used in the USA.

Pastor (1999, p15) proposed that the reason for the omission of electoral administration from research up to the point at which his paper was written was because most of the research had been conducted by people from advanced democracies where the conduct of elections is taken for granted and as a result administration is seen as something that simply happens. The conducting of elections in developing countries is vastly different from first world established democracies, largely due to the immaturity of the public with respect to the election process, the general lack of a good electoral foundation in the form of voter roles, electoral structures, lack of basic infrastructure and the high cost of establishing as well as running an election. Pastor (1999) demonstrated that there was a visible pattern between administration failure and election failure specifically in developing or transitional countries. The author also argued that issues related to the variable of electoral administration is ignored in much of the research and called for more research to be done in this area.

This view is also supported by Altman and Klass (2005) who called for further research on how information technology has influenced elections and electoral institutions.

Based on these recent works, it can be concluded that further research is required on election administration and the application of technology therein, especially in developing countries.

2.2 Literature Review (Survey)

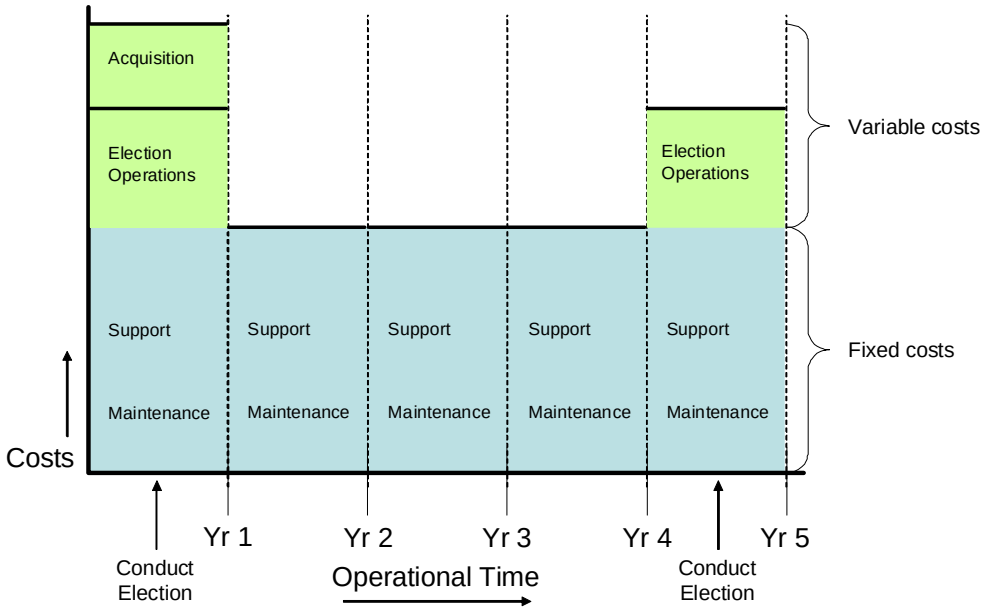
The purpose of the literature survey in the context of this dissertation has been to identify guiding principles that can be used within the framework, based on the work of acknowledged researchers.

The following literature has relevance to the work done in compiling this dissertation and establishing the framework.

2.2.1 A Global Survey on the cost of Registration and Elections

Getting to the CORE - A Global Survey on the cost of Registration and Elections by Lope-Pintor and Fischer (2005) is the final project report for the Cost of Registration and Election (CORE) project. The intent was to establish a framework for identifying and costing elections. The CORE project used case studies and surveys as the means for collecting and analysing research data. The study looked at three different types of environments namely stable, transitional and post-conflict, as well as different sized electorates in the form of small and medium/large sized. The content of the report has relevance to work being done for this dissertation in that cost items can equate to operational electoral activities, which implies that work done by the CORE project can be used to establish a list of electoral activities that require to be executed by an EMB. The resultant list can then be correlated with lists derived from other published literature to establish the activities that will form part of the framework. A second area of relevance is that the report investigates the cost of using election technology.

The study determined that there are a number of different types of costs that influence an electoral scenario. The first of these cost types are fixed and variable costs where fixed costs are associated with the daily running of an EMB and the provision of electoral administration regardless of whether or not an election is executed. Variable costs are the costs that are associated with the actual conduct of elections. The relationship between variable and fixed costs is illustrated in figure 2 below.

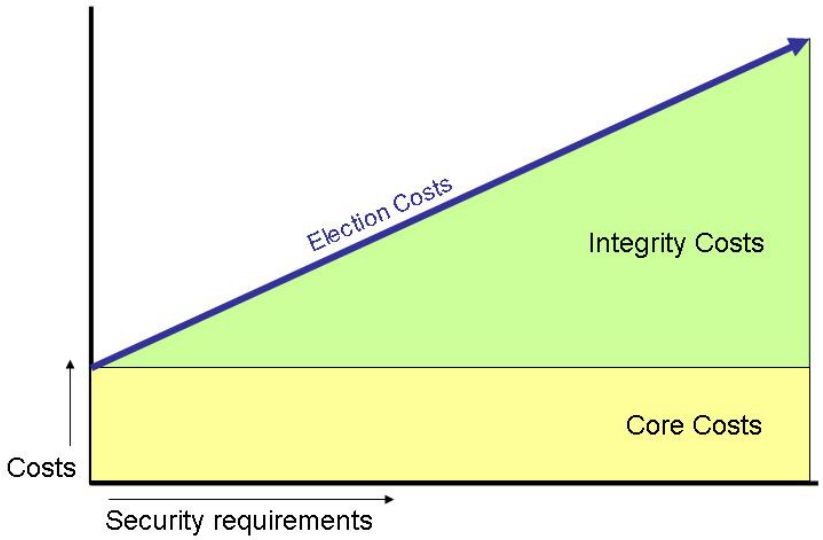


Source: Authors interpretation of Lope-Pintor and Fischer (2005)

Figure 2: Election Costs Over Time

Fixed and variable costs relate to technology decisions in the form of adding the acquisition plus election operational cost as a variable cost to the fixed cost for the maintenance and support of the technology. The effect of technology is that when the total cost (variable plus fixed) for the technology solution is measured over time it should be less than that of the non-technology solution.

A second cost type referred to by the authors as integrity costs are those costs that are necessary to ensure a safe, fraud free and accepted election. Integrity costs are extremely high in conflict elections and generally low in stable elections. The authors refer to remaining election execution costs excluding the integrity cost as core costs. The concept is illustrated in figure 3 below.



Source: Authors interpretation of Lope-Pintor and Fischer (2005)

Figure 3: Cost Profile

The study found that as a country's electoral experience increases, a trend emerges in which comparative electoral costs are reduced, as illustrated in a comparison between the costs of elections in well established democracies to those in less established democracies. It must be noted though that when one looks at a specific country over time, the core costs do not in fact decrease but tend to increase. The author attributes this to general increases in the costs of sustaining bureaucratic organisations over time such as salaries and per diem allowances, as well as costs associated with applying technology.

In countries emerging from conflict or transitioning from non-democratic governance the lack of this supportive infrastructure increases the cost and complexity of running an election. As a result additional funds will be required to create the electoral infrastructure as well as conducting democratic education of the electorate. Table 1 below illustrates the cost relationships for Stable, Transitional and Post-Conflict Democracies

Table 1: Election Costs in Stable, Transitional and Post-Conflict Democracies

	Stable		Transitional		Post-Conflict	
Electoral Activity	**core costs***	**integrity costs***	**core costs***	**integrity costs***	**core costs***	**integrity costs***
Voter registration	High	Not relevant	High	Relevant	Relevant	High
Boundary delimitation	Relevant	Not relevant	Relevant	Not relevant	Relevant	Relevant
Voting: Operations, materials, logistics, training	Very high	High	Very high	Very high	Very high	Very high
Counting and transmission of results	High	Not relevant	Relevant	High	Very high	Very high
Dispute adjudication	Relevant	Not relevant	High	Not relevant	High	High
Voter education and information	High	Not relevant	Very high	High	High	Very high
Campaigning by political parties	Very high	Not relevant	High	Very high	Very high	Very high
Vigilance: Party agents, domestic monitors, international observers	High	Not relevant	Very high	Very high	Very high	Very high

* Cost categories include direct and diffuse costs.

Source: Lopez-Pintor and Fischer (2005, p 18)

The study also found that a large portion of EMB's made use of the services of various government departments. The authors refer to this as diffused costs and highlight that this is one of the factors that make election cost determination extremely difficult. However the authors acknowledge that one of the traits of established democracies is a high level of diffusion of cost. Table 2 below lists the cost categories as proposed by the authors, Lopez-Pintor and Fischer (2005)

Table 2: Cost Categories as proposed by Lopez-Pintor and Fischer

Item	Cost Category	Sub-Category
1	Voter Registration	
2	Boundary Delimitation	
3	Voting	Operations
4		Materials and Logistics
5		Training
6	Counting and Transmission of Results	
7	Dispute Adjudication	
8	Voter Education and Information	
9	Campaigning by Political Parties	
10	Vigilance	Party agents
11		Domestic Monitors
12		International Observers

Regarding technology it is important to note that 20 out of 34 Electoral Management Bodies (58%) surveyed indicated that they had or were planning to introduce new election technologies as a means of long-term cost reduction.

Although the authors indicate that technology application can be beneficial, they do express specific reservations. Australia is an example of where technology has been successfully used to reduce the operational costs of registration and elections. The authors' reservations lie specifically with the motivation as to the implementation of technology. The authors' propose that in a number of cases technology is implemented as a status symbol or to satisfy requirements of donor agencies and as a result costly high-tech solutions are chosen rather than low-tech alternatives. The authors' cite the 2004 Afghanistan election as an example.

2.2.2 A framework for the systematic study of election quality

"A framework for the systematic study of election quality" by Elklit and Reynolds (2005) is an article published in the journal Democratization that proposes a framework for assessing the quality of elections. The relevance of the article lies in the framework that it proposes, in which it describes activities that are performed by an EMB that can be used to assess quality. The proposed framework was tested against the electoral scenario in six countries, namely Australia, Denmark, South Africa, East Timor and Zimbabwe. The proposed list can then be correlated with those derived from other published literature to establish the activities that will form part of the technology assessment framework. The authors propose that by nature of the complexities associated with elections, errors will occur and provided these errors are random in nature and do not accumulate to such a degree that they influence the outcome, the credibility of the election will be maintained. Election quality is therefore a function of the quantity of errors and the integrity of the resultant outcome.

The model consists of 11 steps starting with the evaluation of the legal framework in which the election will be conducted, through the processes of demarcation, registration

and actual voting to post election activities. Each step consists of a range of questions specifically focused on assessing quality within that area.

The authors acknowledge that the importance of the different steps/ categories will vary depending on the maturity of the democracy and as such proposed a weighting system as illustrated in the Table 3 below, where the weight factor indicates a degree of importance/ relevance to the specific scenario.

Table 3: Weighting Systems For Established And Fledgling Democracies

	Essential (weight factor: 3)	Important (weight factor: 2)	Desirable (weight factor: 1)
Established democracies	1. Legal framework 6. Access to ballot 8. Polling 9. Counting the vote	2. Election management 3. Constituency demarcation 5. Voter registration 10. Resolving disputes	4. Voter education 7. Campaign regulation 11. Post-election procedures
Fledgling democracies	1. Legal framework 2. Election management 6. Access to ballot 8. Polling 9. Counting the vote 10. Resolving disputes	4. Voter education 5. Voter registration	3. Constituency demarcation 7. Campaign regulation 11. Post-election procedures

Source: Elklit and Reynolds (2005, p155)

The authors' view is supported by the work done by Lopez-Pintor (2005) in "Post-Conflict Elections and Democratization - An Experience Review". He highlights the costs of post conflict elections which are far greater than those of stable democracies as a result of the costs associated with peace keeping and security. Also because it is a post conflict situation, additional effort is required for voter registration as well as logistics and administration and a higher level of International Support is required in order to put into place the required operational capacity and infrastructure needed to run a successful election.

Elklit and Reynolds (2005) have relevance to the study in two distinct areas.

- The first being that the quality framework can be used as a means of establishing a reference list of areas where technology can be applied.

- The second is that the importance of electoral activities will vary depending on the specifics of the scenario. Conducting of post conflict elections is different to the run-

ning of repetitive elections in a stable democracy and as such the importance/ relevance of the different steps will differ.

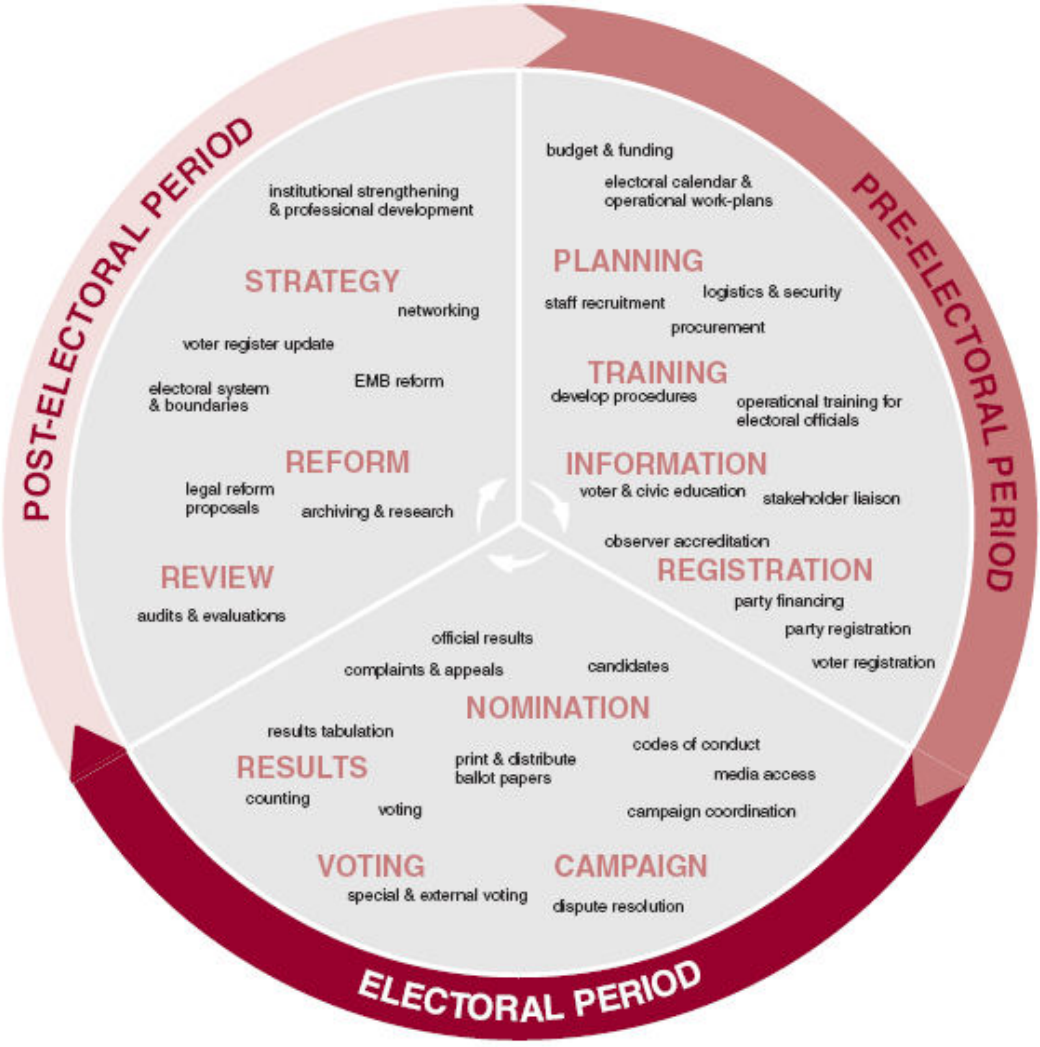
The concept of reference activities is examined further in the following paragraph where election education publications from IDEA and the UNDP are discussed.

2.2.3 Electoral Management Design: The International IDEA Handbook

Electoral Management Design: The International IDEA Handbook by Wall et al (2006) and published by the International Institute Democracy and Electoral Assistance (IDEA) is intended to be a reference book and tool for Election Management Bodies. The contents are based on a survey of Election Management Bodies in 214 countries and 24 detailed case studies. The scope of the book addresses the legal foundation, how to organise an EMB, its powers and functions, codes of conduct, training of staff and the fundamentals of its day to day operations. The book also has a section that addresses elections and technology.

The relevance of the book is twofold in that it proposes a framework of activities that can be used as a means to establish the technology assessment framework and secondly addresses the application of technology.

The authors not only identify a range of core activities but also introduce the concept of the electoral cycle, which implies activities are repeated each time an election is conducted. The electoral cycle model as proposed by the authors' is illustrated as a cyclic model in Figure 4 below.

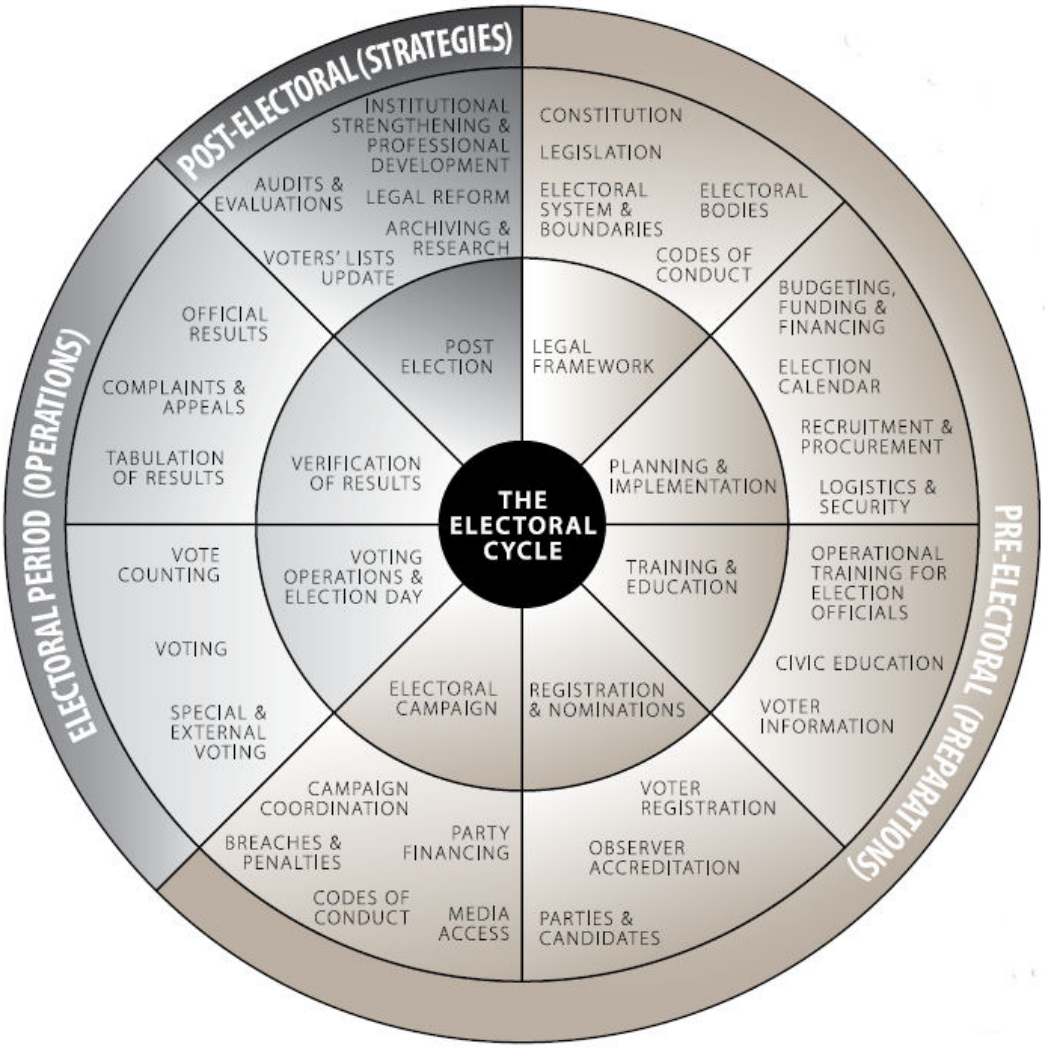


Source: Wall et al (2006, p16)

Figure 4: The Electoral Cycle as proposed by Wall et al

In regard to technology the authors highlight that database solutions for voter registration, delimitation (GIS) and logistics planning have been successfully used by numerous Electoral Management Bodies for at least the last 20 years. They emphasise that electronic voting is not only a new application of technology but is also to a large degree founded on unproven technology. They acknowledge that although there are a number of perceived benefits to electronic voting, these benefits have yet to be empirically proven. They further propose that a decision to use electronic voting should be a considered decision that looks at the full impact as well as associated costs and involves all stakeholders. The electoral cycle model as proposed by the authors is similar in nature to the electoral cycle

model proposed by the United Nations Development Programme Democratic Governance Group's Electoral Assistance Implementation Guide as illustrated in Figure 5 below.



Source: United Nations Development Programme Democratic Governance Group (2007, p3)

Figure 5: The Electoral Cycle as proposed by the UNDP

The models are similar in that they both are cycle based and consist of pre electoral, electoral and post electoral periods. Secondly within each period there are primary activities that take place in the form of Planning, Registration, Result Verification, etc. Lastly within each activity there are a number of events that must occur. The difference between the models lies primarily in the association of activities to the electoral periods.

The activities identified in the models described above will be consolidated to establish a reference list of electoral activities that require to be executed by an EMB.

2.2.4 From Power Outages to Paper Trails: Experiences in Incorporating Technology into the Election Process

From Power Outages to Paper Trails: Experiences in Incorporating Technology into the Election Process is a paper prepared by Yard M, McDermott R, Edgeworth L. and Jones D from IFES for presentation at the 2007 Global Election Official Conference on Electoral Technology. The paper considers how to introduce new technologies and maximize the potential of success of election technology projects. In addition the paper discusses the introduction of electronic voting. The authors raised some very relevant questions in relation to the deployment of the technology, the following should be a standard question whenever technology related decisions are being made, namely: Yard et al. (2007, p1) "*Is the technology on the cutting edge of electoral processes being pursued for the sake of being on the cutting edge, or for the sake of the electoral process?*". This question challenges the fundamental reasoning behind the use of technology and what the authors refer to as using "*appropriate technology*". The concept of appropriate technology was introduced by the economist E.F. Schumacher and looks at the total cost of ownership of technology including environmental, social and cultural impacts associated with a technology solution. The relevance of this work to this paper is that there is no silver bullet and as such the framework established through this dissertation can only be used for guidance as any decision must be qualified by the specifics of an EMB's situation. The authors propose that appropriate technology is:

- Cost effective;
- Easy to manage, deploy, support and extend;
- Mature;
- Interoperable, modular and flexible; and
- Standards-based.

The authors highlight that election technology projects are faced with the same difficulties and risks as any other large scale technology project and as such should be:

- Founded on well defined requirements that are driven by the EMB's strategic and operational goals.
- Supported by detailed project plans and effective management.
- Executed with clearly defined roles and responsibilities, as well as well written contracts.
- Actively involve all stakeholders through an efficient communication system.

The authors emphasise that an EMB should first implement basic technologies such as email, local area networks, internet access and desktop applications before moving into the more advanced and complex technologies.

The authors' position in regards to technology is supported by The United Nations Development Programme Democratic Governance Group (2007, p18) which although more detailed suggest a similar list of principles that should be considered when contemplating technology upgrades.

Lastly the authors propose that an EMB should adopt automated voting technologies for of the following reasons:

- To centralize control over the conduct of elections
- To deal with the complexity of voting rules
- To increase access to the polls
- To reduce cost
- To satisfy a desire for modernization

However in response to the authors' interpretation as to why voting technologies should be adopted, the following counter arguments can be made:

- Centralized control can be achieved without necessarily using automated voting technologies.

- Complex voting rules are not addressed when a ballot is cast and only come into play during vote counting and determination of results. As a result technology can be used to assist in this area without the need to fully adopt automated vote counting.

- Although it may appear that automated voting technologies increase access they can also reduce access as a result of the limitation in availability of voting machinery.

- Lastly although the authors claim automated voting technologies reduce costs they do not offer any empirical evidence to support this claim. They also do not take total cost of ownership into account in their argument.

It is proposed that more research is required to conclusively determine the specific benefits that can be derived. In the meantime automated voting technologies should be used with extreme caution and only after their full impact has been properly assessed.

The following paragraph looks at norms and standards applicable to electronic voting and election administration.

2.2.5 Challenging the Norms and Standards of Election Administration

Challenging the Norms and Standards of Election Administration is a white paper produced by IFES for the USAID. The paper addresses five key issues that the authors believe currently do not have accepted norms and standards, namely:

- Electronic voting;

- Election administration and use of the Internet;

- External and absentee voting;

- Boundary delimitation; and

- Political finance

Only the issue of electronic voting and Election administration and use of the Internet will be discussed further as the other issues are not related to technology or this report.

In Blanc et al (2007) the author acknowledges that information technology has affected election management by making communication and internal management more effective, as well as by systematizing voter registration records. The author highlights that electronic voting is a new technology and although claims are made that it improves the electoral process, there is little evidence to support these claims. Although the author concedes that electronic voting technologies have been successfully used in a number of countries including the United States and India, the author questions the logic of using this type of technology in a transitional or post-conflict scenario. The author cautions international donors from getting involved in the decision to use this technology and emphasises that it must be made by the EMB without interference and based on the specifics of their scenario. The author's position regarding electronic voting technologies is supported by the work of a number of researchers and published works such as Norden et al (2007), Alvarez and Hall (2008) and Rubin (2006). All of whom have found vulnerabilities with electronic voting technologies and/or the associated processes and all recommended additional research be conducted to improve the situation and remove the vulnerabilities. It must be noted that in all cases the concern is more to do with the integrity of election results as although the vulnerabilities can be proven, to date there is no recorded case of proven election fraud via the tampering with electronic voting technologies.

In regard to the Internet the authors express concern about the lack of electoral standards and regulations associated with the Internets' use in election campaigns and the associated democratic/ political processes. The authors propose that these standards and regulations need to be established rather sooner than later as the rate of increase of internet usage in the election arena is exponentially growing.

The authors' position on the need for regulations and standards is supported by Best et al (2007) in which it was demonstrated that involvement in politically oriented activities on the Internet by the general public was negatively influenced by their risk perception of the Internet and its use. The authors' position in regard to these standards and regulations being established rather sooner than later is to a degree supported by work done by the PEW Internet Project which in its report "*The internet and the 2008 election*" PEW Internet Project (2008, p2) states that 40% of all Americans (internet and non-users alike) have gotten news and information about this year's campaign via the internet. This is a 9% increase from the same point in the 2004 election cycle.

2.3 Literature Survey Findings

As indicated above one of the objectives of the literature survey was to use existing literature to establish a reference list of electoral activities that require to be executed by an EMB. Table 4 below is a comparison of the views of the various authors in respect of electoral activities that an EMB should conduct.

Table 4: Comparison of views in respect to electoral activities

S/No	Lopez-Pintor and Fischer (2005)	Elklit and Reynolds (2005)	Wall et al (2006)	United Nations Development Programme Democratic Governance Group (2007)
1		Legal Framework	Reform	Legal Framework
2		Electoral Management	Planning	Planning & Implementation
3			Strategy	
4			Training	Training & education
5	Voter Registration	Voter registration	Registration	Registration and nomination
6	Boundary Delimitation	Constituency and polling district demarcation		
7				
8			Nomination	
9	Voter Education and Information	Voter education	Information	
10	Campaigning by Political Parties	Campaign regulation	Campaign	Electoral campaigning
11	Voting	Polling	Voting	Voting operations & election day
12	*Operations*	Access to and design of ballot paper. Party and candidate nomination and registration		
13	*Materials and Logistics*			
14	*Training*			
15	Counting and Transmission of Results	Counting and tabulating the vote	Results	Verification of results
16	Dispute Adjudication	Resolving election related complaints. Verification of final result and certification		
17	Vigilance			
18	*Party agents*			
19	*Domestic Monitors*			
20	*International Observers*			
21		Post election procedures	Review	Post election

Although the similarities between the various views is immediately apparent the most striking feature is also how sensitive a list of activities is to the authors' perspective. The primary differences are not in what activities should be conducted, but more in what the activity is called and where it fits into the list. The intent is to use the different view to create an electoral activity reference list. The reference activity will be used as a contextual reference point to determine if technology can be used or not. The concept is illustrated in Figure 6 below.

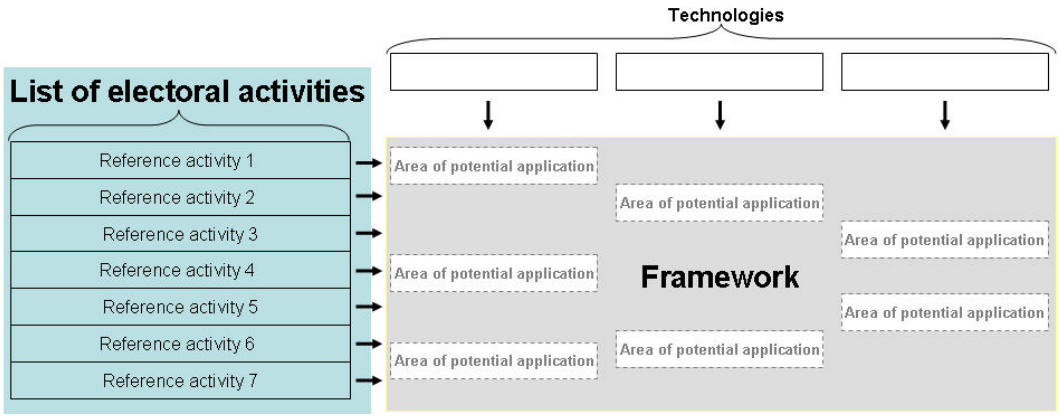


Figure 6: Application of a standard list of activities

Table 5 below is the proposed electoral activity reference list that has resulted from an analysis of the different activity lists as described above.

Table 5: Electoral Activity Reference List

S/No	Electoral Activity
1	**General Administration**
1.1	Policies, procedures and regulations
1.2	Election planning
1.3	Election management
1.4	Internal correspondence
1.5	External correspondence
1.6	Electoral staff recruitment and training
2	**Financial Management**
2.1	Fund Administration
2.2	Procurement Administration
2.3	Contract Administration
3	**Logistic Management**
3.1	Logistic Planning
3.2	Distribution of registration material
3.3	Distribution of election material
3.4	Distribution of ballot papers
4	**Delimitation**
4.1	Zone definition, demarcation and boundary maintenance

S/No	Electoral Activity
4.2	Map production
4.3	Voting station identification and management
4.4	Dispute Resolution
5	**Voter Registration**
5.1	Voter Registration
5.2	Voter Roll Publication
5.3	Dispute Resolution
6	**Political Party Management**
6.1	Party Registration
6.2	Campaign Management
6.3	Dispute Resolution
7	**Candidate Management**
7.1	Candidate Registration
7.2	Ballot Paper Production
7.3	Dispute Resolution
8	**Ballot Casting**
8.1	Voter Identification
8.2	Voting
8.3	Vote Counting
8.4	Result Reporting
8.5	Result Auditing
8.6	Dispute Resolution
8.7	Result Distribution/ Publication
9	**Observation Management**
9.1	Accreditation of observers
9.2	Accreditation of party agents
9.3	Accreditation of press agents
9.4	Dispute Resolution

Another common element that emerged from the literature survey is that technology should only be used after the specifics of an Electoral Management Bodies scenario have been assessed and the benefits of using technology determined within that scenario.

Lastly the literature survey found that there was little evidence to support the claimed benefits of electronic voting and many unanswered questions in regard to security and vulnerability. As a result it was proposed that more research be done and that electronic / automated voting technologies should be used with extreme caution and only after the full impact of their use has been properly assessed.

The following chapter will discuss the factors influencing technology selection.

Chapter 3. FACTORS INFLUENCING TECHNOLOGY SELECTION

3.1 Introduction

The previous chapter established what electoral administration was and defined a list of electoral reference activities, as well as the criteria that should be used when selecting technologies based on a literature survey.

This chapter looks at additional factors that need to be taken into account when making technology selection decisions about election technology in developing countries.

The first factor that must be taken into account is how IT capable is the organisation as this will drive the organisations ability to utilise and support complex technologies. Determining an organisation IT capability is referred to as capability maturity modelling.

The second factor that must be taken into account is the risks associated with a technology.

The last factor that must be taken into account is the extent of the digital divide between the developed and the developing world.

3.2 Capability Maturity Modelling

Nolan (1979) observed that organisations progressively grew into the use of ICT technology over a period of time. Based on his research Nolan proposed 6 stages of growth in a company's ICT capability. An organisation moves through the different stages as their ICT capability, utilisation and management requirements mature. The importance of Nolan's work is that it demonstrated the effective utilisation of ICT technology is subject to the maturity of the organisation in regard to ICT technology. Nolan's work has been used by numerous researchers including Bharadwaj et al (1999) who continued Nolan's work to include aspects of a corporate IT capability and proposed that an organisation's maturity can be measured using the following 6 categories: IT business partnerships, external IT

linkages, business IT strategic thinking, IT business process integration, IT management, and IT infrastructure.

Renken (2004) proposes a capability maturity framework that is similar to Bharadwaj et al (1999) that could be used in developing countries. The capability maturity framework consists of 7 categories/ capability areas as illustrated in Table 6 below. The organisations maturity level is then plotted in each area in the form of maturity level.

Table 6: Capability Maturity Model

Capability Area	Maturity Level				
	Level 1	**Level 2**	**Level 3**	**Level 4**	**Level 5**
IS/ICT Applications	Running the business	Growing the business	Forming the business		
	Automation of operational and transactional level functions	Information centred approach with interoperability	Full integration focused on continuous business improvement		
Business-IT relationship	Uncertainty	Scepticism	Acceptance	Trust	Respect
	Role of IS/ICT in the business is uncertain	Policies have been developed to define roles but organisational acceptance has not been achieved	Working relationship between IS/ICT and all business/ operational areas	Integrated planning and execution of activities	ICT and business areas operate as one
IS/ICT Strategy Alignment	Unaligned	Ad hoc alignment	Formal Alignment	Shaping Business Strategy	
	Unaligned and motivated by efficency requirements	Measured against approved business plans/ strategy	Aligned to approved business plans/ strategy	A fully integrated part of the business strategy	
IS/ICT User Profile	Computer literate	Information systems literate	Knowledge worker		
	Users have moderate computer literacy	Users are competent to use information systems but operate in islands	Users understand the value of knowledge and actively share information		
IS/ICT Managerial Paradigm	Technology Management	Systems Management	Strategic ICT Management	Strategic Business Management	
	Focused on the management of technology and data	Focused on systems and information management	Coordinated and integrated business planning focused on value addition	Encapsulated into the business strategic management process	
IS/ICT Governance	Initial	Repeatable	Defined	Managed	Optimised
	Ad hoc or no procedures	Documented but not standardised procedures	Standardised and documented procedures	Compliance monitoring in place	Continuous improvement
IS/ICT Organisation	Ad-hoc	Business-Driven	Formalised Middle Management	Formalised Top Management	
	Limited if any staff with no clear lines of management responsibility	Ad hoc specialists reporting within business driven structures	Formal ICT organisation in place with middle management representation	Top management representation	

Data Source: Renken (2004)

Ahituv and Neumann (1990) propose that there are 7 stages to office computerisation. By office computerisation they imply the execution of day-to-day office activities via computer related technologies. The first stage is where computers are used to produce electronic documentation and includes the use of word processors, spreadsheets and presentation applications. The last stage is where integrated operation of various systems and application occurs. The 7 stages as proposed by Ahituv and Neumann (1990) are as follows:

- Stage 1 - Word Processing
- Stage 2 - Electronic filing
- Stage 3 - Controlling performance
- Stage 4 - Electronic mail
- Stage 5 - Message switching
- Stage 6 - Calendar keeping and scheduling
- Stage 7 - Integrated systems operation

Ahituv and Neumann's (1990) seven stages of computerisation fit into Renken's capability maturity model as illustrated in Table 7 below.

Table 7: Enhanced Capability Maturity Model

Capability Area	Maturity Level				
	Level 1	**Level 2**	**Level 3**	**Level 4**	**Level 5**
IS/ICT Applications	Running the business	Growing the business	Forming the business		
	Automation of operational and transactional level functions	Information centred approach with interoperability	Full integration focused on continuous business improvement		
	Computerisation Stages 1 to 3	Computerisation Stages 4 to 6	Computerisation Stage 7		
	Produce and use electronic documentation and data	Effectively use email, scheduling and calendar keeping. Online sharing of information	Online collaboration in all aspects of the business		
IS/ICT User Profile	Computer literate	Information systems literate	Knowledge worker		
	Users have moderate computer literacy	User are competent to use information systems but operate in islands	Users understand the value of knowledge and actively share information		
IS/ICT Organisation	Ad-hoc	Business-Driven	Formalised Middle Management	Formalised Top Management	
	Limited if any staff with no clear lines of management responsibility	Ad hoc specialists reporting within business driven structures	Formal ICT organisation in place with middle management representation	Top management representation	

The capability maturity model has relevance to the technology framework in that it is used to establish the suitability of technology solutions to a specific EMB based on its present capabilities and level of computerisation.

3.3 Digital Divide

The digital divide describes the discrepancy between the ICT capabilities of developed countries and that of developing countries as a result of know-how, infrastructure, funding and/or resources. Table 8 below illustrates the difference in internet diffusion statistics between Europe and America and Africa

Table 8: Internet Diffusion Statistics for 2005

	Users per 10,000 people	Internet Hosts per 10,000 people
Europe	3,333	955
America	2,444	1,440
Asia	585	37
Africa	111	3

Data Source: International Development Research Centre (2005, p14)

Table 9 below illustrates that although there has been a dramatic increase in Internet usage in Africa, Africa is still well below the world average.

Table 9: Internet User Statistics for 2007

Region	Users per 100 people	Users per 10,000 people	Growth factor from 2005
Europe	41.18	4118	24%
Americas	41.18	4118	68%
Oceania	44.91	4491	n/a
Asia	14.34	1434	145%
Africa	4.99	499	350%
World Average	20.05	2005	n/a

Data Source: International Telecommunication Union (2008)

According to International Development Research Centre (2005, p14) the lack of internet penetration can be attributed primarily to the high cost of communication and unreliable connections.

The one technology that is showing the potential to enable Africa to leapfrog the digital divide is mobile telecommunication technologies. According to the International Development Research Centre (2005) it forecasted that Africa will reach a 250 million subscriber level by 2010. Figure 7 below shows the actual and forecasted growth of cellular phone subscribers in Africa.

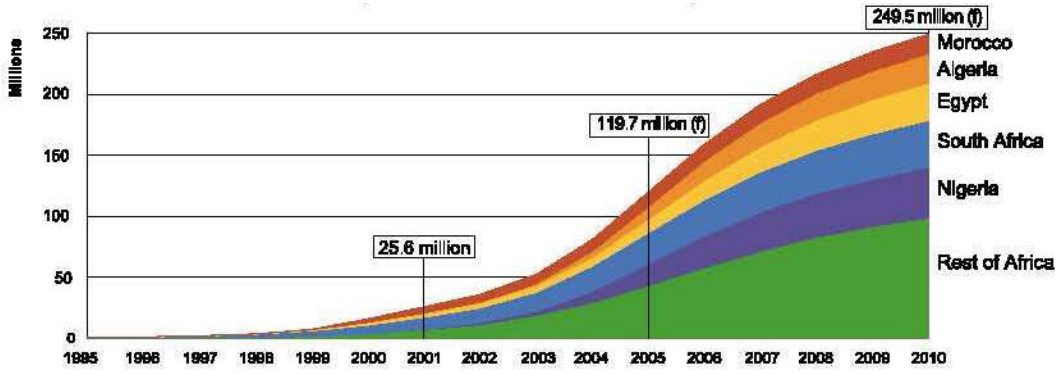


Figure 7: African mobile subscribers, actual and forecast 1995 to 2010

Source: International Development Research Centre (2005, p23)

The IDRC prediction indicated exponential growth that would start to flatten from around 2008. Using data from International Telecommunication Union (2008) indicates that in

reality the growth has exceeded predications and is still exponential as illustrated in Figure 8 below.

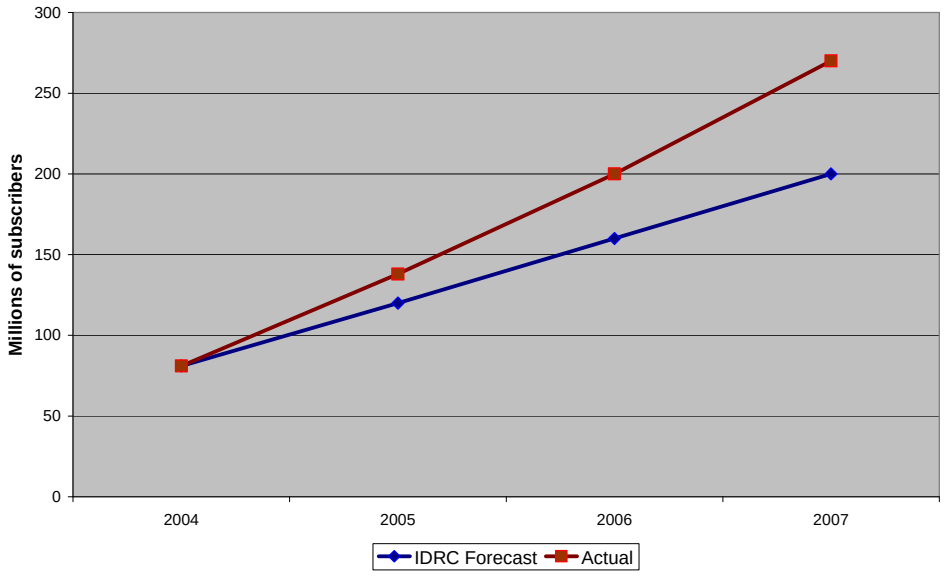


Figure 8: Actual growth in African Cellular Phone Subscribers 2005 to 2007

Data Source: International Telecommunication Union (2008)

Although the growth rate of cellular phone coverage and subscribers is positive, the extent of the digital divide is illustrated in Table 10 below in which the subscriber rate per 100 inhabitants is compared. The table clearly indicates that even with the present growth rate Africa is still behind the world average.

Table 10: Regional Comparison of Cellular Subscribers for 2007

Region	Subscribers per 100 inhabitants
Europe	109.6
Americas	71.9
Oceania	78.9
Asia	66.8
Africa	28.1
World Average	49.5

Data Source: International Telecommunication Union (2008)

The importance of acknowledging the digital divide in the context of the framework that is being developed is that solutions that have worked in developed countries may not necessarily work in developing countries as a result of the digital divide. Secondly specific

attention must be paid to the infrastructure and resource requirements of solutions to ensure that they are sustainable and affordable. Lastly attention has to be paid to skills development as what is commonplace from an IT perspective in Europe and the America's may be something completely new in an African context.

In summary the digital divide influences:

- General IT literacy of the workforce. In this regard it must be noted that at present the majority of Africans have had no exposure to personal computers, internet or even cellular phones.
- General awareness of IT potential and associated risks
- Availability of skilled IT resources. This in turn influences the ability to operate and/or support specific solutions over long periods of time
- Availability of infrastructure in the form of
    - Telecommunication infrastructure
    - Stable power supply
    - In-country IT products and spare parts
    - Transportation

3.4 Application Discussion

Within the framework it is intended to use an enhanced version of Renken (2004) capability maturity model to establish an EMBs IT capability level. The EMBs IT capability level serves as the basis for determining a master plan for growing their capability, as well as the selection of technologies for immediate use. For example an EMB that is not yet proficient with email should not be contemplating the immediate use of an electronic document management system with on-line collaboration capabilities.

Although commercial off-the-shelf (COTS) technologies have a lower risk associated with them because of the digital divide they may not be suited for use in a developing country. When assessing the suitability of technology cognizance will have to be taken of the following:

- Risks associated with the technology
- Implications associated with using and supporting the technology in a developing country.

The development of a custom solution, even if founded on established and stable technologies has inherent risk associated with it and as should be viewed in the context of dedicated technology. The experience of the vendor in developing and implementing custom election solutions then becomes the primary risk mitigating factor. Lastly the availability of the applicable enabling technologies will influence the resultant cost of acquisition, implementation and support.

The relevance of this chapter is that the results of the research must be adjusted to take the various factors discussed herein into account. The following chapter examines the design of the research and study.

Chapter 4. ANALYSIS AND DESIGN

4.1 Research Technique

The research method will be primarily qualitative in nature and will make use of questionnaires, interview transcripts, research notes and observation sheets.

The nature of the research topic, being the establishment of a selection framework, lends itself to the grounded theory method. Practically this implies an iterative approach to developing the framework, in that a literature and product search will be used to establish the basis for the questionnaires and other data collection methods. These in turn will be refined as the study progresses, ultimately resulting in the selection framework being developed.

A typical example is the use of the literature survey as described in section 2.3 to establish a standard list of electoral management activities and then the inclusion of the list in the questionnaire for Electoral Management Bodies.

The resultant report and hence the selection framework will be founded on the data collected via the following means:

- A primary survey of role players and stake holders in the election arena
- Literature survey
- Product and technology search

4.2 Primary Survey

The primary survey consisted of two surveys each of which targets a specific target group. The details of each survey are discussed in the subsequent paragraphs.

- Election Management Bodies/ Authorities

- Political Parties, NGOs, International Aid Organisations and Consultants

4.2.1 Election Management Bodies Questionnaire

The EMB questionnaire was developed using Adobe Acrobat 9 and focused on collecting data on the EMB present and planned use of technology. The questionnaire for Election Management Bodies/ Authorities consisted of 3 sections.

- The first section captured details about the EMB, including how many voters they service, the nature of the body (independent, government funded or part of a government department), how long they have been in operation, organisational structure as well as how many permanent employees work for the body. The questions in this section are predominantly quantitative so as to enable comparisons between EMBs.

- The second section captured the status of their present use of technology as well as the technology literacy of their employees and the voting public. The questions in this section are predominantly quantitative so as to enable comparisons between EMBs.

- The third section captured their views, future intentions and plans in regard to using technology. By nature of discussing views, plans and intention the questions in this section are predominantly qualitative. Comparison between EMBs will be facilitated by the use of common terms.

The logic of the Election Management Bodies Questionnaire is illustrated in the form of a mind map in Figure 9 below. A copy of the questionnaire is attached as Appendix A.1.

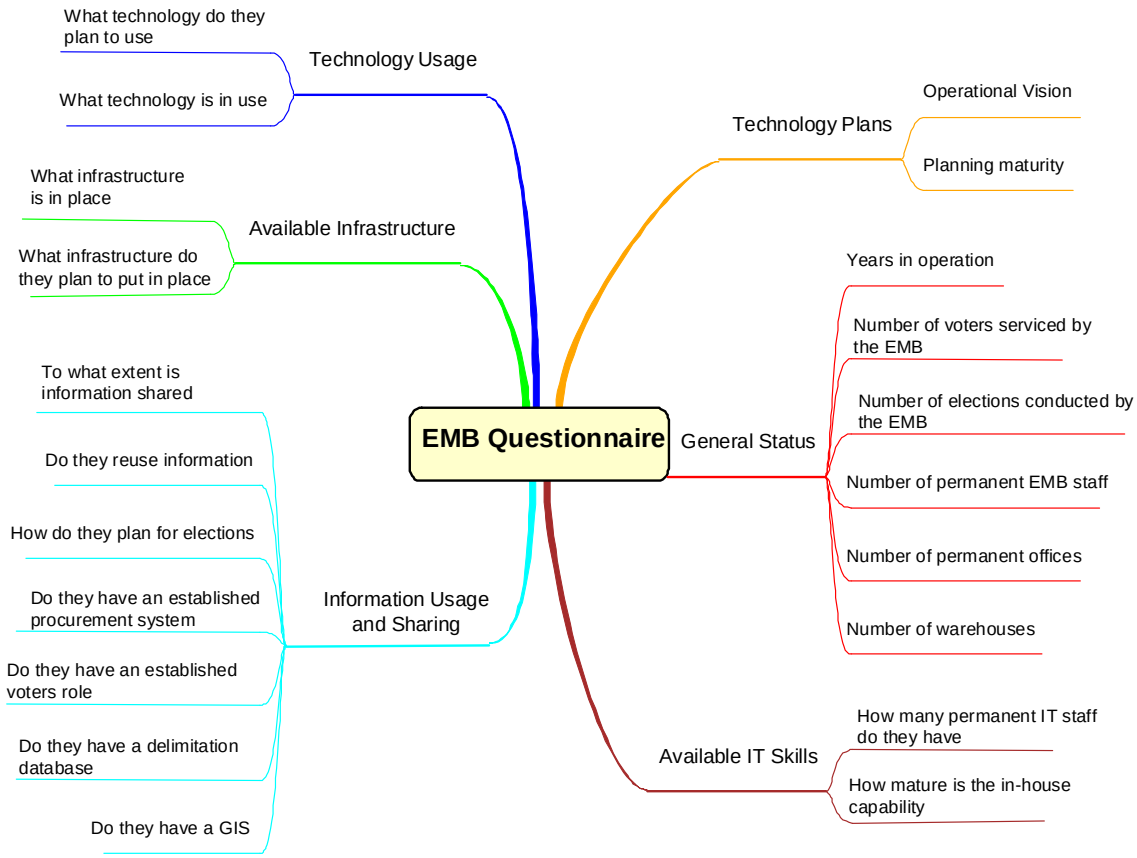


Figure 9: Election Management Bodies Questionnaire Logic

The results obtained from the questionnaire will firstly enable the applicable EMB to be plotted on the capability maturity model described in section 3.2. The results will secondly enable EMB to be compared. This in turn will enable the framework to be tested and in some areas validated.

4.2.2 Political Party, Aid Agencies and Consultants Questionnaire

Although it was originally intended to have separate questionnaires for each target group the lack of responses within some of the groups forced a rethinking of the approach and as a result the questionnaires were consolidated into a single questionnaire thereby enabling all responses to be evaluated.

The questionnaire was developed using Adobe Acrobat 9 and focused on collecting data on the respondent's views of the use of technology in elections.

By nature of discussing views the questions in this questionnaire are predominantly qualitative. A question records the respondent's view on the application of technology in a specific area of election operations, as well as the risks and benefits they perceive in regard to applying technology in that area. Comparison between respondents will be facilitated by the use of common terms, points and ideas that will be assigned to the responses during the response analysis phase. Quantitative analysis of the reference to common terms, points and ideas will enable triangulation of the results.

The logic of the Questionnaire is illustrated in Figure 10 below. A copy of the questionnaire is attached as Appendix A.2.

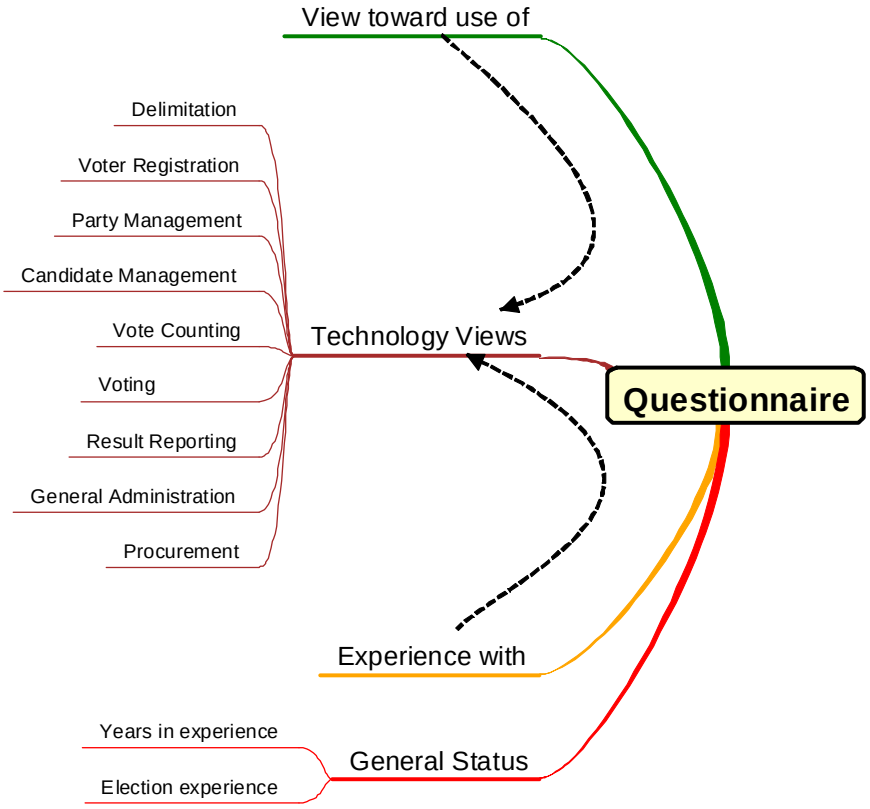


Figure 10: Political Party, Aid Agency and Consultants Questionnaire Logic

4.3 Conclusion

The iterative nature of the grounded theory approach has enabled the framework to be developed as data was collected and analysed.

The following chapter describes how the research materialised.

Chapter 5. METHODS AND REALIZATION

5.1 Primary Survey

5.1.1 Electoral Management Bodies

A total of 25 emails and 12 faxes were sent out inviting EMBs to participate. Although 12 EMBs showed interest to participate in the interview, however, only 3 active participants were ultimately recorded, namely:

- Tanzania
- Malawi
- Zambia

To establish the proposed framework, the participation of these three countries is strategically important because Tanzania and Zambia have advanced technology solutions and Malawi is representative of the EMB in process of implementing technology. In addition the issue associated with poor infrastructure and large rural populations are also common to all the respondents.

The IT Manager of each of the EMB was interviewed using the questionnaire as a means to ensure that the information collected from the different EMB's could be correlated.

The number of EMBS that ultimately participated was influenced by the following factors:

- The operational status of the EMB. A number of EMBs are only active when required to conduct elections.
- The presence of language barriers. A number of EMBs are French or Portuguese speaking and as such may be unwilling or unable to participate in an English based study.

- Accuracy of the contact information. A number of EMBs do not maintain a permanent office presence and as such their contact information changes.

- Present commitments of the EMB and their available capacity to participate in the study.

The results of the survey of EMBs are described in section 6.1.1.

5.1.2 Political Parties, NGOs, Aid Organisations and Consultants

A total of 40 emails were sent out to political parties inviting them to participate in the study. A further 44 emails were sent out to aid agencies and recognised election consultants inviting them to participate in the study.

As a result of the possibility of a low response rate within the individual groupings as well as the fact that a number of the consultants were also part of the aid agencies, it was decided to consolidate the responses into a single questionnaire that could then be analysed in the context of a “panel of experts”, rather than specific organisational views.

A total of 15 participants were ultimately recorded. Although the number is not as high as would be desired the quality of the respondents make up for the lower number. Each respondent has been involved in elections in multiple countries and 4 of the respondents are published academics on the subject of elections and election administration. The profile of the respondents is described in detail in section 6.1.2.2.

The results of the survey of Political Parties, NGOs, Aid Organisations and Consultants are described in section 6.1.2.

5.2 Product and Technology Search

IFES (2008), ACE Project (2008b), International Association of Clerks, Recorders, Election Officials and Treasurers (2007) and e-Government Consulting Group (n.d) amongst others were used to identify suppliers of election solutions. The type of solution identified was further analysed to identify supportive COTS application and/or enabling technologies that were being used in the solution. Ziff Davis Publishing Holdings Inc (2008), Technology Evaluation Centre (2008) and GIS Lounge and DM Geographics (2008) amongst others were used to identify suppliers of the supportive COTS applications or enabling technologies. The web sites of the suppliers were visited so as to be able to compile a catalogue of COTS products and enabling technologies. The detailed results are described in section 6.2.

Chapter 6. RESULTS AND EVALUATION

6.1 Primary Survey

As indicated in section 5.1 the primary survey consisted of two questionnaires, namely:

- Election Management Bodies/ Authorities
- Political Parties, NGOs, Aid Organisations and Consultants

The results of the survey are discussed herein

6.1.1 Survey Results for Election Management Bodies/ Authorities

6.1.1.1 Tanzania

Introduction

The information in Figure 11 below is provided so as to orientate the reader in regard to the Tanzanian scenario.

Key Statistics	
Total Population	40,213,160
Population above the age of 14 years	53.7%

Labour Force	20,040,000
agriculture	*80%*
industry and services	*20%*

Literacy Level	69.4%

Mobile Telephone Subscribers	9,358,000
Landline Telephones	165,013
Internet Users	400,000

Figure 11: Key Information for Tanzania

Source: USA Central Intelligence Agency (2008, Tanzania Page)

The Tanzanian Election Management scenario in the context of management offices, communications and facilities is described in Figure 12 below.

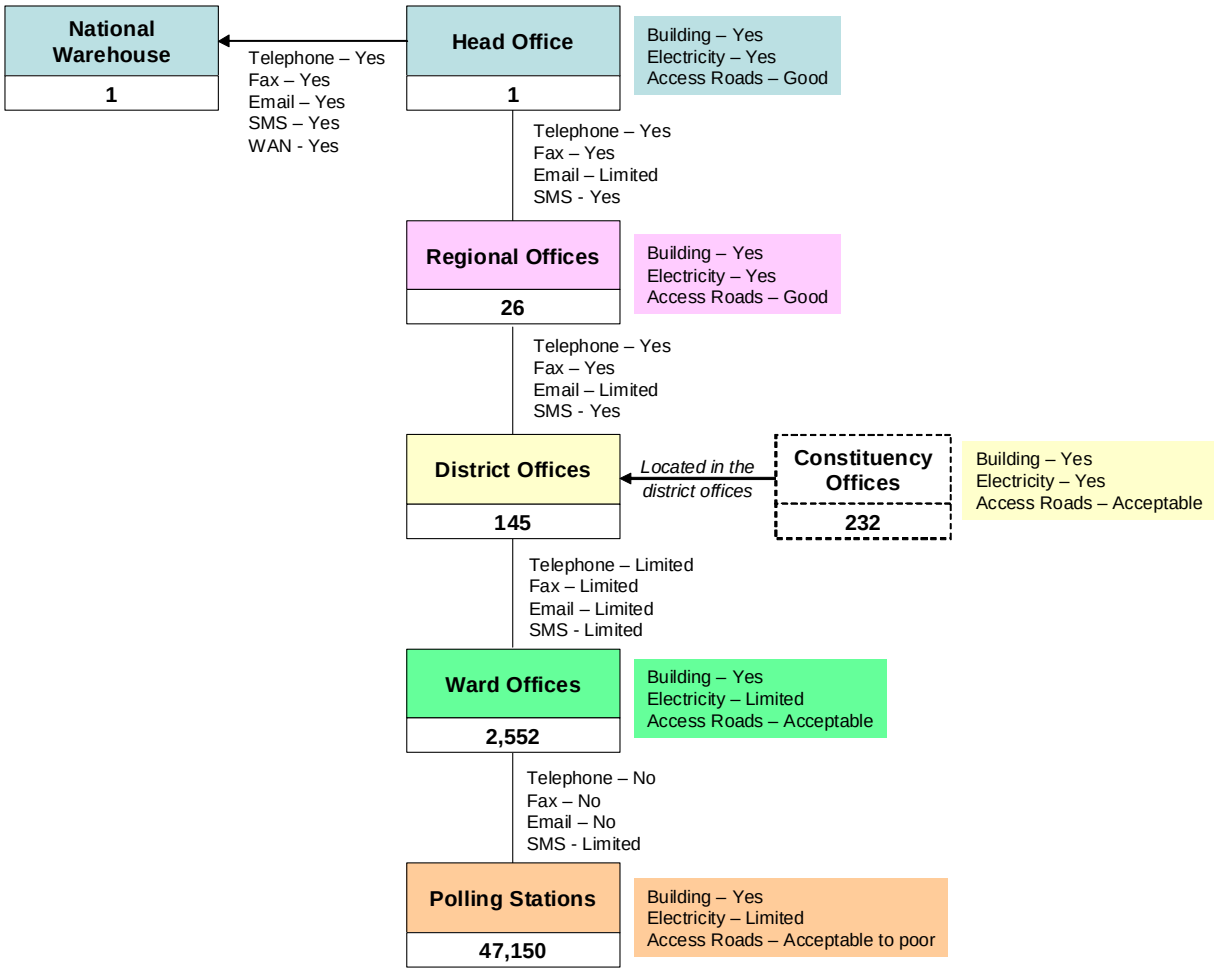


Figure 12: Tanzania Election Management Scenario

Technology Application

The National Election Commission of Tanzania (NEC) successfully implemented an election system for the 2005 elections. The election system consists of voter registration via OMR forms, Central Voter Database, GIS, Candidate Registration, Ballot Paper production, result capturing and result reporting. The system uses an Oracle database and is supported out of a state of the art data centre run by permanent NEC IT staff.

Table 11 below indicates the primary IT utilisation statistics for NEC.

Table 11: Tanzanian EMB General Technology Utilisation

Permanent Staff at Head Office	102
Computer Work Stations	40
Printers	40

Computer to staff ratio	2.6 staff to 1 work station
Printer to work station ratio	1.0 printers to 1 work station

Local Area Network	Yes
Shared File Store	Limited
Email Server	Yes
Internet Server	Yes

The computer staff ratio indicates that IT technology has yet to permeate throughout the organisation. The printer to work station ratio indicates that although a local area network is present it is not being optimally used.

Table 12 below shows that although the organisation has not fully adopted information technology from an election execution perspective NEC has an advanced capability with solid infrastructure. A key feature of the Tanzanian solution is the extensive use of paper as the medium for use in the field integrated with an advanced central processing capability. This is illustrated by:

- The use of paper voter registration forms.

  Paper registration forms were processed using OMR scanning technology to create a central voter register. Photograph voter roles were produced and distributed to the various polling stations. A total of 16 million voters were successfully registered.

- The use of paper candidate registration forms.

  Paper registration forms were processed using OMR scanning technology to create a central candidate list. The electronic candidate list was used to produce ballot paper proofs.

- The use of paper ballot papers

- The use of paper results forms

  Paper result forms were certified at district level and then faxed and/or SMS'd to a

central reporting system that correlated the results where applicable and communicated them to the press.

Table 12: Application of Technology by the Tanzania EMB

	Unix	Linux	Windows Vista	Windows XP/NT	Macintosh			
Operating Systems in use		X	X	X				
	Oracle	SQL Server	SyBase	IBM DB2	MySQL	Microsoft Access		
Database Technology in use	X	X				X		
	Server clusters	Network Attached Storage	Storage Area Network	Ethernet Network	Wireless Network	LDAP	VoIP	
Other Technologies in use	X	X	X	X	X	X	X	
	Photographs		Fingerprint		Signature		Voter Card	
	Polaroid/ Instant	Digital	Ink	Digital	Ink	Digital	Printed Card	Smart Card
Voter Registration	X		X		X		X	
	Via Telephone	Via SMS	Via Internet					
Voter Verification of Registration		X	X					
	Paper	CD/DVD	Internet					
Voters Roll Inspection	X	X						
	Central voters database	Paper voters roll	Electronic voters roll	Biometric verification	Smartcard			
Voter Verification for Polling	X	X						
	Paper Ballot	Voting Machines						
		Punch Card	Optical Mark	Touch Screen				
Voting	X							
	Central Results Database	Result Transmission			Electronic Result Form			
		Via Fax	Via SMS	Via WAN				
Central Result Capture	X	X	X					
	GIS	AFIS	Facial Recognition	ERP	EDMS			
Specialist Systems	X	½	X					

Note: The voter registration system has a fingerprint matching capability, that is able to do one to one and one to many matching

The table above shows that NEC is able to operate and support sophisticated IT technology in the form of database technology, server and network technology, as well as specialist systems. In regards to their head office they have all the required enabling technologies in place to employ fully integrated solutions.

Technology Plans

Election administration is done primarily using a stand alone capability and is largely detached in nature. Fund administration is done using the mandatory government system. Ultimately NEC wants to move towards a collaboration environment where information is openly shared. In order to achieve this objective NEC will not only have to acquire col-

laboration tools but will have to expend effort on increasing computer usage throughout the organisation. Table 13 below describes NEC's election administration technology plans.

Table 13: Tanzanian Election Administration Plans

Area of Election Administration	Implemented Technology	Planned Technology	Remarks
General Administration			
Policies, procedures and regulations	Print and file	EDMS/ Collaboration Suite	
Election planning	Stand-Alone Planning Software	None	
Election Management	Stand Alone Project Plans	None	
Internal correspondence	Word Processor & Email	EDMS/ Collaboration Suite	
External correspondence	Word Processor & Fax	EDMS/ Collaboration Suite	
Financial Management			
Fund Administration	Stand Alone Application	None	NEC uses the government fund administration system.
Procurement Administration	Spreadsheets	None	
Contract Administration	Spreadsheets	None	
Logistic Management			
Logistic Planning	Integrated Log Management System	Integrated Election System	
Distribution of registration material	Integrated Log Management System	Integrated Election System	
Distribution of election material	Integrated Log Management System	Integrated Election System	
Distribution of ballot papers	Integrated Log Management System	Integrated Election System	

NEC already has all the primary building blocks for a fully integrated election system in the form of the following systems that share common database architecture:

- Voter Registration System
- Candidate Registration System
- Result Reporting System
- GIS planning system
- Logistic Management System

The future intent is to further integrate the various components and add additional functionality where required.

Table 14: Tanzanian Election Operations Plans

Area of Election Operations	Implemented Technology	Planned Technology	Remarks
Delimitation			
Zone definition, demarcation and boundary maintenance	Integrated GIS Database	Integrated Election System	
Map production	Integrated GIS Database	Integrated Election System	
Voting station identification and management	Integrated Election System	None	
Dispute Resolution	None	None	
Voter Registration			
Voter Registration	Integrated Election System	None	Looking to upgrade the VR System to use digital fingerprints & photographs
Voter Roll Publication	Integrated Election System	None	
Dispute Resolution	None	None	
Political Party Management			
Party Registration	None	None	NEC does not do party management it is done by the Registrar of Political Parties.
Campaign Management	None	None	
Dispute Resolution	None	None	
Candidate Management			
Candidate Registration	Integrated Election System	None	
Ballot Paper Production	Integrated Election System	None	
Dispute Resolution	None	None	
Ballot Casting			
Voter Identification	Printed Voters Roll	None	The Voter Roll contains a photograph of the voter. Voter also has a voter card with unique number.
Voting	None	None	Voting is done using paper ballots
Vote Counting	None	None	Vote counting is manually done by the polling station staff, party agents and observers
Result Reporting	Central Result Database	Integrated Election System	
Result Auditing	Central Result Database	Integrated Election System	
Dispute Resolution	None	None	
Result Distribution/ Publication	None	Integrated Election System	
Observation Management			
Accreditation of observers	None	None	
Accreditation of party agents	None	None	
Accreditation of press agents	None	None	
Dispute Resolution	None	None	

The existing NEC solution was designed specifically for use in their environment, applying a balance between the application of technology and the use of paper solution. This gives

NEC a solid platform from where they can expand the use of technologies as the national infrastructure permits. Their immediate challenge is the implementation of a digital photographic and biometric capture solution to be ready for use for the 2009 elections.

Technology View

NEC's view towards the application of technology in elections is described in Table 15 below.

Table 15: Tanzanian View Towards Election Technology

Question	Answer				Remarks
	Definitely	Possibly	Limited	No	
Do you think technology can be successfully applied in support of Delimitation?	X				Presently in use by NEC
Do you think technology can be successfully applied in support of Voter Registration?	X				Presently in use by NEC
Do you think technology can be successfully applied in support of Party Management?	X				
Do you think technology can be successfully applied in support of Candidate Management?	X				Presently in use by NEC
Do you think technology can be successfully applied in support of Voting and Vote Counting?				X	Although the technology may work electronic voting and vote counting will not work within the present environment as a result of the levels of computer literacy and the availability of infrastructure.
Do you think technology can be successfully applied in support of Result Reporting?	X				Presently in use by NEC

6.1.1.2 Zambia

Introduction

The information in Figure 13 below is provided so as to orientate the reader in regards to the Zambian scenario.

Key Statistics	
Total Population	11,669,534
Population above the age of 14 years	52.3%

Labour Force	4,989,000
agriculture	*85%*
industry	*20%*
services	*20%*

Literacy Level	80.6%

Mobile Telephone Subscribers	2,639,000
Landline Telephones	91,800
Internet Users	500,000

Figure 13: Key Information for Zambia

Source: USA Central Intelligence Agency (2008, Zambian Page)

The Zambian Election Management scenario in the context of management offices, communications and facilities is described in Figure 14 below.

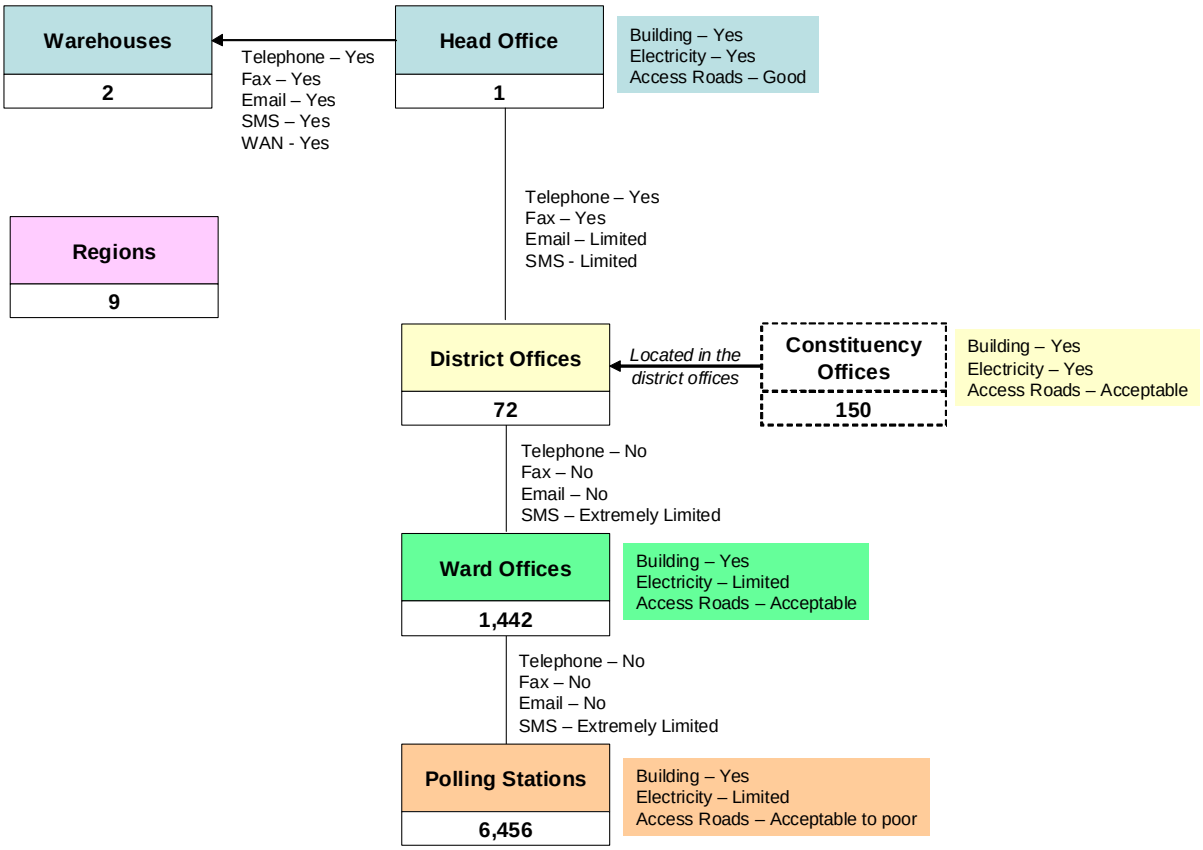


Figure 14: Zambian Election Management Scenario

Technology Application

The Zambian Election Commission (ZEC) successfully implemented an election system for the 2006 elections. The election system consists of voter registration via OMR forms, Central Voter Database, GIS, Candidate Registration, Ballot Paper production, result capturing and result reporting. The system uses an Oracle database and is supported out of a state of the art data centre run by permanent ZEC IT staff.

Table 16 below indicates the primary IT utilisation statistics for ZEC.

Table 16: Zambian EMB General Technology Utilisation

Permanent Staff at Head Office	125
Computer Work Stations	130
Printers	56

Computer to staff ratio	0.96 staff to 1 work station
Printer to work station ratio	0.43 printers to 1 work station

Local Area Network	Yes
Shared File Store	No
Email Server	No
Internet Server	No

The printer to work station ratio indicates that although there is a local area network and some printer sharing is taking place, the network is not being optimally used as a relatively large number of printers are still connected directly to work stations. This view of network utilisation is supported by the fact that they have no shared file store or Email server. It must be noted that the computer to staff ratio has been skewed as a result of 30 of the computers indicated are correction workstations that are used as a part of the registration and election system. This implies that a more accurate computer staff ratio is 1.25 to 1. This in turn indicates that IT technology has yet to fully permeate throughout the organisation.

Table 17 below shows that although the organisation has not fully adopted information technology from an election execution perspective ZEC has an advanced capability with solid infrastructure. The ZEC election system is of a similar nature to the system implemented in Tanzania and described in section 6.1.1.1. A key feature of the Zam-

bian/Tanzanian solution is the extensive use of paper as the medium for use in the field integrated with an advanced central processing capability.

Table 17: Application of Technology by the Zambian EMB

	Unix	Linux	Windows Vista	Windows XP/NT	Macintosh			
Operating Systems in use			X	X				
	Oracle	SQL Server	SyBase	IBM DB2	MySQL	Microsoft Access		
Database Technology in use	X	X				X		
	Server clusters	Network Attached Storage	Storage Area Network	Ethernet Network	Wireless Network	LDAP	VoIP	
Other Technologies in use		X	X	X	X	X		
	Photographs		Fingerprint		Signature		Voter Card	
	Polaroid/ Instant	Digital	Ink	Digital	Ink	Digital	Printed Card	Smart Card
Voter Registration	X		X		X		X	
	Via Telephone	Via SMS	Via Internet					
Voter Verification of Registration								
	Paper	CD/DVD	Internet					
Voters Roll Inspection	X							
	Central voters database	Paper voters roll	Electronic voters roll	Biometric verification	Smartcard			
Voter Verification for Polling	X	X						
	Paper Ballot	Voting Machines						
		Punch Card	Optical Mark	Touch Screen				
Voting	X							
	Central Results Database	Result Transmission			Electronic Result Form			
		Via Fax	Via SMS	Via WAN				
Central Result Capture	X			X				
	GIS	AFIS	Facial Recognition	ERP	EDMS			
Specialist Systems	X	X		½				

The table above shows that ZEC is able to operate and support sophisticated IT technology in the form of database technology, server and network technology, as well as specialist systems. In regards to their head office they have all the required enabling technologies in place to employ fully integrated solutions.

Technology Plans

Election administration is done primarily using a stand alone capability and is largely detached in nature. Fund administration is done using an ERP system that is operated solely by the financial department.

Ultimately ZEC wants to move towards a collaboration environment where information is openly shared. In order to achieve this objective ZEC will not only have to acquire col-

laboration tools but will have to expend effort on increasing computer usage throughout the organisation. Table 18 below describes ZEC's election administration technology plans.

Table 18: Zambian Election Administration Plans

Area of Election Administration	Implemented Technology	Planned Technology	Remarks
General Administration			
Policies, procedures and regulations	Print and file	EDMS	
Election planning	Spreadsheets	Integrated Election System	
Election Management	Integrated Election System	None	Enhancements are planned for the existing system
Internal correspondence	Word Processor & EMail	EDMS/ Collaboration Suite	
External correspondence	Word Processor & Fax	EDMS/ Collaboration Suite	Post and Email are also used
Financial Management			
Fund Administration	ERP System	None	
Procurement Administration	Spreadsheets	ERP System	
Contract Administration	Spreadsheets	ERP System	
Logistic Management			
Logistic Planning	Spreadsheets	Integrated Log Management System	
Distribution of registration material	Spreadsheets	Integrated Log Management System	
Distribution of election material	Spreadsheets	Integrated Log Management System	
Distribution of ballot papers	Spreadsheets	Integrated Log Management System	

ZEC already has all the primary building blocks for a fully integrated election system in the form of the following systems that share common database architecture:

- Voter Registration System
- Candidate Registration System
- Result Reporting System

ZEC also has a dial-up WAN that allows the various district offices to connect to the central processing centre.

The future intent is to further integrate the various components and add additional functionality where required.

Table 19: Zambian Election Operations Plans

Area of Election Operations	Implemented Technology	Planned Technology	Remarks
Delimitation			
Zone definition, demarcation and boundary maintenance	Desktop GIS	Integrated GIS Database	
Map production	Desktop GIS	Integrated GIS Database	
Voting station identification and management	Spreadsheets	Integrated GIS Database	
Dispute Resolution	None	None	
Voter Registration			
Voter Registration	Integrated Election System		Enhancements are planned
Voter Roll Publication	Integrated Election System		
Dispute Resolution	None	Integrated Election System	
Political Party Management			
Party Registration	n/a	Integrated Election System	
Campaign Management	None	Integrated Election System	
Dispute Resolution	None	Integrated Election System	
Candidate Management			
Candidate Registration	Integrated Election System		Enhancements are planned
Ballot Paper Production	Integrated Election System		Enhancements are planned
Dispute Resolution	None		
Ballot Casting			
Voter Identification	Printed Voters Roll	None	
Voting	Paper Ballot	None	
Vote Counting	None	None	
Result Reporting	Integrated Election System		Enhancements are planned
Result Auditing	None	Integrated Election System	
Dispute Resolution	None		
Result Distribution/ Publication	Combination of Internet and request a DVD		
Observation Management			
Accreditation of observers	Observer Database	Integrated Election System	
Accreditation of party agents	Observer Database	Integrated Election System	
Accreditation of press agents	Observer Database	Integrated Election System	
Dispute Resolution	None	Integrated Election System	

The existing ZEC solution was designed specifically for use in their environment, applying a balance between the application of technology and the use of paper solution. This gives ZEC a solid platform from where they can expand the use of technologies as the national infrastructure permits.

Technology View

ZEC's view towards the application of technology in elections is described in Table 20 below.

Table 20: Zambian View Towards Election Technology

Question	Answer				Remarks
	Definitely	Possibly	Limited	No	
Do you think technology can be successfully applied in support of Delimitation?	X				GIS is already being used
Do you think technology can be successfully applied in support of Voter Registration?	X				Polaroid and OMR technology has been applied successfully
Do you think technology can be successfully applied in support of Party Management?	X				Though not under the EMB's jurisdiction now - it can be applied
Do you think technology can be successfully applied in support of Candidate Management?	X				Polaroid and OMR technology has been applied successfully
Do you think technology can be successfully applied in support of Voting and Vote Counting?		X			Ballots are paper based and will be for a long time to come because of literacy of voters
Do you think technology can be successfully applied in support of Result Reporting?	X				WAN and OMR technology has been applied successfully

6.1.1.3 Malawi

The following information in Figure 15 below is provided so as to orientate the reader.

Key Statistics	
Total Population	13,931,831
Population above the age of 14 years	51.4%

Labour Force	4,500,000
agriculture	*90%*
industry and services	*10%*

Literacy Level	62.7%

Mobile Telephone Subscribers	1,051,000
Landline Telephones	175,200
Internet Users	347,000

Figure 15: Key Information for Malawi

Source: USA Central Intelligence Agency (2008, Malawi Page)

The Malawi Election Management scenario in the context of management offices, communications and facilities is described in Figure 16 below.

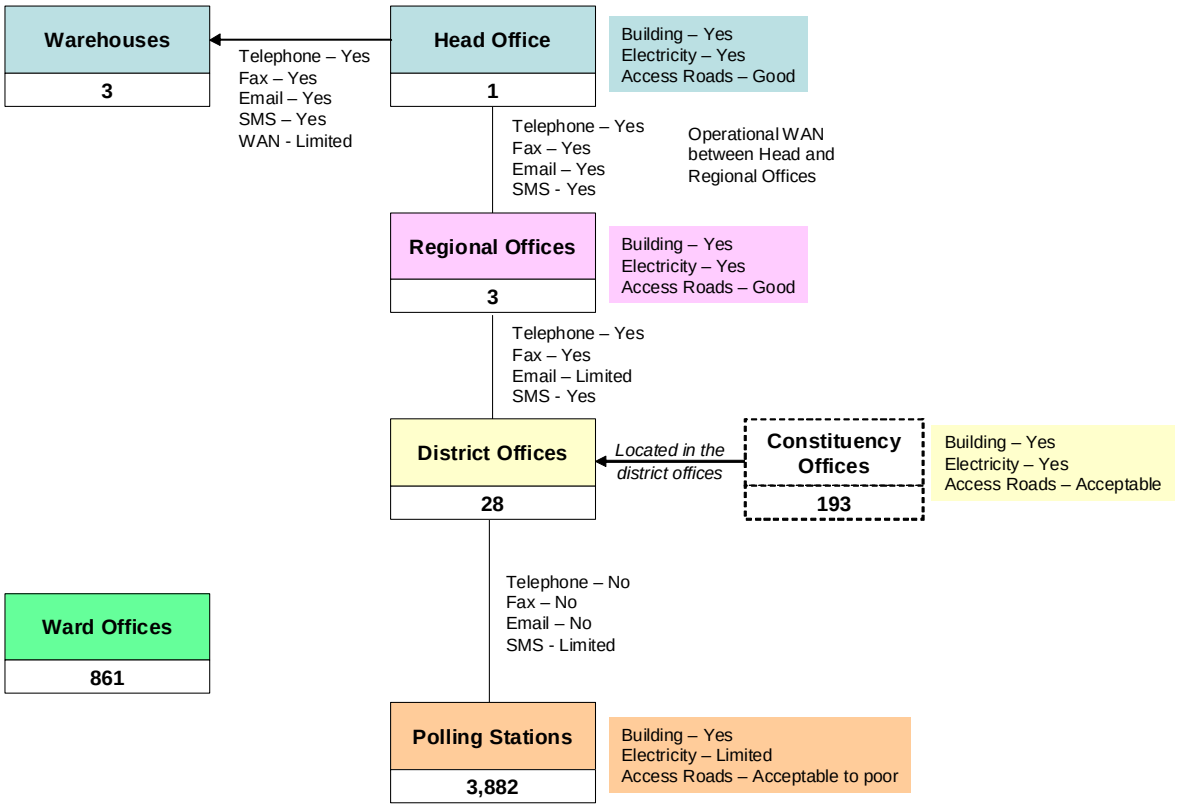


Figure 16: Malawi Election Management Scenario

Technology Application

The Malawi Electoral Commission (MEC) is in the process of implementing an election system for the 2009 elections. The election system consists of voter registration via OMR forms, Central Voter Database, Candidate Registration, Ballot Paper production, result capturing and result reporting. The system uses an Oracle database and will be supported out of a state of the art data centre run by permanent MEC IT staff.

Table 21: Malawi EMB General Technology Utilisation below indicates the primary IT utilisation statistics for MEC.

Table 21: Malawi EMB General Technology Utilisation

Permanent Staff at Head Office	110
Computer Work Stations	70
Printers	11

Computer to staff ratio	1.57 staff to 1 work station
Printer to work station ratio	0.16 printers to 1 work station

Local Area Network	Yes
Shared File Store	Yes
Email Server	Yes
Internet Server	Yes

The printer to work station ratio indicates MEC has an operational network, it still has some way to go before the organisation is fully computerised as 36% of the staff do not have access to their own work station.

Table 22 below shows that although the organisation has not fully adopted information technology from an election execution perspective MEC has an advanced capability with solid infrastructure.

The MEC election system is of a similar nature to the system implemented in Tanzania and described in section 6.1.1.1. A key feature of the Malawi/Tanzanian solution is the extensive use of paper as the medium for use in the field integrated with an advanced central processing capability.

Table 22: Application of Technology by the Malawi EMB

	Unix	Linux	Windows Vista	Windows XP/NT	Macintosh			
Operating Systems in use				**X**				
	Oracle	SQL Server	SyBase	IBM DB2	MySQL	Microsoft Access		
Database Technology in use		**X**						
	Server clusters	Network Attached Storage	Storage Area Network	Ethernet Network	Wireless Network	LDAP	VoIP	
Other Technologies in use			**X**	**X**	**X**			
	Photographs		Fingerprint		Signature		Voter Card	
	Polaroid/ Instant	Digital	Ink	Digital	Ink	Digital	Printed Card	Smart Card
Voter Registration		**X**	**X**		**X**		**X**	
	Via Telephone	Via SMS	Via Internet					
Voter Verification of Registration								
	Paper	CD/DVD	Internet					
Voters Roll Inspection	**X**							
	Central voters database	Paper voters roll	Electronic voters roll	Biometric verification	Smartcard			
Voter Verification for Polling	**In process**	**X**						
	Paper Ballot	Voting Machines						
		Punch Card	Optical Mark	Touch Screen				
Voting	**X**							
	Central Results Database	Result Transmission			Electronic Result Form			
		Via Fax	Via SMS	Via WAN				
Central Result Capture	**In process**							
	GIS	AFIS	Facial Recognition	ERP	EDMS			
Specialist Systems	**X**	**In process**						

The table above shows that although MEC is in process of implementing a registration and result reporting system it is able to operate and support sophisticated IT technology in the form of database technology, server and network technology, as well as specialist systems. In regards to their head office and regional offices they have all the required enabling technologies in place to employ fully integrated solutions.

Technology Plans

Election administration is done primarily using a stand alone capability and is largely detached in nature.

MEC wants to move towards a more integrated election planning and management scenario with election administrators using live election data sourced from the integrated

election system. Table 23 below describes MEC's election administration technology plans.

Table 23: Malawi Election Administration Plans

Area of Election Administration	Implemented Technology	Planned Technology	Remarks
General Administration			
Policies, procedures and regulations	None	None	
Election planning	Stand-Alone Planning Software	Integrated Election System	Will be encouraging staff to use MS Project
Election Management	Integrated Election System	Integrated Election System	Managers use reports from the computerised Voters Roll, Nomination and Results Systems
Internal correspondence	Word Processor & Email	None	
External correspondence	Word Processor & Email	None	
Financial Management			
Fund Administration	Stand Alone Application	Integrated Election System	
Procurement Administration	None	Integrated Election System	
Contract Administration	None	None	
Logistic Management			
Logistic Planning	Spreadsheets	Integrated Election System	
Distribution of registration material	Spreadsheets	Integrated Election System	
Distribution of election material	Spreadsheets	Integrated Election System	
Distribution of ballot papers	Spreadsheets	Integrated Election System	

MEC has a vision of a fully integrated election system and to achieve this vision it is in process of implementing the following systems that will use common database architecture:

- Voter Registration System
- Candidate Registration System
- Result Reporting System

MEC has a functional WAN between the Head Office and the 3 Regional Offices. MEC personnel and computer equipment are used in the Regional Office. The future intent is to further integrate the various components and add additional functionality where required.

Table 24: Malawi Election Operations Plans

Area of Election Operations	Implemented Technology	Planned Technology	Remarks
Delimitation			
Zone definition, demarcation and boundary maintenance	None	Integrated GIS Database	
Map production	None	Integrated GIS Database	
Voting station identification and management	Integrated Election System	Integrated Election System	Poling station identification is done in a module of the voter registration system. Ultimately once the GIS database is in place it will be a module on its own
Dispute Resolution	None	Integrated Election System	
Voter Registration			
Voter Registration	Integrated Election System	None	
Voter Roll Publication	Integrated Election System	None	
Dispute Resolution	None	Integrated Election System	
Political Party Management			
Party Registration	None	None	We are not the legal party registration entity and get our information from this body
Campaign Management	None	None	
Dispute Resolution	None	Integrated Election System	
Candidate Management			
Candidate Registration	Integrated Election System	None	
Ballot Paper Production	Integrated Election System	None	This is just for the templates. Actual printing is outsourced
Dispute Resolution	None	Integrated Election System	
Ballot Casting			
Voter Identification	Printed Voters Roll	None	We also have a voter certificate with photo
Voting	None	None	Paper ballot
Vote Counting	None	None	Paper ballot
Result Reporting	Central Result Database	None	
Result Auditing	None	None	
Dispute Resolution	None	Integrated Election System	
Result Distribution/ Publication	Internet/DVD	None	
Observation Management			
Accreditation of observers	None	None	
Accreditation of party agents	None	None	
Accreditation of press agents	None	None	
Dispute Resolution	None	Integrated Election System	

The MEC solution has been designed specifically for use in their environment, applying a balance between the application of technology and the use of paper solution. Once the

full system is operational it will give MEC a solid platform from where they can expand the use of technologies as the national infrastructure permits.

Technology View

MEC's view towards the application of technology in elections is described in Table 25 below.

Table 25: Malawi View Towards Election Technology

Question	Answer				Remarks
	Definitely	Possibly	Limited	No	
Do you think technology can be successfully applied in support of Delimitation?	X				Presently being implemented
Do you think technology can be successfully applied in support of Voter Registration?	X				Presently being implemented
Do you think technology can be successfully applied in support of Party Management?	X				
Do you think technology can be successfully applied in support of Candidate Management?	X				Presently being implemented
Do you think technology can be successfully applied in support of Voting and Vote Counting?	X				
Do you think technology can be successfully applied in support of Result Reporting?	X				Presently being implemented

6.1.1.4 Conclusion

The manner in which the various EMB's completed the questions on area of election administration and area of election operations has validated the Electoral Activity Reference List as described in Table 5 on page 22, as being a functional break down of activities that can be related to.

All three of the respondents have or are in the process of implementing the following election components:

- Voter Registration System
- Candidate Registration System
- Result Reporting System

All three are using these components as a means to create an integrated election system that address the full scope of management and service functions, with the exception of electronic voting and counting. All three indicated they had no plans to implement electronic voting or counting within the next 5 years.

Lastly all three of the respondents indicated that below District level communications are extremely difficult which is largely true for all countries in developing Africa. Although cellular phones are showing that they have the potential to bridge the digital divide as discussed in section 3.3, the divide has not yet been bridged especially in rural areas not frequented by tourists.

A capability maturity model as described in section 6.2.3, will be developed from the information in this paragraph for each of the respondents in section 7.2.

6.1.2 Survey Results for Political Parties, NGOs, Aid Organisations and Consultants

6.1.2.1 Questionnaire

The purpose of the questionnaire is to record the respondents views towards the application of technology in support of various election activities. The responses will be correlated to establish the collective view of all of the respondents. Where applicable the view point will supported by a reference to an actual case study.

A copy of the questionnaire used has been attached as Appendix A.2

6.1.2.2 Respondents

A list of the respondents has been included as Appendix A.3

A total of 15 responses were received to the questionnaire. The respondents have a cumulative election experience of 265 years, with the average experience being 17.6 years. The average is skewed to the high side as a result of 5 of the respondents having 26 years or more experience. The year's election experience profile of the respondents is as illustrated in Figure 17 below.

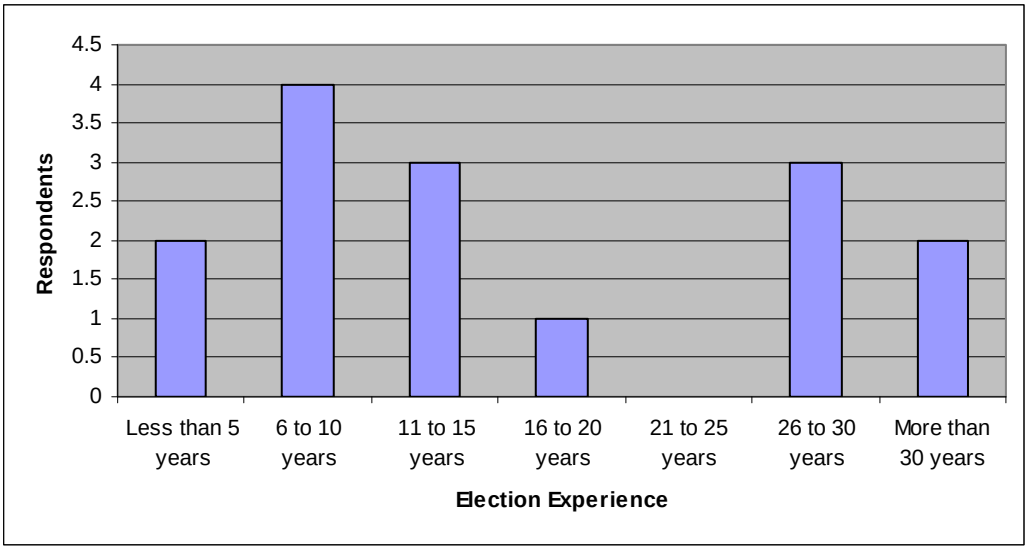


Figure 17: Respondents Election Year's Experience Profile

Cumulatively the respondents have conducted 327 elections. The experience profile of the respondents in the form of number of elections is as illustrated

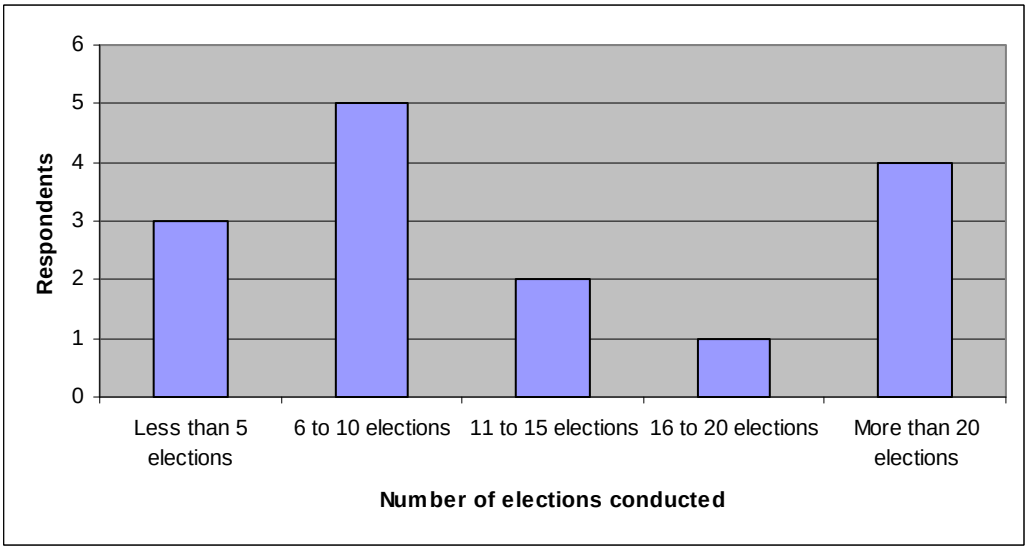


Figure 18: Respondents Elections Conducted Profile

The qualification profile of the respondents is as illustrated in Figure 19 below.

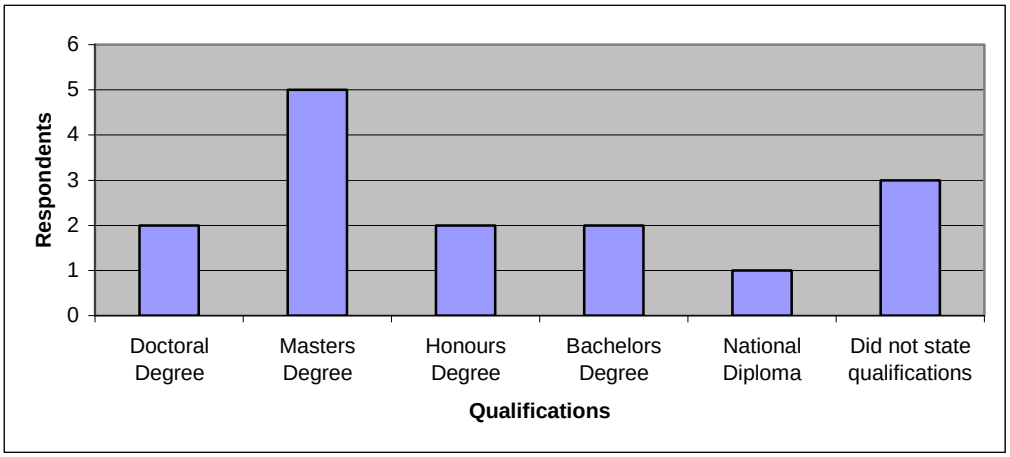


Figure 19: Respondents Qualification Profile

Discussion

The profile of the respondents shows them to be clearly suitable to reference as a panel of experts whose members have adequate qualifications and practical election experience to be able to voice a qualified opinion on the topic of the application of technology in election activities.

6.1.2.3 Question 1 - Technology use in Delimitation

Question: Do you think technology can be successfully applied in support of Delimitation in developing countries?

The respondents' answers to question 1 are shown in Figure 20 below.

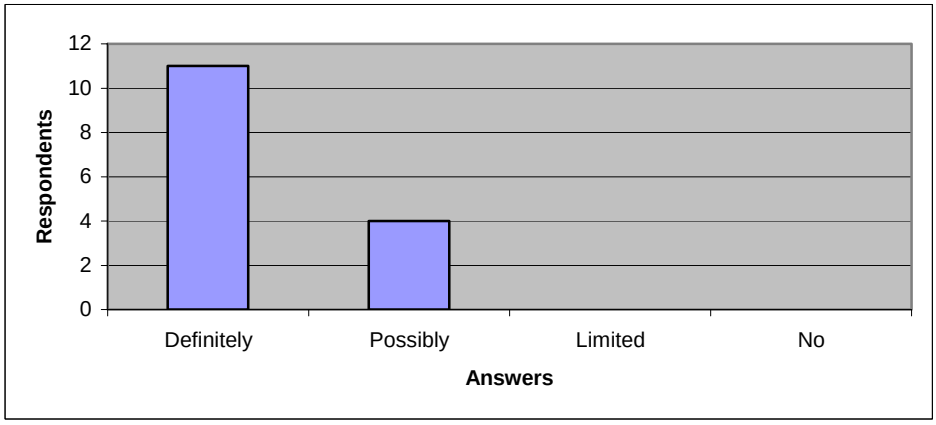


Figure 20: Respondents Answers to Question 1

A consolidated list of risks and benefits for using technology in Delimitation as identified by the respondents is shown in Table 26 below.

Table 26: Consolidated List of Risks and Benefits for Using Technology in Delimitation

Risks	Benefits
Sustainability	Potential for increased efficiency and transparency
That the cost to create and maintain is far greater than initially anticipated	Facilitates the process of managing demarcation with improved accuracy, response time and long-term cost-efficiency
Possibility for gerrymandering if not done in an open and transparent manner	It is possible through technology to give even representation to the population, voters and the geographically compact areas because they are scientifically grouped to form an electoral district or a constituency. GIS can be used in crafting the maps of the constituencies/electoral districts.
Potential to open political wounds if the process of demarcation is not handled correctly	If the output of VR databases is integrated with good GIS, delimitation can be de-politicised and de-conflicted.
Lack of source data	Maps can be made on demand
Availability of skilled resources	

Discussion

The respondents sited Cambodia, East Timor, Kosovo and Liberia as examples where GIS had been effectively implemented and used in the demarcation of boundaries and delimitation. In addition to these countries South Africa and Tanzania can be added to the list.

The respondents overwhelmingly believe that technology in the form of GIS can and has added value. However the respondents do though raise a number of risks, with sustain-ability and the manner in which GIS is applied being the most common.

It must be noted that although a number of respondents identified gerrymandering as a risk; this type of risk exists whether or not technology is used. In fact if technology is used in an open and transparent manner it has the ability to remove the fear of gerrymandering from the various role players and stakeholders.

6.1.2.4 Question 2 – Technology use in Voter Registration

Question: Do you think technology can be successfully applied in support of Voter Registration in developing countries. The respondents' answers to question 2 are shown in Figure 21 below.

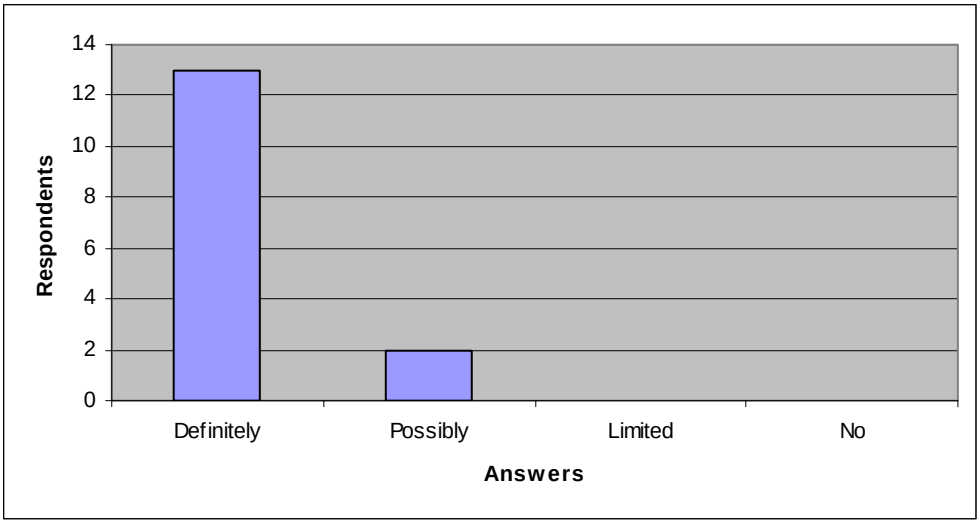


Figure 21: Respondents Answers to Question 2

A consolidated list of risks and benefits for using technology in Voter Registration as identified by the respondents is shown in Table 27 below.

Table 27: Consolidated List of Risks and Benefits for Using Technology in Voter Registration

Risks	Benefits
The complexity of technology is such that it is not sustainable	Potential for increased efficiency and transparency
Potential for fraud if the system is not transparent and has adequate audit trails and controls	A credible voters roll reduces election tensions and objections
Potential that the stake holders will reject the voter database if the process is not transparent and the controls in the system are deemed to be inadequate	Accurate voter information leads to better planning, more effective use of logistics and ultimately cost savings
Due to contract size there is potential for procurement fraud if a transparent and acceptable procurement process is not followed	Technology, specifically a database makes the voters roll more accessible and manageable
Potential that donor enthusiasm leads to the use of inappropriate technologies that cannot be supported by the EMB in the long-term.	

Discussion

The respondents cited the Afghanistan pilot scheme in 2004 that used both facial and iris biometrics as an example of the excessive use of technology to the point where it is unable to deliver additional value.

The respondents cited Pakistan where they registered 72 million voters as an example of the successful use of technology for voter registration. In addition to Pakistan, South Africa, Botswana, Nigeria, Tanzania and Zambia can be also be added as countries that have successfully implemented sustainable registration systems.

The respondents overwhelmingly believe that technology if appropriately selected can and has added value to the voter registration process. However the respondents do raise a number of risks, with security being the most common.

6.1.2.5 Question 3 – Technology use in Party Management

Question: Do you think technology can be successfully applied in support of Party Management in developing countries?

The respondents' answers to question 3 are shown in Figure 22 below.

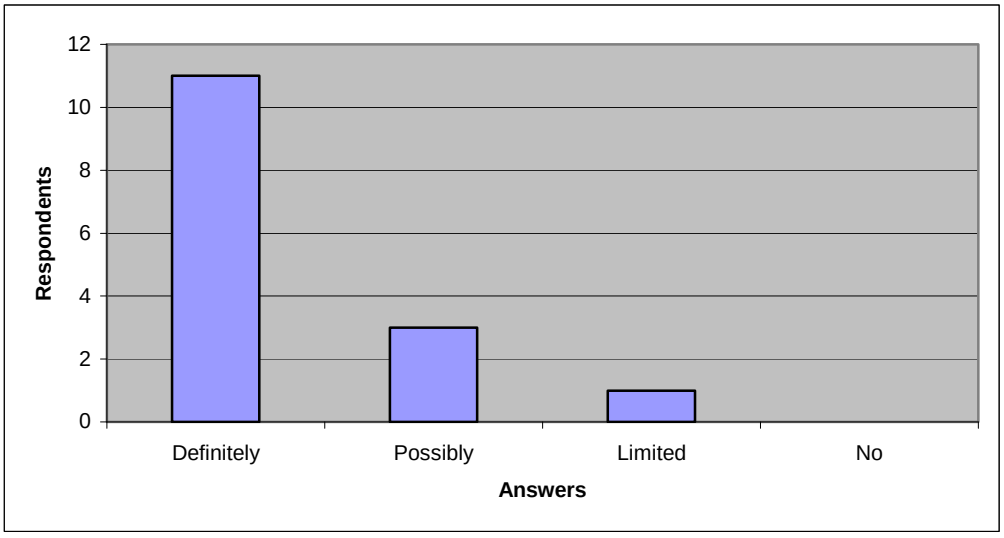


Figure 22: Respondents Answers to Question 3

A consolidated list of risks and benefits for using technology in Party Management as identified by the respondents is shown in Table 28 below.

Table 28: Consolidated List of Risks and Benefits for Using Technology in Party Management

Risks		Benefits
The solution is made overly complicated, when all that is required is a relatively simple database		Accurate and relevant information is available on demand
		Process of maintaining party information is made more efficient

Discussion

The majority of respondents felt that there were limited risks in using technology in this area provided it was kept simple. A number of respondents felt there was a risk that the desire to use technology would result in a complex and costly solution that would not be able to provide what is required.

South Africa was cited as an example where technology has been used successfully for political party management.

The respondents overwhelmingly believe that if kept simple technology can add value to party management process.

6.1.2.6 Question 4 – Technology use in Candidate Management

Question: Do you think technology can be successfully applied in support of Candidate Management in developing countries?

The respondents' answers to question 4 are shown in Figure 23 below.

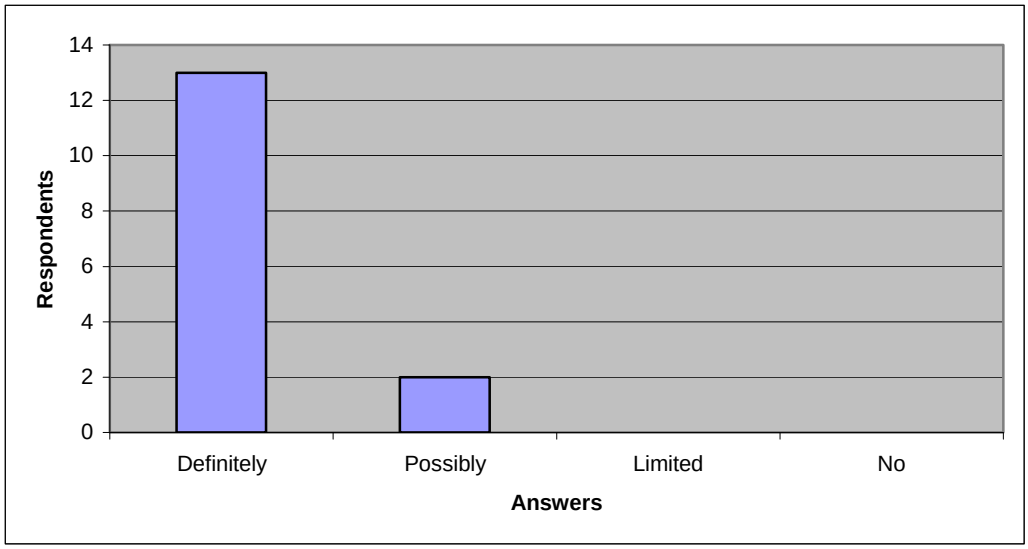


Figure 23: Respondents Answers to Question 4

A consolidated list of risks and benefits for using technology in Candidate Management as identified by the respondents is shown in Table 29 below.

Table 29: Consolidated List of Risks and Benefits for Using Technology in Candidate Management

Risks	Benefits
Could increase level of distrust if not done in a transparent manner	More accurate readily available candidate information will lead to a more efficient ballot production process
Could create a tendency to centralise election control	Improved efficiency and effectiveness in the candidate registration process
	If integrated with the voters roll there is an improved ability to validate candidate qualification criteria
	More accurate ballot proofing and distribution data will lead to cost savings in regard to the production of ballot papers

Discussion

The majority of respondents felt that there were limited risks in using technology in this area provided it was kept simple. A number of respondents felt there was a risk that the desire to use technology would result in a complex and costly solution that would not be able to provide what is required.

South Africa, Tanzania and Zambia were cited as examples where technology has successfully been used for candidate management.

The respondents overwhelmingly believe that if kept simple technology can add value to the candidate management process.

6.1.2.7 Question 5 – Technology use in Voting and Vote Counting

Question: Do you think technology can be successfully applied in support of Voting and Vote Counting in developing countries?

The respondents' answers to question 5 are shown in Figure 24 below.

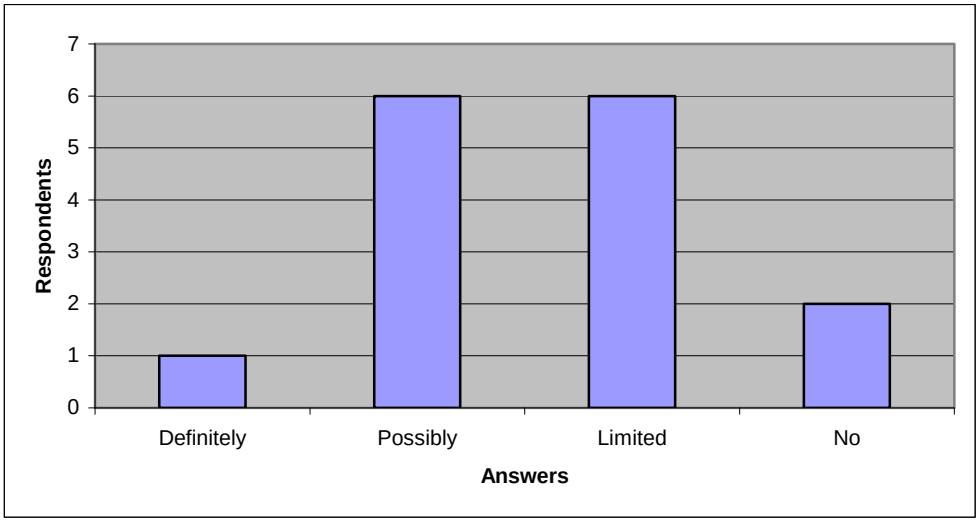


Figure 24: Respondents Answers to Question 5

A consolidated list of risks and benefits for using technology in Voting and Vote Counting as identified by the respondents is shown in Table 30 below.

Table 30: Consolidated List of Risks and Benefits for Using Technology in Voting and Vote Counting

Risks	Benefits
At present all electronic voting solutions have vulnerabilities of some form or another, if these are not addressed in a transparent and open manner there will always be a risk that the results of an election will be challenged.	If used correctly, can provide fully auditable trail from count in polling station to aggregated results.
In developing countries where there is a general lack of infrastructure the complexities associated with electronic voting increases the risk of administrative/ system failures to beyond an acceptable level	Improve accuracy in counting with reduced response times
In developing countries where IT literacy is low voters may find the electronic voting terminals too confusing	Improved control over voting can increase the credibility of the elections
The lack of infrastructure may require the vote correlation and tabulation process to be redesigned and developed	

Discussion

The respondents are equally split with a slight tendency to the negative side on the application of voting and vote counting technologies in developing countries. This is largely representative of the broader community which is also split primarily as a result of possible vulnerabilities. The primary concern is that one risks the success of an election held in a developing country on the use of technology with identified issues, when the benefits of using technology have yet to be proven for developed countries

6.1.2.8 Question 6 – Technology use in Result Reporting

Question: Do you think technology can be successfully applied in support of Result Reporting in developing countries?

The respondents' answers to question 6 are shown in Figure 25 below.

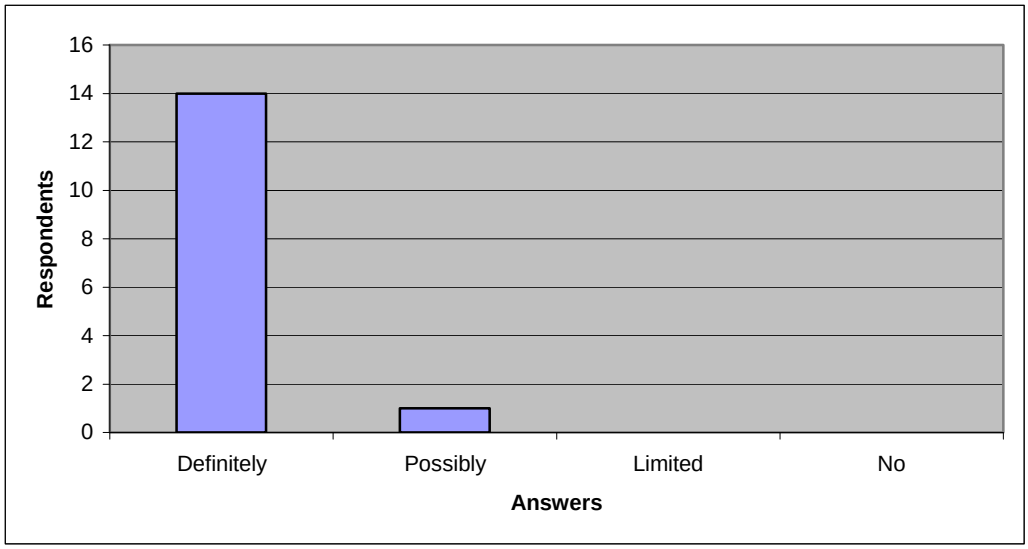


Figure 25: Respondents Answers to Question 6

A consolidated list of risks and benefits for using technology in Result Reporting as identified by the respondents is shown in Table 31 below.

Table 31: Consolidated List of Risks and Benefits for Using Technology in Result Reporting

Risks	Benefits
Unless adequate precautions are taken the paper trail could be lost and the results could become such that they are not auditable	Able to deliver and correlate results far quicker than the manual method
The transparency can be double edged sword as it reveals the inevitable minor flaws in elections which likely do not change the result but can be used to discredit the process by those looking for weaknesses.	Potential for greater efficiency and transparency.
	Dramatically reduces tabulation errors

Discussion

The respondents proposed that more sophisticated reporting that provides frequent updates, as well as presentation of results in multiple formats (table, graphs, maps, etc.) can help provide transparency and allay suspicions that election management body is manipulating the outcome.

The respondents overwhelmingly believe that technology if appropriately selected, can and has added value to the result reporting process. However the respondents do raise a

concern that it should be implemented in such a manner that it will not compromise the audit trail.

South Africa, Tanzania and Zambia are cited as examples where technology has been successfully used for result reporting.

6.1.2.9 Question 7 – Factors inhibiting the use of technology

Question: Please indicate the factors that inhibit the implementation of technology in election operations in developing countries.

The respondents' answers to question 7 are shown in Figure 26 below.

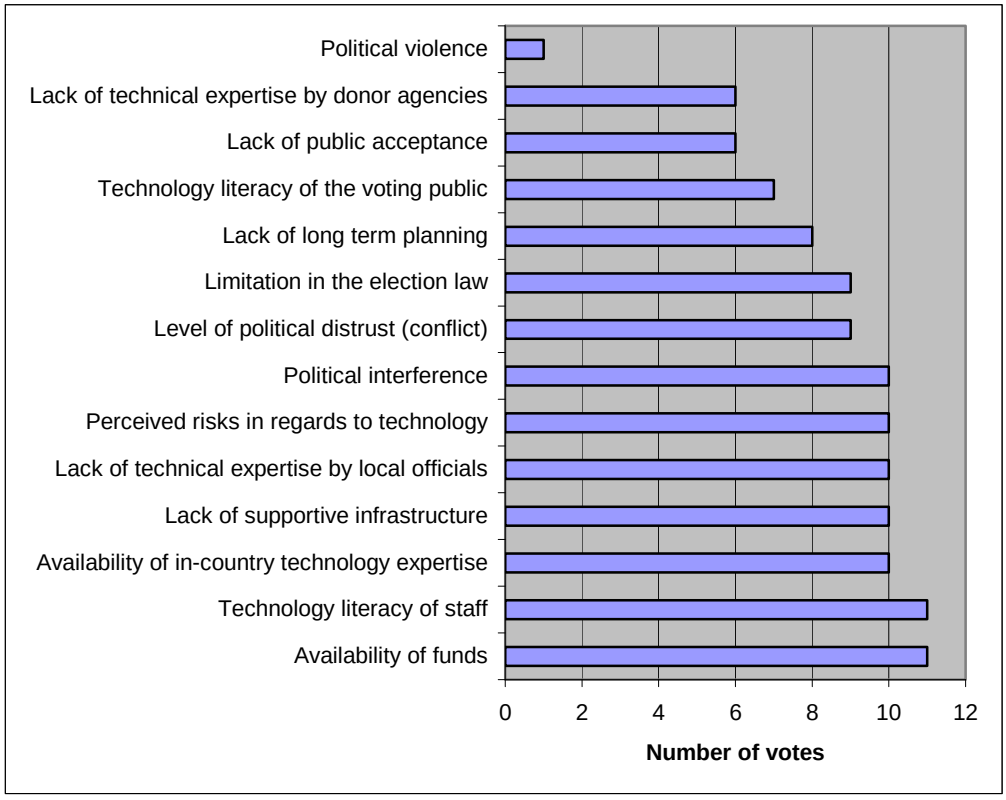


Figure 26: Respondents Answers to Question 7

The respondents indicated that with the exception of political violence which only received 1 vote; to some degree all the other factors listed inhibit the use of technology

The following factors received 10 or more votes (two thirds of the panel) and as such can be viewed as the primary factors:

- Availability of funds
- Technology literacy of staff
- Availability of in-country technology expertise
- Lack of supportive infrastructure
- Lack of technical expertise by local officials
- Perceived risks in regards to technology
- Political interference

Discussion

The respondents overwhelmingly believe that the funding is the major inhibitor. The 2nd, 3rd, 4th and 5th ranked factors are all associated to the digital divide and the ability for technology to be able to be maintained and the operations sustained over a long period of time.

6.1.2.10 Question 8 – Factors supporting the use of technology

Question: Please indicate the factors that support the implementation of technology in election operations in developing countries.

The respondents' answers to question 8 are shown in Figure 27 below.

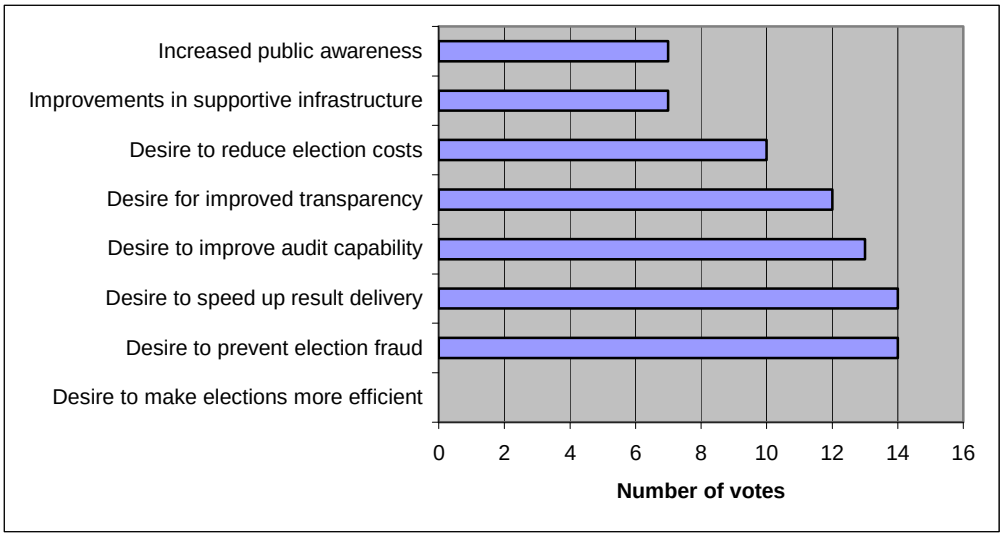


Figure 27: Respondents Answers to Question 8

The respondents indicated that to some degree all the other factors listed support the use of technology

The following factors received 10 or more votes (two thirds of the panel) and as such can be viewed as the primary factors:

- Desire to make elections more efficient
- Desire to prevent election fraud
- Desire to speed up result delivery
- Desire to improve audit capability
- Desire for improved transparency
- Desire to reduce election costs

Discussion

The respondents overwhelmingly believe that the desire for fraud prevention and improved service delivery are the primary factors supporting the use of technology.

6.1.2.11 Question 9 – Other Comments

Question: Please include any additional comments on the use of technology election in the box below?

A number of respondents highlighted the need to accommodate the following:

- The challenge for EMB's to maintain complex technology during the non-election period when funding is restricted.
- The rapid rate technology is changing and growing

6.2 Product and Technology Search

The detailed results of the product and technology search have been attached as Appendix B.

The results of the search will be discussed in the following paragraphs by firstly looking at COTS Products and thereafter Enabling Technologies. The conclusion of the product and technology search is a computerisation maturity map that maps the different COTS application and enabling technologies to the different computerisation stages and proposes a growth path that will be compatible with the user and infrastructure maturity levels.

6.2.1 COTS Products

COTS Products are commercial off the shelf products that can be applied with limited customisation/ modification. If the customisations/ modifications become too extensive it should rather be seen as a custom development. COTS products will be discussed in the following two sections, namely general application and election applications.

6.2.1.1 General Applications

General Applications will be used by an EMB to perform the day to day administration and management functions. The COTS general applications that the product and technology search identified that may be used by an EMB are described in Table 32 below.

Table 32: General COTS Applications

Application Type	Product Examples	Benefits	Considerations
Office automation applications [1]	• Adobe Buzzword • Corel Wordperfect Office • eXpresso • Google Docs • iWorks • Lotus Symphony • Microsoft Office • OpenOffice • ShareOffice • StarOffice • Zcubes	More efficient production and utilisation of documentation	The technology environment of the office in the form of operating systems
		Facilitates the sharing of information	The type/ formats of electronic documentation used by the EMB's partner organisations
		Establishes IT literacy of staff	Budgetary limitation
Accounting Applications [3]	• AccountMate • Infor FMS • iScala • MS Office Accounting • MYOB • NetSuite • Peachtree • QuickBook	Enables the EMB to meet general standards of good governance	Government prescriptions and standards (if applicable)
		Makes the financial department more efficient	Donor Agencies reporting and accounting requirements (if applicable)
		Improves quality of management decisions by making financial information more readily available	Budgetary limitation
Supply Chain Management Applications [2]	• Supply Chain Apptricity • Lawson M3 • E2e • SCM Live • Warehouse Under Control • eGPS • Supply Chain Advantage	Stock levels can be optimised and better controlled	Attention must be given to how the information for supply chain management will be captured/ integrated
		Distribution time of election logistics can be minimised	Due to the digital divide it is necessary to look at the viability of using some of the supporting technologies such as vehicle tracking and the impact on system functionality if that mechanism is not available
		Costs savings can be achieved through reduced stock losses and more effective distribution	Budgetary limitation
Project Management Applications [3]	• Primavera • Microsoft Projects • Tenrox • Genius Project • PSNext • Deltek • Epicor	Projects can be planned and managed	Implementation of enterprise level Project Management Systems implies adoption of the project management methodology by the EMB
		Scheduling and planning information can be shared	Collaboration can only take place if a server and LAN are available
		Progress of election preparations can be measured	Budgetary limitation

Application Type	Product Examples	Benefits	Considerations
Geographical Information System [4]	• AGIS • Autodesk • ESRI • Intergraph • Xmap GIS • GRASS GIS • Quantum GIS	Maps can be produced that enable EMB staff to visualise the situation on the ground	A GIS requires specialist skills to operate and maintain
		Optimum location of registration and polling stations can be determined	A GIS capability must include not only software but also hardware such as plotters and printers
		Reporting of progress, incidents and election results is far more effective	Budgetary limitation
		EMB staff can perform geographical analysis of voter trends	
Enterprise Resource Planning and Management System (ERP) [3]	• Oracle E-Business Suite • Microsoft Dynamics AX • SAP • Epicor • NetSuite • Agresso • IFS Applications	All disciplines utilise a common data source facilitating the process of sharing of information and optimising business processes	An ERP system should only be considered when the EMB staff are fully IT literate and able to operate the standalone applications applicable to their discipline
		The number of independent applications in use is dramatically reduced thereby facilitating maintenance and support	An established LAN and server infrastructure is required to implement an ERP system
		Quality of management decisions is improved by the availability of more accurate information	The ERP system will require a degree of customisation in order to meet the EMB's specific needs
		The EMB's response time to incidents is dramatically improved by the availability of information	Budgetary limitation
Document Management System [3]	• CentricMinds • CrownPeak CMS • DB2 Content Manager • Documentum • Imagelink • Stellent Universal • TRIM Context	Efficient and effective management of documentation	A Document Management system should only be considered when the EMB staff are fully proficient producing and using electronic documents and emails
		Improved quality of documentation through sharing of information and on-line collaboration	An established LAN and server infrastructure is required to implement Document Management system
		Improved distribution of documentation	Budgetary limitation

Application Type	Product Examples	Benefits	Considerations
Learning Management System [3]	• Advanced Learning • Eedo Frce Ten • GeoMaestro • Meridian Global LMS • Saba Learning Suite • SumTotal Talent • Training Partner LMS • uLearn • WebEx LMS	Training costs can be dramatically reduced while the ability to reach student is increased	The full promise of a Learning Management System can only be achieved if in the EMB's scenario the applicable students have adequate access to the internet
		Effectiveness and efficiency of training can be improved	Students must be computer literate in order to utilise the training material
		Students can access training in their own time and training is more efficient	Budgetary limitation
References [1] Maggiolini (1986), [2] Mathur (2008), [3] Technology Evaluation Centre (2008), [4] GIS Lounge and DM Geographics (2008)			

6.2.1.2 Election Applications

The search has identified that although there are a number of suppliers who offer to develop custom built election systems, no vendors could be found that are offering a complete COTS election system. In addition no reference to a complete COTS election system could be found in any literature. The reason for this is that the specific nature of election legislation as applicable to each country makes it extremely difficult to develop a system that can be adapted to each scenario without some degree of customisation.

Vendors were identified who supply:

- Registration Systems and Solutions;
- Electronic Voting Systems; and
- Counting and Result Reporting Systems

The results of the product search for COTS election service providers are tabulated in Table 33 below.

Table 33: Typical COTS Election Service Providers

Vendor	Scope of offering							Web Reference
	Paper Registration Solutions	Digital Registration Solutions	Online Registration Solutions	Registration Solution for Electronic Voting	Electronic Voting Products	Counting Solution for Electronic Voting	Counting Solution	
Code		X						http://www.codeinc.com/index.php
ComputerShare			X					http://www.strand-bsl.com/electoral%20registration.html
DCS Group		X						http://www.dcsgroup.com/prod_electionmat.ASP
Diebold Election Systems, Inc		X		X	X	X	X	http://www.dieboldes.com
Dominion		X					X	http://www.dominionvoting.com
DRS	X	X						www.drs.co.uk
dsicmm			X					http://www.dsicmmgroup.com/democracy
Election Systems & Software		X			X	X	X	http://international.essvote.com/uk.html
Electoral Reform Services			X					http://www.electoralreform.co.uk/default.asp
Halarose			X					http://www.halarose.co.uk/eros.php
Lantrade Global Supplies (LGS)		X						http://www.lantrade.com/index.htm
OPT2VOTE			X					http://www.opt2vote.com/products_reg.htm
Scytl			X	X	X	X		http://www.scytl.com/eng/soluciones.htm
Waymark Infotech	X	X						http://www.waymarkit.com/
Avante International				X	X	X	X	http://www.avantetech.com/products/elections/
Hart InterCivic				X	X	X	X	http://www.hartintercivic.com
MicroVote General Corporation					X			http://www.microvote.com/products.htm
Nepad				X	X	X		http://www.election-systems.eu/website/Read.php?PageID=1103
Populex, Inc				X	X			http://www.populex.com/
Sequoia Voting Systems					X		X	http://www.sequoiavote.com
UniLect Corporation					X	X		http://www.unilect.com/products01.html

Data Source: IFES (2008) and IACREOT (2007)

In order for a central database of voters to be created the software will have to be installed on a number of servers and accessed via a local area network. A number of high volume printers are also required if a voter roll is to be produced. If the registration system is a paper registration system then a number of high speed document scanners will be

required to process the registration forms. The scanning process will also require a number of quality assurance work stations where the data extraction process can be verified and corrected if necessary.

When contemplating implementing electronic voting in developing African countries the influence of the digital divide as described in paragraph 3.3 above must be taken into account.

The benefits of an election system lie with more efficient elections with fewer administrative errors and an ability to correct errors more rapidly. This in turn leads to more credible elections. This claim is supported by the work done by Burnell (2002), Elklit and Reynolds (2001), Mozaffar and Schedler (2002), Pastor (1999) and Wise (2001) in which the authors, all demonstrated a clear relationship between election issues and problems and administrative effectiveness or the failure thereof.

An election system is founded first and foremost on the register of eligible voters and their association to the demarcation structure, as well as the various registration and polling stations. This information alone leads to better planning, more focused procurement of election logistics and a credible election in which only eligible voters will be participating. Without this information the election administrator has to “shoot in the dark” so to speak and distribute election logistics on past experience and gut feel. This in turn leads to situations where there is not necessarily a lack of election logistics; they are simply in the wrong place. A voter database populated with accurate data allows these types of problems to be avoided.

6.2.2 Enabling Technologies

Enabling technologies do not address specific election administration functions but by nature of their definition they provide an enabling capability. Enabling technologies include:

- **Networking Technology.**

  A network is an essential component for any form of communication and collaboration

to take place between computers and users. Secondly a network allows resources to be shared which in turn allows for infrastructure to be optimised. Lastly a network is required in order for computers to connect to the Internet. A local area network (LAN) is the network that interconnects computers within a single location. A wide area network (WAN) interconnects locations. The internet is able to serve as a public WAN

- **Server Technology.**

  A server is a computer that is able to provide a range of services or applications to other computers connected to it via the network. Due to the fact that a server provides services to multiple users, a server is normally a large computer with a high processing capacity and an inherent level of redundancy to ensure its availability. The practical issue with servers is that they should be located in a secure, temperature controlled environment with stable power. In developing countries power supply is normally not stable and temperature controlled environments are not necessarily standard.

- **Database and Application Server Technology**

  An election system is primarily a transaction system that is responsible for processing and maintaining a total number of records greater than the total amount of voters the EMB services. In practical terms the above statement implies that the heart of an election system is its database, in which there will be a large volume of data stored. Even a small EMB is going to store around a million records; while some of the larger EMB's will store hundreds of millions of records. This level of data should be stored in an enterprise level database that has a database management system with the tools required to manage this type of volume of data.

It must be noted that it is normally the lack of an enabling technology that prevents solutions being implemented or attaining their desired objective.

6.2.3 Computerisation Maturity Map

The computerisation maturity map has been derived from the product and technology search described in detail in Appendix B. as well as the work in section 3.2 above on capability maturity modelling. The model maps the different COTS application and enabling technologies to the different computerisation stages and proposes a growth path that will be compatible with the user and infrastructure maturity levels.

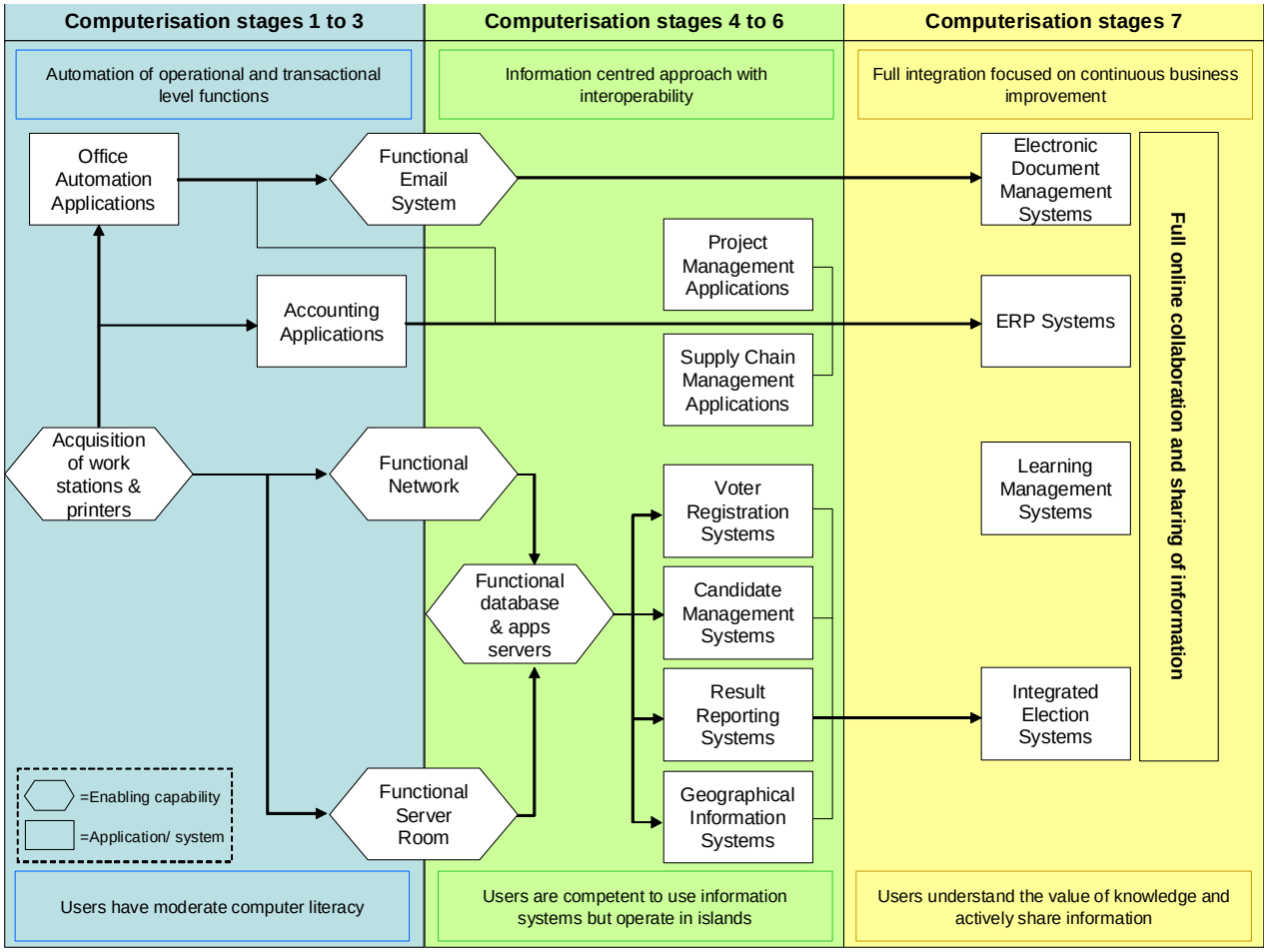


Figure 28: EMB Computerisation Maturity Map

The technology maturity map described in Figure 28 above proposes the following with respect to the growth of an EMB's Information Technology capability.

- The first stage of computerisation is to enable user with work stations and office automation applications. Where appropriate stand alone versions of specialist appli-

cations like accounting applications can be implemented. In conjunction with this the EMB needs to establish a functional network, email system and server room.

- The entry to the second stage is dependent on the availability of the infrastructure items. Within this stage various election system modules are established and complex applications like supply chain management are implemented.

- The entry to the third stage will be driven by the demand from the EMB users for additional functionality and information sharing. Within this stage an integrated election system is established and advanced systems like ERP systems and Document Management Systems are implemented.

The Computerisation Maturity Map as well as the Capability Maturity model will be validated in section 7.2 below by plotting the participating EMB's against the model and map.

Chapter 7. FRAMEWORK APPLICATION

7.1 Framework Description

The framework consists firstly of an Electoral Activity Reference List as described in Table 5 on page 22.

The Electoral Activity Reference list consists of two primary components, namely:

- Election administration activities
- Election operations

The framework consists secondly of discussions on suitability as well as risks and benefits for using technology to address the various electoral activities. These discussions are contained in the following sections:

- Section 6.1.2 contains the results of the survey of a panel of experts in regard to the application of technology in the various areas of election operations. The suitability, risks and benefits of applying technology in each area of election operations is discussed in detail.
- Section 6.2.1.1 discusses the available COTS products, risks and consideration when applying them for election administration activities.
- Section 6.2.1.2 discusses the available COTS products, risks and considerations when applying them for election operation.
- Section 3.3 looked at the implications of the digital divide when selecting technologies.
- Section 2.3 established the criteria to use when selecting technology based on a literature survey.

The framework consists lastly of a capability maturity model to be used to determine the best growth path for an EMB, taking into account its present capabilities. Section 6.2.3 proposes a computerisation maturity map for implementing the various technologies. The computerisation maturity map forms part of the capability maturity modelling described in section 3.2.

The framework consists of the following components:

- Criteria for selecting technology
- Capability Maturity Model
- Election Administration Technology Framework
- Election Operations Technology Framework

The components of the framework will be discussed in the following sections.

7.2 Criteria for Selecting Technology

The United Nations Development Programme Democratic Governance Group (2007, p18) propose the following as the criteria to use when selecting technology:

- Analysis of the actual vs perceived benefits
- Analysis of the legal implications
- Assessment of voter view towards the new technology
- Cost effectiveness
- Risks
- Viability and feasibility within the available timeframe
- Sustainability and maintenance requirements

- Impact on present electoral practises and procedures

- Skills requirement to operate as well as support

In addition to the above cognisance must be taken of the influence of the Digital Divide in respect of the operation and sustained support of the technology in developing African countries.

7.3 Election Administration Technology Framework

The proposed technology framework for election administration activities is described in Table 34 below.

Table 34: The Technology Framework for Election Administration Activities

Area of Election Administration	Technology Applicable to the EMB Capability Maturity Level			Considerations
	Level 1	Level 2	Level 3	
General Administration				
Policies, procedures and regulations	Word Processor, Print & File	Common file store	EDMS	There are number of COTS Office Automation Suites available, as a result the decision is more about which application to use. The decision criteria is driven primarily by the operating system preference of the applicable EMB and secondly standardisation of application so as to facilitate the training of EMB staff. Lastly cognisance must be taken of the electronic documentation formats that are used by the EMB's operating partners. The issue of staff training in developing countries is often neglected and as a result office automation drives do not achieve full potential.
Election planning	Spreadsheets	Stand alone planning software	Integrated planning solution	
Election Management	Spreadsheets	Stand alone planning software	Integrated management solution	
Internal correspondence	Word Processor, Print & post/fax	Word Processor, Email & common file store	EDMS	
External correspondence	Word Processor, Print & post/fax	Word Processor, Email & common file store	EDMS	

Area of Election Administration	Technology Applicable to the EMB Capability Maturity Level			Considerations
	Level 1	Level 2	Level 3	
Financial Management				
Fund Administration	Spreadsheets	Stand alone financial management software	ERP	Accounting applications are used to manage the Electoral Management Bodies finances and maintain the accounting records. The degree of freedom an EMB has to selects its own accounting applications is dependent on whether or not it is bound to the government's financial procedures or not. Secondly donor agencies may prescribe accounting and reporting procedures in regards to funds provided.
Procurement Administration	Spreadsheets	Stand alone procurement management software	ERP	
Contract Administration	Spreadsheets	Stand alone contract management software	ERP	
Logistic Management				
Logistic Planning	Spreadsheets	Logistic Planning System	Integrate Logistic Management System/ ERP	The supply chain management system cannot operate in isolation as it requires election planning and management data produced by other election operational areas as well as suppliers in order to function correctly. Specific attention must be given during implementation as to how the supply chain management system will get information such as number of voters, voting/ registration station locations and key election planning and execution dates
Distribution of registration material	Spreadsheets	Warehouse/ Distribution System	Integrate Logistic Management System/ ERP	
Distribution of election material	Spreadsheets	Warehouse/ Distribution System	Integrate Logistic Management System/ ERP	
Distribution of ballot papers	Spreadsheets	Warehouse/ Distribution System	Integrate Logistic Management System/ ERP	

In order to use the framework above the EMBs computerisation and technology capability maturity must be determined using the modelling concept described in Sections 3.2 and 6.2.3. The framework then indicates the technology that is compatible with the EMB's capabilities. The framework is support by section 6.2.1.1 which contains more detail on the various COTS products that can be used for election administration activities.

7.4 Election Operations Technology Framework

The election operations framework consists of 6 tables, one for each of the primary area's of election operation. The framework functions in the same manner as the administration framework in that the EMBs computerisation and technology capability maturity must first be determined using the modelling concept described in Sections 3.2 and 6.2.3. The technology framework for delimitation activities is described in Table 35 below.

Table 35: The Technology Framework for Delimitation Activities

Area of Election Operations	Technology Applicable to the EMB Capability Maturity Level			Considerations
	Level 1	Level 2	Level 3	
Zone definition, demarcation and boundary maintenance	Spreadsheet/ independent databases	Desktop GIS	Integrated GIS System	If the geospatial data is not readily available the EMB may have to create its own Geo-graphical Information System. In establishing its own GIS the EMB will not only have to look at software and hardware but more importantly the acquisition of the skills required for operating and maintaining a GIS. If geospatial data is readily available the EMB may implement a map production capability rather than a full GIS. It must be noted that when implementing a full GIS server hardware, printers, plotters and scanners will be required.
Map production	Spreadsheet	Desktop GIS	Integrated GIS System	
Voting station identification and management	Spreadsheet/ independent databases	Custom developed database	Integrated Election System	
Dispute Resolution	Spreadsheet	Custom developed database	Integrated Election System	
Delimitation Application Factors				
Risks			**Benefits**	
Sustainability			Potential for increased efficiency and transparency	
That the cost to create and maintain is far greater than initially anticipated			Facilitates the process of managing demarcation with improved accuracy, response time and long-term cost-efficiency	
Possibility for gerrymandering if not done in an open and transparent manner			It is possible through technology to give even representation to the population, voters and the geographically compact areas because they are scientifically grouped to form an electoral district or a constituency. GIS can be used in crafting the maps of the constituencies/electoral districts.	

Potential to open political wounds if the process of demarcation is not handled correctly		If the output of the VR databases is integrated with a good GIS, delimitation can be de-politicised and de-conflicted.
Lack of source data		Maps can be made on demand
Availability of skilled resources		

The registration and recording of voter details forms the core of an EMB's election data capability. The technology framework for voter registration activities is described in Table 36 below.

Table 36: The Technology Framework for Voter Registration Activities

Area of Election Operations	Technology Applicable to the EMB Capability Maturity Level			Considerations
	Level 1	Level 2	Level 3	
Voter Registration	Spreadsheet/ independent databases	Central Voter Database	Integrated Election System	There are three distinct types of registration solutions, namely: **Online registration solutions** require a terminal/ web browser to be connected directly to a database. The connection could be made via the internet, local area network or a wide are network. The applicant or a registration official completes an on-line form that is submitted to the database for immediate verification. **Digital registration solutions** require a digital field kit where the voter's details are captured, locally stored and correlated at a later stage at a central data processing centre. This type of solution is used when the nature of a countries infrastructure make it practically impossible to have a system that requires to connect to a central database. **Paper registration solutions** collect voter details primarily on paper. In some system a digital photograph and fingerprint are recorded separately. The registration form and voter biometrics are processed at a central data processing centre. Although logistics are more complex this type of solution can reduce the cost of field kits.
Voter Roll Publication	Spreadsheet/ independent databases	Central Voter Database	Integrated Election System	
Dispute Resolution	Spreadsheet/ independent databases	Central Voter Database	Integrated Election System	

Voter Registration Application Factors		
Risks		**Benefits**
The complexity of technology chosen is such that it is not sustainable in the long term by the EMB staff		Potential for increased efficiency and transparency
Potential for fraud if system is not transparent and has adequate audit trails and controls		A credible voters roll reduce election tensions and objections
Potential that the stake holders will reject the voter database if the process is not transparent and the controls in the system are deemed to be inadequate		Accurate voter information leads to better planning, more effective use of logistics and ultimately cost savings
Due to contract size there is potential for procurement fraud if a transparent and acceptable procurement process is not followed		Technology specifically a database makes the voters roll more accessible and manageable

The technology framework for political party management activities is described in Table 37 below.

Table 37: The Technology Framework for Political Party Management Activities

Area of Election Operations	Technology Applicable to the EMB Capability Maturity Level			Considerations
	Level 1	Level 2	Level 3	
Party Registration	Spreadsheet	Custom developed database	Integrated Election System	The need for a political party management system is dependent on the scope of the EMB's responsibilities. In a number of African countries the EMB is not responsible for the registration of political parties. If implemented this type of system is an extension of the voter registration system.
Campaign Management	Spreadsheet	Custom developed database	Integrated Election System	
Dispute Resolution	Spreadsheet	Custom developed database	Integrated Election System	
Political Party Management Application Factors				
Risks			**Benefits**	
The solution is made overly complicated, when all that is required is a relatively simple database			Accurate and relevant information is available on demand	
			Process of maintaining party information is made more efficient	

The technology framework for candidate management activities is described in Table 38 below.

Table 38: The Technology Framework for Candidate Management Activities

Area of Election Operations	Technology Applicable to the EMB Capability Maturity Level			Considerations
	Level 1	Level 2	Level 3	
Candidate Registration	Spreadsheet	Custom developed database	Integrated Election System	This type of system is an extension of the voter registration system.
Ballot Paper Production	Spreadsheet	Custom developed database	Integrated Election System	
Dispute Resolution	Spreadsheet	Custom developed database	Integrated Election System	
Candidate Management Application Factors				
Risks			**Benefits**	
Could increase level of distrust if not done in a transparent manner			More accurate readily available candidate information will lead to a more efficient ballot production process	
Could create a tendency centralise election control			Improved efficiency and effectiveness in the candidate registration process	
			If integrated with the voters roll there is an improved ability to validate candidate qualification criteria	
			More accurate ballot proofing and distribution data will lead to cost savings in regards to the production of ballot papers	

The technology framework for ballot casting is described in Table 39 below. It must be noted that the application factors are addressed in 2 sections, namely:

- Voting Applications; and
- Result Reporting.

Table 39: The Technology Framework for Ballot Casting

Area of Election Operations	Technology Applicable to the EMB Capability Maturity Level			Considerations
	Level 1	Level 2	Level 3	
Voter Identification	Printed voters roll	Printed voters roll	Electronic identification (Biometrics)	Presently there is much debate as to the security and vulnerability of electronic voting systems. Further to this there is little empirical evidence to substantiate claims in regards to cost benefits.
Voting	Paper Ballots	Paper Ballots	Electronic Voting	

Area of Election Operations	Technology Applicable to the EMB Capability Maturity Level			Considerations
	Level 1	Level 2	Level 3	
Vote Counting	Manual counting	Manual counting	Electronic Counting	When contemplating implementing electronic voting in developing African countries the influence of the digital divide must be taken into account. The primary cost driver is the number of voting stations that are required to be deployed and the infrastructure required to support them. The technology literacy levels of the voting public will be the primary inhibitor and as such electronic voting should be supported by an intensive voter education program.
Result Reporting	Spreadsheet	Central Result Database	Integrated Election System	
Result Auditing	Spreadsheet	Central Result Database	Integrated Election System	
Dispute Resolution	Spreadsheet	Custom developed database	Integrated Election System	
Result Distribution/ Publication	Spreadsheet	Internet	Internet and portable medium	

Electronic Voting Application Factors		
Risks		**Benefits**
At present all electronic voting solutions have vulnerabilities of some form or another, if these are not addressed in a transparent and open manner there will always be a risk that the results of an election will be challenged.		If used correctly, can provide fully auditable trail from count in polling station to aggregated results.
In developing countries where there is a general lack of infrastructure the complexities associated with electronic voting increases the risk of administrative/ system failures to beyond an acceptable level		Improve accuracy in counting with reduced response times
In developing countries where IT literacy is low voters may find the electronic voting terminals too confusing		Improved control over voting can increase the credibility of the elections
The lack of infrastructure may require the vote correlation and tabulation process to be redesigned and developed		

Result Reporting Application Factors		
Risks		**Benefits**
Unless adequate precautions are taken the paper trail could be lost and the results could become un-auditable		Able to deliver and correlate results far quicker than the manual method
The transparency can be double edged sword as it reveals the inevitable minor flaws in elections which likely do not change the result but can be used to discredit the process by those looking for weaknesses.		Potential for greater efficiency and transparency.

The technology framework for Observation management activities is described in Table 40 below.

Table 40: The Technology Framework for Observation Management

Area of Election Operations	Technology Applicable to the EMB Capability Maturity Level			Considerations
	Level 1	Level 2	Level 3	
Accreditation of observers	Spreadsheet	Custom developed database	Integrated Election System	This type of system is an extension of the voter registration system.
Accreditation of party agents	Spreadsheet	Custom developed database	Integrated Election System	
Accreditation of press agents	Spreadsheet	Custom developed database	Integrated Election System	
Dispute Resolution	Spreadsheet	Custom developed database	Integrated Election System	
Application Factors				
Risks			**Benefits**	
The solution is made overly complicated, when all that is required is a relatively simple database			Accurate and relevant information is available on demand	
			Process of accreditation and maintaining of observer and agent information is made more efficient	

The technology framework tables as described above are supported by section 6.2.1.2 which contains more detail on the various COTS products that can be used for election operational activities

7.5 Capability Maturity Modelling

The modelling concept described in Sections 3.2 and 6.2.3 will be validated through the process of plotting the three EMB's that participated in the study in order to determine their present technology capability and computerisation levels

7.5.1 Tanzania

The National Election Commission of Tanzania's (NEC) computerisation maturity as described in section 6.2.3 is shown on the computerisation maturity map in Figure 29 below.

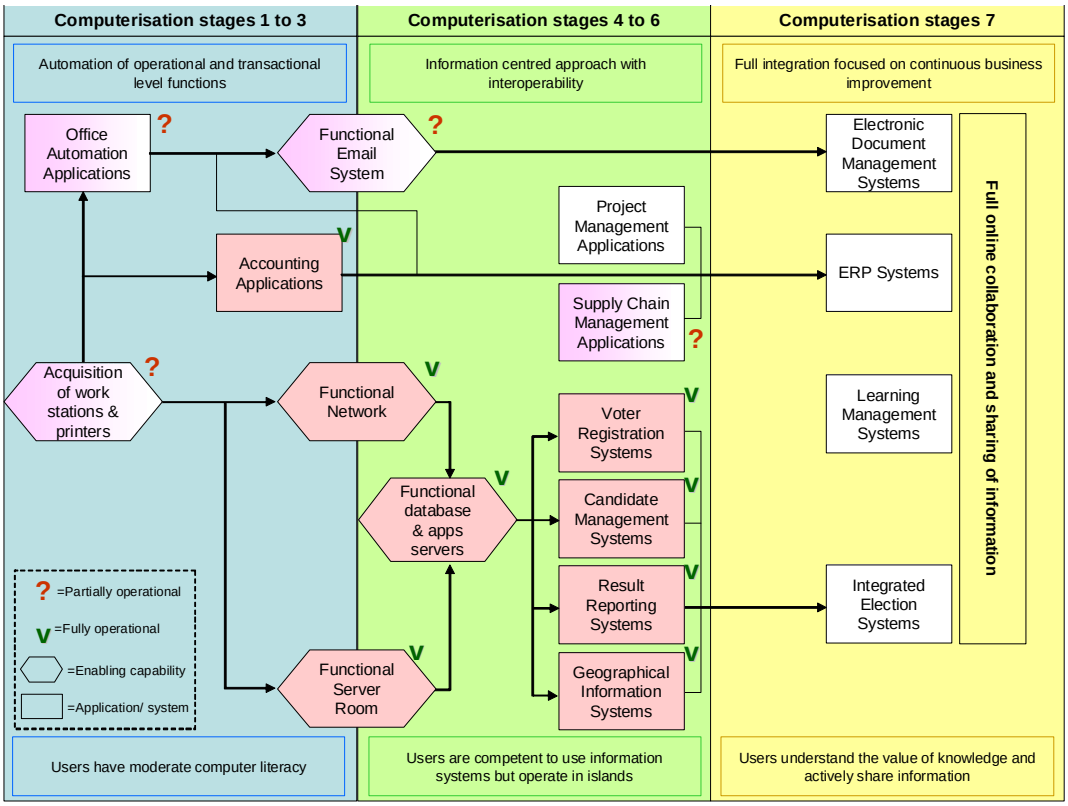


Figure 29: Tanzania Computerisation Maturity Map

The primary factors influencing where NEC plots on the computerisation maturity map are as follows:

- In reality not every permanent person at NEC head office has access to a computer work station. In addition printer utilisation is not optimised at all.

- NEC does not have an operational common file store which indicates that limited collaboration is taking place on common data files, which is a primary indicator for reaching stage 4 to 6.

- NEC does not have an operational mail/ exchange server which would then make it impossible to manage and coordinate schedules, which is a primary indicator for reaching stage 4 to 6.

- NEC doe not have an approved technology master plan in place.

- NEC does not have documented standard IT policies and procedures in place.

When plotted on the enhanced capability maturity model as described in section 3.2 NEC is at a level 1 maturity level. This implies that although they are using IT technology it has not yet been fully integrated into the business and the users are not sharing information. The Tanzanian IT capability maturity plot is as indicated in Table 41 below.

Table 41: Tanzanian Capability Maturity Plot

Capability Area	Maturity Level				
	Level 1	**Level 2**	**Level 3**	**Level 4**	**Level 5**
IS/ICT Applications	**Running the business**	Growing the business	Forming the business		
	Automation of operational and transactional level functions	Information centred approach with interoperability	Full integration focused on continuous business improvement		
	Computerisation Stages 1 to 3	Computerisation Stages 4 to 6	Computerisation Stage 7		
	Produce and use electronic documentation and data	Effectively use email, scheduling and calendar keeping. Online sharing of information	Online collaboration in all aspects of the business		
IS/ICT User Profile	**Computer literate**	Information systems literate	Knowledge worker		
	Users have moderate computer literacy	Users are competent to use information systems but operate in islands	Users understand the value of knowledge and actively share information		
IS/ICT Organisation	Ad-hoc	Business-Driven	Formalised Middle Management	**Formalised Top Management**	
	Limited if any staff with no clear lines of management responsibility	Ad hoc specialists reporting within business driven structures	Formal ICT organisation in place with middle management representation	Top management representation	
Business-IT relationship	Uncertainty	Scepticism	**Acceptance**	Trust	Respect
	Role of IS/ICT in the business is uncertain	Policies have been developed to define roles but organisational acceptance has not been achieved	Working relationship between IS/ICT and all business/ operational areas	Integrated planning and execution of activities	ICT and business areas operate as one
IS/ICT Strategy Alignment	**Unaligned**	Ad hoc alignment	Formal Alignment	Shaping Business Strategy	
	Unaligned and motivated by efficiency requirements	Measured against approved business plans/ strategy	Aligned to approved business plans/ strategy	A fully integrated part of the business strategy	
IS/ICT Managerial Paradigm	**Technology Management**	Systems Management	Strategic ICT Management	Strategic Business Management	
	Focused on the management of technology and data	Focused on systems and information management	Coordinated and integrated business planning focused on value addition	Encapsulated into the business strategic management process	
IS/ICT Governance	**Initial**	Repeatable	Defined	Managed	Optimised
	Ad hoc or no procedures	Documented but not standardised procedures	Standardised and documented procedures	Compliance monitoring in place	Continuous improvement

7.5.2 Zambia

The Zambian Election Commission (ZEC) computerisation maturity as described in section 6.2.3 is shown on the technology maturity map in Figure 30 below.

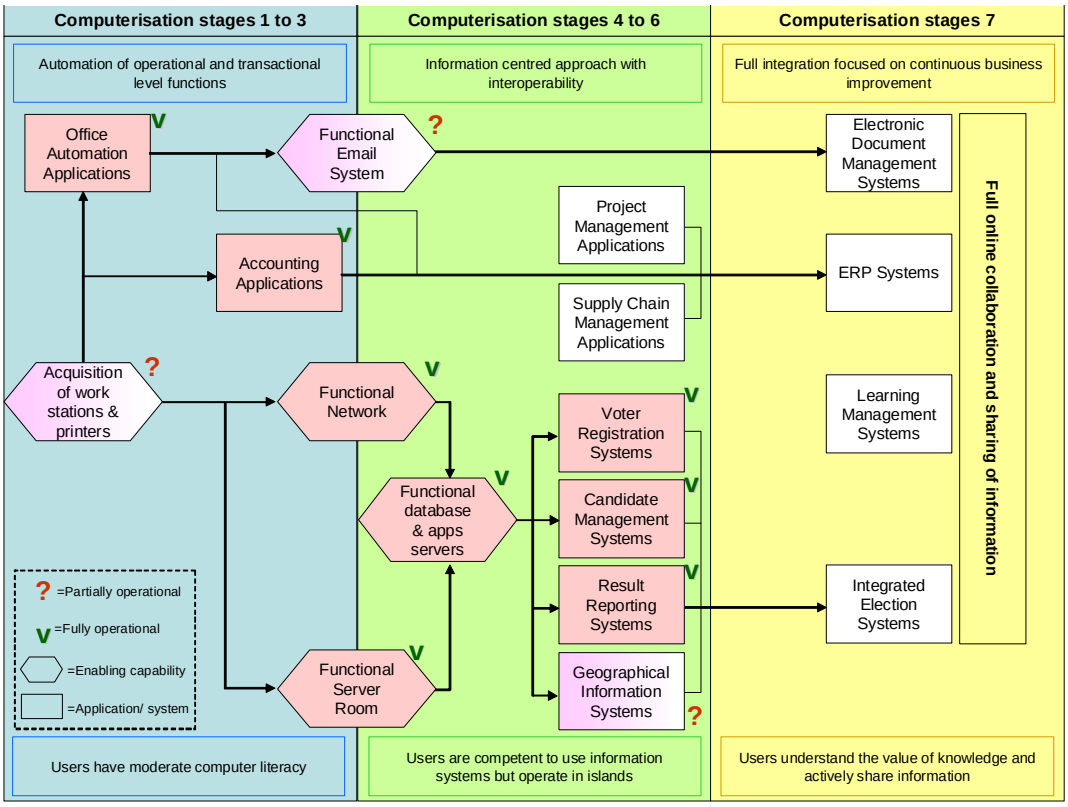


Figure 30: Zambian Computerisation Maturity Map

The primary factors influencing where ZEC plots on the computerisation maturity map are as follows:

- In reality not every permanent person at ZEC head office has access to a computer work station. In addition printer utilisation is not fully optimised, as there are still a high number of directly connected printers.

- ZEC does not have an operational common file store which indicates that limited collaboration is taking place on common data files, which is a primary indicator for reaching stage 4 to 6.

- ZEC does not have an operational mail/ exchange server which would then make it impossible to manage and coordinate schedules, which is a primary indicator for reaching stage 4 to 6.

- ZEC does not have documented standard IT policies and procedures in place.

When plotted on the enhanced capability maturity model as described in section 3.2 ZEC is at a level 1 maturity level. This implies that although they are using IT technology it has not yet been fully integrated into the business and the users are not sharing information. The Zambian IT capability maturity plot is as indicated in Table 42 below.

Table 42: Zambian Capability Maturity Plot

Capability Area	Maturity Level				
	Level 1	**Level 2**	**Level 3**	**Level 4**	**Level 5**
IS/ICT Applications	**Running the business**	Growing the business	Forming the business		
	Automation of operational and transactional level functions	Information centred approach with interoperability	Full integration focused on continuous business improvement		
	Computerisation Stages 1 to 3	Computerisation Stages 4 to 6	Computerisation Stage 7		
	Produce and use electronic documentation and data	Effectively use email, scheduling and calendar keeping. Online sharing of information	Online collaboration in all aspects of the business		
IS/ICT User Profile	**Computer literate**	Information systems literate	Knowledge worker		
	Users have moderate computer literacy	Users are competent to use information systems but operate in islands	Users understand the value of knowledge and actively share information		
IS/ICT Organisation	Ad-hoc	Business-Driven	Formalised Middle Management	**Formalised Top Management**	
	Limited if any staff with no clear lines of management responsibility	Ad hoc specialists reporting within business driven structures	Formal ICT organisation in place with middle management representation	Top management representation	
Business-IT relationship	Uncertainty	Scepticism	**Acceptance**	Trust	Respect
	Role of IS/ICT in the business is uncertain	Policies have been developed to define roles but organisational acceptance has not been achieved	Working relationship between IS/ICT and all business/ operational areas	Integrated planning and execution of activities	ICT and business areas operate as one
IS/ICT Strategy Alignment	Unaligned	**Ad hoc alignment**	Formal Alignment	Shaping Business Strategy	
	Unaligned and motivated by efficiency requirements	Measured against approved business plans/ strategy	Aligned to approved business plans/ strategy	A fully integrated part of the business strategy	
IS/ICT Managerial Paradigm	Technology Management	**Systems Management**	Strategic ICT Management	Strategic Business Management	
	Focused on the management of technology and data	Focused on systems and information management	Coordinated and integrated business planning focused on value addition	Encapsulated into the business strategic management process	
IS/ICT Governance	**Initial**	Repeatable	Defined	Managed	Optimised
	Ad hoc or no procedures	Documented but not standardised procedures	Standardised and documented procedures	Compliance monitoring in place	Continuous improvement

7.5.3 Malawi

The Malawi Election Commission (MEC) computerisation maturity as described in section 6.2.3 is shown on the technology maturity map in Figure 31 below.

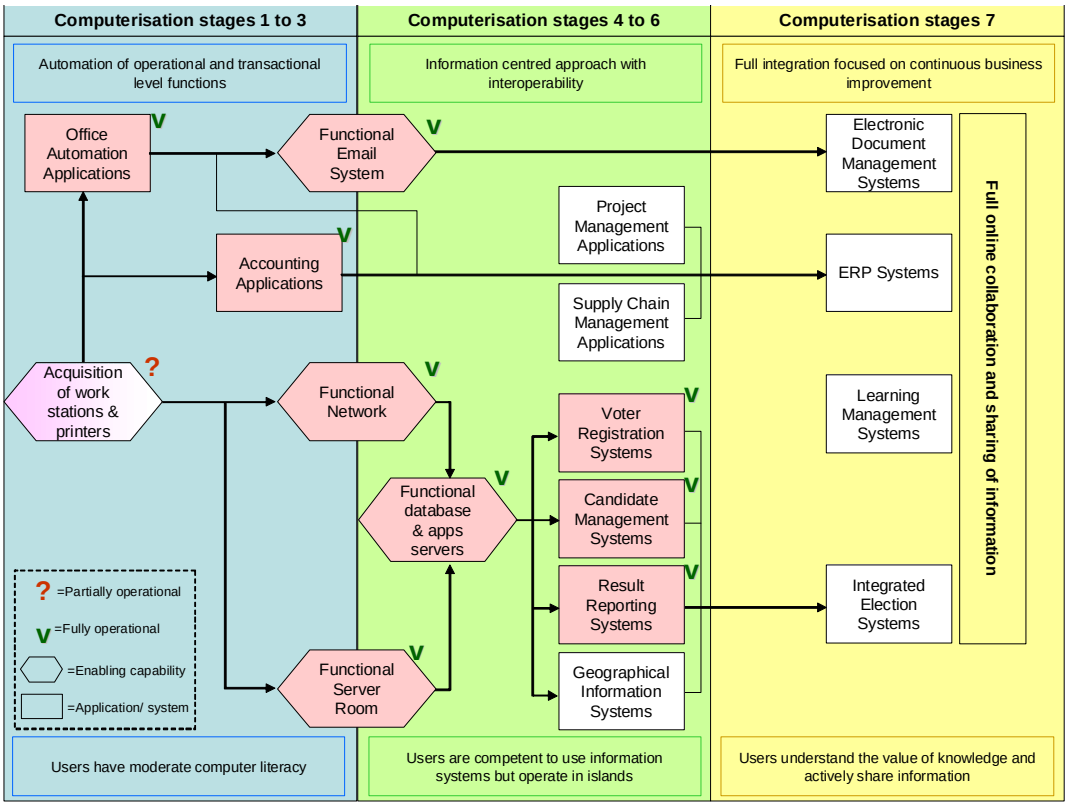


Figure 31: Malawi Computerisation Maturity Map

The primary factors influencing where MEC plots on the computerisation maturity map are as follows:

- In reality not every permanent person at MEC head office or Regional Offices has access to a computer work station.
- MEC does not have documented standard IT policies and procedures in place.
- MEC is not striving to establish a collaboration environment where information is shared.

When plotted on the enhanced capability maturity model as described in section 3.2 MEC is at a level 1 maturity level. This implies that although they are using IT technology it has not yet been fully integrated into the business and the users are not sharing information. The MEC IT capability maturity plot is as indicated in Table 43 below.

Table 43: Malawi Capability Maturity Plot

Capability Area	Maturity Level				
	Level 1	**Level 2**	**Level 3**	**Level 4**	**Level 5**
IS/ICT Applications	**Running the business**	Growing the business	Forming the business		
	Automation of operational and transactional level functions	Information centred approach with interoperability	Full integration focused on continuous business improvement		
	Computerisation Stages 1 to 3	Computerisation Stages 4 to 6	Computerisation Stage 7		
	Produce and use electronic documentation and data	Effectively use email, scheduling and calendar keeping. Online sharing of information	Online collaboration in all aspects of the business		
IS/ICT User Profile	**Computer literate**	Information systems literate	Knowledge worker		
	Users have moderate computer literacy	Users are competent to use information systems but operate in islands	Users understand the value of knowledge and actively share information		
IS/ICT Organisation	Ad-hoc	Business-Driven	Formalised Middle Management	**Formalised Top Management**	
	Limited if any staff with no clear lines of management responsibility	Ad hoc specialists reporting within business driven structures	Formal ICT organisation in place with middle management representation	Top management representation	
Business-IT relationship	Uncertainty	Scepticism	**Acceptance**	Trust	Respect
	Role of IS/ICT in the business is uncertain	Policies have been developed to define roles but organisational acceptance has not been achieved	Working relationship between IS/ICT and all business/ operational areas	Integrated planning and execution of activities	ICT and business areas operate as one
IS/ICT Strategy Alignment	Unaligned	**Ad hoc alignment**	Formal Alignment	Shaping Business Strategy	
	Unaligned and motivated by efficiency requirements	Measured against approved business plans/ strategy	Aligned to approved business plans/ strategy	A fully integrated part of the business strategy	
IS/ICT Managerial Paradigm	Technology Management	**Systems Management**	Strategic ICT Management	Strategic Business Management	
	Focused on the management of technology and data	Focused on systems and information management	Coordinated and integrated business planning focused on value addition	Encapsulated into the business strategic management process	
IS/ICT Governance	**Initial**	Repeatable	Defined	Managed	Optimised
	Ad hoc or no procedures	Documented but not standardised procedures	Standardised and documented procedures	Compliance monitoring in place	Continuous improvement

7.6 Conclusion

The project's intent was to propose a framework that will establish a set of criteria that can be used to determine what and how technology can be used to enhance and improve election operations in developing countries. The framework and its application are described in detail in Chapter 7. The framework looks at potential technologies in context of an EMB's capabilities and technology maturity. The content of the framework was determined via a questionnaire completed by a panel of experts and a product and technology search, the results of which are described in detail in Appendix B.

The study found extensive support for the use of technology in general administration activities as well as delimitation, voter registration, candidate management and result reporting. The study proposes that electronic voting technologies only be used in Developing African countries after extensive thought and consultation with stake holders.

The framework is supported by a capability modelling concept that is described in Sections 3.2 and 6.2.3 that allows an EMB's capabilities and technology maturity to be plotted. The modelling concept was validated in section 7.5, where the participating EMB's were plotted on the model and the results discussed. The modelling concept in the form of the Computerisation Maturity Map allows an EMB to plot a growth path and thereby establish a Technology Master Plan that will ultimately establish a fully integrated solution suited to the EMB's needs and requirements.

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APPENDICES

Appendix A. QUESTIONNAIRES

A.1 Election Management Bodies Questionnaire

THE UNIVERSITY of LIVERPOOL

African Election Technology Study
Electoral Management Body Questionnaire

Email Completed Form | Print Form

This questionnaire is used to collect data on how an Electoral Management Body is using technology in the execution of election operations. The results of the survey will be used by Mr Nick Erleigh to develop a framework that will establish a set of criteria that can be used to determine what and how technology can be used to enhance and improve election operations in developing countries. The framework is part of Mr Erleigh's dissertation for a MSc degree in Information System Management from the University of Liverpool.

Mr Erleigh's contact details are:
Email: N.Erleigh@liverpool.ac.uk or nickerleigh@hotmail.com
Cellphone: +27825790569 Fax: +27 123689347 (mark for my attention)

Section A: Details of the Election Management Body (EMB)

This section records details about the Election Management Body, including how many voters they service, the nature of the body (independent, government funded or part of a government department), how long have they been in operation, organisational structure as well as how many permanent employees work for the body

EMB Name

Country

Head Office Physical Address

Head Office Postal Address

Telephone Number

Fax Number

Name of person completing the form

Position of person completing the form

EMail address of person completing the form

Year the EMB commenced operations

Number of voters serviced by the EMB in thousands

Total number of permanent staff

Number of permanent staff at Head Office

Number of permanent offices

Number of permanent warehouses

Total Number of elections conducted since the EMBs inception

Current Date 2008/11/09 *Electoral Management Body Questionnaire: Version 1.00* *Page 1 of 8*

Please indicate the nature of your Electoral Management Body

○ Independent ○ Government Funded ○ Government Controlled

Additional Comments

Please indicate the quantities of the electoral components that are applicable to your election scenario. (Approximation is fine)

Regions/Provinces	Districts	Constituencies	Wards	Polling Stations

Section B: Technology Application

This section records details about how the Election Management Body uses technology.

Please indicated in the following table the methods of communication that are available between the different election components.

Communication Method	Head Office to Province	Head Office to District	Province to District	Head Office to Ward/ Constituency	District to Ward/ Constituency	Ward/ Constituency to Polling Station
Telephone	n/a	n/a	n/a	n/a	n/a	n/a
Email	n/a	n/a	n/a	n/a	n/a	n/a
Fax	n/a	n/a	n/a	n/a	n/a	n/a
Video Conferencing	n/a	n/a	n/a	n/a	n/a	n/a
SMS	n/a	n/a	n/a	n/a	n/a	n/a

Additional Comments

Please indicated in the following table the nature of the available infrastructure at the different election offices applicable to the EMB.

Office	Building	Furniture	Electricity	Access Roads	Land Line Telephone	Cellular Telephone	Internet	Wide Area Network
Head Office	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Warehouses	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Provincial/ Regional Offices	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
District Offices	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Constituency Offices	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Ward Offices	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Polling Station	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Other Offices	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Please include any additional comments on infrastructure availability in the box below.

Additional Comments	

Please indicated in the following table what information technology is available at the different office levels that are applicable to the EMB.

Office	Number of Workstations	Number of Printers	Local Area Network	Shared File Store	EMail Server	Internet Server
Head Office			n/a	n/a	n/a	n/a
Warehouses			n/a	n/a	n/a	n/a
Provincial/ Regional Offices			n/a	n/a	n/a	n/a
District Offices			n/a	n/a	n/a	n/a
Consituency Offices			n/a	n/a	n/a	n/a
Ward Offices			n/a	n/a	n/a	n/a
Polling Station			n/a	n/a	n/a	n/a
Other Offices			n/a	n/a	n/a	n/a

Please include any additional comments on the availability of information technology in the box below.

Additional Comments	

Please indicate the computer literacy level of the staff groups as applicable to the EMB.

Staff	Level of Computer Literacy	Remarks
Permanent Staff		
Commissioners	n/a	
Departmental Heads	n/a	
Permanent Election Operations Staff (Election Officers)	n/a	
Legal Officers	n/a	
General Administrative Staff	n/a	
Financial & Procurement Administration Staff	n/a	
Election Staff		
District Election Officers	n/a	
Polling Station Managers	n/a	
Polling Station Staff	n/a	
Registration Staff	n/a	

Please include any additional comments on staff literacy levels in the box below.

Additional Comments	

Please indicate the quantity of IT staff employed by the EMB.

Project Managers/ Business Analysts	Database Administrators	Programmers	Network Administrators	General IT Support/ Trainers

Please indicated below the technologies that are presently being used by the EMB. (Use the Ctrl Key to select multiple items)

Operating Systems	Databases	Other Technologies
Unix	Oracle	Server clusters
Linux	SQL Server	Network Attached Storage
Windows Vista	SyBase	Storage Area Network
Windows XP/NT	IBM DB2	Ethernet Network
Macintosh	MySQL	Wireless Network
Other	Microsoft Access	LDAP
None	Other	VoIP (Voice over Internet Protocol)
	None	None

Please indicated in the following table what technology is already implemented in support of election administration, as well as what technology the EMB has on budget to implement in the next 12 months.

Area of Election Administration	Implemented Technology	Planned Technology	Remarks
General Administration			
Policies, procedures and regulations	None	None	
Election planning	None	None	
Election Management	None	None	
Internal correspondence	None	None	
External correspondence	None	None	
Financial Management			
Fund Administration	None	None	
Procurement Administration	None	None	
Contract Administration	None	None	
Logistic Management			
Logistic Planning	None	None	
Distribution of registration material	None	None	
Distribution of election material	None	None	
Distribution of ballot papers	None	None	

Please include any additional comment on election administration technologies in the box below.

Additional Comments	

Please indicated in the following table what technology is already implemented in support of election operations, as well as what technology the EMB has on budget to implement in the next 12 months.

Area of Election Operations	Implemented Technology	Planned Technology	Remarks
Delimitation			
Zone definition, demarcation and boundary maintenance	None	None	
Map production	None	None	
Voting station identification and management	None	None	
Dispute Resolution	None	None	
Voter Registration			
Voter Registration	None	None	
Voter Roll Publication	None	None	
Dispute Resolution	None	None	
Party Management			
Party Registration	None	None	
Campaign Management	None	None	
Dispute Resolution	None	None	
Candidate Management			
Candidate Registration	None	None	
Ballot Paper Production	None	None	
Dispute Resolution	None	None	
Ballot Casting			
Voter Identification	None	None	
Voting	None	None	
Vote Counting	None	None	
Result Reporting	None	None	
Result Auditing	None	None	
Dispute Resolution	None	None	
Result Distribution/ Publication	None	None	

Area of Election Operations	Implemented Technology	Planned Technology	Remarks
Observation Management			
Accreditation of observers	None	None	
Accreditation of party agents	None	None	
Accreditation of press agents	None	None	
Dispute Resolution	None	None	

Please indicated in the tables below the technologies that are **presently being used** by the EMB in election operations.
(Use the Ctrl Key to select multiple items)

Voter Registration
Polaroid Photograph
Digital Photograph
Ink Fingerprint
Digital Fingerprint
Ink Signature
Digital Signature
Printed Voter Card
Smart Voter Card

Voter Verification of Registration
Via SMS
Via Internet
Via Telephone

Voters Roll Inspection
Internet Inspection
CD/DVD Inspection
Paper Inspection

Voter Verification
Central voters database
Paper voters roll
Electronic voters roll
Biometric verification
Smartcard

Voting
Paper Ballot
Punch Card Voting Machine
Optical Mark Voting Machine
Touch Screen Voting Machine

Central Result Capture
Central Result Database
Result transmission via Fax
Result transmission via SMS
Result transmission via WAN
Electronic Result Forms

EMB Internet Capability
General Information Site
Election time table publishing
Result distribution
Voter registration verification
Voter notification of change of address
Dispute recording

Specialist Systems
GIS
AFIS
Facial Recognition
ERP
EDMS

Please include any additional comment on election operational technologies in the box below.

Additional Comments	

Section C: Views and Experience

This section records the Election Management Bodies views towards and experience with technology.

Does your EMB have an established technology master plan? ○ Yes ○ No

What is your intent in regards to the application of technology in the next 5 years	

Please indicated in the tables below the technologies that the EMB intends to use in election operations in the next 5years. Only indicate the new technologies that will be added to your existing capability. (Use the Ctrl Key to select multiple items)

Voter Registration
Polariod Photograph
Digital Photograph
Ink Fingerprint
Digital Fingerprint
Ink Signature
Digital Signature
Printed Voter Card
Smart Voter Card

Voter Verification of Registration
Via SMS
Via Internet
Via Telephone

Voters Roll Inspection
Internet Inspection
CD/DVD Inspection
Paper Inspection

Voter Verification
Central voters database
Paper voters roll
Electronic voters roll
Biometric verification
Smartcard

Voting
Paper Ballot
Punch Card Voting Machine
Optical Mark Voting Machine
Touch Screen Voting Machine

Central Result Capture
Central Result Database
Result transmission via Fax
Result transmission via SMS
Result transmission via WAN
Electronic Result Forms

EMB Internet Capability
General Information Site
Election time table publishing
Result distribution
Voter registration verification
Voter notification of change of address
Dispute recording

Specialist Systems
GIS
AFIS
Facial Recognition
ERP
EDMS

Please indicate the factors that support or inhibit the implementation of technology. (Use the Ctrl Key to select multiple items)

Inhibiting Factors
Availability of funds
Lack of supportive infrastructure
Availability of technology expertise
Technology literacy of staff
Technology literacy of the voting public
Limitation in the election law
Perceived risks in regards to technology
Lack of public acceptance
Political interference
None

Supportive Factors
Desire to make elections more efficent
Desire for improved transparency
Desire to prevent election fraud
Desire to speed up result delivery
Desire to improve audit capability
Desire to reduce election costs
Improvements in supportive infrastructure
Increased public awareness
None

Do you think technology can be successfully applied in support of Delimitation

○ Definately ○ Possibly ○ Limited ○ No

Please elaborate on your answer

Do you think technology can be successfully applied in support of Voter Registration

○ Definately ○ Possibly ○ Limited ○ No

Please elaborate on your answer

Do you think technology can be successfully applied in support of Party Management

○ Definately ○ Possibly ○ Limited ○ No

Please elaborate on your answer

Do you think technology can be successfully applied in support of Candidate Management

○ Definately ○ Possibly ○ Limited ○ No

Please elaborate on your answer

Do you think technology can be successfully applied in support of Voting and Vote Counting

○ Definately ○ Possibly ○ Limited ○ No

Please elaborate on your answer

Do you think technology can be successfully applied in support of Result Reporting

○ Definately ○ Possibly ○ Limited ○ No

Please elaborate on your answer

I would like to thank you for the time and trouble you have gone to in completing this questionnaire.
Please verify your answers and submit the completed form.

A.2 Political Party, Aid Agencies and Consultants Questionnaire

African Election Technology Study
Consultants Questionnaire

Email Completed Form | Print Form

This questionnaire is used to collect data on how Electoral Aid Agencies would like to see technology being used in the execution of election operations. The results of the survey will be used by Mr Nick Erleigh to develop a framework that will establish a set of criteria that can be used to determine what and how technology can be used to enhance and improve election operations in developing countries. The framework is part of Mr Erleigh's dissertation for a MSc degree in Information System Management from the University of Liverpool. Please note all information supplied will be treated with the strictest of confidence and only used for academic purposes.

Mr Erleigh's contact details are:
Email: N.Erleigh@liverpool.ac.uk or nickerleigh@hotmail.com
Cellphone: +27825790569 Fax: +27123689347 (mark for my attention)

This questionnaire will take 30 minutes to complete

Section A: Details of the Consultant

This section records details about the consultant.

Consultants Name

EMail address

Contact Telephone Number

Qualifications

Please indicate your years of election experience

Years Election Experience

Please indicate in how many elections you have participated in

Number of Elections

Please indicate in what countries you have gained your election experience

Countries of operation

Please indicate in what areas of elections do you have hands-on experience. (Use the Ctrl Key to select multiple items)

Areas of Experience
Election Observation
Voter Education
Voter Registration
Voting
Counting
Result Reporting
Dispute Resolution
Election Logistics
Election Security
Election Law
Election Administration
Election Management
Technology Application
None

Election Roles Performed
Election Administrator
Polling Station Staff
Party Agent
Registration Officer
Election Officer
Counting Officer
Election Observer
Voter Educator
Consultant
Other
None

Section B: Views

This section records the consultants views towards the use of technology in elections.

Do you think technology can be successfully applied in support of Delimitation in developing countries.

○ Definately ○ Possibly ○ Limited ○ No

Please elaborate on your answer	
What do you see as the primary benefits	
What do you see as the primary risks	

Do you think technology can be successfully applied in support of Voter Registration in developing countries.

○ Definately ○ Possibly ○ Limited ○ No

Please elaborate on your answer	
What do you see as the primary benefits	
What do you see as the primary risks	

Do you think technology can be successfully applied in support of Party Management in developing countries.

○ Definately ○ Possibly ○ Limited ○ No

Please elaborate on your answer	
What do you see as the primary benefits	
What do you see as the primary risks	

Do you think technology can be successfully applied in support of Candidate Management in developing countries.

○ Definately ○ Possibly ○ Limited ○ No

Please elaborate on your answer	
What do you see as the primary benefits	
What do you see as the primary risks	

Do you think technology can be successfully applied in support of Voting and Vote Counting in developing countries.

○ Definately ○ Possibly ○ Limited ○ No

Please elaborate on your answer

What do you see as the primary benefits

What do you see as the primary risks

Do you think technology can be successfully applied in support of Result Reporting in developing countries.

○ Definately ○ Possibly ○ Limited ○ No

Please elaborate on your answer

What do you see as the primary benefits

What do you see as the primary risks

Please indicate the factors that support or inhibit the implementation of technology in election operations in developing countries. (Use the Ctrl Key to select multiple items)

Inhibiting Factors
Availability of funds
Lack of supportive infrastructure
Availability of in-country technology expertise
Lack of technical expertise by donor agencies
Lack of technical expertise by local officials
Lack of long term planning
Technology literacy of staff
Technology literacy of the voting public
Limitation in the election law
Perceived risks in regards to technology
Lack of public acceptance
Political interference
Level of political distrust (conflict)
Political violence
None

Supportive Factors
Desire to make elections more efficent
Desire for improved transparency
Desire to prevent election fraud
Desire to speed up result delivery
Desire to improve audit capability
Desire to reduce election costs
Improvements in supportive infrastructure
Increased public awareness
None

Please include any additional comments on the use of technology election in the box below.

Additional Comments

I would like to thank you for the time and trouble you have gone to in completing this questionnaire.
Please verify your answers and submit the completed form.

Statement of Confidentiality

Please note all information supplied will be treated with the strictest of confidence and only used for academic purposes.
Information/ data provided will only be disclosed in the context of a published dissertation.

A.3 Respondents to Political Party, Aid Agencies and Consultants Questionnaire

The following were respondents to the Political Party, Aid Agencies and Consultants Questionnaire:

- Chedomir Flego
- Dean Lategan
- Doug Lewis
- Frank Vassallo
- Hennie Meeding
- Joergen Elklit
- Matthew Blakley
- Michael Yard
- Ole Holtved
- Rasool Wahidi
- RJ Grobbelaar
- Ronan McDermott
- Sam Alfandika
- Staffan Darnolf
- Tony Farnum

Appendix B. PRODUCT AND TECHNOLOGY SEARCH

B.1 Product and Technology Search Methods

IFES (2008), ACE Project (2008b), International Association of Clerks, Recorders, Election Officials and Treasurers (2007) and e-Government Consulting Group (n.d) amongst others were used to identify suppliers of election solutions.

The type of solution identified were further analysed to identify supportive COTS application and/or enabling technologies that were being used in the solution. Ziff Davis Publishing Holdings Inc (2008), Technology Evaluation Centre (2008) and GIS Lounge and DM Geographics (2008) amongst others were used to identify suppliers of the supportive COTS applications or enabling technologies.

The web sites of the suppliers were visited so as to be able to compile a catalogue of COTS products and enabling technologies.

B.2 Categories of Election Technology

The following quotes from researches are intended to put the technology discussion in context:

- Blanc et al (2007, p11) "*The information technology revolution has affected election management in a number of ways. Electoral authorities use computer systems to make their internal management and communications more effective, to systematize voter registration records, and to communicate with voters, among other tasks. In recent years, computerized voting has also become prevalent, starting with the adoption of optical scan voting and counting systems in the 1980s and extending more recently to direct recording electronic (DRE) voting systems.*"

- Wall et al (2006, p.240) "*Over the past 20 years, electoral administrators have readily adopted two main types of technology into the electoral process: database systems (to support voter registration systems) and geographical information systems (GIS,*

for re-districting and logistics planning). It should be noted that, while they have brought great benefits in efficiency and effectiveness to the electoral process, these earlier technology adoptions were drawn from other fields, where the technology had been thoroughly and rigorously developed and tested. In comparison, the emerging field of electronic voting (e-voting) is new and exists primarily within the field of public and private electoral administration."

The quotations above highlights firstly that the use of technology in the election arena is not necessarily something new, as well as the fact that electoral technologies are a sub-set of information technology in general and consist primarily of established technologies that have been used as is or adapted for use within the election administration scenario. However in response to Wall's statement that electronic voting is new technology one can contest the statement as even electronic voting is founded on technologies that were established in other fields and not uniquely developed for the election arena.

In practical terms this implies that from an election administration view point there are 3 types of technologies, namely:

- COTS (commercial off-the-shelf) technology, implying it will be used as is in the election arena. Due to the fact that these technologies are applied as is the risk associated with their application is limited to the extent to which they have been proven in other fields. COTS technology typically include:
    - General office software such as word processors, spreadsheets and presentation applications
    - Off the shelf accounting or warehouse applications
    - GIS applications
- Enabling technologies, implying they will be used to create capability and functionality in the election arena. Although the technologies may have been proven in other fields, the risk associated with enabling technologies is proportionate to the

degree of customised development required to create the functionality needed for the election arena. Enabling technologies typically include:

  - Database management systems such as Oracle, SQL Server or DB2
  - Application server technologies
  - Networking technologies
  - Biometrics technologies

- Dedicated technologies, implying they will be specifically developed for the election arena. Due to the fact that these technologies have not been used in other areas their initial use implies a high degree of risk as they are unproven. Custom built election systems and solutions also fall into this category.

Within each type of technology there will be emerging technologies, as well as stable technologies. Emerging technologies are largely unproven, while stable technologies have a number of reference installations and are less risky to use.

The discussion on the nature of technology has relevance to the study in that risk is a factor that must be assessed within the framework in order to facilitate decision making.

B.3 COTS (commercial off-the-shelf) Technology Search Results

The key characteristic of COTS technology is that it is in use in the field and has been commercialised. This in turn implies that the risk of using the technology is reduced as it has a proven track record. Although COTS can be used to describe components of a system, in the context of this paper COTS is being used to describe complete applications that can be purchased off-the-shelf.

The primary issue with COTS applications is the extent to which they address the specific requirements and needs. Mohamed et al (2008) proposes a method and model for assessing the extent of mismatches. The extent of the mismatch is the driver for the amount

of work that is required to customise the application to meet the specific requirements and needs. The greater the extent of work required to address the mismatch, the higher the risk of using the application. Secondly if the work required to address the mismatch is to great then the solution should rather be viewed as a custom built solution.

B.3.1 Office automation applications

Office automation applications are the foundation of the Electoral Management Bodies staff's IT application capability. Office automation applications include word processing, spreadsheets, email, graphic presentation, activity scheduling and filing. These applications are available as COTS applications and come as a suite of products; typical examples of commercially available office application are listed in Table 44 below.

Table 44: Typical Office Suites

S/No	Office Suite	Scope of the Suite							Operating System					Web Reference
		Word Processing	Spreadsheets	Presentations	Email	Calendar	Contact Management	Database	Microsoft Windows	Macintosh	Linux	UNIX	Online Browser Based	
1	Adobe Buzzword	X		X									X	http://www.adobe.com
2	Corel WordPerfect Office	X	X	X	X	X	X		X					http://www.corel.com
3	eXpresso	X	X	X									X	http://www.expressocorp.com
4	Google Docs	X	X	X	X	X							X	http://www.google.com
5	iWorks	X	X	X	X	X	X			X				http://www.apple.com
6	Lotus Symphony	X	X	X					X		X			http://www.ibm.com
7	Microsoft Office	X	X	X	X	X	X	X	X	X				http://www.microsoft.com
8	OpenOffice.org	X	X	X	X			X	X	X	X	X		http://www.openoffice.org
9	ShareOffice	X	X	X									X	http://www.sharemethods.com/products/shareoffice.html
10	StarOffice	X	X	X	X			X	X		X	X		http://www.sun.com/software/staroffice/index.jsp
11	Zcubes	X	X	X				X					X	http://home.zcubes.com/

Data Source: Ziff Davis Publishing Holdings Inc (2008)

Although not a comprehensive list Table 44 above clearly illustrates that there are number of COTS Office Automation Suites available. The issue is more about which application to use. The decision criteria is driven primarily by the operating system preference of the applicable EMB and secondly standardisation of application so as to facilitate the training of EMB staff. Lastly cognisance must be taken of the electronic documentation formats that are used by the EMB's operating partners. The issue of staff training in developing countries is often neglected and as a result office automation drives do not achieve full potential. Yard et al (2007, p12) indicates that in the 25 countries where he has worked only a handful of EMB's are using email effectively. He ascribes this primarily to a lack of skills. A last point to note is that although a number of vendor's are producing on-line solutions the viability of using these solutions in developing countries with high internet costs, unstable and slow connections is questionable.

B.3.2 Accounting applications

Accounting applications are used to manage the Electoral Management Bodies finances and maintain the accounting records. The degree of freedom an EMB has to selects its own accounting applications is dependent on whether or not it is bound to the government's financial procedures or not. Secondly donor agencies may prescribe accounting and reporting procedures in regards to funds provided.

Accounting software includes the functionality required for managing and maintaining information related to an organisations financial operation. These applications will support at a minimum general ledger, accounts payable and receivable. More advanced packages will include payroll, bank reconciliation, multinational accounting, procurement and inventory management. Typical examples of commercially available accounting application are listed in Table 45 below.

Table 45: Typical Accounting Applications

Accounting Application	Scope of Application						Web Reference
	Basic Accounting	Advanced Accounting	Payroll	Project Accounting	Procurement and Inventory Management	Contract Management	
AccountMate	X	X	X		X	X	http://www.accountmate.com/
Infor FMS	X	X	X	X	X	X	http://www.infor.com
iScala	X	X	X	X	X	X	http://www.epicor.com/
Microsoft Office Accounting Express 2008	X	X					http://www.microsoft.com
MYOB	X	X	X				http://myob-us.com/
NetSuite	X	X	X	X	½	X	http://www.netsuite.com/
Peachtree Premium Accounting	X	X	X				http://www.sagesoftware.com
QuickBook	X	X	X	X	½	X	http://quickbooks.intuit.com/

Note:
Basic Accounting = General Ledger, Accounts Receivable, Accounts Payable
Advanced Accounting = Bank reconciliation, multinational accounting, EFT

Data Source: Technology Evaluation Centre (2008)

It must be noted that ERP related financial management solutions such as Oracle Financials have been excluded from the table as they will be addressed within the scope of the ERP discussion. Although not a comprehensive list Table 45 above clearly illustrates that there are number of COTS accounting applications available. The primary issue associated with the selection of an accounting application is whether or not it provides the range of functionality required to support the Electoral Management Bodies financial function. An important point to note is although the scope of users of a financial application is limited; the nature of the application tends to drive the associated work procedures, which influences the Electoral Management Body in general.

B.3.3 Supply Chain Management applications

A key component to successful election is the management of the procurement and distribution of election logistics. A supply chain management application enables the management of demand, warehousing, packaging and transportation of election logistic items. Taking into account the volume of election logistic items that must be distributed, this type of application is invaluable, especially when it come to account for the logistics used in an election. Typical examples of commercially available Supply Chain Management applications are listed in Table 46 below.

Table 46: Typical Supply Chain Management Applications

Supply Chain Management Application	Scope of Application						Web Reference
	Demand Management	Order Management	Warehousing	Transportation	Packaging	Event Planning and scheduling	
Supply Chain Apptricity	X	X	X	X	X	X	http://www.apptricity.com
Lawson M3 Supply Chain Management	X	X	X	X	X	X	http://www.lawson.com/wcw.nsf/pub/scm
E2e	X	X	X	X			http://www.redprairie.com
SCM Live		X	X	X		X	www.mitrix.com
Warehouse Under Control		X	X	X	X		http://www.4ulogistics.com/
eGPS		X	X		X	X	http://www.adexa.com/
Supply Chain Advantage		X	X	X		X	http://www.highjumpsoftware.com

Data Source: Technology Evaluation Centre (2008)

It must be noted that ERP related supply chain management applications such as Oracle Supply Chain Management or SAP have been excluded from the table as they will be addressed within the scope of the ERP discussion. Although not a comprehensive list Table 46 above clearly illustrates that there are number of COTS supply chain manage-

ment applications available. For the supply chain management system to be truly effective it requires to use a number of supportive technologies, such as:

- Barcode label printing and reading
- Radio Frequency Identification (RFID) tag printing and reading
- Wireless or remote terminals for data entry
- Vehicle tracking

Secondly and more importantly the supply chain management system cannot operate in isolation as it requires election planning and management data produced by other election operational areas as well as suppliers in order to function correctly. Specific attention must be given during implementation as to how the supply chain management system will get information such as number of voters, voting/ registration station locations and key election planning and execution dates.

B.3.4 Project Management Systems

An election can be viewed as a large project that is run once every 4 or 5 years depending on election legislation. As with any project there is a need to be able to compile and management the project plan. A project management system enables project events and resources to be scheduled and the progress of the project to be tracked, as well as reported on.

Project Management Systems will vary from stand alone desktop solutions through to enterprise level collaboration systems. An important point to note with respect to enterprise level Project Management Systems is that the system requires the organisation and its staff to operate using a project management methodology. This implies that before making a decision to acquire an enterprise level project management system, the EMB must have already made a decision to adopt a project management methodology. The software as such is simply the tool that is used to enable the project management methodology. A project management system can still add value even if the EMB has not made

the decision to adopt a project management methodology but then one is looking at desk-top solutions that can aid managers in compiling and managing schedules, rather than enterprise level solutions.

Typical examples of commercially available Project Management applications are listed in Table 47 below.

Table 47: Typical Project Management Applications

Project Management Applications	Scope of Application						Web Reference
	Event Planning and Scheduling	Resource Scheduling	Project Budgeting and Costing	Project Analysis and Optimisation Tools	Project Reporting	Project Team Collaboration	
Primavera	X	X	X	X	X	X	http://www.primavera.com
Microsoft Projects	X	X	X	X	X	X	http://www.microsoft.com/
Tenrox	X	X	X	X	X	X	http://www.tenrox.com/
Genius Project	X	X	X	X	X	X	http://www.geniusinside.com
PSNext	X	X	X	X	X		http://www.sciforma.com
Deltek	X	X	X	X	X		http://www.deltek.com/products/epm/default.asp
Epicor	X	X	X	X	X		http://www.epicor.com/pages/default.aspx

Data Source: Technology Evaluation Centre (2008)

It must be noted that ERP related project management applications such as Oracle, Peoplesoft or SAP have been excluded from the table as they will be addressed within the scope of the ERP discussion. Although not a comprehensive list Table 47 above clearly illustrates that there are number of COTS project management applications available.

It must be noted that in order to enable collaboration functionality the software will have to be installed on a server and accessed via a local area network.

B.3.5 Geographical Information Systems

The need and benefits of a Geographical Information System (GIS) will vary from country to country and is largely dependent on the availability of geospatial data. The EMB requires geospatial data for the following:

- Determination of demarcation areas;
- Determination of the location of registration centres and polling stations;
- Production of visual maps showing demarcation areas, registration centres and polling stations; and
- Analysis of voting trends and the planning of voter education drives

If the geospatial data is not readily available the EMB may have to create its own Geographical Information System. In establishing its own GIS the EMB will not only have to look at software and hardware but more importantly the acquisition of the skills required for operating and maintaining a GIS. If geospatial data is readily available the EMB may implement a map production capability rather than a full GIS.

Typical examples of commercially available GIS applications are listed in Table 48 below.

Table 48: Typical GIS Applications

Geographical Information System	Scope of Application						Web Reference
	Utilise and manipulate vector data	Utilise and manipulate raster data	Can use a spatial database	Thematic Mapping	Map Printing	Integratable Map Viewer	
AGIS	X	X		X	X		http://www.agismap.com/
Autodesk	X	X	X	X	X	X	http://www.autodesk.com
ESRI	X	X	X	X	X	X	http://www.esri.com/
Intergraph	X	X	X	X	X	X	http://www.intergraph.com/default.aspx
XMap GIS	X	X	X	X	X	X	http://www.delorme.com/xmap/default.aspx
GRASS GIS	X	X	X	X	X		http://grass.itc.it/
Quantum GIS	X	X	X	X	X		http://www.qgis.org/

Data Source: GIS Lounge and DM Geographics (2008)

Although not a comprehensive list Table 48 above clearly illustrates that there are number of COTS Geographical Information System applications available.

It must be noted that when implementing a full Geographical Information System server hardware, printers, plotters and scanners will be required. Furthermore EMB staff may have to be equipped with GPS receivers so that they may collect mapping data while in the field. The typical components of a GIS are as illustrated in Figure 32 below.

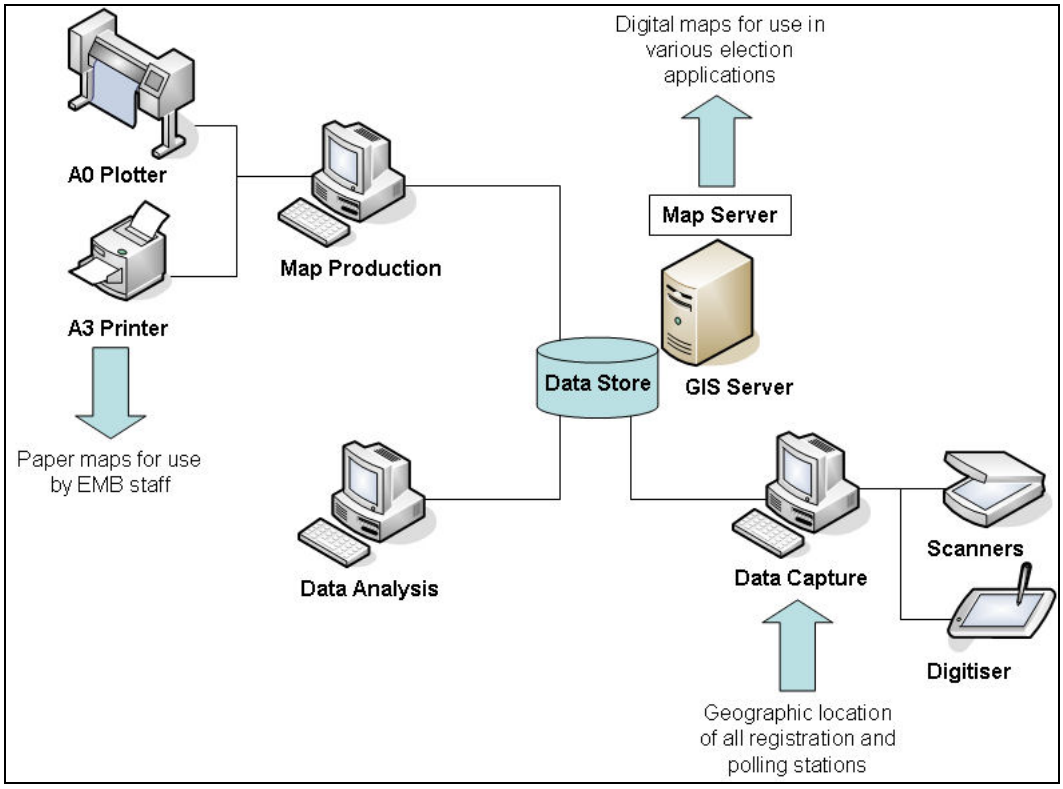

Figure 32: GIS System Components

B.3.6 Enterprise Resource Planning and Management Systems

The key feature of an Enterprise Resource Planning and Management System (ERP) is integration. The system is specifically designed to integrate the various business operations and facilitate the transfer of information between them. The aim is one system servicing the needs of the various business areas. This in turn results in optimum business processes and practises.

Depending on the Industry it is being applied in an ERP typically consists of the following modules:

- Financials
- HR
- Supply Chain Management
- Customer Relationship Management

- Projects

- Manufacturing

As a result of its integrated nature the utilisation of an ERP demands a high level of IT proficiency amongst all staff members. It must be further noted that during implementation of an ERP, some form of customisation will be required to the ERP or to the business procedures and practises. To minimise customisation if an EMB want to implement an ERP it should select one that has been designed for use in the services industry.

Typical examples of commercially available GIS applications are listed in Table 49 below.

Table 49: Typical ERP Applications

Enterprise Resource Planning and Management System (ERP)	Scope of Application							Web Reference
	Financials	Payroll	Human Resource Management	Customer Relationship Management	Supply Chain Management	Projects	Integrated business intelligence and reporting	
Oracle E-Business Suite	X	X	X	X	X	X	X	http://www.oracle.com/
Microsoft Dynamics AX	X		X	½	X	X	X	http://www.microsoft.com/dynamics/
SAP	X		X	X	X	½	X	http://www.sap.com
Epicor	X	X	X	X	X	X	X	http://www.epicor.com
NetSuite	X	X	X	X	X		X	http://www.netsuite.com
Agresso Business World	X	X	X		X	X	X	http://www.agresso.com/
IFS Applications	X		X	X	X	X	X	http://www.ifsworld.com/

Data Source: Technology Evaluation Centre (2008)

Although not a comprehensive list Table 49 above clearly illustrates that there are number of COTS ERP applications available.

The implementation of an ERP is extremely costly and should only be undertaken when the staffs of the EMB are IT literate and able to use stand alone applications in the various disciplines. In addition it must be noted that in order for the ERP System to function the software will have to be installed on a server and accessed via a local area network.

B.3.7 Electronic Document Management Systems

A document/ content management system enables an organisation to manage the documentation it creates and facilitates the process of moving towards a paperless environment. In practical terms the system captures and stores documents and then allows them to be processed by different staff members through a workflow process.

The primary benefit of a document/ content management system lies with the ability to find information on demand and to share information without the need to recreate content.

As a result of its integrated nature the utilisation of an electronic document management system it demands a high level of IT proficiency amongst all staff members in order for it to be fully utilised and the benefits derived.

A document management system typically consists of the following modules:

- Content creation and versioning. This module is used to capture or create documents as well as manage there versioning.

- Document processing and storage. This module allows documents to be processed and stored.

- Digital Asset Management. This module allows other digital formats in the form of video, audio, graphics and photographic images to be managed and presented in an optimum manner.

- Records Management. This module enables compliance with document archiving policies and practises

- Workflow. This module enables business processes to be implemented and documents to be electronically processed.

- Collaboration Environment. This module enables multiple users to share information and collaborate in an electronic environment.

Typical examples of commercially available Electronic Document Management Systems are listed in Table 50 below.

Table 50: Typical Electronic Document Managemnt Systems

Document Management Systems	Scope of Application						Web Reference
	Content creation and versioning	Document processing and storage	Digital Asset Management (Multimedia)	Records Management	Workflow	Collaboration Environment	
CentricMinds	X	X			X		www.centricminds.com
CrownPeak CMS	X	X	X		X		www.crownpeak.com
DB2 Content Manager	X	X		X	X	X	http://www-306.ibm.com/software/data/cm/
Documentum	X	X	X	X	X	X	http://www.emc.com
Imagelink	X	X			X		http://www.compinfo.com/
Stellent Universal Content Management	X	X	X	X	X		http://www.stellent.com
TRIM Context	X	X		X	X		http://www.towersoft.com

Data Source: Technology Evaluation Centre (2008)

Although not a comprehensive list Table 50 above clearly illustrates that there are number of COTS Document Management Systems available.

The implementation of a document management system is extremely costly and should not be done before the EMB staffs are fully proficient producing and using electronic documents and emails, as these skills are fundamental to the successful utilisation of a Document Management System.

In addition in order for the Document Management System to function the software will have to be installed on a server and accessed via a local area network

B.3.8 Learning Management System

A learning management system is a collection of applications that enable training material to be compiled and training to be presented. A key feature in the latest generation of

learning management systems is the ability to present and manage on-line training. On-line could imply either intranet or internet or both but in essence means a student obtains training material, instruction and assessments via a computer work station. The advantage of this training is that a single instructor can service a high volume of students all located at different locations.

In the EMB's scenario a learning management system can be used for:

- Training and certification of EMB staff in work place related training;
- Training and certification of election and registration officials who will be working in the field;
- Training and certification of party agents;
- Training and certification of election observers; and/or
- Provision of online voter education;

A learning management system typically consists of the following modules:

- Content creation and management. This module gives the ability to create and manage training content that will be presented to the student.
- Online training presentation and management. This module gives the ability to manage a students training process and present online training content.
- Classroom training management. This module enable classroom training to be scheduled and managed.
- Competency and performance management. This module enables work related competencies to defined, assessed and managed.
- Online testing and assessments. This module enables online tests and assessments to be defined, presented, marked and managed.

Typical examples of commercially available Electronic Document Management Systems are listed in Table 51 below.

Table 51 : Typical Learning Management Systems

Learning Management Systems	Scope of Application						Web Reference
	Content and course creation	Content management	Classroom training management	On-line training presentation and management	Competency and performance management	Online testing and assessments	
Advanced Learning Platform	X	X		X		X	http://www.intelladon.com
Eedo ForceTen	X	X		X		X	http://www.eedo.com/
GeoMaestro	X	X		X	X	X	www.geolearning.com
KMx	X	X		X	X	X	http://www.kmsi.us
Meridian Global LMS	X	X	X	X	X	X	http://www.meridianksi.com/
Saba Learning Suite	X	X	X	X	X	X	http://www.saba.com
SumTotal Talent Development Suite	X	X		X	X	X	http://www.sumtotalsystems.com/
Training Partner LMS	X	X		X		X	http://www.trainingpartner.com
uLearn	X	X		X	X	X	www.umindsoft.com
WebEx - Learning Manager				X		X	http://www.webex.com/

Data Source: Technology Evaluation Centre (2008)

Although not a comprehensive list Table 51 above clearly illustrates that there are number of COTS Learning Management Systems available.

In addition to the vendors above who are supplying generic learning management systems a number of vendors provide election specific solutions. The following are examples of vendors who supply election specific solutions:

- Meisse Productions (available at <http://www.votertraining.com/>) supply a voter and election staff training kiosk and web based training solutions.

- SOE Software (available at <http://www.soesoftware.com/> supply an online election training system called Clarity TRAINING.

- CODE Inc (available at http://www.codeinc.com/) supply an online election learning management system.

It must be noted that although Learning Management Systems are showing great promise, that is within the context of developed countries with low cost internet access and high levels of internet use. The full extent of value that can be derived by an EMB from a Learning Management System must be assessed within the context of internet access and use as applicable to them.

In addition in order for the Learning Management System to function the software will have to be installed on a server and accessed via a local area network and where applicable the Internet.

B.3.9 Election Systems

The search has identified that although there are a number of suppliers who offer to develop custom built election systems, no vendors could be found that are offering a complete COTS election system. In addition no reference to a complete COTS election system could be found in any literature. The reason for this is that the specific nature of election legislation as applicable to each country makes it extremely difficult to develop a system that can be adapted to each scenario without some degree of customisation.

Vendors were identified who supply:

- Registration Systems and Solutions;
- Electronic Voting Systems; and
- Counting Systems

The reason vendors were found supplying either registration, voting or counting systems is because registration or voting are core election system views and as such the vendor is able to provide a solution for a specific issue. If you view an election system as consisting of three core data entities, namely the voter, the candidate and a demarcation area,

where demarcation area is a data structure such as ward, constituency and province. You will note that you can take one of two view points as illustrated in Figure 33 below, namely the voter registration view which is focused on producing a voter's roll or the voting view which is focused on recording the vote and producing results. In practical terms a system capability can be established either around voter registration or around voting and expanded from there to encompass additional functionality so as to create an election system. In the more established democracies where voter registration is not an issue the preferred view has been from the voting perspective, where as in developing countries where voter registration is an issue the preferred view has been from the registration perspective. Furthermore the voting view has concentrated solely on electronic voting and counting.

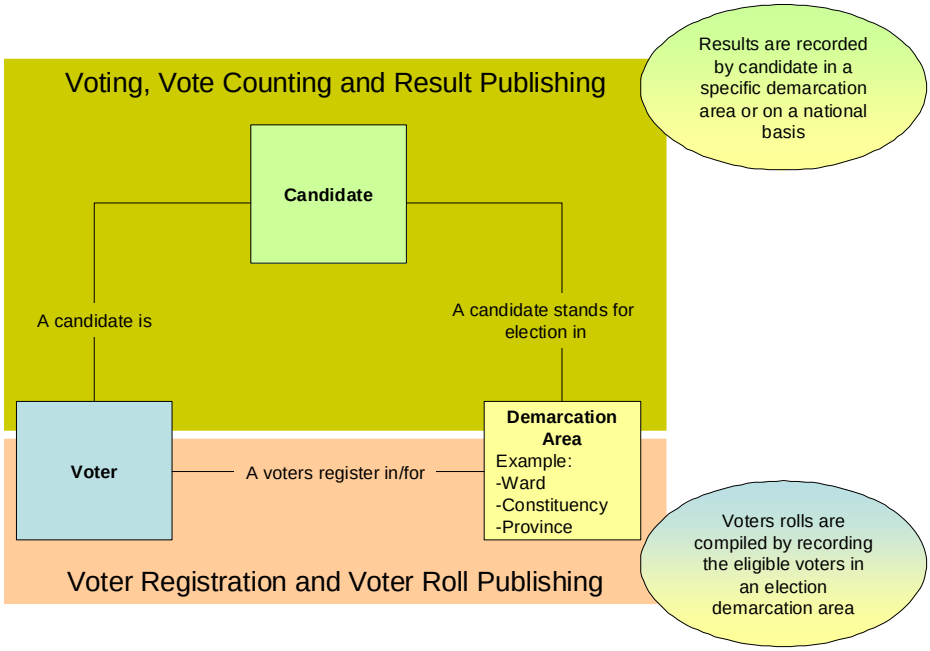

Figure 33: Core Election System Views

It must be noted that during the search a number of specialist suppliers and solution were also identified. A typical example would be Election Data Services, Inc which is a USA based company that provides redistricting services and has a product called PRECIS® that integrates with ArcView-based geographic information system and to enable street level verification and management of voters. In the context of this dissertation these products have been designed specifically for use in the USA and as such the product cannot

be applied as a COTS product in developing African country. These types of suppliers and products have been excluded from this dissertation as a result of there specialist nature.

B.3.9.1 Registration Systems and Solutions

There are three distinct types of registration solutions, namely:

- Online registration solutions
- Digital registration solutions
- Paper registration solutions

Online registration solutions require a terminal/ web browser to be connected directly to a database. The connection could be made via the internet, local area network or a wide are network. The applicant or a registration official completes an on-line form that is submitted to the database for immediate verification.

Digital registration solutions require a digital field kit where the voter's details are captured, locally stored and correlated at a later stage at a central data processing centre. This type of solution is used when the nature of a countries infrastructure make it practically impossible to have a system that requires to connect to a central database.

Paper registration solutions collect voter details primarily on paper. In some system a digital photograph and fingerprint are recorded separately. The registration form and voter biometrics are processed at a central data processing centre. This type of solution is also used when the nature of a countries infrastructure make it practically impossible to have a system that requires to connect to a central database. Although logistics are more complex than the digital registration solution, this type of solution can reduce the cost of field kits by a factor of 2 to 3 times.

Typical examples of commercially available Registration Systems are listed in Table 52 below.

Table 52: Typical COTS Registration Systems

Providers of packaged Registration Solutions	Type of Registration Solution	Scope of Application						Web Reference
		Field Data Capture Kits	Central Database Solution	Voter Roll Production	Objection Handling	Ongoing Registration	Extendable to a full election solution	
Code	Digital Registration	X	X	X				http://www.codeinc.com/index.php
ComputerShare	Online Registration		X	X		X		http://www.strand-bsl.com/electoral%20registration.html
DCS Group	Digital Registration	X	X	X				http://www.dcsgroup.com/prod_electionmat.ASP
Diebold Election Systems, Inc	Digital Registration	X	X	X				http://www.dieboldes.com
Dominion	Digital Registration	X	X	X				http://www.dominionvoting.com
DRS	Digital and paper	X	X	X	X	X	X	www.drs.co.uk
dsicmm	Online Registration		X	X		X		http://www.dsicmmgroup.com/democracy
Election Systems & Software	Digital Registration	X	X	X		X		http://international.essvote.com/uk.html
Electoral Reform Services	Online Registration		X	X		X		http://www.electoralreform.co.uk/default.asp
Halarose	Online Registration		X	X	X	X	X	http://www.halarose.co.uk/eros.php
Lantrade Global Supplies (LGS)	Digital Registration	X	X	X				http://www.lantrade.com/index.htm
OPT2VOTE	Online Registration		X	X		X		http://www.opt2vote.com/products_reg.htm
Scytl	Online Registration		X	X	X	X	X	http://www.scytl.com/eng/soluciones.htm
Waymark Infotech	Paper Registration	X	X	X	X	X	X	http://www.waymarkit.com/

Data Source: IFES (2008) and IACREOT (2007)

Although not a comprehensive list Table 52 above clearly illustrates that there are number of COTS Registration Systems available.

A factor that influences the complexity of the registration system is whether or not to issue a voter identification card. The need for the card is dependent on the availability of a national population register as well as a national ID document and the voter's confidence in the validity/ credibility of both the national population register and the national ID document. If a voter card is required then decisions will have to be made in regards to:

- Capturing of Voter Biometrics
- Production of the Voter Card

A further factor that influences the complexity of the registration system is the extent of fraud preventative measures that must be included in the system. Fraud prevention measures include:

- Photograph voters rolls
- Finger print matching
- AFIS
- Facial recognition scanning

According to ACE Project (2008b) photograph voter rolls are an efficient way of deterring fraud by impersonation and have been applied in a number of African countries including Tanzania, Ghana, DRC, Liberia, Zambia and Uganda. Fraud resistance is hardened even further when the individual is required to have an identity document or voter card that bears the same name as that which is on the roll. Photograph voter rolls increase the printing cost by around 20% if a black and white roll is produced and 40% if a colour roll is produced.

Figure 34 below illustrates the paper registration process. The digital registration process is similar with the exception that digital data is passed to the central processing centre from where voter rolls are produced.

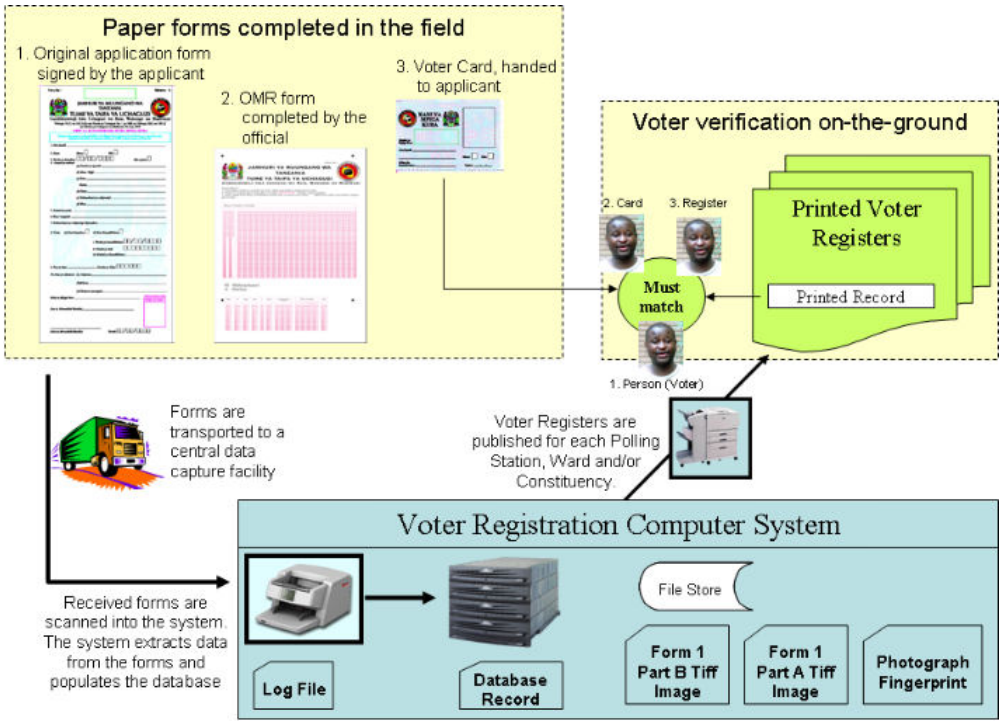

Figure 34: Typical Paper Registration Process

Data Source: Erleigh, personal communication, 2 June 2005

Finger print matching must not be confused with AFIS for although the technology is the same in finger print matching the finger prints of potentially fraudulent records are matched on a one to one basis. AFIS implies one to many and many to many matching. Finger print matching does not identify fraudulent records it confirms them.

According to ACE Project (2008b) AFIS is an extremely costly technology that has the capability to remove duplicates from the voter roll, although it has never been fully applied in the African context, as a result of cost and processing time. Although AFIS was used in Nigeria and Zambia, matching was not done against the complete data set but rather reduced data sets based on gender and physical location in context with geographic limitations.

In addition in order for a central database of voters to be created the software will have to be installed on a number of servers and accessed via a local area network. A number of high volume printers are also required if a voter roll is to be produced. If the registration system is a paper registration system then a number of high speed document scanners will be required to process the registration forms. The scanning process will also require a number of quality assurance work stations where the data extraction process can be verified and corrected if necessary.

Figure 35 below shows the typical infrastructure that will be required to establish a central process centre that could handle the registration of around 10 million voters.

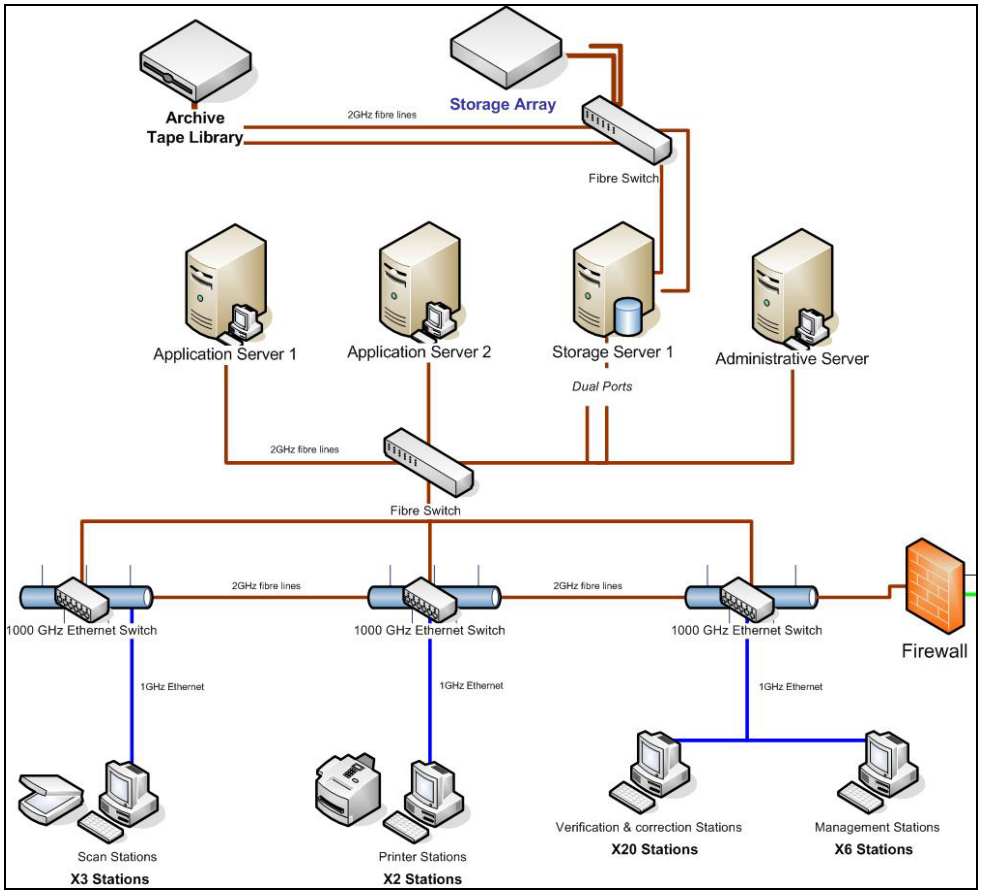

Figure 35: Typical Registration Central Processing Infrastructure

Data Source: Erleigh, personal communication, 2 June 2005

B.3.9.2 Electronic Voting Systems

There is much debate as to the security and vulnerability of electronic voting systems, authors such Blanc et al (2007), Norden et al (2007), Alvarez and Hall (2008) and Rubin (2006) have all raised concerns. Further to this there is little empirical evidence to substantiate claims in regards to cost benefits. The conclusion of the literature survey described in paragraph 2.2 was that there was little evidence to support the claimed benefits of electronic voting and many unanswered questions in regards to security and vulnerability. As a result it was proposed that more research be done and that electronic / automated voting technologies should be used with extreme caution and only after the full impact of there use has been properly assessed. Notwithstanding the purpose of this paragraph is to describe what COTS Electronic Voting Systems are available and no comments are made as to the merits or demerits of any specific product.

There are a number of different types of electronic voting systems, namely

- Direct Recording (DRE)
- Direct Recording with voter verified paper trail (DRE w/VVPT)
- Optical Scan of paper ballots
- Ballot printing with Optical Scan
- Internet

It must be noted that Optical Scan of paper ballots will be discussed as a part of electronic counting systems.

Typical examples of commercially available Electronic Voting Systems are listed in Table 53 below.

Table 53: Typical COTS Voting Systems

Providers of packaged Electronic Voting Systems	Product Name	Type of Registration Solution	Scope of Application				Web Reference
			Voter Registration	Voting	Counting & result publishing	Election & incident management	
Avante International	DRE VOTE-TRAKKER	DRE w/VVPT	X	X	X		http://www.avantetech.com/products/elections/
	OPTICAL VOTE-TRAKKER	Ballot printing with Optical Scan	X	X	X		
Diebold Election Systems, Inc	AccuVote-TSX	DRE	X	X	X		http://www.dieboldes.com
	AccuVote-TSX with printer	DRE w/VVPT	X	X	X		
Election Systems & Software, Inc	IntElect™ E-Vote	Internet and GSM		X	X		http://www.essvote.com
Hart InterCivic	eSlate	DRE	X	X	X		http://www.hartintercivic.com
	eSlate with VBO	DRE w/VVPT	X	X	X		
MicroVote General Corporation	Infinity Voting Terminal	DRE		X			http://www.microvote.com/products.htm
Nepad	LibertyVote	DRE	X	X	X		http://www.election-systems.eu/website/Read.php?PageID=1103
Populex, Inc	Populex	Ballot printing with barcode	X	X			http://www.populex.com/
Sequoia Voting Systems	AVC Edge	DRE		X			http://www.sequoiavote.com
	AVC Advantage	DRE		X			
	AVC Edge Plus	DRE w/VVPT		X			
Scytl	Pnyx.DRE	DRE	X	X	X	X	http://www.scytl.com
UniLect Corporation	Patriot	DRE		X	X		http://www.unilect.com/products01.html
	Patriot with VVPT	DRE w/VVPT		X	X		

Data Source: IFES (2008) and IACREOT (2007)

Although not a comprehensive list Table 53 above clearly illustrates that there are number of COTS Voting Systems available.

When contemplating implementing electronic voting in developing African countries the influence of the digital divide as described in paragraph 3.3 above must be taken into account. The primary cost driver is the number of voting stations that are required to be deployed and the infrastructure required to support them.

B.3.9.3 Electronic Counting Systems

Electronic counting systems use optical scanning devices to read a completed ballot paper and identify the marks made by the voter on the ballot paper.

A counting system must not be mistaken for a result reporting system. The counting system will count the ballot papers cast at a polling station and produce tabulated results for that polling station. A result reporting and management system will correlate the results from various polling stations and determine the results for specific elections based on the demarcation structure. Some counting systems have a result correlation and reporting component.

Typical examples of commercially available Electronic Counting Systems are listed in Table 54 below.

Table 54: Typical COTS Counting Systems

Providers of packaged Electronic Counting Systems	Type of Counting Solution	Scope of Application				Web Reference
		Counts paper ballots	Prevents double or fake ballot counting	Maintains a fully auditable record in tamper proof media	Includes a result correlation and reporting system	
Avante International	Optical Scanning with pixel recognition	X	X	X	X	http://www.avantetech.com/products/elections/opticalvote/
Diebold Election Systems, Inc	Bulk ballot paper scanning	X	X		X	http://www.dieboldes.com
Dominion Voting Systems	Optical Scanning with OMR	X	X	½	X	http://www.dominionvoting.com
Election Systems & Software, Inc	Optical Scanning with ICR	X	½	½	X	http://www.essvote.com
Hart InterCivic	Bulk ballot paper scanning	X	½	½	X	http://www.hartintercivic.com
Sequoia Voting Systems	Integrated OMR scanning ballot box	X	X			http://www.sequoiavote.com
	Bulk ballot paper scanning	X	X			

Data Source: IFES (2008) and IACREOT (2007)

Although not a comprehensive list Table 54 above clearly illustrates that there are number of COTS Counting Systems available.

B.3.9.4 Result Reporting and Management Systems

Result reporting and management systems provide the capability to correlate and report results as well as to manage the process of collecting and verifying results. Some voting and counting systems provide a software module for result reporting.

Although a number of suppliers of result reporting and management software for the American market could be found, the product and technology search did not manage to identify a single supplier offering a COTS Result Reporting and Management System that could be applied outside of the USA.

The reason for this is that the result reporting scenario is very specific to an EMB and its associated legislation and election structure. A large proportion of EMB's have custom developed solutions for result reporting, these solutions address the specifics of their scenario. Figure 36 below illustrates an actual result reporting scenario applicable to an African country.

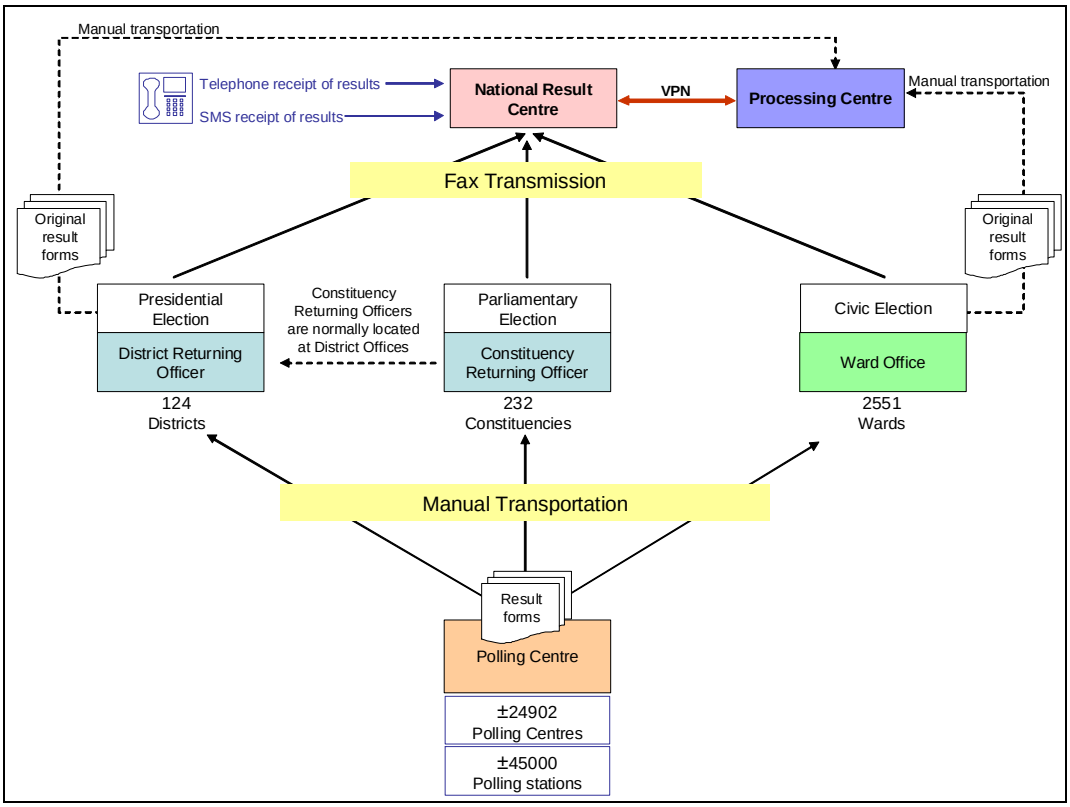

Figure 36: Example Result Reporting Scenario

Data Source: Erleigh, personal communication, 27 June 2005

B.4 Enabling Technology Search Results

B.4.1 Operating Systems

It is not the intent of this dissertation to debate the merits and/or demerits of the different operating systems that is a subject on its own. The purpose of highlighting the operating system decision is that in a large number of cases no decision is ever taken it simply evolves. This in turn ultimately leads to support and licensing issues.

Presently there are 4 major workstation operating systems that are available, namely:

- Mac OS X
- Linux
- Microsoft Windows XP
- Microsoft Windows Vista

The advantages of standardization are as follows:

- Maintenance and support is made a lot easier as only one set of updates require to be done
- Staff training is easier as all workstation have a common operating system
- Software license fees can be optimised

When making the decision as to what workstation operating system to standardize on, the following should be taken into account:

- Availability of local skills to provide support
- Availability, relevance and cost of compatible applications
- Cost of licensing

- Operating system requirements imposed by any custom built or specialist applications that the EMB is running or intends to run

- Staff training implications

B.4.2 Database and Application Server Technology

An election system is primarily a transaction system that is responsible for processing and maintaining a total number of records that is greater than the total amount of voters the EMB services. In practical terms the above statement implies that the heart of an election system is its database, in which there will be a large volume of data stored. Even a small EMB is going to store around a million records, while some of the larger EMB's will store in the hundred of millions of records. This level of data should be stored in an enterprise level database that has a database management system with the tools required to manage this type of volume of data.

Typical examples of commercially available enterprise level database products are listed in Table 55 below.

Table 55: Typical Enterprise Level Database Products

Database Product Name	Company	Web Reference
Adaptive Server Enterprise	Sybase	http://www.sybase.com/
DB2	IBM	http://www.ibm.com/us/
Firebird	Firebird Project	http://www.firebirdsql.org/
Ingres	Ingres	http://www.ingres.com/
Oracle	Oracle	http://www.oracle.com/
PostgreSQL	PostgreSQL	http://www.postgresql.org/
SQL Server	Microsoft	http://www.microsoft.com/en/us/
Teradata	Teradata	http://www.teradata.com/t/

Data Source: Ziff Davis Publishing Holdings Inc (2008)

Database systems like Microsoft Access or MySQL are not recommended as enterprise level databases as they have size limitation and do not have the inherent support tools required to maintain large volume complex databases.

The advantages of standardizing on a specific enterprise level database are:

- Optimisation of licenses

- Minimising the amount of local support skills and staff required

The database decision is also influenced by the broader architectural decisions in regards to what application servers the EMB will be implementing. The application server is the server that bridges the data and application layers in a n-tier architecture. It is also the server through which application are delivered to client work stations and web browsers.

Typical examples of commercially available application servers are listed in Table 56 below.

Table 56: Typical Commercially available Application Servers

Application Server Name	Company	Web Reference
Adaptive Server Enterprise	Sybase	http://www.sybase.com/
Apache Geronimo	Apache Software Foundation	http://geronimo.apache.org/
BEA WebLogic Server	Oracle	http://www.oracle.com/
Internet Information Server (IIS)	Microsoft	http://www.microsoft.com/en/us/
JBoss Application Server	Red Hat	http://labs.jboss.com/jbossas
JRun	Adobe Systems	http://www.adobe.com/products/jrun/
Oracle Application Server	Oracle	http://www.oracle.com/
WebSphere Application Server	IBM	http://www.ibm.com/us/

Data Source: Ziff Davis Publishing Holdings Inc (2008)

The type of application server that will be implemented is influenced by:

- The nature and architecture of the applications that are run by the EMB

- The preferred application development environment, for example J2EE or .NET. This in turn is influenced by the availability of skills

- Requirements of any COTS products the EMB intends to use

B.4.3 Networking Technology

A network is an essential component in order for any form of communication and collaboration to take place between computers and users. Secondly a network allows resources to be shared which in turn allows for infrastructure to be optimised. Lastly a network is

required in order for computers to connect to the Internet. A local area network (LAN) is the network that interconnects computers within a single location. A wide area network (WAN) interconnects locations. The internet is able to serve as a public WAN.

A LAN can be established using wired technologies, wireless technologies or a combination thereof.

B.4.4 Server Technology

A server is a computer that is able to provide a range of services or applications to other computers connected to it via the network. Typical examples of servers are:

- Mail server
- Database server
- Application server
- Proxy server
- File server
- Print server

Due to the fact that a server provides services to multiple users, a server is normally a large computer with a high processing capacity and an inherent level of redundancy to ensure its availability.

The advantages of using servers are as follows:

- Processing power and storage capacity can be maximised
- Maintenance is facilitated
- Data can be backed up and secured
- Infrastructure can be optimised and consolidated

The practical issue with servers is that they should be located in a secure, temperature controlled environment with stable power.

In developing countries power supply is normally not stable and temperature controlled environments are not necessarily standard. This means that an EMB must plan to establish a server capability.

B.4.5 Barcodes and RFID Tags

Barcodes and RFID tags are technologies that are used to mark/ label items so that they may be electronically read by a computer system.

Barcodes consist of black and white lines or dots spaced in such a way that they can be read with a laser. The pattern of lines or dots has a specific meaning to the computer system.

Figure 37: Barcode Examples

Source: Altek Instruments Ltd (2008)

RFID tags are Radio Frequency Identification tags. These tags are encoded with information and can be read by a radio receiver. Tags may be passive meaning they have no transmission capability or active meaning they have a power source and are able to transmit information. Active tags can be read at a greater range than a passive tag.

The benefit of barcode labels and RFID tags is that information can be systematically extracted at a faster rate and with greater accuracy that manual data entry.

Within the election context barcodes are used to mark documents such as registration forms and ballot papers. Barcode labels and/or RFID tags are used to mark logistic items

In a logistic context RFID tags can be read at a greater range than barcode labels and do not require the item to be positioned so the label is visible to the reader. The distinguishing factor at present is cost as RFID tags cost around 10 times that of barcode labels.

Appendix C. TABLE OF ABBREVIATIONS

Abbreviation	Meaning
AFIS	Automatic Fingerprint Identification System
COTS	Commercial off the shelf
DRC	Democratic Republic of the Congo
DRE	Direct Recording
DRE w/VVPT	Direct Recording with voter verified paper trail
EDMS	Electronic Document Management System
EMB	Electoral Management Body
ERP	Enterprise Resource Planning
GIS	Geographical Information System
ICT	Information Communication Technology
IT	Information Technology
LAN	Local Area Network
LOG	Logistics
MEC	Malawi Electoral Commission
NEC	National Election Commission of Tanzania
OMR	Optical Mark Recognition
RFID	Radio Frequency Identification
SMS	Short Message Service
VR	Voter Register
WAN	Wide Area Network
ZEC	Zambian Election Commission