

**A SURVEY OF CHALLENGES FACED IN DATA
MIGRATION BY COMPANIES QUOTED AT THE NAIROBI
STOCK EXCHANGE**

BY

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Requirement of the Degree of Master of Business Administration,
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DECLARATION

The research project is my original work and has not been presented for a degree in any other University.



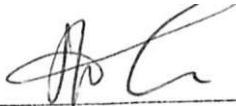
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DEDICATION

To my son Franklin for his inspirations during my studies

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LIST OF ABBREVIATIONS

E.A.	East Africa
CEO	Chief Executive Officer
Co	Corporation
EMEA	Europe, Middle East and Africa
IBM	International Business Machines
ICT	Information and Communication Technology
IS	Information Systems
IT	Information Technology
MD	Managing Director
MIS	Management Information Systems
M & A	Merger and Acquisition
NSE	Nairobi Stock Exchange
USA	United State of America

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ABSTRACT

The study objective was to investigate the challenges faced in data migration by companies listed at Nairobi Stock Exchange (NSE). In order to achieve the objective, a survey design was used and data was collected using questionnaire administered using a drop and pick later method to the 54 firms listed at the NSE. The questionnaire had both open ended and closed ended questions. Data collected was analyzed using descriptive statistics and presented using frequencies tables, percentages and charts. In addition, factor analysis was also used to analyze the data.

Findings of the study revealed that, despite majority of the firms having been in operations for more than 30 years, they faced numerous challenges in data migration. These challenges were grouped into four main categories namely, software/tools related challenges, people related challenges, planning and/or policy related challenges and resource related challenges. Due to these challenges, majority of the respondents indicated that they experienced problems in data migration. These problems included unexpected application downtime, programs incompatibility, application performance problems, data corruption and loss.

To overcome these challenges and problems organizations need to involve top management, data migration experts and users of information systems in data migration projects. Organizations require choosing appropriate data migration methodologies and tools. In addition, organizations need to properly plan for data migration projects and align data migration projects objectives with business needs.

CHAPTER ONE

INTRODUCTION

1.1 Background of the study

Information systems have become a vital component of successful business firms and other organizations (O'Brien, 1993). They provide information needed for efficient operation, effective management and competitive advantage. However, there are managerial challenges presented by the use of information systems. One of these challenges is data migration (Pick, 2001).

According to Morris (2006), data migration is defined as any movement of persistent data that involves some sort of restructuring of that data while the usage of data (operational versus analytical) remains constant. Chester (2006) defines data migration as the transfer of data between storage types, data formats, or computer systems. Data migration is considered successful if data in the new format, system or location is an accurate and usable representation of the original data.

Morris (2006) notes that successful data migration focuses on more than just migrating data from one system to another. Data migration focuses on realizing all benefits promised by new system. For instance, creating improved enterprise performances, maintaining the best, appropriate and cleanest data that will enhance business operations and maintaining regulatory, legal and governance compliance criteria for data migration projects.

According to Chester (2006), the major driver for data migration is technological changes. Other drivers include replacing an old system with a new one when the lease on a piece of equipment ends, change in the structure of an organization applications or when organization decides to standardize on a particular technology. Data migration may also be undertaken primarily for business reasons, for instance in order to implement new functionality, consolidate existing and acquired applications after a merger or acquisition, or due to outsourcing to a service provider.

Data migration is not a discipline per se, as it does not exist in isolation but it is always linked to an application (Howard, 2006). It is a subset of some overarching application project. The implication of this is that those who make decisions involving data migration projects tend not to be expert in dealing with data. They tend to focus mainly on processes and interfaces rather than data semantics. Often these people do not appreciate the scope of any data issues that may be involved in the data migration projects and frequently underestimate resources required in data migration. This may result in cost overruns, late delivery and lack of user acceptance for overall data migration projects.

Sommerville (1995) points that data held by information systems is one of the most important business resources as it represents mission critical knowledge which cannot be easily replaced. Due to this, many organizations are reluctant to carry out data migration. There are many significant risks of retaining legacy information systems, with implication that they may become increasingly outdated, cumbersome and unmanageable. At the same time, there are also considerable risks involved in migration of data from such systems. The risks includes application downtime, unexpected application disfunctionality, data loss and data corruption.

Sceales (1997) notes that data migration has an impact on an organization. Successful data migration transforms organization business so that it is ready for future challenges while failed data migration adversely affects negatively on the organization operations. According to Navathe et al (1986), data migration is more difficult due to the fact that, the source and the target systems are rarely identical. When the source and target are structurally different or data is inconsistent across multiple data sources, then many decisions need to be made on how data will be transferred most reliably.

1.1.1 Nairobi Stock Exchange

Nairobi Stock Exchange (NSE) is the Kenya's stock market that deals in exchange of securities of publicly quoted companies and the Government. In the NSE willing buyers and sellers using authorized stockbrokers as their intermediaries are able to acquire and dispose of securities at a price that is fair and equitable (source: www.nse.co.ke).

The NSE began in early 1920s as an informal marketplace for local stock and shares. NSE was officially recognized as a formal stock exchange in 1954. In April 2008, the NSE adopted an automated trading system, to keep pace with other major world stock exchanges (source: www.nse.co.ke).

As at 17th June, 2008 there were 54 companies quoted at the Nairobi Stock Exchange (Daily Nation, Tuesday, 17th Jun 2008). These companies were categorized under various investment segments as follows; agricultural, commercial services, finance and investment, industrial and allied, and alternative investment markets firms.

Hodgetts and Kuratko (1995) notes that listed companies operate in diverse business, segments and environments, they also formulate and implement strategies in a competitive business world. These companies are under pressure from the stakeholders to deliver superior year by year performances and returns. Due to this demand, they are ever looking for innovations and cost saving opportunities in their operations that enables them to focus on value adding activities to maximize their wealth.

In Kenya, mobile phone service provider, Safaricom, a company quoted at the NSE recently switched over to a new pre-paid management system called the Intelligent Network (IN) platform. The new system provides additional capacity and enables the company to offer new and enhanced customer services. But according to the company Chief Executive Officer, during the switchover

process when data was being migrated to the new system, problems were experienced (Daily Nation February 19, 2008). Other companies that had experienced data migration challenges include Kenya Commercial Bank, NIC Bank and Access Kenya.

1.2 Statement of the problem

Information Systems nowadays form the backbone of information process and flow within an organization (Wu et al, 1997). Data stored in these systems is considered as an immensely valuable asset and protection of the data is critical to the success of any organization. Due to this, when an organization prepare to migrate the data, they need it to be carried out as efficiently as possible with reduced downtime and with little business disruption as possible.

Softtek Storage Solutions commissioned a survey to investigate how data migrations affected organizations (Hurley, 2005). More than 550 end users responded to the survey, which covered North America and the Europe, Middle East and Africa (EMEA) region. The survey results found that 75% of users had experienced problems with data migrations. The findings also revealed that many of the users find migrating data as a complex and challenging process.

In Kenya, Ndulu (2006) conducted a survey of the causes of information systems failure among microfinance institutions. The study revealed unsuccessful data migration was one of the causes of IS failure. Kiprono (2006), carried a survey of challenges facing users of computer based IS at National Hospital Insurance Fund. The study found that during migration of data to new systems, users experience normally data loss.

According to Pick (2001), data migration processes are very challenging and most failure of information system replacements are caused by unsuccessful data migration. This raises questions on why majority of data migration projects are unsuccessful and what are the challenges faced in data migration. Hence, this study aims at investigating the challenges in data migration for companies quoted at the Nairobi Stock Exchange.

1.3 Objective of the study

The objective of the study was to establish the challenges faced in data migration by companies quoted at Nairobi Stock Exchange.

1.4 Significance of the study

The findings from this study will be of benefit to companies quoted at the NSE in addressing challenges that they may likely to face in data migration.

The findings of the study will assist information systems' developers in designing data migration tools that will help organizations in overcoming data migration challenges.

The study findings also form as a basis for further studies by scholars and researchers who might be interested in carrying out further research in the same or related areas.

CHAPTER TWO

LITERATURE REVIEW

2.1 An overview of data migration

According to industry analysts estimate, two third of organizations are engaged in some form of data conversion projects including migrating legacy systems to packed application, data consolidation, data quality improvements and creation of data warehouses and data marts (Shepherd, 1999).

Breeding and Ruddy (2003), notes that in the last two decades, there has been rapid economical, social, political and technological changes globally. Due to this, organizations have acquired and installed new information systems to cope with the changes. Brodie and Stonebraker (1995) adds that as a result of internal financial pressures, increasing competition, ongoing deregulations, and industry organization restructuring due to mergers and acquisitions. Organizations are being compelled to implement new or restructure their information systems.

However, research done by The Standish Group, in 1998, most IT projects do not go on smoothly as anticipated, 74 percent of all IT projects overran or fails (Shepherd, 1999). One of the key causes of the IT project failures is due to unsuccessful data migration.

Softek Storage Solutions commissioned a survey to understand how data migration impacted on the organizations (Hurley, 2005). More than 550 end users responded to the survey, which covered North America and the Europe, Middle East and Africa (EMEA) region. The study found that 75% of users had experienced problems with data migration, with 58% of the respondents reporting extended or unexpected downtime, and 36% of the respondents experiencing application performance problems. The study also revealed that more than 72% of respondents exceeded allocated cost budget for data migration projects.

The study also found that a significant number of IT administrators were either not aware of the available tools or had not yet adopted tools that could address their data migration problems.

Pick (2001) points that the failures of data migration projects are often due to a lack of understanding of the mechanics of data migration. Project schedules typically pay little or no attention to the complexity of data migration. Instead, all of the focus is placed on analysis, design and development tasks, without regard for data migration requirements that articulate the business needs that drives data migration projects.

NepApp Global Services (2006) suggested that to minimize the impact of data migration, use of best practices in data migration is critical. Best practices incorporate solid planning before actual data migration, use of appropriate methodologies, techniques and tools. Best practices also include pre and post data migration validation. Planning helps organizations to identify data migration problems and how to overcome the problems. Planning also helps IT professionals to define mitigation strategies for unavoidable problems. To minimize data migration impact, organizations also need to explore software options in order to determine the best software technology to use for each data migration. In additional, data migration team requires to perform pre and post migration validation to fix data migration problems that may arise when the business is running.

Kelly and Nelly (2003) suggested that to overcome data migration challenges, data need to be audited to ensure that migration occurred accurately. The auditing process may occur after the data has been migrated, checking the data while it is being migrated or reviewing the methodological approach of management for migration process. All these approaches are valid and effective. Although, auditing data after the data has been migrated requires additional downtime and may not be appropriate in all working environments.

2.2 Drivers of data migration

Drivers of data migration includes technological changes, standardizations to a particular technology, end of lease of an equipment, implementing new functionalities, change in organization structure and outsourcing to a new service provider.

2.2.1 Technological changes

According to Dean (1998), Changes in technologies and market structures have shifted competition between organizations to global level. This has resulted for the need of new organizational structures to accommodate the emerging technologies. Furthermore, the turbulent business environment is forcing organization to re-evaluate totally their processes and structures by adopting new technologies to remain competitive or gain competitive advantage.

2.2.2 Standardization on a particular technology

The benefit of technology standardization is that the cost and investment risk for consumers decrease because consumers are not tied to a single producer (Hallmark, 2006). Organizations nowadays are shifting to a breed approach and continue to integrate applications from several vendors. Standard business rules let the entire rule-enabled applications share a common rule repository so that all rules are viewed and modified in one place. In the process of standardizing the systems, organizations are compelled to migrate data that meet the new standard business rules.

2.2.3 Merger or acquisition

Slotcgraaf et al (2008), notes that the dominant rationale used to explain merger and acquisition activity is that acquiring firms seek improved financial performance. For instance, combined company can often reduce duplicate departments or operations, lowering the costs of the company relative to the same revenue stream, thus increasing profit. Mergers and acquisitions changes structures and management of an organization that includes change of information systems.

2.2.4 Outsourcing to a new service provider

The most crucial contemporary issue of information management is whether to outsource all or some of the information technologies to specialized-services firms (Strassmann, 1998). The shift from company-management computing to outsourcing is accelerating. The main reasons are that organizations are incapable of attracting or retaining talent for specialized technologies, especially for innovative uses. In addition, nowadays organizations wish not to devote scarce managerial resources to managing IT. When organization outsource IT infrastructure, data have to be migrated to the new outsourced systems.

2.2.5 Implementing new functionalities

Brew et al (2004), points that at some point, every business faces the question, "Should we implement new functionality?" This is in response to maintain a competitive position, be more efficient, or enhance an existing system that no longer meets the needs of the business. Whatever the impetus, the implementation of new functionality requires a change in data repository.

2.2.6 End of a lease of equipment

Leasing equipment can be a good option for business owners who have limited capital or who need equipment that require upgrading every few years. Leasing business equipment allows firms to acquire assets with minimal initial expenditures.

Leasing also allows businesses to address the problem of obsolescence. Organizations lease to obtain items that become outdated in a short period, such as computers or other high-tech equipment, after lease ends, a lease passes the burden of obsolescence onto the lesser. Data stored in the obsolescence systems is migrated to the new leased systems.

2.2.7 Change in organizational structure

Lumpkin and Gregory (2004) points that industry consolidation that includes creating huge global corporations through joint ventures, mergers, alliances, and other kinds of inter organizational cooperative efforts has become increasingly important in the twenty-first century. Among organizations of all sizes, concepts such as agile manufacturing, just-in-time inventory management, and ambidextrous organizations are impacting managers' thinking about their organizational structure. Changes in the organizational structure may also bring changes in data repository and data migration.

2.3 Data migration tools

According to Radding (2004), there are a number of data migration tools. These tools falls into two major categories, array based and host based data migration tools.

Array based migration tools is further divided into two main sub categories, array-to-array tools used to migrate off an old array, or within an array itself, if migrating from older sets of disks to newer ones. Array based migration tools are recommended for organizations with homogenous storage environments. They are organization's proprietary tools provided by the array vendor (Hurley, 2005).

The other category is host based migration tools, where the operating systems provide basic tools to copy data from one location to another on the same server or another server that is accessible via Internet Protocol. Host based migration tools are recommended for heterogeneous storage environments. These tools take the form of software from independent vendors.

2.4 Data migration approaches

2.4.1 Database first (forward migration) method

The database first (forward migration) method involves the initial migration of legacy data to a modern, probably relational, database management system and then incrementally migrating the

legacy applications and interfaces. While legacy applications and interfaces are developed, the legacy system interoperates with its target system through a forward gateway. This enables the legacy applications to access the database environment in the target side of the migration process. This gateway translates and redirects the calls forward to the new database service. Results returned by the new database service are translated for use by legacy applications (Ganti and Brayman, 1995).

2.4.2 Database last (reverse migration) method

According to Bateman and Murphy (1984), the legacy applications are gradually migrated to the target platform while the legacy database remains on the original platform. The legacy database migration is the final step of the migration process. A reverse gateway enables target applications to access the legacy data management environment. It is employed to convert calls from the newly created applications and redirect them to the legacy database service.

The reverse gateway is responsible for mapping the target database schema to the legacy database. The mapping is complex and slow which affect the new applications. In addition, many of the complex features found in relational databases (integrity, consistency constraints, triggers etc.) may not be found in the archaic legacy database, and hence cannot be exploited by the new application. For reverse migration method, the migration of the legacy data takes a significant amount of time during which the legacy system is inaccessible. When dealing with mission critical information systems this may be unacceptable.

2.4.3 Chicken little methodology

Brodic and Stonebraker (1995) proposed an eleven step generic strategy for migration, employing a series of gateways. With this approach, the legacy system and target systems are operated in parallel. The target system is small at the outset, but grows during the migration process until it replaces the legacy system. Forward gateway is created which enable the legacy system access the

new system. At the same time, there is also a reverse gateway for target application to access the legacy system. Brodie and Stonebraker (1995), recognizes the complexity of this system and submit that this complexity present a technical problem and migration challenges.

2.4.4 Butterfly methodology

This approach assumes that the legacy information system and target system both run in parallel but they do not interoperate during the process. The objective of this method is to migrate mission critical legacy system to a target system in a simple, fast and safe way by eliminating the need to simultaneously access both legacy and target system, and therefore avoid the complexity of maintaining the consistency between these heterogeneous information systems.

Using butterfly methodology, the target system is not in production while the legacy system is being migrated. The legacy system remains in full production during the whole migration process. There will never be a case where live data is stored, at the same time, in both the legacy and target systems. Any transactions during transfer are logged in tables that are transferred to the target database. During transfer of the temporary tables, any further manipulations of data are stored in other temporary tables. This iteration goes on until the last temporary tables reach a stage where the migration of these last tables would not cause any serious inconvenience to the core business. Wu et al (1997), notes that although the approach seems comprehensive and sound, it is only database administrators who have had ample experience with general migration procedures could apply it.

2.5 Benefits of successful data migration to businesses

Accrued benefits as a result of successful data migration include increased revenues due to the ability to launch and support new services more quickly, efficiently and at lower cost. Another benefit is reduced costs resulting from overall lower cost of migrating data and the ability to remove duplicated or expensive to maintain legacy systems and data.

Further, successful data migrations leads to better business planning, since the business can plan new product launches based on the knowledge derived from successful data migration. This is important because project delays mean that lost revenues that might never be recouped.

In addition, successful data migration results to increased shareholder value, an enterprise that can reliably deliver migration projects demonstrate both good corporate governance and the ability to respond to change (Sceales, 2008).

2.6 Challenges faced in data migration

According to Kelly and Nelms (2003) there are a range of practical challenges and inhibitors around data migration that makes data migration to be seen as risky and complex process and due to this, data migration projects are avoided or delayed. Some of these challenges include:

2.6.1 Poor understanding of source data

For data migration project to be successful, understanding of data is the first essential step before undertaking data migration. Data analysts need to learn as much as possible about data they plan to migrate. According to Shepherd (1999), understanding source data is accomplished by implementing a two-step process, data profiling and data mapping. Data profiling involves studying the source data thoroughly to understand its content, structure, quality and integrity. Once data profiled, an accurate set of data specification is developed on the profile, a process called data mapping. Lack of proper data profiling, analyzing and mapping tools have been an impediment to successful data migration.

Shepherd (1999) suggests that to create an effective data migration strategy, companies need to dedicate substantial up-front effort to understanding source data. Simply profiling and sampling the data are not comprehensive enough to support the creation of a detailed strategy or an accurate estimate of the effort required. Instead, organizations need to devote a significant amount of time to make a full and accurate identification of source data.

Once the source data has been properly identified, the strategy team then test the data to check whether it support the required functionality of the target application. The team should begin by identifying quality problems in the source data such as syntax and semantic errors, format problems, and integrity issues and plan how to correct outstanding issues. The team should also identify and prepare to correct problems accessing source data. For example, there might be potential problems accessing legacy data or data from external feeds.

The team may need to address mismatches between the business* need for timely data and the system's ability to deliver the data on the business" schedule. Moreover, a good strategy should allow flexible interfaces to various data sources that can evolve over time.

2.6.2 Incompatibilities caused by migration of data between arrays from different vendors

Today's enterprise computing environment contains a complex mix of application servers, operating systems, storage devices and networks. Hence successful data migration from heterogeneous enterprise environments requires professional service teams to maintain detailed knowledge of all available computing configurations and interaction among all components.

2.6.3 Invasive migration software

Migration software used to avoid downtime associated with data transfers, presents another set of challenge. IT administrators responsible for the day-to-day availability and performance of enterprise application servers are understandably hesitant to accommodate new software installs on production hosts.

By necessity, migration software runs deep within the operating environment of application server, requiring careful installation and removal by professionals. The intrusive nature of the software, its

potential to destabilize an environment and it demand for resources from application hosts, each offers a challenge to IT administrators.

2.6.4 Lack of data migration expertise

Involving data migration experts in the data migration projects is key to the success of data migration projects. But, Howard (2007) points that data migration is regarded as a dead end job that nobody wants, it is regarded as a short term job and many fear that as soon as data migration projects are finished, they will be out of job. Due to this, few people train as data migration experts. Scarcity of data migration expertise has led to organizations faced with a challenge of building up data migration teams with the required expertise needed to perform successful data migration.

2.6.5 Complex validation thresholds

When target systems are not yet in production, the design of data validation strategies and quality thresholds for data migration presents a challenge. Most organizations rely on their end users to validate whether data migration had been successful or not. Without validation procedures, problems show up when the business is running. This results to downtime of systems during working hours.

Organizations must establish user confidence in the data. In order to trust data, business users want the ability to trace it, to find out where it came from and how it was changed. This requires some form of data lineage capability, such as metadata management. Data profiling, validation, and cleansing are also important. In application environments, data quality is also about business rules. Data must obey to unique business rules, as well as meet validation thresholds.

2.6.6 Choice of data migration tools

Data migration problems often derail valuable application projects and provoke blame storms that affect even the most skilled and conscientious business and IT staff. Organizations can overcome

data migration challenges by placing a higher priority on data migration, and acquiring tools or a toolset that supports high-level system information, technical architecture design, technical process design, and process rationalization (Radding, 2005).

Choosing the right tool for data migration is critical. The tool should support business acceptance criteria and transition planning. The tools need to provide key technical capabilities, such as data re-engineering and cleansing, logical entity mapping, and logical attribute mapping.

Use of appropriate data migration tools also helps in understanding data to be migrated and its relationships. Heterogeneous systems require different migration tools from homogeneous systems. One of the biggest challenges is that although a variety of migration tools exists in the market nowadays, organizations may not be aware of the best tools that suit their migrations.

2.6.7 Resource allocation

In any organization, utilization of resources is a major factor in cost control. In large enterprises where multiple migrations may be taking place, resource allocation to different data migration projects pose a major challenge. The problem is compounded by the agility and iterative nature of data migration projects. For instance, specific skills may need to be shared. This might impinge on some project timescales as the resources may not be available when needed, bringing about a consequential cost increase and project delay.

Another problem faced by organizations in data migration is viewing each application project as a standalone effort. They often do not realize that some of the expertise that the team has developed could be applied to another project. This is particularly true of data migration where teams end up unknowingly recreating the wheel as they painstakingly build connections to a source system, unaware that another team has already created an extensive library of objects for accessing that **same source.**



Organizations benefit when they centralize their resources to address all data migration projects, encouraging the development and leverage of data migration processes and best practices that incorporate lessons learned from all projects. A dedicated team finds it easier to recognize common problems, regardless of business area, and reuse solutions and tools that they have developed earlier. The team can also leverage its collective experience of tapping into the same legacy sources, regardless of different targets.

This approach helps end unnecessary duplication of efforts, but perhaps most important is the shift in strategic perspective where a team focused on integration, data migration isn't about getting one project done as quickly and efficiently as possible. It is about coming up with the wisest way of managing and leveraging key enterprise resources. The team's design decisions, resource allocations, and prioritizations reflecting the needs of the enterprise as a whole, not just the requirements of the immediate project at hand.

2.6.8 Poor documentation of target and source systems

Good documentation is an important part of the **implementation process** ((T Brien. 199.1). Documentation serves as a method of communication among the people responsible for developing, implementing and maintaining an information system. Documentation also is extremely important in diagnosing errors and making changes in a system. Due to lack of historical documentation (audit trails) about the source of data, data migration teams faces many challenges. For instance, conducting data gap analysis between data from source and target systems.

2.6.9 Deciding whether data migration is strategic or tactical project

Because data migration is part of a larger, strategic project, most organizations view it as a tactical challenge, not a strategic project in its own right. This perspective lead organizations seeking quick-fix solutions to data migration. This may not work because data migration is much more

complex than organizations initially expect, with a longer learning curve than they have usually planned. Overlapping tools and technologies on the market compound confusion about what they need to do. The 'quick-fix' approach to data migration ultimately only contributes to the high failure rates of data migration projects.

Even organizations that have prior experience with migration frequently fail to leverage their hard-won data migration expertise. Their ad-hoc approach to migration means that there may be no mechanism to capture, leverage, or re-use best practices.

In order to improve their data migration success rate, organizations need to replace a purely tactical approach with a strategic one. This means addressing data migration, not just as a one-time move, but also as an ongoing process of making the data work no matter what changes occur in the company's systems. A data migration strategy should address the challenges of identifying source data, interacting with continuously changing targets, meeting data quality requirements, creating appropriate project methodologies, and developing general migration expertise.

2.7 Conclusion

The overall goal of this chapter has been to provide a literature review of some of the key areas in data migration research. This includes drivers of data migration, research done in data migration, **suggestions** of minimizing the impact of data migration, tools and approaches used in data **m'gration**. The literature also consists of some of the challenges faced in data migration. Although, there is little **in depth information** and research done to look at some of the challenges faced in data migration.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Research design

The study used a survey design. The study involved a survey of companies quoted at Nairobi Stock Exchange. According to Kolter and Armstrong (2001), the survey design is best suited for gathering descriptive information.

3.2 Target population and sample of the study

The population of the study consisted of all 54 firms listed at the NSE as at 17th June 2008 (see Appendix III). Since the population was not large, a census study was conducted. The respondents were the IT managers of the companies quoted at the NSE. The researcher considered them to have the necessary knowledge and skills required to respond to questions asked in the questionnaire.

3.3 Data collection method

The study made use of primary data that was collected through administration of questionnaires to IT managers of the companies quoted at the NSE. "A drop and pick later" method was used in administering the questionnaires.

The questionnaire consisted of two main parts labeled as Part I and Part II. Part I consisted of institutional background details and Part II consisted of data migration and ICT issues. The questionnaire contained both open and closed ended questions (see Appendix II).

3.4 Methods of data analysis

Descriptive statistics was used to analyze data in this study. This included the use of frequencies, percentages and measure of central tendency to analyze data collected in Part I and II of the questionnaire.

Factor analysis was used to identify and isolate factors related to data migration challenges captured in Part II of the questionnaire.

The Statistical Packages for Social Sciences was used to perform the analysis.

CHAPTER FOUR

DATA ANALYSIS AND FINDINGS

This chapter presents analysis of the findings. The findings are presented using frequency tables, pie charts, bar charts and percentages.

4.1 Demographic profiles

4.1.1 Distribution of the respondents

Out of 54 administered questionnaires, 39 questionnaires were returned and analyzed. This represented a response rate of 72.2%. Table 1 shows the distribution of the respondents according to their line of business.

Table 1: Distribution of the respondents firms

Line of business	Number of respondents	Percentage of the respondents (%)
Agricultural		5.1
Commercial and Services		20.5
Finance and Investment	12	30.8
Industrial and Allied		28.2
Alternative Investments		15.4
Total	39	100

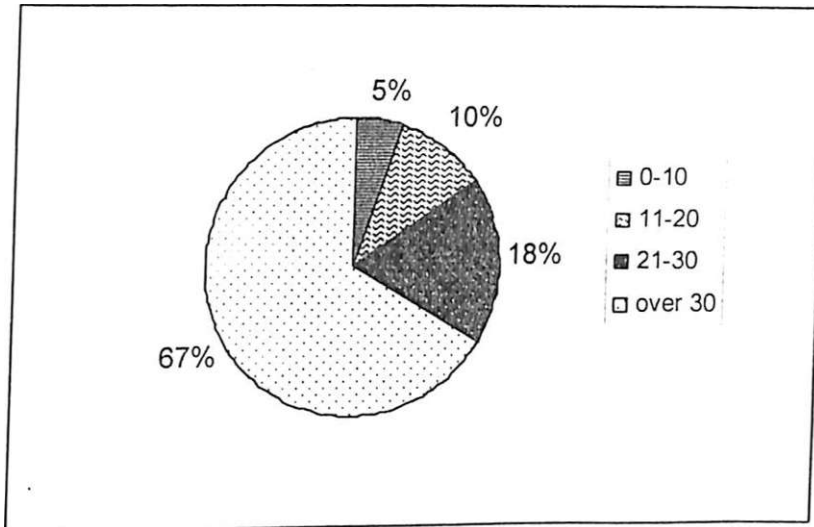
Source: Research Data October 2008

As shown in Table 1, **majority of** the respondents are from Finance and Investment segment represented by 30.8 %, **followed** by Industrial and Allied segment represented by 28.2% of the respondents, While 20.5 % of the **respondents** represented Commerce and Services segment, 15.4% of the **respondents represented** Alternative Investments segment. Only 5.1% of the respondents represented Agricultural segment.

4.1.2 Firms' duration of operation

The findings presented in figure 1 indicate duration between when the firms started operation in Kenya and the date of interviews (year 2008). The findings indicated that majority of the firms (67%) have been in operation for more than 30 years, while 18% of the total respondents have been in operation between 21 -30 years, 10% of the respondents have been in operation between 11 - 20 years and only 5 % of respondents have been in operation for less than 10 years.

Figure 1: Firms' duration of operation

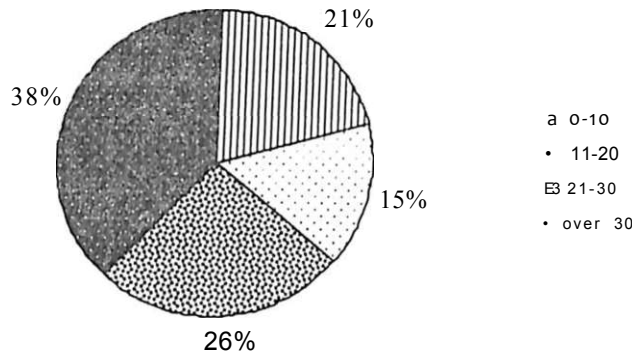


Source: Research Data October 2008

4.1.3 Duration the firms have been listed at NSE

Figure 2 indicates that 38% of the respondents have been listed at the NSE for more than 30 years, while 26% of the surveyed respondents have been listed between 21-30 years, 15% of the respondents have operated in the NSE for 11-20 years, while 21 % of respondents have been listed for less than ten years.

Figure 2: Duration the firms have been listed at the NSE



Source: Research Data October 2008

4.1.4 Firm's ownership structure

Out of 39 respondents, 59.0% indicated partly local and foreign ownership structure, while 35.9% respondents indicated foreign ownership structure. Only 5.1% of the total **respondents** had local ownership structure. The statistics of those responded are summarized in Table 2

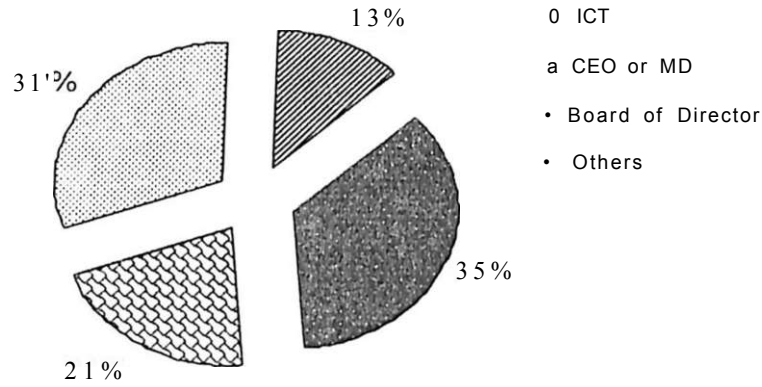
Firm ownership	Frequency	Percentage (%)
Foreign	14	
Local	2	5.1
Partly local and foreign	23	59.0
Total	39	100

Source: Research Data October 2008

4.1.5 Reporting structure

Findings showed that 35% of the respondents indicated they reported to the CEO or MD. 21% of the respondents' reports to the board of directors and 13% are those who reports to ICT committees as shown in Figure 3 below.

Figure 3: Reporting structure



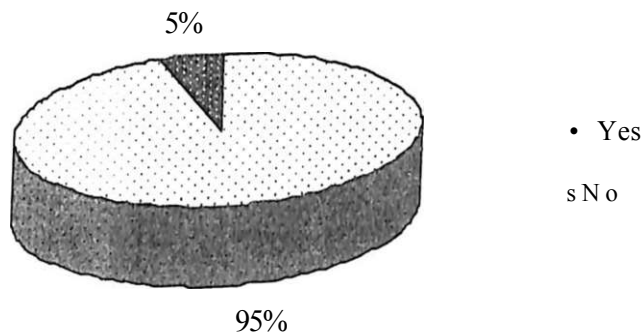
Source: Research Data October 2008

4.2 Data migration and ICT issues

4.2.1 Involvement in data migration

Out of 39 respondents, 37 or 95 % indicated that they had been involved in data migration. Only 5% of the respondents had not been involved in data migration since they started operation. The results are as shown in figure 4

Figure 4: Involvement in data migration



Source: Research Data October 2008

4.2.2 Drivers of data migration

The study sought to establish the drivers of data migration. The summary of the respondents' analysis is as shown in figure 5

Figure 5: Drivers of data migration

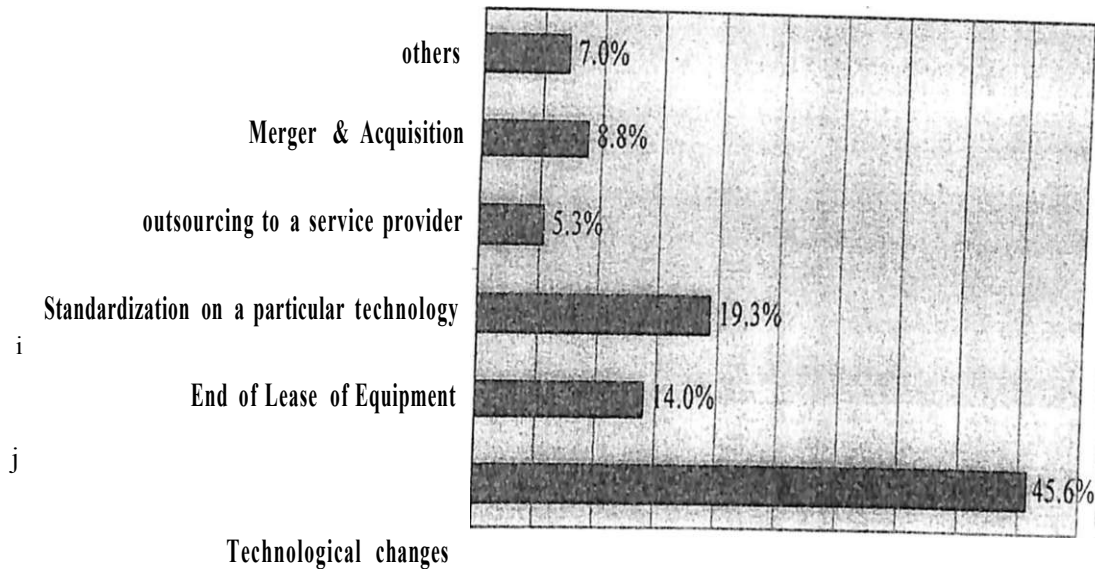
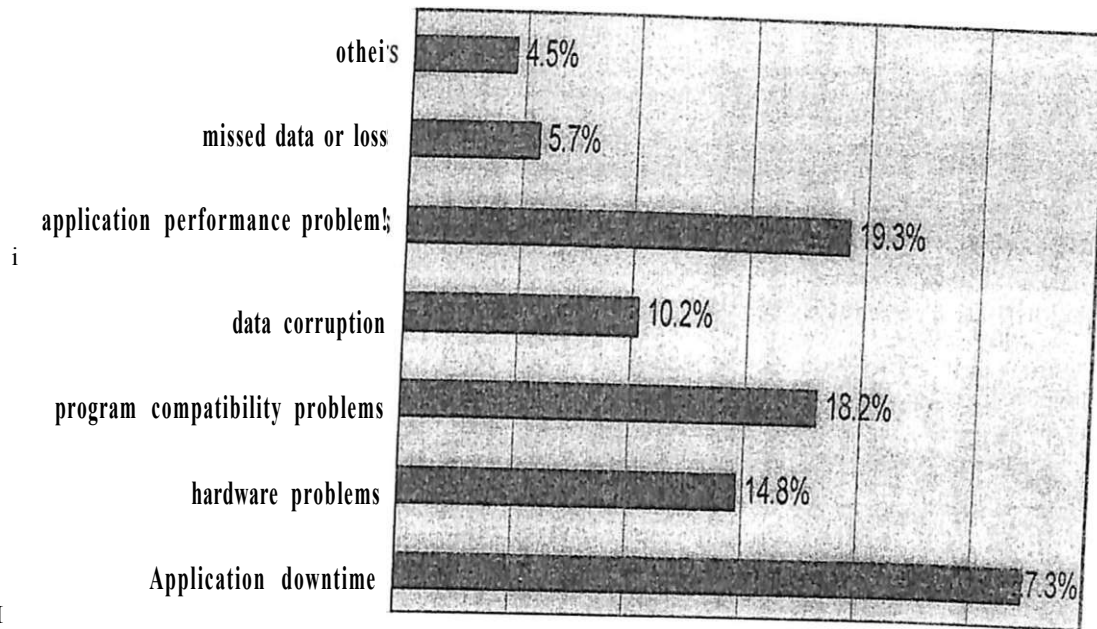


Figure 5 Research Data, October 2008
Respondents (45.6%) indicate technological changes as the main driver of data migration. 19.3 % of the respondents indicated the need of the organization to standardize on a particular technology as cause of data migration. End of lease of equipment accounted for 14.0% of the respondents, while 8.8% of the respondents indicated that merger and acquisition caused data migration. Only 5.3% of the respondents indicated outsourcing to a service provider as their driver to data migration.

4.2.3 Problems experienced during data migration

Respondents were asked to indicate the problems they experience during data migration. Figure 6 shows that majority of the respondents had experienced problems with data migration, 27.3 % reporting extended or unexpected downtime, and 19.3 % of the respondents experiencing application performance problems, 18.2% experiencing program compatibility problems, while 14.8% experiencing hardware compatibility problems, 10.2% of the respondents experience data corruption and only 5.7% of the respondents had lost or missed their data.

Figure 6: Problems experienced during data migration



Source: Research Data October 2008

4.2.4 Methodologies used in data migration

The study sought to investigate the methodology or methodologies used in data migration. 45.5% of the respondents indicated that they used forward migration methodology while 15.9% of the respondents used Chicken Little methodology. 13.6% of the respondents indicated they used butterfly methodology and only 4.5% of the respondents used reverse methodology. The respondents who indicated they "don't know" were represented by 20.5%.

Table 3: Methodologies used in data migration

Methodology	Frequency	Percent (%)
Forward	20	45.5
Reverse	1	2.2
Chicken Little	12	26.7
Butterfly	5	11.1
Don't know	17	37.8
Total	45	100%

Source: Research Data October 2008

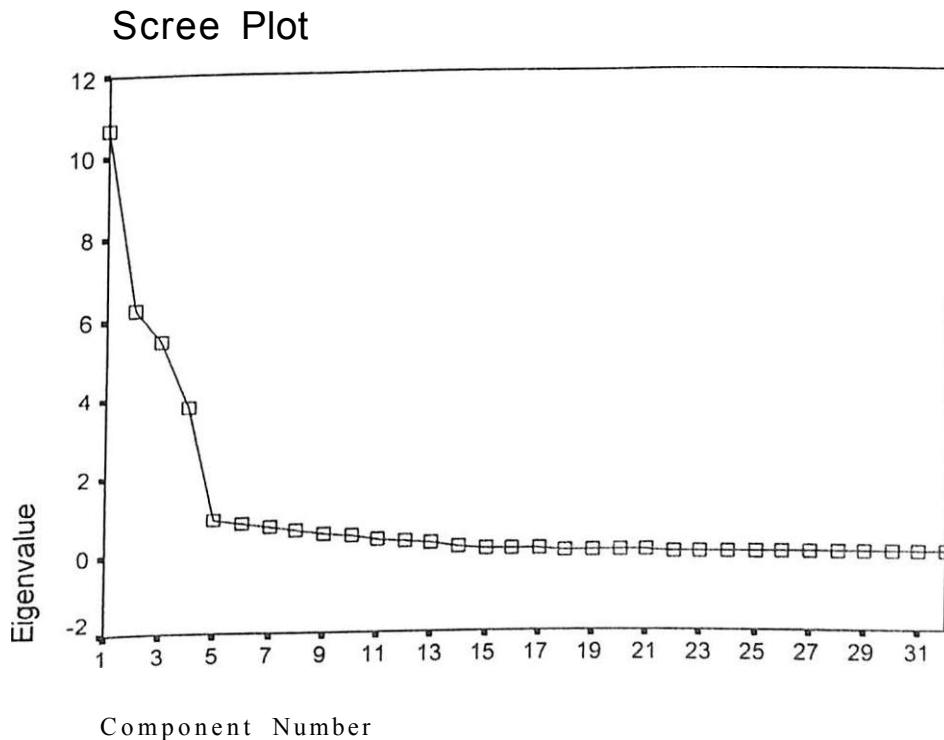
4.2.5 Challenges faced in data migration

The key objective of the research was to establish the challenges faced in data migration. Data collected on the challenges in data migration was analyzed using factor analysis. Factor analysis is a technique that attempts to identify underlying variables, or factors, that explain the pattern of correlation with a set of variables (Field, 2005). Factor analysis is used in data reduction to identify a small number of factors that explain most of the variance observed in a much larger number of manifest variables. In this study, four factors were extracted using Varimax rotation from thirty-two variables.

Scree plot based on the 32 components

Initial statistics from the principal components analysis were used to draw a scree plot. This indicated clear change in the steepness of the curve at the fourth components as shown in figure 7. The scree test method (as proposed by Catell, 1978) for the selection of an appropriate number of factors for extraction is generally considered the most suitable technique (Kline, 2000).

Figure 7: Scree plot based on thirty two components



Total variance explained

Table 4 shows the variance of the 32 variables, the percentages of variables attributable to each factor and the cumulative variance of all the factors. Principle component analysis was used and it extracted 4 orthogonal (independent) principle factors. These were the factors with eigenvalues greater than 1.

Table 4: Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared			Rotation Sums of Squared		
				Loadings			Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	10.645	33.265	33.265	10.645	33.265	33.265	9.540	29.811	29.811
2	6.232	19.473	52.738	6.232	19.473	52.738	6.103	19.071	48.882
3	5.472	17.100	69.838	5.472	17.100	69.838	5.574	17.418	66.300
4	3.831	11.973	81.810	3.831	11.973	81.810	4.963	15.510	81.810
5	.939	2.935	84.745						
6	.813	2.542	87.287						
7	.740	2.313	89.600						
8	.623	1.946	91.547						
9	.517	1.614	93.161						
10	.491	1.534	94.695						
11	.383	1.196	95.891						
12	.298	.930	96.822						
13	.264	.826	97.647						
14	.167	.523	98.170						
15	.125	.390	98.560						
16	.094	.292	98.853						
17	.086	.269	99.122						
18	.057	.179	99.301						
19	.054	.168	99.469						
20	.045	.140	99.608						
21	.034	.106	99.714						
22	.031	.098	99.812						
23	.021	.067	99.879						
24	.018	.055	99.934						
25	.014	.042	99.977						
26	.004	.012	99.989						
27	.003	.008	99.997						

Extraction Method: Principal Component Analysis.

The results in Table 5 above shows that four (4) components explained total of 81.81% of the variance. It also so that component 1 represents 29.81% importance, whereas components 2,3 and 4 are represented by 19.07%, 17.41% and 15.51% of variance across all items respectively.

Rotated component matrix explained

The initial component matrix was rotated using Varimax (Variance Maximization) with Kaiser Normalization and gave the component transformation matrix as shown on table 5. This matrix shows the loading of the 32 variables on the four factors extracted. The higher the absolute value of the loading the more the factor contribute to the variable. These results aid in identification of variables that falls under each of the extracted factors. The gaps on the table represents loading that are less than 0.5. This omission ensures easier readability.

Table 5: Rotated Component Matrix

No		Component			
		1	2	3	4
1.	lack of proper documentation of the source systems	.973			
2.	Poor understanding of source data format	.967			
3.	Migration software affects other applications	.965			
4.	Existence of differences between data formats	.963			
5.	Lack of proper documentation of the target systems	.961			
6.	Insufficient testing prior to actual data migration	.926			
	Organization not aware of new data migration tools	.921			
8.	Lack of proper validation procedures	.871			
9.	No suitable data migration software	.854			
10.	Lack of appropriate data migration tools	.837			
11.	Lack of support from migration vendors	.826			
12.	Limited technical skills among IT/MIS staff	.952			
13.	Non involvement of users in data migration causes failure in migration project	.942			
14.	Poor user training	.931			
15.	There are few data migration experts	.921			
16.	Most IT managers do not involve users of information system during data migration	.894			
17.	Organization relies on users feedback	.836			
18.	Non involvement of data migration experts	.767			
19.	Data migration is more of a business issue than technical issue				
20.	Lack of understanding of business needs		.958		
21.	Lack of dedicated data migration infrastructure		.946		
22.	Lack of proper planning		.939		
23.	Nowadays there is less tolerance for application downtime during data migration		.855		
24.	Lack of proper strategy		.838		
25.	Limited data migration knowledge by managers		.797		
26.	The fast changing operational policies and procedures make data migration challenging		.753		
27.	Migration projects exceed planned staff time			.929	
28.	Financial constraints			.922	
29.	Migration projects exceed planned downtime			.864	
30.	Non peak migrations leads to costly migrations to costly overtime			.836	
31.	Migration projects exceed planned cost budget			.826	
32.	To minimize risks, most organizations conduct migrations on non peak times			.796	

Extraction Method. Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.

a Rotation converged in 5 iterations.

Factor Isolation

Isolation of factors involves isolating each factor based on the factor loading. These are the correlation between the factors and the factors encountered. The compositions of the four factors as shown in Table 5 are presented as follows;

Factor 1: Consists of 11 items. These items are numbered 1, 2,3,4,5,6,7,8,9,10 and 11. These items are associated with software and tools issues that affect data migration projects. They can therefore be treated as software and tools challenges.

Factor 2: Consists of 7 items. These are represented by item numbered 12 through to 18. The items address issues of users and MIS/IT staff involvement in data migration. They are therefore regarded as people related factors or challenges.

Factor 3: Consists of 7 items. These are represented by items numbered 20 through to 26. The challenges jointly address planning and policy issues of data migration. They are regarded as planning and policy factors.

Factor 4: Consists of 6 items. These items are numbered 27, 28,29,30,31 and 32. These items are associated with resources like time, staff and finance needed in data migration. The items therefore relate to resource factors.

CHAPTER FIVE

SUMMARY, DISCUSSIONS, AND SUGGESTIONS

5.1 Summary and discussions

The main objective of the study was to establish the challenges faced in data migration by companies quoted at Nairobi Stock Exchange. The study established that despite majority of the organizations being in operations for more than 30 years, the firms still faced numerous problems and challenges in data migration.

The challenges faced in data migration were grouped into four main broad categories namely software/tools related challenges, planning and policy related challenges, people related challenges and resource related challenges.

The key challenges related to software and tools contributed to 32.26% of variation. Respondents indicated that lack of proper documentation for both source and target systems, insufficient testing of system prior to actual data migration, poor understanding of source data formats, migration software affecting other applications, existence of differences data formats between source and target systems are key software related challenges. Others were insufficient testing of systems prior to actual data migration and lack of appropriate data migration tools. To counter these challenges it is essential to test and validate data migration software and tools. Choice of appropriate data migration tools is also critical in overcoming the software/tool related challenges.

The second key factor points towards user and people related challenges, this contributed to 19.47% of the variation. Limited technical skills among IT/MIS staff, non-involvement of users in data **migration**, poor user training on data migration issues, few data migration experts, most IT managers not involving users of information system in data migration projects are aspects that pointed towards users and personnel. The research finding indicated that users' plays an important

role in data migration and need to be fully involved in planning, implementation and maintenance of data migration projects.

Planning and policy related challenges contributed to 17.10% variation. These challenges included lack of understanding of business needs, poor planning of data migration projects, inappropriate dedicated data migration infrastructure and strategy. To overcome these challenges organizations needs to develop and formulate proper strategies and dedicated data migration infrastructures. Further, proper planning for data migration projects is required. Organizations also need to make sure that they understand the business needs before undertaking any data migration projects.

Other challenges faced in data migration were data migration projects exceed planned staff time, budget and downtime. The challenges related to resources. These challenges have great impact on organization critical mission activities, as they are associated with hidden costs. Hurley (2005) suggests the use of online data migration tools to reduce application downtime.

5.3 Limitations of the study

Some respondents did not return the questionnaires in spite of the assurance that the data collected will be confidential and used for academic purposes only. Time was also a limiting factor as it was not also possible to collect data from all the respondents and carry out more advanced data analysis techniques. These reduced the responds rate to 72.2 %, reducing the probability of reaching to a more conclusive study.

5.2 Conclusions

The findings of this study revealed various challenges faced in data migration by firms listed at the NSE These findings concurred with the challenges that were discussed by various researchers and scholars in the literature review.

To overcome the challenges identified, it is imperative for organizations to involve top management, data migration experts and users of information systems in planning, implementation and maintenance of data migration projects. Organizations entail understanding the business needs before undertaking data migration projects. Successful data migration projects also require use of appropriate data migration tools and methodologies.

5.4 Suggestions for further study

This study has highlighted the challenges faced in data migration by only the firms listed at the NSE. However, better results of the study may be achieved if extended to wider business sectors and industries not limited to NSE.

More in depth study should be carried out to determine the kind of resources a firm need in order to carry out successful data migration. Other studies could also focus in the areas of extent of use of online data migration tools and choice of data migration methodologies.

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APPENDICES

Appendix 1: Covering letter

Department of Management Science
School of Business,
University of Nairobi,
P.O. Box 30197,
Nairobi

Dear Respondent,

I am a postgraduate student at University of Nairobi pursuing a course in Masters of Business Administration (MBA), specializing in Management Information Systems. In Partial fulfillment of the course requirements, I am conducting a survey on the challenges faced in data migration by companies quoted at the Nairobi Stock Exchange.

You have been selected as one of the respondents. I therefore kindly request you to fill the attached questionnaire. The information from the questionnaire is needed purely for academic research purposes and will be treated with utmost confidentiality. A copy of the final report can be made available to you upon request. If you require any further information, please do not hesitate to contact me on cell phone number 0722 915 219.

Your cooperation is highly valued and appreciated.

Thank you in advance

Yours faithfully

KAMAU N. GABRIEL

D61/P/8456/05

Appendix II: Questionnaire

Please fill in the questionnaire provided

PART 1: Institutional Details

1. From the list below, tick your firm's line of business.
 - a) Agricultural
 - b) Commerce and Services
 - c) Finance and Investment
 - d) Industrial and Allied
 - e) Alternative Investments

2. How long have your organization been in operation? Tick appropriate range
 - a) 0 - 10 years
 - b) 11 - 20 years
 - c) 21 - 30 years
 - d) Over 30 years

3. For how long have your organization been listed at NSE? Tick appropriate range of period.
 - a) 0 - 10 years
 - b) 11 - 20 years
 - c) 21 - 30 years
 - d) Over 30 years

4. What is the ownership structure of your organization?
 - a) Locally owned
 - b) Foreign owned
 - c) Partly local and foreign

5. What is the highest position held by the person in charge of IT section/department

6. To who does the head of IT reports to? Tick appropriate authority.
 - a) ICT committee
 - b) CEO or Managing Directors
 - c) Board of Directors
 - d) Others (Specify)_____

PART II (Data Migration and ICT Issues)

7. How many computers does your organization have? Tick the appropriate range of numbers.

- a) 1 - 50
- b) 51 - 100
- c) 101 - 150
- d) 151 - 200
- e) 201 and above

8. Have your organization been involved in data migration?

Yes No

9. Indicate with a tick, whether the following have caused migration of data in your organization

- a) Technological changes
- b) End of equipment lease period
- c) Standardizing to a particular technology
- d) Outsourcing to a new service provider
- e) Acquiring application due to merger or acquisition
- f) Other causes of data migration (Specify)

10. Indicate with a tick, whether you have experience the following during data migration in organization?

- a) Extended or unexpected downtime Yes No
- b) hardware compatibility problems Yes No
- c) program compatibility problems Yes No
- d) Data corruption Yes No
- e) Application performance problems Yes No
- f) **Missed** data or data loss Yes No
- g) Other problems (specify).

What type of data migration methodology (ies) have your organization been using?

- a) Forward migration []
- b) Reverse migration []
- c) Chicken Little []
- d) Butterfly []
- e) Don't know []

12 From your experience, to what extent do you agree or disagree with Hip iu • about data migration as applying to your firm. g C f o , , o w m g statement

Statement	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
1 Lack of proper planning causes problem during data migration					
2 Non involvement of data migration experts causes problem during data migration					
3 Poor understanding of source data format causes failure in data migration					
4 Existence of differences between data formats of the source and target systems is a challenge in data migration					
5 Lack of appropriate data migration tools causes problem during data migration					
6 There are few data migration experts in the country.					
7 Most IT managers do not involve users of information system during data migration					
8 Non involvement of users in data migration causes failure in migration projects					
9 Data migration is more of a business issue than technical issue.					
10 The fast changing operational policies and procedures make data migration challenging.					
11 Nowadays there is less tolerance for application downtime during migration					
12 To minimize risks, most organizations conduct migrations on DOWNTIME.					
13 Non peak migrations leads to costly overtime					

1 HI

- 14 Most organizations rely on user feedback to determine the success of their data migration activities
- 15 Lack of support from data migration vendors' leads to unsuccessful data migration.
- 6 Lack of proper documentation of source system causes problem during data migration.
- 17 Lack of proper documentation of target system causes problem during data migration.
- 8 Due to lack of proper validation procedures, problems show up much later when business is running
- 9 Most organizations are not aware of new data migration tools.
- 20 There is no suitable data migration software in the market today.
- 21 Lack of understanding of business needs results in failure of data migration projects.
- 22 Insufficient testing prior to actual data migration leads to data migration failure.
- 23 Limitation of data migration knowledge leads to wrong choice.
- 24 Limited technical skills among IT/MIS staff causes poor internal support resulting *to* unsuccessful migration
- 25 Financial constraints is a reason why many organization have not adopted new migration technologies
- 26 Most organizations lack proper strategy in carrying data migration
- 27 Poor user training causes data migration failure
- 28 Most organizations do not have dedicated infrastructure for data migration

Migration applications if installed running systems

30 Most data migration projects exceed planned cost budget.					-
31 Most data migration project exceed planned staff time					
32 Most data migration project exceed planned downtime					

13. Why do you think that data migrations are not always successful as anticipated?

14. Please, provide any other additional information that you feel is important in this research that regard data migration

Thank you for taking your time to fill this questionnaire. Your participation is highly appreciated.

Appendix III: Firms quoted at the NSE

Main Investment Market Segment

a) Agricultural

Uniliver Tea Kenya

Kakuzi

Rea Vipingo Plantations

Sasini Tea and Coffee

b) Commercial and Services

Access Kenya Group

Car & General (K)

CMC Holdings

Hutching Biemer

Kenya Airways

Marshall (E.A)

Nation Media Group

Safaricom Ltd

ScanGroup

Standard Group

TPS EA (Serena)

c) Finance and Investment

Barclays Bank

CFC Stanbic Holdings

Diamond Trust Bank

Equity Bank

I lousing Finance Co

Centum Investment Co

Jubilee Holding

KCB

Kenya-Re Corporation

NBK

NIC Bank

Pan Africa Insurance

Standard Chartered Ltd

d) Industrial and Allied

Athi River Mining

B.O.C Kenya

Bamburi Cement

British America Tobacco Kenya Ltd

Carbacid Investments

Crown Berger

E.A. Cables

E.A. Portland Cement

East Africa Breweries

Eveready EA

Kenya Oil Co

Kenya Power & Lighting Co.

KenGen

Mumia Sugar Co.

Olympia Capital

Sameer Africa

Total Kenya

Unga Group

Alternative Investment Market Segment

A Baumann & Co

City Trust

Eaagads

Express

Williamson Tea Kenya

Kapchoria Tea Co.

Kenya Orchards

Limuru Tea Co.