

UNIVERSITY OF NAIROBI



SCHOOL OF COMPUTING AND INFORMATICS

**TOWARDS SECURE, EFFICIENT AND EFFECTIVE SCRIPT MANAGEMENT
SYSTEM: A CASE STUDY OF THE KENYA NATIONAL EXAMINATIONS COUNCIL**

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**Project work submitted to the school of computing and informatics in partial fulfilment of
the requirement for the award of Masters of Science degree in information systems**

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DECLARATION

This project as presented in this report is my original work and has not been presented for any other University Award.

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ABSTRACT

Over the years, KNEC has relied on manual documents prepared by Contracted Professionals (examination officers managing distribution centres, supervisors, examiners and invigilators) in order to account for candidates' scripts in all examinations. This has created difficulties in accurately accounting for candidates scripts. KNEC has in the recent past embraced ICT even while interacting with its clients and stakeholders. One major such innovation was the introduction of online registration of candidates for national examinations in particular, Kenya Certificate of Secondary Education (KCSE) and Kenya Certificate of Primary Education (KCPE) in 2011. The secure collaborative script management system project was intended to take advantage of the advancements in ICT and recent KNEC innovations to re-engineer the management of examinations manuscripts process, which is currently seen to be costly, time consuming and insecure. This was done by investigating the gaps of the current – heavily manual oriented process used at KNEC, and then designing a secure and collaborative script management system (SCSMS), to replace it. The main purpose of the study was to understand the current manual script management system, identify the challenges associated with it, level of efficiency and effectiveness, at KNEC, and help to design, and develop a prototype script management system for national examinations. If implemented, the SCSMS aims to ensure a paperless system that will significantly reduce delays in all aspects of the examinations cycle, while promoting collaboration among various actors in examination management, with secure environment. Though the initial cost of coming up with the system might be seen to be high due to the purchase of hardware-server, software and training or sensitisation of personnel, the system will in long run be cheaper and improve on efficiency.

DEDICATION

This project is dedicated to God for granting me an opportunity to complete after a long period of my struggle of trying to secure time to complete it. God you are faithful. I also dedicate this work to my family, my dear wife Dorcas and our children, Sammy and Timothy for their perseverance and support during the writing of the project, my late brother James and his wife Nelly for helping me pay my fees for the Master of Science degree Course through the ministry of Finance. I wish also to thank God for my parents Ezekiel and Penina Makenzi for their dedication in ensuring that I complete my studies. It is through their contributions and encouragement that I managed to complete the course. I extend the same to my classmates and colleagues at work place whom I consulted frequently on many occasions in relation to this project. I could not have managed without their input and understanding.

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ABBREVIATIONS AND ACRONYMS

AEAA	-	Association for Educational Assessment in Africa
ASTS	-	Attendance and Script Tracking System
CEO	-	Chief Executive Officer
CSCW	-	Computer Supported Cooperative Work
EA	-	Examination Administration Department
ECDE	-	Early Childhood Development Education
ECRS	-	Examination Centre Recording System
EMIS	-	Education Management Information System
ERSWEC	-	Economic Recovery Strategy Paper for Wealth and Employment Creation
ESM	-	Electronic Script Management
HKDSE	-	Hong Kong Examinations and Assessment Authority
HKEAA	-	Hong Kong Examinations & Assessment Authority
ICT	-	Information and Communication Technology
IMS	-	Web-based Item Management System
KCPE	-	Kenya Certificate of Primary Education
KCSE	-	Kenya Certificate of Secondary Education
KNEC	-	The Kenya National Examinations Council.
NARC	-	National Rainbow Coalition
OFQUAL	-	Office of Qualifications and examinations Regulations
PECSS	-	Public Communication and Support System
RQA	-	Research and Quality Assurance Department
SDLC	-	System Development Life Cycle
SEESMS	-	Secure, Effective, Efficient Script Management System
TD	-	Test Development
US	-	United States of America
ZIMSEC	-	Zimbabwe Secondary Examinations Council

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CHAPTER ONE: INTRODUCTION

1.1 Background of the study

The Kenya National Examinations Council (KNEC) was established by the Government of Kenya in 1980 through an Act of Parliament (CAP 225A) as a Semi-Autonomous Government Agency in the Ministry of Education and a non-profit making institution to conduct school and post-school national examinations except university examinations, and award certificates to successful candidates (KNEC, 2010). As a result of the emerging issues in the constitutional dispensation, education and assessment fields, the Act was reviewed in the year 2012 and KNEC is now operating within the confines of the KNEC ACT 2012.

The mission of KNEC is to objectively evaluate learning achievements so as to continually enhance and safeguard nationally and internationally acceptable certification standards. The core functions of KNEC include; development of both school and post school examinations, registration of candidates, administration and processing of examinations, certification, researching into examinations and the curriculum, and equation of certificates from other examination bodies. Specifically, the overall mandate of KNEC includes; to conduct such academic, technical and other examinations within Kenya as it may be desirable in the Public interest, to award certificates or diplomas to successful candidates in such examinations, to invite anybody or bodies outside Kenya as it may find fit to conduct academics, technical and other examinations within Kenya or to conduct these examinations jointly with the Council and to award certificates or diplomas to successful candidates in these examinations, to advise anybody or bodies invited from outside Kenya, upon the adaptation of examination necessary for the requirements of Kenya and to assist any such bodies to conduct such examinations, and to make rules regulating the conduct of examinations and for all purposes incidental thereto.

1.1.1 Examinations offered by KNEC

Under the Kenya education system referred to as the 8-4-4 system, pupils are expected to go through eight years of primary education, four years of secondary education followed by at least four years of University education. Due to the Free Primary

Education policy, launched after National Rainbow Coalition (NARC) came to power in 2003, enrolment has been rising steadily from 5.9 million in 2000 to 7.6 million in 2005 , 9.3 million in 2010 and 12.6 million in 2014 (Republic of Kenya, 2011). School examinations (KCPE and KCSE) are offered to candidates at the primary and secondary school levels respectively and only once in a year.

The KCPE examination is offered through the use of multiple choice questions which are machine scored while English composition and Kiswahili Insha are marked by examiners selected by KNEC. The KCSE examination is offered once a year between October-November. Technical and Business examinations is offered in July and November each year, Diploma in Teacher Education is offered in March each year, Primary Teacher Education (PTE) is offered in August each year. The ECDE examination is offered in December each year and Special Needs Education (SNE) is offered in April of every year.

1.1.2 Current practice of managing scripts in the Kenya National Examinations Council

The scripts for all the examinations are managed centrally by the Scripts Management Section within the Council using a manual system. Before the start of every examination, the Scripts management section assisted by the ICT department prepares a script *receiving checklist* in duplicate; this document lists all the entries in a particular paper and has a column for actual papers enclosed by the supervisor and a second column for explaining any discrepancy. The discrepancies to be explained include issues such as absentees, extra scripts due to under protests, presence of double scripts as a sign of examination malpractices either at the police armoury or other areas. The checklist is sent to the DEOs for use at the distribution centres as the scripts are being received back from schools.

i) The management of scripts from examination centres to the distribution Centres and back to KNEC for storage

Scripts from schools are all returned to collection points (distribution centres) manned by DEOs or their appointees. The officers at the distribution centres receive the scripts using the checklists provided by the KNEC. Once all the scripts have been received and ticked on the checklist, they are packed in a green bag provided by the Council, sealed

and kept in safe storage (police armoury) to await return to the KNEC warehouses. Scripts are returned to KNEC on a weekly basis, a script return programme is sent to all the districts. The DEOs return scripts with the provided check lists duly filled in duplicate. At the KNEC warehouses, the DEO and the Council officer receiving the scripts go through all the packets to be returned to KNEC by ticking against the checklist and the two officers append their signatures on the checklists once they are assured all the schools in a particular district have had all their scripts returned to the Council. The KNEC officer retains the original copy of the checklist while the DEOs keep the copy.

ii) The dispatch of scripts to the marking centres

Once all the scripts in a particular paper are received by KNEC, they are sequenced in ascending order of random numbers then packed in cartons. The contents in every box are recorded in a script dispatch form (one duplicate); the original is filed while the copy is enclosed together with the scripts (Ochuodho & Matuga, 2004). At this stage the scripts management section will have received a master apportionment printout from ICT department. This document lists all centres entered for a particular paper in ascending order. The information entered on the script dispatch form is posted on this printout. The printout will basically show the specific box where each paper is packed. The boxes are numbered sequentially and the corresponding marking centre indicated on the label.

Once packing is finalized, the scripts are now ready for dispatch to the marking centres for marking. Examiners are advised to ensure that all packets are returned to the specific box after marking. *The box number is always written on the script packet in order to enable the examiners and KNEC officers deal with any stray packets without much difficulty.*

iii) The management of scripts from marking centres to the KNEC offices for storage

After marking exercise is completed, the scripts are returned to KNEC for storage. The contents are verified at the point of receiving using the master apportionment. Once received, the scripts are arranged on shelves in the order of boxes although now with the boxes removed. The end of every box is marked using a stiffened card and again the

position of every box is marked on the shelf using an adhesive sticker. For example 231/1 BOX 1 and 122/1 LAST BOX.

iii) Management of scripts during validation of the marking and resolving of result queries

During processing of results and resolving results queries, officers fill a script requisition form. Once received, the staff in scripts management unit uses the master apportionment print out to decode the specific position where the packet containing the specific script is stored (Jain, 2006). All scripts are supposed to be disposed off after six months. However, before this is done an approval is sought from the CEO. The respective sections dealing with candidates' results in Examination Administration department are also advised to salvage any scripts with queries before disposal (Kozma, 2005). Disposal here entails destruction of the papers by the contracted service provider in the presence of an officer from the scripts management section.

v) Challenges in the Management of scripts in the Kenya National Examinations Council

Over the years, KNEC has relied on manual documents prepared by Contracted Professionals (examinations officers managing distribution centres, supervisors, examiners and invigilators) to account for candidate's scripts in all examinations and has been faced with the problem of accurately accounting for candidates' scripts (Odero-Musakali, 2007).

Many a times the Contracted Professionals do not accurately report on absent candidates and quantities enclosed in script return envelopes making it extremely difficult for the Council to account for all candidates' scripts. The system for retrieval of the scripts while in storage in the warehouse is also manual and takes a lot of time and human resource to search for required scripts during processing of examination results (Ochuodho, 2004). Although a lot of effort is made to ensure that return envelopes containing candidates' scripts are arranged on shelves where they can easily be retrieved, the packets often get mixed up and their retrieval becomes quite difficult.

The use of a manual process in managing scripts for national examinations has resulted in a number of challenges, which continues to increase every year, with increasing candidature. Insecurity of scripts posed by people contracted to handle them and

pressure piled by interested parties operating outside the Council with an intention of changing marks for candidates and other examinations related incidences, there is need to develop a more secure, effective and efficient Script Management System (Buede, 2009). Higher administrative costs in hiring casuals to manage manual work of searching scripts, and procurement of stationeries are also associated with the manual system. It is on the basis of the aforementioned challenges that a prototype script tracking system that can be used to track the movement of scripts from KNEC warehouses to different departments of the Council and back is being developed (Ochuodho & Matuga, 2004).

1.1.3 E-Government Strategy

The E-Government Strategy, which was adopted in 2004, emphasizes transformation of Government services from manual to digital-based operations. The Government's specific objectives include; improved coordination of government agencies to reduce duplication of efforts and to enhance efficiency in utilization of resources; to improve the competitive position of the country through provision of timely information and delivery of services; to reduce transaction costs, and to engage citizens and the private sector through digital on-line service provision (ERSWEC, 2007). The strategy has been developed taking into consideration the policy environment captured in the National ICT Policy of 2006 and sector policy in Sessional Paper No. 1 of 2005. The strategy has also been developed in line with the E-Government Strategy of 2004 and the wider Economic Recovery Strategy Paper for Wealth and Employment Creation (ERSWEC, 2003 Kenya Government).

In pursuing these objectives, the strategy gave considerable emphasis on the use of education to equip the nation with appropriate ICT competencies and skills and related innovations. In addition, the Strategy outlined information systems to be driven by the education sector that include operationalization of the Education Management Information System (EMIS). EMIS, the Strategy envisages, will be used to collect and process data required for improvement of education policy, planning, implementation and monitoring. It also encompasses provision of online examinations, processing admissions for primary and secondary schools and online dissemination of school and other educational curricula (National ICT Policy for Education & Training 2006).

1.2 Problem Statement

Over the years, KNEC has relied on manual documents prepared by Contracted Professionals (examinations officers managing distribution centres, supervisors, examiners and invigilators) in order to account for candidates' scripts in all examinations and has been faced with the problem of accurately accounting for candidates' scripts.

Manual systems are faced a myriad of challenges, and are getting phased out in this era of technology. To start with, manual systems make it difficult to enforce accountability. This is occasioned by manual filing of records and reports, and the time needed to peruse through all the documents. In addition, manual systems require huge resources to maintain and mainstream them. The resources are in terms of human resources, finances, space and bureaucracy. Moreover, a delay in processing of information is common with these types of systems.

The Council hires Contracted Professionals to manage the examination scripts especially during marking. However, challenges of under reporting and inconsistent information still persist. Moreover, the system for retrieval of the scripts while in storage in the warehouse after marking is also manual and takes a lot of time and human resource to search for required scripts during processing of examination results. Although a lot of effort is made to ensure that return envelopes containing candidates' scripts are arranged on shelves where they can easily be retrieved, the packets often get mixed up and their retrieval becomes quite difficult. This problem is necessitated by massive scripts handled and the process of managing the scripts is manual.

The use of a manual process in managing of scripts for national examinations has resulted to a number of challenges, which continues to increase every year, with the increase in candidature for these examinations. Insecurity of scripts posed by people contracted to handle them and pressure piled by interested parties operating outside the Council poses a major challenge to the security of the scripts and hence the need to develop a more secure, effective and efficient Script Management System. Higher administrative costs in hiring of casuals to manage manual work of searching scripts, and procurement of stationeries are also associated with the manual system (Odero-Musakali, 2007). It is on the basis of the aforementioned challenges that a prototype script tracking system that can be used to help track the movement of scripts from

KNEC warehouses to different departments of the Council and back has been prepared in this study. In addition, the challenges facing the people involved in the manual systems are not well documented. In this regard, the researcher did an indepth study in order to have an understanding of the current system, and the challenges it poses to the users and also giving a feed back on the nature of the system they would wish to have.

1.3 Purpose of the Project

The purpose of the study is to understand the current script management process, identify the challenges associated with it, level of efficiency and effectiveness, at KNEC, and help to design, and develop a prototype script management system for national examinations.

1.4 Objectives

- i. To establish how script are currently managed at KNEC.
- ii. To determine the effectiveness and efficiency of the current manual system in serving our customers;
- iii. To determine the items/ activities in the current manual script management process at KNEC that poses higher threats/risks, consume more time and attracts higher expenses;
- iv. To design, develop and test a secure efficient and effective script management system that will make scripts more secure, cut on cost and time consumed in management of scripts for national examinations.
- v. Testing and validation of the system.

1.5 Research Questions

- i. How are scripts managed at KNEC?
- ii. How effective and efficient is the current manual script management system?
- iii. Which Items/Activities poses higher security threats, have high overhead costs and consume more time, in the management of scripts at KNEC?
- iv. What are the user requirements for an effective and efficient computerized script management system?
- v. What security features should be deployed in the system to make it more secure?

- vi. How well should the script management system, be designed for use by KNEC and its stakeholders?

1.6 Significance of the Project

The findings of this study will contribute to the field of tracking parcels through integration of Information Communication Technology. Success in enhancing script management process will be assured if outcome of this project are implemented and therefore provide secure, accountable, efficient and effective scripts management process to all the people working in the script unit. This move is aimed at saving on cost, reducing the amount of time spent on searching scripts, serve both internal and external customers effectively and efficiently. The findings of the study and the system developed from the specifications given will greatly reduce redundancy, improve efficiency and make the working effective.

The system will serve to assure confidence to the stakeholders and reduce examination irregularities that arise from planting and loss of candidates scripts, reduce the amount of time spend in searching the scripts, take shorter time in releasing of results, and reduce the amount of time spend in resolving queries.

The ultimate goal will be a computerized script management system which will be secure, efficient and effective in its operations. By the end of this project, a system will be availed to KNEC and its stakeholders in that a lot of work previously done manually will go digital and will improve the general efficiency in examination management, enhance security and in the long run, save costs.

1.7 Limitations and Scope of the Project

This project studied the challenges of the current script management process and the level of preparedness at KNEC for the implementation of a secure, efficient and effective script management system. The system was designed to handle the script for KCSE only from receipt/ submission from the marking centres to the Council strong rooms up to the time they are shredded and disposed. The management of scripts from the examination centres/schools/institutions to the Council and then to the marking centres and back to Council will be left for further studies because of the time constrain.

1.8 Assumptions

The study makes the following assumptions:

- i. That the current script management process at KNEC is similar to all others in other examination Boards/Bodies, and that the solution proposed, could be used by any other examination body across the region, and not necessarily KNEC;
- ii. It is assumed that the shelving of the scripts at the search rooms is accurate and the personnel handling the system are well trained and that the data being entered is also accurate and being updated continuously;
- iii. It is assumed that a packet containing scripts for a particular centre is for that subject and that a candidate's script is in the right envelop;
- iv. That the data that is input into the script tracking system will be accurate and logical;
- v. That the data captured by the invigilators is accurate;
- vi. That scripts as packed in the boxes at the point of dispatch to the marking centres will be the same scripts packed in the same boxes at the point of receipt at the KNEC warehouses from the marking centres;
- vii. That there will be no mix-up of scripts arising out of the conveyor belt marking system used in various marking centres;

1.9 Project Deliverables

The outcome of this project will be a secure, effective and efficient script management system that will cut on cost and time associated with the manual system, while ensuring security of scripts at the KNEC.

1.10 Definition of Terms

Information Technology (IT) - is the application of computers and telecommunications equipment to store, retrieve, transmit and manipulate data, often in the context of a business or other enterprise. The term is commonly used as a synonym for computers and computer networks, but it also encompasses other information distribution technologies such as television and telephones. Several industries are associated with information technology, including computer hardware, software, electronics, semiconductors, internet, telecom equipment, e-commerce and computer services.

Information and Communication Technologies (ICT) - refers to technologies that provide access to information through telecommunications. It is similar to Information Technology (IT), but focuses primarily on communication technologies. This includes the Internet, wireless networks, cell phones, and other communication mediums.

Information Systems - A combination of hardware, software, infrastructure and trained personnel organized to facilitate planning, control, coordination, and decision making in an organization.

Strategy Formulation - stage of strategic management that involves planning and decision making that lead to the establishment of the organization's goals and of a specific strategic plan.

Strategy Implementation - stage of strategic management that involves the use of managerial and organizational tools to direct resources toward achieving strategic outcomes.

Script - an examination answer sheet in its original form, written and submitted by a candidate

School examinations - KCPE and KCSE examinations

Post School examinations - Tertiary level / Post-Secondary examinations apart from University examinations.

1.11 Summary

This chapter dealt with the core areas of the research to be carried out. The background, statement of the problem, purpose of the study and objectives are explained. Research questions, significance of the study, limitations and assumption plus the deliverable in this study are clearly outlined.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This chapter provided a review of existing work in the area of script management processes. It involved examination of documents such as journals, magazines, scholarly works and books that have a bearing on this study. The review provided the researcher with insights into what has already been done pinpointing its strengths and weaknesses. It can be noted that studies and systems have been done in the area of Electronic Manuscript Management Systems, Library Management Systems but rarely in connection with Scripts Management Systems in National Examinations, hence the gap. This study aimed at zeroing down to management of KCSE scripts at the Kenya National Examinations Council, and development of computerized Scripts Management System that can be used to enhance national examinations process.

2.2 Manual Script Management System in Africa

Management of examination scripts in most Africa countries has not evolved as compared to developed countries of the world. Majority of examinations bodies especially in Africa are still using the traditional systems, which are heavily-manual oriented. For example at West Africa Examination Council-WAEC, Joint Admission and Matriculations Board- JAMB of Nigeria, Umalusi of South Africa, Uganda National Examination Board (UNEB), The National Examination Council of Tanzania (NECTA), Examination Council of Zambia, Zimbabwe National Examinations Council, examinations Boards are still dealing with the challenges associated with the management of scripts in their Boards (NASA, 2007).

2.3 Security of Scripts

Security is defined as enforcing a policy that describes rules for accessing resources. It can be implicit or explicit but must not affect the functionality and reliability of the system. In securing a system, the users must ask themselves what they want to secure the system from (Karl Lieberherr, 1987). The script management system for National

examinations must be secured from a number of issues and by use of multi-level security strategy.

Unauthorized access by candidates or any other malicious persons prior to disposing examinations scripts must not be allowed for fear of introducing viruses onto the system which might destroy the system (Cohan, 2005). To ensure only authorized persons access the system, system administrators, will authorize users and all stakeholders will be required to register and be approved by KNEC, before being given a user name and password.

Requirement to use the allocated login credentials to access the system from anywhere, use of firewall, audit trail and System detections and denial of Service (DoS) where authorized persons are denied access to the systems system (Gaurav, 2009, Privacy is essential for secure mobile devices.) are essential and as a result prevent attempts to introduce viruses. Gaurav (2009) also points out that the social aspects of security failure must also be considered in securing a system, which includes the 3Bs: Burglary, Bribery, and Brutality. In addition, the sever hosting the system must be at a secure place, preferably at a data centre, with 2 dimension unlocking mechanisms. Also use of Biometric is also encouraged. In conclusion, Karl Lieberherr stresses the importance of system monitoring, and he suggested real-time auditing of high security system.

2.4 Collaborative System

Collaborative software or groupware is application software designed to help people involved in a common task achieve goals (Ezingard, 1999). The design intent of collaborative software is to transform the way documents and rich media are shared to enable more effective team collaboration. Collaboration requires individuals working together in a coordinated fashion, towards a common goal. Accomplishing the goal is the primary purpose for bringing the team together (Potterton, 2003). Collaborative software helps facilitate action-oriented teams working together over geographic distances by providing tools that aid communication, collaboration and the process of problem solving.

In coming up with an examination Script Management System, the proposed new system must be able to utilize collaboration among officers manning the script room, officers from different departments in the Kenya National Examinations Council.

2.4.1 Collaborative Framework by Charles Sheppard

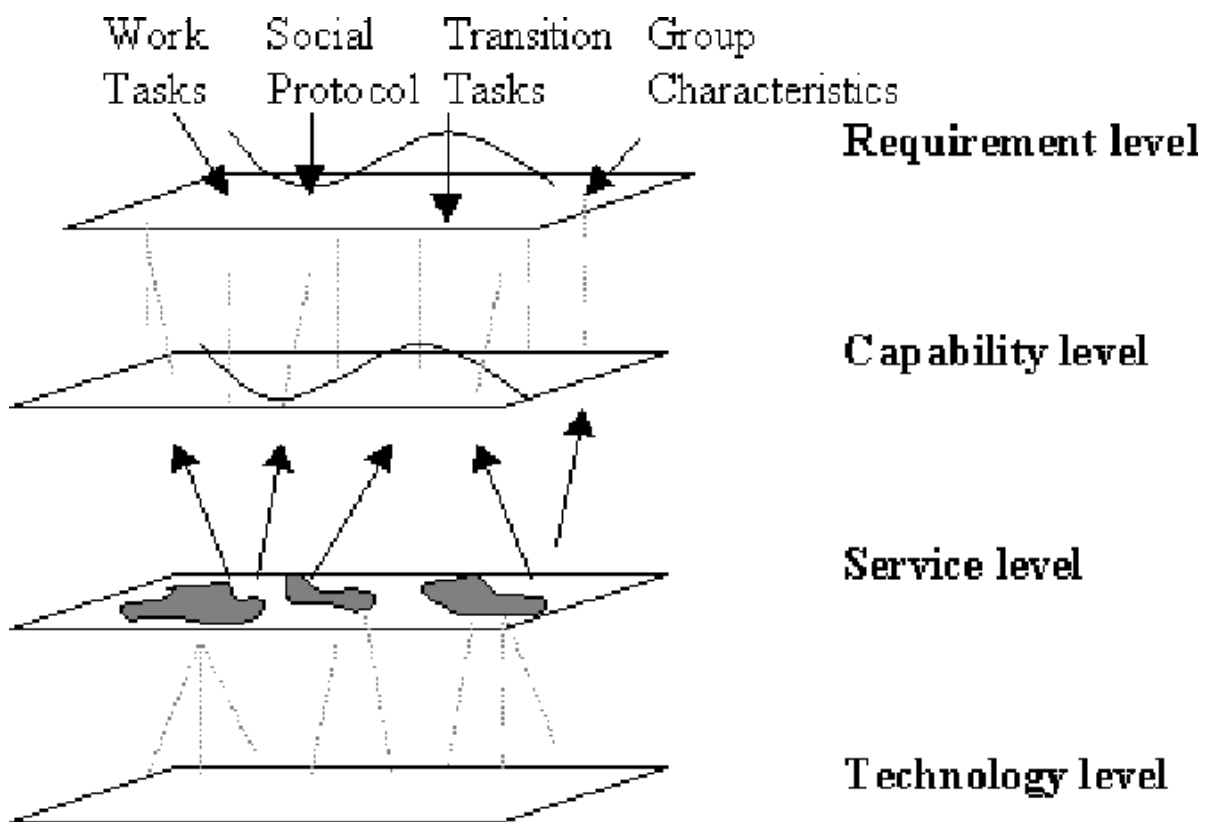
Charles Sheppard divides the collaborative framework into four levels: to begin with, there is the requirement level of the collaborative framework which describes the requirements of the group with respect to the tasks being performed by the group and the support necessitated by the characteristics of the group (Pinsonneault, 1993). The tasks described in the framework include work tasks as well as transition tasks. Requirements for supporting different types of groups include support for the social interactions of the group as well as the requirements due to group size, location, computer platforms, etc. The requirement level is divided into four sections: work tasks, transition tasks, social protocol requirements, and group characteristics (Watts, 1996).

The other level is the capability level of the framework which describes functionality that is needed to support the different requirements. The capabilities can be divided into subsections that correspond to the four subsections of the requirement level. The functionality described in capabilities can be obtained from different services (Watts, 1996). For example: the capability to have a side chat with another meeting participant during an electronic meeting could be accomplished by a text chat service or by telephone service. Certain capabilities may be necessary or recommended to support work and transition tasks, social protocols, and group characteristics in the requirement level (SEI, 2007).

The next level is the service level which describes services such as e-mail, audio, video, application sharing, networking services, etc. that can be used to support the capabilities needed in Computer Supported Cooperative Work (CSCW) systems. Different types of services can be used to provide the same capabilities needed to support specific requirements. Comparisons and trade-offs of performance and cost can be made at this level (Jaffe, 1967).

The fourth level is the technology level which describes specific implementations of services. This level could be considered as the set of all possible components needed to build a given CSCW system, including integration and user interface components (Pinsonneault, 1993). For example, all different e-mail systems would exist at this level, as would the numerous ways to implement floor control, and the various algorithms to control documentation locking and requesting, and the various networking services such as ATM. Specific implementations can be compared with respect to performance, cost, functionality, and usability.

Figure 2. 1: Collaborative framework



2.5 Related Work

2.5.1 Delivering efficiently and strengthening the links in Public Service delivery chains

Effective and efficient are common words in business cycles that have become clichés. Something is effective if it is adequate to accomplish a purpose; producing the intended or expected result. On the other hand it is efficient if it performs or functions in the best possible manner with the least waste of time and effort. In other words, "Being

effective is about doing the right things, while being efficient is about doing the things in the right manner."(Sam Kebongo, 2012, Rwanda).

Providing local public services, which offer value for money and are tailored to the needs of different communities, is an immensely complex task. It requires central and local government to work closely together and to make the best use of a wide range of other agencies (Lyons, 2006). This study analyses the different ways in which public services are delivered, examines the nature of the links between partners in public service delivery chains, and explores how these can be made more efficient and effective (Hofstrand, 2006).

Atlanta based United Parcel Service (UPS), the largest package delivery company in the US, provides various specialized transportation and logistics services. In 2002, UPS transported more than 13 million packages and documents per business day throughout the US and to more than 200 countries and territories (in 2002 delivery volume was 3.4 billion packages and documents). It used a fleet of about 88,000 motor vehicles and more than 575 jet aircraft to serve about 1.8 million shipping customers per business day. During peak season- between Thanksgiving and Christmas, UPS delivered an average of 208 packages a second. This was only possible because there was effective technology.

2.5.2 Effective Technology

The effective management of technology needs to be viewed as a structured iterative business process, which offers organizational learning during the lifecycle of the technology. This feedback is necessary so as to offer businesses the opportunity to learn from their experiences, or mistakes (Demirhan, 2006). Technology management should be seen as a business process that facilitates the development of a comprehensive and robust technocentric infrastructure, consequently enhancing the delivery of accurate, timely, and appropriate services within an organization, which in turn increases the economic vitality of the business. There remains, however, a so called “technology management gap” within many businesses, which may result in a competitive advantage being jeopardized (Irani, 2001).

Remenyi et al (1996) proposes that technology management (when viewed from an evaluation perspective) may not be deployed in an effective manner in many businesses, and thus initiators of the new technology often becomes distanced from the development process. In addition, developers may lose sight of the business focus and as a result not deliver what was originally proposed and justified (Kozma, 2005).

Similarly, Irani et al (2001) suggest that technology management policies and procedures based on the use of traditional appraisal techniques have worked well for decisions concerning manufacturing capital equipment replacement, but are myopic for the appraisal of complex IT/IS such as Material Requirements Planning (MRP) or Enterprise Resource Planning (ERP). The reason for this is that the human and organizational implications associated with adopting new technology (and its management) are often overlooked, or simply ignored. Yet such factors can significantly impact the success or failure of IT/IS investments. Clearly, efficient and effective technology management has the scope to impact companies in a positive or negative way during the technology's lifecycle (i.e., feasibility, justification, requirements definition/engineering, system design, details design, test and pre-operation, implementation, operation, maintenance, and post-implementation audit/evaluation).

2.5.3 Public Examinations Communication & Support System (PECSS) and Attendance & Script Tracking System (ASTS) in HONG KONG

In order to enhance reliability and efficiency of the examination administration process, the “Public Examinations Communication & Support System” (PECSS) and “Attendance & Script Tracking System” (ASTS) in Hong Kong are implemented in all Hong Kong Diploma School Examination (HKDSE) Category A written examinations by the Hong Kong Examinations and Assessment Authority (HKEAA).

PECSS is a user-friendly system involving the use of webcams and an instant messaging programme linked to the HKEAA Command Centre. It comprises 2 modules: (1) Examination Centre Recording System and (2) Examination Centre Communication System.

The Examination Centre Recording System is a programme recording the examination proceedings while the Examination Centre Communication System is an instant messaging programme enabling real-time communication between Centre Supervisors and the HKEAA Command Centre (Demmel & Askin, 2009). It facilitates the smooth conduct of public examinations through enhanced communication with centre Supervisors and support for examination centres to minimise possible impacts on candidates during emergency situations.

The System is used to record the examination proceedings and environment of the examination centre rather than individual candidates. Testing sessions will be arranged with centre schools a few days before the first examination day to ensure good functioning of the PECSS equipment (G.Winter, 2007). Since all equipment is placed on the stage and activated before the examination starts, the examination proceedings will not be affected (INCOSE, 2012). The PECSS will be fully implemented in all HKDSE Category A written examinations conducted in School halls. If the PECSS is used, posters will be displayed at the entrance and prominent locations of the examination centre for candidates' attention and the Centre Supervisor will make an announcement before the examination (Vallance, 2009).

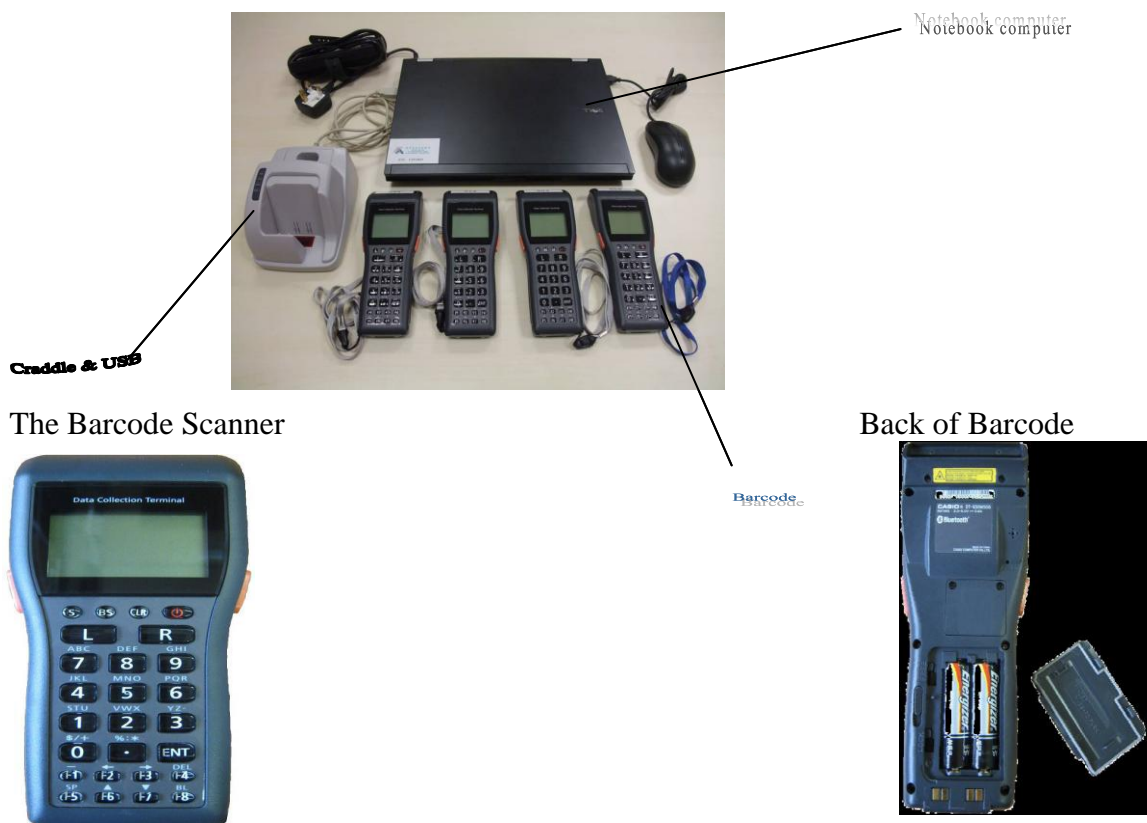
In order to enhance reliability and efficiency of the examination administration process, the Hong Kong Examinations and Assessment Authority has developed an Attendance and Script Tracking System (ASTS) to facilitate the tracking of candidates' attendance and collection of answer scripts in written examinations. The ASTS comprises two components: tracking of candidates' attendance records and tracking of candidates' answer scripts (Farbey, 1993).

During attendance taking, invigilators will use hand-held barcode scanners to scan the barcode printed on candidates' admission forms and on their personalized barcode sheets. Invigilators will also scan the barcode labels stuck on the cover of answer books/multiple-choice answer sheets to record the collection of answer scripts at the end of the examination session (Potterton, 2003). After the scanning process, invigilators will upload the data to the computer for verifying the accuracy of the number of scripts collected against the candidates' attendance records. If there is any discrepancy, all the relevant information will be displayed automatically for the Centre Supervisor to

follow up the matter. Such information will then be transmitted to the Authority for record.

To facilitate the transmission of information to the Authority, the Centre Supervisor will make use of Public Examinations Communication and Support System (PECSS) which involves use of the notebook computer with power supply unit (1 set, share use with PECSS), Barcode Scanners (depending on the number of candidates allocated to the exam centre) and Cradle & USB cable. These are shown below in figure 2.2

Figure 2. 2: Public Examinations Communication and Support System (PECSS).



Source: *Hong Kong Examinations and Assessment Authority (HKEAA).*

2.6 Zimbabwe School Examinations Council increases speed of delivery and accuracy using DRS E-Marker® Technology

The Zimbabwe School Examinations are to be increasingly marked electronically, following a successful trial in 2010. The Zimbabwe School Examinations Council (ZIMSEC) launched the electronic marking scheme in June 2011, a move that saw

them become the first country in Africa to use e-marking for public examinations (SEI, 2007). About 80,000 O-level exam scripts were scanned for certain core subjects like Mathematics and Integrated Science in June 2011 rising to 600,000 scripts for additional subjects including accounting, physics and chemistry. In November 2013, over 1,500 trained markers have been using the new technology, provided by UK specialists DRS Data Services, to mark a growing number of papers on screen, rather than by hand as was previously the case.

“Before, the old conveyor belt system (of manual marking) took 12 to 14 days per subject,” said John Maramba, the Deputy Director at ZIMSEC. “With DRS e-Marker, it takes just 3 to 4 days per subject.” ZIMSEC acknowledged that speed of delivery of exam results was one advantage for adopting electronic marking, but that raising marking standards was the primary objective.

The DRS software is designed to flag up concerns if ever a marker tries to give more or less marks than those expected and also eases the burden of adding the marks manually as it automatically adds and sends the final marks to the database within seconds, eliminating arithmetic errors as well. It was reported that “If a marker does not improve their scoring accuracy, the system closes them out,” said Esau Nhandara, Director at ZIMSEC. It was reported that speed of delivery has also meant that November exam results are now typically being delivered in January, whereas in previous years, it sometimes wasn’t until May as was the case in 2008.

The system has benefited from reducing costs. Given the significant time savings, ZIMSEC estimates savings of up to \$30,000 a day from labour costs alone. Further cost savings are anticipated as the new system becomes more embedded and improvements when the IT infrastructure is realized. Markers will also eventually be able to mark scripts securely from any location and will not be limited by having to attend a centralized marking facility.

ZIMSEC is increasing the number of scripts marked electronically as it adds more and more subjects. This year, two more large papers for both English Language and Maths will be added. This will see the number of scripts scanned in June rise to 150,000, and

over a million in November, representing 50% of all the marked scripts (Hofstrand, 2006).

This current shift towards e-marking follows widespread adoption in other countries, like the UK, where up to two-thirds of exams are being marked electronically, according to a 2013 UK government report by Ofqual (Karl J Lieberherr, 1987).

2.7 Barriers to use of Technology

In a 2006 study, *Hew and Brush* found six general barriers typically faced by K-12 schools in the United States and other countries when integrating technology into the curriculum for instructional purposes. These include lack of resources, inadequate knowledge and skills, institutional barriers, attitudes and beliefs, assessment and subject culture (Green, 1983).

A case study on Patient Care Management and rewards Program in a health centre in USA, by name Aaron E. Henry (AEH) –University of Chicago (2012) which was promoting and tracking wellness behaviours within the context of an existing case-management program noted that while the case study presented several positive findings relative to the use of care management software for improved patient engagement and quality of care, there were notable barriers which do not automatically pull information from other IT systems – instead all health-related documentation must be scanned or entered manually into each system (ISO/IEC/IEEE, 2015). The only current interface existing between system and Incent Pay requires a manual prompt from users to import data as opposed to an automatic process that updates data in the system (Ness, 2004). It was reported that though the system presents opportunities for providers to engage patients in holistic care, rural patients often lack access to transportation or must travel greater distances to obtain services. It was further noted that care management software cannot overcome all barriers to care for some in this vulnerable population. Lack of trust of new technologies inhibits adoption and use.

2.8 Service Delivery

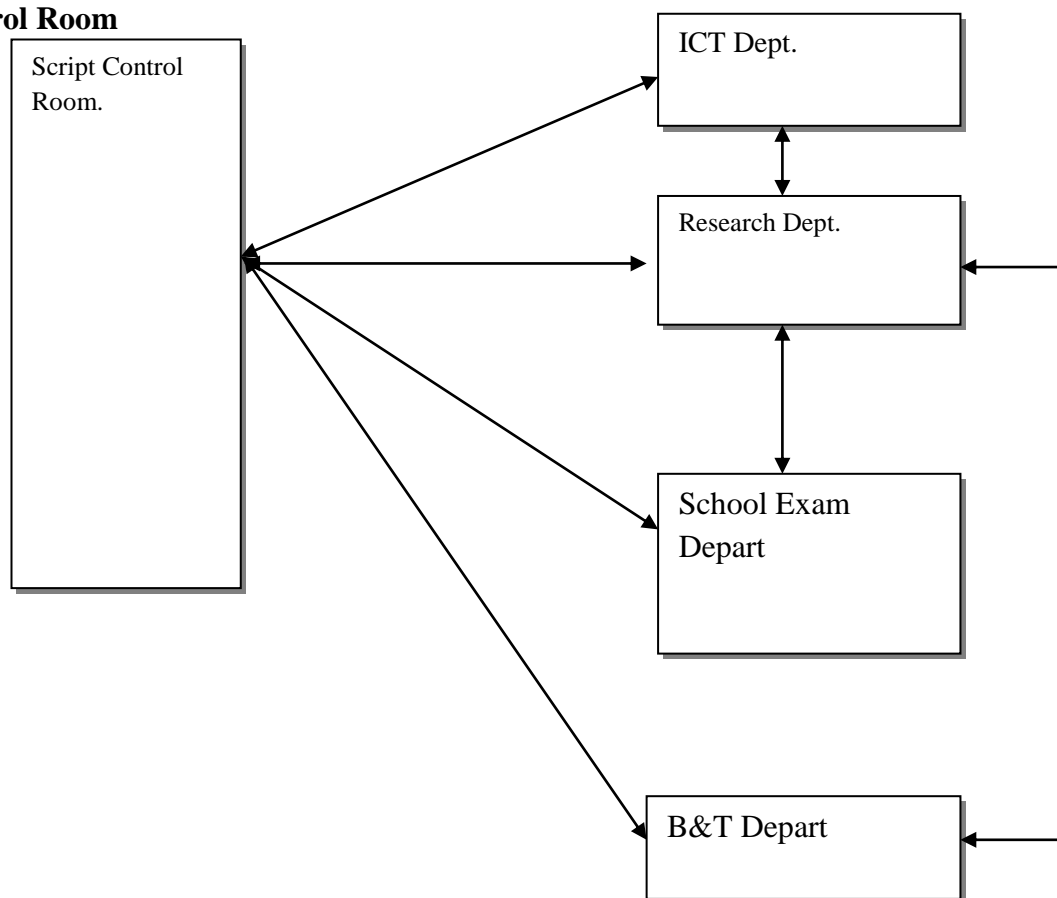
Service Delivery (SD) provides good-practice guidance on the design of ICT services, processes, and other aspects of the service management effort. Significantly, design is understood to encompass all elements relevant to technology service delivery, rather

than focusing solely on design of the technology itself (Chung, 2000). As such, service design addresses how a planned service solution interacts with the larger business and technical environments, service management systems required to support the service, processes which interact with the service, technology, and architecture required to support the service, and the supply chain required to support the planned service (MITRE, 2011). Within script management system design work for an ICT service is aggregated into a single service design package (SDP). Service design packages, along with other information about services, are managed within the service catalogues.

2.9 Conceptual Framework

This is a theoretical structure of assumptions, principles, and rules that holds together the ideas comprising a broad concept. It is an analytical tool with several variations and contexts. It is used to make conceptual distinctions and organize ideas. Strong conceptual frameworks capture something real and do this in a way that is easy to remember and apply. This concept is summarized in figure 2.3

Figure 2. 3: The movement of scripts from different departments to the Script Control Room



After the marking exercise is completed, the candidates' scripts are returned to the Council ware houses for storage. During the processing of results after the marking exercise, the following departments in the Council requisition candidates' scripts for various reasons:

2.9.1 ICT department

Uses candidates' scripts for discrepancies that arise as a result of poor capture of marks.

2.9.2 Research & Quality Assurance (RQA) department

Uses candidates' scripts for validating capture of marks during the marking, remarking exercise and also cases of examination malpractices.

2.9.3 Examination Administration (SE& TE) department

Uses candidates' scripts for remarking, confirming absentee cases and other gaps with blanks of candidates who did the examination.

2.9.4 Examination Administration (B& T) departments

Uses candidates' scripts for remarking, confirming absentee cases and other gaps with blanks. The procedure for the scrip requisitioning is purely manual and all the scripts are centrally warehoused in a go down for better management. The movement of the scripts sometimes is interdepartmental, where for example the Examination Administration department may requisition scripts for remarking and after the remarking exercise, all candidates' scripts of the remarking requests are taken to RQA department for validation and awarding of new grades in case of positive deviation. The requisitioned scripts are then returned to the script control room for storage.

CHAPTER THREE: METHODOLOGY

3.1 Introduction

Methodology provided the various steps that are generally adopted in studying and resolving the research problem along with the logic behind them (Kothari, 2008). In carrying out this project, the researcher used System Development Life Cycle (SDLC) methodology for the sake of control and monitor in particular agile development. This is in order to allow for adjustments in the system to be made as development goes on and in consultation with the users. This chapter describes the steps that were undertaken in designing and developing the Secure, Effective, Efficient, Script Management System. It gives the details of how data was collected from respondents, the system design and the implementation process.

3.2 Study Design

This is a mixed methods study involving both analysis of individual interviews and development of a system to manage scripts at KNEC. Qualitative data and background information collected from the participants was adopted because of the few number of people managing scripts at KNEC as well as for in depth understanding of the current manual script management systems, its challenges and views of the participants on what a good automated system should entail. To conduct this study, the following stages were undertaken

3.2.1 Preliminary Analysis

The objective of this phase was to get an in-depth understanding of the current manual script management process, its nature and scope. The researcher was also to determine the various costs incurred in the current process and time consumed. In regard to the new system, the researcher was to determine approximate cost of how much it will cost to come up with the system, and what will be the benefits before submitting a preliminary plan.

3.2.2 Systems analysis, requirements definition

Defines project goals into defined functions and operation of the intended application. Analyses end-user information needs.

3.2.3 Systems design

This describes the desired features and operations in detail, including screen layouts, business rules, process diagrams, pseudo code and other documentation. The system was developed based on the users responses and researchers knowledge. In this stage, a number of activities were performed to come up with a detailed model of the system. This included the database (back end), interface (front end) and reports structure.

This stage came up with the architecture of the system, and the decision on platforms to be used in developing the system, based on the research knowledge and available software. For back end and reporting, MS SQL server 2008 was used and visual studio 2008 for front end. These platforms are licensed to KNEC and given that the system will benefit it, if implemented, they allowed me to use it. Finally a low level prototype was presented to users for comments, due to their availability and experience at the time when the researcher needed someone for critique.

3.2.4 Development

This stage largely involved the coding of the system, the data base user interface and expected reports. It saw the construction of the application, development of users aids and implementation work plan. The researcher came up with evolutionary prototypes and took each to be evaluated by the users to determine usability before proceeding to the next stage. The feedback obtained from every evaluation done by users was analysed, in cooperated in the design and coded in the system. This was a continuous cycle until the final product was obtained.

Coding of the system was done, and the system was developed using Visual Studio 2008/2010 Package at the front end, given that the package has a number of programming languages, which can be used interchangeably, and also its Support for Parallel Programming. This languages include; Visual Basic, C#, Java script etc. It is loaded with new capabilities, and it stands poised to deliver on the growing requirements of software in a world that now stretches across platforms, cores, styles and standards. Visual Studio 2010 addresses today's challenges, it helps developers build solutions that thrive in the complex industry where they now reside. MS SQL was

used at the backend, given that it is currently being used at KNEC hence can be assumed that majority of the ICT staff are conversant with it.

3.2.5 Visual Studio IDE Improvements

As software development continues to address more and more complex scenarios, developers often feel pressure to be more productive. Visual Studio 2010 adds several new visual features to the editor itself that help with productivity. One of the simpler improvements to try out in the Visual Studio 2010 Integrated Development Environment (IDE) is the ability to drag a child window outside of the IDE parent window.

3.3 Sources of Data

Different approaches of sourcing of data related to the study were employed in this study to give more insight on the script management process. This study interviewed staffs working in the script management unit, officers working in Research department, KNEC officials who are and who will be the managers of the process, Secondary data from magazines, websites, KNEC script management hand book, script apportionment register used to dispatch scripts from KNEC warehouses to the marking centres and back, candidates' registration print out among others were also used. In addition, information on best practices from literature on system design was used. From the documents studied and analysed, the researcher was able to find out the various factors considered in coming up with a system for managing the scripts.

3.4 Sampling of Respondents

Due to the small number of the target population, purposive sampling was employed in selection of the study participants. The sampling was stratified in such a way that the different departments that deal with script management within KNEC were represented. In total, fourteen (14) officers, across 3 departments of ICT, Examination administration and Research and Quality Assurance, were selected for in-depth interviewing.

3.5 Data Collection Tools and Methods

An interview guide was used to collect information from the participants. The guide included a background section of the study participants. In addition, the guide contained both closed and open ended questions that elicited qualitative responses from

the respondents (Mugenda & Mugenda, 2003). Open ended questions in this regard are important because they gather rich information and participants will not be constrained to fit within given categories. By so doing, in depth information was collected.

The questionnaire was structured to fish data from the various officers from the script management unit on a wide range of issues including description of the current system. The issues included cost, time spent, the work force involved, security risks, level of ICT know how and the future envisaged by users. The questionnaires were administered to all the 14 respondents. The researcher worked very closely with one officer in-charge of the script management system unit who was able to guide and critique the system as design and development went on. The questionnaires were interviewer administered. The open ended questions touched mainly on the knowledge of the manual system, its challenges, and possible solutions, and what one would like to see in an automated system both in terms of security and improved efficiency. Specifically the interview guide covered the challenges of the current process in terms of challenges of the current system, cost of the various activities and items in the current manual process and the duration of the various activities. Information on the main features and functionalities the users would want to see in the system was also collected.

From the analysis of the questionnaires, the researcher was able to find out the cost and time spend in carrying out the activities associated with the current manual system, the risks involved and features to be included on the new system.

During the data collection, analysis, design and implementation, the officer in-charge of the script control unit, volunteered to work with me in carrying out the task. He helped with valuable information and guidance on script management and was very instrumental in pre-testing of the data collection tools, and in particular, the questionnaire.

From the interview, the researcher was able to obtain features the users would wish to have them included in the system.

3.6 Rapid Application Development (RAD)

From the James Martin methodology, he noted that RAD recognized that software development was a knowledge intensive process and sought to develop flexible

processes that could take advantage of knowledge gained over the life of the project and use that knowledge to reinvent the solution. He noted that RAD is a development life cycle designed to give much faster development and higher quality results than those achieved with traditional life cycle. It is designed to take advantage of the powerful development software that have evolved recently. The secure collaborative script management system was developed using RAD. RAD is a form of system development life cycle that comprises the conventional step by step such as waterfall model into an iterative process. The method thus includes developing and refining the process models, data models and prototype models in parallel using interactive method. User requirements were collected through interviews and administered questionnaires to KCSE officers at KNEC. The solution was then designed based on the responses which were then prototyped and subjected to users views. The prototype was then reviewed based

on users reactions and again presented back to users. The process repeated itself until a high level prototype was obtained, which was transformed to final system, tested and evaluated.

Justification: RAD allowed for active participation of the users throughout the process to ensure that the expectations and requirements were well understood. This avoided the danger of the system failing the User Acceptance Testing (UAT) and rejecting the system at the end after a lot of work had been accomplished.

Rapid Application Development used less time compared to the conventional software (SDLC) such as the waterfall approach. The various secure collaborative script management system users had an early visualization of the end –product and hence performed rapid unit testing and gave rectifying suggestions in time. They were also able to give suggestions on the appearances of the system to ensure a more user friendly interface.

The current ever changing technological world and competitive business scenarios demands frequent software updates to ensure the customer remains on the business edge. RAD enabled a faster system review method by elimination of redundant steps or using prototyping methods. Rapid Application Development made development process more credible by facilitating customers to provide input in the development process. It utilized the use of evolutionary prototype that were eventually transferred to a final product.

3.7 Description of the System Flow Diagram

Figure 3. 1: System Flow Chart

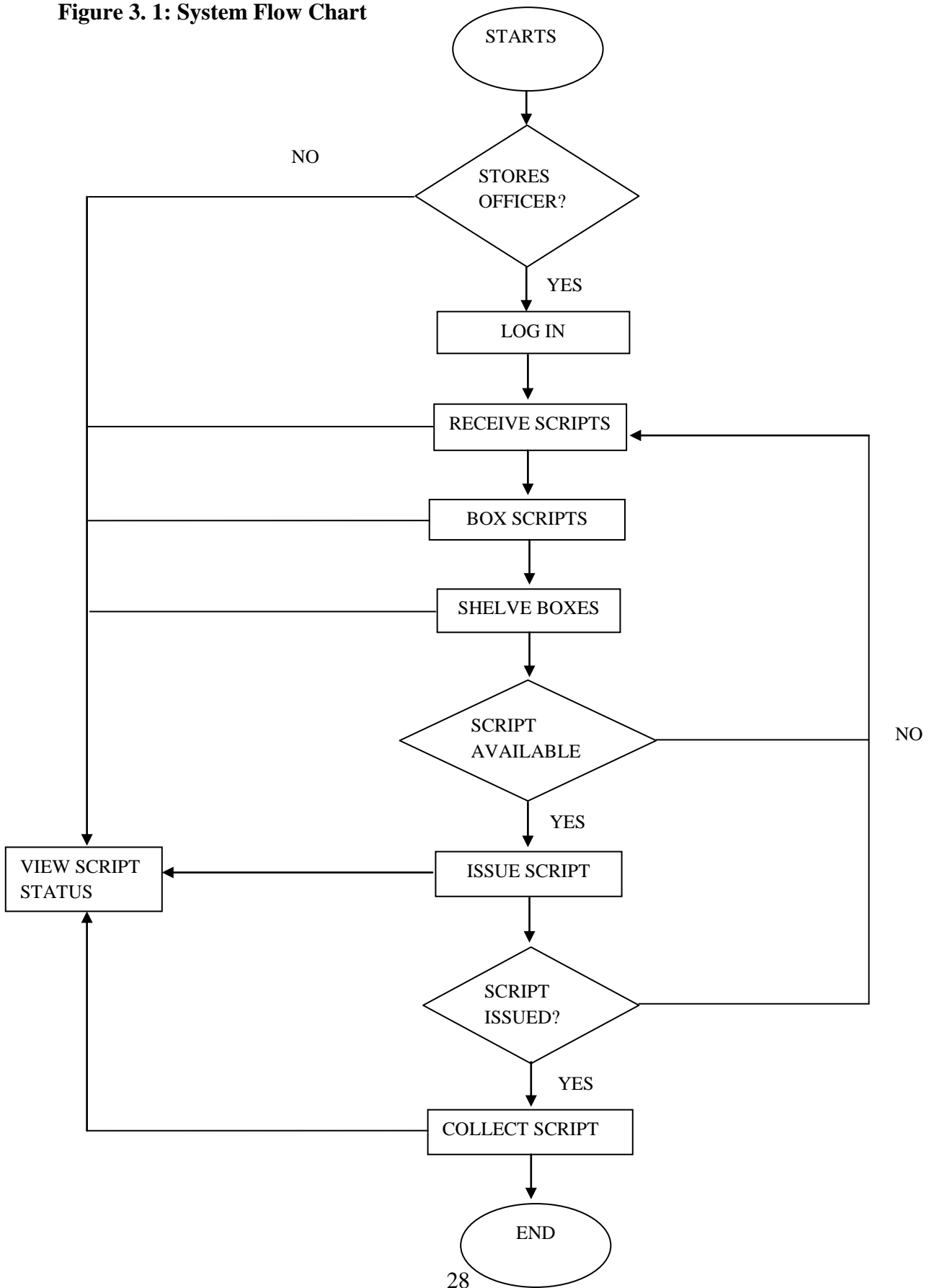


Figure 3.1 above shows the system flow diagram of the secure collaborative script management system. The system works as follows: The Systems Administrator adds users into the script Tracking System. The users added could either be members of the processing team (Subject Officers, officers from Examination Administration, Research and Quality Assurance and Test Development department) or script tracking administrators (Officers who record script details both at dispatch and receipt to and from the marking centres) and are assigned access rights to the system accordingly.

The script tracking administrator is given the rights to sign into the system and add details of scripts and other system users; All the details of the scripts as received from the marking centres are entered into the system by the administrator operating from the Council's warehouse; Script details as mentioned above go into a centralized database housing all script details. The details here include the master apportionment register.

Cataloguing is done to ensure scripts packets are arranged systematically on the shelves. The system catalogue should contain details such as the centre number, the shelf number where the script packet is contained, the row and the box number of the script. The Scripts packets are then removed from cartons and arranged on shelves. At this point, the criteria mentioned above MUST be observed; an officer from processing team signs into the system to locate sample scripts identified for validation.

The criteria formulated by the larger processing team for use during the validation process should guide the officer in locating the relevant shelves with the said scripts. Criteria for selecting scripts for validation could be on the basis of districts, public or private centres, rural or urban examination centres or even the particular subject to be validated. The aforementioned officer will input these details into the system and will have their details (name, date of access, time of access and scripts accessed) captured in the system. These details should be available real time for any other officer trying to locate the same resources. Once the scripts are returned by the said officer, the system should reflect the same.

Depending on the criteria adopted, sampled scripts from various centres obtained from the shelves are then taken for validation. Validation of sampled scripts is done. At this

point, the ICT department provides the processing team with two documents; a printout of all marks captured from all marking centres and data for specific centres sampled for validation.

During validation, authorized amendments are made and discrepancies rectified appropriately. On successful validation, the officer who collected the sample scripts from the shelves has to sign into the system and clear the scripts back into the shelves (Kothari, 2008). This information should be available real time to any other member of the team who signs into the system.

If validation of a particular script is not successful at this point, further scrutiny of the said script is done to ascertain possible cases of examination malpractice. Any discrepancies should have been rectified by the time results are released. Any follow ups can still be done through the system if need be.

Finally is the Generation of reports. This should be the last process in the scripts tracking system. The system should allow generation of various reports such as a report on all scripts validated, a report on all scripts received from the marking centres, a report on the criteria used to pick particular scripts for validation, a report on the subjects validated and many others enough to allow developers to use two (or more) in their work, and this new feature allows you spread out your coding and design windows across multiple screens.

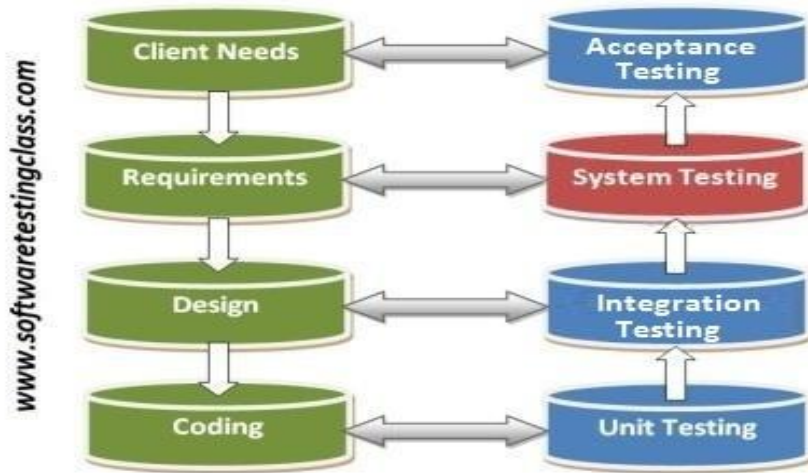
In this system, the user may log in as a normal user or super administrator.

3.8 System Testing

This is the first time end to end testing of application on the complete and fully integrated software product before it is launch to the market. System testing is mainly a black box type testing. This testing evaluates working of system from user point of view, with the help of specification document. It does not require any internal knowledge of system like design or structure of code. System Testing contains functional and non-functional areas of application/product.

3.8.1 Hierarchical levels of testing

Figure 3. 2 Hierarchical levels of testing



(i) Unit testing

Testing is done in the development process while developer completes the unit development. The object of this testing is to verify correctness of the module. The purpose of unit testing is to check that as individual parts are functioning as expected. Basically Unit testing is typically carried out by the developer.

(ii) Integration testing

System Integration Testing is started after the individual software modules are integrated as a group. A typical software project consists of multiple modules & these are developed by different developers. So in integration testing is focuses to check that after integrating modules whether two modules are communicating with each other or not. It is critical to test every module's effect on the entire program model. Most of the issues are observed in this type of testing.

(iii) System testing

This is the first time end to end testing of application on the complete and fully integrated software product before it is launch to the market.

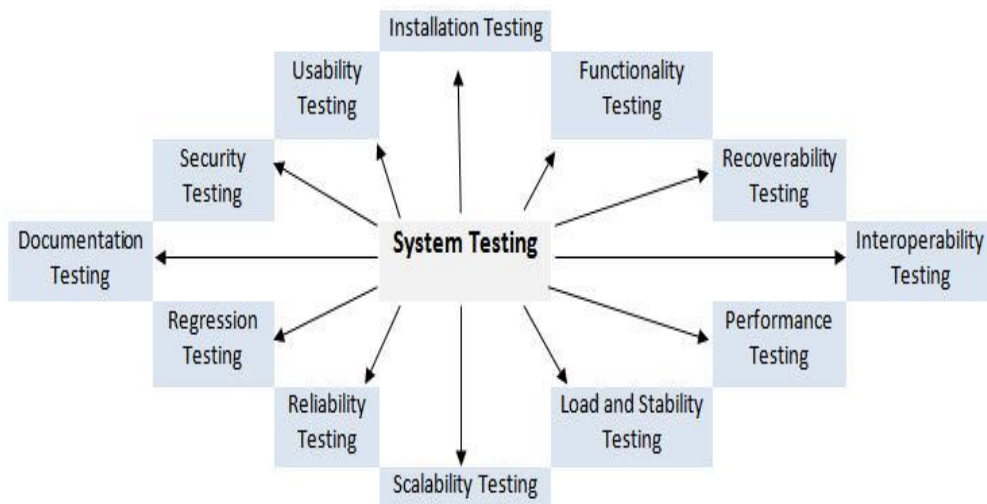
(iv) Acceptance testing

User acceptance is a type of testing performed by the Client to certify the system with respect to the requirements that was agreed upon. This is beta testing of the product & evaluated by the actual end users. The main purpose of this testing is to validate the end to end business flow.

3.8.2 System testing focuses on

- i. External interfaces
- ii. Multiprogram and complex functionalities
- iii. Security
- iv. Recovery
- v. Performance
- vi. Operator and user's smooth interaction with system
- vii. Install ability
- viii. Documentation
- ix. Usability
- x. Load

Figure 3. 3Diagrammatic structure of System Testing



System Testing - © www.SoftwareTestingHelp.com

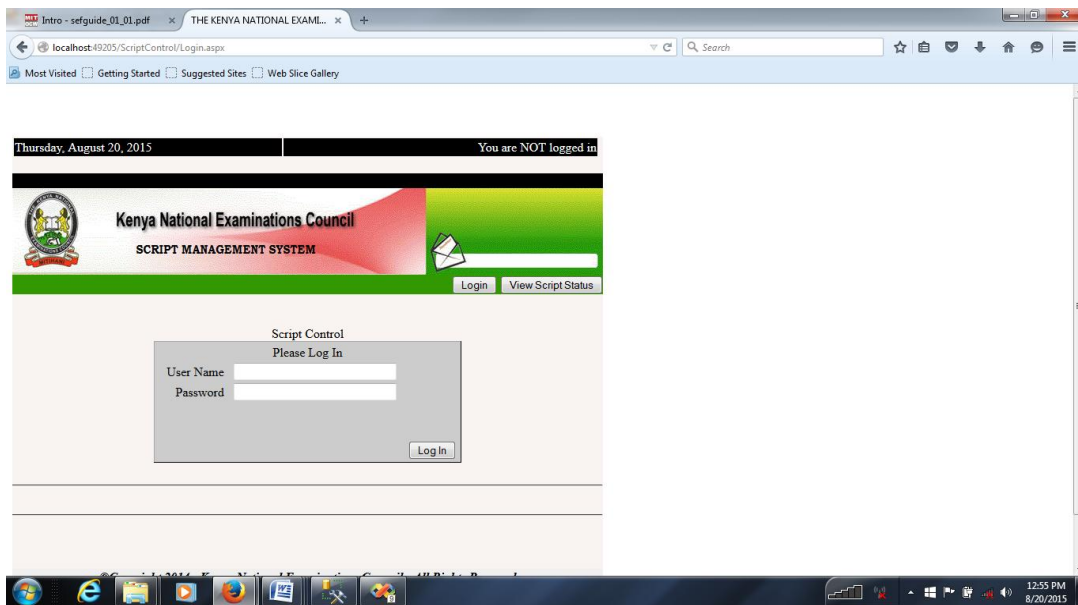
3.8.3 Importance of system testing

- i. It is very important to complete a full test cycle and system testing is the stage where it is done.
- ii. System testing is performed in environment which is similar to the production environment and hence stakeholders can get a good idea of the user's reaction.
- iii. It helps to minimize after-deployment troubleshooting and support calls.
- iv. In this stage Application Architecture and Business requirements are both tested.

3.8.4 System sample test scenarios

- i. If the site launches properly with all the relevant pages, features and logo

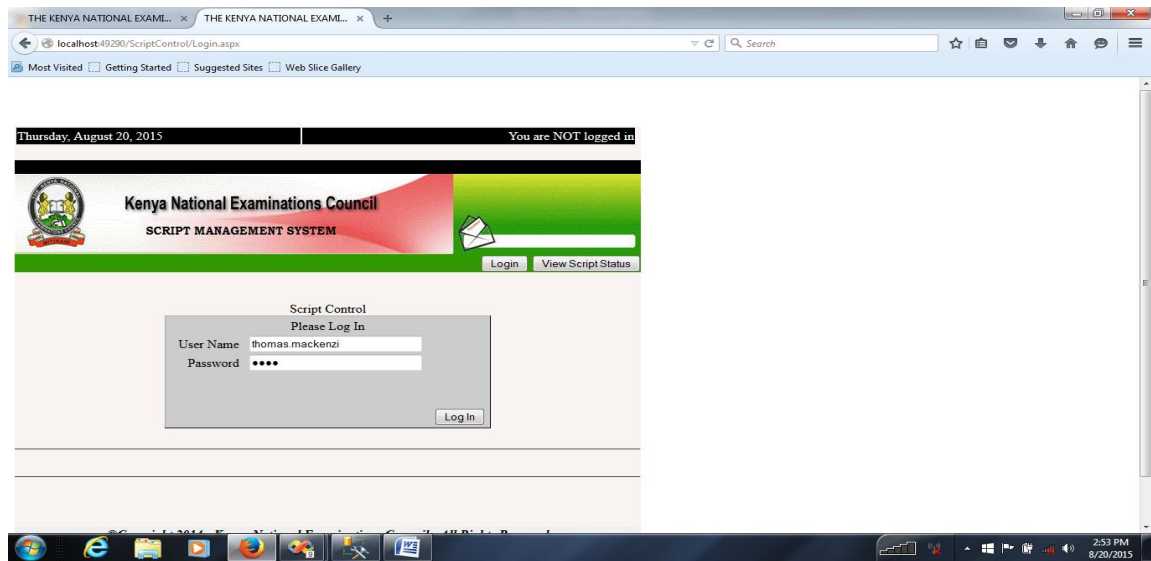
Figure 3.4 System sample test scenarios



The above figure is a template of the features of the script management system with login details for those with access rights when you open the front interface.

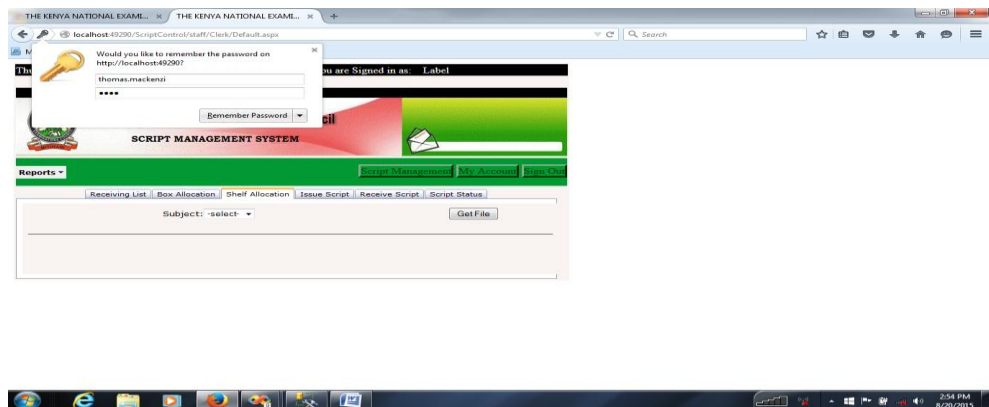
- ii. If the user can register/login to the site

Figure 3.5(a)



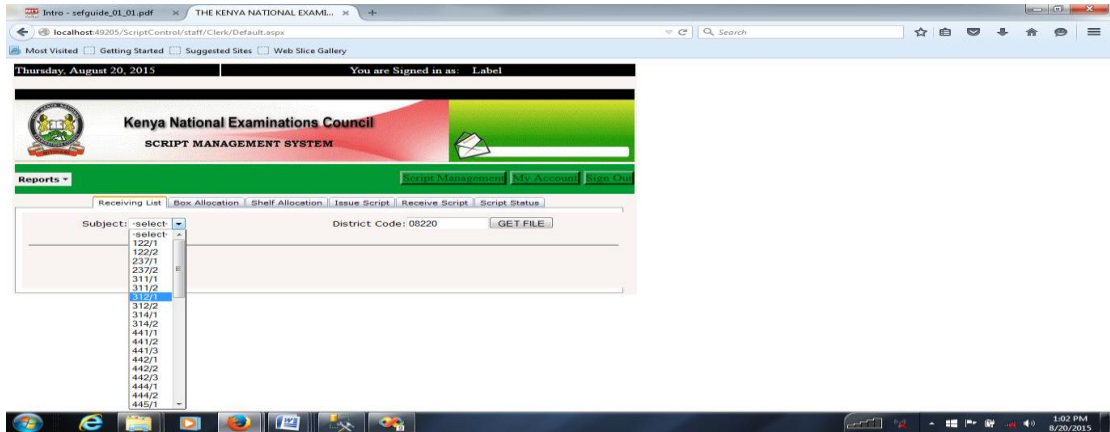
After the user has entered log in credentials, and then clicks login, the system returns the interface in *figure 3.5(b)*

Figure 3.5(b)



2. If the user can see results of requests as previously made (*receiving of scripts from the marking centres*)

Figure 3.6



- i. The user receives scripts from the marking centre.
- ii. He logs in to the system
- iii. He selects the paper for example 312/1- geography paper 1
- iv. He enters the district code where the school resides
- v. He clicks get file
- vi. The system returns a list of schools in that district which are taking that subject and the total number of candidates registered for the subject (*see figure 3.7*)

Figure 3.7



In figure 3.7 above, the user receiving the scripts from the marking centre, enters the details of the scripts i.e. the actual number of scripts against the registered number of

candidates and makes a comment on the discrepancy either as a result of absenteeism (abs) or under protest (up). Once this is done, the user clicks post.

Figure 3.8 below gives the results from the system on the actual scripts and the cause of the discrepancy. On clicking *'post'* the system returns successfully posted see figure 3.9

Figure 3.8



Figure 3.9

3. If the major functionality like assigning the box number to packets received from the marking centre.

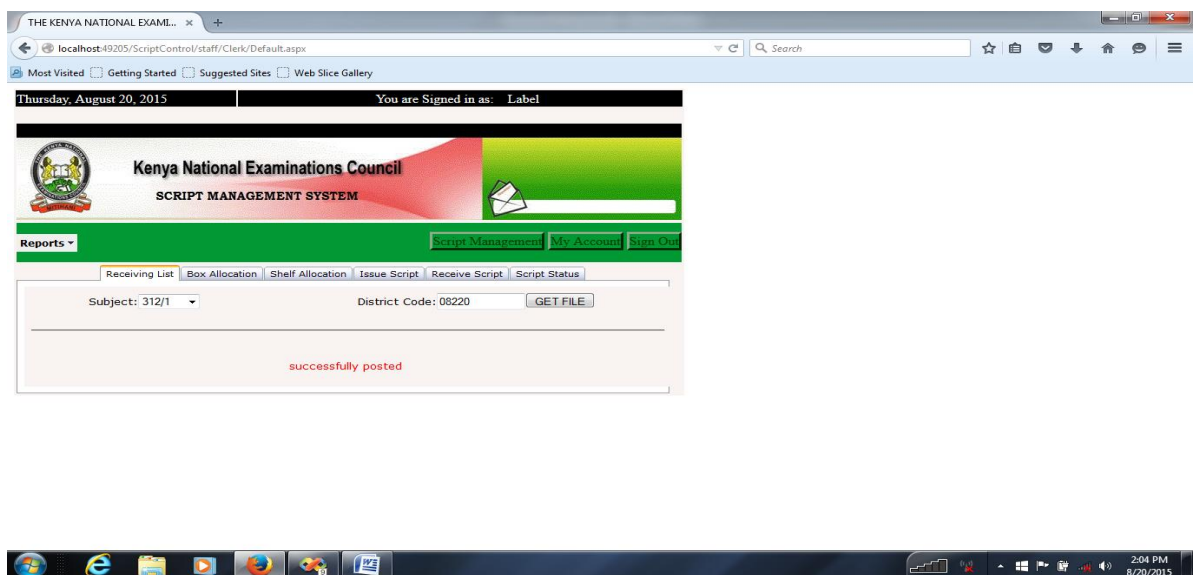
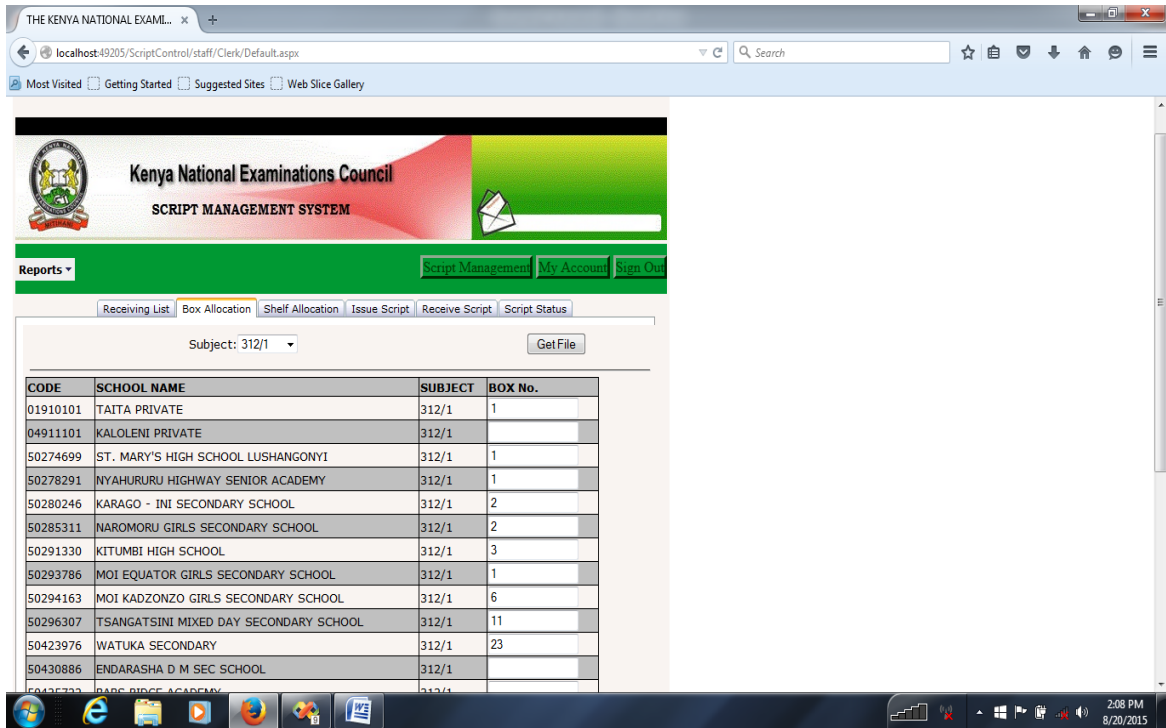
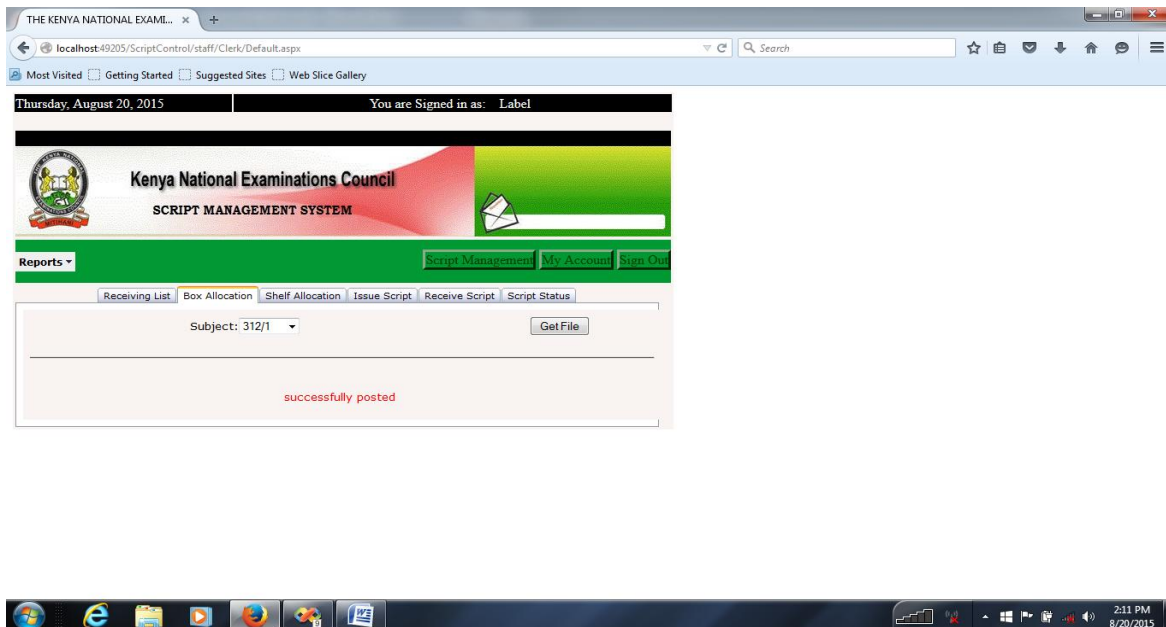


Figure 3.10 shows windows for assigning box numbers to the system of each packet received from the marking centers.



Once the user assigns all the packets for a particular district, and particular subject, he then clicks post and the system returns successfully posted.(*see figure 3.11*)

Figure 3.11 The system successfully post all the entries



The system was subjected in to 3 types of testing namely; unit testing, volume testing and usability testing. Though unit system testing was done by the developer and

internal script unit staff as development progresses, volume testing was done by some officers working in the script room in order to ascertain its suitability.

3.9 System Architecture:

The secure collaborative script management system has three layers,

- i. Interface layer, which is the graphical User interfacing the user, and what he interacts with.
- ii. Input processing layer, used stored procedures for fast processing.
- iii. Database layer where the data is stored.

CHAPTER FOUR: DATA ANALYSIS

4.1 Introduction

This chapter describes the findings of the research in respect to the current manual script management process at the Council and the new system developed. It describes how the manual system works and its limitations.

The background characteristics of the respondents were first presented, followed by the results which were presented for each of the objectives. The first four objectives used data collected from the respondents while the last objective (five) from the system design. For objective 5, a description of the system and procedures of using it as well as its features are described.

4.2 Background characteristics

In total, 14 respondents were interviewed, with 11 (79%) men and the other women. The respondents were drawn from QA (50%) and QB (50%) as shown in table 4.1 below

Table 4. 1: Proportion of the gender of the respondents

Gender	Number	Percentage
Men	11	78.6%
Women	3	21.4%

The age of the respondents varied, with some 21% aged below 25 years; and only 1 aged above 50 years as shown in table 4.2 and in figure 4.1.

Table 4 2: The age of the respondents

Age	Number	Percentage
Below 25	3	21.4%
25 – 30	4	28.6%
31 – 35	1	7.1%
36 – 40	4	28.6%
40 – 50	1	7.1%
51 & above	1	7.1%

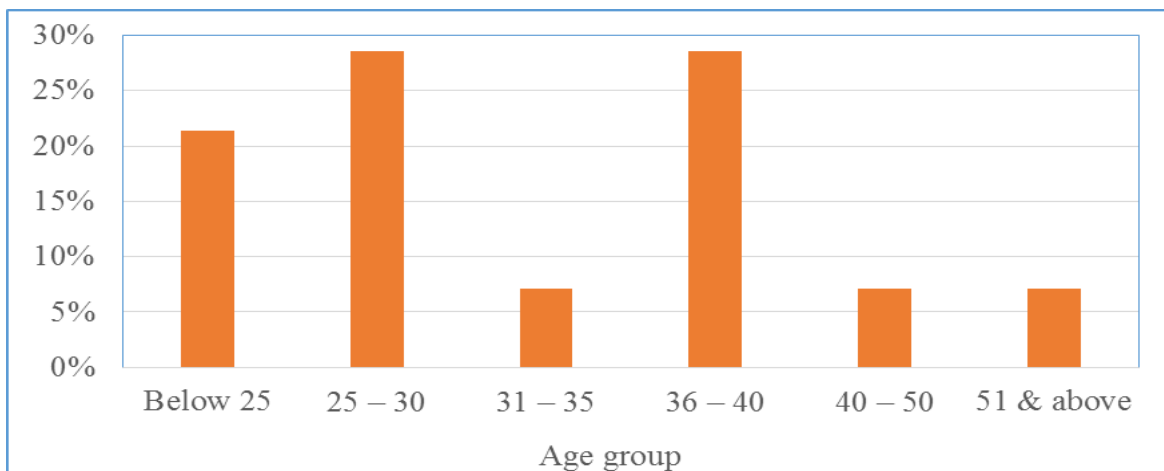


Figure 4. 1 Age distribution of the study respondents

The principle of natural justice holds that particular individuals, groups or communities should neither bear an unfair share of the direct burdens of participating in research, nor should they be unfairly excluded from the potential benefits of research participation.

This purpose of age distribution of the study respondents and consequently their inclusion in research of individuals and groups that might be inappropriately excluded on the basis of attributes such as culture, language, gender, race, ethnicity, age and disability is critical.

The exclusion of individuals, groups or communities may constitute a failure to treat them justly. For example, age has been used to exclude individuals from participation in research, particularly health research (e.g., studies that only accept participants between the ages of 18 to 35). As a result, sufficient research may not be done on groups that fall outside of narrow age criteria. The inclusion of the young and the elderly in research, for example, ensures that treatments frequently given to these populations are effective and safe. In the case of this study, the higher the age, the higher the probability of the individual having spent more years in the use of the system and hence the knowledge of the institutional memory.

4.3 To establish how script are currently managed at KNEC

In this objective, we sought to understand the knowledge of the study participants on the existing manual process and how it works. As expected, all the respondents indicated that they have interacted with the manual system and were quite aware of it.

They indicated that the system is used for managing scripts within KNEC. Specifically, the system involves managing the different stages of scripts from the districts all through marking centres and shelving as well as retrieval. This is captured by one male respondent in **QA**, who noted the use of the manual system: *“the whole process of receiving, arranging or sequencing the scripts because some scripts get open or torn before marking”*

4.3.1 Number of stages in the Current Manual Script Management System

While the respondents seems to all agree on the use of the manual system, there seems not be consistency in reporting of the number of stages. While some reported only two steps, others reported the system to involve five stages as shown in table 4.3 and figure 4.2 as shown below.

Table 4 3: Number of stages in the current manual script management System

Stages	Frequency	Percentage
1	0	0%
2	1	14%
3	4	57%
4	0	0%
5	2	29%

Majority of the respondents reported 3 steps (57%). These results shows, although individuals interact with the system nearly daily, there might not been a clear distinction of some steps or the steps might not have been well articulated and clearly defined.

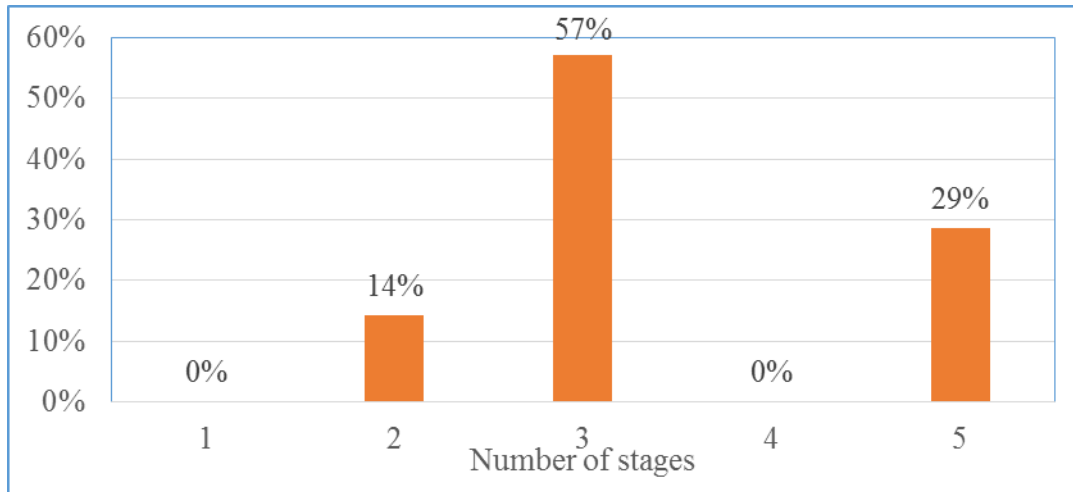


Figure 4. 2: Number of stages in the current manual script management system

4.3.2 Areas with higher security threat

Some stages were reported to have higher security threats and others with high overhead costs. In terms of security, the varied stages were mentioned, however, mixing up of scripts, loss of scripts and receiving the scripts from various stages were noted to as areas with high security threats. In addition, some respondents noted that the whole process of manual management is subject of security threats irrespective of which stage. This is captured by **QB** respondents who noted the following: *“The whole process of receiving, arranging or sequencing the scripts from the examination centres is also prone to security challenges because some scripts get open or torn before marking” and that “Scripts receiving because at the time might not be possible to categorically prove that you received a particular script”*

4.3.3 Areas associated with high overhead costs

In terms of the areas where overhead costs are high, arranging the scripts (sorting, heaping and sequencing) were areas that required a lot of man power, hence high overhead costs. Other areas associated with high overhead costs are, dispatching exams scripts to the centres and also distributing the scripts to the marking centres were noted to be stages which require a lot of resources. These results highlighted some important stages of script management that however, an automated system may not help. However, these stages come with accountability issues as noted by a female respondent in **QA**: Retrieval and search of scripts are other processes that were also reported to require huge resources. A respondent noted that *“retrieval of scripts because someone*

has to go through the recorded script dispatch form to locate the papers required, will need mobilization of personnel”

4.4 To determine the effectiveness and efficiency of the current manual system

In this second objective, I sought to understand the perceived effectiveness of the manual system. If noted to be effective, it is a measure of resistance to new technologies, hence the success of changes within the normal operation. In addition, I sought to get views on how the effectiveness can be increased.

Table 4 4: Level of efficiency and effectiveness

Level	Remarks	Number	Percentage
Effectiveness	Not effective	2	14%
	Effective	12	86%
	Very effective	0	0%
Efficiency	Not efficient	0	0%
	Efficient	13	93%
	Very efficient	1	7%

Table 4.4 and Figure 4.3 shows the reported efficiency and effectiveness of the current manual system being used by KNEC to manage scripts. On the overall, the system is perceived to be both effective (**86%**) and efficient (**93%**). This could be due to its routine operations that people could have been occasioned with. In addition, seasonal workload, which peaks mainly during the examination period could lead to this. Another reason attributed to this is the fact that the only system they have worked with is the manual system and they have no comparison with any other thing.

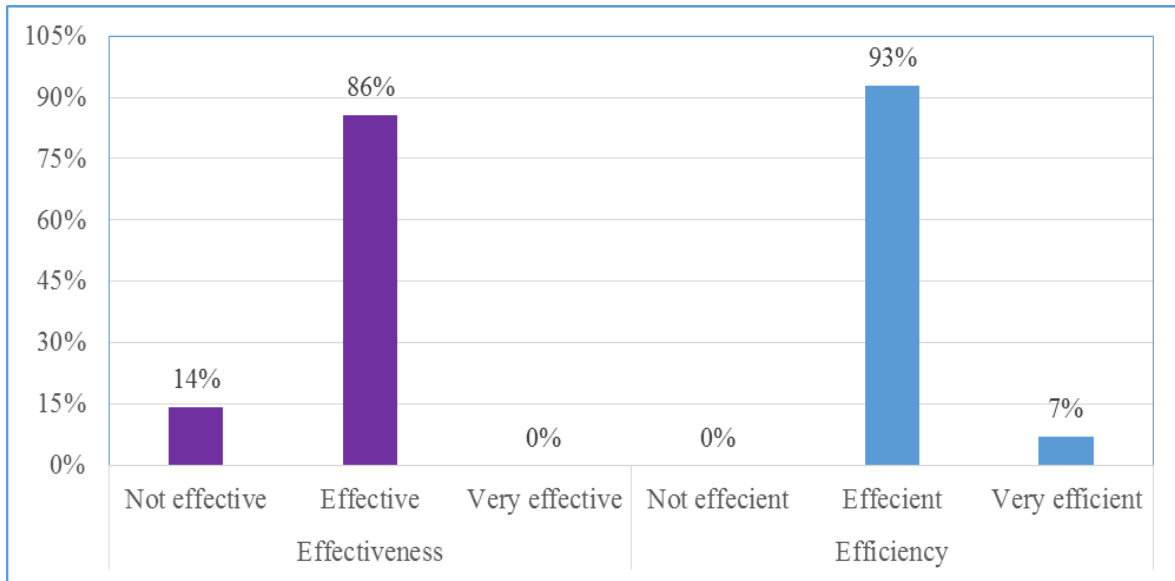


Figure 4. 3: Effectiveness and efficiency of the current manual Script Management System

The efficiency and effectiveness of the system however contrasts the finding that sometimes some scripts are either lost or misplaced and unable to locate them at all. This was reported by all the QA respondents. In terms of the time taken to track lost or misplaced scripts, the respondent indicated that it normally takes a maximum of **20 minutes**. However, in this study we did not seek how often the scripts are lost or misplaced. If this is rampant, then the time spent in locating a script can be surmountable.

In order to have a better understanding of the perceived effectiveness of the manual system, we asked questions related to Online Public Access Catalogue (OPAC). Half of the respondents had used the system before. Among the QB respondents, not only did they note the system to be very effective but also efficient. This could therefore be a penetration point for the automated system.

4.5 To collect user requirements for a script management system at KNEC

One important element of a good system is to critically appraise and take into consideration the user needs. In this regard, their views and involvement in the process from conception to the final stages is paramount. Following this, in this study, respondents were asked to both quantitatively and qualitatively what they would wish to see in an automated system.

First, the respondents were asked whether they think that an automated/computerized script management system would be both effective and efficient than the current manual system, majority, 93% reported in the affirmative. The main reasons given for the perceived effectiveness and efficiency of an automated system touched on saving time and reducing the human errors that characterize the manual system.

For those respondents who reported that the system not to improve efficiency, noted other issues that do not touch on efficiency but rather on security and can easily be abused by some people. For instance, one respondent noted that an automated system: *“Easy manipulation (data may be easily manipulated by those in control or who can easily access it). It may also be lost if in case of security issues”*

4.5.1 Suggestions by respondents on the automated system

a) Requirements for effective and efficient system

In terms of the requirement for an efficient system, the respondents as the end users reported mainly on two issues namely; One, the need for a system that is easily usable and provides the features of not only retrieving, but also locating , tracking and making the scripts secure. *“High security (online security); flexibility; efficiency on collection, processing and diversification/distribution of data and information”*.

Secondly the respondents felt that there is need for suitable hardware component which can help improve on efficiency. For instances, the go-downs where the scripts are stored should be well networked.

b) Security features

The main security features reported by nearly all the respondents was that there should be limited access to the system and those accessible only by use of password with an audit trail of individual transaction. The access to the system should be cascaded, meaning different people have various rights on the system.

In addition, the use of firewalls since the system runs on a network and encryption of information were also mentioned. Also featuring here was use of backups just in case information is lost or compromised. One respondent captured all the three by saying that *“the system needs enforce firewalls as well as passwords. The passwords should*

have hierarchy with different levels of access and rights” and “each officer working on the go-down to have his own password and an audit trail”

4.6 Best practices from the manual system

The current system for now serves the KNEC needs of script management. The system has its own best practices which can be borrowed and transferred to the proposed automated system. The respondents were asked to state what features in the manual system they would wish to have included in the automated system.

They noted that dispatch forms, use of casuals, and the shelves where the materials are stored should continue. This is good news since there are no misconceived minds that the system will deal with all the physical activities that characterize the manual system.

In addition, other features to be incorporated in the system are that it should be able to account for all the scripts if possible identify disparities.

“the box number details where each packet is placed during parking should be maintained even as the scripts are arranged on shelves” and “Include stray papers, re-routed, dispatch forms and masters apportionment receiving checklist”

4.6.1 Design of the computerized system for KNEC

In order to have a feel of what the end users would like to see in the design of the system, the respondents were asked to state how well the computerized system would be designed for use by KNEC officers. The respondents views varied. For instance while some stated simple and efficient system, others were of the opinion that the system should have features that improve efficiency such as bar codes. One respondent noted that the system *“should be simple, accessible and efficient to use by KNEC officers”* and *“Bar code readers can be the most effective in management of the scripts*

In addition, others felt that the system should be designed in such a way that there are controls and accountability levels. By so doing, this keeps track of information within the system and for knowledge management as well. One respondent noted that the system *“Should have a provision for the administrator to key in additional information which might be availed after keying of the main data”*.

4.6.2 Challenges with the manual system

Finally, the respondents were asked to state the challenges they have faced with the manual system, which could be addressed to help improve on the automated system in addition to any recommendations that they may have. Myriad of challenges were noted and included the following:

- i) Increased candidature each year, hence increased work load;
- ii) Manual system consumes a lot of time as compared to automated system, costly, not secure and encourages wastage as summarized by the following respondents *“the manual system is time wasting; tedious and cumbersome; too much paper is used; high costs in matters of paper work”* and *“Very labour intensive; costly in implementation and training personnel; poses security risks”*
- iii) Mixing up of scripts. The respondents proposed different packaging colours for the different subjects for easier identification of misplaced scripts packages.

4.7 The respondents made the following recommendations

- i. Introduction of an automated system, which is efficient and reliable as summarized by one respondents *“introduce an automated or computerized system to assist in script management; enforce reliable and secret passwords”*
- ii. Employment of more qualified personnel, if the current system is to continue being in use
- iii. Use of different packaging materials for the different subjects to easily sort out mix-ups
- iv. Introduction of other features in the packaging materials that ensure accountability such as bar codes *“put a barcode reader in return envelopes so that the user just swipes and gets the records of the packet and the contents”*

4.8 System Analysis

This is the process of studying a procedure or business order to identify its goals and purposes and to create systems that will achieve them in a more official manner.

4.8.1 Feasibility analysis

A feasibility study, also known as feasibility analysis, is an analysis of the viability of an idea. It describes a preliminary study undertaken to determine and document a

project's viability. The results of this analysis are used in making the decision whether to proceed with the project or not. This analytical tool used during the project planning phase shows how a business would operate under a set of assumption, such as the technology used, the facilities and equipment, the capital needs, and other financial aspects. The study is the first time in a project development process that show whether the project create a technical and economically feasible concept. As the study requires a strong financial and technical background, outside consultants conduct most studies. (Matson 2000)

Below is an evaluation and analysis of the implementation potential of the SCSMS project based on the following: economic, operational and technological factors

i) Economic

Economic evaluation is a vital part of investment appraisal, dealing with factors that can be quantified, measured, and compared in monetary terms (Chen 1996). The results of an economic evaluation are considered with other aspects to make the project investment decision as the proper investment appraisal helps to ensure that the right project is undertaken in a manner that gives it the best chances of success.

The cost of collecting requirements, conducting feasibility study was cheaper given that the target respondents were KNEC staff, who are colleagues of the researcher and stationed within Nairobi, where the researcher too was stationed. The travelling cost was therefore reduced near to zero.

When it came to testing, the same KNEC staff, who had interest in the project were able to access the system for their offices and test it, hence no cost incurred. Acquisition of development tools i.e. computer and software was also easy as the company; KNEC had readily provided them to the researcher, given that it had interest in the project too.

ii) Operational

Assessing operational feasibility is to gain an understanding of whether the proposed system will likely to solve the business problems, or take advantage of the opportunities or not. It is important to understand how the new systems will fit into the current day-to-day operations of the organization.

Also, system analysts need to assess whether the current work practices and procedures support a new system and how the organizational changes will affect the working lives of those affected by the system. (Jaffe 1967) Implementing the new IT/IS project may cause some obstructs and may increase difficulty to the staffs in their day-to-day operation.

It is not only important to evaluate whether a system can work, but also evaluate whether a system will work. A workable solution might fail because of the end-user or management resistance, such as, how will the working environment of the end-users change, or whether end-users and management can and will adapt to that change.

The current process is manual and no system is in place, which results to higher cost and much time consumption. The KNEC users on the other hand are eager to have a system that will reduce their work load and time spent on this activity, as evident on the test results.

The SCSMS was intended to adequately solve the problems associated with the script management from the time scripts are received from marking centres to the Council ware houses up to the time they are disposed. The complete management of scripts will be realized when the candidates' scripts will be tracked from the examination centres, to distribution centres, to Council offices, to marking centres, and back to the Council ware houses up to the time they are disposed.

iii) Technological

Assessing technical feasibility is to evaluate whether the new system will perform adequately and whether an organization has ability to construct a proposed system or not. The technical assessment help answer the question such as whether the technology needed for the system exists, how difficult it will be to build, and whether the firm has enough experience using that technology.

“It worked great and clients were happy with it and felt that it met their needs, but obviously that platform needed to be upgraded to meet the current technology direction for the industry. It was no longer going to be supportable long-term” said Sara L. Brooks, chief strategy officer for Fiserv’s credit union division (Swedberg, 2005).

In developing the new system, one has to investigate and compare technology providers, determine reliability and competitiveness of that system, and identify limitations or constraints of technology, as well as the risk of the proposed system that is depend on the size of the system, complexity, and group’s experience with the similar systems.

The system could have been designed using a number of development tools but since KNEC uses Visual Studio 2008, and SQL 2008, which are licensed to the Council, the researcher decided to utilize the same having been allowed by the Council. Other equipments used in this project included the following: a computer, host server for hosting the application, Network/internet and Business intelligence for reporting.

4.8.2 System Limitations

The SCSMS has some limitation, majority due to the platforms it uses:

- (i) The system can only be used in managing KCSE scripts
- (ii) The download able script template can only be used in Microsoft word.
- (iii) The maximum file size when uploading is 18MB, a document with many or large graphics is time out.
- (iv) The response time is about 80-100 seconds and users with slow internet connectivity can be timed out.

4.9 Comparison between the Manual Script Management System and the Secure, Efficient, and Effective Script Management System

Table 4 5: Comparison between the Manual Script Management System and the Secure, Efficient, and Effective Script Management System

S/no.	Check list	Secure , efficient, effective script management System	Manual system	Remarks
4.9.1	Type of system	Semi automated	Completely manual	Automated more efficient than the manual system
4.9.2	Locating or searching a script	If the script was received from a marking centre, then it will take 1 minute	From the study carried out, a lost script takes about 20 minutes to	The automated system is more efficient and effective in

		to locate the script	locate it	terms of time, wastage
4.9.3	Reliability	Automated system is more reliable, as it is performed by tools and/or scripts.	Manual system is not accurate at all times due to human error, hence it is less reliable.	
4.9.4	Speed of the system	Automated system is executed by software tools, so it is significantly faster than a manual approach	Manual system is time-consuming, taking up human resources.	Automated system is more speedy as compared to the manual system
4.9.5	Stimulation	Stimulating	Not stimulating. There is fatigue at times	
4.9.6	Customer satisfaction	The system is able to serve a customer in a better way	Customer queries can be very difficult to resolve as the information is stored in different places	
4.9.7	Time	The system is cheap in hard ware, development and execution	Time consuming and costly to produce results	The manual system is Non effective and efficient while automated one is efficient and effective
4.9.8	Security	The system is more secure since there is less human intervention	There is more human intervention and cases of scripts getting lost is reportedly high	Automated system is more secure than the manual system
4.9.9	Efficiency	Less wastage in time, skills man power in search of	A lot of time, skills, energy wasted in search of	Automated system is more efficient and

		scripts	scripts	hence preferred.
4.9.10	Effective	It has centralized database and queried results are real time and takes less time.	The database is manual and hence slow and shown by the results of the study	Automated system is more effective.

4.10 Discussion of the results of the Questionnaire administered to the respondents on the Automated Secure Collaborated Script Management System

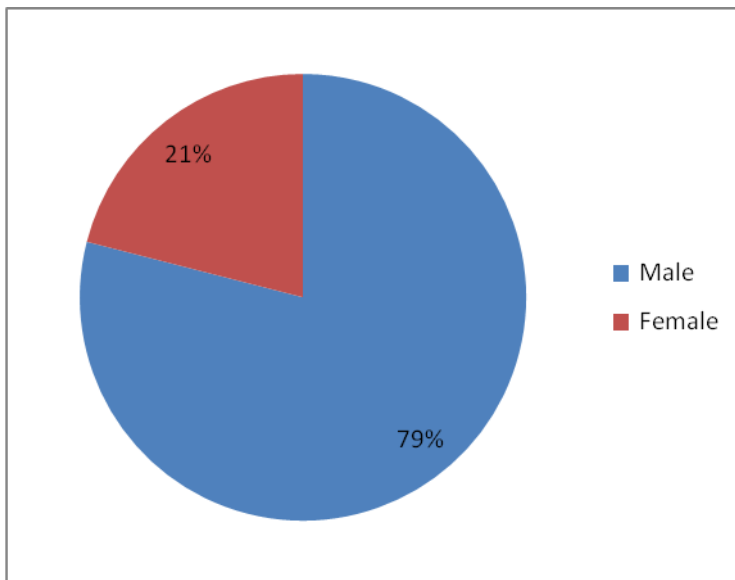
4.10.1 Background characteristics

In total, 14 respondents were interviewed, with 11(79%) men and 3(21%) women as shown below.

Table 4 6: Proportion of the gender of the respondent

Gender	Number	Percentage
Men	11	79%
Women	3	21%

Figure 4. 4 Proportion of the gender through a pie chart



4.10.2 Period of usage of the current SCSMS

All respondents had a prior knowledge of the current automated system and used the system for a couple of months ranging from one month to six months. Six (43%) of the

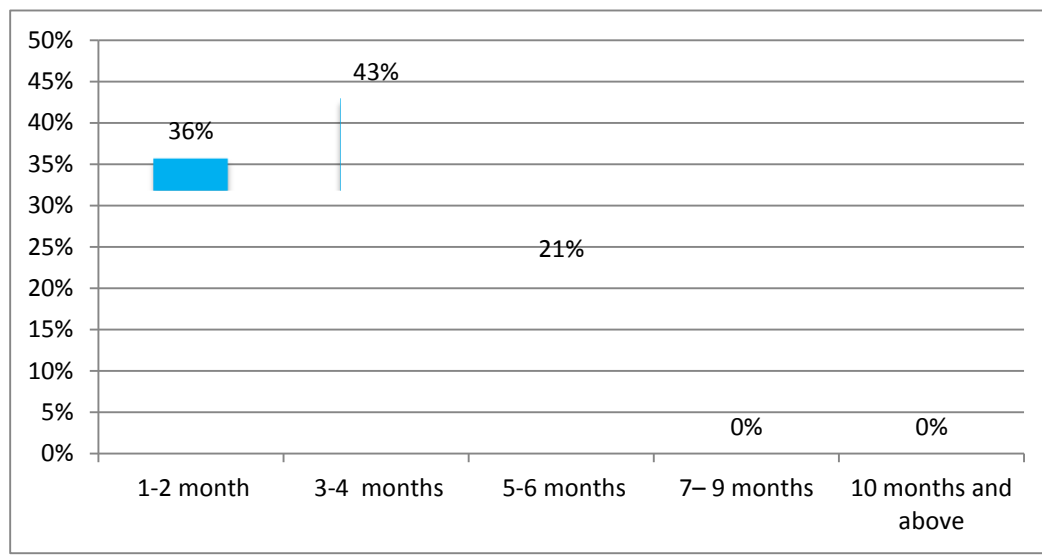
respondents have used the system for a period of 3-4 months which is enough period to know the limitations and advantages of using the system as shown below.

Table 4 7: Period of usage of the current SCSMS

Period	Number	Percentage
1-2 month	5	36%
3-4 months	6	43%
5-6months	3	21%
7– 9 months	0	0%
10 months and above	0	0%

Table 4.7 above and figure 4.5 below shows the period of usage of the current Secure Collaborative Script Management System. 79% of the respondents had used the new system for a period of between one to four months where as 21% of the respondents had used it for a period of 5(five) to 6(six) months. This period was adequate to enable the users to evaluate the efficiency, effectiveness and the level of security.

Figure 4. 5:Period of usage of the current SCSMS



4.10.3 Level of efficiency and effectiveness

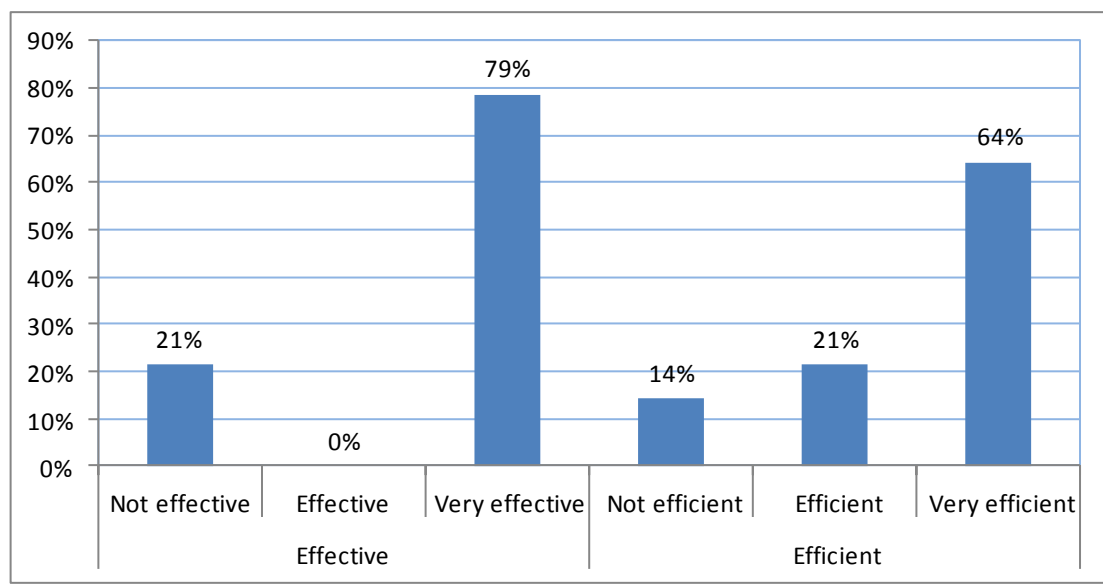
Table 4.8 and figure 4.6 below shows the level of effectiveness and efficiency of the Secure Collaborative Script Management System (SCSMS) designed to manage KNEC

examination scripts. On the overall, the (SCSMS) was perceived to be both effective at (79%) and efficient at (85%). Although there was 21% and 14 % of the respondents indicating that the system was not effective and efficient respectively, all 14 (100%) respondents agreed that the system is more effective and efficient compared to the manual script management system at KNEC since it has reduced the time taken to locate a script and also loss of scripts significantly unlike the case with the manual script management system.

Table 4 8: Level of efficiency and effectiveness

Level	Remarks	Number	Percentage
Effectiveness	Not effective	3	21%
	Effective	0	0%
	Very effective	11	79%
Efficient	Not efficient	2	14%
	Efficient	3	21%
	Very efficient	9	64%

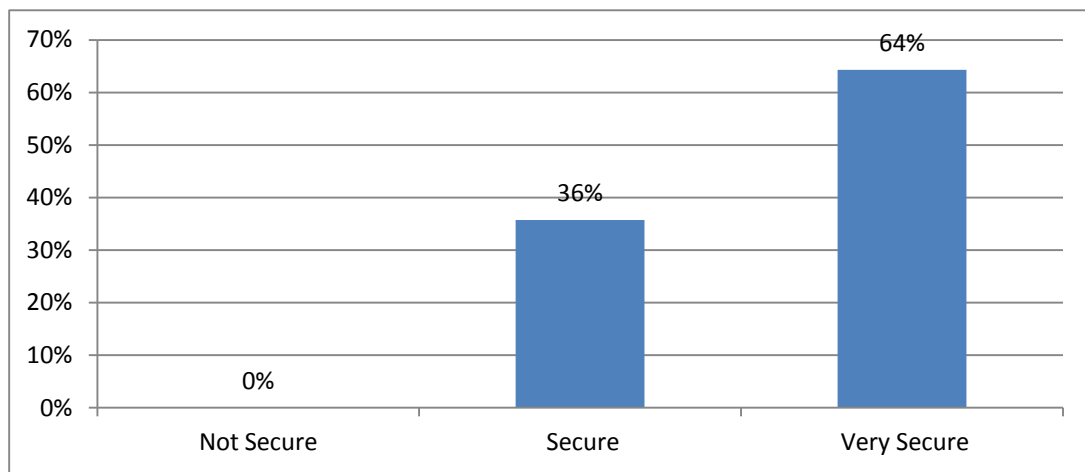
Figure 4. 6: Level of efficiency and effectiveness of the SCSMS



4.10.4 Security requirements

The system is perceived to be very secure with 64% (9) of the respondents agreeing to this aspect and 36% agreeing that the system is secure which amounts to 100% that the system is secure since only the authorised personnel can access the data in the system and there is a main administrator who takes into account through the audit trail the persons who have logged into the system and the activities that have been carried out. The respondents rated the system to be very secure because of the fact that it was not possible to access it without the required authorization control.

Figure 4. 7: Level of Security of the SCSMS System



(i) Audit Trail

An audit trail is a series of records of computer events, about an operating system, an application, or user activities. A computer system may have several audit trails, each devoted to a particular type of activity. Auditing is a review and analysis of management, operational, and technical controls or An *audit trail* (also called *audit log*) is a security-relevant chronological record, set of records, and/or destination and source of records that provide documentary evidence of the sequence of activities that have affected at any time a specific operation, procedure, or event.

Figure 4.7a and 4.7b below shows the interfaces for reports of the script management system. Under this interfaces, there are three types of reports, namely, Receiving of scripts, Issued scripts and Audit trail . Under the audit trail, the system is able to generate reports on box allocation, login details of all the persons who accessed the system at a given moment and all the transactions on the scripts

received. The system is able to capture the time and the date when the transaction was carried out. This is an indication that the system is secure

Figure 4.7a.

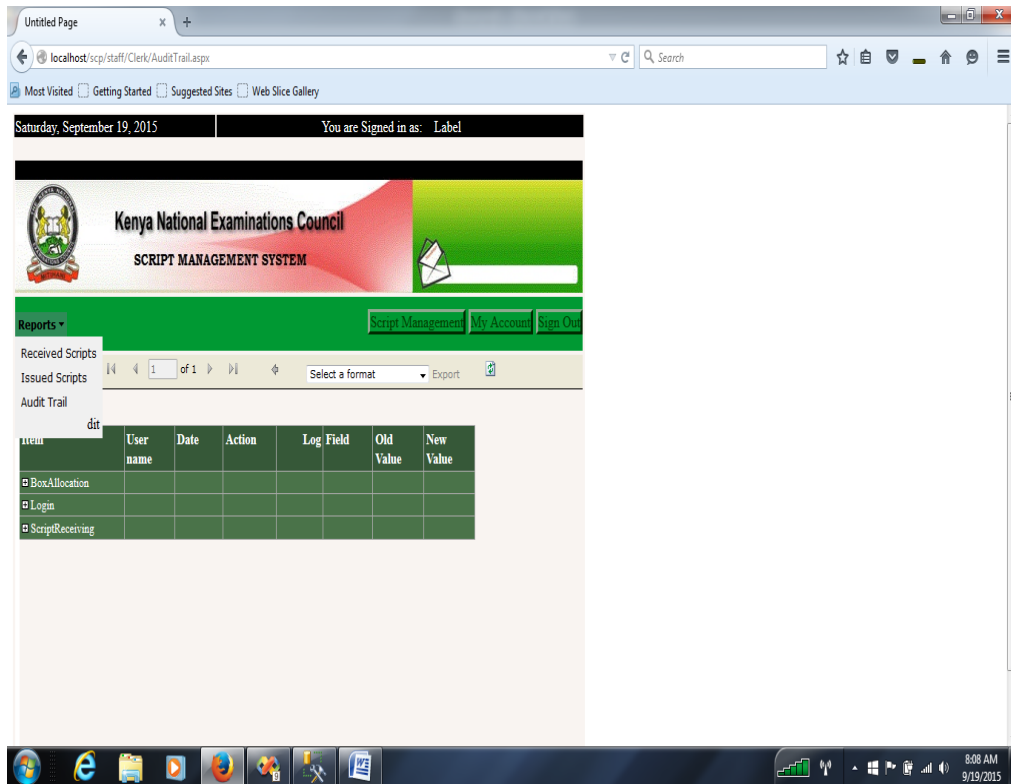


Figure 4.7b.

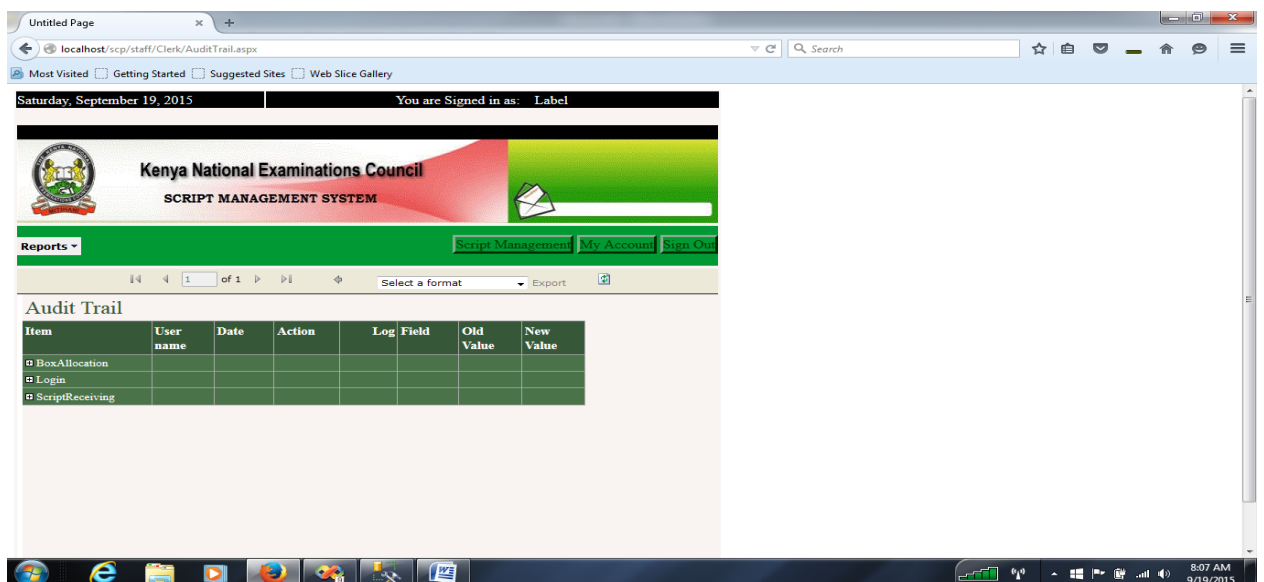


Figure 4.7c and figure 4.7d below shows Audit trail and Audit trail details in terms of audit trail Id, user name, user action, user action log, business objective, record Id,

record Id and date created. Figure 1c shows the details of the Audit trail in the Audit field that shows the actual details of the Audit trail in terms of the old and new field.

Figure 4.7c

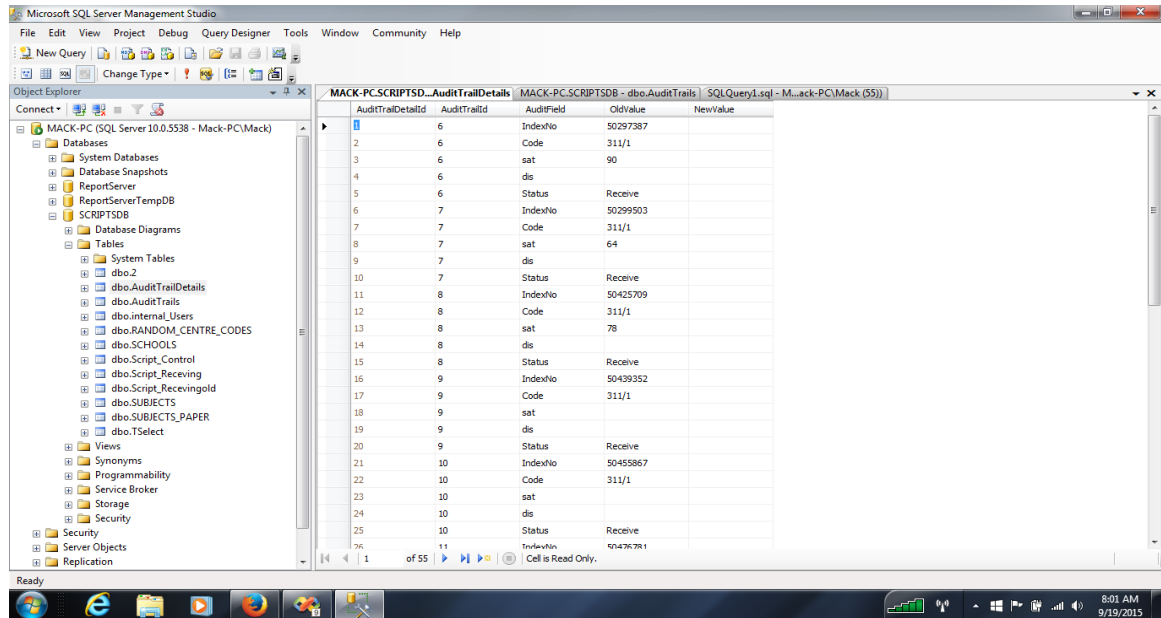
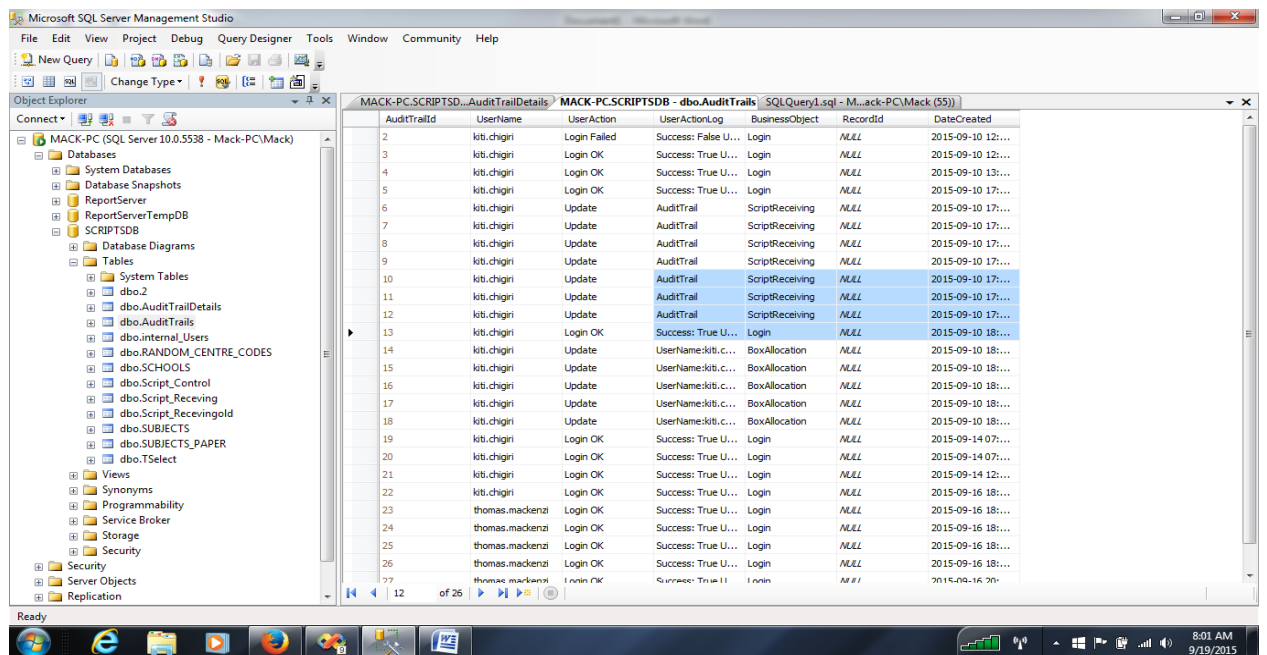


Figure 4.7d



4.10.5 To establish how script are currently managed at KNEC

We sought to understand the knowledge of the study participants on the new automated system and how it works. All the respondents indicated that they have interacted with the new automated system and were quite aware of it. They indicated that the system

shall be used for managing examination scripts within KNEC. Specifically the system involves managing the different stages of scripts from the marking centres, storage at the go downs through systematically shelving for easy tracking during processing, retrieval and movement of the scripts interdepartmental up to the time they are disposed.

4.10.6 The number of stages of the new automated system

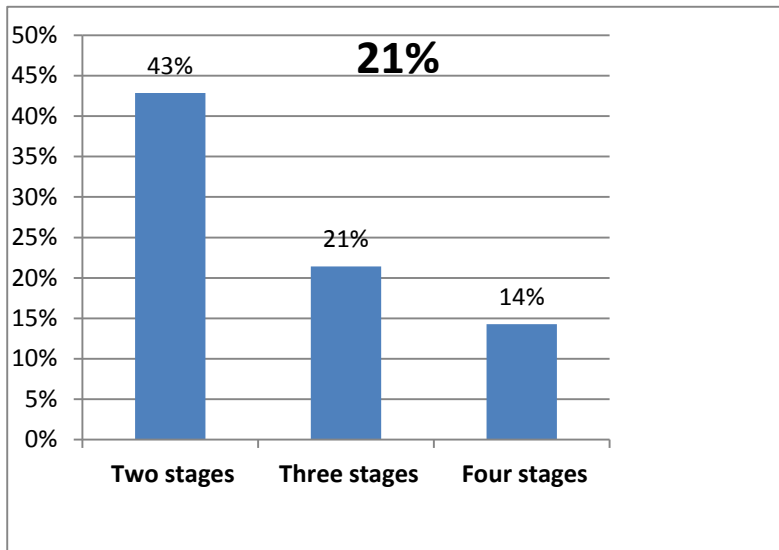
While the respondents seem to agree on the use of the automated system, there seems not to be consistency in reporting of the number of stages. Some reported only two stages while others reported up to four stages as shown below.

Table 4.9 and figure 4.8 shown below shows that majority of the respondents (43%) reported 2 stages in the SCSMS. This observation could be attributed to the fact out of the six main stages i.e. receiving of scripts, box allocation, shelf allocation, issuing of scripts, receiving back the scripts and reports on scripts status, the first three steps are at the lowest level in terms of the management of scripts though very key. It is at this level where majority of the respondents interacted with the system. It is the first level of entering the scripts in the system, boxing and then shelving. In table 4.9 and stages 1 &2, 64% of the respondents lay on this area. It is the lowest level where technician and support staff are allowed to operate from (level of accessibility of different modules in the system).

Table 4 9: The number of stages of the new automated system

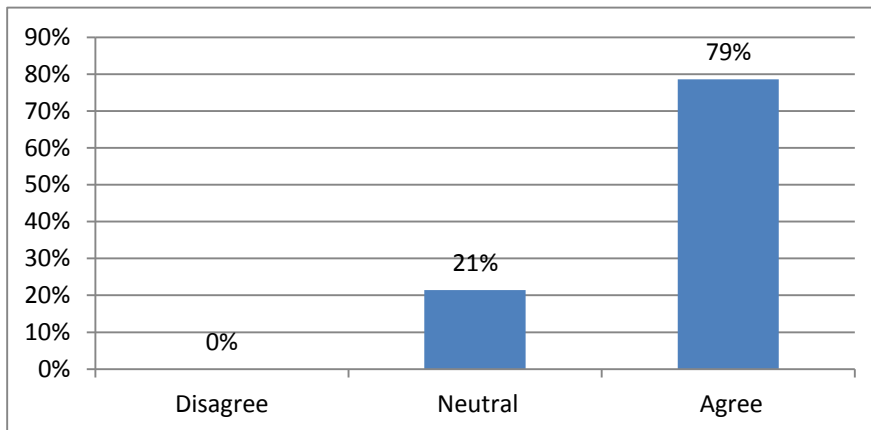
Stages	Frequency	Percentage
1	3	21%
2	6	43%
3	3	21%
4	2	14%

Figure 4. 8: The number of stages in the new automated system



4.10.7 The amount of time and cost required to locate a script has reduced significantly

Figure 4. 9: Time and cost significantly reduced



The interviewer/ researcher sought the opinion of the respondents on whether the amount of time and cost of locating a script has reduced significantly on a three point scale of disagree, neutral and agree. 79% of the respondents were in agreement that the amount of time and money has significantly been reduced and is shown in figure 4.9 above. This position could have been influenced by the fact all the fourteen (14) respondents have worked in the past with the manual script management system and have also used the automated SCSMS and were convinced that the system has shortened time and reduced the cost of locating a script.

4.10.8 Secure collaborative Script Management system (SCSMS) is centralized and results are real time

Figure 4. 10: SCSMS is centralised and results are real time.

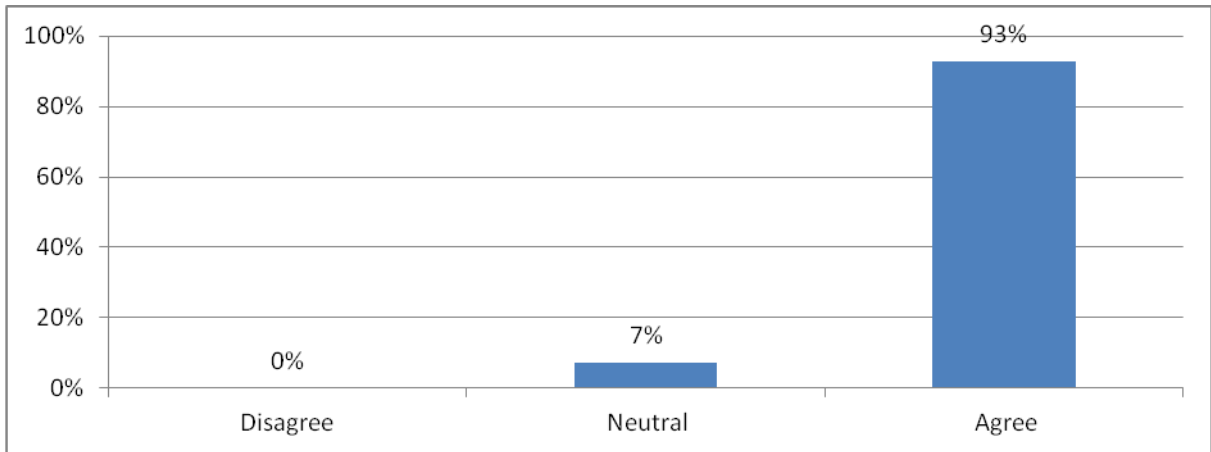
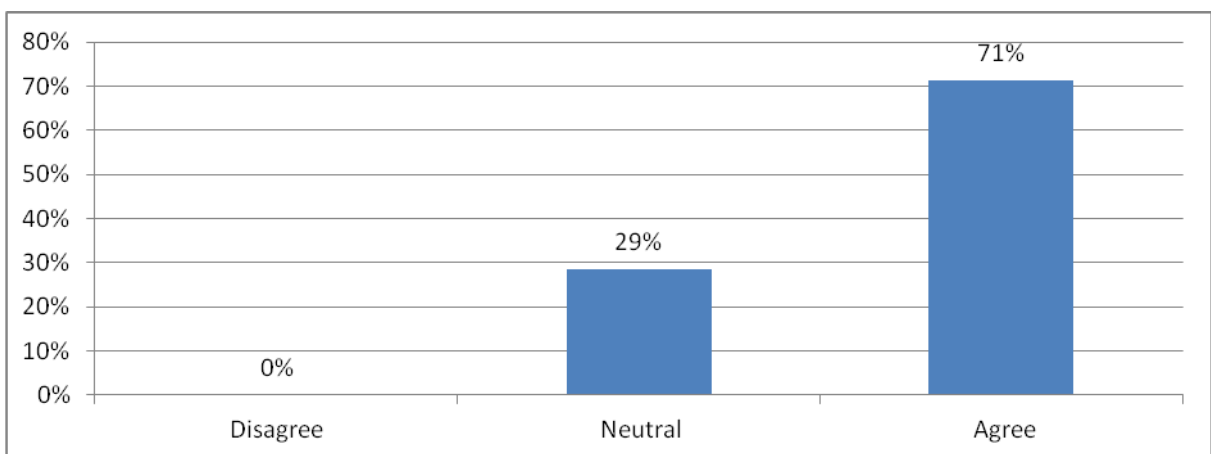


Figure 4.10 above shows the results of responses from 14 respondents. The respondents were asked to give their opinion on whether the SCSMS is centralised and that the results are real time on a three (3) point scale. The above figure shows that 93% of the respondents were in agreement that the system is centralised and the results are real time. From the above results, it indicates that users of the system located in different locations of the Council premises are able to query the system before someone proceeds to collect scripts in order first get the status of the scripts.

4.10.9 Loss of scripts and mixed ups have been reduced significantly

Figure 4. 11: Loss and mixed ups of scripts



The researcher did ask the respondents of the automated script management system on their opinion after interacting with it and especially on whether the loss and mixed ups of scripts had reduced significantly. The results were that 71% of the respondents were in affirmative that loss and mix ups of scripts was reduced significantly (see figure 4.11 as shown above).

4.10.10 The number of personnel used to search scripts has been reduced significantly

Figure 4. 12: Personnel reduced significantly

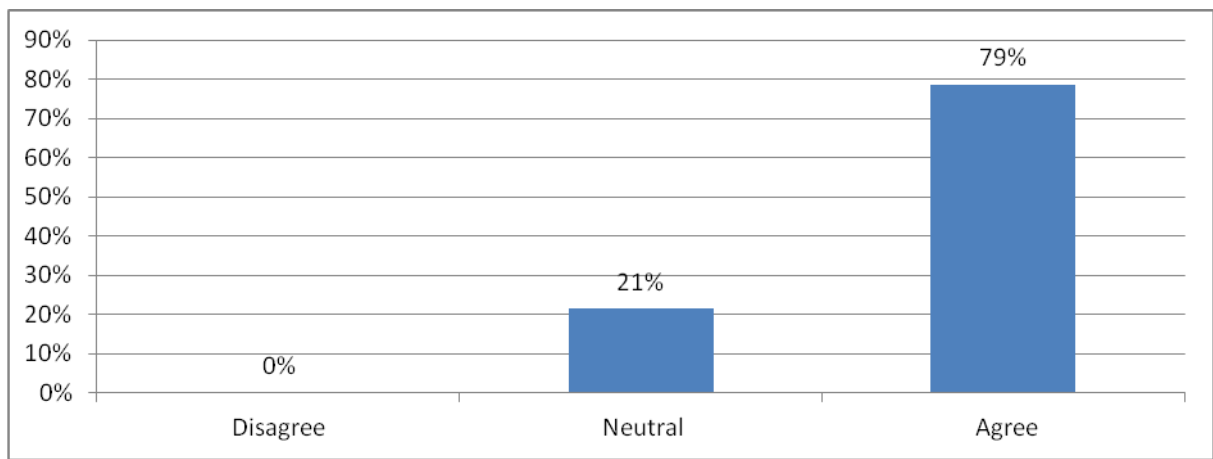
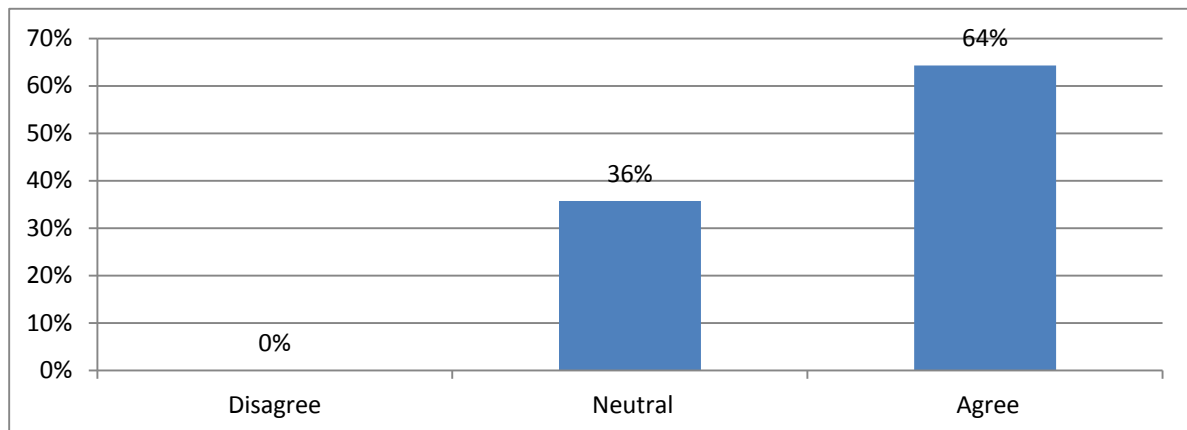


Figure 4.12 shows the results from the analysis of the responses after the researcher sought the opinion of the respondents on whether the number of personnel used to search scripts has reduced significantly. 79% of the respondents were in agreement that the personnel being hired to search for scripts reduced significantly where as 21% of the respondents would neither agree nor disagree. This could be attributed to the fact that search of the scripts is more guided in terms of shelving and box numbering which is as a result of querying of the system. Also any script going and coming back is captured in real time and hence improvement in feedback.

4.10.11 The cost of calling by different departments to the script unit seeking the status of the scripts has reduced significantly

Figure 4. 13: The cost of calling has reduced significantly



The manual script management system was associated with a lot of calling by different departments seeking to find out the status of scripts. Figure 4.13 was the outcome of the results of what the researcher asked the respondents to give based on their opinion on whether there was significant reduction of the cost of calling to the Script unit on the status of the various requests of scripts. 64% of the respondents were in agreement that there was significant reduction on the cost of calling as compared to the manual script management system

4.11 Introduction to Analysis of Levels of IT Literacy

Computer literacy is defined as knowledge and understanding of computers and their uses .To assess the skill levels of users, a computer literate person should be able to perform the following tasks: turn a personal computer (PC) on; use Microsoft Paint to create a designated picture; move objects using folders, shortcuts, cut-and-paste, drag and drop, copy, paste and delete texts; move from one web page to another and back; send and receive e-mail from a PC. A computer literate person can use the computer technology to perform his job more effectively and efficiently.

Being **computer literate** means you have knowledge and understanding of computers and their uses. It is said that a computer is a powerful tool because it is able to perform the information processing cycle operations (input, process, output, and storage) with amazing speed, reliability, and accuracy; store huge amounts of data and information; and communicate with other computers. Computers allow users to generate correct

information speedily and quickly, hold the information so it is available at any time, and share the information with other computer users.

After the development of the secure script management system, the researcher also contacted an in-depth face to face interview with the intended future users in order to understand their computer skills and competencies and the value they will add to the system. This helped the researcher to understand different levels of computer literacy of the officers working in the script management section. The researcher dealt with four basic key areas namely; Operating System and file Management, Word processing, Internet and Email.

Table 4 10: Operating System and File Management

1. Operating System and File Management				
Performance Element	Level 1 Novice	Level 2 Approaching Proficiency	Level 3 Proficiency	Level 4 Above Proficiency
Manage computer operations.	<p>Power on the computer and peripherals.</p> <p>Start an application (such as word processor, Internet browser, e-mail) by desktop icon or menu bar.</p> <p>Use features of an application simply by using the mouse, keyboard, and the application's menu bar.</p>	<p>Connect ports of the computer to peripherals.</p> <p>Install/uninstall an application.</p> <p>Interrupt and restart applications or the computer when they freeze.</p>	<p>Configure desktop environment and applications for efficient operation (e.g., create short cuts, customize monitor size, customize menu bars).</p> <p>Apply basic commands of operating system software. * (e.g., create, rename, and delete directories).</p> <p>Employ desktop operating skills.* (e.g., use mouse buttons, and keyboard shortcuts).</p>	<p>Performance simple testing and diagnostics of devices (e.g., sound card, serial port, disk surface test).</p> <p>Modify configuration of devices (e.g., modem, monitor).</p> <p>Partition hard disk for data and application sharing.</p> <p>Perform disk clean-up and disk defragmenter tasks.</p>

1. Operating System and File Management				
Performance Element	Level 1 Novice	Level 2 Approaching Proficiency	Level 3 Proficiency	Level 4 Above Proficiency
Manage file storage.	<p>Maintain all files on local hard drive.</p> <p>Put all data files in a single level directory or one folder.</p> <p>Do not use different versions of files</p>	<p>Backup data sporadically to a backup media (CD, disk, etc.) or server.</p> <p>Differentiate between files and directories*</p> <p>Use folders or directories with meaningful names to store related files.</p>	<p>Backup data periodically to a backup media (CD, disk, etc.) or server.</p> <p>Apply appropriate file and disk management techniques* (e.g., defragment and rearrange files, reinstall backup data)</p> <p>Determine file organization* (e.g., use appropriate directory structures and names).</p>	<p>Perform scheduled systematic backup procedure.</p> <p>Recover, as much as possible, erased or corrupted data.</p> <p>Demonstrate knowledge of the system utilities used for file management* (e.g., change protection modes, rename, delete).</p>
Remarks	<p><i>It was noted that the computer skills acquired by the script management officers in the section under management of computer operations is above proficiency and therefore they are able to perform simple testing and diagnostics of devices, modify configuration of devices, partition hard disk for data and application sharing, perform disk clean –up and disk defragmentation tasks, Perform scheduled systematic backup procedure, Recover, as much as possible, erased or corrupted data, Demonstrate knowledge of the system utilities used for file management* (e.g., change protection modes, rename, delete).</i></p>			

Table 4. 11: Word Processing

2. Word Processing				
Performance Element	Level 1 Novice	Level 2 Approaching Proficiency	Level 3 Proficiency	Level 4 Above Proficiency
Prepare simple documents and other business communications.	<p>Create documents using default template.</p> <p>Rely on formatting defaults built in to template.</p> <p>Employ spell check.</p>	<p>Create documents using additional templates.</p> <p>Apply basic formatting to text (font face, color and size, alignment).</p> <p>Employ word processing utilities such as grammar check or print preview.</p>	<p>Create documents (letters, memos, reports) both with and without templates.</p> <p>Format text using basic formatting functions (e.g., paragraph spacing, margins, bullets, numbering...).</p> <p>Employ word processing utility tools (e.g., track changes or thesaurus).</p>	<p>Create and use new templates, forms, and style sheets to make documents.</p> <p>Format text using advanced formatting functions (e.g., borders and shading, indents and spacing...).</p> <p>Use word processing utility or add-ins to share documents (e.g., fax, print to file, create a PDF...).</p> <p>Customize the user environment, such as adding/removing toolbars, changing menus, adding utilities.</p>
Remarks	<p><i>It was observed that as a result of long period of working with a manual script system, all the users in the script management system are above proficiency level in word processing. They are able to Create and use new templates, forms, and style sheets to make documents, Format text using advanced formatting</i></p>			

2. Word Processing				
Performance Element	Level 1 Novice	Level 2 Approaching Proficiency	Level 3 Proficiency	Level 4 Above Proficiency
	<i>functions (e.g., borders and shading, indents and spacing...), Use word processing utility or add-ins to share documents (e.g., fax, print to file, create a PDF...), Customize the user environment such as adding/removing toolbars, changing menus, and adding utilities.</i>			

Table 4. 12: Internet

3. Internet				
Performance Element	Level 1 Novice	Level 2 Approaching Proficiency	Level 3 Proficiency	Level 4 Above Proficiency
Access and Navigate Internet (e.g., use a web browser).	<p>Access a given web site using an Internet browser.</p> <p>Navigate within a web site using basic browser software functions (e.g., back, forward).</p>	<p>Use additional browser functions (e.g., refresh, history, bookmarks).</p> <p>Complete and submit web forms.</p> <p>Organize bookmarks for frequently used or important web sites.</p>	<p>Navigate between and within web sites.</p> <p>Access and use multiple browser windows.</p> <p>Differentiate between secure and non-secure web sites.</p> <p>Download a file from a web site to the desired</p>	<p>Troubleshoot problems with a given URL (e.g., a specific file has moved in the domain).</p> <p>Use FTP to upload and download files to a remote computer.</p> <p>Configure Internet browser (e.g., clear history and cache, set security levels...).</p>

3. Internet				
Performance Element	Level 1 Novice	Level 2 Approaching Proficiency	Level 3 Proficiency	Level 4 Above Proficiency
			location.	
Search for information and resources.	<p>Use directory services (e.g., Yahoo, MSN, Netscape, Google directory).</p> <p>Use search function in portals (such as excite.com, netscape.com).</p>	<p>Use one search engine</p> <p>Conduct simple keyword search.</p> <p>Access search results (identified web sites).</p> <p>Use a search function within a web site.</p>	<p>Select search engine(s) appropriate for desired information.</p> <p>Identify and articulate an information search.</p> <p>Use phrase search and simple Boolean logic (AND, OR, NOT, NEAR)</p> <p>Refine search by modifying search terms.</p>	Refine search terms by using selection criteria (e.g., languages, file format, domain)
Remarks	<p>Under the internet performance element (Access and Navigate Internet & Search for information and resources), the users have the ability to troubleshoot problems with a given URL (e.g., a specific file has moved in the domain), Use FTP to upload and download files to a remote computer, Configure Internet browser (e.g., clear history and cache, set security levels...), Refine search terms by using selection criteria (e.g., languages, file format, domain). All the users are above proficiency level.</p>			

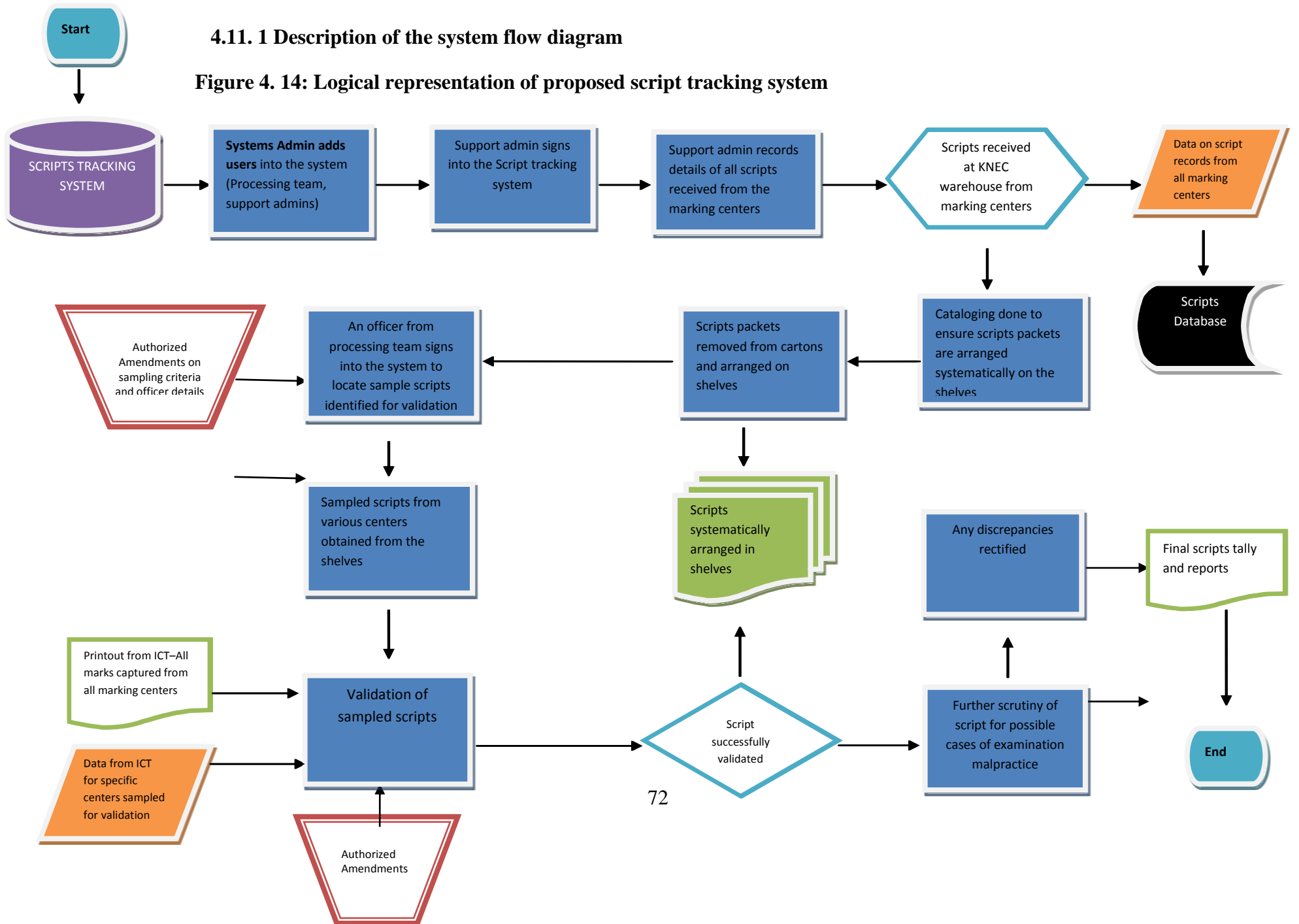
Table 4.13: E-mail				
Performance Element	Level 1 Novice	Level 2 Approaching Proficiency	Level 3 Proficiency	Level 4 Above Proficiency
Use email to communicate within and across KNEC.	<p>Create an e-mail account.</p> <p>Access e-mail system using login and password.</p> <p>Send, receive, and reply to an e-mail.</p> <p>Save, delete, and print e-mail.</p>	<p>Create entry in address book.</p> <p>Use address book to send e-mail.</p> <p>Forward and redirect an e-mail.</p> <p>Demonstrate knowledge e-mail etiquette (do not flame people, no all caps, reply all when only appropriate).</p> <p>Use find and sort functions.</p>	<p>Create e-mail messages in accordance with established business standards (e.g., grammar, word usage, spelling, sentence structure, clarity)</p> <p>Manage mailboxes by deleting and organizing messages.</p> <p>Use e-mail features such as reply requested, return receipt, out-of-office notices.</p>	<p>Filter messages into folders.</p> <p>Set preferences/options.</p> <p>Integrate e-mail and PIM address books.</p> <p>Integrate multiple mail boxes.</p>

<p>Use email to share files and documents.</p>	<p>Open attachments for available applications.</p>	<p>Access (open or detach) attached files and documents from e-mail message</p> <p>Attach files, documents, and links to messages</p>	<p>Open (or detach) and save attachments to the intended location.</p> <p>Select appropriate strategy (attachment vs. link) for sharing information.</p> <p>Use appropriate e-mail security measures. (e.g., use virus scan to check virus, do not download attachments from unknown sources.)</p>	<p>Recognize compressed files and when to send a file or document in compressed form.</p>
<p>Remarks</p>	<p><i>Under the performance element of e-mail (Use email to communicate within and across KNEC & Use email to share files and documents) The users were above proficiency level in terms of skills and have the ability to filter messages into folders, set preferences/options, integrate e-mail and PIM address books, integrate multiple mail boxes, recognize compressed files and when to send a file or document in compressed form.</i></p>			

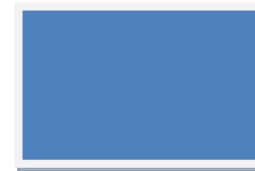
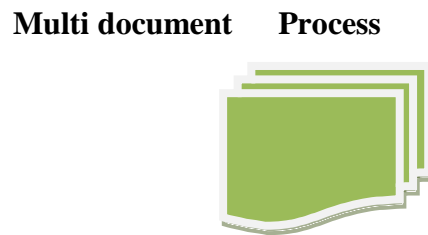
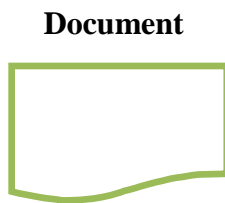
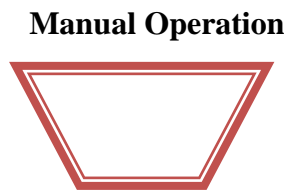
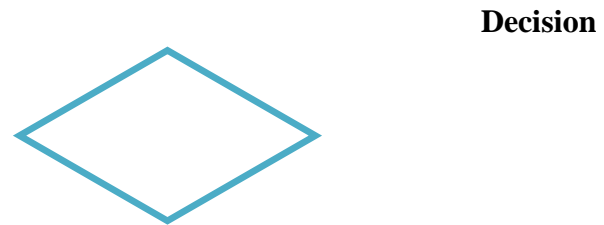
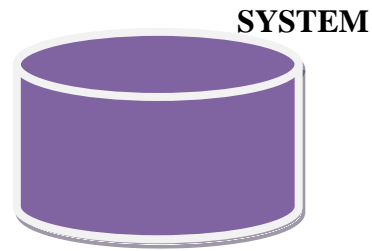
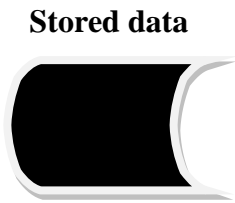
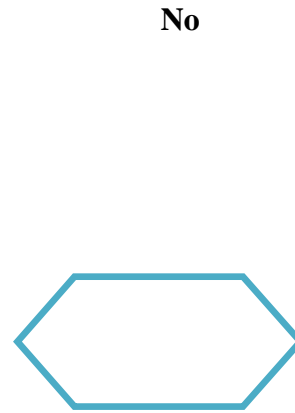
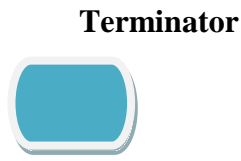
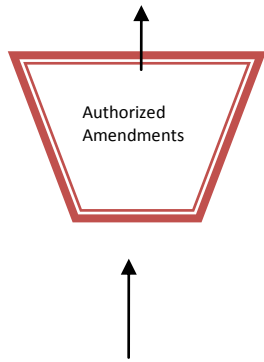
Based on the observations made from the face to face interview conducted on all the officers working in the script management section, it was noted that all the officers have computer skills that are above proficiency level and hence appropriate to manage the secure script management system that is efficient and effective in the Council and can deliver requests on short notice.

4.11. 1 Description of the system flow diagram

Figure 4. 14: Logical representation of proposed script tracking system



DFD SYMBOLS:



4.11.2 Information Flow

- (i) The Systems Administrator adds users into the Script Tracking System (STS).
The users added could either be members of the examination processing team (Subject Officers, officers from Examination Administration department, Research and Quality Assurance and Test Development department) or Script Tracking Administrators (officers who record script details both at dispatch and receipt to and from the marking centers) and are assigned access rights to the system accordingly;
- (ii) The script tracking administrator is given the rights to sign into the system and add details of scripts and other system users;
- (iii) All the details of the scripts as received from the marking centers are entered into the system by the administrator operating from the Council's warehouse;
- (iv) Script details as mentioned in (iii) above go into a centralized database housing all script details. The details here include the master apportionment print out;
- (v) Cataloguing is done to ensure scripts packets are arranged systematically on the shelves. The system catalogue should contain details such as the center number, the shelf where the script packet is contained, the row and the box number of the script;
- (vi) The Scripts packets are then removed from cartons and arranged on shelves. At this point, the criteria mentioned in (v) above MUST be observed;
- (vii) An officer from processing team signs into the system to locate sample scripts identified for validation. The criteria formulated by the larger processing team for use during the validation process should guide the officer in locating the

relevant shelves with the said scripts. Criteria for selecting scripts for validation could be on the basis of districts, public or private centers, rural or urban examination centers or even the particular subject to be validated. The aforementioned officer will input these details into the system and will have their details (name, date of access, time of access and scripts accessed) captured in the system. These details should be available real time for any other officer trying to locate the same resources. Once the scripts are returned by the said officer, the system should reflect the same;

(viii) Depending on the criteria adopted in (vii) above, sampled scripts from various centers obtained from the shelves;

(ix) Validation of sampled scripts is done. At this point, the ICT department provides the processing team with two documents; a printout of all marks captured from all marking centers and data for specific centers sampled for validation. During validation, authorized amendments are made and discrepancies rectified appropriately. On successful validation, the officer who collected the sample scripts from the shelves has to sign into the system and clear the scripts back into the shelves. This information should be available real time to any other member of the team who signs into the system;

(x) If validation of a particular script is not successful at this point, further scrutiny of the said script is done to ascertain possible cases of examination malpractice;

(xi) Any discrepancies should have been rectified by the time results are released. Any follow ups can still be done through the system if need be;

(xii) Generation of reports. This should be the last process in the scripts tracking system. The system should allow generation of various reports such as a report on all scripts validated, a report on all scripts received from the marking centers, a report on the criteria used to pick particular scripts for validation, a report on the subjects validated and many others

CHAPTER FIVE: CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter deals with conclusions and recommendations of the findings based on the objectives outlined at the beginning of the project. The project was intended to design a prototype of a secure collaborative script management system that will enhance the management of scripts in the Council. The purpose of the project was to ensure that there were immediate benefits as a result of the implementations of the project. The current system is manual, cumbersome, lots of redundancy, time wastage, costly in terms of paper work and search time of the scripts, more resources for recruitment of casual clerks. The design of the system was in line with the Council strategic plan (period 2010-2015) of automating its operations for quality and secure delivery to its customers.

5.2 Observations based on the objectives of the secure, efficient and effective script management system

5.2.1 To establish how scripts are managed at KNEC

Once packing is finalized, the scripts are now ready for dispatch to the marking centres for marking. Examiners are advised to ensure that all packets are returned to the specific box after marking. The box number is always written on the script packet in order to enable the examiners and KNEC officers deal with any stray packets without much difficulty.

After marking exercise is completed, the scripts are returned to KNEC for storage. The contents are verified at the point of receiving using the master apportionment. Once received, the scripts are arranged on shelves in the order of boxes although now with the boxes removed. The end of every box is marked using a stiffened card and again the position of every box is marked on the shelf using an adhesive sticker. During processing of results and resolving results queries, officers fill a script requisition form. Once received, the staff in scripts management unit uses the master apportionment printout to decode the specific position where the packet containing the specific script is stored. This objective was to enable the researcher to have an in depth understanding

of the manual system in order to help him design the intended automated script management system. The study of the manual system helped him to understand some of the key items which may need to be in cooperated in the new system. For example; the box number, the shelf number, the district code and the school code of a particular school.

5.2.2 To determine the effectiveness and efficiency of the current manual system in serving our customers

Efficiency of a system is defined as achieving maximum productivity with minimum wasted effort or expenses or the production of the desired effects or results with minimum waste of time, effort where as *effectiveness* of a system- extent to which a system may be expected to achieve its objectives within its specified environment. From the results of the study of the manual system, it was reported that efficiency and effectiveness of the current manual system being used by KNEC to manage scripts on the overall, is perceived to be both effective (**86%**) and efficient (**93%**). However when the respondent were asked to indicate in terms of the time taken to track lost or misplaced scripts, the respondent indicated that it normally takes a maximum of **20 minutes**. This means that *in* one hour, someone will only track three (**3**) scripts and in **eight hours**, a person will track twenty four (**24**) scripts. This therefore will require high number of persons to search for the scripts and hence more time spent in search of script. This is a contrast of the findings from the respondents and this could be due to its routine operations that people could have been occasioned with. In addition, seasonal workload, which peaks mainly during the examination period, could lead to this.

5.2.3 To determine the items/ activities in the current manual script management process at KNEC that poses higher threats/risks, consume more time and attracts higher expenses

The following items poses high security treat; mixing of scripts, loss of scripts, general handling of scripts, Receiving, arranging and sequencing of the scripts to the examination centre is also prone to security challenges. The following items attracts

high over head costs; search of scripts because of the personnel required for the search, retrieval of scripts, sorting, heaping and sequencing- the personnel working there sometimes get fatigued and at times commits errors that makes it very expensive for the Council, mobilization of vehicles and personnel.

5.2.4 To design, develop and test a secure efficient and effective script management system

a) Design: The process evolved from initial identification of a need to automate the script management at the Council. The study involved both the analysis of individual interviews and development of a system to manage scripts at KNEC. Qualitative data and background information collected from the participants was adopted because of the few number of people managing scripts at KNEC as well as for in depth understanding of the current manual script management systems, its challenges and views of the participants on what a good automated system should entail.

b) Systems analysis, requirements:

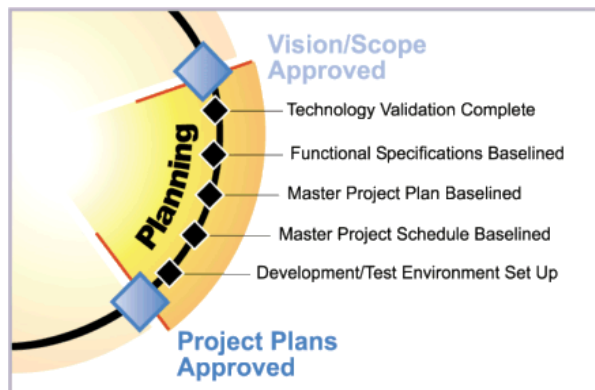
This defined project goals into defined functions and operation of the intended application. This also analyses end-user information needs. Define and allocate appropriate criteria for the system elements and break down of the system into elements for example Equipment(computers, network), People (staff working at the script management unit) Facilities, Data(candidates' registration data, script management data hand book) and information related to management of scripts.

c) System design:

This described the desired features and operations in detail, including screen layouts, business rules, process diagrams, pseudo code and other documentations. The system was developed based on the users responses and researchers knowledge. In this stage, a number of activities were performed to come up with a detailed model of the system. This included the database (back end), interface (front end) and reports structure. This stage came up with the architecture of the system,

and the decision on platforms to be used in developing the system, based on the research knowledge and available software.

For back end and reporting, MS SQL server 2008 was used and visual studio 2008 for front end. These platforms are licensed to KNEC and given that the system will benefit it, if implemented, they allowed me to use it.



d) System Development:

System developed through the accomplishment of feasibility analysis, where design activities were included within each of the life cycle basic functions. This stage largely involved the coding of the system, the

database user interface and expected reports. It saw the construction of the application, development of users aids and implementation work plan. The researcher came up with evolutionary prototypes and took each to be evaluated by the users to determine usability before proceeding to the next stage. The feedback obtained from every evaluation done by users was analyzed, in cooperated in the design and coded in the system. This was a continuous cycle until the final product was obtained.

5.2.5 Testing and Validation of the System

System testing

System testing is usually required before and after a system is put in place. These procedures tell the tester how the system should perform and where common mistakes may be found. The type of testing to check the behaviour of a complete and fully integrated software product based on the software requirements specification (SRS) document. The main focus of this testing is to evaluate Business / Functional / End-user requirements. System testing is important because; performance as the first level of

testing where the system is tested as a whole is key, checks whether system meets functional requirement or not, enables someone to test, validate and verify both the Application Architecture and Business requirements;

a) System Test Plan

The system test plan was carried out on Goals & Objectives – of the study (SCSMS), Scope (KCSE), critical areas to focus(security, effective and efficiency), test deliverable (login test), testing Schedule(unit and volume testing), entry and exit criteria(login and logoff), test environment (visual studio 2008), roles and responsibilities (system administrator, other officers who have been authorized in the system). The following aspects of testing were done: This involved testing of the complete SCSMS based on the objective of designing, developing and testing of a secure, efficient and efficient Script management system. The system was subjected in to 3 types of testing namely; unit testing, volume testing and usability testing. Though unit system testing was done by the developer and internal script unit staff as development progresses, volume testing was done by some officers working in the script room in order to ascertain its suitability.

b) Validation

Validation determines if the system complies with the requirements and performs functions for which it is intended and meets the organization's goals and user needs. It is done at the end of the development process and takes place after verifications are completed. Validation helps in building the right product as per the customer's requirement and helps in satisfying their needs. In the secure, efficient and effective script management system, validation was done on the following; login testing- to validate that it returns successful entry access rights, receiving scripts from the marking centres, Box allocation, Shelf allocation, Issuing of scripts to an officer from either Research department, examination department or ICT department, receiving scripts back from the departments, the status of the scripts at various stages, reports.

5.3 Major achievements and contributions to the area of study

The following are the some of the contributions to the area of study as per the outcome of the study; shortening of time spend on search for scripts, reduction of personnel hired to manage scripts during processing of scripts, the cost of calling by different departments to the script unit will be reduced because individuals seeking the status of scripts will first query the system before making any request and also the movement of vehicles intended to wait for the script will be reduced, unlike the manual system, the computerized system will be centralized and results are real time, the loss of scripts and mix ups will be reduced greatly, better management and transparency of scripts is achieved as well as improved throughput, there is improved feedback, helping in automating KNEC processes and especially management of scripts, there exists a gap for further study on management of scripts from the time the candidates' sits for the examination at the examination centre to the time the scripts are disposed. As a result of the above achievements, the system has therefore proven to be more efficient and effective and hence suited to handle examination scripts.

5.4 Recommendations of the study

This study is limited by a number of factors which are both internal and external in nature. The factors are internal in that some of the processes will still remain manual and hence the human error factor will still play a major role. This study will have more impact if the scope of the study could be extended from the time candidates sit for examination up to the time the scripts are disposed. This method will help in tracking each individual candidate's script, shorten processing period, improvements of accountability and reliability levels. As a result, it will be more reliable in accounting for each script unlike the current practice, where the assumption that all the scripts of the registered candidates in a particular centre were packed. It is also worth noting that both retrieving and return of the scripts to the script unit is assumed to be accurate and reliable. In essence this may not be the case.

5.5 Conclusions

The successful design and testing of this system is a major contribution to the Council operations and in line with the Kenya National Examinations Councils' Strategic plan (2010-2015) which states that all Council operations should be automated by 75% by the year 2015. The Secure Collaborative Script Management System is expected to help manage scripts at the Council and reduce cost and time of examination processing

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APPENDIX I: Needs assessment questionnaire leading to the development of an automated script management system for KNEC (Q A)

- a) This Questionnaire is administered by the researcher to gather information on the effectiveness and efficiency of the current manual script management system while also assessing user requirements for the development of a more efficient automated/computerized script management system.
- b) Do not write your name on the questionnaire, but please give your honest independent responses. Your responses will be treated confidentially and will only be used for purposes intended.
- c) Please respond to all the questions in this questionnaire by ticking (√) the relevant choices. Follow the instructions provided for each question.

1.0 PART 1:

PARTICULARS OF FIELD ADMIN OFFICERS:

1.1 _____ Gender

(Tick one choice)

Male	1	Female	2
------	---	--------	---

1.2 _____ Age Group

(Tick one choice)

Below 25	1
25 – 30 years	2
31 – 35 years	3
36 – 40 years	4
40 – 50 years	5
51 years and above	6

1.3 _____ Have you ever taken part in the current manual script management system?

(Tick one choice)

Yes	1	No	2
-----	---	----	---

1.4 _____ If Yes in (1.3) above, how many years have you taken part in the current manual script management system?

(Tick one choice)

1 – 2 years	2
3 – 4 years	3
4 – 6 years	4
7 – 9 years	5

10 years and above	6
--------------------	---

1.5 _____ When the scripts are received from the marking centres, is there a systematic arrangement used to store the scripts in the shelves for easy tracking during processing?

(Tick one choice)

Yes	1	No	2
-----	---	----	---

1.6 _____ Are there occasions when you were totally unable to locate a script from the shelves during processing?

(Tick one choice)

Yes	1	No	2
-----	---	----	---

1.7 _____ If Yes in (1.6) above, how were the said scripts eventually accounted for?

Lost scripts	1
Script(s) not in the shelves	2
Never accounted for	3

2.0 _____ How many stages are involved in the current manual script management system from the time the scripts are received from the marking centres?

(Tick one choice)

One stage	1
Two stages	2
Three stages	3
Four stages	4
Other (specify).....	5

2.1 Of the stages in (2.0) above, how many have you been directly involved in during the current manual script management system?

One stage	1
Two stages	2
Three stages	3
Four stages	4
All stages	5

2.2 On average, how long did it take you to track and locate one script from the shelves?

Less than 10 minutes	1
11-20 minutes	2
21-30 minutes	3
31-40 minutes	4

41-50 minutes	5
Other (specify).....	6

3.0 In your own view, how effective is the current manual script management system in use at KNEC?

Not effective	1
Effective	2
Very effective	3

3.1 In your own view, how efficient is the current manual script management system in use at KNEC?

Not efficient	1
Efficient	2
Very efficient	3

4.0 PART 2:

5.0 Have you ever used an automated/computerized system for example the **Online Public Access Catalogue-OPAC** to locate a resource from the shelves?

(Tick one choice)

Yes	1	No	2
-----	---	----	---

6.0 If Yes in (5.0) above, how many years have you interacted with an OPAC system?

Less that 1 year	1
------------------	---

1 – 2 years	2
3 – 4 years	3
4 – 6 years	4
7 – 9 years	5
10 years and above	6

7.0 In your own view, how effective is/was the OPAC in locating resources from the shelves?

Not effective	1
Effective	2
Very effective	3

8.0 In your own view, how efficient is/was the OPAC in locating resources from the shelves?

Not efficient	1
Efficient	2
Very efficient	3

9.0 Do you think an automated/computerized script management system would be more effective and efficient than the current manual script management system at KNEC?

Tick one choice)

Yes	1	No	2
-----	---	----	---

9.1 Give reason(s) for your choice in (9.0) above?

9.2 Which item(s) and or activities pose(s) higher security threats in the current manual script management system?

9.3 Which item(s) and or activities have high overhead costs and consume more time in the current manual script management system?

Give suggestions on how to remedy the situations in (9.2) and (9.3) above?

10.0 As an end user, what would be your requirements for an effective and efficient computerized script management system?

10.1 What security features do you think should be deployed in the automated/computerized script management system referred to in (10.0) above?

10.2 What other features of the current manual script management system should be incorporated into the proposed automated/computerized script management system?

10.3 How well should the computerized script management system be designed for use by KNEC officers?

11.0 **CHALLENGES & RECOMMENDATIONS**

11.1 In your opinion, what other challenges may be experienced with continued use of the current manual script management system?

11.2 Kindly, give recommendations that would enable KNEC address the challenges noted in (11.1) above

“THANK YOU”

APPENDIX II

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APPENDIX II: Needs assessment questionnaire leading to the development of an automated script management system for KNEC (QB)

- a) This Questionnaire is administered by a Researcher to gather information on the effectiveness and efficiency of the current KNEC manual script management system while also assessing user requirements for the development of a more efficient automated/computerized script management system.
- b) Do not write your name on the questionnaire, but please give your honest independent responses. Your responses will be treated confidentially and will only be used for purposes intended.
- c) Please respond to all the questions in this questionnaire by ticking (✓) the relevant choices. Follow the instructions provided for each question.

1.0 PART 1:

PARTICULARS OF OFFICER:

1.1 _____ Gender

(Tick one choice)

Male	1	Female	2
------	---	--------	---

1.2 _____ Age Group

(Tick one choice)

Below 25	1
25 – 30 years	2
31 – 35 years	3
36 – 40 years	4
40 – 50 years	5
51 years and above	6

1.3 _____ Tick your
job description from the table below:

EM officer	1
FA Officer	2
Research & Quality Ass Officer	3
Test Development Officer	4
Other	5

1.4 _____ Have you
ever interacted either directly or indirectly with the current manual script management
system in use at KNEC?

(Tick one choice)

Yes	1	No	2
-----	---	----	---

1.5 _____ If Yes in (1.4) above, how many years have you interacted with the current manual script management system?

(Tick one choice)

1 – 2 years	2
3 – 4 years	3
4 – 6 years	4
7 – 9 years	5
10 _____ ars and above	6

1.6 In your own view, how effective is the current manual script management system in use at KNEC?

Not effective	1
Effective	2
Very effective	3

1.7 In your own view, how efficient is the current manual script management system in use at KNEC?

Not efficient	1
Efficient	2

Very efficient	3
----------------	---

2.0 PART 2:

2.1 Have you ever used an automated/computerized system for example the **Online Public Access Catalogue-OPAC** to locate a resource from the shelves?

(Tick one choice)

Yes	1	No	2
-----	---	----	---

2.2 If Yes in (2.1) above, how many years have you interacted with an OPAC system?

Less than 1 year	1
1 – 2 years	2
3 – 4 years	3
4 – 6 years	4
7 – 9 years	5
10 years and above	6

3.0 In your own view, how effective is/was the OPAC in locating resources from the shelves?

Not effective	1
Effective	2
Very effective	3

4.0 In your own view, how efficient is/was the OPAC in locating resources from the shelves?

Not efficient	1
Efficient	2
Very efficient	3

5.0 Do you think an automated/computerized script management system would be more effective and efficient than the current manual script management system in use at KNEC?

Tick one choice)

Yes	1	No	2
-----	---	----	---

6.0 Give reason(s) for your choice in (9.0) above?

6.1 Which item(s) and or activities pose(s) higher security threats in the current manual script management system?

6.2 Which item(s) and or activities have high overhead costs and consume more time in the current manual script management system?

Give suggestions on how to remedy the situations in (5.2) and (5.3) above?

.....
.....
.....

7.0 As an end user, what would be your requirements for an effective and efficient computerized script management system?

7.1 What security features do you think should be deployed in the automated/computerized script management system referred to in (6.0) above?

7.2 What other features of the current manual script management system should be incorporated into the proposed automated/computerized script management system?

7.3 How well should the computerized script management system be designed for use by KNEC officers?

8.0 **CHALLENGES & RECOMMENDATIONS**

8.1 In your opinion, what other challenges may be experienced with continued use of the current manual script management system?

8.2 Kindly, give recommendations that would enable KNEC address the challenges noted in (11.1) above

“THANK YOU”

APPENDIX III

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APPENDIX III: Questionnaire on the appraisal of the automated Script Management System

You have interacted with both KNEC manual and recently developed automated script management system. Taking into consideration your experience in both systems, you are invited to participate in a short survey to appraise the automated system. Your feedback will go a long way in improving the system and ensuring the user needs are met. Please rate the system in a scale of 3 as indicated in each of the items and briefly explain your rating.

NO	Item	Response
1.1	Gender 1=Male; 2=Female	
1.2	Training 1=System Design & Information Technology; 2= Non IT expert 3=Standard IT user	

Item		
2.1	In your opinion, how effective is the automated system compared to the manual system [1=Not effective; 2=Effective; 3=Very Effective)	<input type="checkbox"/>
Explain		
2.2	In terms of security requirement, how you rate the automated system [1=Not secure; 2=Secure; 3=Very Secure)	<input type="checkbox"/>

Explain and please indicate what security features are in place.		
2.3	The amount of time and cost required to locate a script has reduced significantly (1=Disagree; 2=Neutral; 3=Agree]	<input type="checkbox"/>
Explain		
2.4	In your opinion, how efficient is the automated system compared to the manual system [1=Not efficient; 2=Efficient; 3=Very Efficient]	<input type="checkbox"/>
Explain		

Item		
2.5	Secure collaborative Script Management system(SCSMS) is centralised and results are real time [1=Disagree; 2=Neutral; 3=Agree)	<input type="checkbox"/>
2.6	Loss of scripts and mixed ups have been reduced significantly [1=Disagree; 2=Neutral; 3=Agree)	<input type="checkbox"/>
2.7	The number of personnel used to search scripts have been reduced significantly [1=Disagree; 2=Neutral; 3=Agree]	<input type="checkbox"/>
2.8	The cost of calling by different departments to the script unit seeking the status of the scripts has reduced significantly [1=Disagree; 2=Neutral; 3=Agree]	<input type="checkbox"/>

3.0 PART II:

3.1 Have you ever taken part in the SCSMS?

(Tick one choice)

Yes	1	No	2
-----	---	----	---

3.2 If Yes in (1.3) above, for how long have you taken part in the current SCSMS?

(Tick one choice)

1-2 month	2
3-4 months	3
5-6 months	4
7-9 months	5
10 months and above	6

3.3 When the scripts are received from the marking centres, is there a systematic arrangement used to store the scripts in the shelves for easy tracking during processing?

(Tick one choice)

Yes	1	No	2
-----	---	----	---

3.4 _____(a) Are there occasions when you were totally unable to locate a script from the shelves during processing

(Tick one choice)

Yes	1	No	2
-----	---	----	---

3.4(b) If Yes in (1.6) above, how were the said scripts eventually accounted for?

Lost scripts	1
Script(s) not in the shelves	2
Never accounted for	3

3.5 _____ How many stages are involved in the SCSMS from the time the scripts are received from the marking centres?

(Tick one choice)

One stage	1
Two stages	2
Three stages	3
Four stages	4
Other (specify).....	5

3.6 Of the stages in (3.5) above, how many have you been directly involved in during the SCSMS?

One stage	1
Two stages	2
Three stages	3
Four stages	4
All stages	5

3.7 On average, how long did it take you to track and locate one script from the shelves?

Less than 2 minutes	1
3-4 minutes	2
5-7 minutes	3

8-9 minutes	4
10-15 minutes	5
Other (specify).....	6

3.8 In your own view, how effective is the SCSMS in use at KNEC?

Not effective	1
Effective	2
Very effective	3

3.9 In your own view, how efficient is the SCSMS in use at KNEC?

Not efficient	1
Efficient	2
Very efficient	3

4.0 PART 2:

5.0 Do you think the (SCSMS) automated/computerized script management system is more effective and efficient than the manual script management system at KNEC?

Tick one choice)

Yes	1	No	2
-----	---	----	---

5.1 Give reason(s) for your choice in (4.0) above?

6.0 CHALLENGES & RECOMMENDATIONS

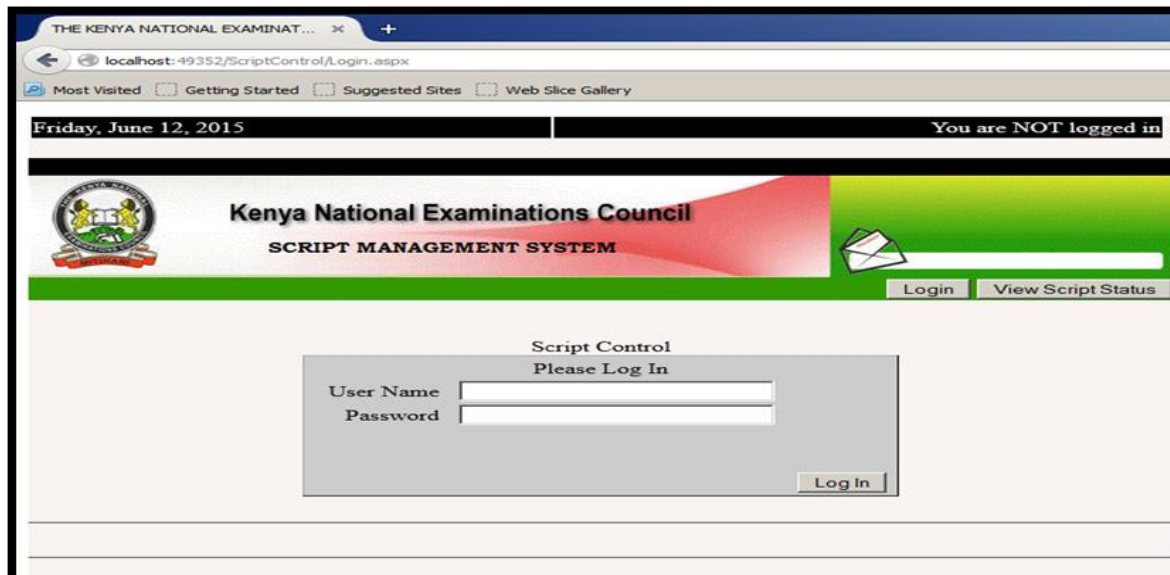
6.1 In your opinion, what challenges have you experienced with the use of SCSMS? _____

6.2 Kindly, give recommendations that would enable KNEC address the challenges noted in (4.1) above

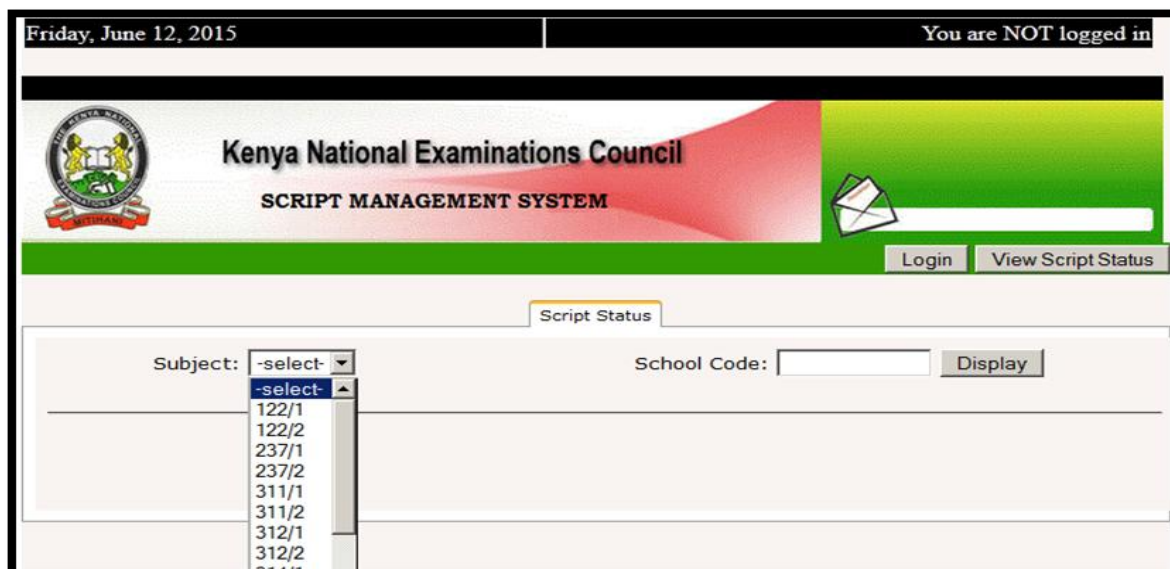
“THANK YOU”

APPENDIX IV: Graphical User Guide of the Script Management System

1. Access the system through the web, by typing in the web address, the below window is displayed



2. From above window, either log in using provided credentials or click on the button **View Script Status** to track a script
 - a. If click on the **View Script Status** button, the below window is displayed



- Select the subject paper and entre code of the school to track its scripts
- Click on **Display** button
- The below window appears, showing the status of the selected school's scripts

CODE	SUBJECT	BOX No	SHELF No	RACK No	ISSUED TO	DATE ISSUED	REMARKS
50465840001	311/1	xxx	xxx	xxx	mackenzi	25/05/2015	security check
50465840002	311/1	2	2	2			
50465840003	311/1	xxx	xxx	xxx	cate	25/05/2015	validation
50465840004	311/1	2	2	2			
50465840005	311/1	2	2	2			
50465840006	311/1	2	2	2			
50465840008	311/1	2	2	2			
50465840009	311/1	2	2	2			
50465840010	311/1	2	2	2			
50465840011	311/1	2	2	2			

- b. If click on the **Login** button and enter valid credentials-username and password, the below window appears

The window has six tabs and four buttons

Tab1 Receiving List: Allows user to key in received examination scripts from the marking centers

- Select subject to be received
- Type in the district code
- Click on **GET FILE** button

The below window is displayed that lists centers in the selected district and entry per school

CODE	SCHOOL NAME	SUBJECT	ENTRY	SCRIPTS	DISCREPANCY
01910101	TAITA PRIVATE	311/1	13	13	
50274699	ST. MARY'S HIGH SCHOOL LUSHANGONYI	311/1	31		
50437926	NGANGAO SECONDARY SCHOOL	311/1	21	22	1 UP
50446895	PJ MWANGOLA MIXED SECONDARY SCHOOL	311/1	35		
50465840	FUNJU SECONDARY SCHOOL	311/1	9	9	
50474720	MGHALU HIGH SCHOOL	311/1	54		
50479318	DALMAS MOKA SECONDARY SCHOOL	311/1	28		

- Key in the number of scripts received and discrepancy if any
- Click on **Post** button to submit

Tab2 Box Allocation: Allows user to key in the box number where scripts are kept

- Select subject to be boxed
- Click on **GET FILE** button

The below window is displayed that lists all centers whose scripts have been received, for the selected paper

SCRIPT MANAGEMENT SYSTEM

Reports ▾ Script Management My Account Sign Out

Receiving List Box Allocation Shelf Allocation Issue Script Receive Script Script Status

Subject: 311/1 ▾ Get File

CODE	SCHOOL NAME	SUBJECT	BOX No.
01910101	TAITA PRIVATE	311/1	9
50273408	ALFARSY GIRLS SEC.SCHOOL	311/1	5
50278291	NYAHURURU HIGHWAY SENIOR ACADEMY	311/1	
50283630	MOMBASA BAPTIST HIGH SCHOOL	311/1	2
50285311	NAROMORU GIRLS SECONDARY SCHOOL	311/1	4
50294408	BAARI SECONDARY SCHOOL	311/1	
50297345	SERANI SECONDARY SCHOOL	311/1	16
50380930	GRACELAND GIRLS SCHOOL	311/1	1
50427183	BURHANIYA SECONDARY SCHOOL	311/1	4
50427695	VALENTINE HIGH SCHOOL	311/1	36
50429871	WARAZO JET SECONDARY	311/1	12
50430449	KIMUUMO SEC	311/1	70
50430606	MAMA NGINA GIRLS	311/1	2
50437926	NGANGAO SECONDARY SCHOOL	311/1	3
50465840	FUNJU SECONDARY SCHOOL	311/1	2

Post

- Key in the number of the box where a given school's script have been kept
- Click on **Post** button to submit

Tab3 Shelf Allocation: Allows user to key in the Shelf number where scripts are kept

- Select subject to be shelved
- Click on **GET FILE** button

The below window is displayed that lists all boxes with scripts for the selected paper

Kenya National Examinations Council
SCRIPT MANAGEMENT SYSTEM

Reports ▾ Script Management My Account Sign Out

Receiving List Box Allocation Shelf Allocation Issue Script Receive Script Script Status

Subject: 311/1 Get File

SUBJECT	BOX No	Shelf No.	Rack No.
311/1	1	2	3
311/1	2		
311/1	2	2	2
311/1	3		
311/1	4		
311/1	4	2	1
311/1	5		
311/1	9		
311/1	12		
311/1	16		
311/1	36		
311/1	70		

Post


- Key in the shelf and rack number, where the box has been kept
- Click on **Post** button to submit

Tab4 Issue Script: Allows user to issue scripts\ center's packets to officers requesting

- Select subject and type in code of school whose scripts to issue
- Click on **GET FILE** button


The below window is displayed that lists all candidates whose scripts for the selected paper had been marked and packed

Friday, June 12, 2015 You are Signed in as: Label



Kenya National Examinations Council

SCRIPT MANAGEMENT SYSTEM



Reports ▾
Script Management
My Account
Sign Out

Receiving List
Box Allocation
Shelf Allocation
Issue Script
Receive Script
Script Status

Subject:
School Code:
Get File
 Tick if whole Center

CODE	SUBJECT	BOX No	SHELF No	RACK No	ISSUE TO	REMARKS
50465840002	311/1	2	2	2		
50465840004	311/1	2	2	2	thomas mackenzi	validation
50465840005	311/1	2	2	2		
50465840006	311/1	2	2	2	joe maina	investigation
50465840008	311/1	2	2	2	lilian muli	remarking
50465840009	311/1	2	2	2		
50465840010	311/1	2	2	2		
50465840011	311/1	2	2	2		
50465840012	311/1	2	2	2		
50465840013	311/1	2	2	2		
50465840014	311/1	2	2	2		


- Key in the name of person requesting-**Issue to**
- key in the reason\remarks on issuing
- Click on **Post** button to submit

Tab5 receive Script: Allows user to receive back the issued scripts\ center's packets from officers requesting

- Select subject and type in code of school whose scripts to issue
- Click on **GET FILE** button


The below window is displayed that lists all candidates whose scripts had been issued out

Friday, June 12, 2015 You are Signed in as: Label



Kenya National Examinations Council

SCRIPT MANAGEMENT SYSTEM



Reports ▾
Script Management
My Account
Sign Out

Receiving List
Box Allocation
Shelf Allocation
Issue Script
Receive Script
Script Status

Subject:
School Code:
GetFile
 Tick if whole Center

CODE	SUBJECT	Remarks	RECEIVE
50465840001	311/1	To return to Box 2, on Shelf 2, at Rack 2	<input type="checkbox"/>
50465840003	311/1	To return to Box 2, on Shelf 2, at Rack 2	<input type="checkbox"/>
50465840004	311/1	To return to Box 2, on Shelf 2, at Rack 2	<input type="checkbox"/>
50465840006	311/1	To return to Box 2, on Shelf 2, at Rack 2	<input type="checkbox"/>
50465840008	311/1	To return to Box 2, on Shelf 2, at Rack 2	<input type="checkbox"/>
<input type="button" value="Post"/>			


- put a tick, on the script that has been received back
- Click on **Post** button to submit

Tab 6 Script Status: Allows user to view the status of a schools script- the whereabouts

- Select subject and type in code of school whose scripts to track
- Click on **VIEW** button


The below window is displayed that lists all candidates and status of their scripts, i.e. location or where issued and for which reason

Friday, June 12, 2015 You are Signed in as: Label



Kenya National Examinations Council

SCRIPT MANAGEMENT SYSTEM



Reports ▾
Script Management | My Account | Sign Out

Receiving List | Box Allocation | Shelf Allocation | Issue Script | Receive Script | Script Status

Subject: 311/1 ▾
School Code: 50465840

CODE	SUBJECT	BOX No	SHELF No	RACK No	ISSUED TO	DATE ISSUED	REMARKS
50465840001	311/1	xxx	xxx	xxx	mackenzi	25/05/2015	security check
50465840002	311/1	2	2	2			
50465840003	311/1	2	2	2			
50465840004	311/1	xxx	xxx	xxx	thomas mackenzi	12/06/2015	validation
50465840005	311/1	2	2	2			
50465840006	311/1	xxx	xxx	xxx	joe maina	12/06/2015	investigation
50465840008	311/1	xxx	xxx	xxx	lilian muli	12/06/2015	remarking
50465840009	311/1	2	2	2			
50465840010	311/1	2	2	2			
50465840011	311/1	2	2	2			
50465840012	311/1	2	2	2			
50465840013	311/1	2	2	2			
50465840014	311/1	2	2	2			

3. Reports

The system also gives reports showing work progress and status of received scripts

To view reports

- Go to Reports dropdown
- Select and click on the report to view

Kenya National Examinations Council
SCRIPT MANAGEMENT SYSTEM

Script Management | My Account | Sign Out

1 of 50 | Select a format | Export

SCRIPT MANAGEMENT SYSTEM-KNEC
RECIEVED SCRIPTS REPORT

DISTRICT: 01101

SBJ	CODE	ENTRY	SAT	ABS	DISCREPANCY	Date Received	Box No	Date Boxed	Shel
122/1	01910101	9	8		1AB	25-May-15	3	01-Dec-14	
237/1	01910101	9	11		2up	08-Jun-15	1	08-Jun-15	
237/2	01910101	9	8		1ab	01-Jun-15	2	29-May-15	
311/1	01910101	13	13			11-Nov-14	9	05-May-15	
	50437926	21	22		1 UP	25-May-15	3	25-May-15	
	50465840	9	9			25-May-15	2	25-May-15	
312/1	01910101	8	7		1ab	23-May-15	1	23-May-15	
	50274600	10	20		1up	22-May-15	1	22-May-15	


You may export the report to ms word, excel, .pdf etc or even print

4. Change password


The system allows users to change password when they wish

- Click on My Account
- below window appears

Friday, June 12, 2015 You are Signed in as: Label



Kenya National Examinations Council
SCRIPT MANAGEMENT SYSTEM



Reports ▾Script ManagementMy AccountSign Out

Change Your Password

Password:

New Password:

Confirm New Password:

- Enter current password
- enter new password and confirm it
- click on **change password** button

APPENDIX V: Source Code

1. The Login credentials

```
protected void btnLogIn_Click(object sender, EventArgs e)
{
    lblLogin.Visible = false;
    string credentials = "SELECT UserName, Password,Status FROM
internal_Users WHERE Password = '" + txtPassword.Text + "' AND UserName = '" +
txtUser.Text + "'";
    SqlCommand cmd = new SqlCommand(credentials, Con);

    Con.Open();
    //create a virtual table and add the query values
    DataTable dt = new DataTable();

    dt.Columns.Add(new DataColumn("UserName", typeof(string)));
    dt.Columns.Add(new DataColumn("Password", typeof(string)));
    dt.Columns.Add(new DataColumn("Status", typeof(string)));
    SqlDataReader reader1 = cmd.ExecuteReader();

    while (reader1.Read())
    {
        DataRow dr = dt.NewRow();

        dr["UserName"] = reader1["UserName"];
        dr["Password"] = reader1["Password"];
        dr["Status"] = reader1["Status"];
        dt.Rows.Add(dr);
    }
    Con.Close();
}
```

```

if (dt.Rows.Count < 1)
{
    lblLogin.Text = "Wrong Username or Password, Check Again";
    lblLogin.Visible = true;
}
else
{
    if (dt.Rows[0][2].ToString() == "1")
    {

        if ((dt.Rows[0][0].ToString() == txtUser.Text) & (dt.Rows[0][1].ToString()
== txtPassword.Text))
        {
            //add to session
            Session.Contents["sesuser"] = dt.Rows[0][0].ToString();
            Session.Contents["sespass"] = dt.Rows[0][1].ToString();
            string v1 = dt.Rows[0][0].ToString();
            string v2 = "xxx";
            Response.Redirect("staff/Clerk/Default.aspx");

        }
        else
        {
            lblLogin.Text = "Wrong Username or Password, Check Again";
            lblLogin.Visible = true;
        }
    }
    else
    {
        lblLogin.Text = "Account de-activated, please contact KNEC";
    }
}

```

```
        lblLogin.Visible = true;
    }
}
```