Design & Development of a Barrack Stores Management System for Zambia Air Force.
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Abstract

Today's world has brought about various innovative ways in which organizations carry out their daily transactions through the use of modern technologies so as to remain competitive in their businesses. These modern technologies help organizations gain competitive advantage against their competing counterparts. The Military world has not been an exception, and is known to be at the Center of most technological advancements (Andel et el, 1996). The military have in the past spearheaded the development of various Computerized Systems and Software that have received global acceptance and currently in use by various Civil organizations that have integrated these systems and redefined them to suite their preferred operational needs. In the United States for example, the military services have played a seminal role in advancing and shaping developments in computer science—from the earliest days to the present.

Owing to this back ground, many defence forces globally have evolved to meet their geographical demands to be forerunners in technological advancements. The Zambia Air Force for instance whose role is that of providing Air Defence (AD) to the Zambian Air Space has in the recent past been steadily growing in size extending its operations to almost all parts of Zambia. Complex Surface to Air Missile (SAM) systems are deployed for Long Range attacks on enemy forces around strategic locations in Zambia. This growth has been met with various challenges in the manner in which goods and services are procured and delivered to all the units of the Zambia Air Force. To enable efficient and timely delivery of goods and services, Barrack Stores Management System (BSMS), a fully featured Asset Management System enabling the management of both Technical (fixed) Stores and Nontechnical (consumable) assets from initial purchase, demand and issuance through to final disposal was be developed to bridge the gap that has been created by the growth of the operational base of the Zambia Air Force. . This Web based Barrack Stores Management System is able to record details of all purchases and procurements that are done by the Central Equipment Depot (CED), a Unit charged with the responsibility of procuring and issuance of barrack assets for all Zambia Air Force Formations

I. INTRODUCTION

A. Overview and Background

Inventory management calls for a smooth, efficient and timely delivery of goods and services as may be requisitioned by end users. It is for this reason that integrated inventory systems are developed to ensure that organisations deliver goods and services to end users across the organization so as to maintain an effective supply chain and retain competitive advantage (Breugelmans et el, 2006).

In the military for instance, goods and services in Warehouses also known as Barrack stores need to be procured way in good time so as to be made readily available for consumption as and when they may be required. This process of procuring Barack stores items and subsequently dispatching them to end users require a robust and effective system to be put in place (ibid). The magnitude of the defence forces calls for a highly integrated mechanism to be put in place to bridge the gaps that may be brought about due to restrictive geographical locations of units that could be deployed remotely in key operational areas that are usually not easy to access as they provide strategic defence to their respective nations (Muyumba and Phiri: 2017). Traditional methods currently obtaining in the Zambia Air Force (ZAF) of administering these Barrack Stores items have encountered various challenges ranging from inadequate provisioning for stocks, logistical support and timely delivery of fast running stores, whose none availability pauses grave challenges to the security of the nation. These procedures are done manually using paper-based systems resulting in negative effects on the general operations of the Zambia Air force (ibid).

In its quest, to ensure that goods and services are provisioned for and stock level be continuously monitored at higher Command by those charged with the responsibility of ensuring that these goods are procured, stored, issued and are made readily available to end users in good time with minimum delays, a Barrack Stores Management System was designed and developed by the researcher to enable remote access (Web-Based). This would also assist higher Command to make strategic projections and decisions based on real-time information and alerts regarding stock levels gathered remotely accessible on the designed and developed web-based Barack Stores Management System (BSMS).

It was therefore the aim of this paper to highlight steps that were taken by the researcher in the design and development of a web-based Barack Stores Management System for the Supply Department of the Zambia Air Force. This system once operational, would be deployed at Central Equipment Depot (CED). CED is a Unit in the Zambia Air Force responsible for bulk procurement and distribution of barrack stores (warehouse) to user units on demand.

B. Motivation of the Study

According to Muyumba and Phiri (2017), the Supply Department of the Zambia Air Force uses traditional manual (Paper-Based) systems of procuring, storage and distribution of various goods and services for its routine operations. This system had been working fairly well for the department due to the size and operational base of the Zambia Air Force at inception. However, the Zambia Air Force has been steadily expanding its operations across all corners of the country and this has brought about lapses in timely delivery of goods and services to all the Units around the country. Among other challenges that the traditional manual system has posed are:

- Late restocking of fast running stores.
- Oversights on inclusion of certain stocks for procurement and errors in accounting for stocks leading to shortages and sometimes unaccountable surpluses.
- Late access of key information for strategic planning at Air Force headquarters.

It is for this purpose that modern ways of integrated systems should be employed to improve on service

2

delivery of the Supply Department to meet its operational mandate. Thus, the development of an integrated web-based Barrack Stores Management System.

C. Significance

The Zambia Air Force has been in existence for several decades since Zambia attained its independence from its colonial master "The Great Britain". The Zambia Air Force adopted much if not all of its operational procedures and culture from Britain (Dick Lord: 2008). However, not all operational procedures could be integrated into the Zambia Air Force due to various reasons such as technological differences, budgetary constraints and limitations, cultural factors and many others.

The evolution of global technologies has brought about the need for the Zambia Air Force to start aligning itself towards global trends in ensuring that it remains in line with new ways of conducting Military operations, lest it remains behind with what other Defence forces are practicing in the global village (ZAF Air News: 2015).

This paper seeks to address a new way in which Supply stores could be managed in a modern way by computerizing the operations of the Barrack Store in the Zambia Air Force. This process is aimed at bringing about efficient and timely provisioning and delivery of various goods (Supplies) and services to all user Units and formations of the Zambia Air Force.

The researcher further hopes this design and development of a BSMS will enable Command at Air Force HQ in planning and make key strategic decisions as they will have real-time access to barrack stores availability and stock levels at the Central Equipment Depot (CED). This will be achieved by allowing senior command at Air Force HQ to remotely login and access statistics at CED so as to make decisions on which barrack items need to be procured immediately.

Svensson (2003) further explains that warehouse management systems aim at providing the following services to any organisation and in this case the Zambia Air Force:

1) Availability

The system shall be available 99.5% of the time. This will increase the general performance of ZAF CED in the delivery of various barrack stores to user units within the Air Force

2) Maintainability

The following requirements increase the maintainability of the Operational Interface software.

- All source code and development related documents shall be controlled under a version control system.
- All source code shall adhere to an agreed upon and well-defined set of coding standards for each development language used.
- A standard naming convention for classes, variables and packages shall be agreed upon and adhered to.

3) Security

The software system needs a robust security mechanism in place so that unauthorized users are not allowed access to the web-based BSMS. All users of the system must be uniquely identified. This could be done by using a user name and associated password scheme that would authenticate and authorize the user access to the system and, if applicable, grant the user access to restricted or controlled Barrack Store Management System. If a user cannot be identified, he/she will not be given access to the system. In order to monitor all past access to the system, all attempts to access the system must be logged.

- All users of the system shall login using some form of unique identification (e.g., username and password).
- All login attempts shall be done so in a secure manner by encrypting passwords using hashing algorithms such as MD5, SHA1 or Bcrypt.
- Each user shall either be an administrator or a regular user.

4) Potability

Since the software must run on several popular hardware platforms and the goal is to achieve a reasonable level of platform independence in terms of hardware and Operating Systems. The system shall be compatible with the Microsoft Windows Operating System (Windows Vista, XP, 7/8/10 or greater) or Linux.

5) Userbility

The system's user interface intuitive, easy to use and provide an overall positive user experience.

D. Problem Statement

According to the Government of the Republic of Zambia: Zambia Country Report on the Fifth National Development Plan (2006-2010), the Supply Department of the Zambia Air Force uses traditional manual systems of procuring, storage and distribution of various goods and services for its routine Barrack Stores (Warehouse) operations. This system had been working fairly well for the Supply Department due to the size and operational base of the Zambia Air Force at inception. However, according to Larmer et al (2007), the Zambia Air Force has been steadily expanding its operations across all corners of the country with the Introduction of Northern Air Defence Command (NADC) and Central Air Defence Command (CADC) and this growth has brought about lapses in timely delivery of goods and services to all the Units around the country.

Among other challenges that the traditional manual system has posed include; late restocking of fast running stores, oversights on inclusion of certain stocks for procurement, as well as errors in accounting for stocks leading to shortages and sometimes unaccountable surpluses and many others (ibid).

It is against this background that the researcher proposed and devised modern ways of integrated computerized systems be employed to improve on service delivery of the Supply Department of the Zambia Air Force to meet its operational mandate. According to Boyson, S. et.al. (1999), computerized systems of warehouse management enable organisations to be more efficient and effective in the management and planning for stocks in the warehouses. Thus, the design and development of a web-based Barrack Stores Management System for the Supply Department of Zambia Air Force to enable higher Command in the Supply department at Air Force headquarters to have real-time access to operations and inventory standing of Barrack Stores (warehouse) at ZAF CED and make informed decisions for strategic planning for the Zambia Air Force.

E. Objectives:

1) General Objective

The general objective of this project was to design and develop a web-based Barrack Stores Management System for the Zambia Air Force.

2) Specific Objectives:

- To identify suitable tools to be used in the development of a web-based BSMS for the Zambia Air Force. Resources, costs, time, benefits and other items were considered at this stage.
- To carry out a Systems Requirements and Analysis by analyzing the needs of the end users to ensure the new system

can meet their expectations and requirements.

- To design user friendly interface that would enable authorized access to the developed system.
- To enable controlled access to the system by use of authorized login credentials by users.
- To enable successfully logged in users to operate and manipulate functional operations of the system depending on their user permissions.
- To carry out operations and maintenance activities on the designed and developed system in order for the end-users to fine tune the developed system to boost performance, add new capabilities or meet additional user requirements.

F. *Research Questions*

A research question is the fundamental core of a research project, study, or review of literature. It focuses the study, determines the methodology, and guides all stages of inquiry, analysis, and reporting. It is for this reason that the researchers deduced the following research questions for this study:

- How best can Barrack Stores be managed?
- What systems can be used to administer Barrack Stores (Warehouses)?
- A comparison between traditional Paper-Based manual processes and Computerized Web-Barrack Stores Management System?

G. *Oraganisation of the Thesis*

Chapter one of this paper introduces the web-based Barrack Stores Management System by pointing out the significance of the project as well as the scope. Furthermore, the writer goes on to define the problem statement as well as the aim of the project. The general objective of the project is then derived from the problem statement. This objective is further refined into sub-objectives also known as specific objectives whose aim is to explain the steps taken to achieve the general objective. The project questions are basically asking possibilities of actualizing different modules that are incorporated in the system. Last but not the least, chapter one is concluded with a summary that describes all the aforementioned parts of the chapter.

The writer goes on to look at chapter two which presents the literature review and aiming at looking at related works that have been developed in the past and provide foundation of knowledge on the topic. Literature review further identifies areas of prior scholarship to prevent duplication and give credit to other researchers that have carried out studies on the design and development of systems similar to the BSMS. By doing so, the researcher identifies inconstancies as well as gaps in research, conflicts in previous studies, open questions left from other researches. This chapter is concluded with a summary of literature reviewed.

The system design and development methodology is then explained in chapter three. Methodology is defined as the process used to collect information and data for the purpose of making decisions on how the system will be designed and developed. This includes publication of the research, interviews, surveys and other research techniques, and include both present and historical information and its introduction clearly mentioning the methodology that was applied during the system development. The writer endeavors to explain the distinctiveness that lead to the choosing of such a methodology, clearly mentioning the advantages it comes with for such a system. Furthermore, chapter three also describes the data collection that was used, research approach that was taken and the system design. Under system design section, different system and design diagrams are shown. The chapters is then concludes with a summary of all the activities that took place in the methodology execution.

Chapter four aims to bring out the system results after implementation by the Zambia Air Force at ZAF CED. Further, this chapter explains the feel and user experience from the users at ZAF CED. These reviews help to point out system shortfalls or indeed if the users have accepted the final product that was given to then to use by the developer.

Finally, the thesis is concluded in chapter five by looking at the baseline study and the technologies compatible with the system. This chapter goes on to compare the BSMS with other similar works by explaining what makes the BSMS to be unique and why it should serve as a solution for the administration and management of warehouse stores also known Barrack Stores for the Zambia Air Force at Central Equipment Depot (ZAF CED). Further upgrades possibilities are the closing part of this chapter were the researcher looks at future works.

H. Summary

The researcher began this chapter by defining Barrack Stores as form of a Warehouse in the military where various goods are procured, stored and subsequently issued to end user Units. Having defined Barrack stores, the researcher went on to describe the design and development of a web-based Barrack Stores Management System (BSMS) for the Zambia Air Force to be deployed at ZAF CED. This BSMS is described as a computerized web-based system that would enable personnel at ZAF CED manage all Barrack Stores items as well as enable higher Command at ZAF HQ to have remote access to the transactions obtaining at ZAF CED for strategic planning purposes. The motivation for this development was explained as being the holdups experienced during the administration of Supply items at ZAF CED due to the current existing paper-based system that was being used. These lags formed the bigger part of the researchers problem statement for this paper. It was against this back ground that the researcher derived their general objective and specific objectives. These objectives prompted for the introduction of the research questions which the researcher hoped to address by designing and developing a web-based BSMS in order to improve provision and service delivery of Barrack items to user Units or formations of the Zambia Air Force.

II. LITERATURE REVIEW

A. Introduction

The researcher surveyed books, scholarly articles, and any other sources relevant to the design and development of Barrack Stores Management System, as well as area of research, or theory, and by so doing, providing an account, summary, and critical appraisal of these works in relation to the research of the designed and developed system. The purpose of a literature review is to enable the researcher convey to the reader what knowledge and ideas have been established before on a particular topic (Ranjit: 2011). The researcher must be certain that their proposed research is new, and a literature review will help them determine that. The main importance is illumination of certain issue with published paper.

Ranjit (2011) further explains that there are many different types of literature reviews, each with its own approach, analysis, and purpose. Through rigorous review and analysis of literature that meets a specific criterion, the systematic review identifies and compares answers to Stores Management Systems related questions (ibid).

B. Review of the Literature

Literature review divulges that organisations must be capable of fast, fundamental changes and those that aspire to be best must lead in changes (Oxley, 2009). Efficient management information system means;

- Quickly and fast response to change,
- Accurately
- Minimum clerical effort
- Up-to-date, and
- Available where and when needed.

Investigations of linkages between IT and firm performance as carried out by Powell and Dent-Micallef (2017) revealed that organisations greatly benefited from the use of Information Systems in their routine daily activities. Some of the major benefits realized from information technology communication are information availability, labour pricing and material tracking (ibid). Additionally, Boyson, et al (1999) reported that the benefits from a more open information flow as:

- Improve planning,
- Develop active operations,
- Smooth product flows,
- Time cost, and
- Improved service delivery.

Yaoa et el (2009) determined that better inventory control bring about increased inventory accuracy and timeliness of real-time data, permits the distribution activities to be performed with confidence and improved profitability. Furthermore, Barut et el (2002) measured the magnitude and the effectiveness of logistics information to firms in both directions of the supply chain. Ahmad and Schroeder (2001) scrutinized on the benefits gained from Electronic Data Interchange (EDI) usage. Helo and Szekely (2005) studied software applications for their functionalities and resulted benefits in relation to Supply Chain Management (SCM). Murphy and Simon (2002) assimilated intangibles like improved customer service into traditional cost benefit analysis in an ERP project. Kuo and Smits (2003) identified issues that improved the performance of integrated supply chains performance, while Evans et el (2005) concluded that SCM could be enhanced through Business Process Re-engineering (BPR)

characteristic of not afraid to be radical with respect to internal integration and continually search for step change improvement ideas. Attaran (2004) examined relationships between Information Technology (IT) and BPR, disagreeing that those wishing to do BPR must begin to apply the capabilities of IT to obtain benefits for successes.

According to the principles of supply chain management, modern companies attempt to achieve high-volume production and distribution using minimal inventories throughout the logistic chain that are to be delivered within short response times. The changes outlined above have had a dramatic impact on warehouse management. Low volumes have to be delivered more frequently with shorter response times from a significantly wider variety of stock keeping units (SKUs). In a further attempt to decrease total inventory, many companies replaced several relatively small distribution centers (DCs) by a small number of large DCs with an extensive distribution network. Often, an entire continent, like North America or Europe, is serviced by a small number of DCs at strategic positions.

These developments have significantly influenced the existing paradigms in inventory research. Unfortunately, the attention paid by researchers in inventory theory to the management of storage systems such as warehouses has been relatively limited. Often, it was considered to be a mainly technical issue and therefore belonging to a different field, i.e., material handling research. The goal of this paper is to show that, apart from the close relationship between inventory and warehouse management problems, the latter often lend themselves to a profound and elegant quantitative analysis.

According to Hussey (2003) in *Business Research*, modern companies make an effort to realize high-volume production and distribution using minimal inventories throughout the logistic chain that are to be delivered within short response times. The changes outlined above have had a powerful effect

on warehouse management. The author further explains that low volumes have to be delivered more frequently with shorter response times from a significantly wider variety of Stock Keeping Units (SKUs). In a further attempt to reduce total inventory, many companies replaced several relatively small Distribution Centers (DCs) by a small number of large DCs with an extensive distribution network. Often, an entire continent, like North America or Europe, is serviced by a small number of DCs at strategic positions. These expansions have significantly influenced the existing models in inventory research (ibid). Unfortunately, the attention rendered by researchers in inventory theory to the management of storage systems such as warehouses has been relatively limited. Often, it was considered to be a mainly technical issue and therefore belonging to a different field, i.e., material handling research.

C. Warehouse Management Systems:
Infrastructure, Integration, and Operations.

A warehouse can be defined as a planned space for the storage and handling of goods and material (Faber et el, 2013). In general, warehouses are focal points for product and information flow between sources of supply and beneficiaries. However, in humanitarian supply chains, warehouses vary greatly in terms of their role and their characteristics (ibid).

The convenience of information technology will enable availability of more efficient communication and control, which is important to a competitive global logistics capability (Reaidy et el, 2015). The motivation for strategic use of Management Information System (MIS) has been emphasized as the world transits into a global village where communication plays a critical role in ensuring that business organisations remain competitive on the trade market (ibid). There is growing research interest in the use of MIS as a strategic tool by organisations to gain competitive advantage.

Globalisation and competitive pressures have heightened the energy for strategic use of MIS. More specifically, Warehouse Management System (WMS) designed to introduce improvement into every aspect of a company's warehouse operation offers an organized approach to manage efficiency (Trujillo et el, 2008). For example, Hussey R. (2003) explains that bar code data collection systems for warehouse management system provides influential and flexible automatic identification system that connects the shop floor to the enterprise software. By integrating advanced radio frequency and bar-coding technologies with core warehousing functionality, WMS provides comprehensive fulfilment centre and warehouse management, including receiving, stocking, picking and related warehouse tasks. The best-of-breed solution forces state-of-the-art technology to deliver all of the functionality desirable to make the most of operational efficiency and increase throughput, thus meet the primary focus of warehouse in accuracy and timely fulfilment of customer orders (ibid).

1) Infastructure
The rapid development of globalization has made the supply chain management more complicated thereby, making necessary Warehouse Management Systems to be developed. These WMSs provide the bridge between corporate level production, scheduling, purchasing, logistics planning and order management systems, which allow the dynamic response to order demand essential goods in the Supply Chain Management (SCM). With barcode, voice data entry and radio frequency identification (RFID) data communications technology, WMS transforms conventional warehouses improving their efficiency and productivity (Peters, J. Eric, 2004). Wilson (2011) did a case study where the implementation of WMS integrated with voice picking resulted on a better organization, helping

the company to determine all the variables and based on them, make the best decision on inventory and shipping. Reaidy et al. (2015) explain the importance of warehouse planning in IT. They propose a bottom-up approach for collaborative warehouse order accomplishment based on a multi-agent system and IT infrastructure. Advances in ambient intelligence and RFID technology have enabled development to new approach in the logistics and production domain called "Bottom-up". It is based on information recovered from products and resources at the bottom of the chain which is then transmitted to the upper levels and impacts decision making across all supply chain areas. Cheng et al. (2006) proposed a WMS based on Aspect Oriented Programming (AOP), saying that AOP with WMS produce benefits: simplify system structure, increase agility, expansibility and maintainability, and solve some existing problems in current WMS. WMS play a critical role in supply chains and large production processes, when a company applies variability modeling techniques in WMS, in order to improve the degree of reuse and shorten the delivery time to customers. Software Product Line Engineering (SPLE) has proved to effectively increase the degree of software reuse in software development (FANG et al., 2013). The authors conclude that feature modeling effectively supports the layering of features, tracing to core SPL assets and configuring high-layered features in the WMS domain. Liu et al. (2013) explain the importance of real time information in WMS; Trujillo and Vázquez (2008), with the same conclusion, explain the construction and use of an IT Infrastructure based in a Data Warehouse and OLAP Technology that can be used in the decision making processes for continuous improvement applied to a quality management system of a manufacturing company.

2) Integration

Moeller (2011) shows that automation for order picking processes in warehouses is only deployed to a limited extent. This is because of the need of large and long ranging investments, dynamic market demand requires more and more systems flexibility, and the products characteristics like size and/or weight may change significantly over time. This is the reason for the majority of order picking systems still be manually operated. He explains the importance of order picking strategies as a core function within a WMS. He concluded that there are no conditions to apply routing heuristics in storage areas. For the cases of routing heuristics application, he suggested the use of Line Sequence Optimization (LSO), which calculates the line sequence with the minimum travel time. A case study showed that the LSO is planned to be integrated as a supplementary functionality into an existing WMS of a supplier, and this functionality will enhance the supplier's product offer to the market. Wu et al. (2013) proposed a WMS based on QR code with the objective of improving the efficiency of warehouse management. They showed how the WMS function with QR code integrated. They provide a basic design thought and scheme of WMS based on QR code and discuss several key problems in the process, given many solutions and relevant code. Zapata Cortés et al. (2012) show Fuzzy Extended Analytical Hierarchy (FEAHP) applied to a WMS. They explain how the method of FEAHP function and how to select a software with FEAHP considering administrative aspects of the product. They chose the Software Quality Assurance (SQA) and showed how to implement the FEAHP with this software. They showed that the tool presented involve many alternatives and benchmarks to be considered. According to the method used they concluded that FEAHP can be used in selecting information tools linked to logistics, involving a huge number of contemplations and a group of specialists. Chen et

al. (2013) present the integration of slender production and Radio Frequency Identification (RFID) technology to advance the competence and success of warehouse management. First of all, "RFID has become a critical technology for competence and helpfulness improvement in production, logistics, and supply chain management. RFID can detect, order, and accomplish the flow of materials and information throughout the supply chain wirelessly without human involvement in order to avoid human error. Information of an object's current location, condition, and history can be stored and retrieved on a real-time basis, giving better perceptibility for decision making." So, they explain how WMS is without lean and RFID, and after they explain how WMS is with lean and RFID. The case study showed that using lean management and RFID to reengineer and alter the operation processes resulted on profits to the logistics operations in warehouse, as reduction of the processing time of data transmitting to WMS at receiving and shipping docks, and on the total operation time from current stage to future stage was.

3)   Operations

According to Faber et al. (2013), high costs of land and labor, and growing labor shortages were forcing companies to capitalize in people and automation systems with a comparatively long-term investment horizon. The authors considered warehouse management as a mixture of planning and control systems and the decision rules used for inbound, storage, and outbound flows. The most significant tactical issues in warehouses include: stock planning, storage-location assignment planning, transport planning, and capacity (personnel and equipment) planning. Stock planning decided which products were kept in storage, in what quantities, and determined when shipments arrived. Intelligent stock planning would reduce warehousing costs. Storage location planning

resolved the location types and the zones within those storage areas where the products would be stored. An effective storage-location assignment plan could reduce the need for space and the mean travel time for storage/retrieval and order picking. Capacity planning and transport planning determined the required personnel, equipment, and transport capacities (ibid). During the process, some changes happened, so a control system was necessary, which encompassed monitoring, analyzing, reporting and intervening in order to increase the control operations, accurate and timely information on the floor. As the speed of the transformation of data into information increased, the control system became more sophisticated. In most warehouses, Information Systems (IS) supported warehouse management and its data. They could have been ERPs, for broader applications, or WMS for specific operations in warehouses. Both of them could be developed for a warehouse (tailor-made) or bought off-the-shelf (standard software package). For warehouses, a WMS had to consider the specificities of the facility, the number of different products handled in the warehouse, the number and variety of the processes carried out by the warehouse, and the number of order lines processed by the warehouse per day. In an external point of view, to build this IS, the variables to be considered were: the unpredictability of market demand, and the rate of change in the taste and preference among customers.

WMS is a database driven computer application, which is used by logistics personnel to improve the efficiency of the warehouse by directing cutaways and to maintain accurate inventory by recording warehouse transactions, thus supporting the daily operations within the warehouse, helping to manage inventory, storage locations and workforce (DOTOLI et al., 2015). So, it is used to physically control the warehouse database improving its system. WMS also directs and optimizes stock put-

away based on real-time information about the status of utilization (ibid). In addition, this system (WMS) optimize all activities (operational and managerial), such as: receive, inspection, address, storage, separation, package, shipping, documents sending, and others. Therefore, this system leads to cost reduction and customer service level increasing, because the productivity can increase. WMS works in real time among different and multiple warehouses, allowing the status of goods visibility local or far. This could be done by remote terminals or by Internet, producing documents, leading to a global view and by sector about goods (Wilson & Marianne, 2011). Shiau and Lee (2010) define missions of a WMS as: achieving transportation economies, achieving production economies, taking advantage of quality purchase discounts and forward buys, supporting the firm's customer service policies, meeting varying market conditions and reservations, disabling the time and space differences that exist between producers and customers, accomplishing the least total cost logistics proportionate with a desired level of customer service, supporting the just-in-time programs of suppliers and customers, providing customers with a mix of products instead of a single product on each order, providing temporary storage of material to be disposed or recycled, providing a buffer location for trans-shipment. In the end of nineties, Electronic Commerce (EC), the Internet had had an obvious influence on warehouse management (ibid).

Wanke and Zinn (2004) explain that the Internet-based stores are less likely to require physical place of selling. However, warehouses are still required to store the goods. On the Internet, direct contact with customers means many small orders, however, this is a different situation from stores which would normally order large numbers of goods. Simply stated, warehouses change from shipping large quantities of goods to shipping large numbers of small quantities of goods. Even though EC involved

new technologies to change from physical to virtual market, the methods used are still very simple.

Although some methods could be simple, e-retailers, as an example for a complex logistic operation because as they receive orders from customers in different locations, they already know which other orders have already been placed. In principle, this allows them to offer a combined delivery service to clients whose orders arrive later, thus overcoming the informational cost (ibid). Therefore, optimal stock levels are affected adversely by the introduction of a Combined Delivery Shipment (CDS) service; for a retailer with lower stock levels, coalitions can be formed less frequently than for those with higher availability of items, ceteris paribus (Michalak et al., 2009). So, in a physical or virtual market, WMS has to be implemented to make the issues of logistic and accounting activities possible. Guarnieri et al. (2006) applied WMS in reverse logistic operations and described that some products returned to warehouses without any use, because of expiry date, warranty, quality, damages during transportation, or to be processed to produce a result by recycle.

D. Related works

1) Global Warehouses

The global warehousing concept has gained popularity over the last decade as stock pre-positioning becomes one of the strategies for ensuring a timely response to emergencies (Ballou, 1999). They are usually purpose built or purpose designed facilities operated by permanent staff that have been trained in all the skills necessary to run an efficient facility or utilising third party logistics (3PL) staff and facilities. For such operations, organisations use, information systems that are computer based, with sophisticated software to help in the planning and management of the warehouse. The operating situation is relatively stable and management attention is focused on the efficient and cost-effective running of the warehouse

11

operation (ibid). Several organizations have centralized pre-positioning units strategically located globally. Some of these offer extended services to other humanitarian organizations on a cost-plus operating charges basis. The United Nations Humanitarian Response Depot (UNHRD) Network for example is one global system utilising Global warehouses (Moeller and Klaus, 2011).

2) Field Warehouses

Field Warehouses are usually temporary in nature in that they may be contained in structures or buildings which were not designed to be used as a warehouse, in a temporary building/structures, and are often in mobile units (rub halls or Wiikhalls) that are little more than a tent in a field (Fleischmann et el, 2003). The preliminary members of staff may be a casual workforce that has never worked in a warehouse before and the inventory system is more likely to be paper based. Mostly, the situation is initially chaotic, sometimes dangerous and coupled with a humanitarian need which may be very urgent (ibid).

Therefore, the management style must be practical and action inclined with a focus on making the humanitarian goods available as quickly and efficiently as possible, while being accountable for all the goods and services being provided at the same time (Stewart, 2012).

E. Summary

It is concluded that WMS has a positive impact on operations measures. WMS represent a Technology employed to advance the outcomes in logistics activities, mainly warehouse operations. The software leads to better issues in the activities (receive, inspection, address, storage, separation, package, shipping, documents sending), registers, warehouses, and directs to other Information Systems precise information, reducing errors, and, as a result, improve the costs of doing business. Therefore, this system brings about higher client service level, because the productivity is guaranteed

to increase. Because the quantity of data is huge, this technology has to be integrated with other technologies and systems, such as some software with QR Code, ERP, and some hardware (RFID). To research in this subject, the amount of data is high, because the quantity of scientific and technical papers, news, case studies, reports, and so on had to be read by researcher. We can conclude that this is a dynamic research area, with applications in many business sectors. Investments in WMS enable the distribution centre to compete successfully against other rivals in the market. To adopt the MIS, wireless barcode embedded WMS in specific, it is necessary to have corporate culture that supports complex operational activities. BPR has to be enacted as such that the WMS and associated physical operations are well integrated. WMS implementation was critical in conveying the reduction of cost in operational level, and effective management in management level, as well as development of the company's competitiveness in strategic level. Companies that manage warehousing of their products are projected to implement WMS in order to preserve their competitive edge in the global market place.

The flows analyzed are the physical (stock management and movements) and informational flows that are associated with the goods distribution activities.

III. METHODOLOGY

A. Introduction

This chapter outlines the methodology of the study. It presents the research design, the population of the study, the sample size, sampling procedure, instruments for data collection, data collection and data analysis.

B. Baseline Study

The system requirement where analyzed by the developer point having put into consideration what the users had submitted in the System

12

Requirements. The researcher then adopted a waterfall model in the design and development of the BSMS in which in "The Waterfall" approach, the whole process of software development is divided into separate phases. Waterfall approach was first SDLC Model to be used widely in Software Engineering to ensure success of the project. In this Waterfall model, typically, the outcome of one phase acts as the input for the next phase sequentially (Cohen et el, 2010).

Cohen et el (2010) further explains that the sequential phases in Waterfall model are:

• Requirement Gathering and analysis −: All possible requirements of the system to be developed are captured in this phase and documented in a requirement specification document.

• System Design −: The requirement specifications from first phase are studied in this phase and the system design is prepared. This system design helps in specifying hardware and system requirements and helps in defining the overall system architecture.

• Implementation −: With inputs from the system design, the system is first developed in small programs called units, which are integrated in the next phase. Each unit is developed and tested for its functionality, which is referred to as Unit Testing.

• Integration and Testing −: All the units developed in the implementation phase are integrated into a system after testing of each unit. Post integration the entire system is tested for any faults and failures.

• Deployment of system −: Once the functional and non-functional testing is done; the product is deployed in the customer environment or released into the market.

• Maintenance −: There are some issues which come up in the client environment. To fix those issues, patches are released. Also, to enhance the product some better versions are released. Maintenance is done to deliver these changes in the customer environment.

All these phases are cascaded to each other in which progress is seen as flowing steadily downwards (like a waterfall) through the phases. The next phase is started only after the defined set of goals are achieved for previous phase and it is signed off, so the name "Waterfall Model". In this model, phases do not overlap.

Waterfall Model - Application
Every software developed is different and requires a suitable SDLC approach to be followed based on the internal and external factors. Some situations where the use of Waterfall model is most appropriate are −

• Requirements are very well documented, clear and fixed.

• Product definition is stable.

• Technology is understood and is not dynamic.

• There are no ambiguous requirements.

• Ample resources with required expertise are available to support the product.

• The project is short.

Waterfall Model - Advantages
The advantages of waterfall development are that it allows for departmentalization and control. A schedule can be set with deadlines for each stage of development and a product can proceed through the development process model phases one by one.

Development moves from concept, through design, implementation, testing, installation, troubleshooting, and ends up at operation and

maintenance. Each phase of development proceeds in strict order (Gabbard, 2003).

Furthermore, according to Gabbard, (2003), Some of the major advantages of the Waterfall Model are as follows:

- Simple and easy to understand and use

- Easy to manage due to the rigidity of the model. Each phase has specific deliverables and a review process.

- Phases are processed and completed one at a time.

- Works well for smaller projects where requirements are very well understood.

- Clearly defined stages.

- Well understood milestones.

- Easy to arrange tasks.

- Process and results are well documented.

Waterfall Model - Disadvantages
The disadvantage of waterfall development is that it does not allow much reflection or revision. Once an application is in the testing stage, it is very difficult to go back and change something that was not well-documented or thought upon in the concept stage (ibid).

The major disadvantages of the Waterfall Model are as follows:

- No working software is produced until late during the life cycle.

- High amounts of risk and uncertainty.

- Not a good model for complex and object-oriented projects.

- Poor model for long and ongoing projects.

- Not suitable for the projects where requirements are at a moderate to high risk of changing. So, risk and uncertainty are high with this process model.

- It is difficult to measure progress within stages.

- Cannot accommodate changing requirements.

- Adjusting scope during the life cycle can end a project.

- Integration is done as a "big-bang" at the very end, which doesn't allow identifying any technological or business bottleneck or challenges early.

A combination of interviews to gather system requirements from users as well as an observation on how procedures on Barrack Stores Management were conducted on a daily basis at ZAF CED for period of 30 days was conducted by the researcher. The researcher then developed an incremental prototype that served as a guide for the system that was designed and developed. The researcher started by analyzing the routine daily operations coupled with the possible challenges that were encountered by the personnel at ZAF CED in their day to day activities as they utilized the existing paper-based manual system.

1) *Data Collection*
The researcher collected system requirements data by conducting interviews and observations on all the users (Personnel) of the would-be system at ZAF CED.
This enabled the researcher to probe the interviewees further where certain issues were not clear and enabled the researcher to provide technical and professional suggestions to the users on how certain activities could be performed. This also helped to serve the researcher in clarifying some concepts and problems about the phenomena that was being studied.

2) *Research Approach*

14

The researcher conducted a qualitative analysis of the research by examining how the existing manual Barrack Stores Management which was being used at ZAF CED would be improved.

3) Sampling Procedures

The researcher used both nonrandom and random sampling methods in identifying both the users and barrack stores items that were used in the design and development of the web-based BSMS. The non-random sampling procedure was used to select the user officer(s) and the simple random sampling procedure was used to select barrack items.

4) Population

The sample of the study was drawn from one area namely Central Equipment Depot (CED), which is a Unit of the Zambia Air Force charged with the responsibility of procurement, administration and subsequent issuance of bulk supply items also known as Barrack Stores Items to user formations, Units, Stations and Commands of the Zambia Air Force. The population included all barrack items and stores such as V and As, Combat Uniforms, Combat boots, Staff Shoes, Routine Operational Dress Uniforms, Stationery, Office Equipment and Furniture and Petroleum, Oils and Lubricants (POLs) but to mention a few.

5) Development of the Application

The researcher conducted system design, development and implementation of the web-based BSMS using Bootstrap, CSS, HTML, Jquery, PHP, and MySQL, which are the open source applications

6) System Design

a) Context Diagram

A context diagram, sometimes called a level 0 data-flow diagram, is drawn in order to define and clarify the boundaries of the software system. It identifies the flows of information between the system and external entities. The entire software system is shown as a single process. Context diagrams are used to illustrate how the system interacts with its environment (Gabbard et al, 2004). The diagram below in Fig.1 shows the flow of information and interaction between the BSMS and system users i.e. the Administrator and the basic User.

System Context Diagram for BSMS
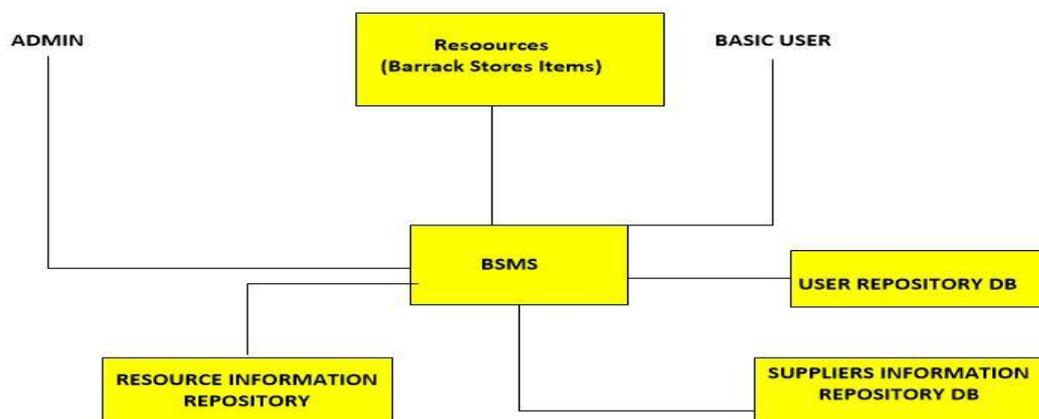
Fig.1 (Adapted from Reaidy et al (2015)

b) System Software Level Architectural Design

The software architecture of a program or computing system is the structure or structures of the system, which comprise software elements, the externally visible properties of those elements, and the relationships among them. Architectural design is concerned with understanding how a system should be organized and designing the overall structure of that system. The output of the architectural design process is an architectural model that describes how the system is organized as a set of communicating components (ibid). This is as shown in Fig. 2

**System Software Level Architectural Design**
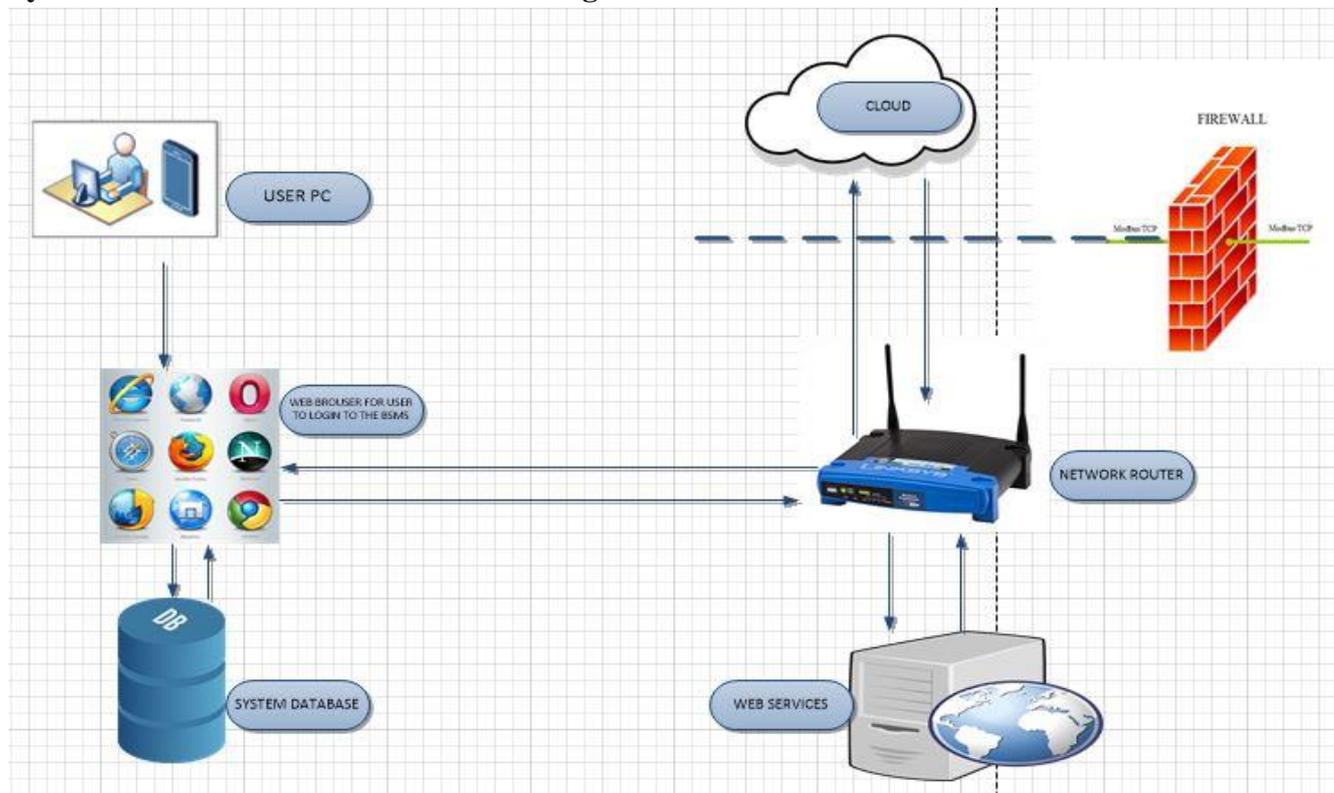
Fig. 2 Adapted from ibid

c)   *Modular design of the system function*

Modular design, or "modularity in design", is an approach (design theory and practice) that subdivides a system into smaller parts called modules or skids that can be independently created and then used in different parts of the systems. This approach offers numerous rewards to system designers such as allowing the designer to work out solutions to common problems independently of projects. This independent work enables them to consistently improve their solutions and it leads to efficiency in development through reuse of modules. It doesn't have to lead to the same design over and over again. This is as shown in Fig.3 and Fig.4 below:

16

Modular design of the system function
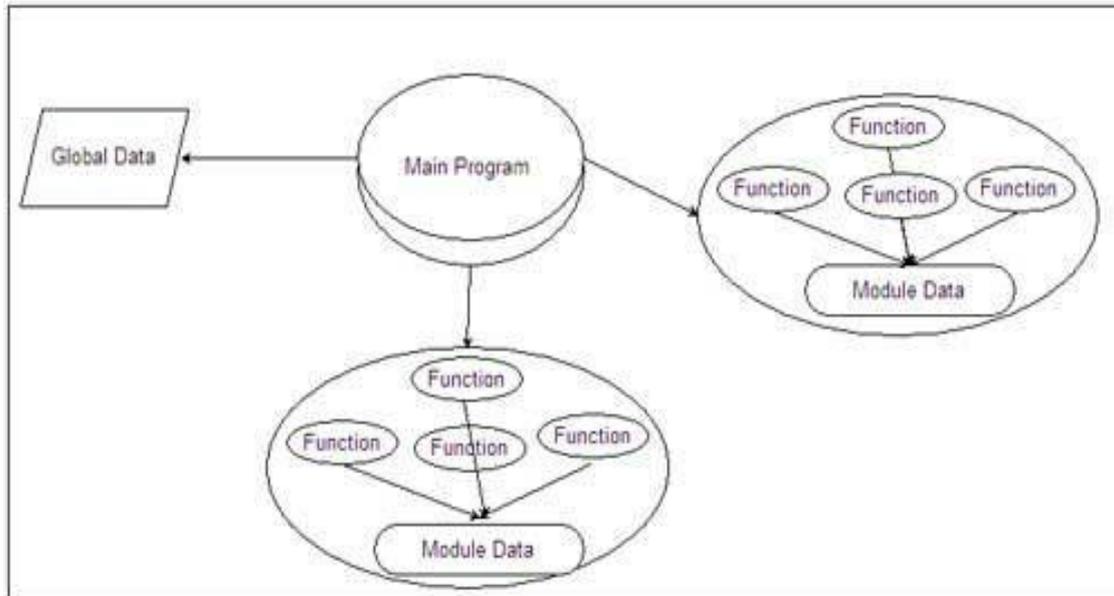
Fig 3. Adapted from Murphy and Simon (2007).

Modular Design of the System Function
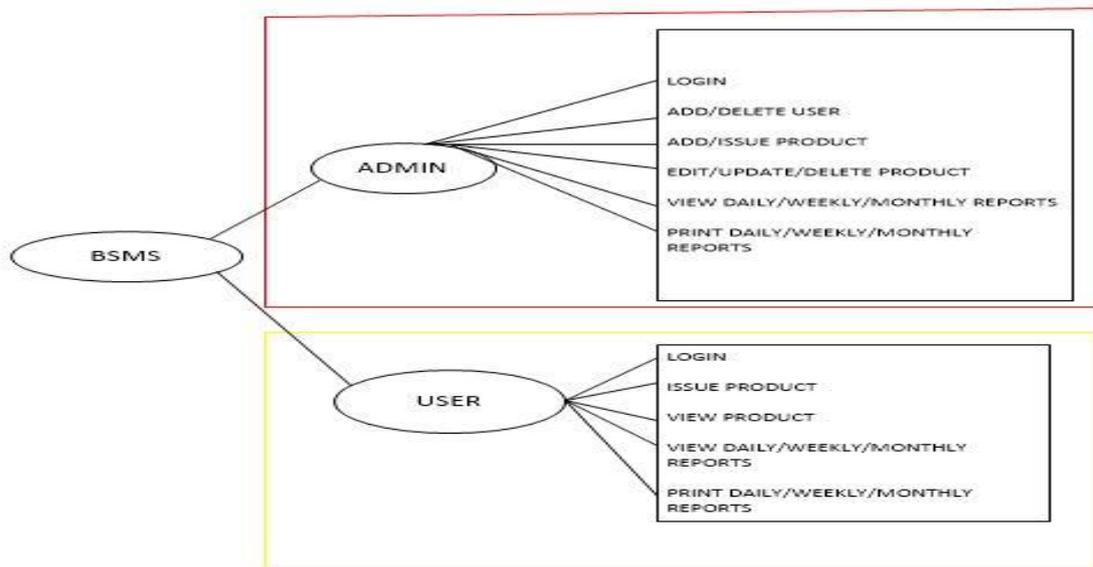
Fig.4

Adapted from Attaran, M (2004).

d)   System Class Diagram

In software engineering, a class diagram is a type of static structure diagram that describes the structure of a system by showing the system's classes, their attributes, operations (or methods), and the relationships among objects. The class diagram is the main building block of object-oriented modeling. It is used for general conceptual modeling of the structure of the application, and for detailed modeling translating the models into programming code. Class diagrams can also be used for data modeling. The classes in a class diagram represent both the main elements, interactions in the application, and the classes to be programmed (Cohen et el, 2010).

17

e)   *System Data Model Design*

Data modeling is a process used to define and analyze data requirements desired to support the operational processes within the scope of corresponding Information Systems in organizations. Therefore, the process of data modeling involves professional data modelers working closely with business stakeholders, as well as potential users of the information system (Whitten et al, 2004).

Furthermore, Whitten et al (2004) explains that there are three different types of data models produced while progressing from requirements to the actual database to be used for the Information System. The data requirements are initially recorded as a conceptual data model which is essentially a set of technology independent specifications about the data and is used to discuss initial requirements with the business stakeholders. The conceptual model is then translated into a logical data model, which documents structures of the data that can be implemented in databases. The last step in data modeling is transforming the logical data model to a physical data model that organizes the data into tables, and accounts for access, performance and storage details. Data modeling defines not just data elements, but also their structures and the relationships between them (ibid).

Data modeling techniques and methodologies are used to model data in a standard, consistent, predictable manner in order to manage it as a resource. The use of data modeling standards is strongly recommended for all projects requiring a standard means of defining and analyzing data within an organization, for example, using data modeling:

•   to assist business analysts, programmers, testers, manual writers, IT package selectors, engineers, managers, related organizations and clients to understand and use an agreed semi-formal model the concepts of the organization and how they relate to one another

•   to manage data as a resource

•   for the integration of information systems

•   for designing databases/data warehouses (aka data repositories)

Data modeling may be performed during various types of projects and in multiple phases of projects. Data models are progressive; there is no such thing as the final data model for a business or application. Instead a data model should be considered a living document that will change in response to a changing business. The data models should ideally be stored in a repository so that they can be retrieved, expanded, and edited over time (Guarnieri, 2006).

f)   *User Interface Design*

Cohen et el (2010) defines a User interface as the front-end application view to which user interacts in order to use the software. The software becomes more popular if its user interface is:

•   Attractive

•   Simple to use

•   Responsive in short time

•   Clear to understand

•   Consistent on all interface screens

Furthermore, Cohen et el (2010) explains that there are two types of User Interface:

•   Command Line Interface: Command Line Interface provides a command prompt, where the user types the command and feeds to the system. The user needs to remember the syntax of the command and its use.

•   Graphical User Interface: Graphical User Interface provides the simple interactive interface to interact with the system. GUI can be a combination of both hardware and software. Using GUI, user interprets the software.

18

User Interface Design Process explained diagrammatically as shown in Fig.5:

User Interface Design
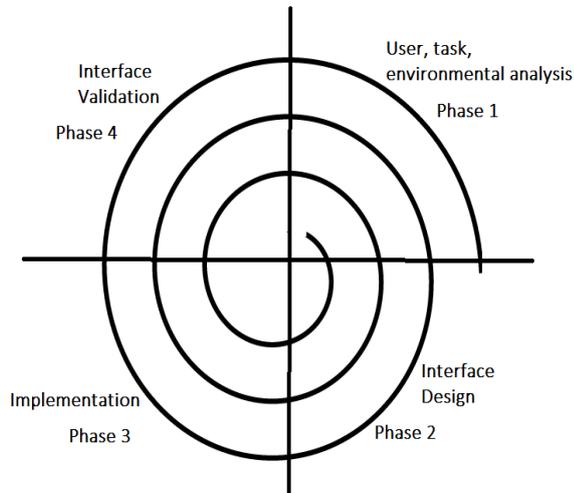
Fig.5   Adopted from Cohen et el (2010).

The analysis and design process of a user interface is iterative and can be represented by a spiral model. The analysis and design process of user interface consists of four framework activities.

- User, task, environmental analysis, and modeling: Initially, the focus is based on the profile of users who will interact with the system, mainly:-understanding, skill and knowledge, type of user based on the user's profile. Users are made into categories, from each category requirements are gathered. Based on the requirements, the developer understands how to develop the interface. Once all the requirements are gathered a detailed analysis is conducted. In the analysis part, the tasks that the user performs to establish the goals of the system are identified, described and elaborated. The analysis of the user environment focuses on the physical work environment. Among the questions to be asked are:

- Where will the interface be located physically?

- Will the user be sitting, standing, or performing other tasks unrelated to the interface?

- Does the interface hardware accommodate space, light, or noise constraints?

- Are there special human factors considerations driven by environmental factors?

- Interface Design: The goal of this phase is to define the set of interface objects and actions i.e. Control mechanisms that enable the user to perform desired tasks. Indicate how these control mechanisms affect the system. Specify the action sequence of tasks and subtasks, also called a user scenario. Indicate the state of the system when the user performs a particular task. Always follow the three golden rules stated by Theo Mandel. Design issues such as response time, command and action structure, error handling, and help facilities are considered as the design model is refined. This phase serves as the foundation for the implementation phase.

- Interface construction and implementation: The implementation activity begins with the creation of prototype (model) that enables usage scenarios to be evaluated. As iterative design process continues a User Interface toolkit that allows the creation of windows, menus, device interaction, error messages, commands, and many other elements of an interactive environment can be used for completing the construction of an interface.

- Interface Validation: This phase focuses on testing the interface. The interface should be in such a way that it should be able to perform tasks correctly and it should be able to handle a variety of tasks. It should achieve all the user's requirements. It should be easy to use and easy to learn. Users should accept the interface as a useful one in their work.

Golden Rules:
The following are the golden rules stated by Theo Mandel that must be followed during the design of the interface.

Place the user in control:

- Define the interaction modes in such a way that does not force the user into unnecessary or undesired actions: The user should be able to easily enter and exit the mode with little or no effort.

- Provide for flexible interaction: Different people will use different interaction mechanisms, some might use keyboard commands, some might use mouse, some might use touch screen, etc., and hence all interaction mechanisms should be provided.

- Allow user interaction to be interruptible and undoable: When a user is doing a sequence of actions the user must be able to interrupt the sequence to do some other work without losing the work that had been done. The user should also be able to do undo operation.

- Streamline interaction as skill level advances and allow the interaction to be customized: Advanced or highly skilled user should be provided a chance to customize the interface as user wants which allows different interaction mechanisms so that user doesn't feel bored while using the same interaction mechanism.

- Hide technical internals from casual users: The user should not be aware of the internal technical details of the system. He should interact with the interface just to do his work.

- Design for direct interaction with objects that appear on screen: The user should be able to use the objects and manipulate the objects that are present on the screen to perform a necessary task. By this, the user feels easy to control over the screen.

Reduce the user's memory load:

- Reduce demand on short-term memory: When users are involved in some complex tasks the demand on short-term memory is significant. So, the interface should be designed in such a way to reduce the remembering of previously done actions, given inputs and results.

- Establish meaningful defaults: Always initial set of defaults should be provided to the average user, if a user needs to add some new features then he should be able to add the required features.

- Define shortcuts that are intuitive: Mnemonics should be used by the user. Mnemonics means the keyboard shortcuts to do some action on the screen.

- The visual layout of the interface should be based on a real-world metaphor: Anything you represent on a screen if it is a metaphor for real-world entity then users would easily understand.

- Disclose information in a progressive fashion: The interface should be organized hierarchically i.e. on the main screen the information about the task, an object or some behavior should be presented first at a high level of abstraction. More detail should be presented after the user indicates interest with a mouse pick.

Make the interface consistent:

- Allow the user to put the current task into a meaningful context: Many interfaces have dozens of screens. So, it is important to provide indicators consistently so that the user know about the doing work. The user should also know from which page has navigated to the current page and from the current page where can navigate.

- Maintain consistency across a family of applications: The development of some set of applications all should follow and implement the same design, rules so that consistency is maintained among applications.

If past interactive models have created user expectations do not make changes unless there is a compelling reason

g) *Summary*

The user interface of this system typically involved those objects that a user will see and interact with directly on their screen. Example given of such objects include the menus, document space, dialog boxes, icons and animations images.

However, the user interface of this system is only one aspect of the overall user experience. Other aspects of the user experience that are not visible to the user, but are integral to the system and critical to its usability, include start up time, latency, error handling, and automated tasks that are completed without direct user interaction.

In general, a user interface requires action by a user to accomplish a task, while a great user experience can be achieved with no user interface at all. Providing a successful user experience requires a balanced approach throughout the development life cycle. To ensure this balance, the designer did not only focus on implementing the functionality required to complete a task but also on how the task is exposed through the user interface. Always keep in mind that the user interface must not only be functional, but also usable.

IV.   **RESULTS**

A. *Introduction*

This aims to bring out the system results obtained by the researcher after the design, development and subsequent implementation of the BSMS at ZAF CED of the Zambia Air Force. Furthermore, this chapter explains the feel and user experience from the users at ZAF CED. These reviews help to point out system shortfalls or indeed if the users have accepted the final product that was designed and developed by the researcher.

B. *Baseline Study Results*

The researcher at this point carried out a desktop system testing to ensure that the designed and developed system met the initial set of goals. Testing was done repeatedly, specifically to check for errors, bugs and interoperability. This testing was conducted until the basic end user requirements were all captured to ensure that the system was acceptable by the user(s). The other important aspect of this testing was to carry out verification and validation of the system, both of which would be helpful to guarantee the program's successful completion

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1) Web page Design

Web design covers many different skills and disciplines in the production and maintenance of websites. The different areas of web design include web graphic design; interface design; authoring, including standardized code and proprietary software; user experience design; and search engine optimization. The term web design is normally used to describe the design process relating to the front-end design of a website including writing mark up. Web design partially overlaps web engineering in the broader scope of web development. Web designers are expected to have an awareness of usability and if their role involves creating markup then they are also expected to be up to date with web accessibility guidelines (Md. Mijanur Rahman, 2015).

The diagrams below are the screenshots of the BSMS tested with various front-end functionalities: -

Fig.6: Login page for the BSMS
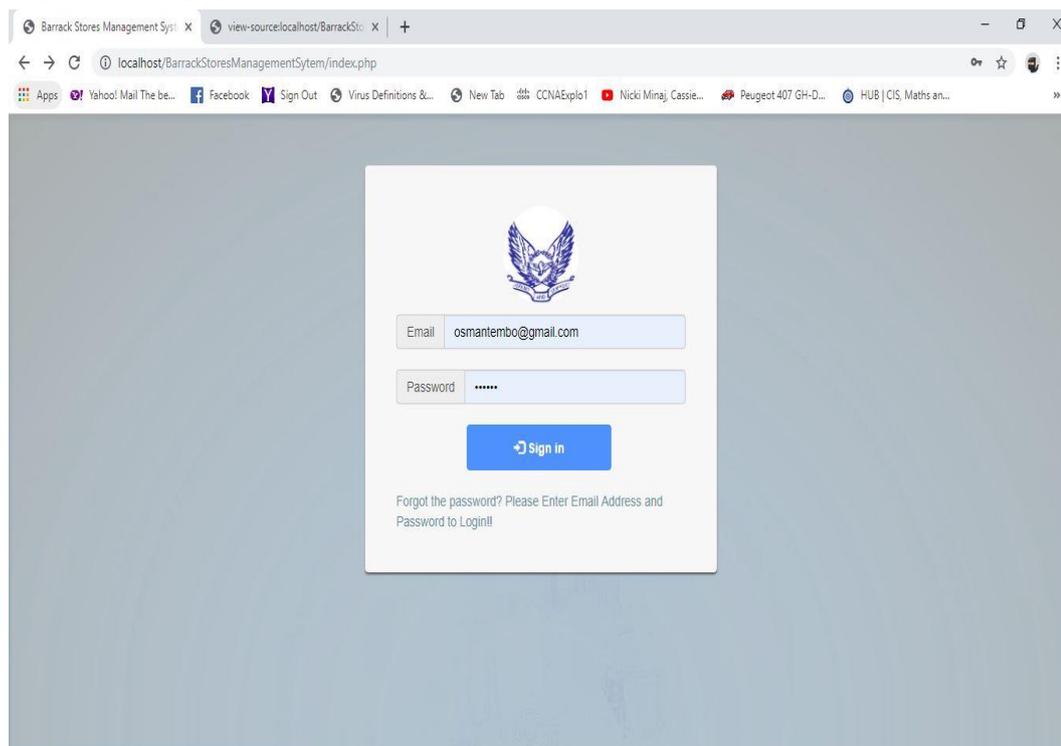
The system was designed to comprise of two (2) types of users both with different user roles or privileges. The first user types whose role was that of administering the web-based BSMS was created. This user had admin rights and privileges to add, delete or edit users, products, manipulate data, view users and products, print daily and other periodic reports on the designed and developed web-based BSMS. The second type of user was the Supply Stores clerk whose roles were limited to basically login to the system, issue barrack stores items and print activity reports. This was done so as to control and safeguard stocks in the supply stores at ZAF CED thereby providing measures of preventing misappropriation of barrack stores items.

The figure shows the outlook of the BSMS on successful login of an admin or stores clerk user;

Fig.7: Homepage or Dashboard for the BSMS
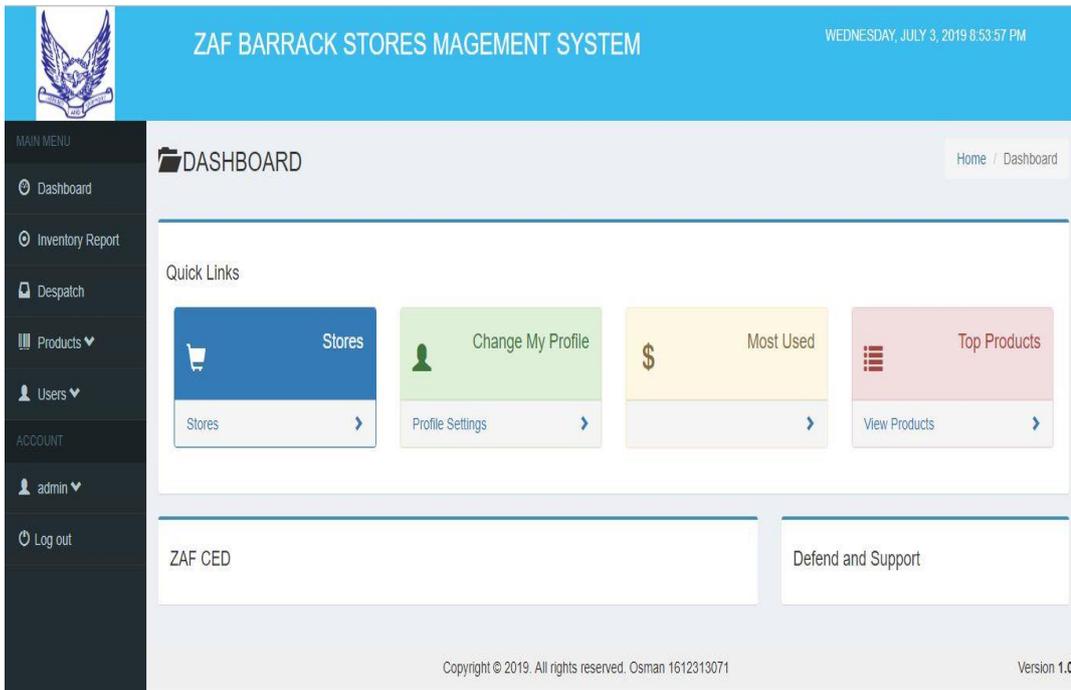
This page shows what is displayed for a successful login of an admin user. The admin user can roam around the BSMS to carry out various operations. The first recommended task the developer issued was to change the login credentials for all registered users so as to safeguard their login details. The default login details were set to be the user's email address for the username and for the password, the BSMS was set to use the user's phone number. This can easily be guessed by any person who would know these details for any registered user (s) of the BSMS, hence the developer strongly recommended that users were to change these details once they logged into the system.

Fig.8: Add User and User Role Form for the BSMS
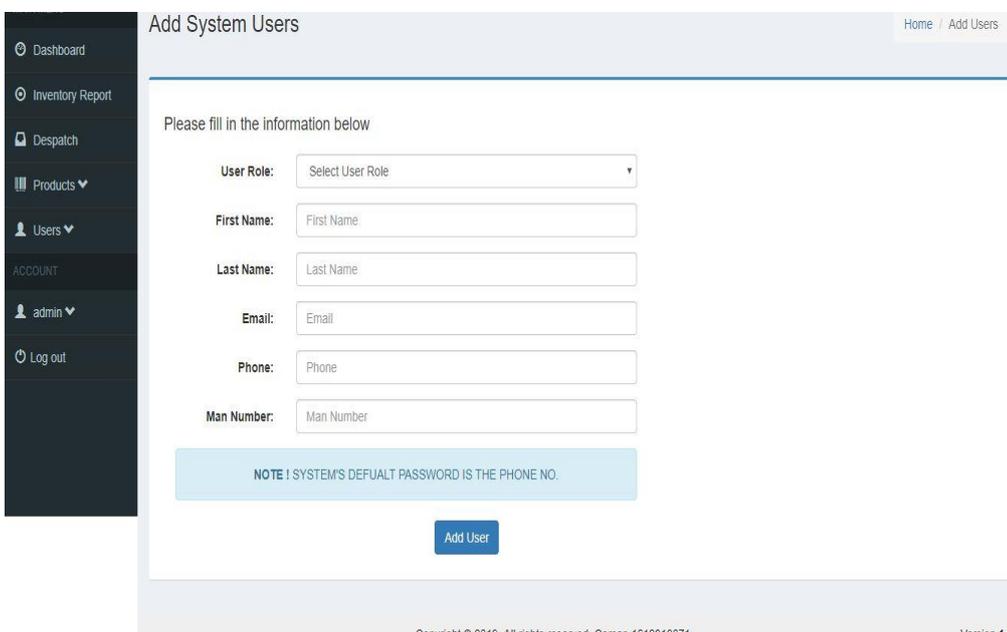
The admin user would then go on to add users to the system by clicking on the Users tab. On clicking on the Users tab, the following window is displayed to enable the admin user to add or view registered Users for subsequent manipulation of their data and login privileges.

Fig.9: List User and User Role Form for the BSMS

Upon successfully adding Users to the system, the admin User can view the registered Users by clicking on the Users tab and then selecting the List Users option.

The registered Users would then be displayed as shown in the figure 9:

The users had submitted that the products or barrack items at ZAF CED were stored in different categories. Therefore, the developer went on to develop the products tab and categorised the barrack items according to the specifications that were submitted by the end users of the would-be BSMS. Some of the categories for the item type included Petroleum Oils and Lubricants (POLs) for fuels and Oils, Clothing for all Uniform attires and last but not the least, Rations for all types of food stuffs. The diagram below shows the page for adding new product or item type.

Fig.10: Add New Product Type Form for the BSMS.

Once the product types were added, the admin user would then be able to add various products to the system using the form below by entering details and quantities of the product being added. This process would be done by filling the form shown in the screenshot below.

24

Add New Item Form for the BSMS

Fig. 12: Stock Levels view for the BSMS

The diagram on the left shows a list of barrack stores products that were added to the BSMS. The list enables the User to view the Stock levels as well as how much stock has since been issued or despatched to user Units.

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Fig.13: Despatching barrack stores items from the BSMS to ZAF Livingstone for Flying Training School.
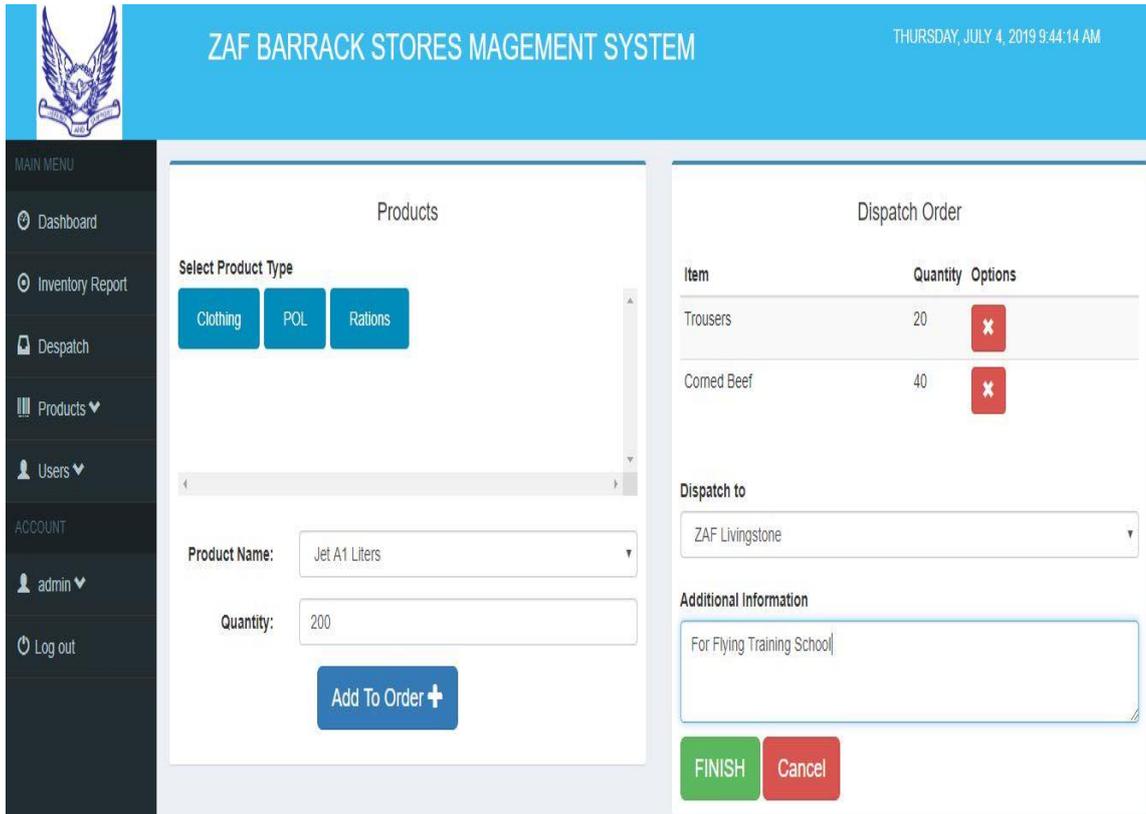
Having added the product type, the admin user (s) would then be able to add new item or product to the database of the BSMS. These products would then be issued on demand by user Units or formations by clicking on the Despatch tab. The despatch process can be done by both an admin user and or a Supply Stores Clerk. The details of the officer that despatches out a product will be captured to enable accountability of barrack stores items. The figure below shows an example of a despatch by an admin user of various barrack stores products to ZAF Livingstone with clear instructions to the user Units on how the items would be utilised. For example, the admin user had despatched 20 pairs of trousers, 50 cans of corned Beef and 200 litres of Jet A1 fuel to Flying Training School of ZAF Livingstone.

Fig.14: Inventory Report showing stock levels of barrack stores items from the BSMS at ZAF CED.
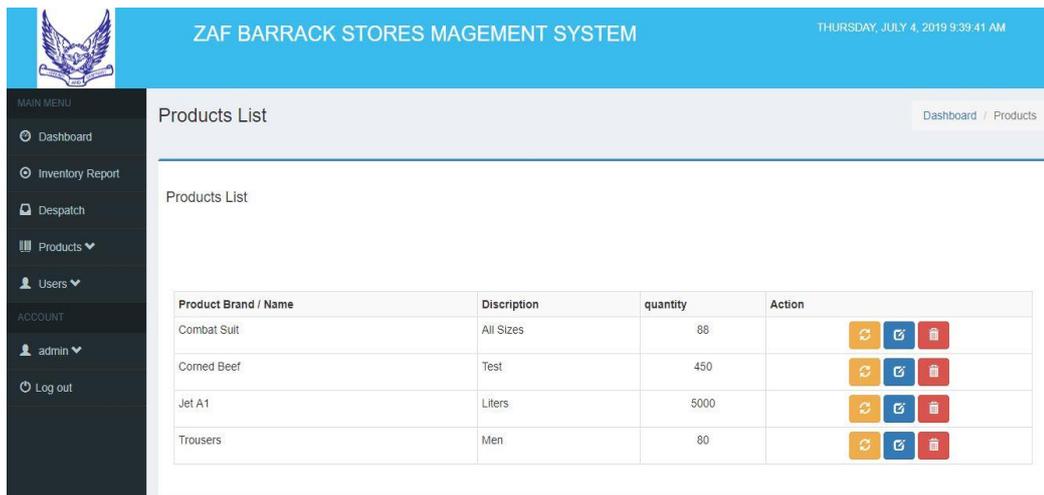
Stock levels can be viewed by admin users thereby giving management foresight on the stock levels obtaining at ZAF CED to enable strategic planning for barrack stores. This web-based remote access to the system also assists

26

command at Air Force headquarters in provisioning for barrack stores as well as make decisions on the distribution and issuance of barrack items to user Units and formations for consumption. This real-time access to barrack stores enables efficient and prudent use of supplies at ZAF CED. The admin user (s) would simply have to click on the Inventory Report to generate and view the stock levels at ZAF CED. The diagram below shows an admin's view of the stocks in the BSMS at ZAF CED.

Fig.15: Product Summary Report obtained from the BSMS.

The BSMS is able to generate reports to show how the barrack stores items were issued and to which Units or ZAF formations for accountability purposes. The report further goes on to indicate the date on which the products were issued, the quantities issued, the receiving Unit with instruction for a particular transaction. Lastly, the report also shows who issued or despatched the barrack stores to a particular Unit for each transaction.
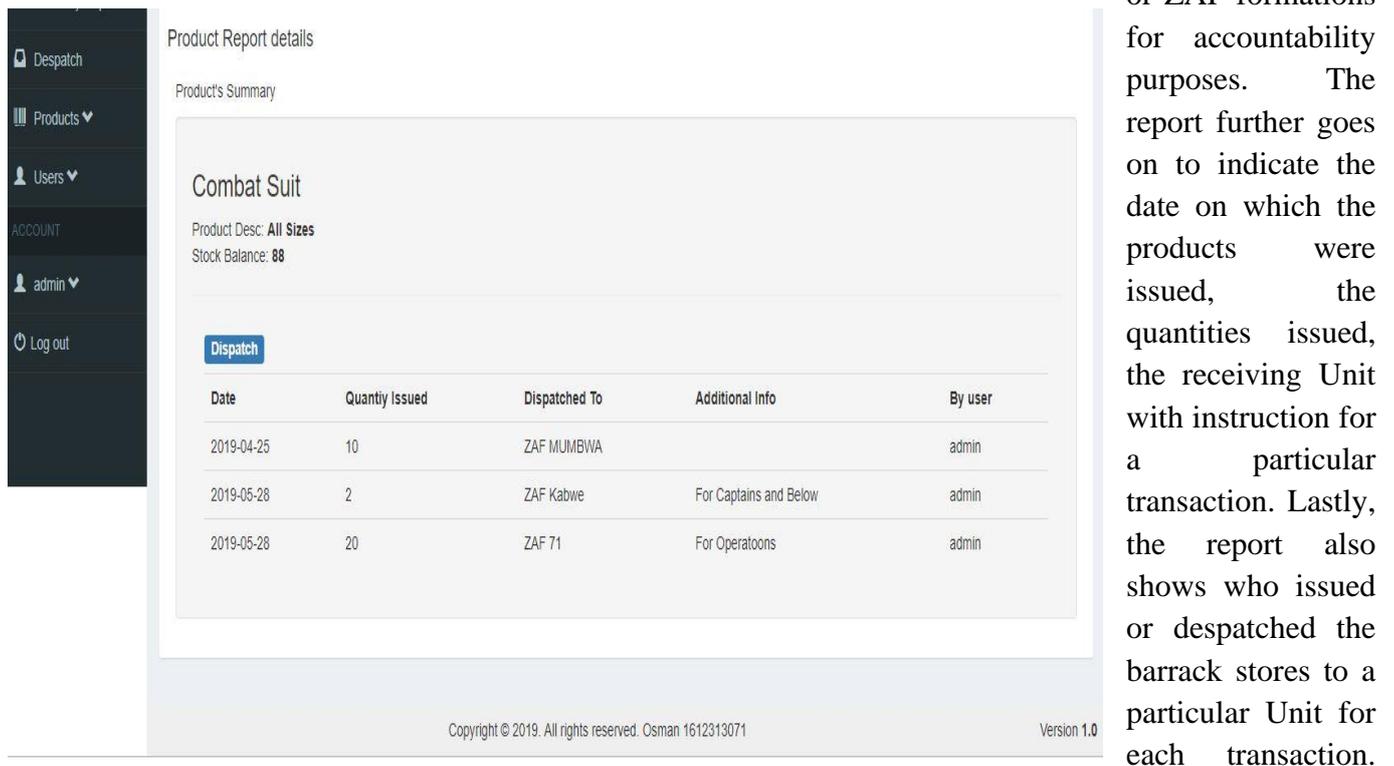
The figure below illustrates a report presentation on transactions conducted by admin user.

C. System Implementation Results

Results from the implemented system for ZAF CED were compiled and collected as indicated in the previous section. The researcher managed to develop a system that could be remotely accessed by enabling logins from personnel at Air Force Headquarters to view and manipulate stock values at the Supply Stores at ZAF CED. The personnel at Air Force HQ were able to make provisions for restocking barrack stores at ZAF CED, make strategic plans and decisions based on the data they would obtain from the BSMS. The personnel at Command level at Air Force HQ were able to tell how much of which product was despatched to which Unit for what consumption. This enables efficient use of resources for the Supply Department of the Zambia Air Force.

27

D. Summary

The researcher managed to design and develop a Barrack Stores Management System (BSMS) for the warehouse (stores) management at ZAF CED. The BSMS has the following stages:

- Admin/Sales person login
- Add Product Type
- Add/Delete Products
- Dispatch Products
- View Detailed Reports
- View Stock levels

Admin/Stores Clerk Login: The BSMS software is able to login to both admin and stores clerk person. Admin Users login to manage the whole BSMS system and stores clerk persons who dispatch the products. Dispatch products is carried out by both admin and Stores Clerks person. The two user types can both view reports on daily, weekly and monthly transactions.

The designed and developed Barrack Stores Management System would enable high accountability for barrack stores items to enable accountability for surpluses, strategic planning, provisioning for restocking of supply stores items and prudent use of barrack stores items in the Supply department of the Zambia Air Force.

V.   DISCUSSION AND COMNCLUSION

A. **Introduction**

This chapter frameworks and aims to converse the baseline study, use of technology, development of the system as a solution, comparison with similar works, possible application, summary, conclusion and future works.

B. **Discussion**

1)   Baseline Study

An analysis of the current situation aimed at identifying starting points for a program or a project. A look at what information must be considered and analysed to establish a starting point or indeed a baseline, the benchmark against which future progress can be assessed or comparisons made.

2)   Use of Technology

The design and development of a web-based Barrack Stores Management System (BSMS) for the Zambia Air Force to be deployed at ZAF Central Equipment Deport greatly intends to eliminate the current obtaining system of paper-based administration and management of barrack stores at the Unit. Through the use of this modern technology, the Zambia Air Force will obtain huge benefits from this system in that it brings about increased inventory accuracy. One of the most important functions and benefits of a Warehouse Management Systems is to improve stock control and inventory tracking. The Zambia Air Force through the use of the BSMS will now be able to provide its user Units with the goods they want when they want them or at least keep them up-to-date with accurate stock information so as to coordinate Air Force activities and operations. In turn, it will help improve user Unit's satisfaction levels but also remove the potential operating costs incurred due to errors - creating greater overall efficiency, cost reductions and improved operations. Aside this improved stock accuracy, the BSMS will also bring about an Effective management control in the system will now offer command at Air Force HQ advance warnings of stock control issues and process events that can be created to generate purchase orders once inventory

28

hits a specified level - such technology can reduce the likelihood of costly mistakes, having excessive stock or not enough stock, help to improve profitability and make the entire ZAF Supply department more efficient and productive. But most importantly, the BSMS allows buyers or senior managers to make informed decisions based on the accurate data generated.

The Air Force will also benefit from the system in that it brings about reduced staffing levels at ZAF CED due to the effectiveness in the BSMS that will result in achieving optimization of processes with very little need for additional staff, thereby allowing the Air Force to reduce staff levels during normal operational conditions at ZAF CED. The fallout personnel can then be redeployed to more needy areas of operations in line with the Vision 2020 of the Zambia Air Force of having a lean but well-trained Air Force in this 21st Century.

Equipment usage and related overheads will also Reduce in the long run as the ability to reduce the workforce at ZAF CED will typically enable the Air Force to use less equipment in the running of the deport

3) *Development of the System as a Solution*

The design and development of the BSMS for the Zambia Air Force has worked as a solution to the many problems that were encountered during the use of the manual paper-based system at ZAF CED to manage barrack stores resulting in improved service delivery and allowing Command at Air Force HQ to effectively plan and strategically provision for barrack stores based on the real time information they obtain from the web-based BSMS.

4) *Comparison with Other Similar Works*

The Barrack Stores Management System can be compared to other warehouse management systems such as: Manhattan Associates Warehouse Management System, IntelliTrack WMS RF Professional, TECSYS WMS, **Robocom** WMS etc. However, what makes the BSMS unique is that the developer specially designed and developed the system according to the user requirement that were obtained from ZAF CED. The source code is open and solely owned by the developer making it easy for integration of the system for accommodate future requirements of the client.

5) *Possible Application*

The application of the Barrack Stores Management System (BSMS) can not only be confined to the Zambia Air Force. This BSMS can be used by other defence wings of Zambia such as the Police, Zambia Correctional Service, Zambia Army, Wildlife and Conservation Society and the Zambia National service or indeed any other government organisations operating huge warehouses to improve on timely delivery of goods and services to consumers as well as help senior managers of these institutions to plan well and effectively for their respective organisations. This process will help the government save so much from overflow stores that may be procured due to uncoordinated activities on the part of those charged with the responsibility to manage these facilities.

C. *Summary*

The design and development of the Barrack Stores management System was successfully done by the researcher. The researcher managed to create the Login page for both the Admin User (s) and the Supply Stores Clerk, upon which the two types of users of the BSMS would explore various options based on their user privileges on the system to administer barrack stores items at ZAF CED of the Zambia Air Force.

D. **Conclusion**

The web-based Barrack Stores Management System is a great improvement for the management of barrack store items at ZAF CED compared to the manual paper-based system which was obtaining at the Unit. The computerization of the system has sped up the processes involved in issuance of barrack stores items to user units as well as helped Command at

Air Force HQ to plan and make strategic decisions for they now have access to real time data of the stock levels obtaining at ZAF CED. The paper-based system became very slow to cope with the demands from the many Units of the Zambia Air Force which has recently expanded its operations to all corners of Zambia. This slowness in delivery of goods and services from ZAF CED to user Units cannot be overlooked as it endangers the security of the nation at large. The BSMS was initially tried and tested using dummy data to examine its operational standing and was observed to meet the requirements submitted by the users. Furthermore, the BSMS boasts of the following advantages:

- It is fast, efficient and reliable
- Avoids data redundancy and inconsistency
- It is web-based enabling remote access
- The number of personnel required to manage it is considerably less hence becoming cheaper to operate.
- Provides more security and integrity to data

E. Future Works

The BSMS was designed and developed under a version control system to enable the designer to make additional changes to the system in the future versions of the software. Improvements to the system such as allowing the user Units to make demands for barrack items using the system will require that the developer develops provisional windows for interacting with user Units. The details of the barrack items would also require to have more details apart from the quantities. Such details as expiry dates, weight, colour, sizes etc. of barrack items will be added in future versions of the software.

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APPENDIX

VIII.   SYSTEM SOURCE CODE

A. Login Page Source Code

```php
<?php
$cookie_name="loggedin";
session_start();
require("script/db.php");
$sql2=mysqli_query($db,"SELECT * FROM
users")or die(mysqli_error($db));
$count2=mysqli_num_rows($sql2);
if($count2<1){
    addAdmin();
}
if(isset($_POST['login'])){
$unsafeEmail = $_POST['email'];
$unsafePassword = $_POST['password'];
//remove on final Release
if($unsafeEmail=="admin@mail.com" &&
$unsafePassword =="admin"){
}else{
//sanitaze the data
$email = mysqli_real_escape_string ($db,
$unsafeEmail);
$password = mysqli_real_escape_string ($db,
$unsafePassword);
$password = sha1 ($password);
$mosecure ="a1z26faqb";
$safePass = $password.$mosecure;
$sql=mysqli_query($db,"SELECT * FROM users
WHERE email='$email' AND password='$safePass'")or
die(mysqli_error($db));
$count=mysqli_num_rows($sql);
if($count>0){
//set cookie
$cookie_value =$email;
setcookie($cookie_name, $cookie_value,
time()+(86400),("/"));
// set session
$_SESSION['email']=$email;
$_SESSION['password']=$safePass;
header("Location:dashboard.php");

}else{
$error="Invalid Email or Password !";
}

}
}
?>
<!DOCTYPE html>
<html>
<head>
<meta charset="UTF-8">
<title>Barrack Stores Management System
| Login</title>
<link rel="stylesheet"
href="css/logstyle.css">
<link rel="stylesheet" href="css/font-
awesome.min.css">
<link href="css/bootstrap.min.css"
rel="stylesheet">
<style>
body, html {
    margin-top:0px
!important;
}
</style>
</head>
<body>
<div class="container">
<div class="card card-container">
<img id="profile-img" class="profile-img-card"
src="images/logo.png" />
<?php
if(isset($error)){?>
<div class="alert alert-danger
alert-dismissable fade in">
<button type="button" class="close" data-
dismiss="alert" aria-hidden="true">&times;</button>
<?php echo $error; ?>
</div>
<?php
}
?>
<form class="form-signin" role="form"
method="post" action="index.php" autocomplete="off" >
<div class="input-
group">
<span
class="input-group-addon">Email</span>
<input
type="email"  class="form-control " placeholder="Email
address" name="email"required autofocus>
</div></br>
<div class="input-
group">
<span
class="input-group-addon" >Password</span>
<input
type="password" id="inputPassword" class="form-control"
placeholder="Password" name="password" required>
</div></br>
<button  class="btn btn-lg btn-primary btn-block
btn-signin" type="submit" name="login"> <i
class="glyphicon glyphicon-log-in"></i> Sign
in</button>
</form><!-- /form --><br>
<a href="passwordrecovery.php" class="forgot-
password">
Forgot the password?
</a>
<a href="Login Intructions.php"
class="forgot-password">
```

Please Enter Email Address and Password to Login!!
```
</a>
</div><!-- /card-container -->
</div>
<script src='js/jquery-
2.2.4.min.js'></script>
<script src='js/bootstrap-3.3.6.js'></script>
</body>
</html>
```

1) Dashboard Source Code
```
<!DOCTYPE html>
<html >
<head>
<meta charset="UTF-8">
<title>Welcome | POS SYSTEM</title>

<link href="css/bootstrap.min.css" rel="stylesheet">
<link rel="stylesheet" href="css/font-awesome.min.css">
<link rel="stylesheet" href="css/style.css">
</head>
<body>
<body class="skin-blue">
<?php
include("includes/mainmenu.php");
include("includes/sidebar.php");
?>
<div class="content-wrapper" style="min-height:
279px;">
<section class="content-header">
<div class="row">
<div class="col-md-8">
<h3 style="margin-top: 5px"><i class="glyphicon
glyphicon-folder-open"></i> DASHBOARD</h3>
</div>
<div class="col-md-4">
<div class="pull-right">
<ol class="breadcrumb">
<li><a href="#">Home</a></li>
<li class="active">Dashboard</li>
</ol>
</div>
</div>
</div>
</section>
<section class="content">
<div class="row">
<div class="col-md-12">
<div class="box box-primary" style="padding-
top:15px">
<div class="box-body">
<div ng-controller="SummaryTableController"
class="ng-scope">
<div class="row">
<div class="col-md-12">
<h4>Quick Links</h4>
<div class="box-body">
```

```
<div class="row">

<div class="col-lg-3 col-
md-6">

<div class="panel panel-
primary">

<div
class="panel-heading">

<div
class="row">

<div class="col-xs-3">

<h3><i class="glyphicon glyphicon-
shopping-cart"></i></h3>

</div>
<div class="col-xs-9 text-right">

<div><h4>Stores</h4></div>

</div>
</div>

</div>

<a
href="pos.php">

<div
class="panel-footer">

<span class="pull-left">Stores</span>

<span class="pull-right"><i class="glyphicon
glyphicon-chevron-right"></i></span>

<div class="clearfix"></div>

</div>

</a>

</div>

</div>

<div class="col-lg-3 col-md-6">
```

35

```html
<div class="panel panel-success">
    <div class="panel-heading">
        <div class="row">
            <div class="col-xs-3">
                <h3><i class="glyphicon glyphicon-user"></i></h3>
            </div>
            <div class="col-xs-9 text-right">
                <div><h4>Change My Profile</h4></div>
            </div>
        </div>
    </div>
    <a href="myprofile.php">
        <div class="panel-footer">
            <span class="pull-left">Profile Settings</span>
            <span class="pull-right"><i class="glyphicon glyphicon-chevron-right"></i></span>
            <div class="clearfix"></div>
        </div>
    </a>
</div>
<div class="col-lg-3 col-md-6">
```

```html
<div class="panel panel-warning">
    <div class="panel-heading">
        <div class="row">
            <div class="col-xs-3">
                <h3><i class="glyphicon glyphicon-usd"></i></h3>
            </div>
            <div class="col-xs-9 text-right">
                <div><h4>Most Used</h4></div>
            </div>
        </div>
    </div>
    <a href="sales.php">
        <div class="panel-footer">
            <span class="pull-left"></span>
            <span class="pull-right"><i class="glyphicon glyphicon-chevron-right"></i></span>
            <div class="clearfix"></div>
        </div>
    </a>
</div>
<div class="col-lg-3 col-md-6">
```

```
<div class="panel panel-danger">

    <div class="panel-heading">

        <div class="row">

            <div class="col-xs-3">

                <h3><i class="glyphicon glyphicon-list"></i></h3>

            </div>

            <div class="col-xs-9 text-right">

                <div><h4>Top Products</h4></div>

            </div>

        </div>

    </div>

    <a href="products.php">

        <div class="panel-footer">

            <span class="pull-left">View Products</span>

            <span class="pull-right"><i class="glyphicon glyphicon-chevron-right"></i></span>

            <div class="clearfix"></div>

        </div>

    </a>

</div>

</div>
```

```
                        </div>
                    </div>
                </div>
            </div>
        </div>
    </div>
    <div class="row">
        <div class="col-md-8" >
            <div class="box box-primary" style="padding-top:15px">
                <div class="container">
                    <h4>ZAF CED</h4>
                    <div class="box-body">
                    </div>
                </div>
            </div>
        </div>
        <div class="col-md-4">
            <div class="box box-primary">
                <div class="container">
                    <h4>Defend and Support</h4>
                    <div class="box-body">
                    </div>
                </div>
            </div>
        </div>
    </section>
    <?php
    include("includes/footer.php");
    ?>
    </div>
</body>
<script src='js/jquery-2.2.4.min.js'></script>
<script src='js/bootstrap-3.3.6.js'></script>
<script src='js/other.js'></script>
</body>
</html>
```

2) Add User Source Code

```
<?php
session_start();
require("script/db.php");
$cookie_name="loggedin";
if( (!isset($_SESSION['email'])) ||
(!isset($_SESSION['password']))||(!isset($_COOKIE[$cookie_name])) ){
    header('Location:logout.php');
}
$email=$_SESSION['email'];
$sql="SELECT * FROM users WHERE email='$email'";
$run=mysqli_query($db,$sql);
$row=mysqli_fetch_array($run);
$userType=$row['userType'];
if($userType!="Admin"){
    header('Location:dashboard.php');
}
```

37

```php
if(isset($_POST['adduser'])){

    $userType=$_POST['userType'];
    $fname=$_POST['fname'];
    $lname=$_POST['lname'];
    $userEmail=$_POST['userEmail'];
    $phone=$_POST['phone'];
    $manNumber=$_POST['manNumber'];
    //validate a few things
    if($userType=="Select User Type"||$userType=="
    "){
        $error="Select a user type";
    }else{

        if((strlen($phone)<=9)||(strlen($phone)>=14)){
            $error="Invalid Phone Number";
        }else{
            //secure data

$safeUserType=mysqli_real_escape_string($db,$userType);

$safefname=mysqli_real_escape_string($db,$fname);

$safelname=mysqli_real_escape_string($db,$lname);

$safeuserEmail=mysqli_real_escape_string($db,$userEmail);

$safephone=mysqli_real_escape_string($db,$phone);

$safemanNumber=preg_replace("#[^0-9a-z]#i","",$manNumber);
            //check Email and manNumber
            $sql="SELECT * FROM users
WHERE email='$safeuserEmail' OR
manNumber='$safemanNumber' ";
            $runSql=mysqli_query($db,$sql);

    $count=mysqli_num_rows($runSql);
            if($count>0){
                $error="Email Or man
Number Already Registered";
            }else{
                //make defualt password
                $pass=sha1($phone);
                $mosecure
="a1z26faqb";

    $safepass=$pass.$mosecure;
                //insert

    $stmt=mysqli_query($db,"INSERT INTO
users(firstName, lastName, email, phone, manNumber,
password, createdAt, userType)
VALUES('$safefname','$safelname','$safeuserEmail','$safephone','$safemanNumber','$safepass',now(),'$safeUserType')"
    )or die("Opps! this Failed");

    echo"<script>alert('Registration was
successful!')</script>";
                            header('Location:
users.php');

                }
            }
        }
    }
?>
<!DOCTYPE html>
<html >
<head>
<meta charset="UTF-8">
<title>Welcome | BARRACK STORES MANAGEMENT
SYSTEM</title>

<link href="css/bootstrap.min.css" rel="stylesheet">
<link rel="stylesheet" href="css/font-awesome.min.css">
<link rel="stylesheet" href="css/style.css">
</head>
<body>
<body class="skin-blue">
<?php
include("includes/mainmenu.php");
include("includes/sidebar.php");
?>
<div class="content-wrapper" style="min-height:
279px;">
<section class="content-header">
<div class="row">
<div class="col-md-8">
<h3 style="margin-top: 5px"><i class="fa fa-
folder"></i>Add System Users</h3>
</div>
<div class="col-md-4">
<div class="pull-right">
<ol class="breadcrumb">
<li><a href="#">Home</a></li>
<li class="active">Add Users</li>
</ol>
</div>
</div>
</div>
</section>
<section class="content">
<div class="row">
<div class="col-md-12">
<div class="box box-primary" style="padding-
top:15px">
<div class="box-body">
<div ng-controller="SummaryTableController"
class="ng-scope">
<div class="row">
```

38

```
<div class="col-md-12">
<h4 style="margin-left:10px;">Please fill in the information below</h4>

<?php
if(isset($error)){?>

<div class="alert alert-danger alert-dismissable fade in">

<button type="button" class="close" data-dismiss="alert" aria-hidden="true">&times;</button>

<?php echo $error; ?>

</div>

<?php

}

?>
<div class="box-body">

<div class="col-md-7">

<form class="form-horizontal" role="form" method="POST" action="adduser.php">

<div class="form-group">

<label class="control-label col-sm-3" for="type">User Role:</label>

<div class="col-sm-9">

<select name="userType" class="form-control">

<option selected disabled>Select User Role</option>

<option value="Admin" >Admin</option>

<option value="Salesperson">Stores Clerk</option>

</select>

</div>

</div>

<div class="form-group">

<label class="control-label col-sm-3" for="fname">First Name:</label>
```

```
<div class="col-sm-9">

<input type="text" name="fname" class="form-control" id="fname" placeholder="First Name" required>

</div>

</div>

<div class="form-group">

<label class="control-label col-sm-3" for="lname">Last Name:</label>

<div class="col-sm-9">

<input type="text" name="lname" class="form-control" id="lname" placeholder="Last Name" required>

</div>

</div>

<div class="form-group">

<label class="control-label col-sm-3" for="email">Email:</label>

<div class="col-sm-9">

<input type="Email" name="userEmail" class="form-control" id="email" placeholder="Email" required>

</div>

</div>

<div class="form-group">

<label class="control-label col-sm-3" for="phone">Phone:</label>

<div class="col-sm-9">

<input type="text" name="phone" class="form-control" id="phone" placeholder="Phone" required>

</div>

</div>

<div class="form-group">
```

```html
          <label class="control-
label col-sm-3" for="manNumber">Man Number:</label>

          <div class="col-sm-9">

          <input type="text"
    name="manNumber" class="form-control"
  id="manNumber" placeholder="Man Number" required>

          </div>

          </div>

          <div class="alert alert-
info" align="center">

          <p><b>NOTE !
</b>  SYSTEM'S DEFUALT PASSWORD IS THE PHONE
NO.</p>

          </div>

      <div class="form-group" align="center">

          <div class="col-sm-
offset-3 col-sm-9">

          <button type="submit"
  name="adduser" class="btn btn-primary">Add
User</button>

          </div>

          </div>

          </form>

          </div>
          </div>
          </div>
          </div>
          </div>
          </div>
          </div>
          </div>
          </section>
          <?php
    include("includes/footer.php");
          ?>
          </div>
          </body>
  <script src='js/jquery-2.2.4.min.js'></script>
  <script src='js/bootstrap-3.3.6.js'></script>
      <script src='js/other.js'></script>
          </body>
          </html>
```

3) *Add Product Type Source Code*

```html
          <!DOCTYPE html>
          <html >
          <head>
          <meta charset="UTF-8">
      <title>Welcome | POS SYSTEM</title>
  <link href="css/bootstrap.min.css" rel="stylesheet">
<link rel="stylesheet" href="css/font-awesome.min.css">
    <link rel="stylesheet" href="css/style.css">
          </head>
          <body>
          <body class="skin-blue">
          <?php
    include("includes/mainmenu.php");
        include("includes/sidebar.php");
          ?>
  <div class="content-wrapper" style="min-height:
          279px;">
      <section class="content-header">
          <div class="row">
          <div class="col-md-8">
    <h3 style="margin-top: 5px"><i class="fa fa-
folder"></i>Add System Users</h3>
          </div>
          <div class="col-md-4">
        <div class="pull-right">
        <ol class="breadcrumb">
      <li><a href="#">Home</a></li>
    <li class="active">Add Users</li>
          </ol>
          </div>
          </div>
          </div>
          </section>
      <section class="content">
          <div class="row">
          <div class="col-md-12">
  <div class="box box-primary" style="padding-
          top:15px">
          <div class="box-body">
  <div ng-controller="SummaryTableController"
          class="ng-scope">
          <div class="row">
          <div class="col-md-12">
    <h4 style="margin-left:10px;">Please fill
  in the information below</h4>

          <?php

        if(isset($error)){?>

  <div class="alert alert-danger alert-dismissable fade
          in">

      <button type="button" class="close" data-
dismiss="alert" aria-hidden="true">&times;</button>
```

```php
<?php echo $error; ?>

        </div>

    <?php

        }

    ?>
    <div class="box-body">

        <div class="col-md-7">

            <form class="form-horizontal"
role="form" method="POST" action="adduser.php">

                <div class="form-group">

                    <label class="control-
label col-sm-3" for="type">User Role:</label>

                        <div class="col-sm-9">

                            <select
name="userType" class="form-control">

                                <option selected
disabled>Select User Role</option>

                                <option
value="Admin" >Admin</option>

                                <option
value="Salesperson">Stores Clerk</option>

                            </select>

                        </div>

                </div>

                <div class="form-group">

                    <label class="control-
label col-sm-3" for="fname">First Name:</label>
                        <div class="col-
sm-9">

                            <input type="text"
name="fname" class="form-control" id="fname"
    placeholder="First Name" required>

                        </div>

                </div>

                <div class="form-group">
```

```php
                    <label class="control-
label col-sm-3" for="lname">Last Name:</label>

                        <div class="col-sm-9">

                            <input type="text"
name="lname" class="form-control" id="lname"
    placeholder="Last Name" required>

                        </div>

                </div>

                <div class="form-group">

                    <label class="control-
label col-sm-3" for="email">Email:</label>

                        <div class="col-sm-9">

                            <input type="Email"
name="userEmail" class="form-control" id="email"
    placeholder="Email" required>

                        </div>

                </div>

                <div class="form-group">

                    <label class="control-
label col-sm-3" for="phone">Phone:</label>

                        <div class="col-sm-9">

                            <input type="text"
name="phone" class="form-control" id="phone"
    placeholder="Phone" required>

                        </div>

                </div>

                <div class="form-group">

                    <label class="control-
label col-sm-3" for="manNumber">Man Number:</label>

                        <div class="col-sm-9">

                            <input type="text"
name="manNumber" class="form-control"
id="manNumber" placeholder="Man Number" required>

                        </div>

                </div>
```

41

```
                    <div class="alert alert-
info" align="center">

                        <p><b>NOTE !
</b>  SYSTEM'S DEFUALT PASSWORD IS THE PHONE
                    NO.</p>

                            </div>

        <div class="form-group" align="center">

                        <div class="col-sm-
offset-3 col-sm-9">

                    <button type="submit"
name="adduser" class="btn btn-primary">Add
                    User</button>
                            </div>

                        </div>

                        </form>
                        </div>
                        </div>
                        </div>
                        </div>
                        </div>
                        </div>
                        </div>
                        </div>
                        </section>
                        <?php
            include("includes/footer.php");
                        ?>
                        </div>
                        </body>
        <script src='js/jquery-2.2.4.min.js'></script>
        <script src='js/bootstrap-3.3.6.js'></script>
            <script src='js/other.js'></script>
                        </body>
                        </html>
```

4) Database Query Code

```
        -- Adminer 4.3.1 MySQL dump
            SET NAMES utf8;
        SET time_zone = '+00:00';
    SET foreign_key_checks = 0;
SET sql_mode = 'NO_AUTO_VALUE_ON_ZERO';
    DROP TABLE IF EXISTS `cart`;
        CREATE TABLE `cart` (
    `cartId` int(11) unsigned NOT NULL
        AUTO_INCREMENT,
    `product` varchar(255) NOT NULL,
        `qty` int(11) DEFAULT NULL,
    `productId` int(11) DEFAULT NULL,
        PRIMARY KEY (`cartId`)
) ENGINE=InnoDB DEFAULT CHARSET=latin1;
```

```
DROP TABLE IF EXISTS `company`;
    CREATE TABLE `company` (
`companyId` int(11) unsigned NOT NULL
        AUTO_INCREMENT,
`companyName` varchar(255) DEFAULT NULL,
`address` varchar(255) DEFAULT NULL,
`contact` varchar(255) DEFAULT NULL,
    PRIMARY KEY (`companyId`)
) ENGINE=InnoDB DEFAULT CHARSET=latin1;
    DROP TABLE IF EXISTS `dispatch`;
        CREATE TABLE `dispatch` (
`dispatchId` int(11) unsigned NOT NULL
        AUTO_INCREMENT,
`productId` int(11) DEFAULT NULL,
`qty` int(11) DEFAULT NULL,
`userId` int(11) DEFAULT NULL,
`date` date DEFAULT NULL,
`dispatchedTo` varchar(255) DEFAULT NULL,
`additionInfo` text,
`refnum` varchar(255) DEFAULT NULL,
    PRIMARY KEY (`dispatchId`)
) ENGINE=InnoDB DEFAULT CHARSET=latin1;
    DROP TABLE IF EXISTS `products`;
        CREATE TABLE `products` (
`productId` int(11) unsigned NOT NULL
        AUTO_INCREMENT,
`productName` varchar(255) DEFAULT NULL,
`productTypeId` int(11) DEFAULT NULL,
`description` varchar(255) DEFAULT NULL,
    PRIMARY KEY (`productId`)
) ENGINE=InnoDB DEFAULT CHARSET=latin1;
    DROP TABLE IF EXISTS `productstype`;
        CREATE TABLE `productstype` (
`productsTypeId` int(11) unsigned NOT NULL
        AUTO_INCREMENT,
`productsType` varchar(255) DEFAULT NULL,
    PRIMARY KEY (`productsTypeId`)
) ENGINE=InnoDB DEFAULT CHARSET=latin1;

    DROP TABLE IF EXISTS `stockin`;
        CREATE TABLE `stockin` (
`stockinId` int(11) unsigned NOT NULL
        AUTO_INCREMENT,
`productId` int(11) DEFAULT NULL,
`qty` int(11) DEFAULT NULL,
`date` date DEFAULT NULL,
    PRIMARY KEY (`stockinId`)
) ENGINE=InnoDB DEFAULT CHARSET=latin1;
    DROP TABLE IF EXISTS `stockrecordin`;
        CREATE TABLE `stockrecordin` (
`stockRecordinId` int(11) unsigned NOT NULL
        AUTO_INCREMENT,
`date` datetime DEFAULT NULL,
`productId` int(11) DEFAULT NULL,
`qty` int(11) DEFAULT NULL,
`userId` int(11) DEFAULT NULL,
    PRIMARY KEY (`stockRecordinId`)
) ENGINE=InnoDB DEFAULT CHARSET=latin1;
```

42

```
DROP TABLE IF EXISTS `users`;
  CREATE TABLE `users` (
`userId` int(11) unsigned NOT NULL
    AUTO_INCREMENT,
`firstName` varchar(200) NOT NULL,
`lastName` varchar(200) NOT NULL,
`email` varchar(200) DEFAULT NULL,
`phone` varchar(200) DEFAULT NULL,
`nrc` varchar(200) DEFAULT NULL,
`password` varchar(200) DEFAULT NULL,
`createdAt` date DEFAULT NULL,
`userType` varchar(150) DEFAULT NULL,
  PRIMARY KEY (`userId`)
) ENGINE=InnoDB DEFAULT CHARSET=latin1;
            <?php
        session_start();
   require("script/db.php");
  $cookie_name="loggedin";
  if( (!isset($_SESSION['email'])) ||
(!isset($_SESSION['password']))||(!isset($_COOKIE[$cooki
            e_name])) ){
      header('Location:logout.php');
              }
    $email=$_SESSION['email'];
$sql="SELECT * FROM users WHERE email='$email'";
    $run=mysqli_query($db,$sql);
    $row=mysqli_fetch_array($run);
    $userType=$row['userType'];
      if($userType!="Admin"){
echo"<script>alert('Not allowed')</script>";
     header('Location:dashboard.php');
            }else{
    $userId =$_REQUEST['userId'];
            if(!$userId){
     echo"Opps something Went wrong";
              }else{
          // sending query
mysqli_query($db,"DELETE FROM users WHERE
       userId = '$userId'");
     header("Location: users.php");
              }
            }
            ?>
```

5) Edit User Code

```
            <?php
        session_start();
   require("script/db.php");
  $cookie_name="loggedin";
  if( (!isset($_SESSION['email'])) ||
(!isset($_SESSION['password']))||(!isset($_COOKIE[$cooki
            e_name])) ){
      header('Location:logout.php');
              }
    $email=$_SESSION['email'];
$sql="SELECT * FROM users WHERE email='$email'";
    $run=mysqli_query($db,$sql);
    $row=mysqli_fetch_array($run);
```

```
    $userType=$row['userType'];
      if($userType!="Admin"){
     header('Location:dashboard.php');
            }
   if(isset($_POST['edituser'])){
      if(isset($_POST['edituserType'])){
   $edituserType=$_POST['edituserType'];
     $editfname=$_POST['editfname'];
     $editlname=$_POST['editlname'];
  $edituserEmail=$_POST['edituserEmail'];
     $editphone=$_POST['editphone'];

  $editmanNumber=$_POST['editmanNumber'];
     $edituserId=$_POST['edituserId'];

         //validate a few things

if((strlen($editphone)<=9)||(strlen($editphone)>=14
    )){
        $error="Invalid Phone Number";

            }else{
          //secure data

$safeUserType=mysqli_real_escape_string($db,$ed
        ituserType);

$safefname=mysqli_real_escape_string($db,$editfn
        ame);

$safelname=mysqli_real_escape_string($db,$editln
        ame);

$safeuserEmail=mysqli_real_escape_string($db,$ed
        ituserEmail);

  $safephone=mysqli_real_escape_string ($db,
        $editphone);

$safemanNumber=preg_replace("#[^0-9a-z] #i","'",
        $editmanNumber);
       //check Email and manNumber
       $sql="SELECT * FROM users
  WHERE email='$safeuserEmail' OR
  manNumber='$safemanNumber' ";
        $runSql=mysqli_query ($db,
        $sql);

  $count=mysqli_num_rows($runSql);
            if($count>1) {
        $error="Email Or
  manNumber Already Registered";
            } else {
          //update

mysqli_query($db,"UPDATE users SET firstName
        =
'$safefname',lastName='$safelname',email='$safeuserEmail',
```

```
phone='$safephone',manNumber='$safemanNumber',userTy
pe='$safeUserType' WHERE userid='$edituserId'")or
die(mysql_error());
                                echo"<script>alert
('Update was successful!') </script>";
                                header ("Location:
edituser.php?userId=$edituserId");
                                }
                                }

                        }else{
                $error="Select Product Type";
                        }
                        }
                        ?>
                <!DOCTYPE html>
                        <html >
                        <head>
                <meta charset="UTF-8">
                <title>Welcome | POS SYSTEM</title>
        <link href="css/bootstrap.min.css" rel="stylesheet">
<link rel="stylesheet" href="css/font-awesome.min.css">
        <link rel="stylesheet" href="css/style.css">
                        </head>
                        <body>
                <body class="skin-blue">
                        <?php
        include("includes/mainmenu.php");
            include("includes/sidebar.php");
                        ?>
        <div class="content-wrapper" style="min-height:
                        279px;">
                <section class="content-header">
                        <div class="row">
                        <div class="col-md-8">
        <h3 style="margin-top: 5px"><i class="glyphicon
glyphicon-folder-open"></i> Edit System Users</h3>
                        </div>
                        <div class="col-md-4">
                        <div class="pull-right">
                        <ol class="breadcrumb">
                <li><a href="#">Home</a></li>
                <li class="active">Add Users</li>
                        </ol>
                        </div>
                        </div>
                        </div>
                        </section>
                <section class="content">
                        <div class="row">
                        <div class="col-md-12">
        <div class="box box-primary" style="padding-
                        top:15px">
                <div class="box-body">
        <div ng-controller="SummaryTableController"
                class="ng-scope">
                        <div class="row">
                        <div class="col-md-12">
```

```
                <h4 style="margin-left:10px;">Please fill
in the information below</h4>

                        <?php

                if(isset($error)){?>

        <div class="alert alert-danger alert-dismissable fade
                        in">

                <button type="button" class="close" data-
dismiss="alert" aria-hidden="true">&times;</button>

                <?php echo $error; ?>

                        </div>

                        <?php

                        }

        $edituser=$_REQUEST['userId'];

                if(!$edituser){

        echo"Opps Something went wrong";

                        }else{

        $query="SELECT * FROM users WHERE
                userId ='$edituser'";

                $result=mysqli_query($db,$query);

                $dataset=mysqli_fetch_array($result);
                                }

                        ?>
                <div class="box-body">

                <div class="col-md-7">

                <form class="form-horizontal"
role="form" method="POST" action="edituser.php">

                        <div class="form-group">

                        <label class="control-
label col-sm-3" for="type">Type:</label>

                        <div class="col-sm-9">

                        <select
name="edituserType" class="form-control">

                        <?php
        if($dataset['userType']=="Admin"){
```

```
                    echo "<option
selected>Admin</option>";

          echo "<option >Salesperson</option>";

                                        }else{

     echo "<option >Admin</option>";

     echo "<option selected>Salesperson</option>";

                                             }

                                            ?>

                                      </select>

                                        </div>

                                        </div>

                    <div class="form-group">

                          <label class="control-
label col-sm-3" for="fname">First Name:</label>

                    <div class="col-sm-9">

                          <input type="text"
name="editfname" class="form-control" value="<?php echo
$dataset['firstName']?>" required>

                                      </div>

                                      </div>

                    <div class="form-group">

                          <label class="control-
label col-sm-3" for="lname">Last Name:</label>

                    <div class="col-sm-9">

                          <input type="text"
name="editlname" class="form-control" value="<?php echo
$dataset['lastName']?>" required>

                                      </div>

                                      </div>

                    <div class="form-group">

                          <label class="control-
label col-sm-3" for="email">Email:</label>

                    <div class="col-sm-9">
```

```
                          <input type="Email"
name="edituserEmail" class="form-control" value="<?php
echo $dataset['email']?>" required>

                                      </div>

                                      </div>

                    <div class="form-group">

                          <label class="control-
label col-sm-3" for="phone">Phone:</label>

                    <div class="col-sm-9">

                          <input type="text"
name="editphone" class="form-control" value="<?php echo
$dataset['phone']?>"required>

                                      </div>

                                      </div>

                    <div class="form-group">

                          <label class="control-
label col-sm-3" for="editmanNumber">Man
Number:</label>

                    <div class="col-sm-9">

                          <input type="text"
name="editmanNumber" class="form-control"
value="<?php echo $dataset['manNumber']?>" required>

                          <input type="hidden"
name="edituserId" class="form-control" value="<?php echo
$dataset['userId']?>" >

                                      </div>

                                      </div>

                <div class="form-group" align="center">

                          <div class="col-sm-
offset-3 col-sm-9">

                          <button type="submit"
name="edituser" class="btn btn-primary">Submit</button>

                                      </div>

                                      </div>

                                  </form>
                                  </div>
```

```
                </div>
              </div>
            </div>
          </div>
        </div>
      </div>
    </div>
  </section>
<?php
include 'includes/footer.php'
?>
</div>
</body>
<script src='js/jquery-2.2.4.min.js'></script>
<script src='js/bootstrap-3.3.6.js'></script>
<script src='js/other.js'></script>
</body>
</html>
```

6) Fetch Code

```php
<?php
require("script/db.php");
$output="";
$stmt="SELECT * FROM productstype  WHERE
productstype LIKE '%".$_POST["search"]."%'";
$run=mysqli_query($db,$stmt);
if(mysqli_num_rows($run)>0){
    $output.="<h4>Results</h4>";
    $output.="<p>Type</p>";
    while($row=mysqli_fetch_array($run)){

    $output.="<p>".$row["productstype"]."</p>";
    }
    echo $output;
}else{
    echo "No Resilts Found";
}
?>
```

7) Password Recovery Code

```php
<?php
session_start();
require("script/db.php");
if(isset($_POST['change'])){
    $fname=$_POST['fname'];
    $lname=$_POST['lname'];
    $nrc=$_POST['nrc'];
    $svc=$_POST['svc'];
    $password=$_POST['password'];
    $vpassword=$_POST['vpassword'];
    //sanitaze

$safeFname=mysqli_real_escape_string($db,$fname);

$safeLname=mysqli_real_escape_string($db,
$lname);
$safeNrc=preg_replace("#[^0-9a-
z]#i","",$nrc);
```

```php
$safeSvc=preg_replace("#[^0-9a-
z]#i","",$svc);

$safePassword=mysqli_real_escape_string($db,
$password);

$safeVpassword=mysqli_real_escape_string($db,
$vpassword);
    //make sure user is in the database
    $sql="SELECT * FROM users WHERE
nrc='$safeNrc' AND svc='$safeSvc'";
    $run=mysqli_query($db,$sql)or
die("opps");
    $count=mysqli_num_rows($run);

    if($count==0){
        $error="Not a registered user";

    }else{
        if(strlen($password) < 5){
            $error="Your password
is too short";
        }else{

            if($password!=$vpassword){
                $error="Your
passwords do not match";
            }else{
                //pass to the
final part

$_SESSION['fname']=$safeFname;

$_SESSION['lname']=$safeLname;

$_SESSION['nrc']=$safeNrc;

$_SESSION['svc']=$safeSvc;

$_SESSION['vpassword']=$safeVpassword;

$_SESSION['password']=$password;

header('Location:finish.php');
            }
        }
    }
}
?>
<!DOCTYPE html>
<html>
    <head>
        <meta charset="UTF-8">
        <title>Online POS System |
Recovery</title>
        <link rel="stylesheet"
href="css/logstyle.css">
```

46

```
<link rel="stylesheet" href="css/font-
awesome.min.css">
  <link href="css/bootstrap.min.css"
rel="stylesheet">
          <style>
          body, html {
                margin-top:0px
!important;
          }
          </style>
        </head>
        <body>
          <div class="container">
        <div class="card card-container">
      <img id="profile-img" class="profile-img-card"
src="images/recover.png" />
          <h4>Password Recovery</h4>

          <?php
            if(isset($error)){?>
          <div class="alert alert-danger
alert-dismissable fade in">
          <button type="button" class="close" data-
dismiss="alert" aria-hidden="true">&times;</button>
          <?php echo $error; ?>
          </div>
              <?php
              }
          ?>
        <form class="form-signin" role="form"
method="post" action="passwordrecovery.php">
              <div class="input-
group">
                    <span
class="input-group-addon">First Name</span>
                        <input
type="text"  class="form-control " placeholder="First Name"
        name="fname" required autofocus>
                    </div></br>
              <div class="input-
group">
                    <span
class="input-group-addon">Last Name</span>
                        <input
type="text"  class="form-control " placeholder="Last Name"
        name="lname" required >
                    </div></br>
              <div class="input-
group">
                    <span
class="input-group-addon">NRC No.</span>
                        <input
type="text"  class="form-control " placeholder="NRC No"
        name="nrc" required >
                    </div></br>
              <div class="input-
group">
```

```
                    <span
class="input-group-addon">SVC No.</span>
                        <input
type="text"  class="form-control " placeholder="SVC No"
        name="svc" required >
                    </div></br>
              <div class="input-
group">
                    <span
class="input-group-addon" >New Password</span>
                        <input
type="password" id="inputPassword" class="form-control"
    placeholder="Password" name="password" required>
                    </div></br>
              <div class="input-
group">
                    <span
class="input-group-addon" >Varify Password</span>
                        <input
type="password" id="inputPassword" class="form-control"
    placeholder="Password" name="vpassword" required>
                    </div></br>
          <button  class="btn btn-primary " type="submit"
name="change"> <i class="glyphicon glyphicon-log-
in"></i> Change Password</button>
              </form><!-- /form --><br>
        <a href="index.php" class="btn btn-danger">
                  Back
                </a>
        </div><!-- /card-container -->
          </div>
          <script src='js/jquery-
2.2.4.min.js'></script>
        <script src='js/bootstrap-3.3.6.js'></script>
              </body>
          </html>
```

*8) **Logout Code***

```
          <?php
        require("script/db.php");
          session_start();
          //unset cookie
    setcookie("loggedin","val",time(),-(120),"/");
        // remove all session variables
          session_unset();
        // destroy the session
          session_destroy();
        header("Location:index.php");
              ?>
```