ADDIS ABABA UNIVERSITY
SCHOOL OF COMMERCE
DEPARTMENT OF LOGISTICS AND SUPPLY CHAIN MANAGEMENT

DIAGNOSING THE LEVEL OF SUPPLY CHAIN AUTOMATION AT PHARMACEUTICAL FUND AND SUPPLY CHAIN AGENCY CENTRAL OFFICE

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF
MASTER OF ART IN LOGISTICS AND SUPPLY CHAIN MANAGEMENT

ADVISOR

MATIWOS ENSERMU (PhD)

By: Daniel Tamirat
Addis Ababa
Ethiopia May, 2018

Acknowledgements

I would ~~also~~ like to express my heartfelt thanks to Dr. Matiwos Ensermu associate professor logistics and supply chain management vice president for administration and student services at Addis Ababa University for his valuable advice and discussions for the improvement of this work. I further extend my sincere thanks to PFSA central office employees for their thoughtful completion of the questioners and the comments they provided. Special thanks to my parents for all the sacrifices they made for me to come this far.

Table of Contents

CHAPTER ONE 1

1.1 Background of the study.. 1

1.2 Statement of the Problem.. 2

1.3 Research Questions..3

1.4 Objective of the study.. 3

1.5 Significance of the Study.. 4

1.6 Scope of the Study.. 4

1.7 Limitation of the study... 4

1.8 Definition of terms... 4

1.9 Organizational of the paper 6

CHAPTER TWO

LITERATUREREVIEW...7

2.1 Introduction... 7

2.2 Information system in health commodity supply chain 8

2.2.1 Health commodity Logistics Information Systems 8

2.2.2 LIMS: Typical challenges in developing countries...9

2.2.3 Standardizing commodity ordering in LMIS.. 10

2.3 Level of SC automation implementation..11

2.4 Drivers for employing SC automation information system 11

2.5 Challenges of supply chain automation system implementation 11

2.11 Information System Effectiveness and Success...13

2.12 Theories of Information Systems...14

2.12.1 Technology Acceptance Model...14.

2.12.2 The System Usability Scale (SUS)...15

2.13 Conceptual Framework...16

CHAPTER THREE

2.13 Research methodology 18

3.2 Research Design 18

3.3 Data Type and source 18

3.4 Data Gathering Tools 19

3.5 Data analys.. 19

3.6 Analysis tools used 19

3.7 Sample Size Determination …………………………………………………………………………………………. 19
3.8 Ethical coordination ……………………………………………………………………………………………………….20
CHAPTER FOUR
4.1 Results and Discussions...21
4.2 Reliability Test 21
4.3 Respondents' Demographic Information...21
4.4 Descriptive Statistics...23
4.5 System usability scale...23
4.6 Frequency of Use...26
4.7 Complexity..27
4.8 Easy to Use……28
4.9 Need for Support from Technician..29
4.10 Functional Integrity...30
4.11 Inconsistency...31
4.12 Quick Learning of the System...32
4.13 Difficult to use...33
4.14. Confidence..34
4.15. Need to Learn Before the Use of the System..35
4.16 Correlation Analysis.. 36
4.17 Challenges to Implementing SCautomation...38
4.18 Summary of results……………………………………………………………………………………………………….42
CHAPTER FIVE
CONCLUSIONS AND RECOMMENDATIONS………………………………………………………………………….41
5.1 Conclusions…………………………………………..41
5.2 Recommendations……………………………………………………………………………………………………….42
5.3 Limitation and Suggestions for Future Studies……………………………………………………………… 42
5.4 References………………………………………...44
5.5 Appendix……48

Abstract

The aim of this study was to diagnosing the level of supply chain automation at pharmaceutical fund and supply chain agency head office from system usage perspective based on Technology Acceptance Model and the challenges of implementing the systems in the organization. : A cross-sectional study was designed using an online survey, the System Usability Scale (SUS) and adapted questioner on barriers of SC automation implementation to evaluate the level of SC automation in PFSA. Descriptive design was adopted with 55 respondents considered for the sample. A census was used and a total of 55 questionnaires were administered for research. 50 questionnaires of valid answers were returned and analysis and various tests were done using SPSS. The research findings in the research indicated that the level of SC automation in PFSA is in marginally acceptable level based on subjective user rating of SUS score of 65. A risk of the systems being hacked and hence resulting in the data being corrupt or sensitive information leaking and used by unscrupulous people, ~~the system having errors in transaction and leading to costly decisions hence loss of business~~. System not integrated to suppliers is some of the challenges facing the implementation of supply chain automation system.

CHAPTER ONE: Introduction

1.1 Background of the study

Supply chain automation is the application of information technology to improve the effectiveness and efficiency of entities and activities within the supply chain process; (Donald Waters, 2010) Trends In supply chain point towards the more common themes of increasing dependence of information systems, specifically electronic data interchange and the inventory management systems which have become the norm in the pharmaceutical sector. Pharmaceutical supply chains are a critical element of a well-functioning health system and a vital input to advancing national and regional health security goals. Medicine and health commodity supply chains begin and end with patients To implement supply chain processes effectively there must be an understanding of patient disease trends and product consumption patterns, as well as how and where patients seek health care services; (Asian development bank, 2016). This requires investments and capacity development in information management.

There are numerous logistics and inventory management Information Technology (IT) systems in the marketplace, including many open source mobile and online-based systems. Inventory tracking and reporting, invoice and delivery note generation, and restocking are among the core functionalities in many of these systems. In more advanced applications, inventory management systems are able to interface with tender management, purchasing, or patient dispensing platforms. Inventory management systems can provide real-time information which enables health managers to understand current stock levels of vaccines, medicines, and diagnostics in national supply pipelines; (Asian development bank, 2016).

Automated, accurate, and real-time inventory data enhance the ability of supply chains to reduce waste and manage limited resources more effectively. It also supports the accuracy and timeliness of product quantification, budgeting, and forecasting efforts. Procurement automation and process improvements can minimize the risk of procurement errors, improve transparency, and reduce sourcing lead times. (Tippins, 2003). These improve supply chain performance and yield significant cost savings. Procurement performance information management systems track unit price history, on-time delivery, and supplier order fill rates. This can help supply chain organizations better plan orders with suppliers, increasing the scope for cost savings.

In some countries dedicated logistics management units have been established within the Ministry of Health to better organize, monitor, and support all public health supply chain activities. (USAID DELIVER, 2010). As a semi-autonomous agency to coordinate the health commodity logistics of Ethiopia, Pharmaceuticals Fund and Supply Agency was established in 2007 by Proclamation No. 553/2007. (Negarit Gazeta, 2007)

Since 2007, Pharmaceuticals Fund and Supply Agency (PFSA) has been the entity to procure, store and distribute medicines and health commodities for the Government of Ethiopia. The entity has been reformed, and is today a government-owned, yet autonomous Central Medical Store. PFSA works with the Government of Ethiopia, and a range of donors. It is managed on a financially self-sustaining basis. It has a revolving drug fund that is used to fund procurement conducted by PFSA.

The Agency with its partners has introduced a logistics management information system project which is called Integrated Pharmaceuticals Logistics System (IPLS) since 2009; (Pharmaceuticals Fund and Supply Agency (PFSA) (2014). The goal of the project was to integrate the fragmented medical commodity supply chain in Ethiopia and establish information systems to minimize stock outs and wastage. In line with implementation of IPLS, PFSA with its partners institutionalize the automation of its supply chain with health commodity management information system (HCMIS) for the inventory of pharmaceuticals. The software was developed locally and developed over the years.

The HCMIS, a systematic recordkeeping tool, manages daily transactions at central and branch warehouses; it captures real-time transactional data across the PFSA network. With these data, users can forecast, procure, distribute, and dispense health commodities. An HCMIS dashboard, released in December 2015, allows PFSA employees real-time access to the supply chain data captured by HCMIS across the entire PFSA network of central warehouses and 16 branch warehouses. Recently HCMIS has been incorporated in to procurement in generating purchase orders. These and similar information management technologies are undergoing and shaping the current supply chain management at PFSA.

The purpose of this article is therefore to diagnose the level of supply chain automation system in central PFSA in terms of user acceptance and barrier for successful adoptions

1.2 Statement of the problem

Previous researches identified that PFSA’s supply chain is characterized by high and frequent Stock-out rate, leading to shortage of (vital) health commodities, overstock inventory (mostly with a shorter shelf life and near expiry dates), leading to high rate of expiry, counterfeited commodities within the legitimate line, hectic and manually laborious commodity tracing system during a product recall leading to inefficient tracking and tracing of all the required items belonging to the batch recalled and a non-speedy system allowing some of those items to already be used. Information on product status is very poor in terms of accuracy and freshness (Manebo 2016).

In addition Global fund office of inspector general audit report indicated that even though PFSA has procured Health Commodity Management information System in 2012 to improve traceability of medicines at the central level, most of the functionalities in the system were not enabled at the time of the audit.. This limits the ability to trace and to determine stock balances at the central and regional offices of PFSA. (GF audit report 2017)

This seems to indicate that the current supply chain automation is not serving its intended purpose in full, which leads the researcher to wonder if the problem is related with the adoption of the technology it is not known if there are any processes in need of automation or the problem.is related to limited usage of the system by employees.

This study, therefore, intends to identify the extent of supply chain automation in the PFSA head office and describe the level of automation in terms of system usability and challenges of system adoption.

1.3 Research Questions

This study aimed to describe the supply chain automation level of central PFSA and to identify and characterize system usability and barriers related to supply chain automation adoption. Therefore the major research question of this research is:

What is the level of supply chain automation in central PFSA central office?

In order to answer this major research question, the study will address the following specific research questions;

What is the system usability level of supply chain automation in central PFSA?

What are the barriers that hamper the supply chain automation adoption in PFSA?

1.4 Objective of the Study

The main objective of the study is to examine the extent to which supply chain automation is adopted in PFSA head office. The research will also identify the level of systemusability and barriers associated with the supply chain automation adoption

1.5 Significance of the Study

This research will help to diagnose acceptance and barriers of acceptance of the SC automation technology in PFSA. This will help the agencies' management to better understand what employees' expectations, questions and concerns are while working with the system. After finding the answers to the above questions, management may take action to overcome the acceptance barriers in daily working conditions for employees.

The findings will benefits PFSA to apply the out coming possible recommendations based on these research findings or formulate own policy actions to tackle problems with regard to setbacks in automating its supply chain.

Furthermore this research paper can serve as a reference material either to students or researchers as there are few studies in the area, it will give a comprehensive starting point for more supply chain automation system study for pharmaceutical supply chain.

Finally the research outcomes will be good resources for the general public and scholars by providing information about the level of supply chain automation from the study point of view.

1.6 Scope of the study

This study is limited to the assessment of extent to SC automation in central PFSA supply chain management system. And the research will be delimited to diagnose the level of supply chain management automation system in the head office of PFSA only.

1.7 Limitation of the Study

Due to budget and time constraint, it will be difficult to extend the study to all PFSA branches and at heath facility levels with all aspects of supply chain management information system which would have given a better overview of efforts, challenges and opportunities in supply chain information management in PFSA as a whole. The researcher is not an IT expert and the recommendation for better supply chain automating systems may turn out to be difficult due to limitations of prevailing IT infrastructure.

1.8 Definition of Terms

The following are definitions of terms which are used in the research

Supply chain management: The planning and management of all activities involved in sourcing, procurement, conversion, and logistics management, (Council of Supply Chain Management Professionals).

Logistics: The process of planning, implementing, and controlling procedures for the efficient and effective transportation and storage of goods including services, and related information from the point of origin to the point of consumption for the purpose of conforming to customer requirements. This definition includes inbound, outbound, internal, and external movements. (Council of Supply Chain Management Professionals, 2013, p. 117).

logistics management information system (LMIS): "A logistics management information system (LMIS) is a system of records and reports - whether paper-based or electronic - used to aggregate, analyze, validate and display data (from all levels of the logistics system) that can be used to make logistics decisions and manage the supply chain" (USAID, 2012, p. 3).

Warehouse management system (WMS): a system supporting the management and control of products within a warehouse, as well as "warehouse processes such as receiving and storage, order processing picking and packing, and shipping products out of the warehouse." (USAID, 2012, p. 4).

Health systems: As defined by WHO, all the organizations, institutions, resources, and people whose primary purpose is to improve health. (World Health Organization (WHO) 2014).

A health information system: refers to any organized effort to systematically collect, maintain and disseminate data relevant to the performance of a health system or any of its component parts. As such, any health system has potentially many health applications functioning within it.

Public health facilities: these are health facilities owned by the government of Ethiopia and managed under FMOH or regional health bureaus.

Pharmaceuticals: means any substance or mixture of substances used in the diagnosis, treatment, mitigation or prevention of a disease, and include medical instruments and medical supplies (Proclamation No 553/2007)

Service delivery point: Any facility where users receive supplies related to health services. Service delivery points (SDPs) are usually hospitals and health centers, but may also include mobile units, community-based distributors, laboratories, and health posts.

Lead time: The time between when new stock is ordered and when it is received and available for use. When logistics managers evaluate how well a logistics system is meeting the six rights, they measure the lead time and try to reduce it. Goods should be available to customers at *the right time*—before the customer asks for the product. Lead time can be calculated within the entire in-country system, from arrival in port to the end user, between specific levels of the system, or even the procurement lead time from when a product is ordered with the manufacturer until it arrives in port.

Pipeline: The entire chain of physical storage facilities and transportation links through which supplies move from the manufacturer to the user, including port facilities, central warehouse, regional warehouses, district warehouses, all SDPs, and transport vehicles, including community-based distribution networks.

1.9 Organization of the paper

The whole research work is presented in five different chapters. The first chapter gives an outline of the general background of the study. This chapter also explains the statement of the problem, objective of the study, significance of the study to be followed with the scope and probable limitations. The second chapter is the literature review chapter; which give a generalized concept and current practice of supply chain automation on which this research work intends to be carried out. The third chapter is the research methodology chapter; where an elaboration of the design of the research work is given including the methods of collecting data, population and population size, place of study and study period, and analysis tools used. The fourth chapter is the analysis of the results chapter; which encompasses the interpretation of the data in the appropriate format using the analytical methods. This chapter also provides the results regarding existing level of supply chain automation adoption in central PFSA and finding out possible ways for improvement of the existing performance. The fifth chapter winds up the paper by summarizing the major findings giving conclusion, recommendation, by listing limitation of the study and by pointing out further study in this topic.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

A supply chain consists of all stages involved, either directly or indirectly, in fulfilling a customer request. A supply chain includes manufacturer, supplier, transporters, warehouses, retailer, third-party logistics provider, and customer. Supply chain management aims to maximize the overall value generated rather than profit generated in a particular supply chain (Chopra, and Meindl, 2001).

Managing the supply chain plays an important role in creating competitive advantages for companies. Adequate information flow in supply chain is one of the most important issues in SCM. Therefore, using certain Information Systems can have a significant role in managing and integrating data and information within the supply chain. Pharmaceutical supply chain is more complex than many other supply chain industries as it is directly linked to human life. On the other hand, managing the pharmaceutical supply chain is difficult because of its complexity as it handles a diversity of items in widely varying quantities in response to the large number of diagnosis types and procedures (AbuKhousa et al., 2014).

Although, a lot of progress has been achieved in health commodity supply chain management after the establishment of Ethiopian Pharmaceutical Fund and Supply Agency, still there are many unsolved issues in managing the information flow in the pharmaceutical supply chain. This literature review focuses on the different kinds of automation and information systems in the supply chain and the possible challenges with regard to implementation and usage~~. This review article was performed in order to explain the different types of information systems in supply chains, and also to elucidate the applications of this systems for management of decision on health commodity logistics.~~

In supply chain management, the accessibility of complete, real time and correct information is crucial for the efficient flow of material (Jonsson, 2008; Helo & Szekely, 2005). To capture and share the right information various kinds of information systems are used in logistics and supply chain management (Copacino, 1998; Gold et al., 1998; Knill, 1998).

2.2 Information system in health commodity supply chain

A well-designed, well-operated supply chain is critical to the success of any health system. To ensure essential health commodities are available to the right clients, when they need them, supply chain managers need to have visibility into all functions of the supply chain, such as procurement, warehousing, inventory, distribution, funding, and policy. Some functions can operate independently, which is why a strong logistics management information system (LMIS) is needed. A strong LMIS can ensure data visibility throughout each function, and essential logistics data can be communicated to supply chain managers for decision making. Information is the engine that drives the logistics cycle; without information, the logistics system would not run smoothly. As technology continues to evolve in public health systems within developing countries, managers are beginning to demand up-to-the-minute, accurate data, which helps them to manage product flow better for all levels within the system.

2.2.1 Health commodity Logistics Information Systems

Logistics can be defined as the planning, development, organization, coordination, governing and controlling the material flow from commodity suppliers to end-users (Persson & Virum, 2006, p. 16). A different sub-system in supply chains is LMIS. The term LMIS has often been used by international agencies and other stakeholders to describe information systems used for supporting logistics decision making in developing countries. As USAID (2006, p. 1) emphasizes, a LMIS collects, processes, and reports logistics data. Moreover, LMIS (Logistic management information system) should facilitate informed decisions in the supply chain, striving for accurate, timely, and appropriate data (USAID, 2006, p. 1). Importantly, such a system is used for gaining useful information for decisions made on all the different levels of the health system. To improve health in developing countries, one needs good and reliable information on where to prioritize resources. This implies that a well-functioning LMIS should ensure that medical commodities are accessible for patients needing help, delivered at the right time and place (Raja & Mohammad, 2005).

An LMIS collects data about commodities; this information is often used for activities, such as filling routine supply orders for health facilities. An LMIS can be understood as a management information system used to support the flow of information and commodities between warehouses and patients. In the context of Ethiopia, this includes information handling at the facility, Hubs and central level. Through such a system, collection, processing and reporting on commodity data are used to get an informative overview of where logistics resources are needed in the supply chain. The goal of a successful LMIS is to better facilitate well-informed decision making.

2.2.2 LMIS: Typical challenges in developing countries

In developing countries, several challenges are identified in the development of, and caused by, LMIS'. Some examples include: fragmentation resulting in vertical LMIS', inefficiencies caused by this, paper-based systems and lack of standardization.(USAID DELIVER.2011) Research articles on LMIS in developing countries has found that sometimes the vertical LMIS collects similar information in similar formats between programs. (Chindove& Mdege ,2012). This is related to a critical challenge in LMIS' in developing countries, namely lack of standardization in reporting formats (Chindove & Mdege, 2012). Overall, the lack of standardization is influenced by different health initiatives maintaining their own ordering tools and methods, thereby resulting in differences in methods. Another issue prominent in LMIS in developing countries is that they are predominantly paper-based (Chindove & Mdege, 2012). This leads to a more demanding information handling process than in digitalized management systems and may cause delays in the overall information creation process (SIAPS, 2014b).

There are several challenges that are caused by poor LMIS' in developing countries. The common denominator with the challenges mentioned above is that they all ultimately may lead to lowered access of commodities, such as life-saving drugs. Such challenges are caused by the prevalence of stock shortages and stock-outs, as well as over-stocking resulting in medicine and vaccine wastage (Kaufmann, Miller & Cheyne, 2011; Jahre et al., 2012; Zaffran et al., 2013).

The issue causes the more dangerous risk of decreased availability of health commodities to the people. In turn, the lowered availability and access to life-saving medicines, vaccines and equipment pose a serious threat to the public health of developing countries (Kraiselburd &Yadav, 2013; Jahre et al., 2012; Zaffran et al., 2013). In order to improve the access of important commodities, reliable information on where, when and what products are needed should be readily available in order to help health program managers make decisions (Chandani et al., 2006). By utilizing such information, wastage can be decreased and accountability enhanced (Chandani et al., 2006).

2.2.3 Standardizing commodity ordering in LMIS

As a possible solution to typical challenges, Chindove and Mdege (2012) has found that standardizing the collection and reporting on logistics data seem to improve the availability of health commodities and essential medicines in developing countries. Standardization of commodity ordering systems will help make the comparison of data from vertical health programs easier, and create a common ground for stakeholder alignment at the organizational level of standardization.

Further, Raja and Mohammad (2005, p. 6) emphasizes that in order to move towards a full supply of drugs and supplies, one need to implement an automated LMIS for making supply chain data (i.e., stock levels and consumption patterns) more transparent. Chindove and Mdege (2012) further supports this view in their findings, indicating that an automated and standardized LMIS help decision-making processes, which ultimately may lead to enhanced availability and access to commodities.

Many countries are currently moving from paper-based LMIS to digital and more automated systems, Ethiopia being one of them. The national pharmaceutical supply system reform in 2007 has gave rise to the designing of an Integrated Pharmaceutical Logistics System (IPLS) as primary mechanism to ensure un-interrupted supply and continuous availability of quality-assured essential medicines at all public health facilities at affordable prices (Pharmaceuticals Fund and Supply Agency (PFSA) (2014).). In line with implementation of IPLS, PFSA with its partners institutionalize the automation of its logistics with health commodity management information system (HCMIS) for the inventory of pharmaceuticals.

The HCMIS, a systematic recordkeeping tool, manages daily transactions at central and branch warehouses; it captures real-time transactional data across the PFSA network. With these data, users can forecast, procure, distribute, and dispense health commodities. An HCMIS dashboard, released in December 2015, allows PFSA employees real-time access to the supply chain data captured by HCMIS across the entire PFSA network of central warehouses and 16 branch warehouses.

PFSA employees and MOH officials use the HCMIS dashboard, an online business intelligence tool, to track key performance indicators for stock levels, expiries, and the pipeline in real-time. To enhance usability, users can select customized dashboards for various programs, including HIV, family planning, malaria, child health, etc.; or users can generate specific reports, identify trends, and discover business insights.

2.3 Level of supply chain automation information system implementation process

The implementation of supply chain automation information system is an organizational effort for which needs systematic process control (Cooper and Zmud, 1990). Zmud and Apple (1989) described the implementation process into six parts: Initiation is the process that an organization identifies the supply chain problems and the need for automation is put forward. The next level is the adoption process where negotiations are made for supporting the implementation of information system. Adaptation is the process that the information system program is developed, installed and maintained. Acceptance is the process that members of the organization are come to commit to the information system program. Routine is the process that the information system program has become a normal activity in the organization. Infusion is the last process that continuous efforts are made in using the information system.

.

2.4 Drivers for employing supply chain automation information systems:

The main driver for employing supply chain automation information systems for a company is cost saving and perceived benefits of information systems (Iacovou et al., 1995; Janssens & Cuyvers, 1991). Cost saving consists of many aspects: reduced operation cost, reduced labor cost because of less material handling, reduced lead time, and less identified defects (Aggarwal et al., 1998). Another driver is better inventory management. For example, RFID and WMS are able to keep tracking of the goods through the transportation processes, improve inventory accuracy, and allow collaboration on inventory management, planning, forecasting, and replenishment (Frazelle, 2002; Lee & Moon, 2002).

2.5 Potential Barrier and Challenges for Implementation of supply chain automation

The main challenge for employing various kinds of advanced supply chain automation information system is accounted to cost control while realizing the significant benefits (Vijayaraman & Osyk, 2006). Take RFID as an example, Alvarez (2004) said that the costs of tags and related infrastructure are greater than perceived benefits. Some automating information tools such as EDI and RFID lack international standard. Companies on one supply chain have different standard information, which made information sharing difficult to operate in the real world. It is hard to meet the administrative requirement of information systems for both upstream and downstream companies in the supply chain, due to the variation of information systems.

Lack of systematic understanding for information systems is also an obstacle (Iacovou et al., 1995; Vijayaraman & Osyk, 2006).lack of knowledge and technological infrastructures in organizations and heterogeneity of languages and technologies that are used in different systems which all must be dealt with. Technology concerns are not easy to deal with. For instants, the difficulty to integrate certain complex SC automation information system with existing business processes (Iacovou et al., 1995). Privacy and security concerns also emerged, as McGinity (2004) discovered, the information collection may violate consumers privacy. The key issue is the security of the data gathered from identification systems. Moreover, data insecurity due to an insecure Internet environment is an important concern (Gharabaghi, and Hesami, 2010).

The willingness to share data with trading companies sometimes is weak. In another word, trust issues are critical for the integration of information system (Iacovou et al., 1995). Trust in any supply chain is necessary in order to share critical information such as costs, prices and etc. Cooperation between all business partners in a supply chain should be based on commitment in cooperation and sustaining that.

SCISs (supply chain information systems) are used to coordinate information between internal and external customers, suppliers, distributors, and other partners in a supply chain. The most important sign for the success of any installed information system in a supply chain is how well this system has been able to support the activities of that supply chain, reduce buffer inventory stocks, reduce lead times, increase sales and improve customer services (McLaren, and Yuan, 2004).

In order to achieve the highest performance level, supply chain strategies should be aligned with information systems strategies. In this situation, information systems meet the supply chain requirements in the best possible manner (Torabizadeh and Noshadi, 2012). However, not information technology values can be created only by using technology but applying managerial skills for using information plays an important role in value creation through IT. Moreover, the size of an organization, its successes, uncertainties, support of the senior management and the pressure applied by other partners play an important role in the effect that information technologies have on supply chains (Dong and Zhu, 2009).

So, using IT and supply chain automation applications can provide various benefits such as improving customer services, improving human resources efficiency, improving the total efficiency by allocating more time to more vital business activities, improving information quality and supporting collaborated planning and consequently improving the agility of the supply network. However, despite all benefits, there are some difficulties such as changing the business processes and business relations to adapt to the IT environment. In addition, organizations face more risks in an electronic supply chain including delay, system breakdown, lack of information security and *etc.* (Rajab-zadeh and Nalchigar 2011).

2.11 Information System Effectiveness and Success

Today, a lot of large, highly efficient systems and software have developed in the healthcare field. These have different goals, effectiveness and quality that need to be updated constantly and errors recovered. Testing systems helps to determine their effectiveness, limitations, weaknesses and strengths.

The main criteria for measuring information system effectiveness include system's usage, user information satisfaction, quality of decision-making, productivity from cost benefit analysis and system quality. From the above criteria, system usage and user satisfaction are more eminent measures (Southon, Sauer, and Crant, 1997). To measure the effectiveness of a health commodity information system, the processes that reflect the effects should be formed in an articulate way in order to be analyzed during the evaluation research (Kaplan, 1997). On the other hand, in order a system to be successfully implemented, developers should assume whether users will use the system or not, in accordance to the past usage and the external and internal factors influencing the usage of the information system (Bajaj and Nidumolu, 1998)

Delone and McLean's classification (1992) for information system effectiveness and success consists of six elements (system use, user satisfaction, system quality, information quality, individual and organizational impact). The above model also supports that the relation between system quality and information quality leads to system use and user satisfaction and furthermore, that use and satisfaction encourage an individual impact, which further leads to the organizational impact (Despont-Gros, Mueller and Lovis, 2005).

2.12 Theories of Information Systems

Theories of information systems are considered to comprise various models and approaches:

2.12.1 Technology Acceptance Model and System Usability Scale (SUS)

Technology Acceptance Model (TAM) was developed by Davis which provided a valid and reliable measure that predicts the acceptance of a new technology by end users" (Davis 1989). The TAM is based on two specific beliefs that perceived usefulness and perceived ease of use of a technology system determine a person's behavioral intention to use (Venkatesh & Davis, 2000). TAM has proved to be a powerful model to predict to users' acceptance with substantial theoretical and empirical support. After Davis introduced TAM in 1989, Venkatesh and Davis worked on updating the theory. The updated TAM 2 is a theory that “incorporates additional social theoretical constructs spanning social influence processes (subjective norm, voluntariness, and image) and cognitive instrumental processes (job relevance, output quality, result demonstrability)” to explain the perceived usefulness of a new technology which leads to people’s intention to accept (Venkatesh & Davis, 2000).The subjective norm is defined as a person’s perception that if the majority of people who are important to this person think he or she should perform this behavior; the person will be motivated to comply with that behavior (Fishbein & Ajzen, 1975). Subjective norms help undercover the conditions that can impact social influence on user behavior from a management perspective.

Another social theory in TAM 2 refers to a situation in which an innovation is used to enhance someone’s status in the social systems (Moore & Benbasat, 1991). According to Venkatesh and Davis (2000), the power increase from the social status elevation provides higher productivity, which gives this person an impression that using this system will improve his or her performance. In the cognitive instrumental processes, the job relevance means the degree of individual’s agreement of a target technology matches with the target technology applicable degree to his or her job (Venkatesh & Davis, 2000).

The result demonstrability emphasized the importance of training employees with enough knowledge and understanding of a new system and what this system can actually do. In Venkatesh and Davis' theory, the subjective norm, voluntariness, image, job relevance, output quality and result demonstrability have impact on perceived ease of use which has an impact on perceived usefulness. Both perceived ease of use and perceived usefulness together determine users’ intention to accept the technology. Figure 2.1 below shows TAM 2 theory framework from Venkatesh and Davis'article (2000).

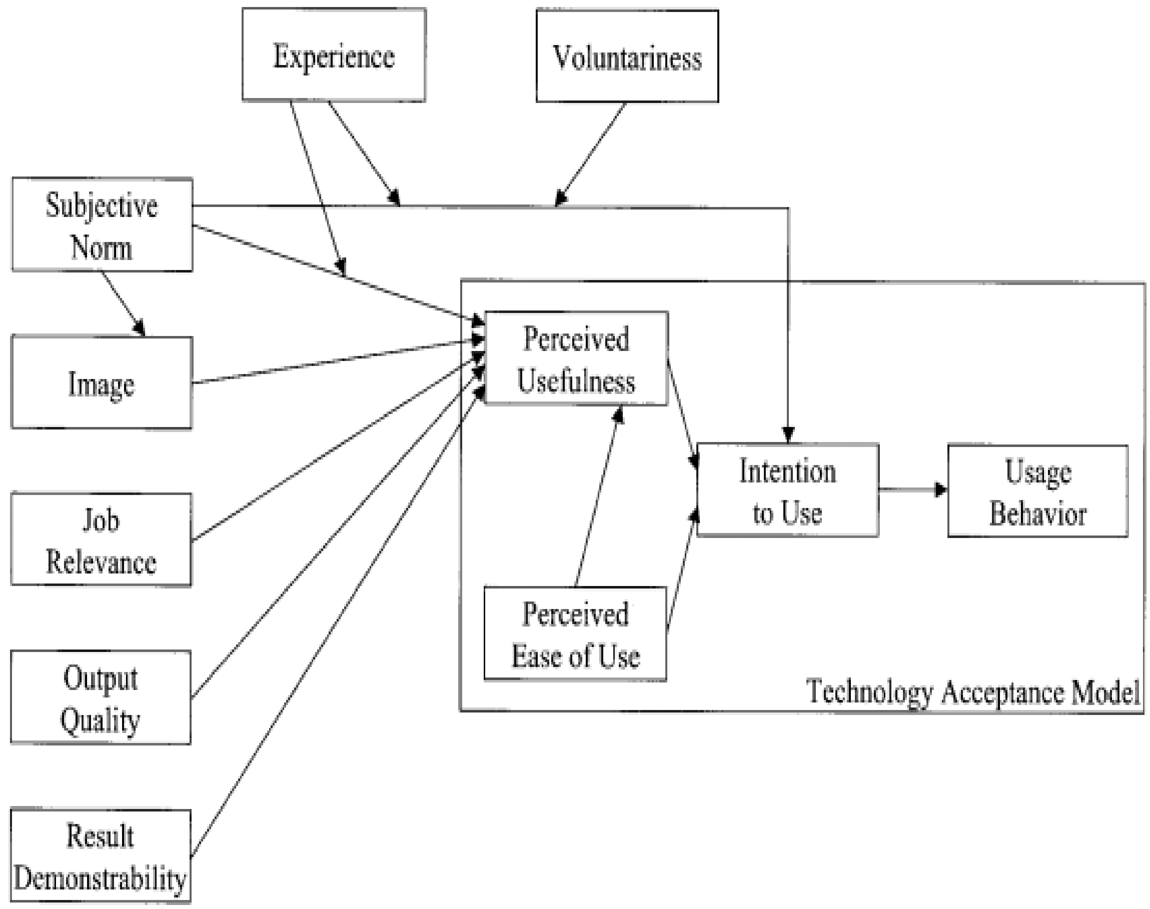

Figure 2.1 Technology Acceptance Model (Venkatesh & Davis, 2000)

2.12.2 System usability scale

The System Usability Scale (SUS) was first developed by John Brooke in1986 at Digital Equipment Corporation in the UK as a tool used in engineering the usability of computer based office systems (Brooke, 1996). It was recognized as a 'quick and dirty' survey using a Likert scale that allowed the usability researcher to quickly and easily assess the usability of a given product or service in order to provide a global view of users' attitudes and subjective assessments (Bangor et al., 2008). John Brooke described the results of 2,324 SUS surveys from 206 usability tests collected over a 10-year period, and found that the SUS was highly reliable (alpha 0.91) and useful over a wide range of interface types.

Brooke's (1996) starting point was usability, defined by ISO 9241-11 as a combination of effectiveness, efficiency and satisfaction. Unfortunately, since these ''classes of metric can vary widely'' (Brooke, 1996), he employed a new and simpler scale which does not evaluate the system on individual dimensions of effectiveness, efficiency and satisfaction, but rather scores the overall subjective experience of the user The SUS is composed of 10 statements with each having a 5-point scale that ranges from ‘Strongly Disagree’ (1) to ‘Strongly Agree’ (5). The SUS (see Appendix 1) was administered soon after the respondent had had an opportunity to use the system but before any debriefing or discussion could take place.

Respondents were instructed to immediately record their response for each item, rather than delay by protracted consideration about the items. Since all questionnaire items should be checked, respondents were told to mark the canter point of the scale if they felt they could not respond to a particular item. The SUS questionnaire was administered as an online survey (http://imstriker.com/survey1/sus.php).

To calculate the SUS score, we first summed the score contributions from each item. Each item’s score contribution ranges from 0 to 4. For items 1,3,5,7 and 9 the score contribution is the scale position minus 1. For items 2,4,6,8 and 10, the contribution is 5 minus the scale position. We multiplied the sum of the scores by 2.5 to obtain the overall value of System Usability (SU). SUS scores have a range of 0 to 100. Ranges for SUS above a 68 would be considered above average and anything below 68 is below average. (McLellan, 2012).

2.13 Conceptual Framework

The Technology Acceptance Model (TAM), by Davis and Venkatesh (2000), and the System Usability Scale (SUS) instrument, by Brooke (1996) are most suitable for the research purpose and have been tested and proven valid in other research. The TAM survey had reliable Cronbach Alpha scores over 0.8 (Venkatesh & Davis, 2000) and SUS survey had an Alpha score 0.91 (Bangor, Kortum & Miller, 2008). The original TAM was designed to assess users’ acceptance for information technology and explains users’ intention to accept a technology from two points: perceived usefulness and perceived ease of use. In the advanced TAM 2, the perceived usefulness is also affected by subjective norm, image, volunteer, job relevance, output quality and result demonstrability (Venkatesh & Davis, 2000). The SUS is a more generalized assessment of usability on variety of products or services (Brooke, 2013). This research uses the validated surveys of SUS questions for “perceived ease of use” section in the TAM theoretical framework. The research objective is to identify level of Supply chain automation technology acceptance and barriers in technology function

Since SUS method is carried out in survey format, the survey instruments were adopted for this research as well. On the other hand to evaluate the barriers for implementation of SC automation system, questioners adapted from (Benjamin Maina Mutugi 2012) are used.

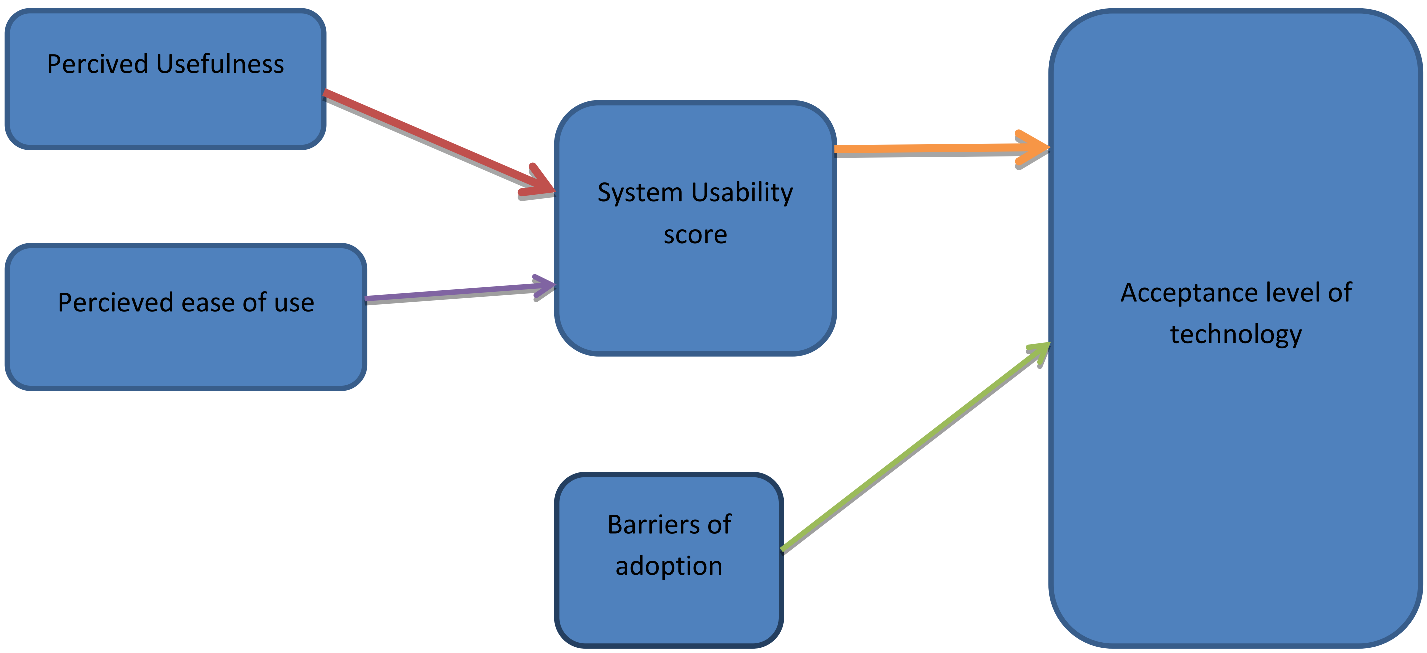

Fig 2.2 conceptual frame work

CHAPTER THREE

3.1 Research Methodology

Research methodology according to Creswell [2002] is defined as general guideline for solving a problem or systematic way of solving a problem through design of novel solution. There are different kinds of research approaches; these include qualitative approach, quantitative approach, and mixed approach (a mixture of qualitative methods and quantitative methods). In this study, a quantitative approach is used because of the nature of the research questions that require this method.

3.2 Research Design

The study adopted a descriptive research design. Descriptive research design allowed the researcher to study the elements in their natural form without making any alterations to them. The design also allowed the researcher to come up with descriptive statistics that can assist in explaining the relationship that exists among variables. Then this study describes the level of supply chain automation in central PFSA

Moreover, obtaining information from a cross-section of a population at a single point in time is a reasonable strategy for pursuing many descriptive researches (Ruane, 2006), hence justifying the use of a cross-section analysis in this particular study.

3.3 Data Type and Source

Officials and experts at central PFSA of Addis Ababa, IT technicians of USAID Deliver assisting the program and officers who have direct contact with the system are considered as the primary source of information. Therefore the proposed number of respondents was fifty five.

3.4 Data Gathering Tools

Survey questionnaires are considered as the major means of data gathering tools. The questionnaire System Usability Scale (SUS) was chosen in order to evaluate the user satisfaction regarding the tested technology. The SUS questionnaire including 12 questions on the dimension of challenges of supply chain automation was completed individually by fifty employees of central PFSA and USAID DELIVER who have direct link with the supply chain automation system and operations. So these are taken as respondents thereby as a target population in this study. Taking in to consideration of these targeted population, census survey is conducted on the entire population rather than sampling. These respondents are familiar with the system and are expected to have the relevant information related to the automation practices in central PFSA.

3.4.1 SUS Reliability and Validity

By using coefficient alpha (a measure of internal consistency often used to estimate reliability of multi-item scales) Bangor et al. (2008) found the reliability for SUS to be equal to 0.91 when he used 2,324 cases as a sample. Lewis and Sauro (2009) found the reliability for SUS to be equal to 0.92 when he used 324 cases as a sample. Tullis and Stetson (2004) have shown that SUS is reliable with a small sample compared to other usability scales such as the Questionnaire for User Interface Satisfaction (QUIS) and the Computer System Usability Questionnaire (CSUQ).

3.5 Data analysis

Collected data have been cleaned, edited, and re-arranged for analysis. In analyzing the data collected, the descriptive analytical methods are used. Statistical analyses were performed with SPSS version 20. Interpretation of histograms, and non-parametric correlation tests were performed.

A SUS score was calculated in the manner described above. In the online version of the SUS there was a ‘no answer’ option. Those ‘no answer’ responses were changed to a score of ‘3’ (Bangor et al. 2009).

Cronbach’s alpha’s were calculated for both the SUS and the 12 questions on the dimension of challenges of supply chain automation to test the reliability of both instruments.

3.7 Sample Size Determination

Target Population,

The logisticians, programmers and supply chain managers and assisting IT technicians at central PFSA who have direct link with the supply chain automation system and operations comprising fifty five in number were taken as respondents thereby as a target population in this study. Taking in to consideration of these targeted population, census survey was conducted on the entire population rather than sampling. The respondents are chosen based on their familiarity with the system and have the relevant information related to the automation practices in central PFSA.

3.8 Ethical Considerations

The study considered some ethical issues. As such, each respondent is aware of having the right to respond or not, the respondent has the right to participate or not, respondents have informed the purpose of the questioner and the study considers the confidentiality of the response

Chapter Four

RESULT AND DISSCUSION

4.1 Result

In this chapter, the data collected from respondents have been analyzed and interpreted. The chapter begins by presenting reliability test, background information of respondent under the demographic variables, followed by descriptive statistics,

4.2 Reliability Test

Reliability is the extents to which a variable or set of variables is consistent in what it is intended to measure and the rationale for this internal consistency is that the individual items or indicators of the scale should all be measuring the same construct and thus be highly inter-correlated (Hair et al., 2007). The Cronbach alpha coefficient is an indicator of internal consistency of scales. A high value of the Cronbach alpha coefficient suggests that the items that make up the scale are internally consistent and measure the same underlying construct. A value of Cronbach alpha above 0.70 can be used as a reasonable test of scale reliability (Cronbach, 1951).The resulting Cronbach's alpha values of the dimensions are presented in the table 4.1 that follows:

Table 4.1: Cronbach's alpha

Dimension	No. of Items	Cronbach's Alpha
SYSTEM USAGE SCALE	10	0.835
Challenges of Supply chain automation implementation	12	0.729

Source: Survey Finding, 2018

.

4.2 Respondents' Demographic Information

As inferred in the preceding part of this study, the entire population of the Pharmaceutical Fund and supply agency of Ethiopia head office logistic personnel was considered in the study, including all the stakeholder of the SC automation process, hence making the total number of respondents 55. However, only 50 respondents have filled and returned the questionnaire, which essentially made the response rate about 90.9%. The demographic information of the respondents who have filled and returned the questionnaire is presented on Table 4.2.

The majority of the respondents (63.3%) were aged between 26 to 35 years followed by the age categories of 18 to 25 years, 36 to 45 years and above 45 years respectively with percentage scores of 18.4%, 16.3% and 2% in that order. The proportion of professional based on education levels during the data collection indicate higher percentage of (88%) first degree holders, whereas those having second degree account for 12%. Most respondent have been working for 1-3 years with 52% followed by 4-7 years with 30%, Those who have served 8-10 years account for 16% followed by 2% of respondents who have served more than 10 years.

Table 4.2: Profile information of respondents

Variable	Frequency	Valid Percent
Age		
18-25 Years	9	18.4
26-35 Years	31	63.3
36-45 Years	8	16.3
Above 45 Years	1	2
Total	***50***	***100***
Educational Qualification		
First Degree (BSc, BA)	44	88
Second Degree (MSc, MA)	6	12
Total	***50***	***100***
Service Year		
1 to3 Years	26	52
4 to 7 Years	15	30
8 to 10 Years	8	16
Above 10 Years	1	2
Total	***50***	***100***

Source*: Survey Finding, 2018*

4.4 Descriptive Statistics

Concerned respondents' feedbacks were captured along the 26 items corresponding to the two dimensions that were introduced to measure the study constructs. Statistical package SPSS 20 was used. The statistical methods used were descriptive statistics, bivariate correlations and non-parametric tests.

4.5 System usability scale

During this study, the System Usability Scale (SUS) questionnaire was used. In order to analyze the results of the SUS questionnaire, the research adopted a scoring system created by the SUS developer (Brooke, 1996 The statements alternate between positive and negative statements about usability. System Usability Testing Scores have a range of 0 - 100. For calculating the System Usability Testing Score:

1. First sum the score contributions from each item
2. Each item's score contribution will range from 0 to 4.
3. For items 1, 3, 5, 7, and 9 the score contribution is the scale position minus 1.
4. For items 2,4,6,8 and 10, the contribution is 5 minus the scale position.
5. Multiply the sum of the scores by 2.5 to obtain the overall value.

Sauro (2011, p. 3) observes that "the alternation of positive and negative items also provides protection against serial extreme responder participants who provide all high or all low ratings, a situation that could be especially problematic for remote usability testing".

The system usability survey has been used in some previous studies as an indicator of the effectiveness of the systems used by the public or of a product in the market. Bangor et al. (2008) collected data on the use of System Usability Testing over more than a decade with a variety of different systems and technologies, generating more than 3,500 System Usability Testing results. These researchers suggest that it is possible to take the System Usability Testing Score for a particular product and give it a grading score. They reached this conclusion after they found that there was a close correlation between System Usability Testing Scores and people's ratings of systems in terms of adjectives such as "good," "poor," or "excellent" (Figure 4.1).It is important to note that the resulting figure is not a percentage (Sauro, 2011).In practice, a SUS score above a 68 would be considered above average and anything below 68 is below average.

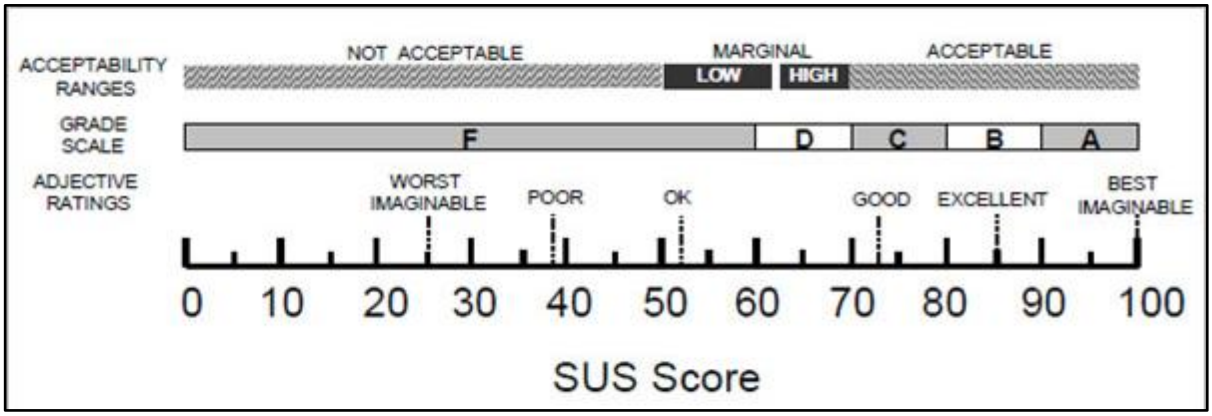

Figure 4.1: Grade rankings of SUS scores
(Source: Brooke, 2013)

This questionnaire is designed only for the users of the system. Subjects were asked to complete a paper-based form of SUS questionnaire given to them hand-to-hand attached with the consent form. One of the main reasons that SUS questionnaire has been selected is that this questionnaire is simple, flexible and covers many aspects as far as for usability of system in order to evaluate user satisfaction.

SUS score

SUS questionnaire data suggests that subjects themselves rated the system as being fairly usable, with an SU score of 65 and SD of 24.23. Additionally, 36% of the respondents scored the questionnaire between 81 to 100 and another 28%of the employees scored between 61 to 80% (10%) scored between 41 to 60 While 22% have scored 21 to 40, a small percentage have scored 0 to 21 usability score

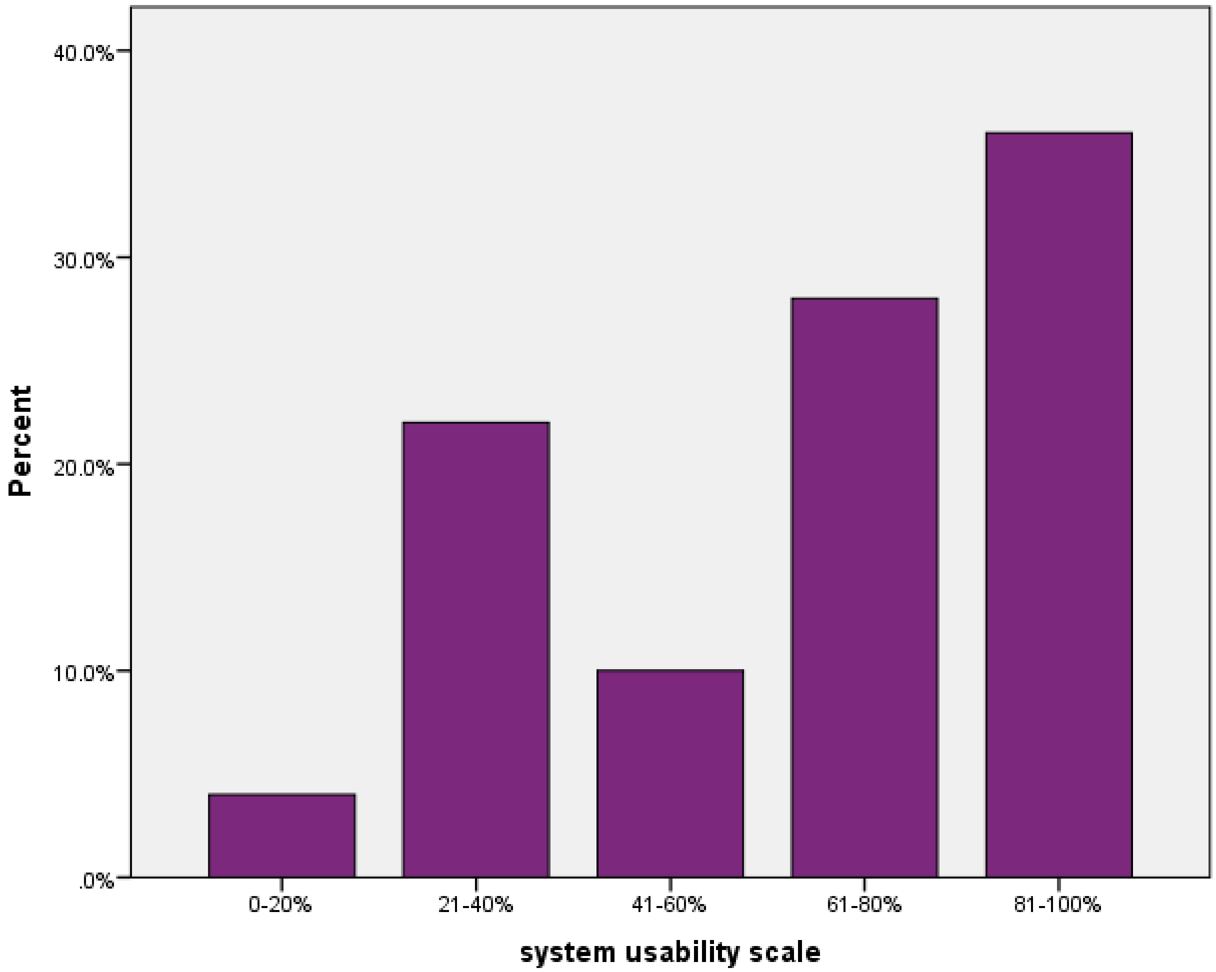

Fig 4.2 System usability score

Based on the responses for the System Usability Testing. The result of the SUS test gives an average score = 65 thus below average but yet marginally acceptable/

Acceptability Ranges	Not Acceptable (0-49)	Low Marginal (50-61)	High Marginal (62-69)	Acceptable (70-100)	
SUS Score	30%	6%	4%	60%	

Adjective Ratings	Worst (0-25)	Poor (26-38)	Ok (39-52)	Good (53-73)	Excellent (74-85)	Best (86-100)
SUS Score	12%	10%	10%	16%	40%	12%

Table 4.3: SUS rating

In the Acceptability Ranges classification, 30% of respondents evaluated the supply chain automation system of PFSA as “ not acceptable” and 6% of them evaluated the system as “low marginal”, compared to the respondents who evaluated the system (4%) (60%) as high marginal and acceptable respectively.

In addition the respondents evaluated the supply chain automation system in Adjective Ratings (10%) (16%) (40%) (12%) as (Ok, Good, Excellent, and Best) respectively.

The findings of the usability survey show that overall respondents gave the supply chain automation system a “good” adjectival rating. The system was evaluated by the respondents according to the criteria provided as an acceptable information technology system.

4.6 Frequency of Use

The statistical evaluation of the data with regard to SUS variable of frequency of use revealed that the logistic professionals and IT technicians (n=24) over the half of them that corresponds to 52% would strongly desire to use the system regularly. Additional 20% of the respondents would prefer to use the system frequently. While a total of 16% of the respondents showed their disagreement for system frequent use 10% have neither agreement nor disagreement on the issue

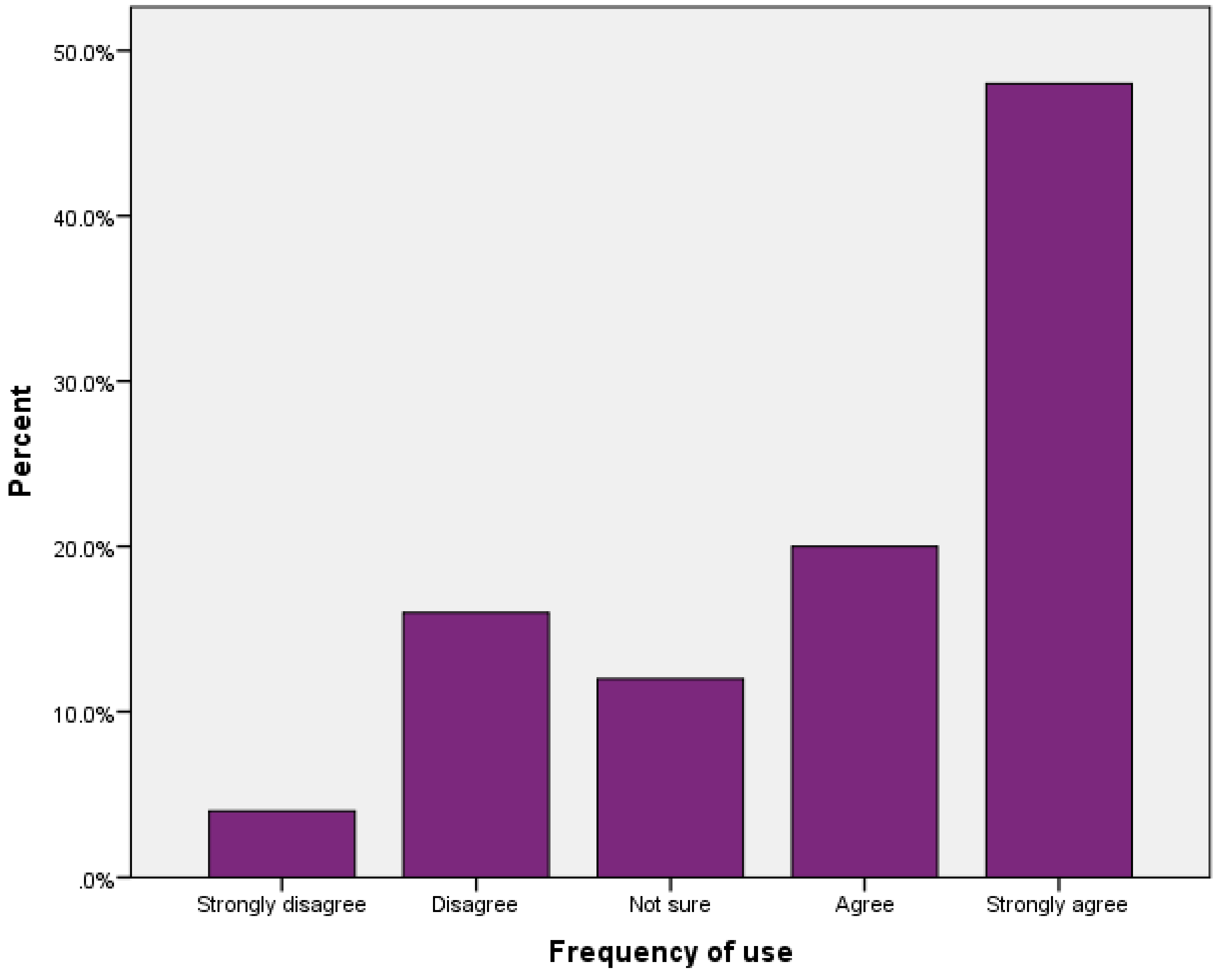

Fig 4.3 Frequency of use

4.7 Complexity

Concerning the complexity of the system, the 32% of the respondent's strongly disagreed and an additional proportion equal to 36% disagreed that the system was complex. A significant percentage of the respondents also characterized the system complex (22%). Moreover a small part (10%) had no specific opinion

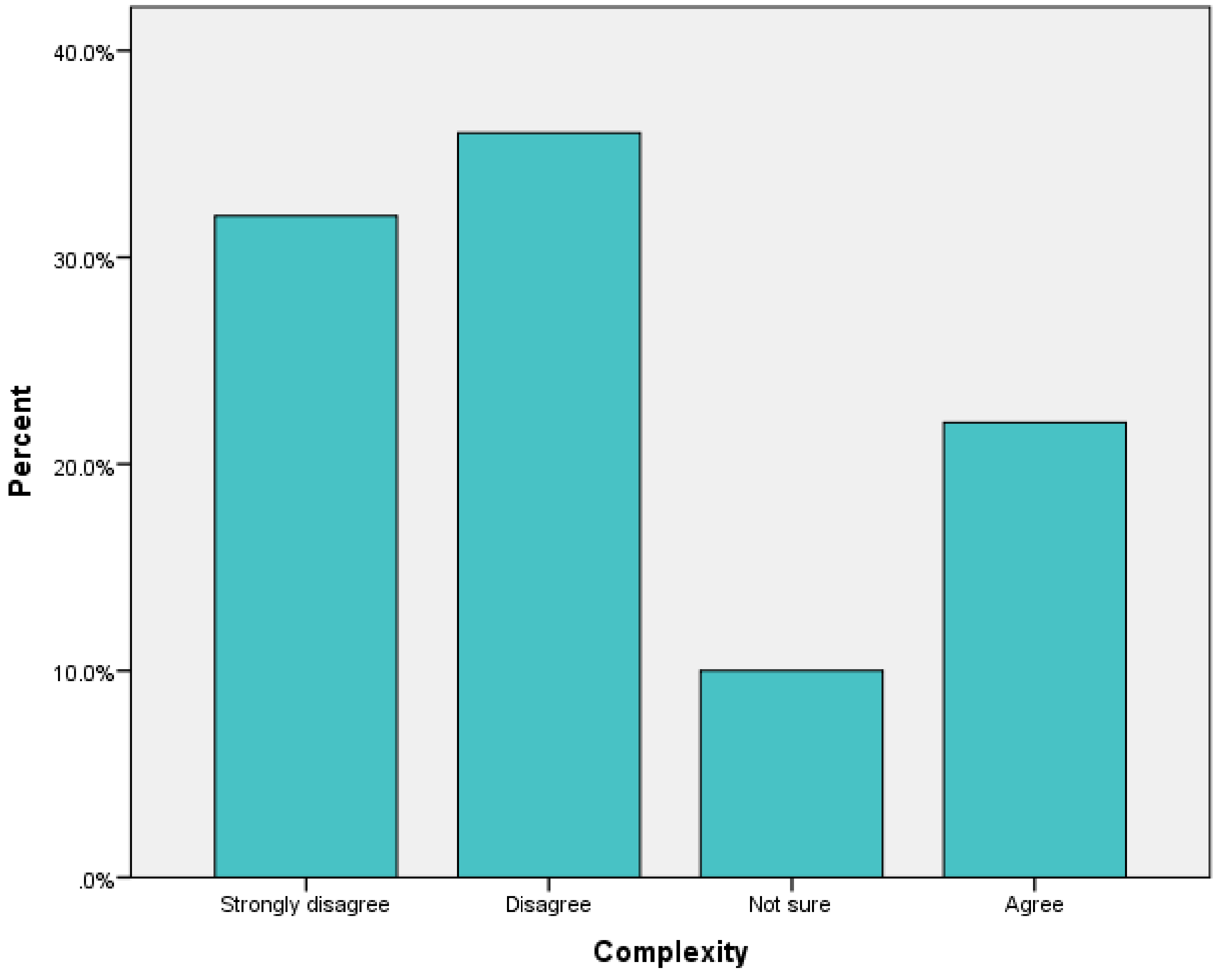

Fig 4.4 System complexity

4.8 Easy to Use

Similarly to the previous results, 28% of the employees thought that the system was easy to use, in addition 20% has strongly agreed to the easiness of the system. On the other hand, a total of 24% of users disagreed with this statement. However, around the 28% of the respondents neither agrees nor disagrees whether the system was easy to use, as they perceived it or not

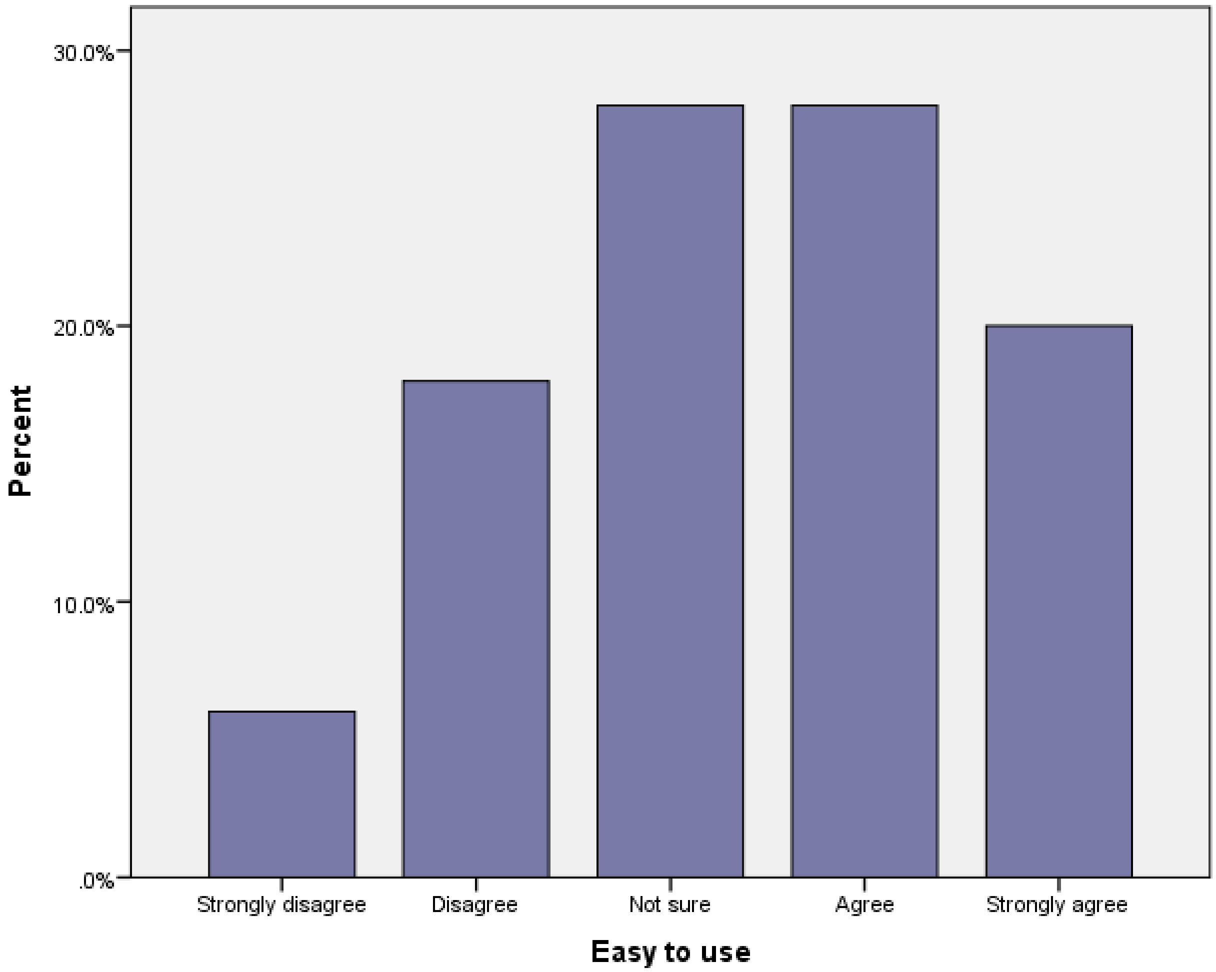

Fig 4.5 System ease of use

4.9 Need for Support from Technician

According to the data the responses with the higher score for the statement. *"I think that I would need the support of a technical person to be able to use this system''* were 34%not sure while32% of the respondents did not believe that the support from a technician is necessary in order to be confident to use the system. However, a similar proportion of employees 36% considered the support and the guidance from a technician as important.

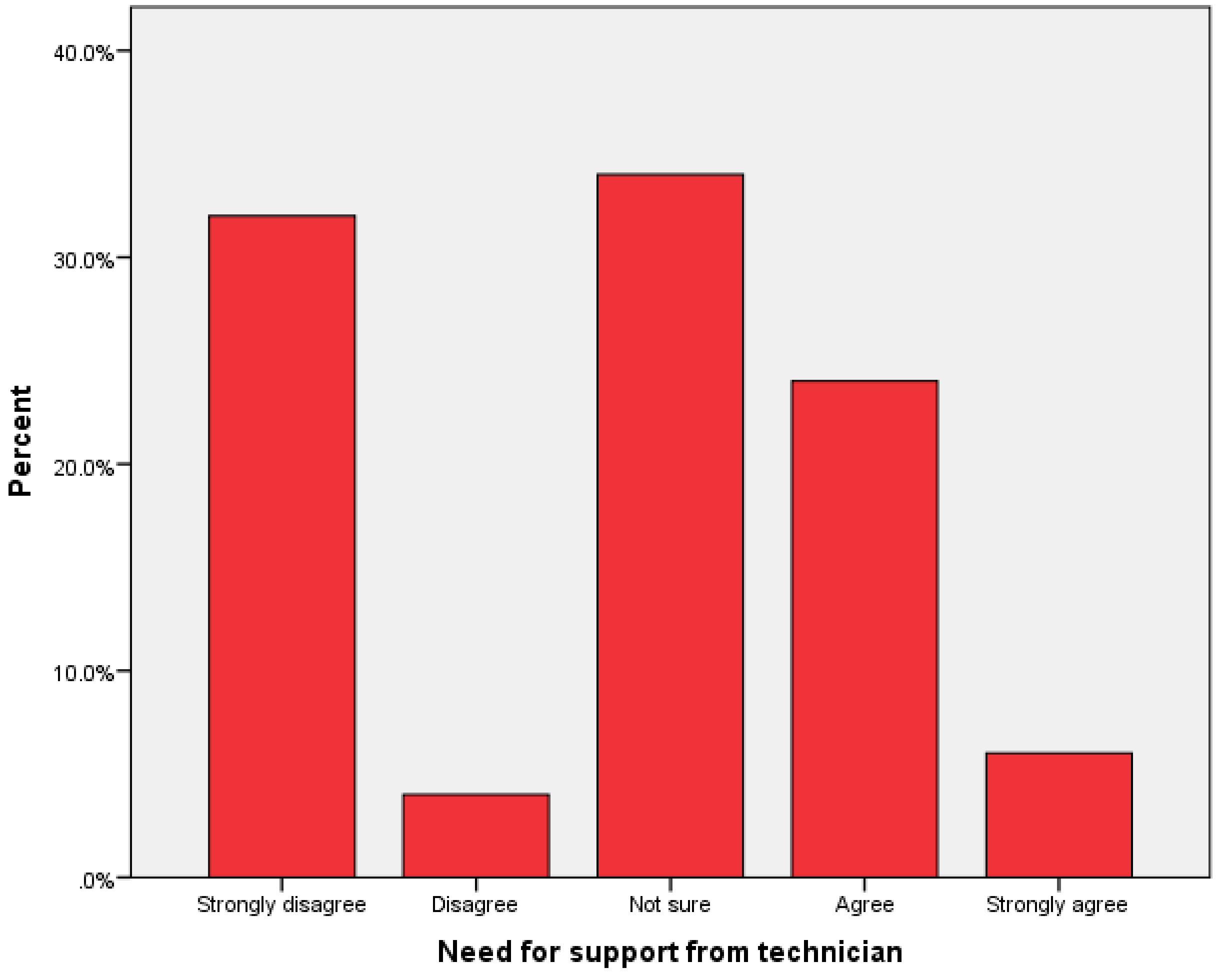

Fig 4.6 Technical support need

4.10. Functional Integrity

Majority of respondents (44%) strongly considered the system as well integrated and a further 24% of respondents simply agreed with this statement. The opposite opinion was reported in 24% of the response and 8% were not sure.

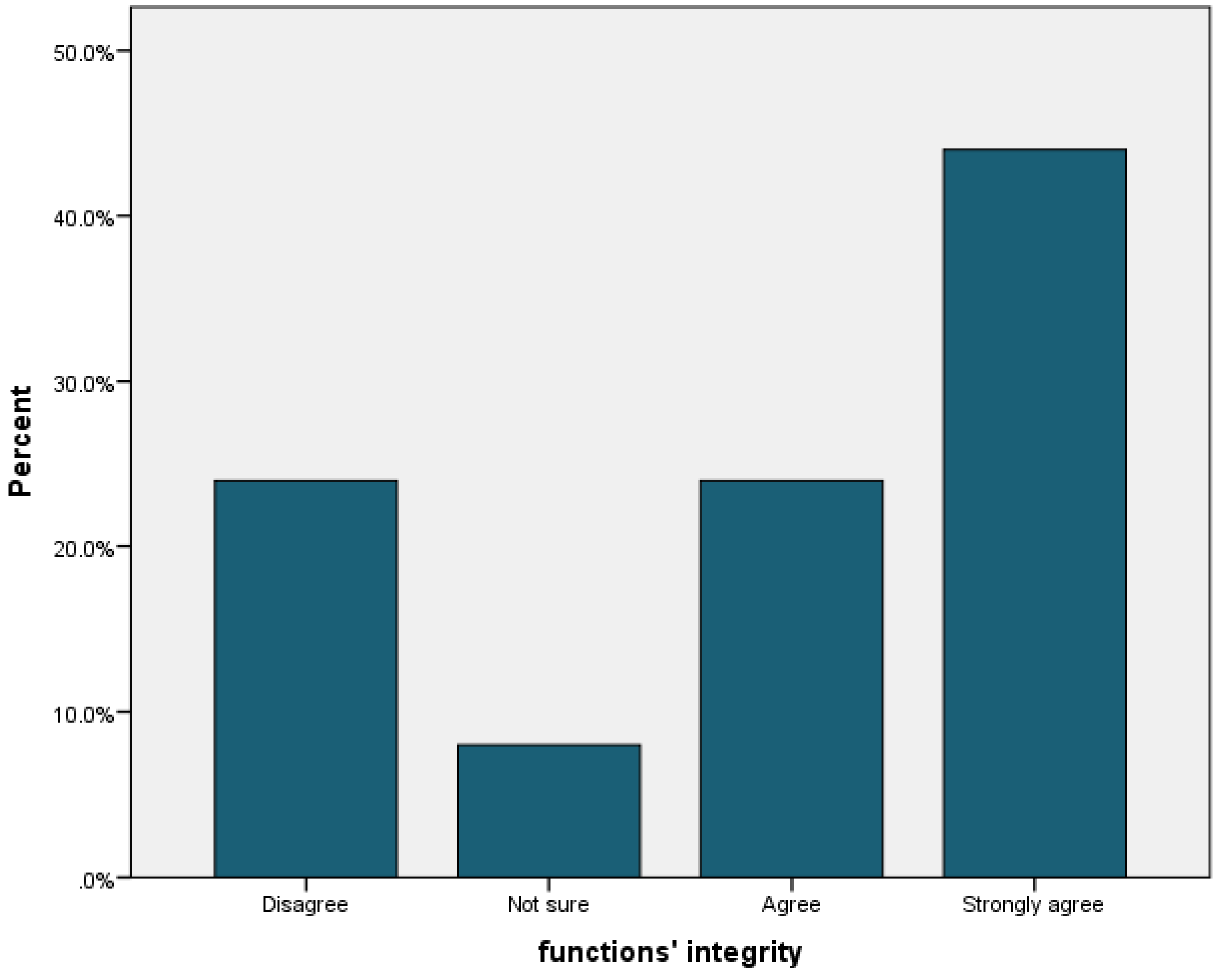

Fig 4.7 System functional integrity

4.11 Inconsistency

Regarding the inconsistency in the system, more than half a total of (60%) disagreed. The second most common response was in agreement to the system being inconsistent 26% of the individuals. Finally, 14% of the respondents are not sure for agreement or disagreement for the system being inconsistent.

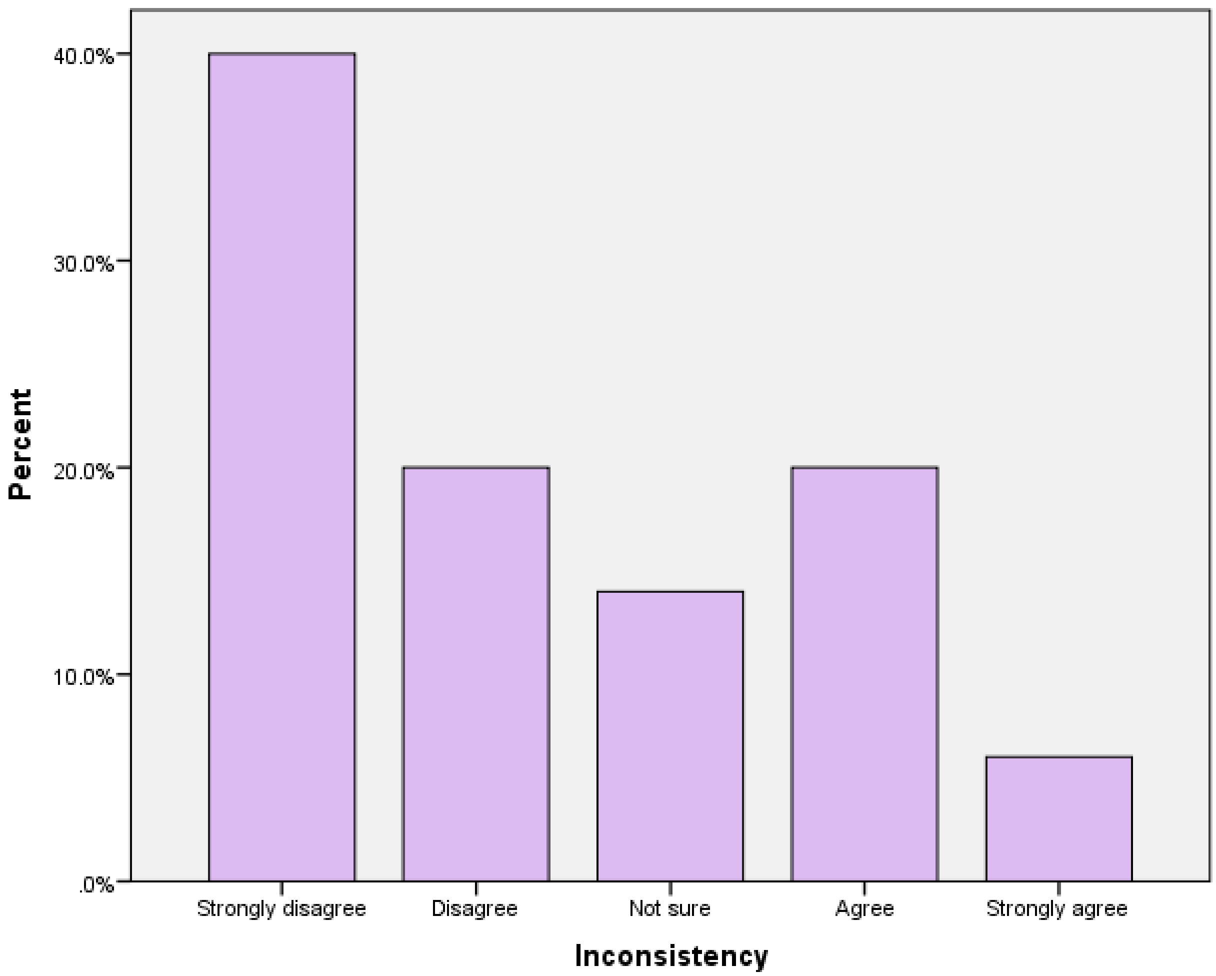

Fig 4.8 Inconsistency in the system

4.12 Quick Learning of the System

44% of respondents strongly supported that the system was easy to be learned and additional 8% agreed on the easiness of the system. The proportion that supported that the system was difficult to be learned rated to 30% and the remaining 18% as not sure

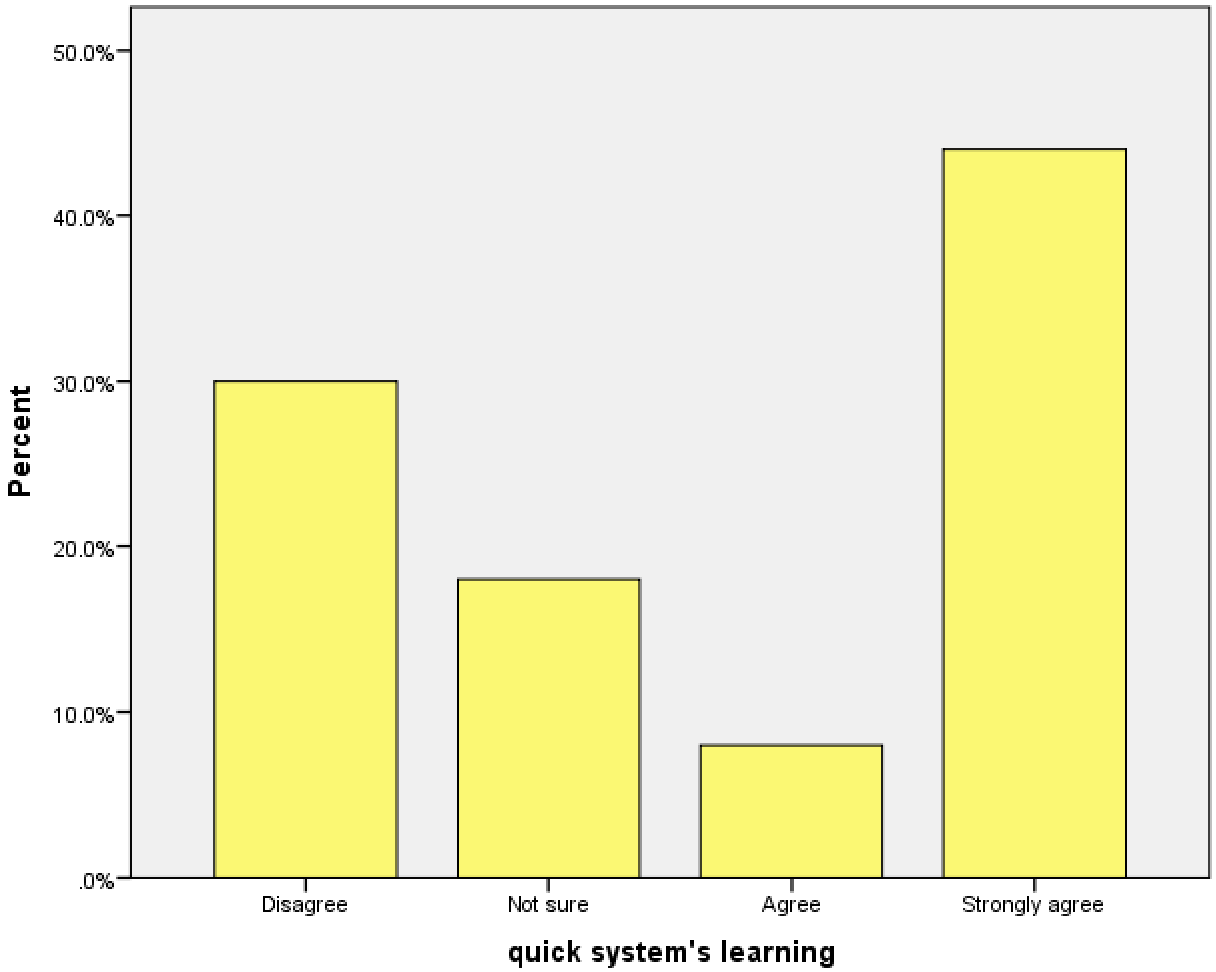

Fig 4.9 Quick system learning

4.13 Difficult to use

With regard to system use difficulty the responses were fluctuated. The 30% of the respondents claimed that the system is convenient to use whereas the 52% of the individuals in the same group asserted that the system was cumbersome to use. The remaining 18% considered neither the first opinion nor the second

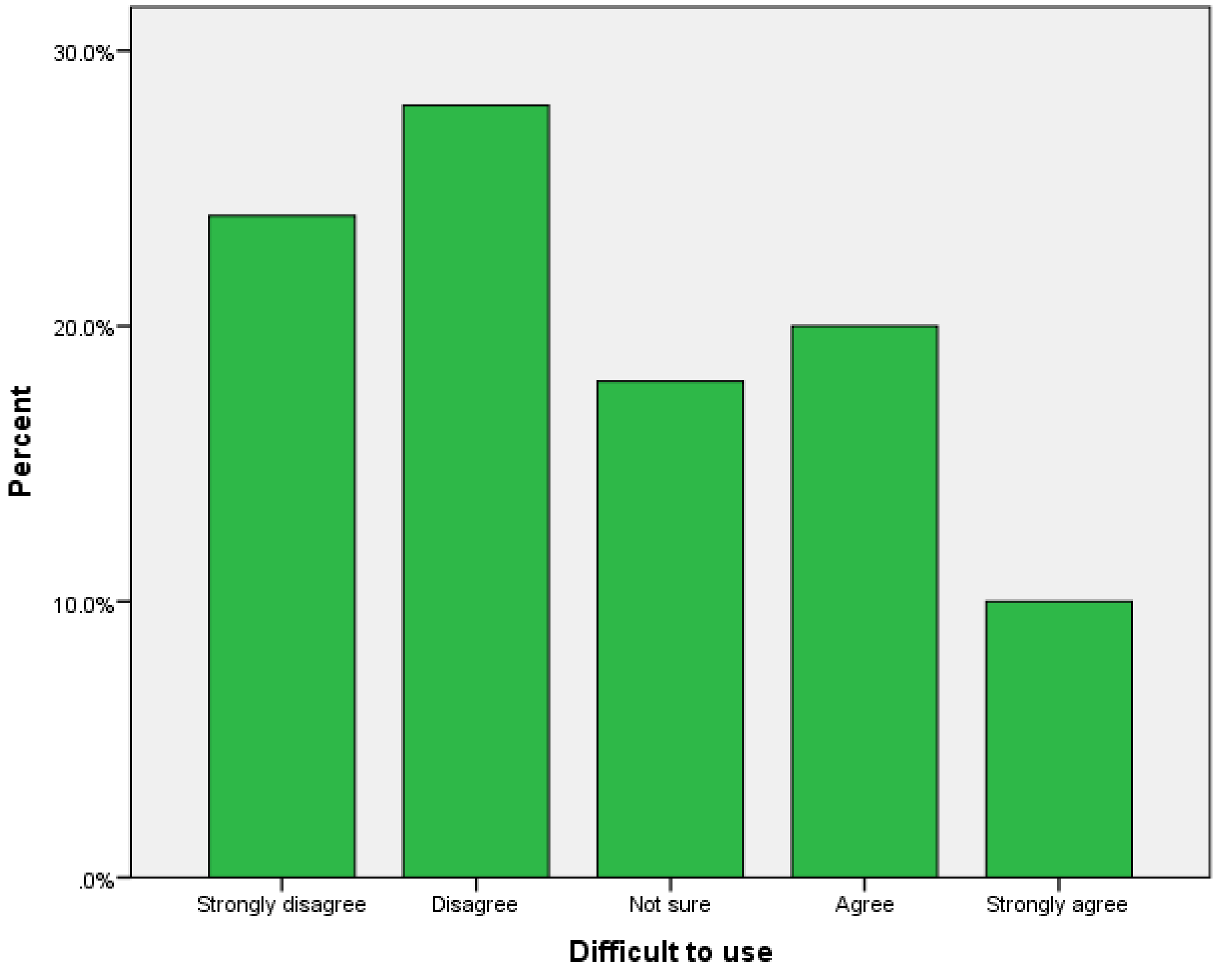

Fig 4.10 System difficulty for use

4.14 Confidence

The majority of the participants on the SUS questioner (62%) felt confident using the system and only 24% of the respondents insecure using the system. The remaining percentage (14%) felt neither confident nor insecure using the system.

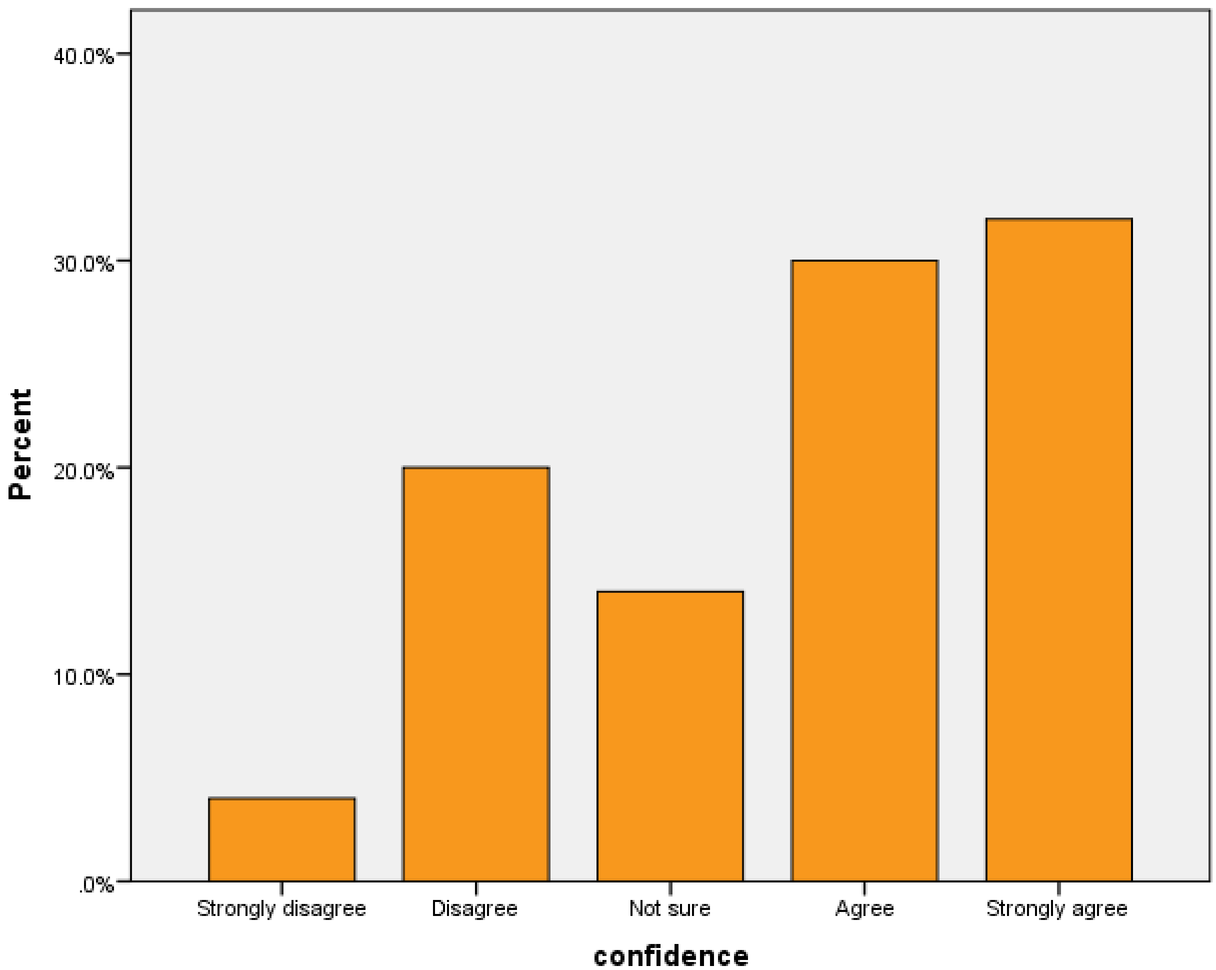

Fig 4.11 Confidence using the system

4.15 Need to Learn Before the Use of the System

Among the respondents (36%) supported that there was no need to learn a lot of things before the use of the system. On the other hand, 44% of the participants in the group supported that the training was necessary, whereas the remaining 20 percentage neither supported nor rejected the necessity of learning things before the use of the system.

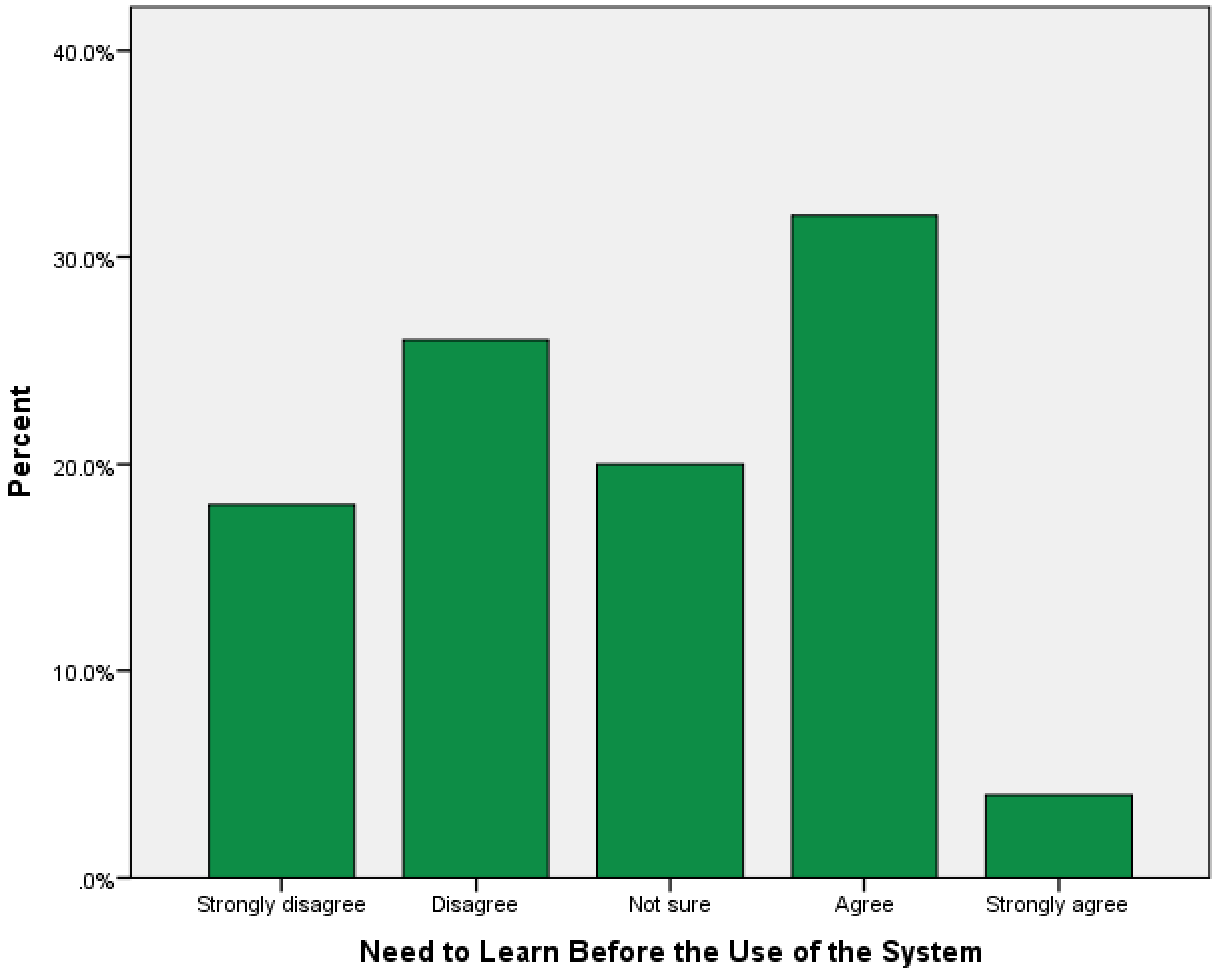

Fig 4.12 Learning need before using the system

The statistical evaluation of the data revealed that the majority of respondents would like to use the system frequently. As far as for the perceived ease to use although the opinions of employees were fluctuated the majority seemed to believe that the system is easy to be learned and so, there is little need to get extra knowledge before its use. They also considered that the system is well integrated and consistent providing them confidence and desire for frequent use.

4.16 Correlation Analysis

The two most widely used non-parametric correlation analysis tests in social science research are Spearman's rank correlation coefficient (Spearman's Rho) and Kendall's rank correlation coefficient (Kendall's tau). The tests can be used in a wide variety of contexts since they make few assumptions relating to the distribution of the variables and the nature of the relationship between variables (Bryman and Cramer, 2001).With regards to which of these non-parametric correlation measures should be reported, Bryman and Cramer (2001) argue that Spearman's rho is more commonly used. In almost all situations the values of Spearman's rank correlation and Kendall's tau are very close and would invariably lead to the same conclusions (Crichton, 2001). Drawing on this discussion, Kendall‘s tau is chosen to be the statistical method. In term of the value of a measure of association, Botsch (2011) provides a guideline specifically for Kendall‘s tau is as follows:

- Less than + or – 0.10 : very small/weak
- + or – 0.10 to 0.19 : small/weak
- + or -0.20 to 0.29 : moderate
- + or -0.40 or larger : strong

Given that within social science research it is extremely unusual to obtain perfect correlation (Saunders et. al., 2009), this guidance will be used in this study to describe the strength of relationship found between pairs of variables.

Therefore based on Kendall‘s tau statistical method, confidence and functional integrity have a significant correlation at the 0.05 level where $r=0.357$. Functional integrity is also significantly negatively correlated to inconsistency at the 0.05 level where r= -r= -0.840. Frequency of use and integrity are correlated with $r=0.376$ at $p<0.05$. The frequency of use is also correlated to confidence where $r=0.272$at $p<0.005$.

Another interesting feature is the significant correlation of difficult to use to technician’s support ($r=0.373$ at $p<0.05$) and to inconsistency ($r=0.503$ at $p<0.05$).The complexity is significantly correlated to inconsistency ($r=0.379$ at $p<0.05$), integrity ($r=-0.505$ at $p<0.05$), difficulty to use ($r=0.656$ at $p<0.05$) and technician’s support ($r=0.554$at $p<0.05$).

The findings of this study suggested that a well-integrated system makes confident users. Therefore they could handle it more frequently. The integrity affects significantly the inconsistency and vice versa. The same bilateral relation is applied to inconsistency, which is significantly affected by complexity. When an automation system is not well integrated then becomes inconsistent and complex and furthermore cumbersome for the user. Due to complexity, which results to a confusing for the user system, support from the technician becomes essential. Therefore, a correlation pathway among significant aspects, affecting the successful adoption of the system may be demonstrated as far as for user satisfaction consideration, in which a well-integrated information system makes its user confident to handle the system frequently. But a non-well-integrated system makes the user impatient and unwilling to use it regularly. The complex system is difficult to use. A well-integrated information system is also consistent and less complex. Thus, according to the findings of the study the negative and bilateral relationship among complexity and integrity is very strong. A complex system is not an integrated system and vice versa. So, a complex system creates a field of insecurity to the users and therefore becomes cumbersome and inconsistent for them. The inconsistent system emphasizes the need for support from a technician as vital.

User satisfaction depends on the way that the system facilitates the user (Dupuits and Hasman, 1995). For the successful adoption of the system and therefore for user satisfaction it is also necessary, the system to be integrated. By this way the users would be confident to use the system frequently

4.17 Challenges to Implementing SC automation

To analyze level of supply chain automation ~~practices~~, adoption challenges Logisticians and IT professionals from PFSA central office were asked additional questions regarding challenges in implementation of supply chain automation in the agency

As previously mentioned, in order to identify barriers to implementing supply chain automation practices a list of challenges was created based on literature review. The final adapted questionnaire was used so participants could indicate the extent of these challenges. Results for this section are summarized in Table 4.4

Table 4.4: Challenges of SC adoption

	Strongly Disagree		Disagree		Not Sure		Agree		Strongly Agree	
CHALLENGES OF SC AUTOMATION ADOPTION	Frequency	%	Frequency	%	Frequency	%	Frequency	%	Frequency	%
There is little support from top management towards supporting the automation system	17	34%	25	50%	3	6%	3	6%	2	4%
The automation system has not been embraced by all the employees in the organization	15	30%	29	58%	2	4%	3	6%	1	2%
The costs of implementing, maintaining and upgrading the SC automation software are very high	6	12%	11	22%	14	28%	7	14%	12	24%
There is a high turnover of staff who are qualified in the operations of the system	27	54%	14	28%	-	-	5	10%	4	8%
The automation system is not user friendly	15	30%	25	50%	3	6%	4	8%	3	6%
The automation system is incompatible with systems used by suppliers	9	18%	16	32%	13	26%	7	14%	5	10%

Errors in transactions carried out the system result to losses and costly business inefficiencies	20	40%	20	40%	2	4%	6	12%	2	4%
Downtime in the system results in delays of operations	10	20%	16	32%	10	20%	9	18%	5	10%
There is limited funding for development and upgrading of the SC automation system	8	16%	12	24%	11	22%	11	22%	8	16%
The automation system cannot be used properly due to poor internet connectivity	5	10%	19	38%	4	8%	18	36%	4	8%
There is a risk of the system being hacked into and data being corrupted	6	12%	12	24%	12	24%	14	28%	6	12%
The data can be used by unauthorized person	18	36%	15	30%	9	18%	8	16%	5	10%

Source: *Survey Finding, 2018*

Executive support has been cited by many authors, including (Dong and Zhu, 2009) as a key characteristic for successful supply chains automation adoption. In this study participants on the questioners were asked to describe their level of agreement with regard to low level top management support for supply chain automation system implementation as challenge. A significantly high percentage of respondents (34%) reported that they strongly disagree with this notion. Additionally 50% disagreed with the statement, while a total of10% respond there is lack of top management support, only 6% showed a neutral position.

Findings in this study might suggest that PFSA executives have become more aware of the importance of supply chain automation system implementation and consequently have begun to offer support for its implementation in the agency.

As stated in the literature, supply chain automation system implementation requires the participation of not only those of top executives, it also requires the involvement all the employees in the organization which are often in day to day contact with the system. In view of this, employees working on the system at the PFSA central level were further asked to express their opinion on whether the system has not been embraced by all the employees in the organization hence a challenge for implementation. Likewise, 88% expressed disagreement with the statement and only 8% agreed that it is one of the challenges while 4% remain neutral.

Responses about the costs of implementing, maintaining and upgrading the SC automation software, as one challenge were much divided. When asked about cost of implementation of supply chain automation system as a challenge (34%) agreed with the statement and 38% consider it not as a challenge while 28% have no say.

Education and training on SC automation represents a key factor for implementation success (Iacovou et al., 1995; Vijayaraman & Osyk, 2006). Therefore, respondents were asked if there are challenges with turnover of staff that had technical skills and knowledge about SC automation system where a significant high percentage of respondents (82%) have responded that is there is no implementation challenge attributed to staff turnover while only 8% considered it as a challenge.

Findings from this question can be further compared with the system being not user friendly. Again, results from this study appear to be consistent as 80% of respondents disagreed with statement and only 14% considered is as a challenge and the rest 6% as not sure.

The automation system is incompatible with systems used by suppliers was also found to be a major barrier in this study. Respondents expressed their level of agreement with the statement “The automation system being incompatible with systems used by suppliers is a major barrier for implementing supply chain automation system in the agency. Half (50%) of the Respondents agreed that the incompatibility of SC information technology system represents a barrier for implementation, 24% disagree, and 26 % responses were neutral. This finding supports the concept on literature by (Iacovou et al., 1995).

Errors in transactions carried out the system result to losses and costly business inefficiencies ~~remain a barrier~~ not considered as a challenge. Respondents have indicated their level of

~~agreement~~t disagreement with the statement “Errors in transactions carried out by the system result to losses and costly business inefficiencies is a major barrier for implementing SC automation. More than half (80%) of participants ~~agreed~~ disagreed that it is a barrier. Less than one fourth (16%) of participants ~~disagreed~~ agreed and 4% were neutral.

Respondents were asked if downtime in the system resulting in delays of operation represents a major barrier for SC automation implementation in their agency. About 52 % of respondents indicated downtime in the system resulting in delays of operations is not a major barrier for implementation. A 28 % of respondents indicated that it is a major barrier, while 20 % indicated a neutral opinion.

Limited funding can greatly reduce SC automation implementation process. In this research respondents from PFSA central office were asked if limited funding for SC automation implementation is a major barrier for implementing SC automation. About 38% indicated that there is limited fund and it is a challenge where as 40% disagreed that limited fund as a challenge for supply chain automation implementation in PFSA, and another 20% remained neutral. Though responses were divided, the majority expressed that there is no lack of fund for SC automation implementation

Another challenge identified to have different opinion by the respondents was if the usage of the system is widely affected by access of internet and power in which most of the time there is power and internet connectivity inturruption.46% disagreed with this statement while 44% agreed that it is one of the challenges 8% remain neutral.

4.17 Summary

On the basis of our SUS scores we can conclude that the investigated SC automation used in PFSA has usability below average but yet high marginal acceptable stage and rated by users as good. The overall rating made by the users' of this system shows us that this system is in need of much improvement.

Based on the research data there was risk of the systems being hacked and hence resulting in the data being corrupt or sensitive information leaking and used by unscrupulous people, ~~error in a system~~ and the system not being integrated with supplier system poses a major challenge for implementation of SC automation in PFSA.

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

This research emphasizes the level of use of logistic management information system automation and challenges of its implementation in PFSA supply chain. It further contributes to a better understanding of logistic management information system automation concepts, best practices,. The main purpose of the research was to diagnose the level of supply chain management information system automation in PFSA central office. The research was conducted on the basis of two sets of questions.

The first set of sub questions was developed to assess the level of supply chain automation system use. The data collected using the SUS questionnaire were analyzed using descriptive statistics and correlation. The objective was to gain accurate insights into the usability of the supply chain management automation system. From SUS score which is 65 it can be concluded that the level of SC automation system in PFSA is in early stages and still under implementation and a great emphasis should be given in the level of training of all professionals. The fact that a lot of the professionals are not frequent users of this technology creates a gap affecting mainly the health commodity supply chain information system adoption.

Secondly, the main objective that was proposed was to investigate the challenges in SC automation implementation. From the survey it was found that. The logistics information software is expensive to set up and maintain, posing a challenge to organizations especially since information technology is quite dynamic. Contrary to this the cost of setting up and maintaining the system was seen to be less a challenge by most of the respondents. This may be due to that the system was developed by donors fund and the respondents may have no knowledge of the cost. Most of the respondent felt that the support they received from the management is more than average but some felt that the management did not give enough support. Most of the respondents were of the opinion that the systems were not adapted well to suppliers system and since the organization was only concentrating on focusing on its own systems and not integrating to the suppliers system. Almost half of the respondents felt that there is a risk of the systems being hacked and hence resulting in the data being corrupt or sensitive information leaking and used by unscrupulous people. ~~A significant amount of respondents thought that the system could have errors in transaction and hence loss of business.~~

5.2 Recommendations

Previous literature revealed the problem of inconsistent and unreliable functionality of the system. The functionality problem of information technology system should be the agency concern for system implementations since system functionality has the most significant and strongest connection in determining users' intention to use.

The Agency should evaluate current job functions and technology needs and supply chain information technology systems character differences in order to make the correct decision in whether or not a new supply chain information technology should be adopted. If the answer is yes, then it should consider what type of technology would be most suitable for the company needs.

The result demonstrability is important for user acceptance as well. New adopted systems might have difficulties in being compatible or linked with existing information system. The incompatibility could create a problem for users to understand the result generated from the new automation system, which tested could prevent users' intention to use. Additionally, while providing training for the automation technology system, it will be beneficial to train the employees to understand the system outputs and what the system is actually doing. Lastly, the importance of having management support in encouraging employees to use supply chain automation system technology should be addressed during the implementation process. According to literature on subjective norm in this research, the encouragement from a person such as a supervisor, who is important to an employee, would have a positive impact on employee's intention to use a supply chain information technology system.

5.3 Limitation and Suggestions for Future Studies

One of the major limitations of this study that worth mentioning is the fact that it does not comprehensively capture all aspects supply chain automation practices rather it made emphasis in SC information system revealing the associations and relationships of user technology acceptance with the level of SC automation. Another limitation of this thesis is that it is only Central PFSA SC automation have been investigated. Within the timeframe and scope of this study, it was not possible to do research throughout the whole branches in the country.

Further research should investigate the effects of SC automation on supply chain performance. At the same time the adoption of new emerging technologies, such as radio frequency identification (RFID) and its benefits to the health commodity supply chain should also be explored. Most of the studies, including this, performed usability evaluations on working systems but it would actually be better if the studies applied usability methods within the development phase

References

Aanestad, M., Jolliffe, B., Mukherjee, A. & Sahay, S. (2014). Infrastructuring

AbouZahr, C. & Boerma, T. (2005). Health information systems: the Affairs, 30(6), 1113–1121.

Aggarwal, R., Rezaee, Z. and Soni, R. (1998), Internal control considerations for global electronic data interchange, *International Journal of Commerce and Management*, Vol. 8, No. 3, pp. 71-84.

Agyei, K. & Lasher, H. (2013). The imperative for stronger vaccine

Alvarez, G. (2004), RFID helps enterprises increase return on assets through tracking, Information Week, December.

Asian Development Bank 2016 www.adb.org/publications/series/adb-briefs

Bamfield, J. A. N. (1994), Implementing EDI: Problems in managing retail/supplier relationships by technology, *Logistics Information Management*, Vol.7, No. 1, pp. 7-10.

Bowen, J (2008) Moving places: the geography of warehousing in the US, *Journal of Transport Geography*, **16**, pp. 379-87

Bangor, A., Kortum, P. & Miller, J. (2009) Determining what individual SUS scores mean: adding an adjective rating scale. *J. Usability Studies,* **4**(3), 114-123.

Brooke, J. (1996) SUS - A quick and dirty usability scale. *Usability evaluation in industry,* **189**(194), 4-7.

Bremer Institut für Produktion und Logistik GmbH (BIBA), 2015.

Cronbach, L.J., (1951) Coefficient alpha and the internal structure of tests. Psychometrika 16, 297–334.Chandani, Y., Felling, B., Allers, C., Alt, D. & Noguera, M. (2006).

Change, Y. and Harris, M (2009).. *"Supply Chain Modeling Using Simulation"*,

Chindove, S. & Mdege, N. D. (2012). Logistics data collection

Ciborra, C. (2000). From control to drift: the dynamics of corporate information

Cooper, R. B. and Zumd, R. W. (1990), Information system implementation research: A technological diffusion approach, *Management Science,* Vol. 36, No. 2, pp.

Cooper, R. B., Zmud, R. W. (1990), Information implementation research: A technological diffusion approach, *Management Science*, Vol. 36, No.2, pp.123-139.

Copacino, W. C. (1998), The IT-Enabled Supply Chain: Key to Future Success, *Logistics Management and Distribution Report*, Vol. 37, No. 4, pp. 36

Council of Supply Chain Management Professionals. Supply Chain Management Definitions.

DELIVER, for the U.S. Agency for International Development (USAID).

Dessalegn Tesfaye (2015) the study of Ethiopian public health supply chain management: before and after pharmaceuticals fund and supply agency (PFSA).
Donald Waters, (2010) Global logistics: new directions in supply chain management 6th edition.
Dong S, Xu SX and Zhu KX. Information technology in supply chains: The value of it-enabled resources under competition. *Inform Sys. Res.* (2009) 20: 18-32.
E.Abukhousa,N.Mohamed,J.Aljazoidi, e-Health cloud:opportunities and challenges,Future Internet 4(2012)621-645
Federal Ministry of Health Ethiopia. (2005). “Essential Health Services Package for Ethiopia,” p.3.
Federal Ministry of Health Ethiopia. (2006). Pharmaceuticals Logistics Master Plan, Executive
Federal Ministry of Health Ethiopia. : Health Sector Transformation Plan October 2015.
Federal Negarit Gazeta 13th year, 64, pp. 3939-3947.
Federal Negarit Gazeta. (2007). *Proclamation No. 553/2007, Drug Fund and Pharmaceutical*
Global Development.for hiv/aids medical commodities.World Bank,Washington DC:
foundations of public health. Bulletin of theWorld Health Organization,
Frazelle, H. E. (2002), *World-Class warehousing and material handling*, McGraw-Hill, New York.
Gharabaghi HH, Rabbani SM and Hesami HZ. Impact of electronic commerce on supply chain management. *Technol. Develop.* (2010) 21: 42-48.
Helo, P. and Szekely, B. (2005), Logistics information systems: An analysis of software solutions for supply chain co-ordination, *Industrial Management & Data Systems*, Vol. 105, No. 1, pp. 5-18.
HMN-WHO, 2007 “Assessment of the Ethiopian National Health Information System,” Final Report ,
http://www.careersinsupplychain.org/what-is-scm/definition.asp
http://www.who.int/medicines/areas/human_rights/en/
Iacovou, C. J., Benbasat, L. and Dexter, A. S. (1995), Electronic data interchange and small organizations: adoption and impact of technology, *MIS Quarterly*, Vol.19, No.4, pp. 465-485.
Jahre, M., Dumoulin, L., Greenhalgh, L. B., Hudspeth, C., Limlim, P.
Janssens, G.K. and Cuyvers, L. (1991), EDI – A Strategic Weapon in International Trade, *Long Range Planning*, Vol. 24 No. 2, pp. 64-53.
John Snow Inc. /DELIVER, 2004. *The Logistics Handbook: A Practical Guide for Supply Chain*

Jonsson, P. (2008), *Logistics and supply chain management*, McGraw-Hill, UK.

Journal of Health Management, 14(4), 397–408.

Kaufmann, J. R., Miller, R. & Cheyne, J. (2011). Vaccine supply chains need

Knill, B. (1998), Managing Flow in the Supply Chain, *Transportation & Distribution*, Vol. 39, No. 4, pp. 2-3.

Lalvani, P., Yadav, P., Curtis, K., Bernstein, M. & Oomman, N. (2010).

Langley, C. J. Jr, Van Dort, E., Ang, A. and Sykes, S. R. (2005), Results and findings of the 10th annual study, *Capgemini Consulting, Technology, Outsourcing Company*, pp. 1-46.

Lee, Y. H., Jeong, C. S. and Moon, C. (2002), Advanced planning and scheduling with outsourcing in manufacturing supply chain, *Computers and Industrial Engineering*, Vol. 43, No. 1/2, pp. 251-274.

Li S and Lin B. Accessing information sharing and information quality in supply chain management. *Decis. Support****.*** *Syst*. (2006) 42(3): 1641-1656.

Logistics and Supply Chain Management, 2(1), 54–84.

Management, Vol. 47, No. 2, pp. 27-31.

Managers in Family Planning and Health Programs. Arlington, Va.: John Snow Inc.

McLaren TS, Head MM and Yuan Y. Supply chain management information systems capabilities. An exploratory study of electronics manufacturers. *Inform. Syst. E-bus. Manag.* (2004) 2(2-3): 207-222.

Mugenda, O. M. & Mugenda, A. G. (2003). Research methods: Quantitative and qualitative approaches. Nairobi: African Centre for Technology Studies.

Pharmaceuticals Fund and Supply Agency (PFSA) (2014) Standard operating procedure manual for the integrated pharmaceutical logistics system in health facilities of Ethiopia.

population.

Raja, S. & Mohammad, N. (2005). A handbook on supply chain management

Rajab-zadeh A, Nalchigar N and Nalchigar S. Model in risk factors in e-supply chain and its impact on organizational performance. *Inform. Technol. Manage.* (2011) 4: 78-59.

reducing complexity of drug supply chains. Journal of Humanitarian

Report, volume 1.

reporting for essential medicines in developing countries: a review.

Sahay, S., Sæbø, J. & Braa, J. (2013). Scaling of his in a global context: same,

same, but different. Information and Organization, 23(4), 294–323.

Sciences for Health.

SIAPS. (2014a). Considerations for the integration of hmis and lmis. Arlington,

SIAPS. (2014b). Promising practices: data management. Arlington, VA: Management

Sunil Chopra, Peter Meindl **-** *Supply Chain Management: Strategy, Planning, and Operation*

*Supply Agency Establishment Proclamation***.** Federal Democratic Republic of Ethiopia,

supply and logistics systems. Vaccine, 31(2), B73–B80.

Supply chain management of antiretroviral drugs: considerations for

to be better funded and strengthened, or lives will be at risk. Health

Torabizadeh M, Khatami Rad M and Noshadi A. Effect of information system strategies on supply chain strategies and supply chain performance. *World Acad. Sci. Engin. Technol.* (2012) 61: 940-945.

USAID | DELIVER PROJECTelmis-selection-guide-electronically-managing-supply-chain-information October 2015

USAID DELIVER. 2011 The Logistics Handbook A Practical Guide for the Supply Chain Management of Health Commodities

USAID DELIVER. April 2010. *Logistics Management Units: What, Why and How of the Central Coordination of Supply Chain Management.* Arlington, VA: US Agency for International Development

VA: Management Sciences for Health.

Venkatesh, V., & Davis, F. D. (2000). A theoretical extension of the technology acceptance model: Four longitudinal field studies. *Management Science, 46 (2),* 186-204.

Zaffran, M., Vandelaer, J., Kristensen, D., Melgaard, B., Yadav, P., Antwi-

Zmud, R. W., Apple, L. E. (1989), Measuring information technology infusion, unpublished manuscript, 1989.

http://imstriker.com/survey1/sus.php

Annex 1
A. Interview Questions for Supply Chain Automation systems

ADDIS ABABA UNIVERSITY
COLLEGE OF COMMERCE SCHOOL OF GRADUATE STUDIES
DEPARTMENT OF LOGISTICS AND SUPPLY CHAIN MANAGEMENT

Dear respondents:

I'm a graduate student at Addis Ababa University College of Commerce in the Department of Logistics and Supply Chain Management. Currently, I'm conducting a research entitled ***'Diagnosing the level of supply chain automation in PFSA'*** as a partial requirement for the award of Masters of Art Degree in Logistics and Supply Chain Management.

The purpose of this questionnaire is to gather data for the proposed study, and hence you are kindly requested to assist the successful completion of the study by providing the necessary information. Your participation is entirely voluntary and the questionnaire is completely anonymous. I confirm you that the information you share will stay confidential and only used for the aforementioned academic purpose, thus not affects you in any way. So, your genuine, frank and timely response is vital for the success of the study. I want to thank you in advance for your kind cooperation and dedication of your precious time to fill this questionnaire.

Sincerely yours,

Daniel Tamirat

Note:

1.No need of writing your name.
2.Indicate your answer with a check mark (✓) on the appropriate cell both for multiple choice and Likert scale questions.

Section I: Respondents Profile:

1. Age:

▢ 18-25 years ▢ 26-35 years ▢36-45 years ▢ above 45 years

2. Educational Qualification:

▢College diploma ▢First Degree (BSc, BA)
▢Second Degree (MSc, MA)▢PHD and above

3. Year of service in the current position: manipulated

▢1 to 3 years ▢4 to 7 years ▢8 to 10 years ▢above 10 years

SECTION II.

1. On a Scale of 1-5 where 5= Strongly Agree, 4 = Agree, 3 = Not Sure, 2 = Disagree and 1 = strongly Disagree, please indicate your level of agreement with the following statements relating to the SC automation systems of your organization.

No.	**Measurement Items**	**Score**				
		1 **SD**	**2** **D**	**3** **NS**	**4** **A**	**5** **SA**
	System usability scale					
1	I think that I would like to use this system frequently					
2	I found the system unnecessarily complex					
3	I thought the system was easy to use					

4	I think that I would need the support of a technical person to be able to use this system					
5	I found the various functions in this system were well integrated					
6	I thought there was too much inconsistency in this system					
7	I would imagine that most people would learn to use this system very quickly					
8	I found the system very difficult to use					
9	I felt very confident using the system					
10	I needed to learn a lot of things before I could begin using this system.					

On a Scale of 1-5 where 5= Strongly Agree, 4 = Agree, 3 = Not Sure, 2 = Disagree and 1 = strongly Disagree, please indicate your level of agreement with the following statements relating to the challenges of implementing logistics information systems in your organization.

No.	**Measurement Items**	**Score**				
		1 **SD**	**2** **D**	**3** **NS**	**4** **A**	**5** **SA**
	CHALLENGESOF SC AUTOMATION ADOPTION					
1	There is limited funding for development and upgrading of the SC automation system					
2	The automation system cannot be used properly due to poor internet connectivity					

3	The automation system has not been embraced by all the employees in the organization					
4	There is little support from top management towards supporting the automation system					
5	The costs of implementing, maintaining and upgrading the SC automation software are very high					
6	The automation system is not user friendly					
7	There is a high turnover of staff who are qualified in the operations of the system					
8	Downtime in the system results in delays of operations					
9	The automation system is incompatible with systems used by suppliers					
10	Errors in transactions carried out the system result to losses and costly business inefficiencies					
11	There is a risk of the system being hacked into and data being corrupted					
12	The data can be used by unauthorized person					

"Thank you very much for completing the questionnaire"

Annex 2

SPSS results

Reliability Test