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# Development of electronic fiscal device stock tracking module to monitor tax evasion in Tanzania

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NM-AIST

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**DEVELOPMENT OF ELECTRONIC FISCAL DEVICE STOCK  
TRACKING MODULE TO MONITOR TAX EVASION IN TANZANIA**

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**A Dissertation Submitted in Partial Fulfilment of the Requirements for the Degree of  
Master's in Information and Communication Science and Engineering of the Nelson  
Mandela African Institution of Science and Technology**

**Arusha, Tanzania**

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## **ABSTRACT**

The Electronic Fiscal Device (EFD) Machines have been operating in Tanzania since the year 2010 for the purpose of helping the Tanzania Revenue Authority (TRA) to increase revenues from tax collection. Regardless of years of its existence, there are still reported cases of tax evasion and this study was conducted to review the current tax collection system and analyze requirements for the development of Stock Tracking Module (STM) to be embedded in the current tax collection system. Data collection was done in Kilimanjaro and Arusha the two regions of Tanzania involving tax officers and Information Technology (IT) personnel from TRA regional offices. This study opted pharmaceutical business as case study due to its sensitivity to human health and the fact that, its regulatory authority's database can be linked with the developed system to track expired and fake drugs in the market. Data collection process involved quantitative and qualitative methods to gather information for the development of the system's Stock Tracking Module (STM) such as interview, questionnaire, role-playing and observation. The study earmarked some problems relating to Electronic Fiscal Device Machine Management System (EFDMS) and EFD machine. The major problems encountered by TRA are; under declaration of sales by traders, non-usage of EFD machines, usage of fake EFD, overestimate of expenses, division of business and conducting business in unknown areas. The main outcomes of the study: The efficiency of the EFDMS was at average, thus, needed some improvements. Therefore, this study developed an enhanced EFD system by introducing stock tracking capabilities to monitor traders' actions that translate to tax evasion in such ways as; underpricing of sales value, avoid using the EFD machine and use of fake EFD system which consequently increase government revenues.

## DECLARATION

I, Paul E. Shao, the undersigned, state that, this dissertation is the innovative work of mine and that it has never been submitted to any other University for the same.

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The above declaration is confirmed by:

**Supervisor Name:** Dr. Mussa Ally, Dida

**Signature:** \_\_\_\_\_

**Date:** \_\_\_\_\_

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## **CERTIFICATION**

The undersigned accredits that he/she has read and found the dissertation accepted by the NM-AIST.

**Supervisor Name:** Dr. Mussa Ally, Dida

**Signature:** \_\_\_\_\_

**Date:** \_\_\_\_\_

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## **DEDICATION**

To my late father Ezekiel Thomas Shao, I dedicate this work.

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## LIST OF ABBRIVIATIONS AND SYMBOLS

EFD	Electronic Fiscal Device
EFDMS	Electronic Fiscal Device Management System
IT	Information Technology
POS	Point of Sale
ICT	Information and Communication Technology
ECR	Electronic Cash register
AS	Accounting System
OECD	Organization for Economic Co-operation and Development
URT	United Republic of Tanzania
STM	Stock Tracking Module
TRA	Tanzania Revenue Authority
VAT	Value Added Tax
NM-AIST	Nelson Mandela African Institution of Science and Technology
MWECAU	Mwenge Catholic University
UI	User Interface
ERCA	Ethiopia Revenue and Customs Authority
MRA	Malawi Revenue Authority
IMF	International Monetary Fund
TBS	Tanzania Bureau of Standards
TFDA	Tanzania Food and Drugs Authority
DFD	Data Flow Diagram
SDLC	Software Development Life Cycle
HTML	Hypertext Markup Language
CSS	Cascading Style Sheet
PHP	Hypertext Preprocessor
JSON	Java Script Object Oriented Notation
ERD	Entity Relationship Diagram
TIN	Tax Identification Number
ESD	Electronic Signature Device
EFP	Electronic Fiscal Printer
EFPP	Electronic Fiscal Pump Printer
EJ	Electronic Journal

## CHAPTER ONE

### INTRODUCTION

#### 1.1 Background of the Study

Tax evasion is considered to be the major cause of financial fatigue that most governments are facing nowadays (Matsaganis & Leventi, 2014). Tax collection is the best way that governments use to enhance revenues which are later used to improvise public goods and service provided to citizen (Cvrlje, 2015). Having the increase of the Information Technology (IT) use recently, significant number of nations have adopted ICT tools to combat the problem of tax evasion in different areas of trading whereby Accounting Systems (AS) and e-government systems are designed and/or integrated for collecting, storing and auditing of tax-related information (Tenidou *et al.* 2015).

Electronic Fiscal Devices (popularly known as EFD machine in Tanzania), Electronic Cash Register (ECR), computer-based point of sales systems (POS), or those that are tablet or smartphone-based have proven to be efficient ICT tools to many countries in improving tax collection that include Income, Corporate, Service levy and Value Added Taxes (OECD, 2017).

According to the Organization for Economic Co-operation and Development (2017) whose its 27 member countries are using such systems, revenues from tax had increased. Particularly in Hungary, Australia, Belgium, Canada and Sweden, revenues from tax has increased at an average of 8% per annum. The use of EFD machines to combat tax evasion in East African countries proved to be successful such that in Rwanda between year 2013 and 2015 revenues had increased by 20% annually (OECD, 2017), while in Kenya between year 2000 and 2005 tax collections had increased at rate of 5% per annum (Weru, Kamaara & Weru, 2013).

In 2010, Tanzanian government geared a parliamentary and finance act that fostered to the adoption of EFD machines by businessmen across the country to deal with the problem of tax evasion (URT, 2014). Upon the introduction of the devices, it was observed that the operations of EFD machines had eventually increased the number of government revenues raised from Income, Corporate, Service Levy and Value Added tax (Chege, Kiragu, Lagat & Muthoni, 2015).

Although Tanzania Revenue Authority (TRA) has presented EFD machines to traders that eventually improved tax collections, but underpricing of the sales value still exists due to difficulties of controlling the use of those machines whereby various techniques that appear to popularly being used by some traders being; trading without issuing receipts, issuing underpriced receipts and as well, the existence of fake EFDMS (Shabu, 2017). Even though falsification of information that leads to underpayment of tax is an offense that results in imprisonment or fine (URT, 2008) but still there are reported cases of tax evasion. It is clear that, the use of EFD machines by Tanzania government can be not a single fix solution to tax evasion, but nations that were able to implement it effectively, substantial achievements speaks for themselves.

A case in point, in Tanzania, the current EFDMS can neither detect nor identify traders who trade without issuing a receipt, falsifying sales value nor did issue forged receipts. While EFD machines and EFDMS could be incorporated with Stock Tracking Module (STM) to keep track of stock flow from manufacturers to whole sellers and trickle it down all the way to retailers so that TRA can have information about the amount of stock owned and sold by a trader, it is not yet that way.

Therefore, this study aimed at developing Electronic Fiscal Device Stock Tracking Module to monitor tax evasion in Tanzania. The developed STM will enhance the EFD system with features that will alert TRA of the falsification of sales value, forged receipts and transactions that took place without issuing a receipt.

## **1.2 Statement of the Problem**

Although revenue collection authority has presented Electronic Fiscal Devices to registered traders, which eventually improved tax collection (Chege *et al.* 2015), three problems are yet observed. These include; some traders are trading without issuing receipts, some traders issue underpriced receipts and as well as the existence of fake EFD systems which lowers the revenue collections rose from taxes.

The current EFD system can neither detect traders who avoid EFD usage, falsification of sales value nor receipts issued with none – TRA EFD system. Therefore, the study intended to develop a Stock Tracking Module that will enable the EFD machine and its management system to detect acts that translate to tax evasion.

### **1.3 Rationale of the Study**

Tax collection enables a particular government to raise revenues that are later used to finance public projects and services (Cvrlje, 2015). To enhance tax collection, various techniques have been improvised to seal every possible tax evasion loophole where, currently, the use of modern ICT technologies such as EFD machines is very much embraced by many nations globally (Ikasu, 2014). Having the same technology used in Tanzania and yet traders can avoid using, underprice the sales value, forge, etc., purposely to reduce their taxes due, this alerts scholars and ICT experts to innovate a technological approach to dissolve/reduce such bent. Therefore, the study aims at developing an enhanced EFD system that monitors tax evasion in Tanzania.

### **1.4 Objectives**

#### **1.4.1 General Objective**

To develop the EFD system with Stock Tracking Module that will monitor tax evasion in Tanzania.

#### **1.4.2 Specific Objectives**

The specific objectives of the study were:

- (i) To analyze the requirements for developing Stock Tracking Module
- (ii) To design and implement the Stock Tracking Module
- (iii) To validate the implemented Stock Tracking Module

### **1.5 Research Questions**

- (i) In what ways do EFD users evade tax and what are the requirements needed to develop an Improved EFD system?
- (ii) What are the right methodologies for developing a Stock Tracking Module?
- (iii) Did the developed module meet the end-users requirements?

### **1.6 Significance of the Study**

This study opens dialogs to revenue authority and government in general about adopting various techniques that include improvement of the EFDMS and EFD machines to increase tax

collections across the country. Specifically, the output of this research provides a great contribution to the following:

- (i) Stock Tracking Module keeps track of stock-flow from the source to final consumers
- (ii) Stock Tracking Module compares VAT returns with the stock records available in the system to identify possible tax evaders
- (iii) The system Identifies specific traders trading without issuing a receipt
- (iv) Stock Tracking Module identifies underpriced sales
- (v) The module enables TRA to identify transactions that involved forged Receipt
- (vi) STM reduces manual work on tax estimation and collection process
- (vii) The designed STM reduce the number of human resources needed for tax collection and inspection
- (viii) The process of tax estimation and collection is more open and accurate
- (ix) STM reduce complains both from traders and government
- (x) STM enables traders to track their stock flow
- (xi) STM allows the trader to monitor his/her business transactions

### **1.7 Delineation of the Study**

This study aimed at introducing stock tracking technology into the Electronic Fiscal Device machine and its management system that will enable Tanzania Revenue Authority to monitor tax evasion in Tanzania by tracking stock from importers and manufacturers who are the stock initiators and trickle down to consumers. Thus, the system will detect and identify the actions of the traders that lead to tax evasion and so improve revenue collection. This research was conducted in Kilimanjaro and Arusha regions which are the leading regions in tax collection in Tanzania preceded by capital city Dar-es-Salaam using pharmaceutical business as a case study.

The study took into consideration the validity of the initial stock amounts registered into the system from importers and manufacturers to ensure all possible tax evasion loopholes are sealed. For the case of importers, the study guaranteed the initial stock to be valid using the Tanzania Customs Integrated System (TANCIS) installed on every entry point of the country. However, the study couldn't ensure stock validity to manufacturers hence assumed manufacturers to be loyal.

## CHAPTER TWO

### LITERATURE REVIEW

Following the adoption of EFD machines as a tool for tax collection around the global, a significant number of governments have increased their revenue collections raised from taxes. The main goal of adopting EFD machines by revenue authorities is to have proper business records keeping, easing the process of tax estimation and improving information flow from traders to revenue authorities and vice versa.

Ikasu (2014) presented a study that analyzes challenges that hinder EFD machine implementation in Tanzania. The challenges include; lack of education, system breakdown and commodity underpricing. The study further discussed solutions that could be implemented by the authority to reduce the grief, in such ways as stakeholder's awareness and friendly operating environment; however, the researcher didn't discuss the technological weakness of the system and solutions to bring down the case.

The study done by Chege *et al.* (2015) on the effectiveness of EFD implementation in Tanzania, shows that the problem of tax evasion exists among EFD machine users whereby the scholar identifies the high cost of buying EFD device as the main reason for the lack of support from business operators. Furthermore, the researchers suggest that educational programs and increase of EFD machine rollouts in the country was a good way for pursuing the reduction of tax evasion, but however, the study does not address the EFD Management System and EFD machine gaps that encourage traders to evade tax without being detected.

According to Delphine (2017) on a study that uncovered challenges that the adoption of the EFD machines in Tanzania facing, stipulate that, TRA is facing communication constraints, claiming of false VAT returns, lacking culture of requesting financial receipts, issue of monetary receipt to fewer deals than actual and opposing the procurement and utilization of EFD machines as the major challenges. In spite of the study being among the few studies backing up the revenue authority, but EFD Management System's weaknesses were not discussed.

In Ethiopia, EFD machines were adopted by Ethiopia Revenue and Customs Authority (ERCA) since 2008 for business management and revenue collection. According to Mohammed (2015) the implementation of the EFD automated system increased the number of revenue collections

and so eases the process of preparing tax returns. Results from the study signals challenges of implementing EFD machines being the purchasing and maintenance cost of the devices, inexperienced customer support employees and the inability of users to correct errors. The researcher is, however, focusing only on challenges that business operators are facing rather than the Revenue Authority.

The study done by Nyareru and Kibati (2017) investigated factors influencing the implementation and utilization of the EFD machine in Kenya by SMEs. The study revealed that higher purchasing, installation, maintenance and annual checkup cost, poor quality of service offered by EFD suppliers and inconsistency in business classification influenced traders to evade tax. It was moreover evidenced that, EFD cumbersome when dealing with small transactions. To promote compliance and hence reduce the problem of tax evasion, the study proposes regular training and enforcement of tax law among traders to be increased. Thus, from the solutions proposed by the scholar, none of them touches the technological improvement of the EFD machine and/or EFD Management System.

In March 2014, the Malawi Revenue Authority (MRA) adopted the EFD system to replace the manual receipt system. As in other countries, various challenges in the implementation and administration of the EFD machine are also observed in Malawi. A paper done by Lapukeni (2017) uncovers a number of challenges that hinder smooth deployment, in such ways as resistance from taxpayers, few taxpayers using the device, falsification of sales value and an insufficient number of EFD supply. The researcher furthermore proposes sanctions, penalties, stronger legal standings to offenders of tax evasion and improvement of ICT infrastructures as measures to combat tax evasion. Though the scholar suggests improvements in ICT infrastructure but didn't specify where and how should the ICT infrastructures be improved.

It was earmarked that, most of the works of literature are far more addressing challenges that EFD users are facing than challenges that revenue authorities are encountering. While the few that favors revenue authorities such that of Mohammed (2015) and Lapukeni (2017) are proposing a solution that touch policy, law, education to users, purchasing price and maintenance cost of the machines but none of them are talking about the weakness of the EFD machines and EFD Management System.

According to IMF working paper prepared by Sachlos and Auguste (2008), fiscal devices alone cannot stand as a "Silver Bullet" of tax administration; rather other technological

improvements need to be considered. Therefore, this study suggests developing and embedding Stock Tracking Module into EFD Management System that will enhance the comparison between business stock records and sales return so as to identify tax evaders.

This chapter entailed various literature works done by different scholars across the world relating to the EFD machine and their management system whereby literature from Tanzania Ethiopia, Rwanda, Uganda, Malawi, Kenya, Europe, etc. were exhausted. Chapter three of this study will discuss methods and tools used to develop Stock Tracking Module.

## CHAPTER THREE

### MATERIALS AND METHODS

#### 3.1 Introduction

This chapter describes materials and methods used to develop improved EFDMS and EFD machine application software with Stock Tracking Module embedded. This chapter details the area of the study, sample size and sampling techniques and data analysis methods. Not only that but it lays out requirements, design and development procedures needed for the development of EFDMS and EFD machine application.

#### 3.2 Area of the Study and Business Selection

This research was carried out in Kilimanjaro and Arusha regions both located in the northern part of Tanzania. The regions were selected as the case study due to two reasons; first and foremost is due to their proximity to the Institution which is the base of the research as shown in Fig. 1.

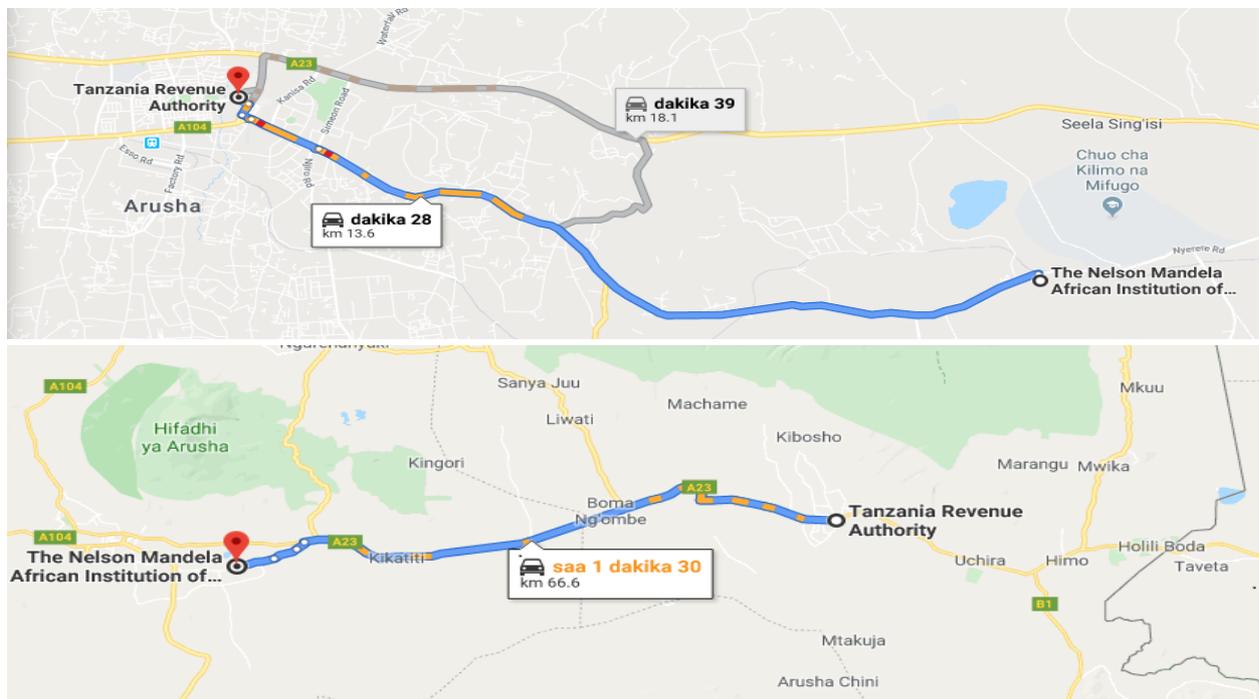


Figure 1: Distance from NM-AIST to TRA Arusha and TRA Kilimanjaro

Secondly, it is because, apart from the capital city Dar es Salaam, these are leading regions in tax collection in Tanzania (URT, 2018).

In these regions, many businesses are conducted but in the implementation, the pharmaceutical business opted. The motive was the fact that human health is considered to be a priority; therefore, since the system tracks stock with their expiry dates, the same system could easily later be integrated with the databases of other regulatory authorities such as Tanzania Bureau of Standards (TBS) and Tanzania Food and Drugs Authority (TFDA) to track expired and fake drugs in the market. Another reason for selecting this business in the implementation is that the pharmaceutical business in Tanzania is well systemized and the existence of more than one regulatory organ (TBS and TFDA) assures the availability of reliable and accurate data. Therefore, data collection target groups were TRA systems analysts, EFD unit officers and drug traders from both regions.

### **3.3 Sample Size and Sampling Technique**

The study used a total number of 47 respondents who were clustered into three groups, namely: drug traders, systems analysts and tax officers. Drug traders were involved to get information on drug acquisition, storage and selling procedures. During the study, we learned that the answers from traders were the same as they were concerning the standard procedures followed by all traders across the country in business operation. Therefore To increase the degree of participation, 36 respondents were randomly selected based on the factor that the pharmaceutical shop uses both an IT system to store drug records and EFD machines to print a receipt. In the second and third groups, a purposeful sampling technique was used in selecting a sample of system analysts and tax officers. System analysts were involved in the study to understand how the current system operates while tax officers to learn procedures that are used in tax collection and estimation process and how they deal with tax evaders. Since each region of Tanzania contains 2 system analysts and 4 tax officers, 4 system analysts were selected in the second group and 7 tax officers out of 8 from both regions were available during the study making the total number of respondents to be 47.

Table 1: Summary of the Study Respondents and their Categories

<b>S/N</b>	<b>Respondent Category</b>	<b>Count</b>
1	Tax Officers	7
2	System Administrators	4
3	Drug Traders	36
<b>Total</b>		<b>47</b>

### **3.4 Data Collection Methods**

Data collection in the stipulated areas of study was done from February to 15 April, 2019. The process involved several techniques including questionnaires, interviews, role-playing and observation.

#### **3.4.1 Survey**

Questionnaires were used to gather data from drug traders. They were structured into multiple-choice questions, close-ended questions, ranking, scaled and open-ended questions. The questionnaire for drug traders was set to acquire information about stock storage, the flow of drug stock from manufacturers/importers to retailers and also to learn their experience in using EFD machines (Appendix 3).

#### **3.4.3 Guided Interview**

Guided interview questions were posed to systems analysts and tax officers to collect information about their experience on how they manage and operate EFDMS and how data exchange between EFD machines to EFDMS is done. Furthermore, the study also investigated whether embedding STM into EFD machines and EFDMS will improve tax collection (Appendix 1 & 2). Since IT analysts and Tax officers were few (4 system analysts and 7 tax officers) interview technique was the best method that could be used to collect data from these groups (Roberts, 2007).

#### **3.4.4 Role-Playing and Observation**

In the data collection process, we participated in selling and buying several items. The main aim was to understand inside-out how EFD machines work in daily business transactions and as well as how information exchange takes place between EFD machines and EFDMS.

### **3.5 Data Analysis Methods**

In data analysis we aimed at ordering, structuring and provide meaning to the collected data which help the researcher to investigate various variables with their effects, relationship and pattern of involvement (Jung, 2019).

The distributed questionnaires, structured interview administered, Role-playing and Observation produced data that later were analyzed using Tableau software with the purpose of; understanding the methods currently used by TRA to deal with tax evaders, identifying techniques used by various traders to evade tax, learning the efficiency of the EFDMS and EFD machines in tax collection and estimation process. Also, data analysis was done to get respondent's opinions on whether embedding STM into EFDMS will; improve tax collection, identify tax evaders and as well improve accuracy in collecting and estimating tax.

### **3.6 Design of the EFDMS and EFD Application**

This section explains how EFDMS and EFD machine application was designed and developed. It explains how the Use case diagrams, Conceptual framework, ERD diagram and data flow diagrams were used to model the system.

#### **3.6.1 Requirements Analysis**

Requirement analysis defines all customer expectations for the system that is to be developed such that it involves all activities that are carried out to identify the needs of all system stakeholders (ReQtest, 2018).

This study outlines functional and non-functional requirements for the development of Electronic FDMS with STM embedded. Functional requirements will present the contribution of STM to EFDMS while non-functional describes the qualities of the proposed system.

#### **3.6.2 Functional Requirements**

- (i) The embedded module must be able to capture stock source
- (ii) The STM must track stock-flow between traders
- (iii) The module must set an estimated price per unit item
- (iv) The STM must produce a report on traders stock
- (v) Produce a report on traders daily sales

- (vi) Generate a comparison summary between traders stock records and sales
- (vii) Issue alert on possible tax evaders
- (viii) Generate projection on the amount of tax to be collected
- (ix) Produce a summary report on total tax collected
- (x) Produce a summary report on total tax evaded
- (xi) A trader must be able to view the amount of cleared and outstanding taxes

### **3.6.3 Non-Functional Requirements**

#### **(i) System Scalability**

While reviewing the existing system and gathering requirements for the development of the stock tracking module we have earmarked several points of benefit to other regulatory organs if their systems will be linked with the proposed system. The system can appropriately enable Tanzania Food and Drugs Authority (TFDA) to identify and locate traders owning fake and expired drugs or food products in the market as among the attributes captured by the module being the manufacturing and expiry date of the stock. Not only that but, the system can be linked with the TBS database to tell the existence of unapproved products in the market.

#### **(ii) System Security**

Since stock details are a crucial attribute for the tax calculation, the security of the stock tracking module will carefully be considered during development. Each user of the system will be provided with login credentials whereby sessions will be generated for every successful login and terminated upon logout. To make the security more robust, the system will have different access levels. Again at each access level, the system will be implemented in a role-based fashion, such that, a user of a certain access level can perform only the assigned tasks of that level.

### **3.7 System Design**

System design serves the purpose of creating a solution that aligns with the system requirements and satisfies customer business needs (Wasson, 2006).

Having the user requirement analyzed already, data transmission decision logic, system framework, use case and data flow diagrams for the system were designed. The following sections detail about various techniques employed during system design.

### **3.7.1 Data Transmission Decision Logic**

According to TRA requirements, the EFD machines should work in real-time and stand-alone mode with each transaction receipt independently submitted to EFDMS, contrary to the previous system where daily transactions submitted as a summary at closing day. Therefore, this study developed EFD application software in a way that fulfilled the stated requirements. Once the trader performs a business transaction using the EFD machine, the EFD application saves the sales information both to the local storage of the device and the TRA server (EFDMS).

At first, the EFD application sends data to SQLite (Local storage) followed by internet connectivity check. If the internet connection is available the same data are also sent to a remote server. For the case when the internet is not available, in the background, the EFD application keeps on checking internet connection every after few seconds and when available the transaction data are pulled from the local storage of the EFD machine and submitted to the TRA server (EFDMS) automatically without involving the trader. Figure 2 describes the data transmission process from the EFD machine to EFDMS.

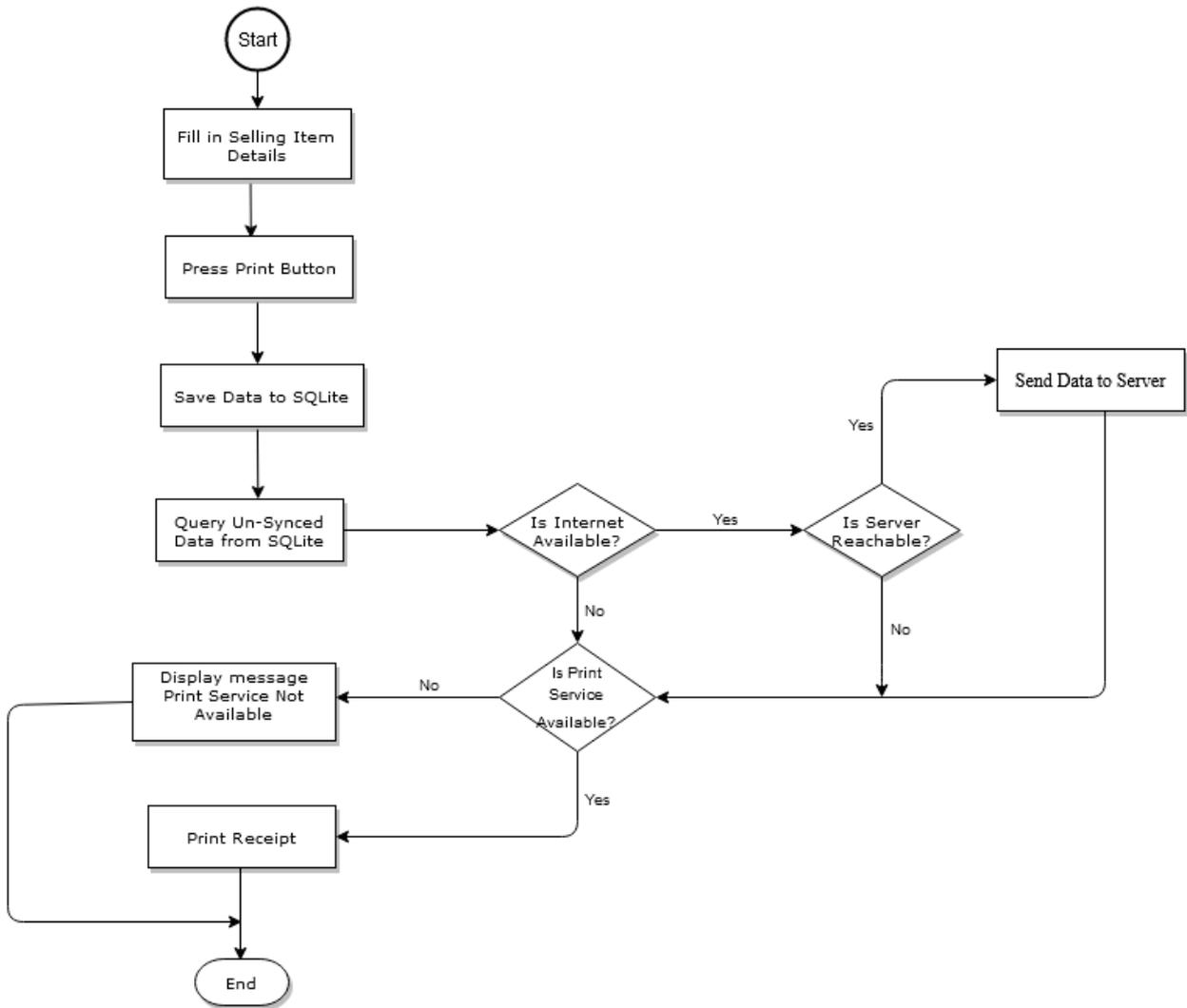


Figure 2: Data Flow from EFD Machine to EFDMS

### 3.7.2 Conceptual Design

The conceptual design provides the system organization which the scholar considers can best describe the components of the system and how the information flow among the system components (Adom, Hussein & Joe, 2018).

The architecture of the EFDMS and EFD machine involves two categories of users; firstly, the category that carries all users accessing the EFDMS (the web system) which includes System administrators, Tax officers and TRA managers. The second category involves users accessing the EFDMS via the EFD machine – who are traders. The traders may either be manufacturers, importers, suppliers, whole sellers or retailers.

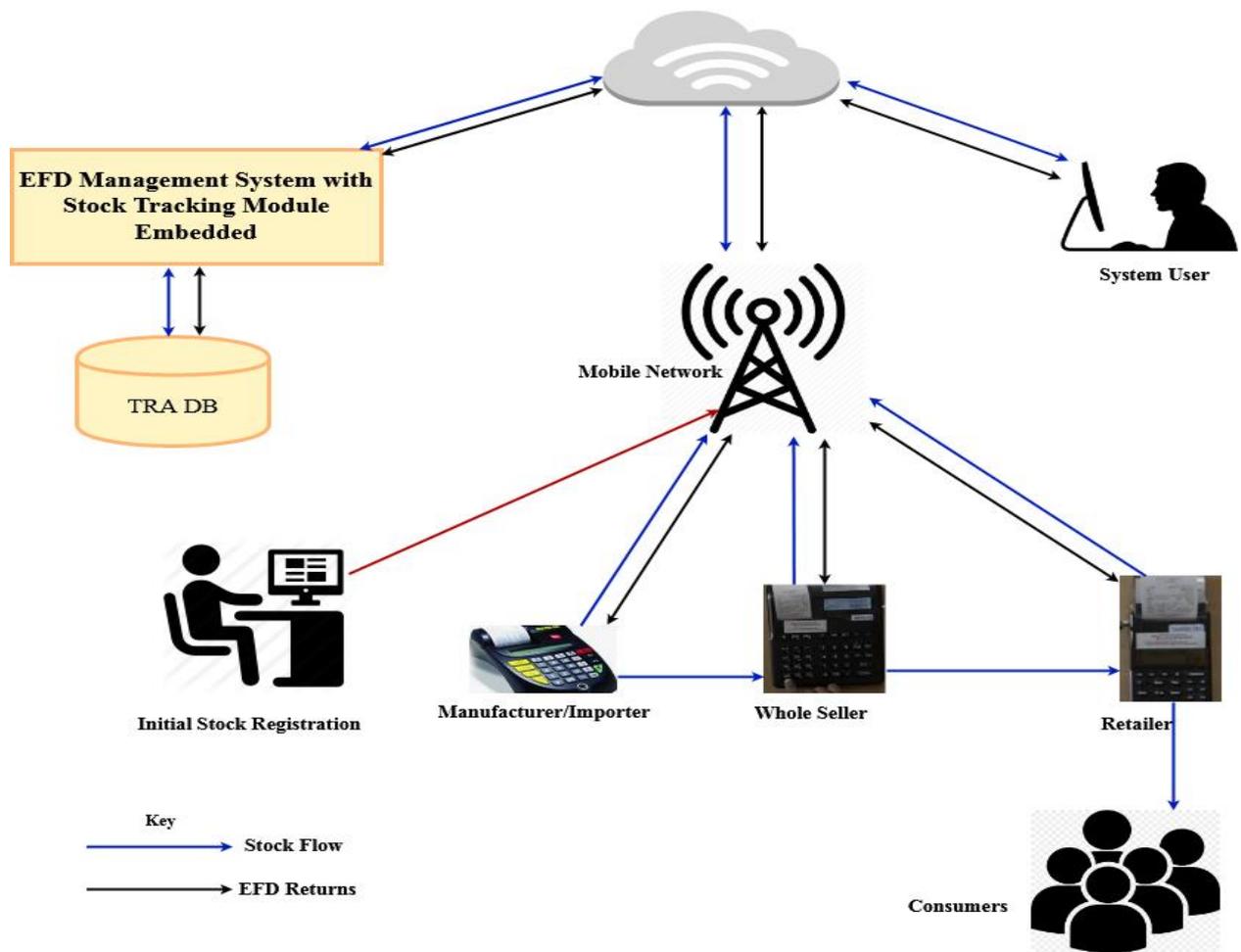


Figure 3: A Conceptual Framework for EFDMS with STM

### 3.7.3 Use Case Diagram

The use case diagram is a powerful visualization tool that helps system designers to the model system from an end-user perspective (James, 2011), it describes the requirements and needed functionalities for the software products (Grechanik, McKinley & Perry, 2007). In this study, we have used a Use Case diagram to visualize how users interact with the EFDMS and EFD machines when performing business transactions. The system consists of four main groups of users; System administrators, Tax officers, Managers and Traders. Traders access the EFDMS via EFD machine to send sales return and querying business information, while the rest access the system via the web. Figure 4 details on such.

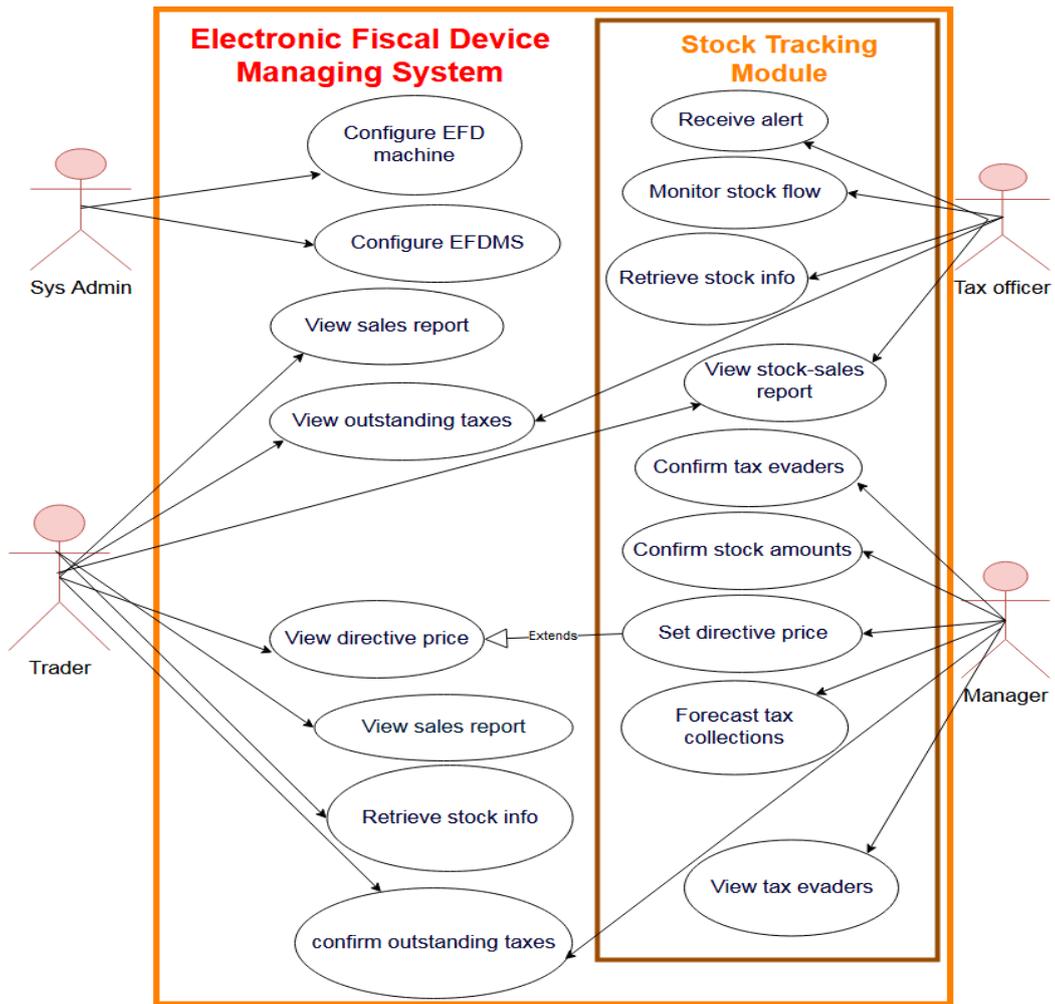


Figure 4: A Use Case Diagram for EFDMS and EFD Machine with STM Embedded

Table 2: Use Case Description

S/N	Use Case	Description
1	Monitor stock flow	The module enables tax officer to keep track of stock-flow from the manufacturer/importer down to the retailer
2	Receive stock information	Tax officer can retrieve initial stock amount entered the market
3	View stock-sales report	The module generates a summary report showing the comparison between stock-flow and sales report submitted
4	Receive alert	The module alerts tax officer of possible tax evader
5	View outstanding taxes	The system produces tax information for each trader based on the stock sold
6	Set directive price	The manager can set directive price for each stock item. This price will be used to compute the amount of tax
7	Confirm tax evader	Based on the comparison between stock information and sales report manager can confirm tax evaders
8	Confirm stock amount	The module enables the tax officer to confirm the amount of stock received and sold in a particular range of period
9	Forecast tax collections	The manager can forecast the amount of tax to be collected in certain business area
10	View tax evaders	The system generates a list of possible tax evaders

### 3.7.4 Data Flow Diagram (DFD)

It is a technique that allows the developer to model and visualizes computer systems as a network of functional processes connected by data flow lines and data stores (Celko, 2006). DFD components include Process, Data flow, Entity and Data-store (Bernhard, Karsten & Rainer, 2016). This study explored level 0 and level 1 of DFDs to model the system such that level 0 DFD pictures the systems in shallow while level 1 pictures the system in more detail.

### 3.7.5 Context Diagram (DFD Level 0)

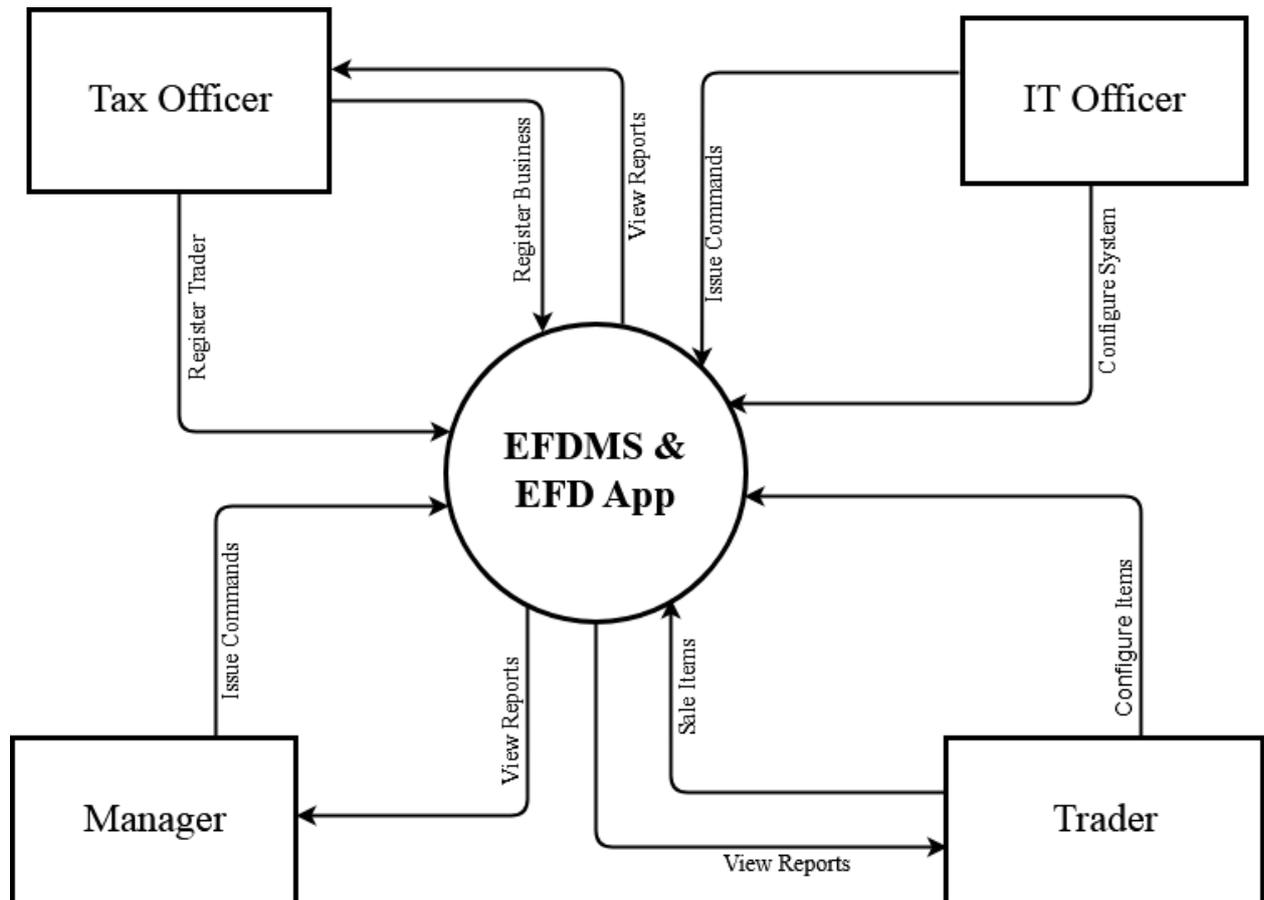


Figure 5: Context Diagram for EFDMS and EFD Application

### 3.7.6 Data Flow Diagram Level 1

Figure 6 shows how information flows between the system and the actors of the system. At this level, the diagram describes the system in detail such that it provides an advanced view of the system that detects the main processes and data stores (Vie, 1998). It categorizes the information that enters and exits the system, the actors who generate and receive information, processes that occur in the system, the information and system boundaries (Kenneth & Julie, 2013).

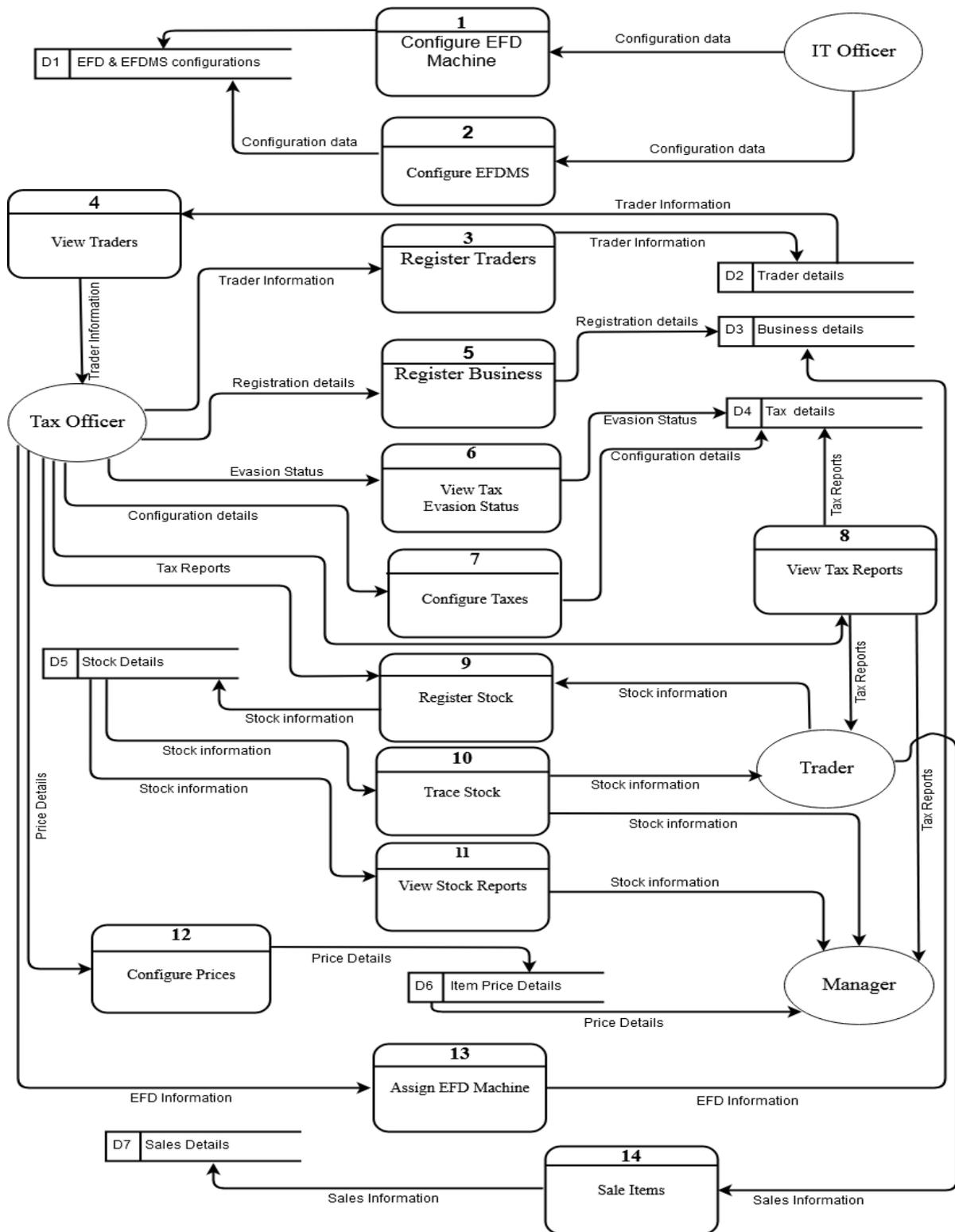


Figure 6: DFD Level 1 of the Developed System

### **3.7.7 Database Schema**

A database schema is a skeleton that represents the overview structure of the system database such that it defines how data in the database are organized and their relationship (Watt & Eng, 2019).

Figure 7 represents the database schema of the developed system. Database tables are categorized into: User and Role management tables – the tables that contain details for user login, access levels, personal information, roles and privileges; Stock and Sales tables – the tables that contain information about stock-flow and sales return; Traders, EFD machine and Tax tables – the tables that store information concerning registration of traders, EFD machines, financial years and various types of taxes charged by TRA.

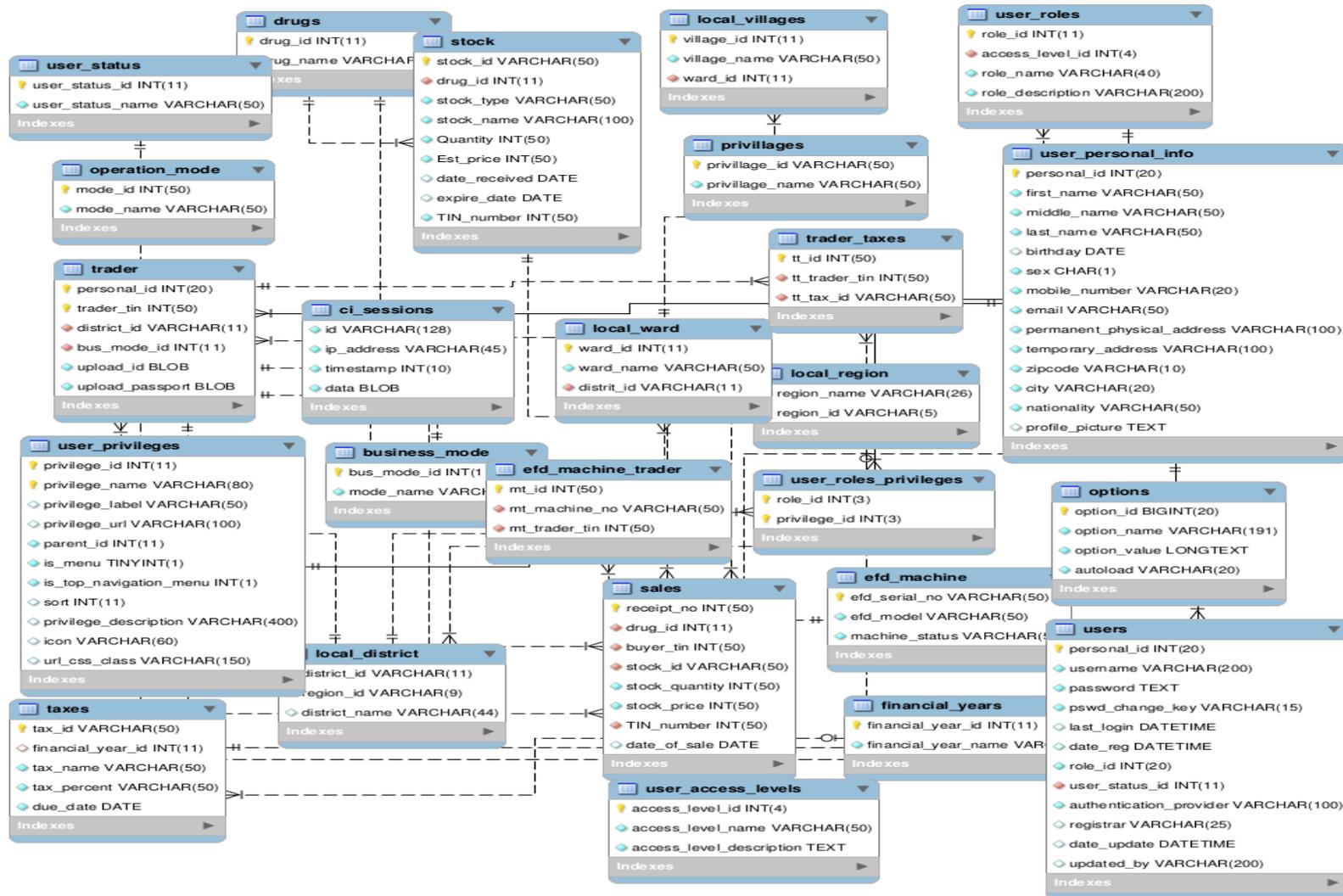


Figure 7: EFDMS Database Schema

### 3.8 System Development Approach

#### 3.8.1 Development Methodology

System development methodology refers to the technique that is used by the system developer to plan, structure and control the operations required to develop an information system (CMS, 2008).

In this study, we have adopted an Evolutionary prototyping methodology as the Software Development Life Cycle in the development of EFDMS and EFD machine application software. Evolutionary Prototyping provides the set of rules that guide system developers to plan, design, develop, testing and maintain a system whereby various steps are followed to reach the real end-user software product (Hulaas, 2019). Evolutionary Prototyping methodology in this study opted since some of the system requirements were not clear. With this methodology, users are allowed to use the prototype, evaluate it and then requirements are refined to improve the next prototype.

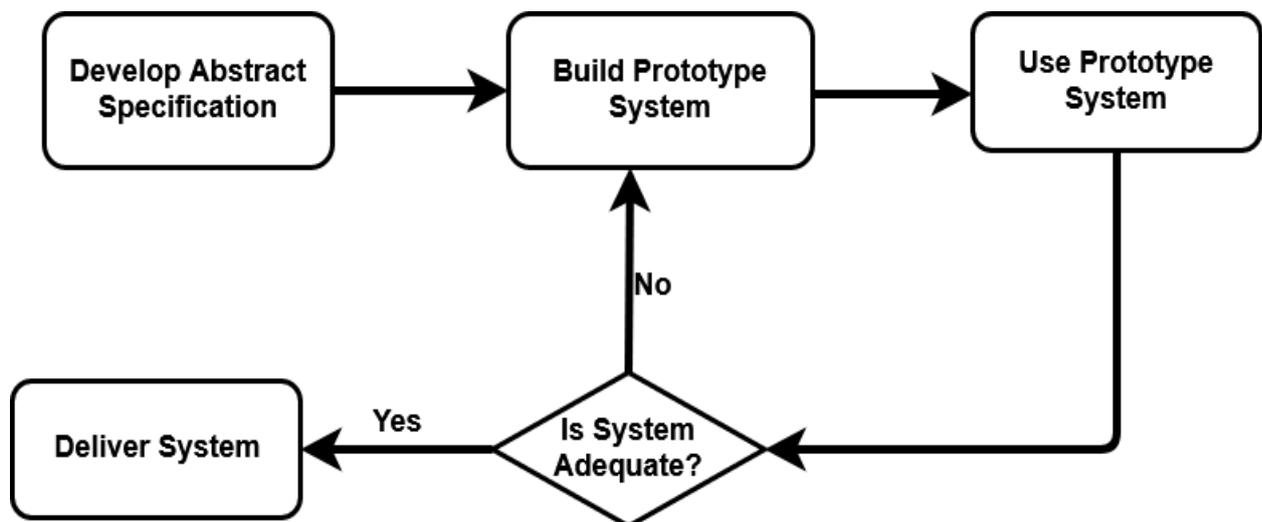


Figure 8: Evolutionary Prototype Model

#### 3.8.2 Tools and Technologies Used

While developing EFDMS and EFD machine application the following tools languages were used.

- (i) HTML and CSS were used to implement the EFDMS user interfaces
- (ii) Java was used in android studio while developing EFD application

- (iii) Android studio was used as an Integrated Development Environment for EFD application development
- (iv) XML was used to design EFD application user interface
- (v) Java Script: Used as a scripting language on the client-side for validation before pushing data to the server.
- (vi) PHP was used as a programming language and connection between client and server while developing EFDMS
- (vii) NetBeans used as Integrated Development Environment while developing EFDMS
- (viii) Apache as a web server
- (ix) MySQL used as a database management system
- (x) MySQL workbench for ERD design
- (xi) Gimp used as an image editor

### **3.8.3 Other Operating Environment Requirements**

- (i) Point of Sale device with a thermal printer (as EFD machine) for testing EFD machine application
- (ii) Android mobile phone
- (iii) Internet connection
- (iv) Operating system: windows
- (v) A web browser: Mozilla

### **3.8.4 Assumptions**

- (i) All EFD users have skills in using EFD machine
- (ii) All web-based application users know how to use a computer
- (iii) Internet connection is available for users to access EFDMS remotely
- (iv) TRA servers are always online for EFD data to be synced with EFDMS
- (v) All initial stock registered into the EFDMS through TANCIS and an EFDMS terminal is valid amounts.

## CHAPTER FOUR

### RESULTS AND DISCUSSION

#### 4.1 Introduction

This chapter presents a discussion of the results gathered from the study area and the results obtained from the developed system. Furthermore, this chapter will also showcase system testing results.

#### 4.2 Description of the Current System

The interviews and questionnaires administered to TRA officials and traders were done to get knowledge on how EFD machines and EFDMS are currently working to develop an improved one. The study uncovered numerous system weaknesses that are used by traders to evade tax. It was observed that using the current EFDMS traders can evade tax without being detected in such ways as under declaration of sales, avoid using the EFD machine, use fake EFD machine, expenses overestimate, division of business and conducting business in unknown areas.

Figure 9 indicates the techniques used by traders to evade tax such that 37.8% of the respondents identified under-declaration of sales as the main technique followed by avoidance of EFD machine at 21.6%, meaning that a lot of revenues are lost due to underpriced sales and avoidance of EFD machine. It was further noticed that the division of business and the use of unknown areas are the two emerging techniques that are not yet popular as they smash 10.8% and 5.4% respectively on the Fig. 9.

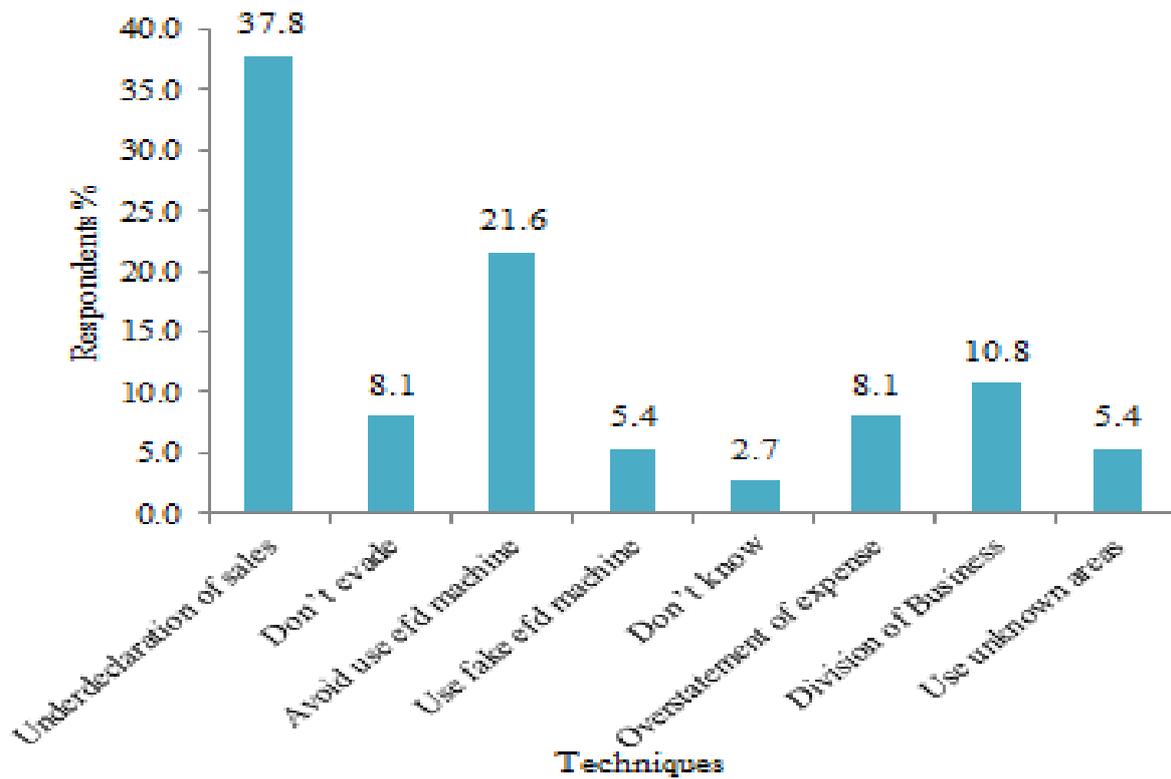


Figure 9: Tax Evasion Techniques

During the study, TRA officials were asked whether TRA has information concerning the trader's stock flow. It was revealed that TRA had no control over such information; therefore tax estimation is done by referring to sales reports submitted by traders whose loyalty is questionable.

Following the weaknesses pointed out, TRA respondents were asked to rank the efficiency of the current EFDMS in collection tax whereby the ranking scale was 90% - 100%, 75% - 90, 50% -75% and Less than 50%. After performing data analysis we observed that 54.5% of the respondents ranked the efficiency of the current system in collecting tax to be between 50% - 75% which confirms that the current system needs some improvement. Figure 10 provides more details on such.

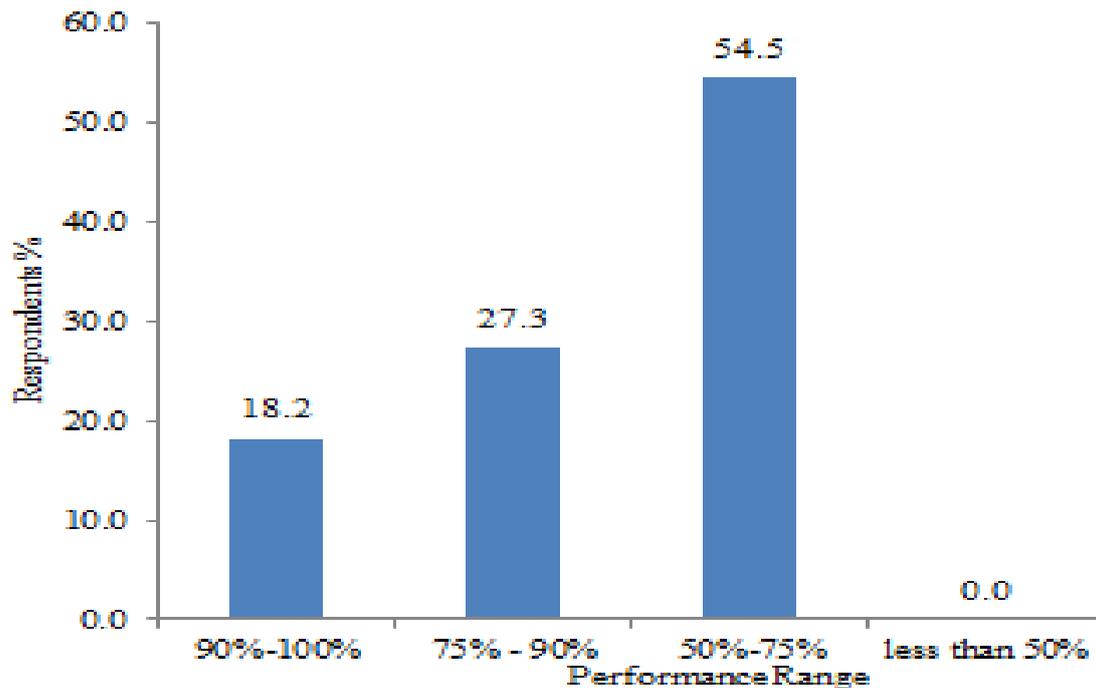


Figure 10: EFDMS Efficiency in Collecting Tax

#### 4.3 Results Discussion from the Case Study

From the data collection methods employed in the research that included guided interviews and questionnaires, respondents were asked to give opinions concerning the embedding Stock Tracking Module into EFD machine and EFDMS. Respondents were asked to assess the impact of the Stock Tracking Module into EFDMS and EFD machine in identifying tax evaders, increase the number of tax collections, identify traders with smuggled drugs and improve accuracy on tax estimation. The assessment criteria were scale strongly agree, agree, neutral, disagree and strongly disagree. Figure 11 presents the results.

##### 4.3.1 Embedding STM into EFDMS and EFD Machine Identify Tax Evaders?

Users were asked to give their opinion on the introduction of the stock tracking technology. The question was asked to system analysts and tax officers only since they are aware of how the EFD system works and they frequently improvise various techniques to combat tax evasion. The results show that 64% of the respondents strongly agreed that by introducing stock tracking technology into EFDMS and EFD machine will help to identify tax evaders since sales report submitted by a trader to TRA is compared with traders stock-in and stock-out making easier to tax officers to know whether there is a falsification of sales information. Twenty seven percent

(27%) of the respondents agreed, while 9% were neutral none disagree nor strongly disagree. Figure 11 gives more description.

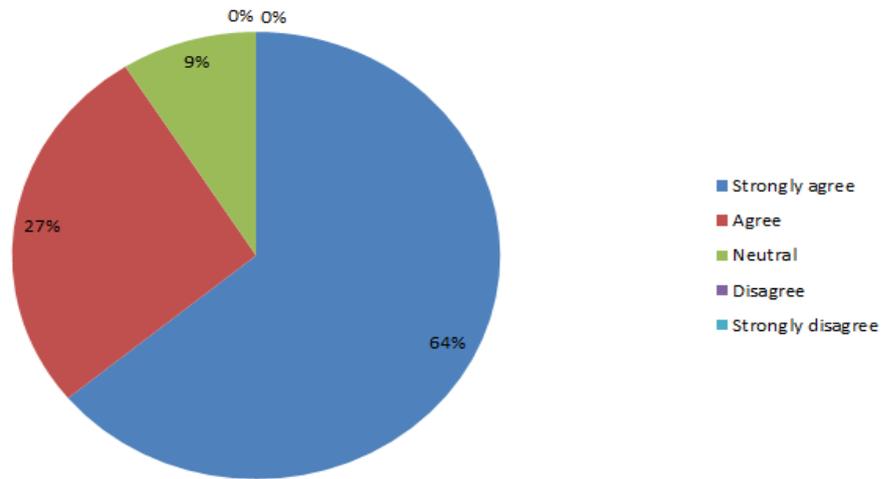


Figure 11: Respondents Opinion that STM Identify Tax Evaders

About the increasing amount of revenue collection, 53.3% of the respondents strongly agreed, 46.7% agreed while none of the respondents were neutral, disagree or strongly disagree. The results are presented in Table 3.

Table 3: Responses STM Increase Amount of Tax Collections

Assessment Criteria	Frequency	Percent	Cumulative Percent
Strongly agree	8	53.3	53.3
Agree	7	46.7	100
Neutral	0	0.0	100
Disagree	0	0.0	100
Strongly disagree	0	0.0	100

With the fact that TRA does not keep track of trader’s stock-flow then there may be a lot of smuggled drugs in the market whose transactions are not reflected by EFDMS. Therefore, the majority of the respondents (60%) strongly agreed that by embedding STM into EFDMS and EFD machine will identify smuggled drugs in the market, 33.3% agreed, 0% were neutral, 6.7% disagreed while none strongly disagreed. Figure 12 present the results.

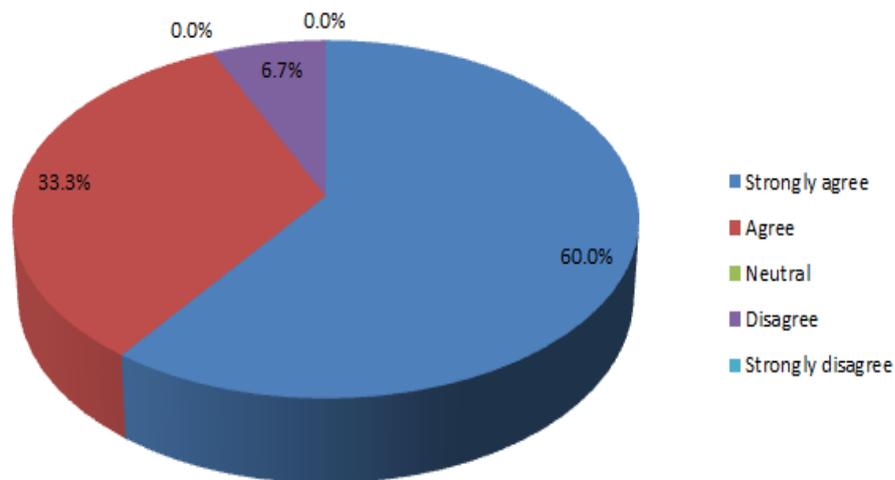


Figure 12: Respondents Opinion that STM Identify Smuggled Drugs

Not only that but, respondents also expressed the need for improving the accuracy of tax estimation. Currently, tax estimation is done based on sales report submitted by traders whose validity is not guaranteed, therefore, 60% of the respondent strongly agree that by embedding STM into EFDMS and EFD machine will increase the accuracy of tax estimation, 33.3%

agreed, 6.7% were neutral, while neither of the respondents disagreed or strongly disagreed. Table 4 summarizes the results.

Table 4: Responses STM Increase Accuracy in Tax Estimation

<b>Assessment Criteria</b>	<b>Frequency</b>	<b>Percent</b>	<b>Cumulative Percent</b>
Strongly agree	9	60.0	60.0
Agree	5	33.3	93.3
Neutral	1	6.7	100
Disagree	0	0.0	100
Strongly disagree	0	0.0	100

The general fieldwork was done in Arusha and Kilimanjaro that involved the use of questionnaires, guided interviews and observation, and role-playing techniques gathered enough information to understand the real situation regarding tax collection and estimation process, challenges facing revenue authority and how they deal with tax evaders. This study realized that having EFDMS and EFD machines embedded with STM will improve the process of tax collection by increasing the amount of the tax collected as well as reduce trader complaints. Therefore, the next section will describe the newly developed EFDMS and EFD machine application with STM embedded.

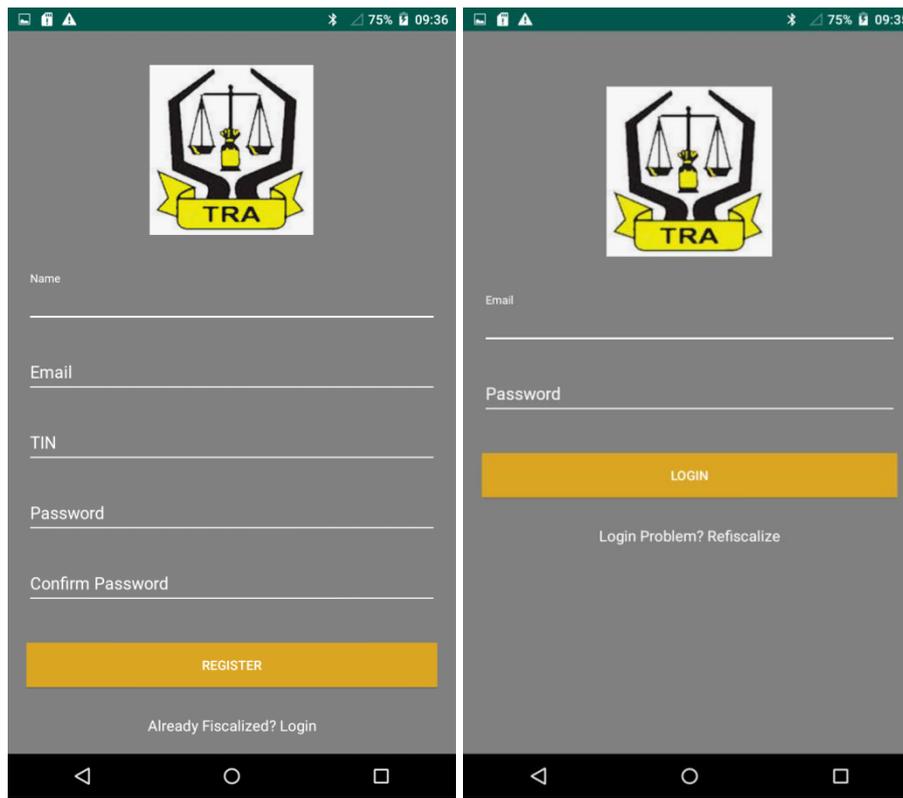
#### **4.4 System Development**

The development of Electronic Fiscal Device Management System and Electronic Fiscal Device application was based on MySQL and SQLite management systems respectively. MySQL is the relational database management system that allows database developers/users to insert, update, select or delete from the database (Bassil, 2012). On the other hand, SQLite is the light relational database management system designed to run on android devices to serve the same purpose as MySQL. Figure 7 presents the EFDMS database schema.

##### **4.4.1 Development of the EFD Application**

The EFD application was developed using the Android Studio platform with additional features to track the trader's stock as described in chapters three. The application will be installed and run on the trader's EFD machines. On the first use, the EFD user must first fiscalize the device. Fiscalization is the process of providing the necessary information so that the EFD machine

can be identified and communicate with TRA EFDMS (Ips, n.d.). Among the information prompted include TIN, Trader names, server IP address and passwords that will be used authentication when using the EFD machine. After successful fiscalization users will be taken to log in screen where Tax Payer Identification Number must be supplied to continue with application use. Figures 13(a) and 13(b) show the fiscalization screen and login screen of the application respectively.



(a)

(b)

Figure 13: Fiscalization UI & Login UI

Login UI On successful login EFD machine user is taken to the main screen of where all operation modes are displayed. The major operation modes are Registration, Programming, Service, X-report, Z-report and Y-report mode. Figure 14 shows the home page of the EFD machine with all operation modes listed.



Figure 14: EFD Machine Operation Modes

**(i) Electronic Fiscal Device Application Security**

**Login:** During the study, it was noted that all users of a certain EFD machine model use the same password to authorize a particular operation. For security consideration, this study identified this as the security loophole that has to be fixed. It is for the said purpose that during the fiscalization of the device trader provides his/her password as is shown in Fig. 13.

**Logout:** To ensure that the trader's business information continuous to stay confidential, the EFD application also provides a logout option that allows the trader to terminate the session when he/she is done with the business transaction.

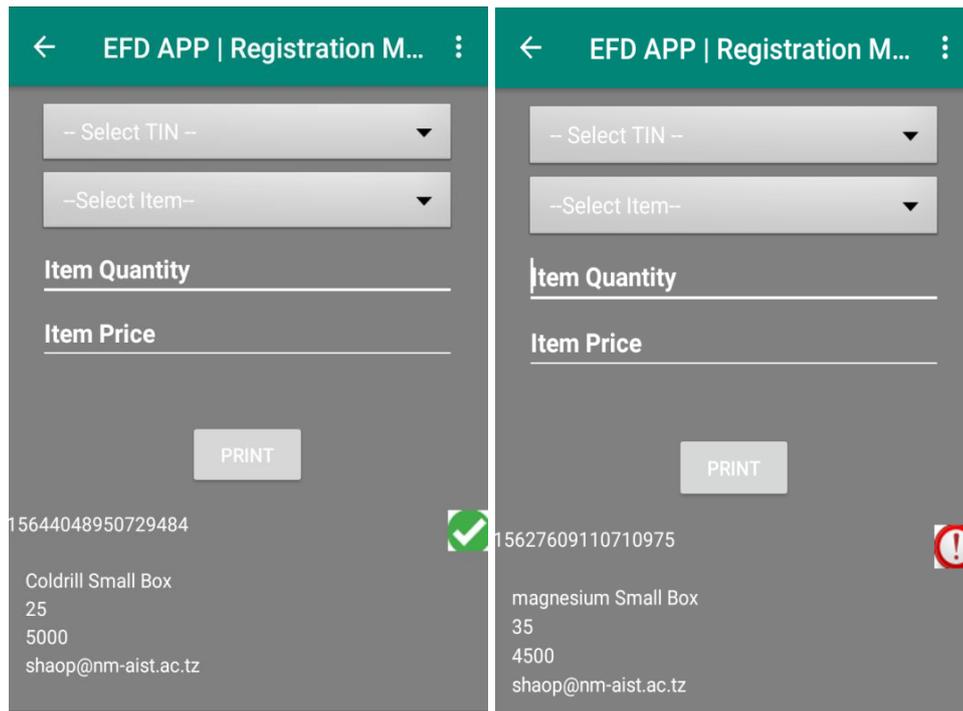
**(ii) Registration Mode**

Registration mode is the operation mode of EFD machine mode that gives the trader a room to enter details of the commodity to be sold which include buyers TIN, drug name, item quantity and items price. After entering all required details the application allows a trader to send the details both to local storage of the device and TRA server (EFDMS) and finally prints the receipt for that transaction. Figure 16 provides more details.

### **(iii) Real-Time Mode Versus Stand-Alone Mode**

As explained in the last section that, on performing business transaction the details are both submitted to the EFDMS server and EFD machine local storage. If the internet connection is available the sales report is sent both to EFDMS server and local and in this state we say that the device is operating in real-time mode. On another hand, if internet connection is not available the sales report is saved only on the local storage of the device but later on when the internet connection is made available the report will also be submitted to EFDMS server such that at this state we say that the device is operating in standalone mode. When a device is operating in real-time mode the min-report displayed at bottom of the registration page is associated with a green tick, so it is, when the device is operating in standalone mode the mini-report is associated with red caution.

A case in point, in Fig. 15(a), item named “Coldril” was sold to a customer with TIN 15644048950729484 and the sales report was successfully submitted to EFDMS, which means the device was operating in real-time mode. On another hand, in Fig. 15(b), the item named “Magnesium” was sold to a customer with TIN 15627609110710975 and the sales report was not submitted to EFDMS due to internet unavailability; this means the device was operating in Stand-Alone mode.



(a)

(b)

Figure 15: EFD in Real-Time Mode and Stand-Alone Mode

Figure 16 entails that, the same sales report that couldn't be submitted to EFDMS due loss of internet connection, is now synced automatically one (1) minute later when the internet was made available.

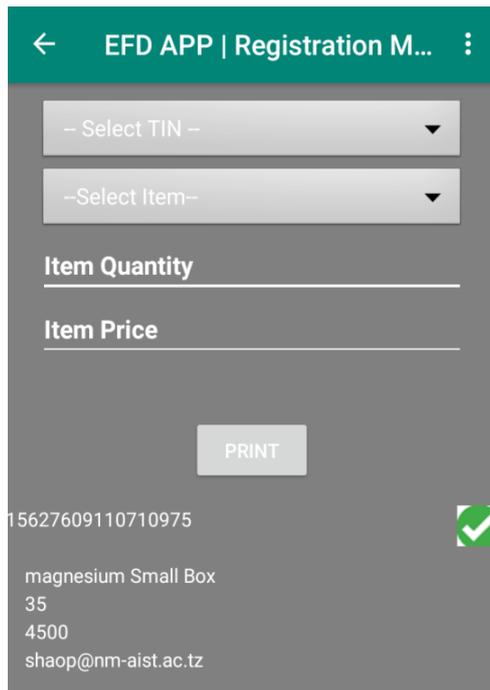


Figure 16: Sales Report Synced with EFDMS

After the sales information saved to local storage and submitted to the EFDMS server, then the same information together with additional information queried from the device is printed using the inbuilt printer of the device to get a physical receipt that is issued to buyer. Figure 17 pictures a physical receipt being printed by the EFD machine.

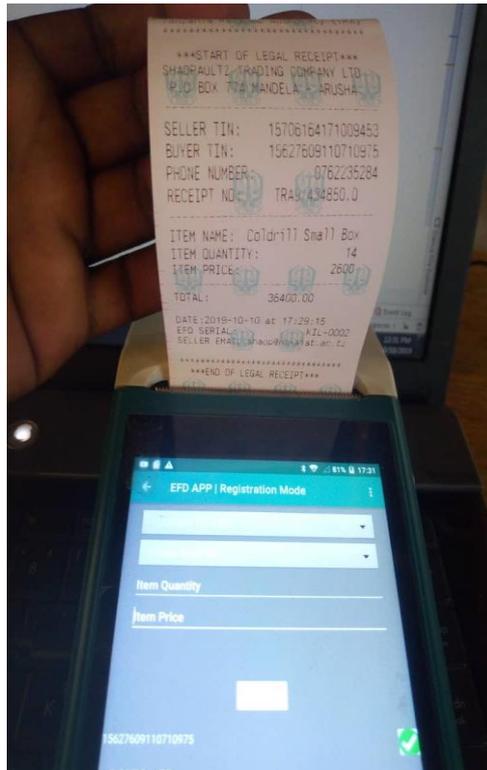
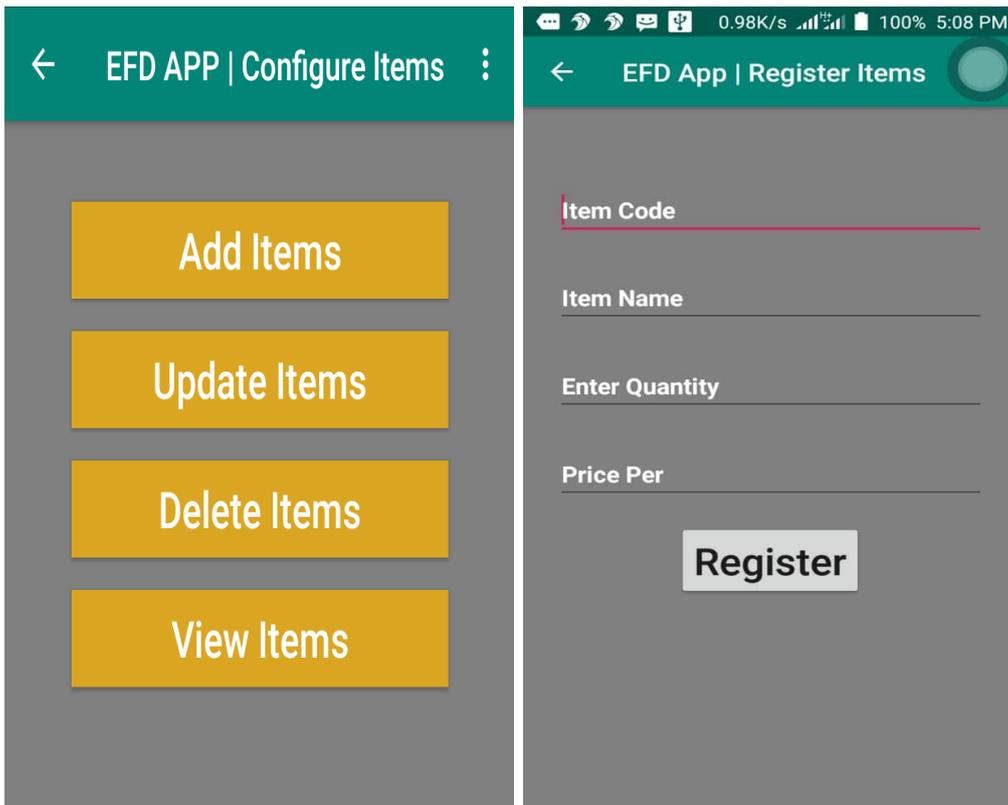


Figure 17: Physical Receipt Issued to Customer

#### (iv) Programming Mode

Programming is an operational mode of the EFD machine that allows the system analyst and/or tax officer to configure/program various services available on the device. An authorized user can add new items, delete and update or view the list of items added in the system with their respective features as is done in the web interface, etc.

Figure 18 presents a screenshot of the EFD machine operating in Programming mode showing item registration.



(a)

(b)

Figure 18: Programming Mode

**(v) Z-Mode**

Z-Mode is the operation mode that allows a trader to print/view the sales report. The trader can choose to print/view the current day report or any other day chosen. Figure 19 is the screenshot of the EFD machine operating in Z-Mode.

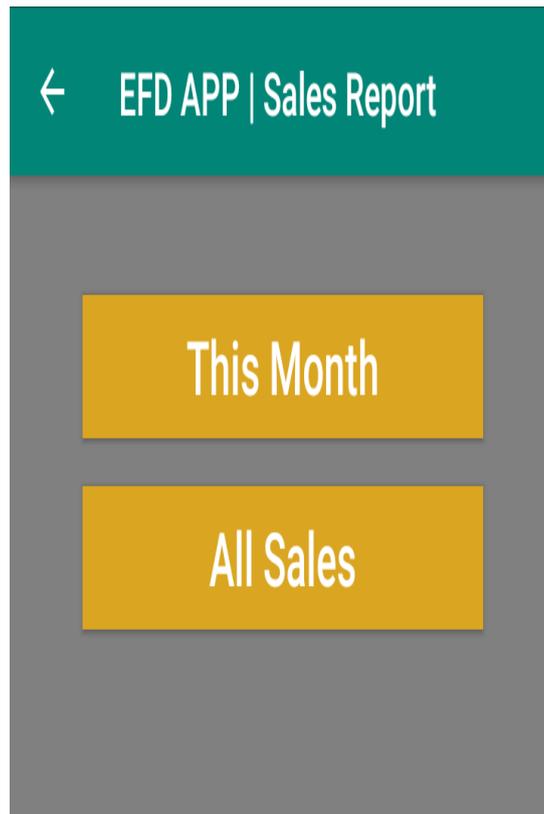


Figure 19: EFD Machine in Z-Mode

**(vi) X-Mode**

X-Mode is an operational mode that gives a trader interface to print/view tax reports. The trader can choose to print/view the current month report or any other month chosen. Not only that but this mode allows a trader to view cleared taxes as well as outstanding taxes. Figure 20 is the screenshot of the EFD machine operating in X-Mode.

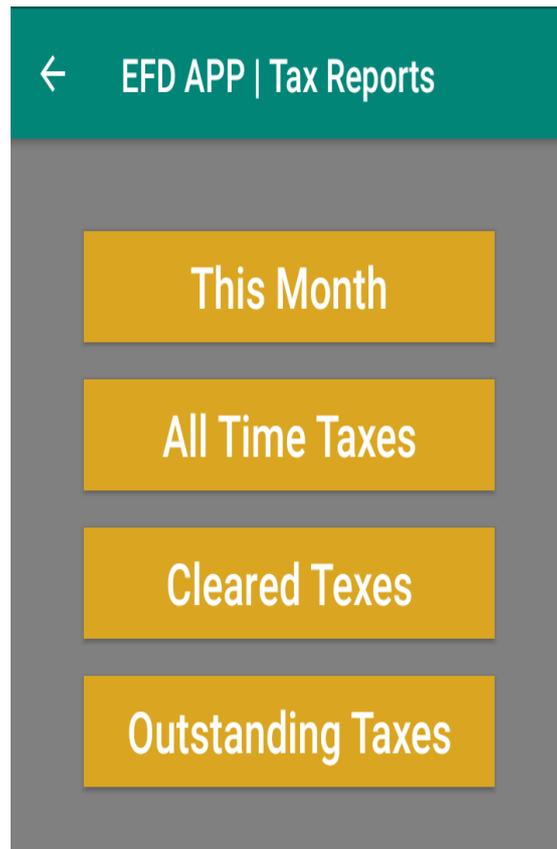


Figure 20: EFD Machine in X-Mode

**(vii) Y-Mode**

This is the EFD operational that enables a trader to print/view purchase reports. The trader can choose to print/view purchase report on daily bases, monthly or all-time purchases that have ever done by the trader. Figure 21 is the screenshot of the EFD machine operating in Y-Mode.

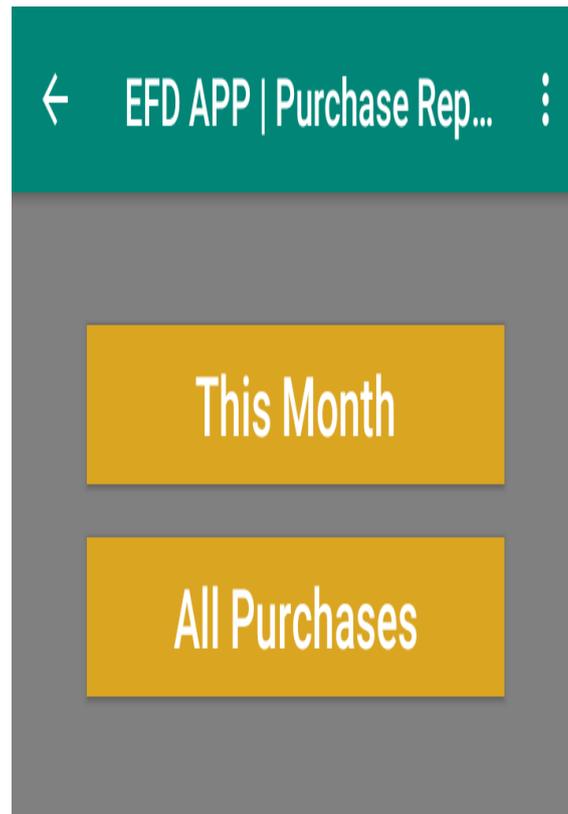


Figure 21: EFD Machine in Y-Mode

#### 4.4.2 Development of the EFDMS

The Electronic Fiscal Device Management System was developed to receive and manipulate sales and stock information from the EFD machine. Not only that but EFDMS also provides necessary sales, stock and tax reports when requested by the trader via EFD machine application. Since this study focused much on building algorithms that support TRA to track trader's stock, sales and generate reports that will detect/identify tax evaders, therefore, this section will describe only necessary functionalities to achieve stated objectives.

The system consists of three categories of users including system administrators, tax officers and managers. The system administrator performs administrative roles of the system, tax officers perform tax-related roles while managers perform authorization, approval and report related roles. Each user of the system will be provided with login credentials whereby sessions are generated for every successful login and terminated upon logout. To make the security more robust, the system was designed to have different access levels. Again at each access level, the system was implemented in a role-based fashion, such that, a user of a certain access level can perform only the assigned tasks of that level.

Figures 22 and 23 show the user login screen and administrator home screen. The administrator home screen lists all general functionalities of the system while the specific items are collapsed.

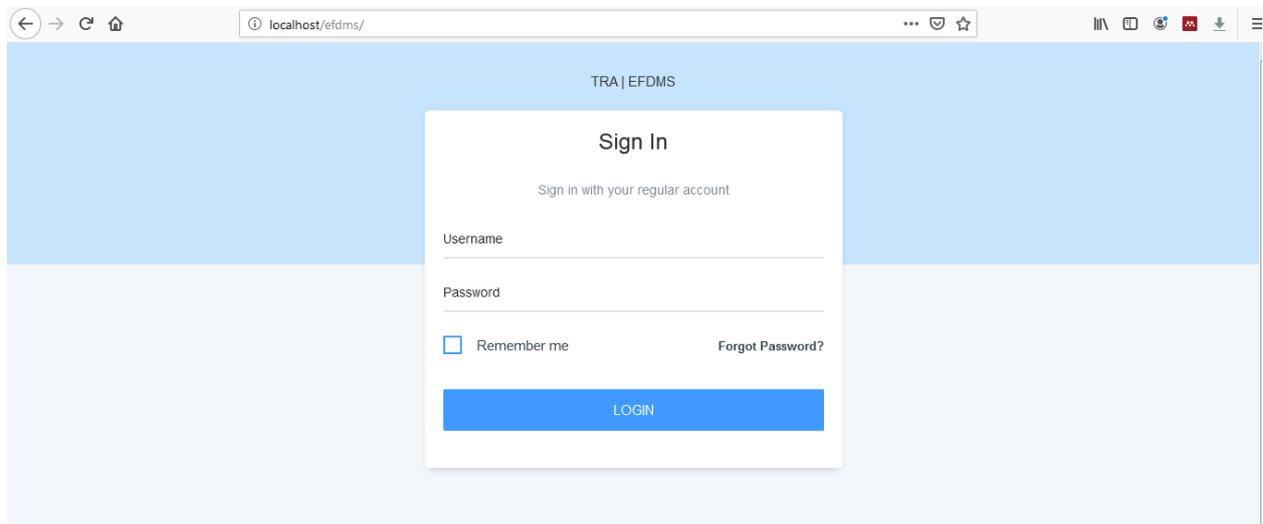


Figure 22: EFDMS Login Screen

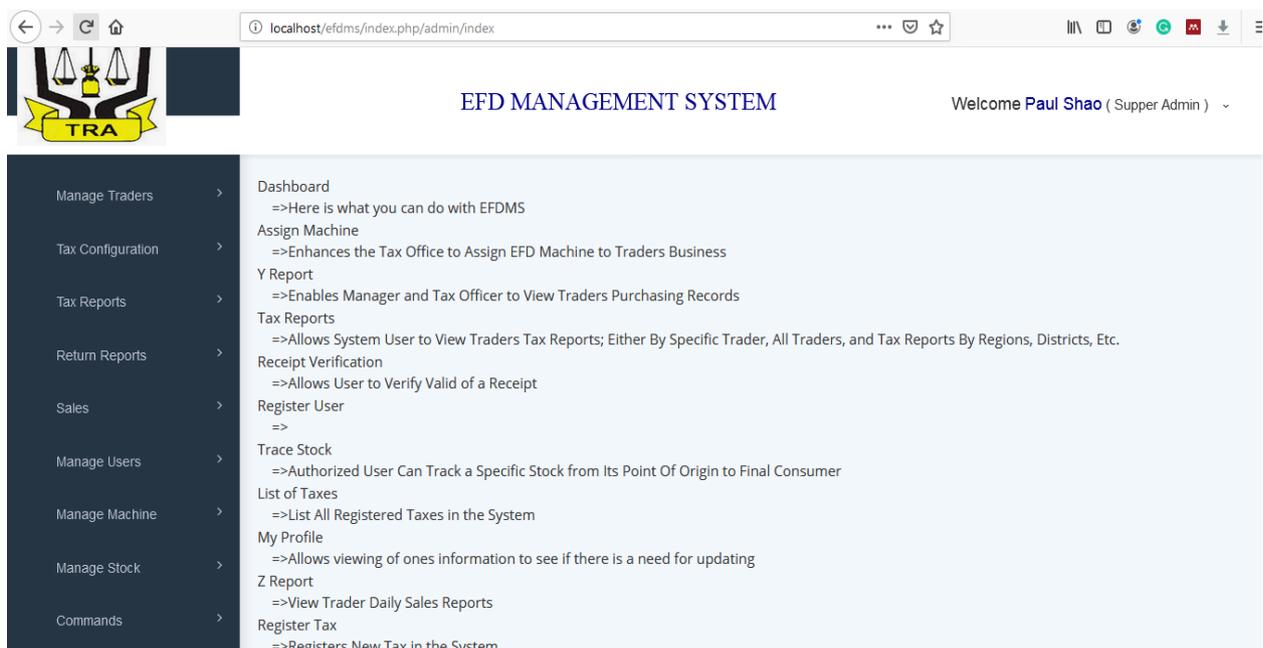


Figure 23: EFDMS Home Page

Figure 24 shows some of the general system functionalities with specific one collapsed (hidden) with one of them expanded (Manage Users) such that the specific functionalities are seen (View list of users, Register user and My Profile).

After the administrator successfully login into the system, configures necessary items so that other users can have their respective working environment. Among few configurations include user registration, role assignment and EFD machine registration. Figure 24 shows that Mussa Ally was successfully registered as a tax officer.

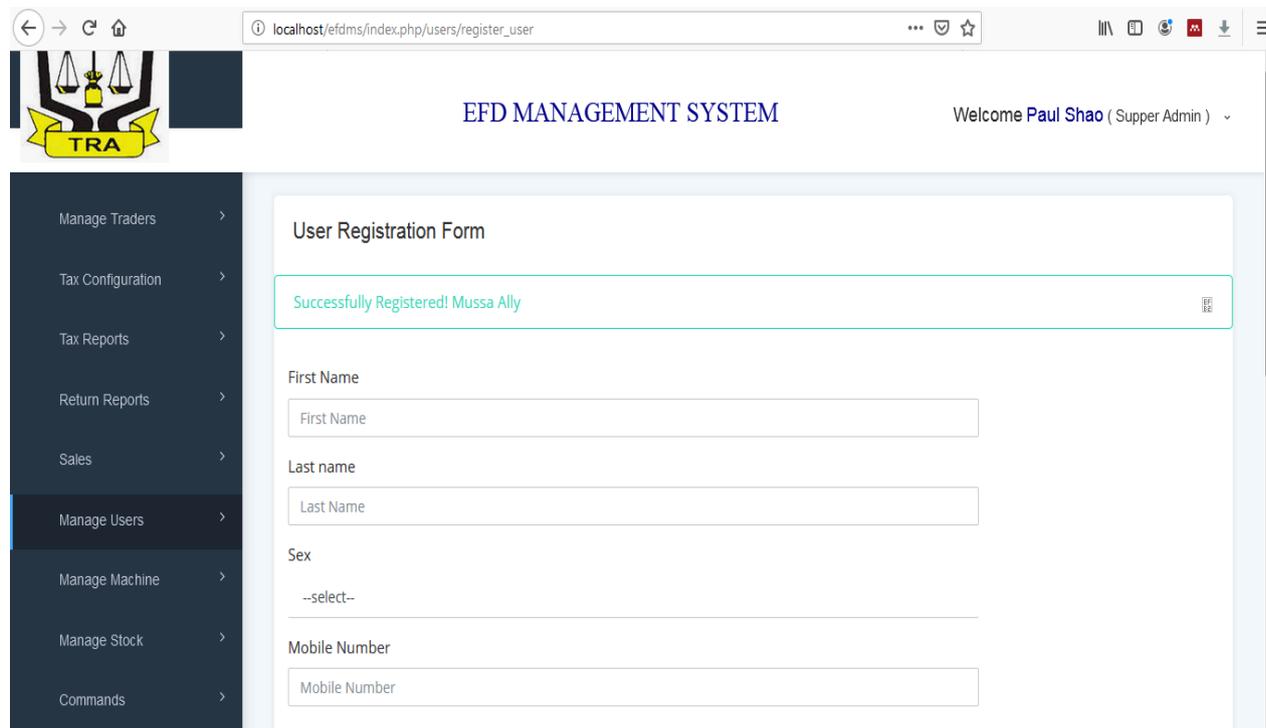


Figure 24: EFDMS User Registration

The Electronic Fiscal Device Management System is now having a tax officer registered with all necessary roles assigned to. Figure 25 shows tax officers dashboard with general functionalities that include Manage Traders, Manage EFD, Manage Stock, Tax Configuration, sales, Commands and Tax Returns. Under Manage Traders, a tax officer can register trader, register business and view a list of registered traders as is depicted in Fig. 25.

Figure 25: Tax Officer Registering a Trader

After registering a trader into the system, the tax officer registers a business for that trader whereby a trader can be doing different business modes such as manufacturer, importer, whole seller, supplier or retailer. Figure 26 shows the tax officer registering a business for the trader registered earlier.

Figure 26: Tax Officer Registering a Business for Trader

At this point, the trader's business exists but the EFD machine is not yet assigned. The tax officer will query all businesses to which the EFD machine is not assigned and assigned accordingly. Figure 27 below depicts the tax officer assigning EFD machine to a traders

business that was registered in the previous step above. Once the EFD machine is assigned to a business, the business and the EFD machine will no longer be listed on the next EFD machine assignment window as is shown in Fig. 27.



Figure 27: Tax Officer Assigning EFD Machine to a Registered Business

Figure 28 pictures EFD machine with serial no 0001 successfully assigned to trader Thomas Ezekiel Malamsha with business TIN 15670652020829548.

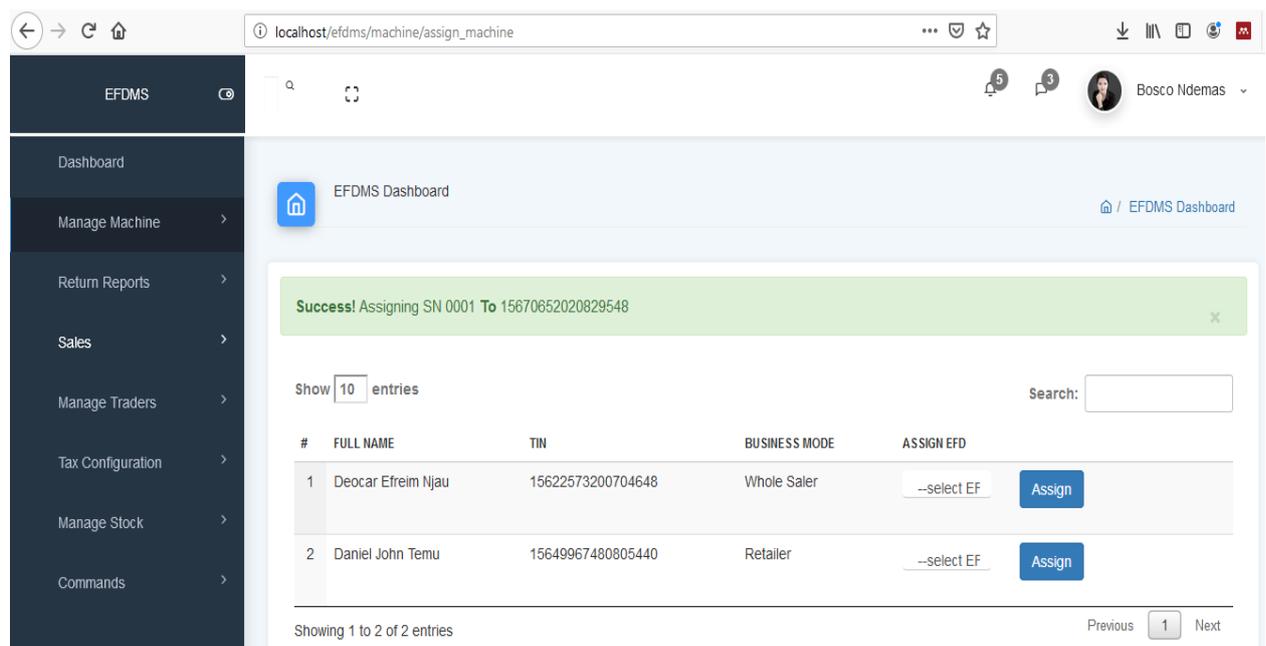
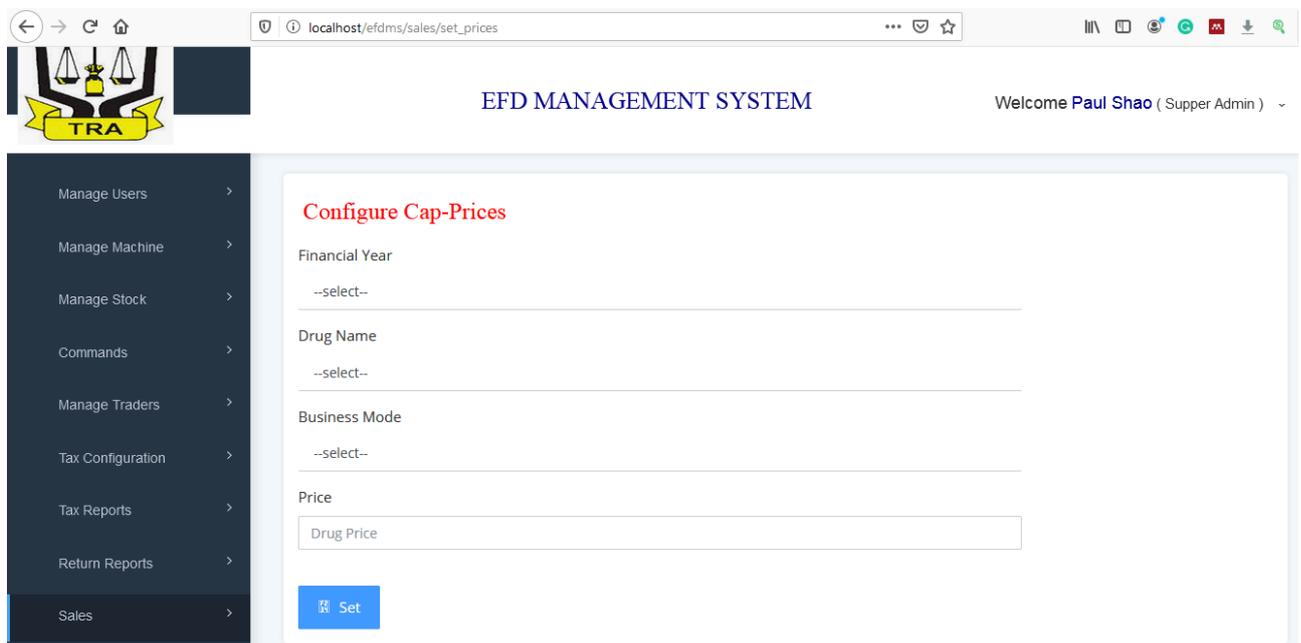


Figure 28: EFD Machine Successfully Assigned to a Trader

### (i) The Need for Cap-prices

Up to this point, the trader can use his/her EFD machine to perform a business transaction. Now, Under Manage Stock menu tax officer configures cap-prices for all types of drugs in the market depending on the market situation and financial year.

In Tanzania, every trader sets commodity price depending on the market situation and financial year such that exceptional is made only to petroleum products where traders receive cap-prices from Energy and Water Utilities Regulatory Authority (EWURA) monthly (EWURA, 2019). For the case of pharmaceutical businesses, earlier this year, the Tanzanian government released an official statement showing the intention of having cap-prices as it is for petroleum products to protect final consumers (Eric, 2019). Therefore, during the study the researcher and system users came into agreement that, for the system to identify underpriced transactions, the system should have a reference price set for each drug type so that the system can run a comparison between the sales price supplied by a trader and the one in the system. Figure 29 screenshots the cap-price configuration form.



The screenshot shows a web browser window with the URL `localhost/efdms/sales/set_prices`. The page title is "EFD MANAGEMENT SYSTEM" and the user is logged in as "Paul Shao (Supper Admin)". On the left is a dark sidebar menu with options: Manage Users, Manage Machine, Manage Stock, Commands, Manage Traders, Tax Configuration, Tax Reports, Return Reports, and Sales. The main content area is titled "Configure Cap-Prices" and contains the following form fields:

- Financial Year:
- Drug Name:
- Business Mode:
- Price:

A blue "Set" button is located at the bottom left of the form area.

Figure 29: Tax Officer Configuring Cap-Prices

### (ii) Stock Tracking for Pharmaceutical Business in Tanzania

In Tanzania, drug stock enters the market through local manufacturing industries or imported from other countries. Manufacturers and importers are the stock initiators. For the case of

importers, stock information is registered into the EFDMS via Tanzania Customs Integrated System (TANCIS) (Rose, 2014), while manufacturers register their stock information into EFDMS via computer terminal using the web interface provided. The assumption is made that, the stock information registered into EFDMS by importers and manufacturers is valid since TANCIS is owned by the same authority for the case of importers while TRA agents can be placed in manufacturing industries to verify registered stock information.

The EFDMS was developed in a way that, when importer/manufacturer sales stock items to a supplier or wholesaler through the EFD machine, the system deducts the amount from importer/manufacturer stock account and increments it to the supplier's or whole seller's stock account. So it is when wholesaler trade with the retailer, the stock amount is deducted from the wholesaler's stock account and incremented to retailer's stock account and finally when retailer sale to the final consumer the system deducts the stock amount from retailer's stock account.

To track the trader's stock-flow the EFD application captures the following: buyer's and seller's TIN (Trader Identification Number), item name and item quantity. TIN helps to know the stock issuer and receiver; normally buyer's TIN is entered by the seller on the EFD application interface as shown in Fig. 17, while the seller's TIN is captured from the user's login session. Item name identifies the type of stock involved in the transaction while item quantity tells the amount of stock being transferred from seller to buyer. For tax evasion detection, the EFD application captures item prices. The item price is used to compute the total cash received by the seller where the tax percentages are calculated from. The details of tax evasion detection are described in section 4.4.2(ii). Figure 30 presents the stock registration interface used by manufacturers to register their stock into EFDMS.

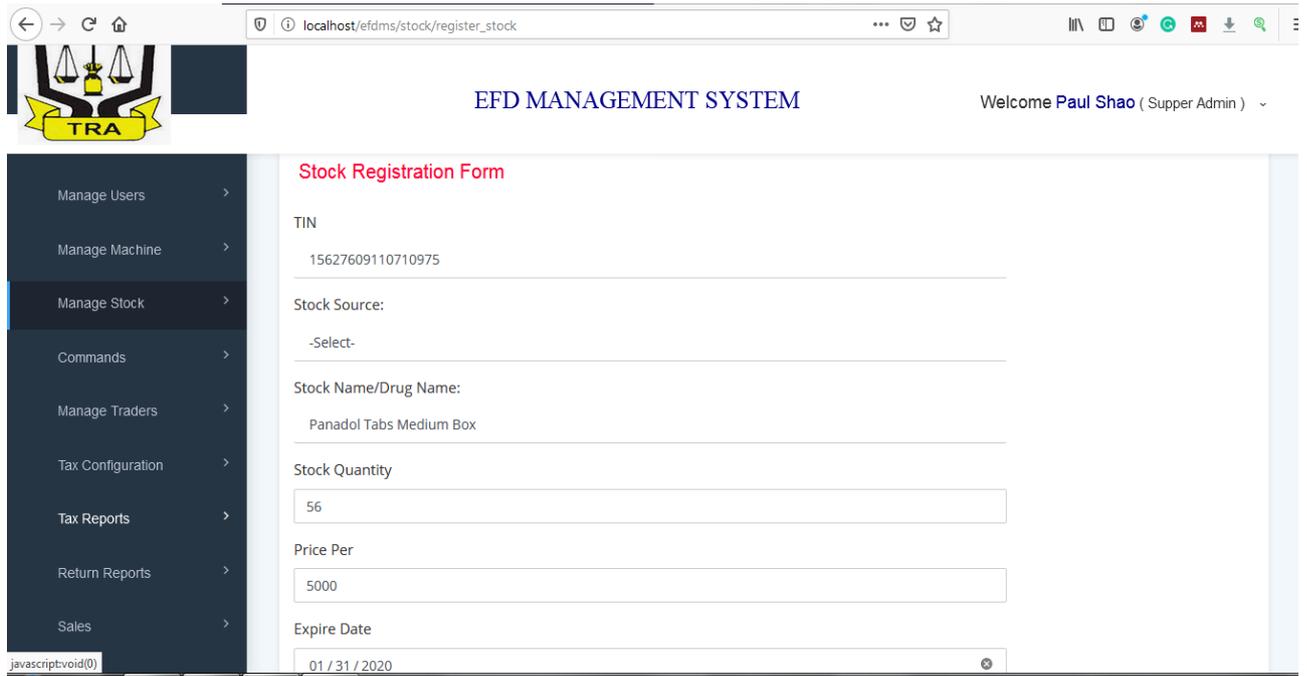


Figure 30: Local Manufacturer Registering Stock to EFD

Since each transaction prompts for buyer's and seller's TIN which uniquely identifies each trader in the system (David, 2016), therefore, TRA can identify all stock transactions involved with each trader in both buying and selling with their corresponding dates. Not only that but we can also confirm that TRA can tell the total amount of stock received, sold and currently owned by a trader. Figure 31 presents system screenshot showing trader's stock account with details of the amount of stock received, sold and amount remained to date.

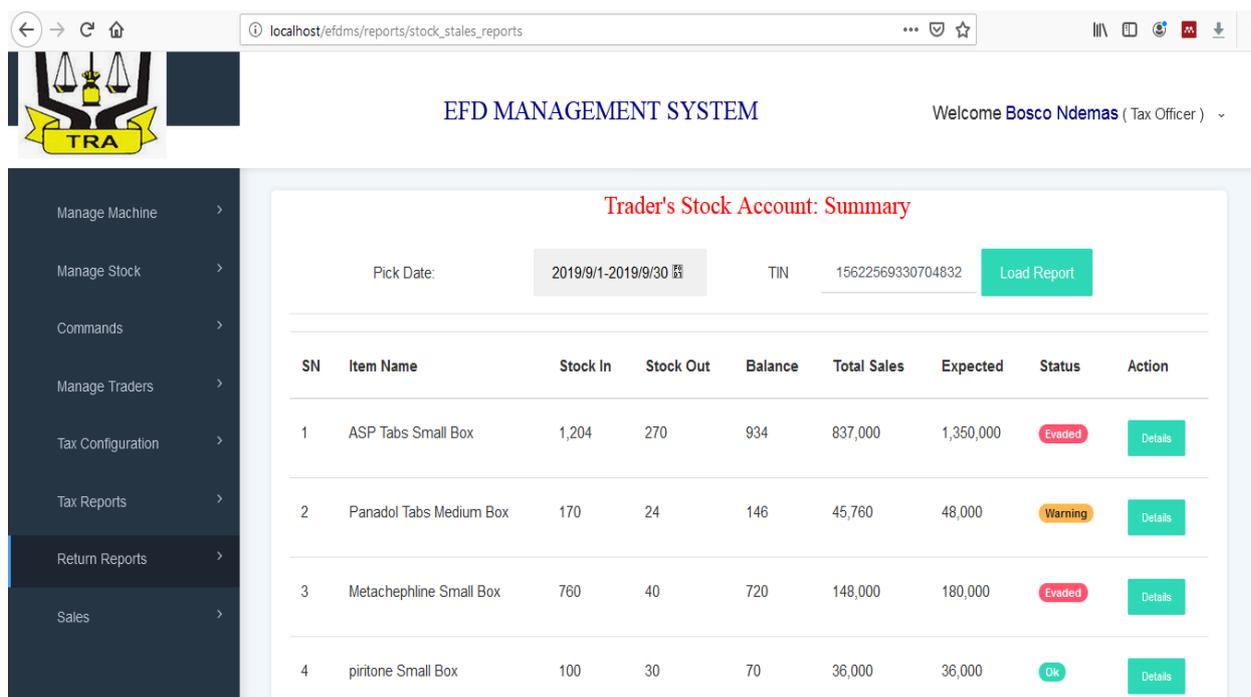


Figure 31: Trader's Stock Account in Summary

### (iii) Identifying Tax evaders

For the system to have the ability to identify tax evaders, the parameters concerning the amount and price of the stock involved in a transaction had to be known by the system. As described in section 4.4.2(i) and 4.4.2(ii) the developed system tracks the trader's stock and the cap-price for each drug is configured in the system. Therefore, when a trader executes business transactions the system multiply the stock quantity with a cap-price set in the system to get expected total cash and then compares the product with the real amount submitted by a trader via EFD machine. Thereafter, the system produces a report showing all underpriced transactions with the difference amount indicated. This translates that, for any transaction executed by the EFD machine and its report submitted to EFDMS, the system can tell whether it is underpriced or otherwise. Normally with this nature of the business, TRA calculates tax referring to trader's annual total sales, meaning that the amount of tax evaded in a certain financial year quarter can therefore be stipulated (TRA, 2019).

Not only that the system detects underpriced business transactions but also identifies those who avoid the use of EFD machines and who use fake EFD. From the developed solution TRA officers see how stock-in and stock-out operations take place in the trader's stock account. When several drug stocks are acquired by a trader and time elapses without discharging

reasonable amount to other traders/consumers, alert is issued to tax officer where the physical inspection can be arranged to the suspect’s store to confirm whether the stock amount really exists or was sold without using EFD machine or using fake EFD machine. Figure 30 presents the trader's stock account with each transaction statured “Ok” if the transaction diverted not more than -4% from system estimation, “Warning” if diverted -5% from the system estimation and “Evaded ” if transaction deviation is above -5% from the system estimation.

TIN: 15622573200704648  
Item: Panadol Tabs Medium Box

Stock IN					
Stock Source	Date	Quantity	Price	Expire date	
Manufacturer	19/09/2019 09:38	500	17,500	2020-08-12	
Importer	25/09/2019 09:05	1200	3,000	2021-09-30	

Stock OUT						
Buyer TIN	Date	Quantity	Price	Total Sales	Expected	Status
15622569330704832	18/09/2019 14:52	20	1,900	38,000	40,000	Warning
15627609110710975	19/09/2019 09:41	50	1,800	90,000	100,000	Evaded
15644048950729484	19/09/2019 09:42	30	1,950	58,500	60,000	Ok
15627609110710975	19/09/2019 11:20	15	1,980	29,700	30,000	Ok

Figure 32: Trader’s Stock Account in Detail

From the EFDMS various reports are generated according to user requirements. The system allows managers, tax officers and traders to get sales return, stock and tax reports with the options of getting daily, weekly or monthly reports. Figure 33 the present summary of the individual trader tax report. It also describes the total amount of tax to be paid to TRA, the amount paid already and the outstanding tax amount.

**Trader's Tax Report**

Date: 2019/3/1-2020/3/31  TIN: 15649951960805394 [Load Report](#)

TIN	Business Mode	Sales	Income	VAT	Service Levy	Total	Cleared	Outstanding
15649951960805394	Supplier	3,982,500	358,425	0	119,475	477,900	100,000	377,900

Figure 33: Traders General Tax Report

Not only that but, the tax officer/manager can generate all tax reports for all traders with the option of customizing dates such that daily reports, weekly, monthly and so on may be generated. Figure 34 represents such reports.

**Trader's Tax Report**

Date: 2019/2/1-2020/2/29  TIN: All [Load Report](#)

TIN	Business Mode	Sales	Income	VAT	Service Levy	Total	Cleared	Outstanding
15622569330704832	Whole Saler	1,575,000	141,750	0	47,250	189,000	100,000	89,000
15622573200704648	Whole Saler	32,500	2,925	3,900	975	7,800	500	7,300
15627609110710975	Whole Saler	0	0	0	0	0	0	0
15644048950729484	Retailer	0	0	0	0	0	0	0
15649951960805394	Supplier	3,982,500	358,425	0	119,475	477,900	100,000	377,900

Figure 34: General Traders Tax Report

**Receipt verification:** The EFDMS also allows authorized personnel to verify a sales receipt to determine whether the receipt is valid or invalid. Figures 35 and 36 show receipt verification

performed on the system whereby, one of the receipts was revealed to be valid while another is invalid.

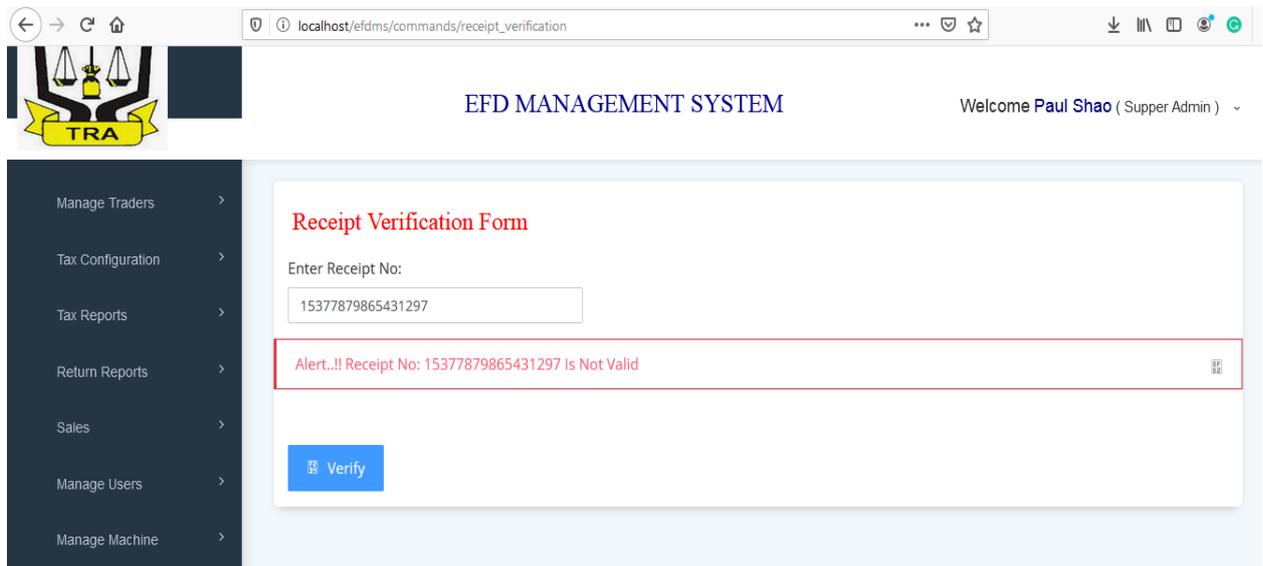


Figure 35: Invalid Receipt

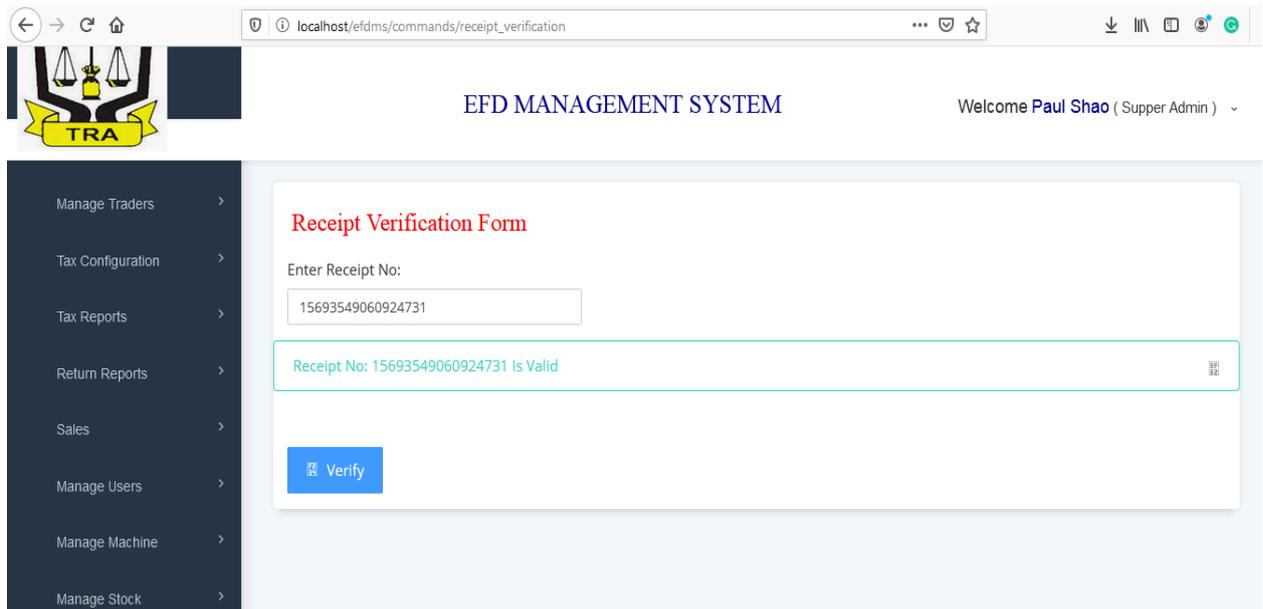


Figure 36: Valid Receipt

## 4.5 System Testing and Validation

As part of system verification and validation, system testing is the process of running the developed system to check whether the system behaves according to user requirements (Kandl

& Elshuber, 2011). In this section, we are going to discuss how unit, integration and user acceptance test was done after system development completed.

#### 4.5.1 Unit Testing

On unit testing, we try each component/module/function to check that they all operate according to designated user requirements. Two system analysts out of four analysts involved during data collection were randomly selected to test whether the system was developed right. Unit testing is considered to be the lowest level of system testing that builds the ground to the next testing hierarchies (Oladimeji, 2007). Table 5 presents the test cases performed.

Table 5: Electronic Fiscal Device Application Unit Test

<b>Unit</b>	<b>Test performed</b>	<b>Status</b>
Fiscalization	Test whether EFD machine configured before use	PASSED
Login	Test whether EFD users are authorized	PASSED
Item Configuration	Test whether item configuration is done	PASSED
Save data (Local)	Test whether sales data are stored in SQLite	PASSED
Send Data to Sever	Test whether sales can be sent to EFDMS server	PASSED
Data Auto-syncing	Test whether SQLite data automatically sync with EFDMS	PASSED
Printing	Test whether EFD machine prints receipts	PASSED
View Reports	Test whether sales reports can be viewed	PASSED
Logout	Test whether login sessions are terminated	PASSED

Table 6: Unit Test for EFDMS

<b>Unit</b>	<b>Test performed</b>	<b>Status</b>
User Management	Check whether user registration, permissions and roles are handled	PASSED
Trader Registration	Check whether traders are registered	PASSED
Generate Trader Reports	Check whether trader reports are generated	PASSED
Business Registration	Check whether businesses are registered	PASSED
Tax Configuration	Check whether tax configurations are done	PASSED
Generate Tax Reports	Check whether X,Y and Z reports are generated	PASSED
Set Prices	Check whether item prices are configured	PASSED
Sales Configuration	Check whether sales routines are configured	PASSED
Register EFD Machine	Check whether EFD machines can be registered	PASSED
Assign EFD Machine	Check whether EFD machine can be assigned to trader	PASSED
Generate EFD Reports	Check whether EFD related reports are generated	PASSED
Drugs Registration	Check whether drugs are registered	PASSED
Stock Registration	Check whether initial stock is registered in the system	PASSED
Trace Stock	Check whether stock can be traced from origin to end	PASSED
Generate Stock Reports	Check whether stock reports are generated	PASSED
Issue Evade Alert	Check whether evade alerts are issued	PASSED
Identify tax evader	Check whether tax evader can be identified	PASSED
Receipt Verification	Check whether receipt can be verified	PASSED
Receive EFD Data	Check whether data can be received from EFD machine	PASSED
Send Data to EFD	Check whether data can be pushed to EFD machine	PASSED
Stock Comparison	Check whether stock can be compared with sales returns	PASSED

#### **4.5.2 Integration Testing**

Integration testing which extends unit testing is the process of testing the overall system by combining all components of the system to test whether the combined units of the system will work properly as it was when were independent (Kandl & Elshuber, 2011).

##### **(i) Electronic Fiscal Device Application**

Considering the EFD application, an integration test was done to check whether by combining synchronization, printing and data submission components we can have the independent system working properly. The test was successful since we had EFD applications send data both to SQLite and EFDMS, printing receipts and as well performing automatic synchronization of data between EFDMS and EFD application.

##### **(ii) Electronic Fiscal Device Management System**

EFDMS had user management, stock management, EFD machine management and trader management units working as independent components. Therefore, system integration involved combining the components to make EFDMS running as a single system.

#### **4.5.3 User Acceptance Test**

This is the stage whereby the system developer takes the developed product to the user to find out whether the solution proposed to solve their problem and answer their business expectations (Ganesh *et al.* 2014). After having full EFDMS and EFD application running, the scholar had to conduct a user acceptance test to have the system operating in a practical environment and get feedback from the user. Thirteen users (13) were involved in testing the system of which two tax officers; one was a system administrator and ten traders who were randomly selected from the sample space involved in data collection. System administrators and tax officers were used to testing both EFDMS and EFD application software while traders were used to testing only EFD application software. Users were left to use the system for seven (7) days and thereafter the questionnaires were provided to them to assess their system satisfaction with assessing criteria being strongly agreed, agree, neutral, disagree and strongly disagree. The results are presented in Table 7.

Table 7: Summary of User Acceptance Test

S/N	Validation Case	Respondents Percentage					Mean Score
		Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	
1	EFD App is compatible with EFDMS	84.6	15.4	0.0	0.0	0.0	4.8
2	The EFDMS is user friend	92.3	7.7	0.0	0.0	0.0	4.9
3	The EFDMS is easier to learn	76.9	23.1	0.0	0.0	0.0	4.7
4	Communication between EFDMS and EFD App is guaranteed	92.3	7.7	0.0	0.0	0.0	4.9
5	EFD machine work as stand-alone and Real time	100	0.00	0.0	0.0	0.0	5.0
6	EFD application generate all required reports	76.9	23.1	0.0	0.0	0.0	4.7
7	EFDMS generate all required reports	69.3	30.7	0.0	0.0	0.0	4.6
8	EFD application is easy to use	84.6	15.4	0.0	0.0	0.0	4.8
9	The system track trader stock	92.3	7.7	0.0	0.0	0.0	4.9
10	The system doesn't fulfilled TRA requirements	0.0	0.0	0.0	15.4	84.6	4.8
11	The system generate reasonable tax estimations	38.5	61.5	0.0	0.0	0.0	4.3
12	The system identifies tax evaders	46.2	46.1	7.7	0.0	0.0	4.3
13	The system will reduce traders complains	30.7	46.2	23.1	0.0	0.0	4.0
14	The system will improve trust between traders and TRA	53.8	38.5	7.7	0.0	0.0	4.4
15	The system will increase tax collection	69.2	30.8	0.0	0.0	0.0	4.6
16	The system will bring chaos	0.0	7.7	7.7	61.5	23.1	4.0

From the results tabled in Table 7, the average mean score is 4.6 which translate to 92%. This explains that the average EFDMS efficiency in tax collection process was improved from 50% - 75% (Detailed in section 4.2) of the current system to 92% of the proposed system.



## CHAPTER FIVE

### CONCLUSSION AND RECOMMENDATIONS

#### 5.1 Conclusion

This study has reviewed both Electronic Fiscal Device Management System, EFD machine and then analyzed requirements for the development of the Stock Tracking Module to mitigating tax evasion to drug traders in Tanzania. Various techniques used by traders to evade tax were uncovered by the study such as; Underpricing of sales, Avoid using EFD machines, Use fake EFD machines to print business receipts, Division of business, Overestimate of expenses and running a business in unknown areas.

Moreover, the study has presented the developed system which is EFDMS and EFD application followed by system testing and validation. The study also confirmed that the developed system if adopted by TRA will increase EFDMS efficiency and hence increase revenue collections as it was able to detect tax evaders.

Lastly, the developed system reduces manual work and the number of tax officers needed for tax inspection and estimation process.

#### 5.2 Recommendations

Though the developed solution detects tax evaders which help the government to enhance revenues collection, however in future, more research is open to integrate EFDMS database with Tanzania Food and Drugs Authority (TFDA) and Tanzania Bureau of Standards (TBS) databases to identify and locate traders owning fake and expired drugs or food products in the market.

The study also opens the door to other scholars to research on incorporating bar code readers into the EFD machine application software to simplify the process of filling-in commodity information during selling items. Since this study considered only one type of business (Pharmaceutical business) future research should also be conducted to gradually bring-in more businesses and finally reach all types of business across the country.

According to the Tanzania tax administration act of 2015, TRA considers a trader as a tax evader when EFD annual returns go below 80% of their expectation (URT, 2015). With

commodity cap-pricing and stock tracking features being incorporated in the developed system the uncertainties of the tax estimation process are much minimized, therefore, this study also recommends that the tax evasion relief percentage be minimized from 20% to 5%.

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## APPENDICES

### Appendix 1: Guided Interview for TRA EFD Officers

**The Nelson Mandela African Institution of Science and Technology**

**Research Tittle: Developing a Tax Evasion Control Module to Improve EFD System Operations for Drug Trading in Tanzania**

#### Guided interview for TRA EFD Officers

My name is Paul E. Shao, a Master Degree student in Information Communication Science and Engineering at Nelson Mandela – African Institute of Science and Technology Arusha. As part of the course, I am carrying out a research on Developing a Tax Evasion Control Module to Improve EFD System Operations for Drug Trading in Tanzania.

This questionnaire is the part of research aiming at gathering necessary data that will help researcher to produce an improved EFD system prototype specifically for drugs trading industry in Tanzania.

The purpose of the research is to develop an improved EFD system prototype with stock tracking module embedded. The improved EFD system will track down drug stock from its point of origin (Manufacturer or Importer) to retailer; making it easy for TRA to detect tax evaders and hence increase amount of tax collections.

The information collected through this questionnaire will highly be treated confidential and used for academic purpose only. Kindly respond to all items to reflect your opinion, suggestion and experience. Your participation is important for the success of this research.

Thanking you in advance and stay blessed.

**SECTION A: Personal Information**

*Please, put a tick (✓) where appropriate*

1. What is your age bracket?
  - (i). 18 to 30 [    ]
  - (ii). 31 to 49 [    ]
  - (iii). 50 and above [    ]
  
2. What is your highest level of educational?
  - a. Primary [    ]
  - b. Ordinary level education [    ]
  - c. Advanced level education [    ]
  - d. College [    ]
  - e. University [    ]
  - f. Other (please specify).....
  
3. What is your occupation?
  - a. Revenue officer [    ]
  - b. EFD machine officer [    ]
  - c. TRA manager [    ]
  - d. Other (please specify).....
  
4. For how long have you been working in your post?
  - a. Less than 6 months [    ]
  - b. 6 months – 1 year [    ]
  - c. 1 year- 5 years [    ]
  - d. More than 5 years [    ]

**SECTION B: Tax & EFD Machine Related Information**

Please tick all items that applies

1. Which are the types of EFD machines used to collect tax?

- a. ETR [ ]
- b. ESD [ ]
- c. EFP [ ]
- d. EFPP [ ]
- e. E – Stamping [ ]
- f. Other (please specify).....

2. Types of tax collected by EFD machine?

- a. VAT [ ]
- b. Income tax [ ]
- c. Import tax [ ]
- d. Corporate tax [ ]
- e. Other (please specify).....

3. Who are eligible traders to pay tax?

.....  
.....

4. Who are eligible traders to pay VAT?

.....  
.....

5. Would you please explain the notion of tax refund? (From TRA to traders).....

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

6. How do you estimate tax to traders?

- a. By looking on trader's capital [ ]
- b. By looking on trader's total sales [ ]
- c. By looking on Z-report submitted [ ]
- d. Other (please specify).....

.....  
.....

7. Does TRA have an estimate on amount of tax to be collected per annum?
- a. Yes [ ]
  - b. No [ ]
  - c. Sometimes 'Yes' sometimes 'No' [ ]
8. Does TRA have information on amount of tax evaded by traders per annum?
- a. Yes [ ]
  - b. No [ ]
  - c. Sometimes 'Yes' sometimes 'No' [ ]

9. What details are printed on EFD machine receipt? *(please tick all items that apply)*

A	Seller's TIN [ ]	G	Buy's Name [ ]	M	Item quantity [ ]
B	Seller's URN [ ]	H	Buyer's TIN [ ]	N	Price per item [ ]
C	Seller's UIN [ ]	I	Receipt Number [ ]	O	Date [ ]
D	Seller's name [ ]	J	Z number [ ]	P	EJ SN [ ]
E	Seller' address [ ]	K	ECR number [ ]	Q	EJ activation date [ ]
F	Seller's phone [ ]	L	Item code [ ]		

Other (please specify)

.....

10. What information are captured on registering new trader.....

.....

.....

.....

.....

11. By not issuing receipt, do traders evade tax?

a. Yes [ ]

b. No [ ]

12. By issuing underpriced receipt do traders evade tax?

a. Yes [ ]

b. No [ ]

13. Are there some traders who issue EFD machine forged receipts?

a. Yes [ ]

b. No [ ]

c. Not sure [  ]

14. If your answer on Qn.9 is 'Yes', is there a way to differentiate between a receipt printed by TRA EFD system and one printed by non-TRA EFD system?

a. Yes [  ]

b. No [  ]

If your answer on Qn.10 is 'Yes', please explain how to differentiate

.....  
.....

15. Is there a way to identify sales with underpriced receipt?

a. Yes [  ]

b. No [  ]

If your answer is Yes, please explain how

.....  
.....

16. Is there a way to identify traders who sales/buy without issuing receipts?

a. Yes [  ]

b. No [  ]

If your answer is Yes, please explain how

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

17. Which techniques are used by traders to evade tax?

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

18. Does the EFD system able to detect tax evaders?

a. Yes [  ]

b. No [  ]

c. Sometimes 'Yes' sometimes 'No' [ ]

If your answer is Yes, please explain how

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

19. Which ways are used by TRA to identify tax evaders?

- a. Using EFD system (Alert from the system) [ ]
- b. Reasonably checking amount of returns on Z report [ ]
- c. Comparing amount of returns and capital [ ]
- d. Other ways (please explain)

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

20. Does TRA set directive price to drug traders?

- a. Yes [ ]
- b. No [ ]
- c. Sometimes 'Yes' sometimes 'No' [ ]

21. Does TRA have information on trader's stock amount?

- a. Yes [ ]
- b. No [ ]
- c. Sometimes 'Yes' sometimes 'No' [ ]

22. Do TRA know on when a drug trader finishes a stock?

- a. Yes [ ]
- b. No [ ]
- c. Sometimes Yes sometimes No [ ]

23. Does TRA have knowledge on when drug trader acquires new stock?

- a. Yes [ ]
- b. No [ ]
- c. Sometimes Yes sometimes No [ ]

24. What are the sources of drugs to Tanzania market?

- a. Domestic industries [ ]



d. Not sure [ ]

32. Please put a tick (✓) on one box per statement using scale of 1-5, **1. Strongly agree** **2. Agree** **3. Neither disagrees nor agrees** **4. Disagree** **5. Strongly disagree.**

Assess the extent to which embedding Stock Tracking Module to EFD system will:

<b>STATEMENTS</b>	1	2	3	4	5
Identify tax evaders					
Increase amount of tax collections					
Identify traders with smuggled drugs					
Improve accuracy on tax estimation					

**Thank you very much for participating in this research, for any question about the study, please call Paul E. Shao at +255762235284 or email him at [shaop@nm-aist.ac.tz](mailto:shaop@nm-aist.ac.tz).**

**Appendix 2: Guided Interview for TRA IT Officers**

**SECTION A: PERSONAL INFORMATION**

*Please, put a tick (✓) where appropriate*

- 5. What is your age bracket?
  - (iv). 18 to 30 [ ]
  - (v). 31 to 49 [ ]
  - (vi). 50 and above [ ]
  
- 6. What is your highest level of educational?
  - g. Primary [ ]
  - h. Ordinary level education [ ]
  - i. Advanced level education [ ]
  - j. College [ ]
  - k. University [ ]
  - l. Other (please specify) .....
- 7. What is your occupation? .....
- 8. For how long have been working in your post?
  - e. Less than 6 months [ ]
  - f. 6 months – 1 year [ ]
  - g. 1 year- 5 years [ ]
  - h. More than 5 years [ ]

**SECTION B: Information Related to EFD System Operation**

*Please tick all items that applies*

2. Which programming languages were used to develop EFD system?

A	PHP [ ]	F	Python [ ]
B	Java [ ]	G	CSS [ ]
C	C [ ]	H	HTML [ ]
D	C++ [ ]	I	Java scripts [ ]
E	C# [ ]		

Other (please specify).....

.....

3. Which types of Database Management System are used in EFD system?

- a. Postgresql [ ]
- b. Mysql [ ]
- c. Oracle [ ]
- d. Other (please specify).....

4. What are the types of users on the EFD system?

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

5. What are the levels of IT users on EFD system?

.....  
 .....

6. What business processes available in EFD system?

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

7. What details are printed on EFD machine receipt? (please tick all items that apply)

A	Seller's TIN [ ]	G	Buy's Name [ ]	M	Item quantity [ ]
B	Seller's URN [ ]	H	Buyer's TIN [ ]	N	Price per item [ ]

C	Seller's UIN [ ]	I	Receipt Number [ ]	O	Date [ ]
D	Seller's name [ ]	J	Z number [ ]	P	EJ SN [ ]
E	Seller's address [ ]	K	ECR number [ ]	Q	EJ activation date [ ]
F	Seller's phone [ ]	L	Item code [ ]		

8. Other (please specify)

.....  
 .....

9. Which operating modes are available on EFD machine?

- a. X-report mode [ ]
- b. Z-report mode [ ]
- c. Registration mode [ ]
- d. Programming mode [ ]
- e. Service mode [ ]
- f. Other (please specify) .....

10. Are there other addition operating modes do you think should be added to EFD machine?

.....  
 .....

11. Which reports are received by EFD system from EFD user?

.....  
 .....

12. What reports do current system generate both to traders and TRA officials

.....  
 .....

13. Are there additional reports do you think the system should generate for traders and TRA officials?

.....

.....  
.....  
14. In what format does Z-report transmitted from EFD machine to TRA system are?

- a. As a text [ ]
- b. As a file [ ]
- c. Both a and b [ ]
- d. Other format (please specify) .....

.....  
15. From EFD machine user to TRA server, Z-reports are uploaded direct to TRA servers via mobile phone operating companies.

- a. True [ ]
- b. False [ ]

16. If your answer on Qn.15 is FALSE, please specify how Z-reports are transmitted between EFD user and TRA servers.

.....  
.....  
17. In what format (data type) does the Z-report stored in database?

- a. As a text [ ]
- b. As a file [ ]
- c. Both a and b [ ]
- d. Other format (please specify).....

.....  
18. How would you rate the efficiency of the current EFD system in collecting tax? (satisfaction level)

- a. 90% -100% [ ]
- b. 75% - 90% [ ]
- c. 50% - 75% [ ]
- d. Below 50% [ ]

19. What technological challenges do you think current EFD system is facing that need immediate rectification?

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

20. Do you think by embedding Stock Tracking Module into the current EFD system will have an impact on mitigating tax evasion?

- a. Yes [    ]
- b. No [    ]
- c. Not sure [    ]

### Appendix 3: Questionnaire for Drug Traders

#### SECTION A: PERSONAL INFORMATION

*Please, put a tick (✓) where appropriate*

9. What is your age bracket?

(vii). 18 to 30 [    ]

(viii). 31 to 49 [    ]

(ix). 50 and above [    ]

10. What is your highest level of educational?

m. Primary [    ]

n. Ordinary level education [    ]

o. Advanced level education [    ]

p. College [    ]

q. University [    ]

r. Other (please specify) .....

11. What is your occupation?

e. A doctor [    ]

f. Pharmacists [    ]

g. Nurse [    ]

h. Pharmaceutical technician [    ]

i. Pharmaceutical assistance [    ]

j. Other (please specify) .....

12. For how long have you been working in your post?

i. Less than 6 months [    ]

j. 6 months – 1 year [    ]

k. 1 year- 5 years [    ]

1. More than 5 years [ ]

## SECTION B: Drugs and Tax Related Information

Please, put a tick (✓) where appropriate (Also note that one question may have more than one answer)

1. At your work, do you normally use an IT system to store drug records?
  - a. Yes [    ]
  - b. No [    ]
2. If your answer on Qn.1 was 'Yes' what information do you fill in to make a drug record?

A	Brand name [    ]	G	Expire Date [    ]
B	Drug type [    ]	H	Drug Formulation [    ]
C	Quantity [    ]	I	Drug content [    ]
D	Serial number [    ]	J	Usage [    ]
E	Batch number [    ]		
F	Manufacture date [    ]		

Other (please specify)

.....  
 .....

3. If your answer on Qn.1 was 'No' how do you store drug records?
  - a. On a book [    ]
  - b. On excel sheet [    ]
4. For Qn.3 what information do you fill in to make a drug record?

A	Brand name [    ]	G	Expire Date [    ]
B	Drug type [    ]	H	Drug Formulation [    ]
C	Quantity [    ]	I	Drug content [    ]
D	Serial number [    ]	J	Usage [    ]
E	Batch number [    ]		

F	Manufacture date [   ]
---	------------------------

Other (please specify)

.....

.....

.....

5. Where do you normally acquire drug stock from?
  - a. Fellow retailer [   ]
  - b. Whole seller [   ]
  - c. Factory within the country [   ]
  - d. Factory outside the country [   ]
6. How much of the stock should remain before you order new stock?
  - a. 50%
  - b. Greater than 25% but less than 50%
  - c. Greater than 10% but less than 25%
  - d. Less than 10%
7. During selling drug, how long does it take to fill in a receipt partial enough to be printed?
  - a. Less than 30 seconds [   ]
  - b. More than 30 seconds but less than a minute [   ]
  - c. More than minute [   ]
8. How long does it take to fill in a receipt fully?
  - a. Less than 30 seconds [   ]
  - b. More than 30 seconds but less than a minute [   ]
  - c. More than a 1 minute [   ]
9. Do you find it tedious to fill in all information prompted by EFD machine during selling?
  - a. Yes [   ]
  - b. No [   ]
10. Do you think some drug traders do evade tax?
  - a. Yes [   ]
  - b. No [   ]

11. If your answer in Qn.10 was 'Yes', for your own understanding what do you think are the techniques used by traders to evade tax?

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

## **Appendix 4: System Validation Questionnaire**

**The Nelson Mandela African Institution of Science and Technology**

**Research Title: Developing a Tax Evasion Control Module to Improve EFD System  
Operations for Drug Trading in Tanzania**

### **System Validation Questionnaire**

Dear Sir/Madam;

The aim of this questionnaire is to validate the developed Electronic Fiscal Device Management System (EFDMS) and Electronic Fiscal Device Application (EFD Application) to check whether the system satisfies the expected user business needs.

#### **SECTION A: Introduction**

What is your occupation?

- a. Tax officer [    ]
- b. TRA manager [    ]
- c. IT officer [    ]
- d. Drug Trader [    ]
- e. Other (please specify .....