



**ADDIS ABABA UNIVERSITY**

**COLLEGE OF BUSINESS AND ECONOMICS**

**DEPARTMENT OF LOGISTICS AND SUPPLY CHAIN MANAGEMENT**

**“The Effect of Implementation of Internet of Things (IoT) on  
Warehouse Management” at Ethiopian Airlines Warehouse**

**By:**

**Teshome Yenealem**

**JUNE/2022**

**ADDIS ABABA, ETHIOPIA**

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**A Master Thesis Submitted to Addis Ababa University College of Business and Economics  
Department of Logistics and Supply Chain Management in Partial Fulfillments for the  
Requirements of Award of Degree of Master of Art (MA) in Logistics and Supply Chain  
Management.**

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**Dr. Mengistu Bogale (PhD)**

**JUNE/2022**

**ADDIS ABABA, ETHIOPIA**

## DECLARATION

I hereby declare that the work which is being presented in this thesis entitled “*Effect of Internet of Things (IoT) on warehouse management at Ethiopian airlines Cargo division*” is an original work of my own, it has not been presented for a degree to any other universities and all the materials used for this thesis have been duly acknowledged.

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**Teshome Yenealem**

**(Candidate)**

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**Date**

This is to certify that the above declaration made by the candidate is correct to the best of my knowledge.

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## **LIST OF ABBREVIATIONS**

ADD	Addis Ababa
EAL	Ethiopian Airlines
MRO	Maintenance Repair and overhaul
IT	Information Technology
SCM	Supply chain management
SKYTRAX	(UK based consultancy which runs an airline and airport review and ranking site)
IoT	Internet of Things
ULD	Unit load device
RFID	Radio Frequency Identification
WMS	Warehouse management System

## **ABSTRACT**

*This thesis was carried out to identify the effect of Internet of things (IoT), the best and contemporary words in logistics and supply chain management which is believed, if applied properly, very helpful on productivity. Ethiopian airline is one of the leading aviation industries in the world and the pioneer in Africa in terms of quality service, profit and capacity. The airline has built a new cargo ware house on March2013. The new warehouse, built in line with the highest international standards, covers a total area of 3700 sq. meters. It has a capacity to accommodate four aircraft cargo loads at one-time. The warehouse has a receiving, skid storage, palatalization, and ULD storage area of 3,500 sq. meters. It has a controlled temperature facility ranging from 2 to 4 degrees centigrade. To track and manage this ultra-modern warehouse, the airlines has equipped with latest applications and technologies or IoT; these technologies, applications and systems are expected to bring change in the overall function of the cargo warehouse. Thus, this thesis used a descriptive study design and targeted 80 respondents selected from different departments and sections of the cargo warehouse, some importers and exporters (customers of EAL). Data was collected using a self-administered questionnaire. Central tendencies such as mean and standard deviation were used to describe the effect of IoT on the warehouse management. The data were analyzed using the SPSS. The finding of this thesis revealed that there is enough IoT tools and applications in the EAL warehouse, IoT Has brought better change in the overall warehouse management despite some discrepancies. However, employees need to get generic and recurrent trainings on IoT, The EAL also shall establish a collaborative agreement with stake holders to establish a common customer service and better customer satisfaction.*

**Key Word:** *Cargo, Internet of things (IoT), Warehouse ,Warehouse management System, Supply Chain Management*

# Chapter One - Introduction

## 1.1 Background of the Study

The concept and word of IoT was first coined in 1999 by Kevin Ashton, co-founder and executive director of the Auto-ID Center at MIT. The IoT is the next generation of internet-connected embedded ICT systems to integrate supply chain and logistics processes seamlessly in a digital environment (Naser, 2019). IoT creates a connected network between physical objects and devices through internet. IoT facilitates things to be located, identified, and controlled via global platform. This allows organizations to real-time manage, organize, and monitor their supply chains. Moreover, enhance the capability of organizations to integrate with suppliers, customers, and internal organizational processes (*De Vass et al., 2018*). IoT are used to gather data and monitor actions through the production environment aiming to solve business problems and improve customer services (*Lu and Weng 2018*). Further, *Manavalan and Jayakrishna (2019)* have defined (IoT) as: “Technology which is intuitive, robust and scalable that enables digital transformation of the connected world through internet and communicates all the relevant information in real time across the value chain”. In order to achieve the innovation of IoT wireless technologies as said before, information and communication technologies (ICT) applications are required to be adopted by organizations. These applications are like enterprise resource planning (ERP), barcode, email, RFID, and warehouse management systems (WMS). The mentioned applications are helpful to collect and share data in a network of organizations on real-time basis via internet connectivity. Therefore, the usage of IoT facilitates bridging the gap between physical and digital world through synchronizing the information flow with the physical flow. Moreover, IoT has evolved from the innovations of wireless technologies sensors and internet that connects the network systems and devices wirelessly like RFID technology, which provides solutions and functions to develop the operation, supply chain, manufacturing and logistics industries (*Manavalan and Jayakrishna, 2019*)

The fourth industrial revolution can be described as “a shift in the manufacturing logic towards an increasingly decentralized, self-regulating approach of value creation, enabled by concepts

and technologies such as cyber-physical system (CPS), Internet of Things (IoT), Internet of Services (IoS), cloud computing and additive manufacturing and smart factories” (Hofmann and Rüsçh 2017). Applying the concepts of IoT and CPS to the manufacturing environment has led to the definition of Industry 4.0 that helps in developing smart production, smart products and smart services (Wollschlaeger et al. 2017).

Warehouse is an area that functions to store goods for production or production results in a certain amount and time span which is then distributed to the intended location based on demand on Warehouse management system (WMS) or PPIC. There are various types of warehouses: they can be classified into production warehouses and distribution centers (Ghiani et al, 2004) and by their roles in the supply chain they can be classified as raw materials warehouses, work-in-process warehouses, finished good warehouses, distribution warehouses, fulfillment warehouses, local warehouses direct to customer demand, and value-added service warehouses (Frazelle, 2001).

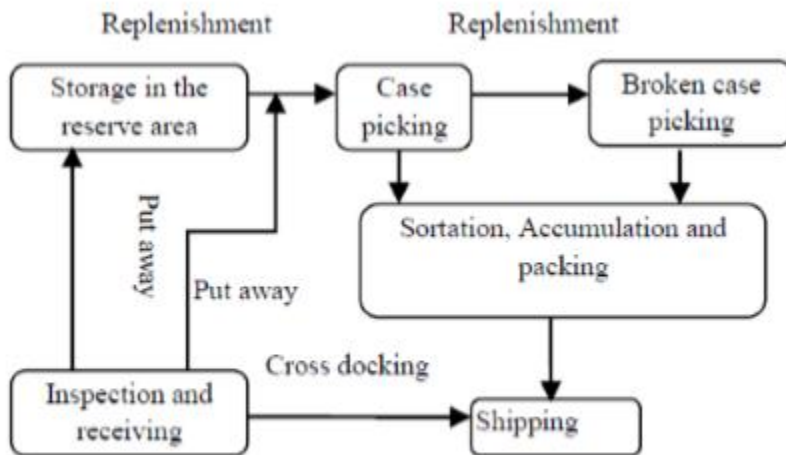


Figure 1. Typical warehouse functions

Figure 1. Typical warehouse functions

Source: (Ramaa, A., Subramanya, K. N., & Rangaswamy, T. M. 2012).

Warehouse Management System (WMS) is a database-based computer application system, which is used to improve warehouse efficiency in maintaining the accuracy of inventory data by recording every transaction in a warehouse (Ramaa et al, 2012).

The purpose of this system is to control the movement and storage of inventory in a warehouse and process transactions related to receiving, selecting, taking and shipping inventory in a warehouse (Faber, 2013).

Warehouses are used mostly to store things that are plainly required for an hour and other commodities. In most situations, it is impossible for users to locate the goods since it must start manually in the very time-consuming storage rooms. A warehouse management system is created to eliminate this problem and may immediately circulate the updates and let everyone know about the activities. (*Manisha Sahu, July 06, 2021 "Internet of things"*)

Ethiopian Airlines has also implemented the concept and practice of IoT almost as earlier as most global best airlines does and are now implementing it in its ultra-modern cargo warehouse.

Taking the above backgrounds, the researcher will assess and evaluate the effect of Internet of things on warehouse management of Ethiopian airlines Cargo division by incorporating Internet of things, Cargo warehouse and IT systems and applications as an Independent variables of the study and on the other side Customer satisfaction, performance of cargo division and effective warehouse management as dependent variables of the research.

## **1.2 Background of the Company**

Ethiopian Airlines is the largest Aviation Group in Africa and SKYTRAX certified Four Star Global Airline which has made its maiden international flight to Cairo in 1946. In its seventy plus years of operation, Ethiopian has become one of the continent's leading carriers, unrivalled in efficiency and operational success.

Ethiopian airline is operating by merging Six business centers: Ethiopian International Services; Ethiopian Cargo & Logistics Services; Ethiopian MRO Services; Ethiopian Aviation Academy; Ethiopian ADD Hub Ground Services and Ethiopian Airports Services. Thus, Ethiopian cargo and logistics is one of the main divisions of these units which mainly provides logistics service through its huge cargo warehouse equipped with a new state of the art facility at a total of 3700 sq. meters established on March 09, 2013.

Ethiopian airline is the largest cargo network operator in Africa and one of the major global cargo carriers with a modern warehouse of 1 million tons storage capacity. Currently, it has an annual cargo uplift of 432,417 tons and an estimated cargo uplift of 493,211tons by end of 2019/2020 fiscal year.

(Ethiopian airlines portal archive and <https://ethiopiancargo.azurewebsites.net/>.)

### **1.3 Statement of the problem**

The possibilities of using the IoT technology are growing in parallel with innovations. In the context of warehousing systems, the IoT allows the connection of previously unreliable physical components to the network, thus managing the storage facility and facilitating it. Particularly problematic components of each warehouse are inventories and operations associated with their management. Traditional systems in most cases include manual manipulations of inventory as well as inventory management based on human. However, by deploying sensors and linking them to the network, sensors can look at real-time inventory, which greatly facilitates their management. Therefore, the new warehouse system is based only on IT with human as an operator that only controls the process. This approach is based on RFID technology, which is the basis for deploying and using this approach. [15] The IoT and RFID technology not only simplify inventory deployment, but anticipate future orders, tracking product durability, temperature, humidity in the air, and other parameters that could affect product damage. RIFD

technology is the foundation for the functioning and development of the IoT system. [16] The application of RFID technology in warehouse management has a number of advantages that primarily relate to increasing efficiency, accuracy and updating of information, as well as tracking stocks and inventory losses.(Kresimir Buntak, Matija Kovacic, Maja Mutavdzija, 2019).

Warehouse errors can be costly. Inaccurate operations and errors require more labor to fix, adding unnecessary costs. IoT devices can help reduce manual labor, errors, and help to increase processing speeds and overall warehouse efficiency. Companies are installing IoT sensors in their warehouses to monitor the movement and use of material and other assets inside their facilities. Businesses are also using sensors on shelves to transmit real-time inventory information to their management system. IoT and smart warehouse management is helping to eliminate expensive and time-wasting mistakes by ensuring inventory levels and equipment locations are clearly known and constantly monitored.

However, the traditional supply chain was not designed to handle a large volume of small orders for immediate delivery. Whether or not a particular item is in stock online or in a nearby store not only affects potential sales, it also can have lasting effects on customer loyalty and a company's reputation. Manufacturers, retailers, warehouses and logistics providers are all struggling to adjust to meet these new demands on their supply chains. Because of these new consumers buying habits, companies are adjusting their internal processes, staffing and technology to meet the needs and expectations of demanding consumers (Grainger 2020).

Based on the physical visit the researcher has made most of the Ethiopian airlines cargo premises, specially its warehouse it was equipped with the latest aviation technologies to run the warehouse service smoothly. However, as per the interview made with staffs and my physical visit, they are still mainly using the worldwide tracer to trace and identify materials and goods which is widely applicable globally and have observed that they seems not fully skilled and manipulating the equipped technology. due to this, the effect of these tools, equipment and applications were not fully disclosed and understood.

Furthermore, it was very difficult to find any article and research made on Ethiopian airlines cargo warehouse as highly exhibited while conducting the whole thesis. I also strongly believe that this thesis might be used for other researchers who will conduct similar research and/or thesis on the area.

## **1.4 Basic Research Questions**

Inferring from the above statement of the problem, this thesis has tried to address the below listed basic questions.

- ❖ Does Ethiopian airline cargo warehouse effectively implement the IoT in its warehouse management.
- ❖ What are the main challenges of practicing IoT in Ethiopian airlines cargo division warehouse?
- ❖ What are the main effects and outcomes of using IoT on the warehouse management of EAL warehouse?

## **1.5 Objective of the study**

### **1.5.1 General objective of the study**

The general objective of this thesis is to assess and evaluate the effect of IoT and its application on the overall warehouse management of Ethiopian airlines Cargo division warehouse.

### **1.5.2 Specific objectives**

Besides the above general objective, the thesis will have the below listed specific objectives to be addressed in the entire content.

- ✓ To identify the basic challenges of using IoT on EAL cargo warehouse and its personnel staffs.
- ✓ To assess the basic changes exhibited in the warehouse management of EAL cargo warehouse after applying the IoT.

- ✓ To assess if EAL cargo division is whether updating the existing IoT tools in its warehouse or not.

## 1.6 Definition of Terms

- ✓ **Air Cargo-** Air cargo is another term for air freight. It is the carriage or the transportation of goods through an air carrier. Transport services via air are the most valuable when it comes to moving express shipments around the globe and it consists of air mail, air freight and air express. Air cargo also flies in the same gateway as the commercial or passenger airlines. (<https://www.saloodo.com/logistics-dictionary/air-cargo/>)
- ✓ **Internet of things (IoT)-** The Internet of Things (IoT) means everyday objects – essentially everything with a plug – get equipped with electronics and can exchange data over the internet (Gartner 2015).
- ✓ **Inventory Management-** Inventory management refers to having sufficient inventories to fulfill the customers' requirements and simultaneously reducing the storage cost. Inventory control basically aims at balancing the customer satisfaction level and reducing the cost at the same time. (*logistics and warehousing management ISBN:978-93-8979-50-9*)
- ✓ **Supply chain management (SCM)-** Supply chain management (SCM) is the management of the interconnection of organizations that relate to each other through upstream and downstream linkages between the process that produces value to the ultimate consumer in the form of products and services. The main key of the success of any supply chain is to understand and satisfy customers' needs with the highest quality of products on time, that can be obtainable by eliminating non value-added activities, improving processes and making the supply chain more agile” (Kovács and Kot 2016)
- ✓ **Smart warehouse-** Smart warehouses are inventory systems where part or all of the inventory processes are automated. Interconnected technologies work together to streamline warehouse operations towards increased productivity and efficiency. Smart warehouses use artificial intelligence (AI) and the Internet of Things (IoT) to connect each warehouse process. This helps automate tasks, consolidate information, and analyze

data towards improved operations (<https://www.redwoodlogistics.com/smart-warehouses-and-inventory-management/>)

- ✓ **Warehouse-** Warehouses are a basic part of the supply chain; they are used to store products and manage the inventory level. A sound warehouse management system can lead to cost reduction and also can improve customer satisfaction. Traditional warehouse management models have become less efficient and unsuitable for today's increasing market requirements. (Noha 2019)
- ✓ **Warehouse management-** Warehouse management is the act of organizing and controlling everything within your warehouse – and making sure it all runs in the most optimal way possible. This includes: Arranging the warehouse and its inventory, Having and maintaining the appropriate equipment, Managing new stock coming into the facility, Picking, packing and shipping orders, Tracking and improving overall warehouse performance, Most high growth retailers would use automation tools (like some form of warehouse Management System) to control this part of their supply chain (warehouse management complete guide, <https://www.veeqo.com/wp-content/uploads/2018/04/Warehouse-Management-PDF.pdf>)
- ✓ **Warehouse management system (WMS)-** it is a system that processes the data and converts it into useful information and actions. (Noha 2019, 6-7)

## 1.7 Significance of the study

As the term and practice of Internet of things (IoT) is a new fashion phenomenon which has changed the global business connection and smooth operational functioning in many industries by exhibiting many benefits from it, I believe Ethiopian airlines to use the IoT at optimum level and proceed in leading the global cargo service competition. Hence, this study is expected to bring the below listed significances.

- ✓ It might enable the Ethiopian airlines cargo division to identify where the challenge and gap of using IoT lies in.
- ✓ The EAL cargo division might get inputs to take proactive action for the identified gaps on IoT.

- ✓ It might also be used as a reference for future researchers who will conduct on similar topic; as I have observed, there is no any research in this topic made so far.

## **1.8 Limitation of the study**

This thesis has been limited by some challenges like the work load of employees and to share their time and prevalence of limited access on some documents by claiming it as confidential. Absence of related researches made locally in similar topics has also challenged the researcher. Besides these, high work load on employees and existing work ethics in the Ethiopian airlines cargo warehouse made many respondents to give less attention and time for the data being collected. However, the researcher has been going through lots of management staffs to get the approval and used some related international publications for reference purpose.

## **1.9 Scope of the study**

This study is limited only in Ethiopian airlines cargo and logistics division warehouse only. However, the use of IoT in the EAL cargo warehouse is operated through different active applications and different aviation sectors working globally to trace cargo items. Thus, this interconnectedness globally might affect the IoT application on the EAL cargo division warehouse management service. Consequently, the research findings and hypothetical analysis in this study will be stronger while applying only in the EAL cargo section warehouse service and would have been better in reliability and findings if it was wider in scope wise.

## **1.10 Organization of the study**

The content of this study is organized in five chapters. Chapter one contains with introduction part of the whole study on which general concepts and information about Internet of Things (IoT) were discussed , chapter two deals with the review of related literature where many related topics with this study are being discussed with different topics, chapter three presented the research methodology part where the specific research methodologies which is applied in this specific thesis have been mentioned, chapter four contains about data result and discussion where

the data presentation, analysis and interpretation of the paper is being carried out as per the findings of different types of data collected in many ways and the final chapter which is chapter five is comprised of valid summary, conclusion, recommendations and proposed future research directions ; here possible recommendations and future course of actions have been forwarded and suggested following the summary findings of the paper.

## **Chapter II**

# **Literature Review**

### **2.1 Internet of things (IoT)**

The term IoT was used first in 1999 by Kevin Ashton (2009) and the popularity increased when the automotive industry was the pioneer in using new approaches evolving from IoT (Fang, Huang, & Li, 2013). But also, in other industries the transformation from traditional technologies to Industry 4.0, which is regarding to Lee et al. (2017) the IoT technology, is getting more important (Lee & Lee, 2015). Existing literature defines IoT as a “dynamic global network infrastructure where objects are connected, monitored and optimized” (Zhang, Zhao, & Qian, 2017, p. 1891). It is a kind of a network which is exchanging real-time information and communicating by using sensing methods to combine the different systems via the Internet with wired or wireless systems (Zhang et al., 2017). This makes it possible to monitor, track, locate and identify different objects (Jiang, Yang, & Gao, 2015). Dixon, Jonas, and McCaughan (1982) describe the advantage of increased automated processes with reduced labour and labour costs or newly attracted customers due to value-added services and innovative solutions (Dixon et al., 1982; Lee et al., 2017). The literature already introduces a further development of IoT, the Industrial Internet of Things (IIoT) which is an expansion of IoT to manufacturing or industrial domains (Lee et al., 2017).

## 2.2 Layers of the IoT structure

According to Jiang et al. (2015), Atmojo, Salcic, Wang, and Park (2015) and Atzori et al. (2010), the structure of IoT has three different layers: sensing, network and application. An overview of the three different layers is given in Figure 2. This system is based on the Internet and is able to connect virtual networks with the real world. “The structural elements of an IoT system rely on things and people through the use of services associated with devices, sensors, actuators and software components” (Trab et al., 2017, p. 56). This means that the IoT structure needs to be able to deal with huge quantities of data and numerous types of devices, sensors and actors (Lee et al., 2017).

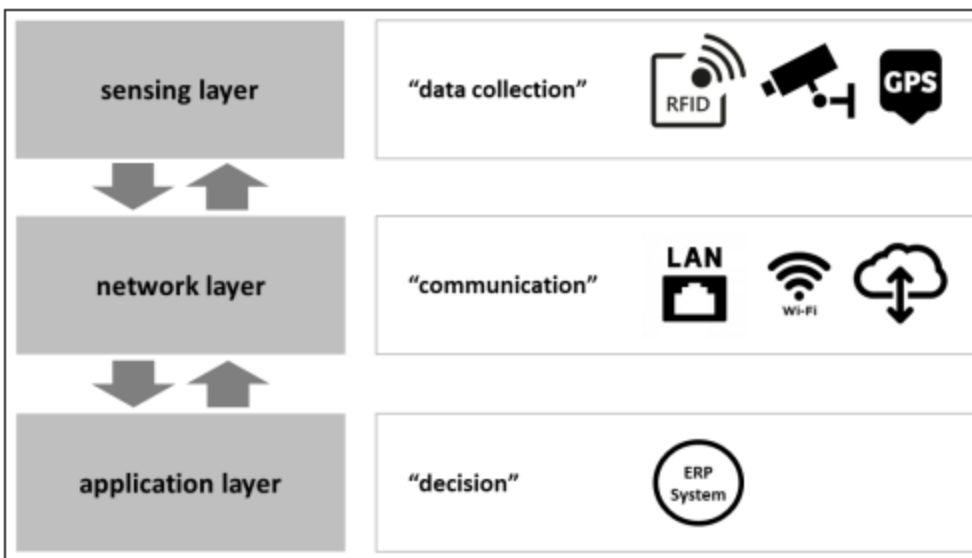


Fig2. Layers of IoT structures

- I. the sensing layer, Jiang et al. (2015, p. 93) qualify it as “a comprehensive, intelligent perception by obtaining the data of the physical world.” This layer includes for example code tags, RFID tags, readers, cameras, GPS or other sensors. The basis of the sensing layer is to collect and store information which is read and identified by using a RFID device or bar code. Zhang et al. (2017) exemplary describe the usage of sensor technologies for the transportation of perishable goods. Sensors can monitor and track the

temperature, light and humidity in the transportation vehicle or region. The identified information is needed later on for the application layer to take scientific decisions based on the system. This information will be transferred back to the sensing layer to be able to fulfil the analyzed task from the application layer.

- II. The network layer is the connection between the other two layers – sensing and application (Atzori et al., 2010; Jiang et al., 2015). The most commonly used network technologies are wired communication, wireless communication, the Internet and cloud computing. These networks represent the communication between ‘people & objects’, ‘objects & objects’ and ‘the physical & real world’.
- III. The application layer is the decision level of the IoT structure (Jiang et al., 2015). All the collected and stored information of the above layers is summarized and exported to the final user. This is mostly done via an enterprise-resource-planning (ERP) system (Atzori et al., 2010).

## **2.3 Industry 4.0 Key Technologies**

The fourth industrial revolution or Industry 4.0 can be described as “a shift in the manufacturing logic towards an increasingly decentralized, self-regulating approach of value creation, enabled by concepts and technologies such as cyber-physical system (CPS), Internet of Things (IoT), Internet of Services (IoS), cloud computing and additive manufacturing and smart factories” (Hofmann and Rüsçh 2017). Applying the concepts of IoT and CPS to the manufacturing environment has led to the definition of Industry 4.0 that helps in developing smart production, smart products and smart services (Wollschlaeger et al. 2017).

Industry 4.0 is the emergence of new digital industrial technology helps companies achieve massive gains in productivity, reliability, and efficiency in order to satisfy customer needs and hence gain more profit (Degryse 2016). Industry 4.0 is based on four key technologies; the first one is CPS, an integrated system of communication, computing and control used for bringing

together the physical and virtual worlds in many fields such as motorcycle manufacturing, transportation, and logistics. The second technology is mobile internet and IoT technologies which help in making interactions between human and machines, and between machines to machines (make things able to talk), and can easily implement intelligent identification, location, monitoring, tracking and control. The third technology is cloud computing technology which deals with a computing a service over the internet with low cost and high performance and provides several internet services such as software, platforms, hardware and other information technology (IT) infrastructures. The fourth technology is big data and advanced analysis techniques which are used for processing different data types by using new processing methods to produce reliable information quickly, hence helping companies in decision making, improving processes, improving operational efficiencies and reducing costs (Zhou et al. 2015).

## **2.4 Warehouse Management System**

Nee (2009) studied the impact of adopting WMS on the overall business performance through using wireless barcodes and Management Information Systems (MIS), it was found that adopting WMS helps in reducing costs, making management more efficient, making process more flexible, and making lead-time delivery shorter, thus meeting customer requirements faster, increasing customer satisfaction that improves competitiveness, and also helping in inventory investment reduction. Sahuri and Utomo (2016) presented a system based on web service that can help small enterprises to improve their warehouse management and business, the main idea of this system is to send information about the stock to the mobile phone through Short Message Service (SMS), it helps in supporting faster and easier decision-making because it provides accurate data compared to the manual system that depends on recording all items the manually. Adiono et al. (2017) proposed an RFID-based goods locator system that consists of RFID tags attached to the items including information about them, and RFID readers to sense the distance to the location of the purchased item. The reader is connected by Bluetooth to a WMS installed in a smartphone. This system helps in updating inventory in a real-time, shortening the time

needed to find the purchased items, increasing the efficiency of the WMS and providing faster delivery. Oner et al. (2017) designed an RFID-based information system framework for a wool yarn industry for the purpose of tracking work-in-progress, counting and tracking inventories, picking, receiving and shipping of semi-finished products. The authors have also performed a cost benefit analysis for the proposed system that reduced the required workforce by 20% and decreased the lost work-in progress rate, thus reducing costs and improving the overall performance of the wool yarn industry. Wei et al. (2015) discussed the functional design of the WMS for a pharmaceutical enterprise by using barcode management application, it helped in managing inventories effectively, decreasing workforce costs, and supporting decision making depending on data warehouses. Qin et al. (2017) studied the impact of using RFID on the problem of inaccurate inventory through proposing an assessment model. The inaccurate inventory problem resulted from information distortion through the supply chain is called the bullwhip effect; this problem leads to an increase in holding and shortage costs. The authors founded that utilizing RFID in the downstream results in more benefits and efficiency compared to when utilizing it in the upstream stages. Han and Zhu (2017) analyzed the logistics of warehousing system and analyzed the existing problems for the purpose of finding methods to improve logistics and storage system. The authors have presented an optimization design of logistics and warehousing by establishing a warehouse management information system that can improve the efficiency of the enterprise, strengthen the coordination between all departments, reduce labor size, solve the problem of material confusion and reduce costs. Patil et al. (2018) proposed a dynamic web application system by using a Software-as-a-Service (SaaS) that provides a cloud-based application of WMS, this helped in converting manual work to a software work that helps the user to access data easily and fast and make work more accurate, the proposed system also helped in managing warehouses effectively, increase visibility, capture real-time data and provide a graphical analysis for product stocks, purchase order, stock in and stock out. Woźniakowski et al. (2018) discussed the difference between ERP systems and WMSs, they founded that the two systems supplement each other, and their integration brings

most profit to the enterprise. Pane et al. (2018) implemented an RFID system in WMS by using Arduino Uno microcontroller and found that it facilitated the work of warehouse labor, helped in Proceedings of the International Conference on Industrial Engineering and Operations Management Washington DC, USA, September 27-29, 2018 © IEOM Society International 2556 controlling operations efficiently, speeded up work processes, reduced error rate, increased warehouse productivity and modernized work processes. Mao et al. (2018) designed a functional framework of intelligent WMS based on cloud model using RFID and GPS and proposed a hybrid genetic algorithm based on bee colony optimization to solve the scheduling problem of the cloud, the proposed system provided a real-time data that helped in making better scheduling and decision making. Information sharing has played a vital role in managing supply chains efficiently, it contributes in reducing the bullwhip effect and improving the performance of the whole supply chain. Jonsson and Mattsson (2013) studied the impact and value of sharing four types of planning information on the inventory capital using re-order point methods by developing a simulation model, the types of information were stock-on-hand data, customer forecasts, planned orders and point-of-sales data, they found that the impact and value of shared information depends on whether the demand is stationary or not; in the case of stationary demand, the stock-on hand information has higher value, in the case of the non-stationary demand, the planned order and demand forecast information has high value. Shared information about point-of sales has no value whether demand is stationary or not, thus it is very significant to decide how and when to share planning information.

## **2.5 RFID System in warehouse**

RFID stands for Radio Frequency Identification. Among the wireless communication technologies like Bluetooth infrared, ultrasonic, video camera, RFID. The RFID suits to be the best because it is low cost, robust can be easily integrated into any field of application. The RFID serves as the representation of any basic RFID system. The RFID works on the revelation of EM

signals. The RFID system consists of a tag and reader, depending on our application the selection of tags can be made. (L.M. Ni, Y. Liu, Y.C. Lau 2004, D. Fortin 2012)

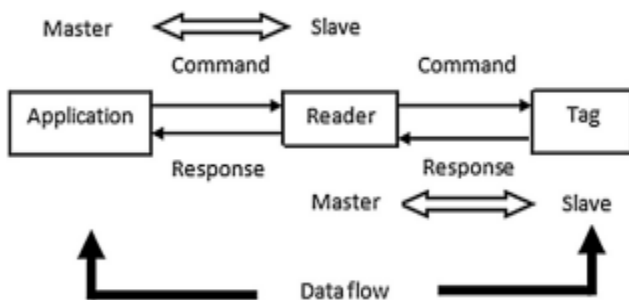


Fig 3. Components of RFID system

According to *Sai Subrahmanya Tejesh 2019*, the Warehouse inventory management system is one of the application of RFID technology, because RFID can uniquely identify products or goods attached with tags. The RFID reader, em-18, used to read RFID tags of 125 kHz frequency tags. The RFID reader operates at a voltage of 5 V. The Reader has two fundamental objectives: initially reader to transmit a carrier signal, and the subsequent is to receive a response from any tags in the proximity of the reader. The RFID reader emits a short range radio signal which is picked by a RFID tag and the tag is triggered on. The two RFID readers em-18 is attached at the beginning of the stockroom 1 and stockroom 2 to read the tags. The RFID em-18 works on Universal asynchronous receiver-transmitter (UART) which is one of the simplest and oldest forms of device-to-device digital communication.

## 2.6 Future of Warehouse Systems

By implementing technologies of Industry 4.0, such as the IoT, warehouse systems become more efficient and their performance is improving. By automating warehouse operations, the warehouse system becomes less dependent and responsive to human work variability. By applying autonomous systems in transportation, transshipment loading operations, and

operations of palletized goods to warehouse regal, the flow of goods through warehouses becomes more fluent. However, autonomous systems must be tailored to the storage environment to minimize the risk of collisions. Existing autonomous systems in a large number of cases, by having a barrier remain standing in place, that is, they can only move through previously defined and narrowly restricted corridors (*Pechanová, L., Stareček, A., Bachár, M., & Caganova, D. (2017)*). A potential solution to such and similar problems of implementation is the development of artificial intelligence that is capable of making decisions similar to man-made decisions. Robotic systems with artificial intelligence enable making simpler decisions and adaptation to new circumstances in the environment. (*Thamer, Hendrik & Börold, Axel & Yoga Benggolo, Ariandy & Freitag, Michael. 2018*). The Deep Learning concept moves artificial intelligence and its application to a higher level through the ability of such systems to learn and improve their knowledge without the need for human intervention. (Kim, K. G. (2016). The necessity of developing new warehouse management technology and automation of warehouse operations is growing with increasing storage space size. The potential for warehouse technology development is growing with the drop in the number of workforce available, which is one of the problems that EU countries face (*Pechanová, L., Stareček, A., Bachár, M., & Caganova, D. 2017*). Increasing the demand of the interested parties and market growth is one of the conditions that are placed on storage systems, which is their flexibility and sensitivity to the requirements set. (*Brockmann, T. & Godin, P*) The response to such requests is often seen through the implementation of smart technologies that improve storage processes. One example of technology is glasses that signal an employee an item to take (*Diete, A., Weiland, L., Sztylek, T., & Stuckenschmidt, H. 2016*). Further, the challenges facing storage systems in the future are the reason why an increasing number of organizations become virtual, allowing customers to create orders online and request that the purchased product be delivered to the required location (*Giannikas, E., Woodall, P., McFarlane,*) The implementation of a large number of sensors generates a large amount of information and data stored on the foreseen servers. The Big Data Concept is a new paradigm for warehouse systems and organizations, enabling tracking and prediction of customer orders,

resulting in easier stock management. However, the implementation of smart systems as a result has some challenges and risks that need to be adequately managed (Rozados 2014).

## **2.7 Types of warehouse management System**

Warehouse management systems come in a variety of types and implementation methods, and the type typically depends on the size and nature of the organization. Based on warehouse control system, literature distinguishes three types of warehouse management systems (Faber et al, 2002):

- ✓ Basic WMS – This system is apt to support stock and location control only. It is mainly used to register information. Storing and picking instructions may be generated by the system and possibly displayed on RF-terminals. The warehouse management information is simple and focuses on throughput mainly.
- ✓ Advanced WMS – Above the functionality offered by a basic WMS, an advanced WMS can plan resources and activities to synchronize the flow of goods in the warehouse. The WMS focuses on throughput, stock and capacity analysis.
- ✓ Complex WMS – With a complex WMS the warehouse or group of warehouses can be optimized. Information is available about each product in terms of where it is located (tracking and tracing), what is its destination and why (planning, execution and control). Further, a complex system offers additional functionality like transportation, dock door, and value-added logistics planning which help to optimize the warehouse operations as a whole. Warehouse management systems can be standalone systems or modules of an ERP (Enterprise Resource Planning) system or supply chain execution suite. The primary purpose of a WMS is to control the movement and storage of materials within a warehouse.

## **2.8 Using IoT in warehousing**

Since the evolution of IoT, researchers started to explore the possibility of using this technology in several fields. Few studies addressed this implementation in the field of Supply Chain Management (SCM). In the field of agricultural supply chains, Yan et al. (2016) proposed an IoT-based model that uses RFID for solving the problem of imperfect information and bullwhip effect and introduced two methods of information inquiry for static and dynamic information that help in increasing supply chain efficiency, improve the authenticity and quality of the products because they help operators to easily trace, track and inspect products anytime and in any stage. Qu et al. (2016) proposed an IoT-based real-time production logistics synchronization system under cloud manufacturing environment that integrated cloud manufacturing and IoT infrastructure to face the dynamics occurring in production logistics processes. They considered the proposed system as an adaptive solution to plan infeasibility that results from execution dynamics, the proposed system provides a general method for mixing IoT and cloud manufacturing implementation. Ding (2013) presented a smart WMS based on IoT that provides a great amount of information about different goods by using sensors technologies, thus providing intelligent processing, more control on the storage compared to the traditional system, improved efficiency, reduced costs and reduced error rate. Lee et al. (2018) proposed an IoT-based WMS with advanced data analytical approach by using computational intelligence techniques integrated with the fuzzy logic technique to select the suitable method for picking process. This system could provide better warehouse performance, improved order fulfilment, enhanced packing method, better inventory tracking and improved overall performance of the warehouse.

## **2.9 IoT and ‘Smart Warehouse’ Management**

Warehouse errors can be costly. Inaccurate operations and errors require more labor to fix, adding unnecessary costs. IoT devices can help reduce manual labor, errors, and help to increase processing speeds and overall warehouse efficiency. Companies are installing IoT sensors in their warehouses to monitor the movement and use of material and other assets inside their

facilities. Businesses are also using sensors on shelves to transmit real-time inventory information to their management system. IoT and smart warehouse management is helping to eliminate expensive and time-wasting mistakes by ensuring inventory levels and equipment locations are clearly known and constantly monitored.

While always critical, the real-time accuracy of inventory has never been more important. This is largely due to the rise in online shopping. Today's consumer expects to point, click and receive their orders within days or sometimes hours. Today it's essential that consumers have real-time accurate information of an item's availability and expected delivery date. This helps reduce out-of-stock items and improves customer service.

However, the traditional supply chain was not designed to handle a large volume of small orders for immediate delivery. Whether or not a particular item is in stock online or in a nearby store not only affects potential sales, it also can have lasting effects on customer loyalty and a company's reputation. Manufacturers, retailers, warehouses and logistics providers are all struggling to adjust to meet these new demands on their supply chains. Because of these new consumers buying habits, companies are adjusting their internal processes, staffing and technology to meet the needs and expectations of demanding consumers (Grainger 2020).

## **2.10 IoT Challenges and Opportunities**

According to Grainger, technology is rapidly powering changes across supply chain networks. An inventory manager's greatest challenge happens when there isn't enough data available to make an informed decision. Updating legacy inventory management systems with IoT devices helps improve overall efficiency by bringing greater tracking, traceability, quality management and compliance.

In recent years, warehouses have been transforming into critical business hubs that increase efficiency and speed across the entire supply chain. Many organizations have started using IoT devices for inventory management. However, there are concerns about IoT implementation that must be considered. Businesses must take into account the investment cost, security, and scalability of integrating IoT devices within their current inventory management system.

Despite these concerns, the cost of the IoT technology continues to decrease as the amount of available IoT integrations for inventory management continues to advance. For many organizations, IoT devices are rapidly becoming a cost-effective and efficient solution for inventory management. The large amount of real-time data from IoT devices can help organizations identify opportunities to improve overall logistics, inventory and supply chain management.

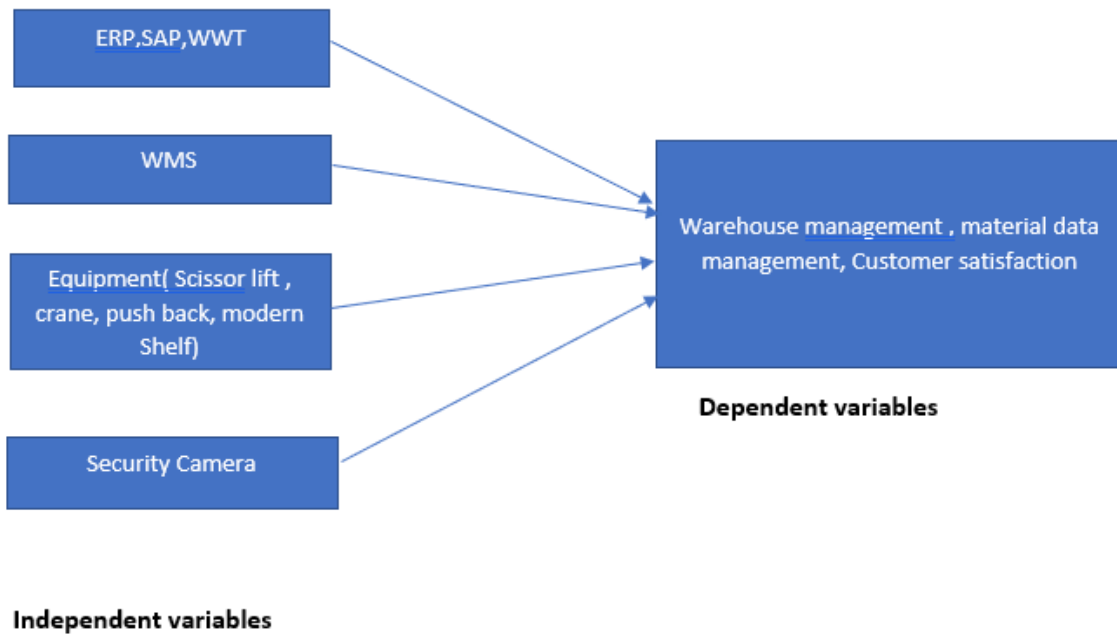
## **2.11 Conceptual framework of IoT implementation in a warehouse**

Conceptual frameworks are used in research for outlining possible options or for presenting the preferred approach, namely defining the problem and purpose, conducting a literature review, devising a methodology, data collection and final analysis. These are very close to empirical inquiry and take different forms according to the research question or problem at hand, e.g. exploration, description, understanding, deciding and consequential explanation (Aparajita Suman 2014).

In the modern business world, warehouse is having a significant role in ensuring customer expectations. It serves as a key source of competitiveness measured by who can deliver the products faster with better cost efficiency and flexibility. In that sense, managers need to have a great understanding of everything related to warehousing and how it affects the whole supply chain (Richards, 2017). Because a warehouse can contain thousands of products, it should be optimally utilized to ensure fast and accurate performance in all functions for meeting customers' demands. Applying IoT in warehousing promises a significant effect because it can be used to eliminate manual interferences and to monitor several processes in the warehouse in real-time. IoT makes the warehouse more intelligent; it can make everything connected and hence enabling the analysis of the vast amount of data captured from these connections and turn them into insights to support decisions and improve the whole performance

In this work, a framework is proposed to implement IoT in warehousing operations. The below figure shows a flowchart for this framework. Here, Internet of things (IoT) is considered as the

independent variable and warehouse management is the main dependent variable. As soon as products with attached tags pass through in/out the gateway, the reader attached on the gate captures data from the tags, this prevent stock-out by providing real-time visibility of inventory levels. When products are loaded on the forklift, readers attached to it read data that includes product's type, product's location and expiry date, and share this data with the driver on an attached screen. Once the products are put on shelves, attached sensors give a confirmation to the driver on the screen. Sensors can also be used for monitoring Heating, Ventilation and Air Conditioning (HVAC) system to optimize energy consumption and to assure warehouse safety and products' quality. The same functions occur for order picking; when an order arrives, the driver goes to the location of the product that appears on the attached screen and make a confirmation that it is the correct order via the readers attached to the forklift. As soon as the order leaves the warehouse, the inventory level is updated immediately. This makes order fulfillment more efficient, easier and accurate, also it prevents counterfeiting. All this captured data from readers and sensors is transmitted via internet to the WMS which process the data and convert it to useful information and actions.



*Conceptual Frame work of IoT on EAL warehouse/*

## Chapter III

### Research Methodology

### **3.1 Introduction**

This chapter mainly aims at explaining how the research has been conducted and what necessary tools have been used. Data collection, processing, design of the research and approaches have been discussed in detail. Besides, the thesis compliance to Ethical consideration, validity and reliability of the study have been mentioned. This chapter covers from the selection of sample to design of the questionnaire, techniques of data collection, processing of the data and evaluation of the data has been discussed.

### **3.2 Description of study area**

Ethiopian airlines new Cargo warehouse which is located in Addis Ababa city under Bole sub city is built at a total of 3700 sq. meters area. As the researcher has observed the entire warehouse it is equipped with the contemporary information technology tools applications and latest technology machines and equipment. The warehouse is used to temporarily store, perishable items like meat, flower, medicines and others and non-perishable items like machineries, medical equipment, jewelry items, government operating technologies.

This warehouse has many stakeholders as a customer; among them importers, exporters, government offices, health institutions, internal organizations, embassies and individuals are the main.

It's obvious that to serve the above-mentioned customers with no or little defect, great effort and parallel operating in the competitive international business arena is expected. One of this is applying Internet of things (IoT) in the warehouse management system. The warehouse is using IoT in its full operation. To assess its effect, the mentioned stakeholders who were found in the cargo warehouse in different times were targeted to be source of the data. In addition to them, the main actors, employees in the warehouse were also selected in strata means.

### **3.3 Research Approach**

Research approaches are plans and the procedures for research that span the steps from broad assumptions to detailed methods of data collection, analysis, and interpretation (Creswell and

Plano Clark, 2007): The overall decision involves which approach should be used to study a topic. Informing this decision should be the philosophical assumptions the researcher brings to the study; procedures of inquiry (called research designs); and specific research methods of data collection, analysis, and interpretation. The selection of a research approach is also based on the nature of the research problem. Often the distinction between qualitative research and quantitative research is framed in terms of using words (qualitative) rather than numbers (quantitative) or using closed-ended questions (quantitative hypotheses) rather than open-ended questions (qualitative interview questions).

According to *Creswell and Plano*, there are three types of research approaches; the first one is qualitative research that involves emerging questions and procedures, data typically collected in the participant's setting. The second one is quantitative research; it is a means for testing objective theories by examining the relationship among variables. The third one is mixed method research, it also an approach to inquiry that combines or associates both qualitative and quantitative forms. Mixed method research is an approach to inquiry that combines or associates both qualitative and quantitative forms. It involves philosophical assumptions, the use of qualitative and quantitative approaches, and the mixing of both approaches in a study.

Hence, this study has used mixed research approach method which uses both qualitative and quantitative approaches in the study. Through qualitative approach, technical explanations, thoughts and concepts has been explained in detail and in its quantitative approach, generalizable facts from different sources, observations and data related to the IoT in the warehouse has been expressed and assessed in quantitative (numerical) figures.

### **3.4 Research Design**

Research design is (*Md. Inaam Akhtar 2016*) the structure of research it is the "Glue" that holds all of the elements in a research project together, it is a process where by a researcher chose the framework of research methods and techniques. There are about four types of research designs (*Md. Inaam Akhtar 2016*). These are ; Exploratory research design which used to achieve new insights into a phenomenon and suitable when there are few or no earlier research/studies to which references can be made for information, Descriptive research design which describes phenomena as they

exist and very suitable to identify and obtain information on characteristic of a particular issue, Explanatory research design which is used to explore a new universe, one that has not been studied earlier and Experimental research design mainly used to test a Research Design of causal relationship under controlled situation.

Accordingly, the type of research design the researcher preferred to use to describe about the effects of IoT on warehouse management by identifying the challenges and process of the application of it on the warehouse is descriptive type.

### **3.5 Population of the study**

To manage this thesis, the target population is comprised of inside and outside the EAL cargo warehouse. From within the warehouse department, I have chosen management staffs, senior staffs and operational employees in the warehouse department. Outside the company, though the EAL cargo has thousands of external customers which works so closely with them, I have chosen long time customers who have been using the cargo warehouse service and understands about it. Consequently, they have been grouped as follow:

- Total of 8 management staffs who have been working for many years in the department and could provide genuine information and data.
- About 51 employees who are not under management staff but have been working several years in the department and actively working in the warehouse operation by contacting external customers each day.
- A randomly selected 19 customers found in different periods from different type of business were also chosen for interview.

### **3.6 Sampling design**

For the data sampling design, the convenience sampling technique was applied in the selection of the samples on position and customer-based segments. Convenience sampling is a specific type of non-probability sampling method which relies on data collection from population members who are conveniently available to participate in study. This sampling method involves in getting participants wherever you can find them and typically wherever is convenient. Simplicity of sampling and the ease of research helpful for pilot studies and for hypothesis generation, data collection can be facilitated in short duration of time and relatively cost-effective method of gathering data. The sampling approach has also its own drawbacks; such as highly vulnerable to selection bias and sampling errors.

Consequently, according to Malhotra, Nk, and Birks 2007, to determine the sample size of this thesis, the researcher has used as per the below quota.

<b>Population Size</b>	<b>Sample size to be selected</b>		
	<b>Low</b>	<b>Medium</b>	<b>High</b>
From 51-90	5	12	20
From 91-150	8	20	32
From 151-280	13	32	50
From 281-500	20	50	80
<b>From 501-1200</b>	32	80	125
From 1201-3200	50	125	200
From 3201-10000	80	200	315
From 10001-35000	125	315	500

Thus, in order to manage time effectively and stay within the thesis budget, from total of about 500 warehouse staffs, about 8 management staffs and 51 non management or operational staffs were chosen. Besides, from many of external customers, about 19 long stayed customers were chosen to be source of interview data collecting process. The data collecting process was managed by dividing the warehouse staffs into strata as those who are working at perishable cargo warehouse, those working at valuable warehouse and those working at dry warehouse as the nature of operation on those warehouses are slightly different.

### **3.7 Data type and source**

The researcher of this thesis has used both primary and secondary data sources for the entire analysis of the thesis. The information was collected through questionnaire and interviews from the selected sample of respondents and/or employees of EAL Cargo warehouse division. The data collected from the respondents through questionnaires and interviews were taken as primary data.

Primary data is the information that the researcher finds out by him/herself regarding a specific topic. It implies that the information resulting from it is more consistent with the research questions and objectives (Kothari 2006).

### **3.8 Data Collection Methods**

For data collection means, documentary sources such as relevant books, different researches, journals, articles, official publications, newspaper clippings, reports, different websites and papers were utilized to present the facts and to substantiate the arguments to obtain the required secondary data.

As a primary data, interviews, questionnaires and physical observations were conducted and used to collect data.

#### **3.8.1 Questionnaire**

The questionnaires of this thesis contained both, structured and unstructured questions. The researcher used questionnaires because they cover a large sample of respondents in the shortest possible time and using low costs. For this thesis, the main data collection method was questionnaire. A structured questionnaire with list of questions was used with probes to elicit relevant information. Each respondent was given a consent form to read and sign before completing the questionnaire and the researcher explained the procedure of the questionnaire and written instructions were also provided.

The questions were designed to be answered in a five-point Likert scale format to identify the practices of IoT in the EAL cargo warehouse.

The main part of the questionnaire was designed in a five-point Likert scale ranging from 1= strongly disagree to 5= Strongly agree.

### **3.8.2 Interview**

In the entire thesis, various interview sessions were conducted as a method of data collection instrument. It was assumed as useful data collection instrument in this study as it has an advantage to obtain detailed information about personal feelings, perceptions and opinions. It allowed more detailed questions to be asked, and it also achieves a high response rate. Semi structure interview was conducted for the purpose of investigating the participants understanding the practice of Internet of things (IoT) in EAL cargo warehouse.

## **3.9 Validity and Reliability test**

To assure that the results on the thesis and analysis are consistent the data reliability has also been measured through Cronbach's Alpha

For the thesis reliability, the researcher has used Chronbach's alpha to assess the internal consistency of variables in the research instrument. Chronbach's alpha is a coefficient of reliability used to measure the internal consistency of the scale.

According to Zikmund (2010), scale with coefficient alpha between 0.6 and 0.7 indicate fair reliability. Thus, for the reliability of this thesis a Chronbach's alpha score of 0.70 or higher is considered as adequate to determine reliability.

To assure the thesis validity, which is the extent to which difference found with measuring instrument reflecting true differences among those being tested. In order to ensure the quality of the research design content and construct validity of the research its been checked. Construct validity establishing correct operational measures for the concepts being studied (John, 2007). The literature review is conducted and thoroughly examined to make sure that the content of measuring is relevant to the study and experts' opinion and idea were also taken in the entire thesis.

### **3.10 Measurement Instruments of Variables**

The main objective of this thesis was to assess the effect of Internet of things (IoT) on Ethiopian airlines (EAL) cargo warehouse management. Thus, the measurement instrument of variables used was the Likert scale for perceived data. A five-point Likert scale was prepared, and it was rated the respondents' agreement on the stated questions. The following are the variable constructs of the thesis:

1. **Internet of things** – It implies that all the equipment, applications and technologies operating through internet which helps to act on behalf and aside with human beings.
2. **Practice of IoT** – The frequency and adaptability of using Internet of things (IoT) in warehouse management and its acceptability in the entire staffs within the warehouse.
3. **Warehouse management** – It's the act of influencing and guiding the practice and operation of activities being carried out in the premises and channels of Ethiopian airlines cargo warehouse.
4. **Customer satisfaction** – This is the level of acceptance and happiness by customers over the service being provided by the Ethiopian airlines cargo warehouse. Here the effect of IoT and its impact on customers satisfaction is considered as vital.
5. **Challenges/ Barriers for the implementation of IoT**- the situation which faces employees and systems on the operational activities of warehouse management most specifically while practicing the IoT.

### **3.11 Data analysis Method**

The data and information that was collected during the thesis is reduced into summary form which were then processed by using Software Package for Social Scientists (SPSS) method. The results and findings of this thesis were organized and presented in the form of words, numbers and percentages by using tables. Data collected from questionnaires were presented in tables and figures and the central tendency of a distribution was taken as it was is in an estimation of the

"center" of a distribution of values. In addition, standard deviation was used as a measure of dispersion which refers to the spread of the values around the central tendency. This thesis also uses descriptive research to draw comparisons between different respondents in different studies.

### **3.12 Ethical consideration**

As better data is the main way of getting better result in conducting a research, the researcher while conducting this thesis, has properly follows the code of ethical principles published by the American Psychological Association, which requires investigators/researchers to obtain informed consent from all subjects, protect subjects from any harm and discomfort, treat all research data confidentially and explain the experiment and the results to the subjects afterwards. Hence, these ethical guidelines were applied in an efficient manner while collecting the required data and information from respondents. Besides, voluntary participants were the main inputs of the thesis. Moreover, proper care was taken not to use offensive, discriminatory, or other unacceptable language in the formulation of questionnaire and conducting an interview; Maintaining privacy and anonymity of respondents had a paramount importance for this thesis.

In the entire thesis, especially in the literature review part, the researcher has acknowledged the works of other authors by using Harvard referencing system. And at the end all the respondents' answers, comment and ideas were analyzed and organized in a proper way which best helps for the thesis.

# Chapter Four

## Data Analysis, Result and Discussion

### 4.1 Introduction

In main chapter of the thesis, the researcher has presented the main findings from which the analysis was this made. The researcher made analysis of the results with respect to research objectives and research questions which are listed and explained in chapter one of this thesis.

In the analysis process of this thesis, when once the respondents had answered the questionnaire, data was coded and analyzed using SPSS version 20.

### 4.2 Demographic data result

The demographic data of the respondents including their age composition, work experience, gender and position is summarized as below

**Table 4.1 Respondents**

<b>S.N</b>	<b>Respondents</b>	<b>No. of sample Target</b>	<b>No. of responses</b>	<b>Percentage of responses</b>
1	Management staffs	20	8	93%
2	Employees	60	51	90%
<b>Total</b>		<b>80</b>	<b>59</b>	<b>74%</b>
3	Customers	20	19	95%
	<b>Total</b>	<b>20</b>	<b>19</b>	<b>95%</b>

This thesis was initially planned to address a total sample size of 80 purposively selected respondents from the population. However, 59 respondents or 74 % of the sample size were effectively managed to be successful respondents.

As shown in the above table summary, from the Customers 95% has been involved in the data collection process.

**Table 4.2 Respondents Demographic information**

<b>Gender</b>					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	41	68.3	69.5	69.5
	Female	18	30.0	30.5	100.0
	Total	59	98.3	100.0	
Missing	System	1	1.7		
Total		60	100.0		

Source : Own data

<b>Age</b>					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	18-30	11	18.3	18.6	18.6
	31-40	26	43.3	44.1	62.7
	41-50	20	33.3	33.9	96.6
	51-60	2	3.3	3.4	100.0
	Total	59	98.3	100.0	
Missing	System	1	1.7		
Total		60	100.0		

Source : Own data

**Years of experience in EAL cargo warehouse**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1-5 years	8	13.1	13.6	13.6
	5-10 years	24	39.3	40.7	54.2
	10-15 years	16	26.2	27.1	81.4

	Above 15 years	11	18.0	18.6	100.0
	Total	59	96.7	100.0	
Missing	System	2	3.3		
Total		61	100.0		

Source: Own data

#### Years of experience in ET

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1-5 years	6	9.8	10.2	10.2
	5-10 years	26	42.6	44.1	54.2
	10-15 years	13	21.3	22.0	76.3
	Above 15 years	14	23.0	23.7	100.0
	Total	59	96.7	100.0	
Missing	System	2	3.3		
Total		61	100.0		

Source : Own data

#### Your Position in the Company

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Junior level	9	15.0	15.3	15.3
	Senior level	29	48.3	49.2	64.4
	Expert (specialist) level	13	21.7	22.0	86.4
	Management	8	13.3	13.6	100.0
	Total	59	98.3	100.0	
Missing	System	1	1.7		

Total	60	100.0		
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Source : Own data

<b>Educational Background</b>					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	High school completed or below	1	1.7	1.7	1.7
	Diploma	4	6.7	6.8	8.5
	Degree	49	81.7	83.1	91.5
	MA and above	5	8.3	8.5	100.0
	Total	59	98.3	100.0	
Missing	System	1	1.7		
Total		60	100.0		

Source: Own data

### Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Gender	59	1.00	2.00	1.3051	0.46440
Age	59	1.00	4.00	2.2203	0.78932
Years of experience in EAL cargo warehouse	59	2.00	5.00	3.5085	0.95363
Years of experience in ET	59	1.00	4.00	2.5932	0.96702
Your Position in the Company	59	1.00	4.00	2.0678	0.63962

Educational Background	59	1.00	4.00	2.9831	0.47312
Valid N (listwise)	59				

Source: Own data

The above demographic data of respondents shows only for EAL employees at the cargo division. Customers were only interviewed, and demographic data were not asked except number of years as a customer, but from the total of 19 interviewed customers 17 of them were males and only the remaining 2 were females.

As per the above tabular data, the majority or 44.1 % of respondent employees age lies between 31-40 which is considered as a productive work force and 18.6 % of the respondents age lies between 18-30 who are juniors and young, 33.9 % of the respondents age lies between 41-50 and the remaining 3.4% respondents age lies between 51-60 with no employee aged above 60 years. Regarding the gender composition of respondents, majority of the respondents (69.5 %) were males while the remaining 35.5% of the respondents were females. As the area is highly operational, as the respondents gender composition and the researchers visual visit depicts, most of the employees are male.

The majority of respondents' number of years of experience in the cargos shows that they have worked there from 5-10 years which is almost 41 % of respondents; those who have worked between years 10-15 are 27.1 %, those who have worked 1-5 years composes 13.6 % and the remaining 18.6 % of the respondents have been working for more than 15 years in the cargo division.

The total years of experience for respondents shows that, 30.5 % lies between 1-5 years, 27.1 % of respondents' lies from 5-10 years, 18.6 % of respondents lies between 10-15 years and the remaining 23.7 % of respondents have worked more than 15 years in the company.

As per the data above, majority of the respondents or 49.2 % are seniors, 15.3 % are juniors, 22.3 % are low level management staffs and 13.6 % are medium level management staffs as higher management staffs were not involved in the data collecting process.

Concerning the Academic background of the respondents, most of the respondents (62.7 %) of the respondents have Degree, 22 % of the respondents have above Degree, 11.9 % of the respondents have Diploma and only 3.4 % of the respondents are high school completed or below.

### 4.3 Practice and Implementation of IoT

To analyze the practice and implementation of IoT on the warehouse, related questionnaires were distributed and collected. Hence the below data result was found.

**Table 4.3 Practice and implementation of IoT**

Variables	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Mean	Std. Deviation	N
Have enough awareness about the use of IoT	16.9	27.1	3.4	30.5	22	3.14	1.47	59
Regularly uses IoT properly	28.8	23.7	8.5	27.1	11.9	2.69	1.44	59
Enough IoT applications and tools are available	1.7	8.5	3.4	57.6	28.8	4.03	0.91	59
Have taken awareness and application trainings	20.3	30.5	5.1	23.7	20.3	2.93	1.48	59
The warehouse is suitable for work and storage	3.4	6.8	1.7	54.2	33.9	4.08	0.97	59

Source: SPSS version 25

As the above data table shows, many of the respondents (30.5 %) believes as there is enough awareness about the use of IoT within the employees and working in understanding, 22% of the respondents also agreed that employees are on the full awareness of the use of IoT, while 16.9 % of the respondents strongly disagree for the prevalence of enough awareness about IoT, 27.1% of the respondents still disagree with the prevalence of enough awareness about the use of IoT and the remaining 3.4% of respondents remained to answer it.

Regarding the regular use of IoT in the warehouse, 28.8 % of the respondents have strongly disagreed, 23.7% of the respondents have disagreed, 11.9 % of the respondents have strongly agreed, 27.1 % of the respondents have agreed on it and the remaining 8.5 % of the respondents remained not answered.

Concerning the availability of enough IoT tools and elements in the ware house, only 1.7 % of the respondents have strongly disagreed, 8.5 % of the respondents have disagreed, 28.8 % of the respondents have strongly agreed, majority of the respondents or 57.6 % of the respondents have agreed on it and the remaining 3.4 % of the respondents remained not answered.

For the question that employees have taken awareness and application trainings, 20.3 % of the respondents have strongly disagreed, 30.5% of the respondents have disagreed, 20.3 % of the respondents have strongly agreed, 23.7 % of the respondents have agreed on it and the remaining 5.1% of the respondents remained not answered.

When respondents have been asked if the warehouse is suitable for work and storage, 3.4 % of the respondents have strongly disagreed, 6.8% of the respondents have disagreed, 33.9 % of the respondents have strongly agreed, most of the respondents or 54.2 % of the respondents have agreed on it and the remaining 1.7% of the respondents remained not answered.

#### 4.4 The Effect of IoT

To analyze the Effect of IoT on warehouse management, the below tabular data report shows the result on it.

**Table 4.4 The effect of IoT**

Variables	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Mean	Std. Deviation	N
The application of IoTs are user friendly and helpful	3.4	11.9	1.7	61	18.6	3.8	1	59
There is an improvement on warehouse management practice after implementation of IoT	0	6.8	0	25.4	67.8	4.54	0.82	59
After implementation of IoT, errors have been reduced	3.4	13.6	8.5	47.5	27.1	3.81	1.09	59
After IoT, tasks were managed too fast and reduced time	1.7	6.8	10.2	20.3	61	4.32	1.02	59
All employees are happy and familiar to IoT	10.2	40.7	1.7	27.1	20.3	3.07	1.39	59
The warehouse is fully and adequately equipped with IoT	3.4	3.4	1.7	64.4	27.1	4.08	0.86	59

elements								
Customers are more satisfied now than before IoT	1.7	6.8	8.5	15.3	67.8	4.41	1.02	59

Source: SPSS version 25

As the table above shows, for the question if the application of IoT user is friendly and helpful, 3.4 % of the respondents have strongly disagreed, 11.9% of the respondents have disagreed, 18.6 % of the respondents have strongly agreed, 61. % of the respondents (most of the respondents) has agreed on it and the remaining 1.7% of the respondents remained neutral.

For the question if there were an improvement on warehouse management after the implementation of IoT, no one has strongly disagreed, 6.8% of the respondents have disagreed, 67.8 % of the respondents have strongly agreed, 25.4 % of the respondents have agreed on it and no one remained neutral.

If errors were reduced after IoT implementation, 3.4 % of the respondents have strongly disagreed, 13.6 % of the respondents have disagreed, 27.1 % of the respondents have strongly agreed, 47.5. % of the respondents (most of the respondents) have agreed on it and the remaining 8.5 % of the respondents remained neutral.

When respondents were asked after the implementation of IoT tasks were managed too fast and reduced time, 1.7 % of the respondents have strongly disagreed, 6.8% of the respondents have disagreed, while the most majority of the respondents (61 % of the respondents) have strongly agreed, 20.3 % of the respondents have agreed on it and the remaining 10.2% of the respondents remained not answered.

When respondents were asked if all the employee are happy and familiar with the use of IoT, 10.2 % of the respondents have strongly disagreed, 40.7 % (most of the respondents) of the

respondents have disagreed, 20.3 % of the respondents have strongly agreed, 27.1 % of the respondents have agreed on it and the remaining 1.7 % of the respondents remained neutral.

For the question that the ware house is fully and adequately equipped with IoT elements, 1.7% of the respondents have strongly disagreed, 6.8 % of the respondents were also disagreed while 27.1 % of the respondents have strongly agreed, 64.4% (majority of the respondents) have agreed on it and only a respondent (1.7 %) of the respondents remained neutral.

When respondents were asked if customers are seeming more satisfied now than the time before the implementation of IoT, 3.4 % of the respondents have strongly disagreed and same number of respondents were also disagreed while most of them (67.8 % of the respondents) have strongly agreed, 15.3% have agreed on it and only 8.5% of the respondents remained neutral.

#### 4.5 Correlation Analysis

A correlation shows the strength and direction of relationship between variables. The linear relationship between variables can be measured by correlation coefficient (r), which is commonly called Pearson product moment correlation. Pearson’s “r” mainly measures the data from the interval or ratio level and used to measure based on the deviation from the mean (*Yabebal, 2017*).

According to Dancy and Reidy (2004) the coefficient of correlation could take values ranging from -1 to +1, where the signs signifying the direction of relationship. A correlation value of 0 implies that there is a little or no linear relationship. Hence, based on the above-mentioned parameters, the tables embedded below revealed that there is a positive relationship between the dimensions of Internet of things (IoT) and Warehouse Management

Measure of Association	Descriptive adjective
>0.00 to 0.20; <-0.00 to-0.20	Very weak or very low
>0.20 to 0.40; <-0.20 to-0.40	Weak or low
>0.40 to 0.60; <-0.40 to-0.60	Moderate
>0.60 to 0.80; <-0.60 to-0.80	Strong or high
>0.80 to 1.0; <-0.80 to-1.0	very high or very Strong

Source: (Mac Eachron, 1982)

Thus, the correlation output of the dependent and independent variables is interpreted as per the table and explanations below.

**Table 4.5 correlation of variables**

**Correlations**

		Have enough awareness about the use of IoT	Regularly uses IoT properly	IoT applications and tools are fully applicable	Have taken awareness and trainings of IoT	The warehouse is suitable for work
Have enough awareness about the use of IoT	Pearson Correlation	1	.916**	.772**	.946**	.755**
	Sig. (2-tailed)		0.000	0.000	0.000	0.000
	N	59	59	59	59	59
Regularly uses IoT properly	Pearson Correlation	.916**	1	.719**	.957**	.722**
	Sig. (2-tailed)	0.000		0.000	0.000	0.000
	N	59	59	59	59	59
IoT applications and tools are fully applicable	Pearson Correlation	.772**	.719**	1	.756**	.955**
	Sig. (2-tailed)	0.000	0.000		0.000	0.000
	N	59	59	59	59	59
Have taken awareness and trainings of IoT	Pearson Correlation	.946**	.957**	.756**	1	.747**
	Sig. (2-tailed)	0.000	0.000	0.000		0.000
	N	59	59	59	59	59
The warehouse is suitable	Pearson Correlation	.755**	.722**	.955**	.747**	1

for work	Sig. (2-tailed)	0.000	0.000	0.000	0.000	
	N	59	59	59	59	59

\*\* . Correlation is significant at the 0.01 level (2-tailed).

From the above correlation table, it is possible to conclude that there is a positive and strong relationship between Regular use of IoT and awareness (where  $r=0.957$ ,  $p=0.00$ ). there is also another positive and strong relationship between regular use of IoT and awareness about IoT (where  $r=0.946$ ,  $p=0.00$ ). significant and positive relationship also has been seen between IoT application and awareness (where  $r=0.756$ ,  $p=0.00$ ), between warehouse suitable for work and IoT awareness (where  $r=0.747$ ,  $p=0.00$ ).

Generally, according to the above table and discussions implied that there is a positive, strong and significant association and relationship between each independent variable

The findings from the correlation test between IoT and its effect on the warehouse management, there is a positive and strong relationship between Regular use of IoT and awareness (where  $r=0.957$ ,  $p=0.00$ ).

Respondents believed that the implementation of IoT has brought positive change on the warehouse. These changes are, it saves time, it increases quality of work, it reduces work load, reduced error and others. From the negative effect of IoT, some of the respondents have replied that there is sometimes system disruption and dependency in the IoT has been observed.

For the bi-optional yes or no questions for identifying whether the implementation of IoT has brought positive change on warehouse 89 % of the respondents believe as it has brought positive change to the warehouse while the remaining 11 % of the respondents believes as there have not been any positive changes came to the warehouse. From the 53 respondents who said yes there has been positive changes to the warehouse many of them these changes are it has saved time, increased quality of work, reduced stress, avoid error and increased customer satisfaction almost all have agreed that it has saved time significantly. Besides some of them have said that it has created conducive work environment.

From all respondents 96.6% of them have agreed that IoT has no any negative effects on the output of warehouse management while only 3.4 % of the respondents said as it would have

some negative impact. And these 3.4 % of the respondents said that the negative effects of IoT as it increased error and sometimes waste time due to limited skill for working on it.

For an optional and open-ended question on what actions shall be taken to increase the benefit of IoT 30.5 % (18 respondents) have suggested to provide recurrent trainings 28.8 % (17 respondents) of them said the application and technologies shall be updated every time and the remaining 40.6 5 of the respondents both and others.

In addition to the above choice questions respondents have also been questioned to provide their comment and opinion in an ended questionnaire and only 31 respondents have better replied for these questions. Hence, for the question which they were asked to explain possible challenges for the implementation of IoT in the ware house they have mentioned some bureaucracies of the management, lack of training update, and not assigning a fit employee in some tools are mentioned as challenges.

From all the IoT elements the remaining tool or application which some (14) of the respondents believes as remained unpracticed is the existence of robots, which they believe that, it would reduce time and human resource by reducing mistake. From the negative effects of implementation of IoT in the warehouse, most respondents (11) have commented that, almost all employees and the operation itself became dependent on the system and tools without which the work seems impossible to operate.

#### **4.6 Summary of interview Result**

From the total respondents nineteen customers who have been working with Ethiopian airlines cargo and warehouse for long time, has been interviewed for short time on relevant issues for the thesis. All they were asked about the effect of warehouse management before and after the implementation of IoT in the warehouse.

Their response result is summarized as below based on the questions they were asked. The first question was about the number of years which they have been working and being customer of Ethiopian airlines cargo ware house. As per their response given, all of them have been customer

of the warehouse for more than five years and considered as long time loyal customers for Ethiopian airlines.

The second question they were asked was how they would compare the warehouse service before and after the new modern warehouse, and almost all of them have replied as same that the new modern warehouse is suitable for customer handling and safe for their properties.

The third question was whether the speed given by EAL cargo warehouse management is fast or not. However significant number of respondents were replied as there is some bureaucracies out of the warehouse management, but the warehouse staffs are providing an appreciable service with good speed.

The fourth question of the interview part was whether the use of internet systems, applications and robots positively affect the cargo warehouse service or not. Even though few (three) of the respondents had no full understanding about all these tools, most of them have an awareness and knowledge about the use of internet systems, applications and machineries and as they thought it has brought significant positive change to the warehouse management despite their fear that it might make the staffs and the company as whole to be fully dependent of these modern applications and tools. Through these, they have also answered the fifth questions that the use of such things has brought positive effect on the customer handling service.

Finally, they were asked to give their comment about the additional services that they do expect from Ethiopian airlines cargo warehouse and though most of them are satisfied with the existing service, some of them still needs the speed to be improved further, cargo service fare to be reviewed, to reduce some unnecessary process to release imported goods and goods to be shipped abroad. And to build coordination with security and others.

## **Chapter Five**

### **Summary, Conclusion and recommendation**

#### **5.1 Summary**

As per the data findings of this thesis, questionnaire and interview, as the demographic and background data shows, majority of the respondents in this thesis were found as male. From the total respondents in this thesis the majority age level lies between 31-40 and most of the respondents have an experience of from 5 to 10 years in their division and in the company as well. Most of the respondents are working in senior positions in the cargo and warehouse department. The most majority (more than 80% of the respondents) have at least first degree and above which shows that the division is staffed with highly professional and skilled manpower.

Regarding their awareness and experience with the IoT, more than 65% of the respondents agree that the staff has enough awareness about the use of IoT and its application and more respondents (76 %) have also agreed and strongly agreed that they are using IoT regularly and properly. According to the respondents there are also enough IoT tools and equipment in the cargo warehouse. However, most of the respondents have responded that they have got the skill and experience while they are on their routine job and no proper trainings were given.

As per the findings of the respondents, the warehouse is believed to be suitable for work and operation of the division.

Regarding the effect of IoT in the cargo warehouse, almost 80% of the respondents were agreed that the application of IoT is user friendly and helpful and almost all respondents have agreed that after the implementation of IoT in the warehouse, there has been improvements in the division. In addition, they also agree that IoT has reduced time, reduced error increased speed and efficiency in the division.

Many of the respondents believes that all employees have positively accepted and feel happy on the implementation of IoT. Besides this, majority of the respondents believes that, the warehouse

is fully and adequately equipped with IoT consequently customers are more satisfied now than the time before the implementation of IoT in the division.

## 5.2 Conclusion

Based on the results of this study and the summary of the findings, the following conclusions are made.

- The nature of work in the cargo warehouse seems that it requires physical movement and energy, due to that, most of the employees are male and young in the section.
- Most of the staffs in the cargo and warehouse are young, educated and seniors which is believed to be a guarantee for the sustainable efficiency of the cargo warehouse output and employees would make themselves to develop their skill and experience more.
- Most of the employees have enough awareness on IoT and practice it in their regular operational activities despite some deviances. The warehouse is equipped with enough IoT tools and application which helps for better system and human capital coordination in the division. The ware house as per the researcher's observation and the respondents' responses, is very suitable for work.
- Even though, there has been some deviance, most of the respondents agreed that the IoT tools are user friendly and helpful, due to that they believe that it has brought many positive changes by reducing error, time wastage and increasing efficiency. As most of the respondents and employees are happy to work with IoTs it leads them to utilize their optimal, skill and energy for better output.
- The majority of respondents and employees understanding on the positive change of IoT on better customer satisfaction, will at the same time leads to employees' satisfaction and better aspiration.
- Most of the customers also have confirmed through an interview and physical discussion that, they are happy and more satisfied in the cargos service after the new cargo warehouse which is equipped with ultra- modern technologies and applications. However, they still want some improvements to be made regarding warehouse's

operational coordination with security, customs and other stake holders for the overall customers satisfactions.

### **5.3 Recommendation**

Based on the findings, discussions and conclusions made, the researchers suggest the below elucidated statements as a possible mechanism to reduce problems identified in this study and to improve the warehouse management practices in Ethiopian airlines warehouse.

- Ethiopian airlines shall provide generic and recurrent trainings regarding the new and existing systems and technologies for the concerned employees to enable them fully to operate and implement it.
- The company shall discuss to different stake holders like Ethiopian customs authority, national intelligence and security service and federal police to establish a coordinated common operation platform to provide better and smooth service for customers by avoiding customer handling gap differences within stake holders and facilitate the operation.
- The airline shall focus more on the system to make the human movement almost to zero so that women employees will also be encouraged to work there.
- The company shall review its operation in different means and shall take lessons and updates from similar organizations which provide cargo warehouse services and update its own in terms of service quality, new and updated technologies and equipment and system applications to stay globally competent.
- As there has not been any research being conducted in the division in the issue of IoT and for some the term IoT was also new, it shall encourage researchers and shall manage by its own to conduct different researches as it could help the company to review its pros and cons on its overall operational activity.

### **5.4 Directions for Future Studies**

This thesis work has been managed by trying to cover number of practices and experiences in the Ethiopian airlines cargo warehouse management, and there are still several research directions in the future, as the researcher were informed, it was a new issue which conducted in the area. The researcher himself has faced problems while accessing some data and research references in similar phenomena. As per the findings of the thesis, it has been revealed that the emergence of IoT has even brought substantial changes in the airlines industry and particularly in warehouse management. The researcher highly believes that this work could be used as a reference and as supportive document for future researchers and those who will conduct similar thesis in the area. Besides it would better to conduct on other factors for ware house management as the company is vast and no adequate researchers were conducted so far.

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## Appendices

### ADDIS ABABA UNIVERSITY SCHOOL OF COMMERCE

Dear Respondent:

I am Teshome Yenealem, a final year Master of Logistics and Supply Chain Management, (MALSCM) student at School of Commerce, School of Graduate Studies, Addis Ababa University. I am conducting a research on my final thesis entitled “The effect of Internet of Things (IoT) on warehouse management The Case of Ethiopian airlines cargo warehouse”.

The purpose of this thesis is to investigate the practices of using IoT on the warehouse at EAL cargo. Your idea and information are so crucial for the better accomplishment of this thesis. The information you are giving will be used for the partial fulfillment for the master’s thesis.

Your participation is totally voluntarily, and you can refuse at any time if you are not convinced to continue. Our university has a research ethical policy and you can report any complaints to postgraduate studies, School of Commerce, Addis Ababa University, if you are feeling un happy and see anything unfair with the way this thesis is being carried out.

**Thank you for your cooperation.**

Sincerely,

**Part One – In relation to personal information, please tick X in the space provided**

1. Age

18-30       31-40       41- 50       51- 60        
 Above 60     

2. Sex

Male       Female

3. The number of your experience with EAL cargo warehouse in years?

Below 1 year       1 -5 years            5-10 years       10-15 years        
 Above 15 years     

4. Total work experience with the company (total number of years)?

Below 1 year  1-5years            5-10 years            10-15years        
 Above 15        
 years

5. Your position in the company

Junior level       Senior level            Expert/Speci            Management        
 alist  
 Top level management

6. Educational background

High School completed or below   
 Diploma   
 Degree   
 Ma and Above

**Question Type 1: Please express your degree of agreement with respect to your full understanding and experience IoT at cargo warehouse. (FYI IoT includes, system applications working with Internet, modern tools, equipment, Robots, Drones and others)**

No	Statement	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree
		1	2	3	4	5
1.	Have enough awareness about the use of IoT					
2.	regularly uses IoT properly					

3.	IoT applications and tools of IoT are fully available					
4.	Have taken awareness and application trainings on IoT					
5.	The warehouse is suitable for work and storage					

**Question Type 2: Please indicate your agreement pertaining your view on the outcomes and changes of IoT.**

No	Statement	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree
		1	2	3	4	5
1.	The applicable IoTs are user friendly and helpful					
2.	There is an improvement on warehouse management practice after implementation of IoT					
3.	After implementing IoT in the warehouse, errors have been reduced					
4.	After implementing IoT properly tasks were managed fast and reduced time					
5.	All Employees are happy and familiar to IoT					
6.	The warehouse is fully and adequately equipped with IoT elements.					
7.	Customer are more satisfied now than before the implementation of IoT					

**Question Type 3: Please indicate your answer by circling the given choices regarding the effect of IoT on warehouse (you can circle more than one).**

1. Do u think that the implementation of IoT has brought positive changes on warehouse?
  - A. Yes
  - B. No
2. If your answer for the above question is Yes, what are these changes? (you can choose more than one)
  - A. Saves time
  - B. Increased quality of work
  - C. Reduced employees stress.
  - D. Avoid error
  - E. Increased customer satisfaction

- F. Others:  
Specify \_\_\_\_\_
3. Do you think that IoT has negative effect on the output of warehouse management?  
A. Yes      B. No
4. If your answer for the above question is Yes, what are the effects?  
A. Increased work backlogs  
B. Increased employees stress  
C. Increased error  
D. Wastes time  
E. Others:  
Specify \_\_\_\_\_
5. What actions shall be taken to increase the benefit of IoT? (you can choose more than one)  
A. Provide training to employees  
B. Update applications and modern equipment  
C. Others:  
Specify \_\_\_\_\_

**Question type 4. Please provide your opinion to the below questions as freely and openly as possible.**

1. What do you think are the challenges of the implementation of IoT in the ware house?  
\_\_\_\_\_  
\_\_\_\_\_
2. From the required IoT elements, which items do you think has/have left in the warehouse. And do you think it has affected the process?  
\_\_\_\_\_  
\_\_\_\_\_
3. What do you think are the effects (negative or positive) of IoT in the warehouse management?  
\_\_\_\_\_  
\_\_\_\_\_

**Thank you again for your cooperation!**

**Interview Questions for customers**

1. How long have you been the customer of EAL cargo services?
2. How would you compare the warehouse service before and after the new modern warehouse?

- 3. Is the speed being given by EAL cargo warehouse satisfying? If not, why?**
- 4. Do you think the use of internet systems, applications and robots positively affect the cargo warehouse service?**
- 5. What improvements do you expect from EAL cargo warehouse service?**
- 6. What is your overall comment on the warehouse service?**

**Thank you.**