ADDIS ABABA INSTITUTE OF TECHNOLOGY
DEPARTMENT OF MECHANICAL AND INDUSTRIAL ENGINEERING

ENHANCING INVENTORY LEVEL THROUGH EFFECTIVE FORECASTING:

THE CASE OF ETHIOPIAN AGRICULTURAL BUSINESS CORPORATION (EABC)

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ADDIS ABABA INSTITUTE OF TECHNOLOGY DEPARTMENT OF MECHANICAL AND INDUSTRIAL ENGINEERING

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BY

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STUDENT'S DECLARATION

I, the undersigned, declare that the work done in the project entitled "Improvement of Demand Forecasting in Inventory: The Case of Ethiopian Agricultural Business Corporation" is an outcome of my original and own effort prepared under the guidance of Gulelat Gatew (PHD), and that all sources of materials used for the study have been duly acknowledged. I further confirm that the thesis has not been submitted either in part or in full to any other higher learning institutions for the purpose of earning any degree.

Declared by:

Beimnet Kinfe	_____	25 June 2019
Student	Signature	Date

SUPERVISOR'S DECLARATION

This is to certify that this thesis is prepared by Beimnet Kinfe a student of Master of science in Industrial Engineering program had been working under my supervision and guidance for his project entitled: Improvement of demand forecasting in inventory: the case of Ethiopian agricultural business corporation. He is submitting his genuine and original work and complies with the regulations of the university and meets the accepted standards with respect to originality and quality.

Sign ..... Date ....., June, 2019

Advisor: Gulelat Gatew (PHD)

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I say May God bless you all. Amen.

Abstract

Evaluating the effect of demand forecasting on inventory managment and identifying the co-factor variables that alter the inventory may influence the overall supply chain performance. The purpose of this research is to find the main factors and viable solution that affect the effectiveness of demand forecasting in inventory of Ethiopian agricultural business corporation. This study was performed in collaboration with the Ethiopian agricultural business corporation, which provided its sales and inventory data from 2011-2019. Data collected by interview, questioners & documents survey. Also, analyzed with SPSS and MS-Excel software. According to the finding of the study it is verified that 90.2% of effectiveness of the forecast is depends on proper mathematical forecasting model, competency of inventory staff, consideration of competitor level, economic viewpoint, the price, type and level of technology of items and the accuracy of inventory recording and the other 9.8% explained by other variables outside this research framework. Other public enterprise can use the findings presented here in to drive their inventory and facility planning decisions and support investments in warehouse and supply chain integration.

Keywords:- Forecasting, Effectiveness, Inventory management

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List of Acronyms

ANOVA-Analysis Of Variance

CD-Compact Disk

EABC-Ethiopian Agricultural Business Corporation

EOQ-Economic Order Quantity

MSE-Mean Squered Forecasting

RFID-Radio Frequency Identification

SBA-Syntetos-Boylan Approximation

SES-Single Exponential Smoothing

SPSS-Statistical Package For Social Sciences

SSE-Squered Forecasting Error

TSB-Teunter-Syntetos-Babai

WMS-Warehouse Managing Systems

CHAPTER- ONE

1. INTRODUCTION

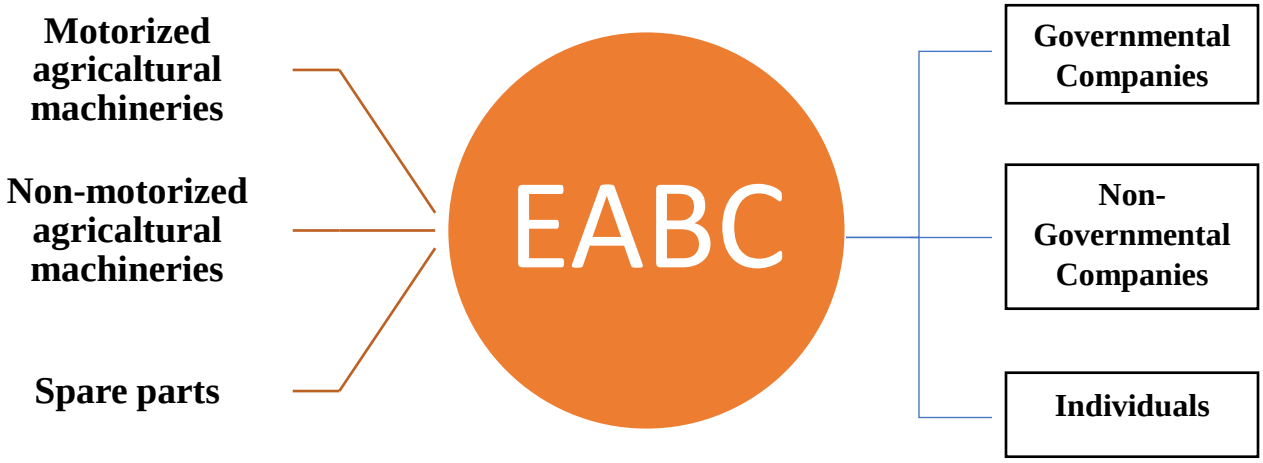
This chapter discusses the background of the study, statement of the problem, research questions, objectives, significance of the study, scope and limitation of the study and organization of the study.

1.1. Background

Inventory theory is perhaps the most carefully studied extent of production and operations management. However, although almost all large corporations and numerous small and medium sized initiatives increasingly progressed to deploy scientific methods for prediction and control of their inventories, unfortunately the use of these methods and tools are usually restricted to some elementary tools like the analysis of economic order quantities (EOQ) and rough guesses of reorder points or base stocks for attaining their pre-determined goal of service levels. Inventory management is known one of the most crucial roles of governmental, commercial and industrial enterprises, which often has a good influence on their total achievement. The distinctive compromise is between high holding and oldness costs of unnecessary stock on one hand and poor service and high scarcity costs subsequent from low inventory levels on the other. The anticipated solution is an appropriate inventory management strategy that will assurance an acceptable service level without having unwanted large inventories that are overpriced and severe to keep.

As Chan et al. (1999), mentioned unnecessary high stocks may the outcome from high demand forecasting errors. Hence, having a forecasting technique with a minor forecast error will support in this difficulty. However, just having a single individual forecasting for inventory determination is not adequate. In this case, a mixture of forecast will be advantageous. The collective forecast might enhance the correctness of the prediction and minimize the forecast error of individual forecast. Demand forecasting embraces the prediction, projection or estimation of probable demand of the items over a stated upcoming period. The demand products frequently change in the marketplace due to the seasonality factor, trend factor, and economic factor. As soon as the main selling season passes, the extra inventories of the product are devalued greatly. Therefore, demand planning is considered the first step of a supply chain planning process, which provides a continuous link to manage the inventory position and the product demand.

As shown in Figure 1.1 Ethiopian agricultural businesses corporation (EABC) is one of the suppliers of agricultural inputs and vehicles for local farmers and investors all over the country. These products are imported from foreign countries from its providers in expense of dollar and fairly distributed to regions, weredas, kebeles. This is not the only task of the company, different kinds of spare parts & agricultural motorized and non-motorized machineries are imported and sealed to local customer.



Source- EABC website (*www.ethioagribusco.com*)

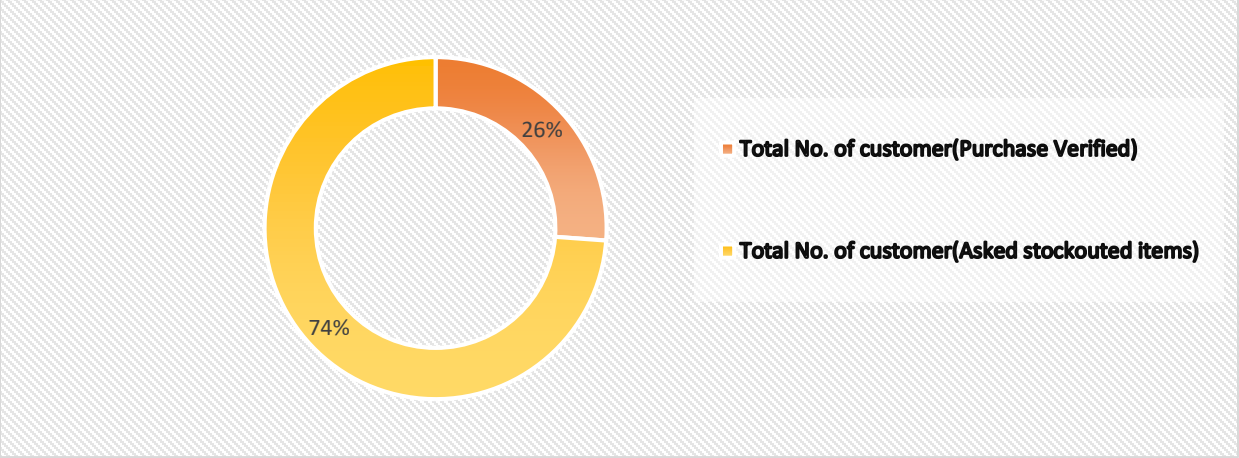
Figure 1-1 Ethiopian agricultural corporation (EABC) imports and customer

From the major distinctive feature of the headache the behavior of demand for the items in the inventory is very intermittent and uneven, thus resisting the typical conventions of Poisson distribution or normal. Thus, Effort must also be made by EABC management to strike best investment in inventory since it costs much money to tie down capital in excess inventory. Solutions must be found to enhance inventory levels and minimize obsolescence costs while maintaining service and availability levels. Therefore, it is important to assess the inventory management practice of demand forecasting in order to understand the seriousness and impacts on EABC's service delivery and operational success and accordingly give corrective solutions.

1.2. Statement of The Problem

Ethiopian agricultural business corporation (EABC) stands to provide agricultural inputs and technologies that should considerably improve production and productivity, increase modern farms and Agro-Industries at very competitive price to make the economic development of the nation grow fast. Even if it has good and relable suppliers it was challenging to satisfy the

increasing and sporadic demand of agricultural machineries and spare parts also, stock outing of critical items is very common in EABC. As figure 1.2 shows that the number of customers asked for items and back without having the items is higher than the customers which are sucessfully purchased.



Source – Self compilation from EABC electronic and paper data

Figure 1-2 Percentage of customers from 2011-2018

If the company have a good practice of demand forecasting, roughly it may get near to additional 2.56 Billion birr or more with those 74% lost customers in those years. But, the corporation is facing the problem of meeting the required inventory level for the items.

As mentioned, the main objective of EABC is providing agricaltural inputs with competitive and lower price to make nation grow fast. By taking the above aim in to consideration investors and farmers must get agricaltural inputs with enough quantitiy and fair price compared to other private suppliers, However in practice the corporation could not satisfy the need of its customers and exposed them to private suppliers which are more expensive and no aftersales service because of inefficient demand prediction. This condition shows the company is failed to achive its main vision. As mentioned by Korpela and Tuominenb (1996), predicting the demand for products both in the near future and over longer periods is one of the most important topics in inventory controlling. The objective of demand forecasting is to project the quantity of items and accompanying service that customers will need at some point in the forthcoming. Based on the forecasts, the management can make a decsion on how much of each product must be stored in the inventory. Thus, the inventory problem in the Ethiopian agricaltural bussines corporation might

be due to inaccurate demand forecast. In this paper, the main target is to find the best way to make the demand forecasting effective in inventory and to find the best forecast to anticipate the right demand in order to solve the inventory difficulties.

In addition, according to the pilot review and inventory problems listed on the 2011E.C Annual Plan of Ethiopian Agricultural Bussiness Corporation, 2018 document; high customer complain due to low service level, high stocks outs, rush ordering, unplanned and urgent purchasing items and having less effective employee are listed as a problems encountered in inventory. Then again, obsolescence and high non-moving stocks were regularly pragmatic. So, Investigating the details behind these complications and finding solutions by improving the forcasting practice in inventory managment system are vital.

1.3. Research Questions

In order to create a competitive solution for Ethiopian agricultural businesses corporation and to meet the required needs, there were several research questions to be answered.

This thesis was based on the following questions.

- ✓ What are the main factors influencing demand forecasting?
- ✓ What remidies should be taken to make the forcasting effective?

The project questions that are detailed here were answered in this thesis.

1.4. Objectives

General Objective

The general objective of this research was to assess the demand forecasting practice in inventory, investigating the major challenges and generating viable solution to the identified forecasting problems in Ethiopian agricultural business corporation (EABC)

Specific Objective

The specific objectives of this research are the following

i) To identify the effects of different inventory issues on effectiveness of demand forecasting in EABC.

ii) To find a solution to the issues found in demand forecasting practice

1.5. Significance of the study

The result of this study has great significant to different stakeholders that include: EABC management, employees, customers and other researchers. Therefore, the study would have both practical and theoretical significance in the following ways:

I). The researcher tried to propose feasible managerial suggestions to improve the company's forecasting practice through analysis, after examining the relevant theories and understanding the operational practice of EABC

II). The researcher expected that the result of the study is significant to deliver information to EABC management and employees to advance an organized thinking on the importance of demand forecasting practices

III). It allows to design and issue on effective forecasting policies that empower government institutions and public enterprises to adopt best demand forecasting practices that increase organizational performance by minimizing wastage of inventory investment

IV). the paper is important to academic areas allowing to have practical training by integrating theoretical training with real working situation

V). Additionally, the result of this study would help as a source document and as a reference for those researchers who need to make more study on the same area to the next.

1.6. Scope and Limitation of The Study

The study is set to explore viable solution to the problems related to the demand forecasting in inventory management. The scope of this research study was focused geographically inventory operation mainly at main store found in addis ababa. It is because of the constrained and limited time and budget. Ethiopian agricaltural corporation has five main sub-organizations which are focused in different kinds of bussiness activities. For this reaserch only one sub-organization which is called Agricultural Equipment and Technical Service was rolled. So readers must know that Agricultural Equipment Technical Service is addressed by the denotation of the corporation which is Ethiopian agricaltural corporation(EABC) in general in this paper. Due to the wide nature of the subject and lack of preserved data the researcher was unable to investigate more than eight years inventory data. Therefore, it is bounded from January 2011 to April, 2019.

The research didn't cover all factors to improve the overall inventory management. Hence it is limited to analyzing the practice of demand forecasting to enhance the inventory management. Also it faced with the difficulties of not getting all respondents on time, were busy and tight with the routine job to reply the questionnaires appropriately, to make interview and formal discussion as much as needed. Moreover, some of the respondents were not agreed to give the required information and not willing to disclose and provide detail info specially the open ended questions on paper. As Mugenda (2008) states a response rate of 50% is adequate, 60% is good and above 70% is perfect to represent the opinion of the entire population. So, it is good to continue and finish the research by 70.52% voluntary respondents in this case.

1.7. Organization of the Study

Considering the research objectives, the structure of the thesis is defined as follows

- ∇ Chapter one introduces the research Topic, Scope and Objectives;
- ∇ Chapter two offers a comprehensive review of related literature on forecasting and inventory concept
- ∇ Chapter three illustrates the research Methodology design of the research methods;
- ∇ Chapter four concentrates on data presentation and analysis;
- ∇ Chapter five presents conclusion and recommendations on the overall study based on the analysis of data collected.

CHAPTER-TWO

2. REVIEW OF RELATED LITERATURE

2.1. What is Inventory

Inventories are a key asset that should offer return for wealth invested and either pending conversion or use for forthcoming. It is also a collection of resources of any kind having some economic value. All required items are stocked in to warehouse to be used when the needs arise (Datta, 2003). Besides these, maintenance equipment, lubricants and fuel, and other items which are many indirect goods are also classified as inventories materials for future use which are used in a manufacturing or service rendering organizations. But they differ only in their use and classification from raw and other direct items. It includes items sold to end customer or retailers (Ackah & Ghansaha, 2016)

Inventory revenue signifies one of the main sources that allow businesses to make income and incessant earnings to the organization's stakeholders. It is an asset and owned by a business that has an advantage of being sold to a customer. Also, it is one of the core portions of the major business assets that is prepared to use or will be ready for sales. It can be the raw materials, work in progress, good and finished goods.

2.2. The Usage of Inventory in Agro-mechanization Business

In agreement with Vrat, (2014) it is important to keep on hand a physical stock in the system to protect the uncertainty because non-availability of material may lead to dalliance in production or project or service delivered. Keeping agricultural machineries in inventory also has an opportunity cost of "carrying "or "storage" inventory to the organization. So, the difference is though we want inventory, it is not easy to have inventory. These conditions make inventory management a difficult problem area in materials management. It also makes high inventory income ratio which can be the indicator of advantageous performance.

Inventories are the stock of an organization that the corporation saves on store for forthcoming usage (Pandy, 2003). Inventory support the agro- mechanization business to make significant choice that is perceptible at all levels of actions, distribution and sales, being a main part of total current assets of many enterprises (Lee, Taylor, & Moore, 2003).

In every organization the decision on inventory is based on the facts about the balance of inventory on hand, forecasting demand information, lead time and time variation, stock cost, ordering cost and shortage cost (Naliaka & Namusonge, 2015). A good inventory management gives the opportunity to make long last competitive benefit and perfection of the competitive position of the organizations. This lead drop in cost of keeping stock by replenishing just sufficient inventories, the right place, exact time and cost. High levels of inventory affect the organization cash flow, reduce efficiency and adversely affect the procurement performance out of the capital. The inventory system helps the operating policies and organizational work flow for replenishing and controlling materials in store. Capable management of inventory system requires a suitable system of making the decisions to keep track of goods in inventory and how much and when the order is applied.

2.3. Inventory Management in Agricultural Machineries Business

According to Sharma (2006) inventory management can be described as the protection of over investment and under investment in inventories, by improving on the main necessary operational activities. Determination of the right level of investment in inventories, consistent with production operation schedules and prompt services, is the activities of inventory management. Mohamad et al. (2016) Inventory management refers as the total activities in each operation stage may be in raw material, semi-finished materials or finished goods, so make sure the availability of stock and the over or under stocks always must be low Brutus A., (2015) explains that inventory materials represents an important asset. It is the largest single item and it has accosted in every organization. Material management is the important aspects of agricultural machineries business to function handling and acquisition of stock, assigning line management, storage, and material transport. Material management and control components role are very similar in order to make organization effective efficient.

2.4. The Need of Inventory Management in Agro-Machinery Retailing

According to Reid & Sanders (2007) inventory management mostly serves two main purposes in machinery business. First, all responsible inventory management takes responsibility for availability of stock material. The availability of inventory is important for the smooth running of operation. The second goal is by performing the required activity; efficient service level can be achieved by minimizing the optimal costs.

The need of inventory management is to identify the amount of inventory items to import the specific product, the system of planning and controlling of inventory items are rely on the product, client needs and the operation actions is based on the available inventory. Moreover, inventory is useful for balance sheet that used as a rise the asset group on the company balance sheet, since numerous firms play a role to minimize their budget in fixed asset, equipment and machinery, warehouses, plants, office buildings by increasing their inventory (Mohamed, 2016). Inventory management system is vital to support the quality of manage in stock handling and the extent of customers served by consumer items. A good inventory system will make the corporation easily to know the period to place an order. Inventory management system is also an important means of tracing large delivery with in short time.

2.5. Inventory Control Systems in Agricultural Machines Inventory

An inventory system controls the level of inventory by determining how much to order (the level of replenishment) and when to order. There are two basic kinds of inventory systems: a continuous system and a periodic system. In a continuous system, an order is placed for the same constant amount whenever the inventory on hand reduces to some amount, but in a periodic system, an order is placed for a different amount after some regular intervals. (Bernard & Roberta, 2011)

2.5.1. Periodic Inventory System

Inventory level of goods is revised at prearranged, fixed points in time. If the primary situation review occurs at time T, the second review would be carried out at time 2T, and so on. Under a periodic system, a company limits the inventory balance and price of items sold at the end of the accounting period. That is, firms or any business organization can determine its inventory on perpetual system. The business organization's the starting balance sheet embraces the opening balance of the inventory. Procurements made during the period increase inventory available for sale. At the time of operation purchase discount and return can be occurred that recorded on temporary account and closed at the end of period. The entire amount of inventory that will either be sold during the period or remain in ending inventory is the sum of the initial inventory balance and the net purchases. As Mosich, (1989) said the ending inventory balance is taken based on a physical count of the inventory.

Recall that in periodic review models, the inventory levels are reviewed at predetermined, discrete times such as every Friday, the last working day of every month, etc. A review of on-

hand inventory is conducted at time, and an order is placed. The order quantity is equivalent to the quantity that is needed to bring the inventory level back up to a prespecified maximum level, Therefore, in periodic review models, the order quantities generated varies each period.

2.5.2. Perpetual Inventory System

Industrial advancement has made the periodic system outdated and provided the computer software for organizations to use a perpetual system. Under this system, organization continually update inventory accounts for each purchase and each sale. A perpetual system is superior to a periodic system because it offers up-to-date info about inventory levels; price of items sold, and gross profit. (Mosich, 1989).

2.6. What is forecasting

Forecasting is a known statistical issue in business, where it assists to notify decisions about the arrangement of production, transportation and personnel, and it offers a guide to long-term strategic planning. However, business estimating is mainly done in bias, and is often distorted with planning and goals. According to (Rob & George, 2018) forecasting is about predicting the future as accurately as possible, given all of the information available, including historical data and knowledge of any future events that might impact the forecasts. According to Evan J. Douglas, “Demand estimation (forecasting) may be defined as a process of finding values for demand in future time periods.” In the words of Cundiff and Still, “Demand forecasting is an estimate of sales during a specified future period based on proposed marketing plan and a set of particular uncontrollable and competitive forces.” Many people wrongly assume that forecasts are not possible in a changing environment. Every environment is changing, and a good forecasting model captures the way in which things are changing. Forecasts rarely assume that the environment is unchanging. What is normally assumed is that the way in which the environment is changing will continue into the future. That is, a highly volatile environment will continue to be highly volatile; a business with fluctuating sales will continue to have fluctuating sales; and an economy that has gone through booms and busts will continue to go through booms and busts. A forecasting model is intended to capture the way things move, not just where things are.

2.7. Forecast Horizon, Capability and Forecasting

The forecast horizon is the number of time periods ahead of the identified data over which forecasts are determined that is extrapolation (Lewis, 2000). In many conditions the supreme forecast horizon is about 6(six) periods ahead, since the assurance with which predictions any more ahead of this can be made is likely to be little. An exception to this general law is when a robust seasonal impact is known to be, in which case predictions up to an entire season ahead might well be better that is up to twelve months for monthly data. Fitting is the method of making a forecasting model which capable of known data that is. Interpolation. whereas predicting is the process of extrapolating a competent model into the upcoming which is ahead of known information.

Within a condition where forecasting models are built on parameters which can be attuned, a better fit is frequently established by altering the value of those parameters to decrease the Sum of Squared forecasting Errors (SSE) or the Mean Squared forecasting Error (MSE). It is normally expected that the top fitted model will also be the greatest model for estimating where, in its severe explanation, predicting produces upcoming estimates ahead of acknowledged statistics.

2.8. Forecasting Methods

Forecasting methods can be divided in three basic categories:

2.8.1. Quantitative or Statistical

Quantitative Forecasts base on mathematical models and supposing that previous statistics and other related issues can be collected into reliable estimations of the upcoming. In making a quantitative forecast it should start with a number of gathered values, previous data, or observations (Makridakis & Wheelwright, 1989). These observations may signify numerous things, from the actual quantity of units sold to the cost of making each unit to the amount of personnel employed (Makridakis & Wheelwright, 1989).

Quantitative methods can be divided into time series methods and causal methods. Time series methods are used for a short period forecasting and there's used historical data about demand. Although causal methods are used to forecast medium and long time period demand. (Fitzsimmons & Fitzsimmons 2006). There is a wide range of quantitative forecasting methods, often developed within specific disciplines for specific purposes. Each method has its own properties, accuracies, and costs that must be considered when choosing a specific method. Most

quantitative prediction problems use either time series data (collected at regular intervals over time) or cross-sectional data (collected at a single point in time).

2.8.1.1. Time series forecasting

Time series methods are quantitative methods that use exists info for predicting the demand. Information is mostly past demand statistics. Time series main purpose are based on the hypothesis that in future will happen the same enhancement than in previous. That hypothesis and past data can analyzed for upcoming demand estimate with different functions. (Arnold et al., 2008).

Time series manage demand with different factors. Along to Mentzer & Moon (2005) these factors are:

- Trend
- Stability
- Cycle
- Randomness

These factors describe demand in different situations: demand can be stable or there can be changes to notice. Time series analysis attempt to understand present situation and forecast demand with that info. The simplest time series forecasting methods use only information on the variable to be forecast, and make no attempt to discover the factors that affect its behavior. Therefore, they will extrapolate trend and seasonal patterns, but they ignore all other information such as marketing initiatives, competitor activity, changes in economic conditions, and so on. Time series models used for forecasting include decomposition models, exponential smoothing models and ARIMA models. There are two kind of time series forecasting: open model time series methods and fixed model time series methods. When these are calculated together there are more than sixty different methods that fall into time series methods. (Mentzer & Moon 2005). For this section there are 2 models presented: moving average and exponential smoothing.

2.8.1.2. Moving average

Moving average method uses past sales data to estimate. It is very beneficial way to prediction if demand is quite immobile. (Haksever et al., 2000). Mentzer & Moon (2005) offer the following formula to estimate with moving average

$$F_{t+1} = (S_t+S_{t-1}+S_{t-2}+\ldots+S_{t-N-1})/N \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ (1)$$

Where: F_{t+1} = Forecast for Period t+1

S_{t-1} = Sales for Period t-1

N = Number of Period in the Moving Average

Problem with moving average is to choose how many periods of sales to use in forecast. The more periods used, the more it starts to look like a basic average. Conversely the fewer periods used, the more reactive the prediction becomes but the more it start to look like naïve technique: the forecast for the next period equals the sales from the last period. (Menzer & Moon 2005).

So, with moving average there's a question need to be answered: how many periods of data to use and how much weight to put on each of those periods? There's no direct answer to that question but exponential smoothing forecast method was developed to answer this question. (Mentzer & Moon 2005)

2.8.1.3. Exponential smoothing

Originally exponential smoothing was called an "exponentially weighted moving average", which is easy to comprehend and it is easy way to clarify what does exponential smoothing means. (Mentzer & Moon 2005) Technique was established around 1950s and there are a many different options to do with exponential smoothing. (Hyndman et al., 2002) Brown & Meyer (1961) presents forecast with exponential smoothing in following way

$$F_{t+1} = \alpha S_t + (1-\alpha) F_t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Where: F_t= Forecast for Period t

S_t = Sales for Period t $\qquad 0 < \alpha < 1$

So, in this method the prediction for next period is function of last period's sales and last period's forecast, with parameter α. (Mentzer & Moon 2005) If F_t will be substituted with previous rounds of forecasting formula will change like this: (Hyndman & Athanasopoulos, 2014).

$$F_{t+1} = \alpha S_t + \alpha (1- \alpha) S_{t-1} + \alpha(1- \alpha)2S_{t-2} + \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(3)$$

The forecast in formula 3 weights moving average of all actual values. With parameter α can be set weight to value that wanted to act biggest role. This is the concept of exponential smoothing: forecast is analyzed using weighted averages where the weight reduces exponentially as observations come from further in the past. (Hyndman & Athanasopoulos, 2014).

2.8.2. Qualitative or Judgmental

Qualitative Forecasts are founded on views, knowledge and skills rather than more proper investigation. It is used where there is no past data. This kind of predictions are one of the easiest and broadly used estimating methods available (Makridakis & Wheelwright, 1989). Its main point based on the corporation of the executives by debating and deciding as a team what their best prediction for is for the thing to be forecast (Makridakis & Wheelwright, 1989). The most

vital judgmental methods are Delphi, Market Surveys and Historical Analogy.

2.8.3. Time Horizon

Forecasts can be categorized in terms of time period that cover in the future. The basic categories of time horizon predictions are long-term, medium-term and short-term (Korpela & Tuominen, 1996). The long-term estimates cover a time span of three up-to ten years and it is used in the study of standard commitments and can be considered as strategic decisions. The medium-term predictions are made for 1 year to sustenance production planning in the face of very trended demand and can be considered as tactical decisions. Lastly short-term forecasts cover a time of one week to three months and they are used to governor manufacturing levels and stock replenishment in short demand difference. It is concerned for operational decisions (Korpela J. et.al, 1996; Waters, 2003).

2.9. Importance of Demand Forecasting in agricultural machinery Retailing

Demand forecasting plays an important role in management of agricultural machinery inventory. It supports an organization to minimize risks involved in business activities and make vital business decisions. In addition to this, demand predicting offers an awareness into the organization's capital investment and development plan (Economics Discussion, 2019).

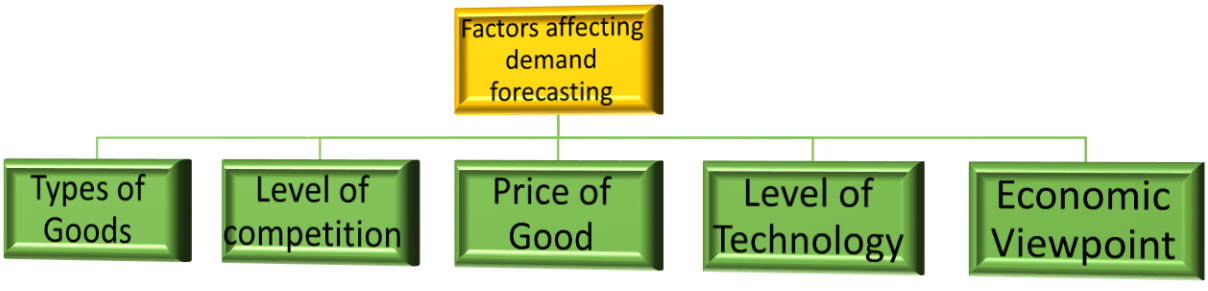
Today's international business market, the methodical move from push to pull manufacturing, and the rise in consumer concern economies, have make a much more complex predicting world (Essays, 2019). Forecasters are being asked to make plans for growing geographies, increased numbers of sales channels, and broader, more diverse, and shorter life cycle product lines. This density means that markets are further energetic and the business situation is not steady (Essays, 2019). The importance of forecasting is finding in a great range of planning and decision-making circumstances. It is essential to mention those perspectives that forecasting can become a useful tool for management in many departments of an organization. In marketing, a great amount of decisions can be improved significantly by connect them with dependable forecasts of market size and market characteristics (Essays, 2019). Having this in mind for example, a company that produces and sells electrical devices should be able to forecast what the demand will be for each of its products by geographic region and type of consumer (Essays, 2019).

In production an essential need of forecasting is the area of product demand. This relates with

the both prediction of volumes mixes so as the organization can plan its production schedule and organize appropriate its inventories (Makridakis and Wheelwright, 1989). Another area that the recent years have linked a lot with forecasting is finance and accounting. These departments must forecast cash flows and the rates at which various expenses and revenues will occur "if they are to maintain company liquidity and operating efficiency" (Makridakis and Wheelwright, 1989). Forecasting uses organizations by serving in achieving the aims when companies predict the current demand for its services in the market and move forward to attain the set goals, by playing an important role in allocating budget by projecting expenses and expected incomes, to governor organizations production and staffing actions by hiring human resources on the bases of the necessities, minimize the wastage of the resource of an organization by producing according to the estimated demand of products, assist the decision about the development of the business of the organization if the anticipated demand for products is higher than the organization may need to expand future, helps in making serious decisions such as deciding the plant size and necessity of raw material, assistances in making improvement if the demand for an organization products is minimum it may corrective action and recover the level of demand by enhancing the products or spending extra ads and allows the government to organize import export business and plan worldwide trade.

2.10. Factors Influencing Demand Forecasting of Agricultural equipment

Demand forecasting is a procedure that aids in identifying which items are required where, when, and in what quantities. There are a number of factors that affect demand forecasting. Some of the factors that affect demand forecasting are shown in Figure 2.1:



Source- Economics Discussion, (2019)

Figure 2-1 Factors affecting Demand forecasting

i. Types of Goods:

As mentioned in *Economics Discussion, 2019* the types of goods affect the forecasting procedure

to much extent. Goods can be established and new goods. Established goods are those goods which previously exist in the inventory, whereas new goods are those which are yet to be introduced in the market. Info concerning the demand, substitutes and the condition of competition of goods is identified only in case of established goods. Else way, it is hard to predict demand for the new goods. Therefore, estimating is dissimilar for different kinds of items.

ii. Competition Level:

Competition level has impact on the process of demand projecting. In extremely competitive market, demand for items also relay on the count of competitors found in the market. Also, in a very competitive market, there is continually a danger of new participants. In such a case, demand forecasting becomes problematic and challenging. (Economics Discussion, 2019)

iii. Price of Goods:

It is a major issue that affect the demand forecasting procedure. The demand forecasts of organizations are vastly affected by alteration in their pricing policies. In such a situation, it is hard to forecast the precise demand of items.

iv. Level of Technology:

According to (Economics Discussion, 2019) level of technology constitutes an important factor in obtaining reliable demand forecasts. If there is a rapid change in technology, the existing technology or products may become obsolete. For example, there is a high decline in the demand of floppy disks with the introduction of compact disks (CDs) and pen drives for saving data in computer. In such a case, it is difficult to forecast demand for existing products in future.

v. Economic Viewpoint:

As discussed in (Economics Discussion, 2019) economic viewpoint plays a crucial role in obtaining demand forecasts. For example, if there is a positive development in an economy, such as globalization and high level of investment, the demand forecasts of organizations would also be positive.

2.10.1. Mathematical Demand Forecasting Model for Inventory of Agricultural Equipment

To make sure never run out of stock, even with minimal stock levels, efficient demand forecasting must be applied. Warehouse managing systems (WMS) can offer useful statistics that illustrates how items are moving through the logistics. Precise demand forecasting is attained by mining actual sales and seeing demand pattern history. The purpose of this function is to minimize warehouse storage costs and maximize the use of space. Experts advise holding

sufficient stock in the inventory to meet one and a half times the average demand for that items, at every time.

Inventory control is the science-based art of controlling the amount of inventory (or stock) held, in various forms, within an organization to meet the demand placed upon that business economically (Lewis, 2012). To govern the level of inventory, it is essential to forecast the level of upcoming demand, where such demand can be viewed as necessary either independent or dependent. forecasting is took as being a scientific procedure of predicting upcoming event by casting forward historical data. The historical information is primarily examined to establish the fundamental trends which characterize the data and this info is then used in a predetermined way to find a prediction of the future.

Inventory control systems must cope with a diversity of different customer demand patterns if an operative overall policy for managing inventory (or stocks) is to be realized. There are different types of demand pattern for instance irregular, intermittent, lumpy and smooth demand patterns. Based on these two dimensions, the literature classifies the demand profiles into four different categories:

- Smooth demand (ADI < 1.32 and CV^2 < 0.49). The demand is very regular in time and in quantity. It is therefore easy to forecast and you won't have trouble reaching a low forecasting error level.
- Intermittent demand (ADI >= 1.32 and CV^2 < 0.49). The demand history shows some variation in demand quantity but a high variation in the interval between two demands. Though specific forecasting methods tackle intermittent demands, the forecast error margin is considerably higher.
- Erratic demand (ADI < 1.32 and CV^2 >= 0.49). The demand has regular occurrences in time with high quantity variations. Your forecast accuracy remains shaky.
- Lumpy demand (ADI >= 1.32 and CV^2 >= 0.49). The demand is characterized by a large variation in quantity and in time. It is actually impossible to produce a reliable forecast, no matter which forecasting tools you use. This particular type of demand pattern is unforecastable. (Frepple, 2019)

Intermittent demands are characterized by infrequent demand influxes interspersed by time breaks during which no demand occurs. Such demand patterns can characterize spare parts

and any stock-keeping units within the variety of items at any level of a supply chain. There is a plethora of methods that have been originated in the academic fictions in the last decade to deal with the predicting of sporadic demands. With regard to the parametric forecasting method, most of the exploration work in the area of intermittent demand stays based on Croston's method. This is the typical method that is broadly functional in practice and that has been largely analyzed in the academic literature (Croston, 1972; Teunter et al.,2011). Croston's method was claimed to be balanced but despite its theoretical dominance modest aids were logged in the literature when it was compared with simpler predicting methods, such as single exponential smoothing (SES) (Willemain, et al., 1994).

Also, intermittent demand products are bare, as slow movers, to a high risk of oldness, which makes their forecasting and stock control a challenging task. Despite this fact, there is very limited investigation that has deliberated the topic of obsolescence in the academic literature, especially in the forecasting literature (Babai et al., 2014). It should be distinguished that Croston's method and SBA update demand sizes and demand intervals only in phases with positive demand, so in phases with zero demand, forecasts are not attuned downwards bearing in mind inventory obsolescence. More recently another technique, referred to as Teunter-Syntetos-Babai (TSB), has been proposed in which the demand possibility is rationalized instead of the demand interval, doing so in every period. Hence, TSB can be used to deal with obsolescence subject by continually giving up-to-date estimates, including after long intervals with zero demand. Note that opposing to Croston's method and SBA, TSB has been revealed to be hypothetically unbiased when considering a random point in time and can lead to low mean squared forecast mistakes.

In 2018 Babai et al., proposed a new method of forecasting intermittent demand that is a modification of the SBA estimator. In periods with positive demand, it changes the demand sizes, intervals, and the estimator, similar to SBA, but at any time period if the actual demand interval becomes higher than the most current predicted demand interval, the update of the demand interval converts as is done for the chance of incidence in the TSB estimator that is in every period. Hence, the new technique takes benefit of TSB by arresting the risk of obsolescence and updating in each period to decrease the bias and takes benefit of SBA by using the same estimator when there is no obsolescence, which has also exposed a high MSE empirical performance even under non-stationary demands. The performance of the new way is evaluated

mathematically by means of an extensive simulation test considering generated demand series with linear and sudden obsolescence and empirically. Forecast accuracy and inventory performance are considered in the empirical investigation. The empirical performance is examined as well by means of datasets of selected stock keeping units that are categorized by decreasing demand patterns. The technique will be referred hereafter to as the 'modified SBA' method. In periods with positive demand, the modified SBA method updates demand sizes, demand intervals, and the estimator exactly like the SBA method, but in any period (with zero demand), if the actual demand interval becomes higher than the most current predicted demand interval, the update becomes in every period the same to the chance of incidence in the TSB method. The estimator of the modified SBA method is given by:

$$D'_t = (1 - \frac{\beta}{2})\frac{z'_t}{T'_t} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

Where

If > 0: $\boldsymbol{z'_t} = \boldsymbol{z'_{t-1}} + \alpha(z_t - \boldsymbol{z'_{t-1}})$ and $\boldsymbol{T_t} = \boldsymbol{T'_{t-1}} + \boldsymbol{\beta}(\boldsymbol{T_t} - \boldsymbol{T_{t-1}})$

$$\boldsymbol{T_{t-1}} + \boldsymbol{\beta T_t} - \boldsymbol{T'_{t-1}}\text{ , If } \boldsymbol{T_t} > \boldsymbol{T'_{t-1}}$$

Otherwise: $\boldsymbol{T'_t} = \{$

$$\boldsymbol{T'_{t-1}}, \text{ If } \boldsymbol{T_t} \leq \boldsymbol{T'_{t-1}}$$

$$\boldsymbol{z'_t} = \boldsymbol{z'_{t-1}}$$

Where

D_t = Demand for an item at time t

$\boldsymbol{z'_t}$ = Estimate of the demand size at time t

z_t = Actual demand size at time t

$\boldsymbol{T_t}$ = Actual demand interval at time t

$\boldsymbol{T'_t}$ = Estimate of the demand interval at time t

2.10.2. Competency of Staff of Agricultural Machineries Inventory

As Kathryn (2008) discussed competence means a potential ability or a fitness to perform a

given task in a given condition. It's the ability to do a specific activity effectively. Competencies are used to make unique standards within disciplines. This includes teachers, students and practitioners. As Verma (2006), mentioned "competencies in education create an environment that fosters empowerment, accountability, and performance evaluation, which is consistent and equitable. The acquisition of competencies can be through talent, experience, or training''.

According to Anni Phillips (2009) Competence is characterized into behavioral & technical competency. Behavioral competency involves behaviors, Skills, abilities and other characteristics that can found into one individual in the company. Technical competency is described as specific knowledge and skills wanted to be able to do a job successfully. Technical competency is part of work description and define what someone desired to perform, however behavioral are not part of work description, they are noticeable and can be evaluated.

Qualified staff that is knowledgeable and skilled will support the organization to attain its goals and objectives by being competent and effective when carrying out their jobs. For an organization to flourish, qualification is therefore a pre-requisite and must be cop up with job prerequisite, hence the essential to hire and mature ambitious personnel. Stock Control is no longer considered a clerical function done independently by unqualified individuals within a governmental agency. If staff in stock supervision is not capable and competent, then there will be ineptness in inventory control.

As Bailey and Farmer, D. (1982) says that for inventory management function to attain a superior performance, it's essential to recruit, train and skilled staffs with the capacity and motivation to do good job. Unskilled employees can render stock control almost ineffective. According to Susan & Michael (2000), employee in warehouse are accountable for the delivery of inventory materials to all storage. They are also in charge for the physical security and safekeeping of items at all store's positions and for all storekeeping activities, including item receiving, put-away, and item picking and delivering.

2.10.3. Agricultural Equipment Inventory records Accuracy

Inventory record is significant to make decision to buy or sell any item. Some company control their stock by counting physical inventories at regular time which is monthly or annually. Other companies use a birr inventory record which gave them a rough clue of what the inventory may be from day to day in terms of money. If the stock is containing thousands of products, as it is for a convenience type store, dollar control may be more handy than physical control (Amlod,

1998). An inventory stock record is accurate when the data on the stock record is the same with the actual physical count, (Schrady, 2006). Inventory records can be attained through the following tactics projected by Lee (2006); choosing and installing inventory tracking software, adjustment of arrangement to permit optimal storage, preparing rack position codes and assigning different identifying number, securing inventories and storage zones to bound unofficial removal or movement of inventory items. Moreover, an organization may combine parts, so that the same items are reserved in the same place, allocate unique part numbers to the items, create units of measure for the items and set out constant and consistent inventory counting. Supply Chain Metric (2016).

There is a six ways or tips to follow and to ensure inventory recorded accuracy which is mentioned by Rohm, Catherine M.T,(2019). They are maintaining a well-organized inventory, establishing good inventory naming and labling practices, define and follow efficient storage and receipt process and policies, use cycle counting, limit and track access to inventory, use technology to owen advantage.

2.11. Effect of Computerized Agricultural machineries Inventory System

The manual inventory system has many challenges compared to the automated one (Opeyemi, 2013). It is very time consumption the updating the system manually after everyday business operations. Also, another challenge is related with communication. In manual system, the inventory records are taken manually hence delaying information movement between stores and related sections. Further difficulties include difficult stock counting, tough in keeping track of day-to-day inventory actions and discrepancy in ordering of items. Many companies are implemented this computerized or automated inventory system in reason of the above difficulties.

2.12. New product forecasting for Machineries

The explanation of a new machine can differ. It may be a completely new machine which has been introduced, a variation of a current product which is improved, an alteration in the pricing scheme of a present machine, or even an existing product incoming to a new marketplace (Rob & George, 2018). Qualitative predicting is mostly the only existing technique for new item estimation, as previous data are not available. Delphi, forecasting by analogy and scenario

forecasting are all valid when predicting the demand for a new item. Additional approaches which are further specific to the state are also obtainable.

2.13. Conceptual Frame work

Conceptual framework is a hypothesized model showing the relationship between the independent and dependent variables (A., 2008). As shown in figure 2.2 conceptual framework demonstrates relations and variables of demand forecasting practice that affect the performance of inventory and service delivery of Ethiopian agricultural business corporation. The model clarifies that factors such as proper mathematical forecasting model, following government economic policy, competency of inventory staffs, inventory records accuracy, competitor level on effectiveness of demand forecasting in the EABC inventory. Therefore, the service delivery of EABC is dependent variable which has been predicted by the effective demand forecasting practices. Therefore, this research needs to use the Conceptual Framework in Figure to examine that the variables has influence on demand forecasting on Ethiopian agricultural business corporation. It is from this conceptual framework that the research design of the study in the next portions was made.

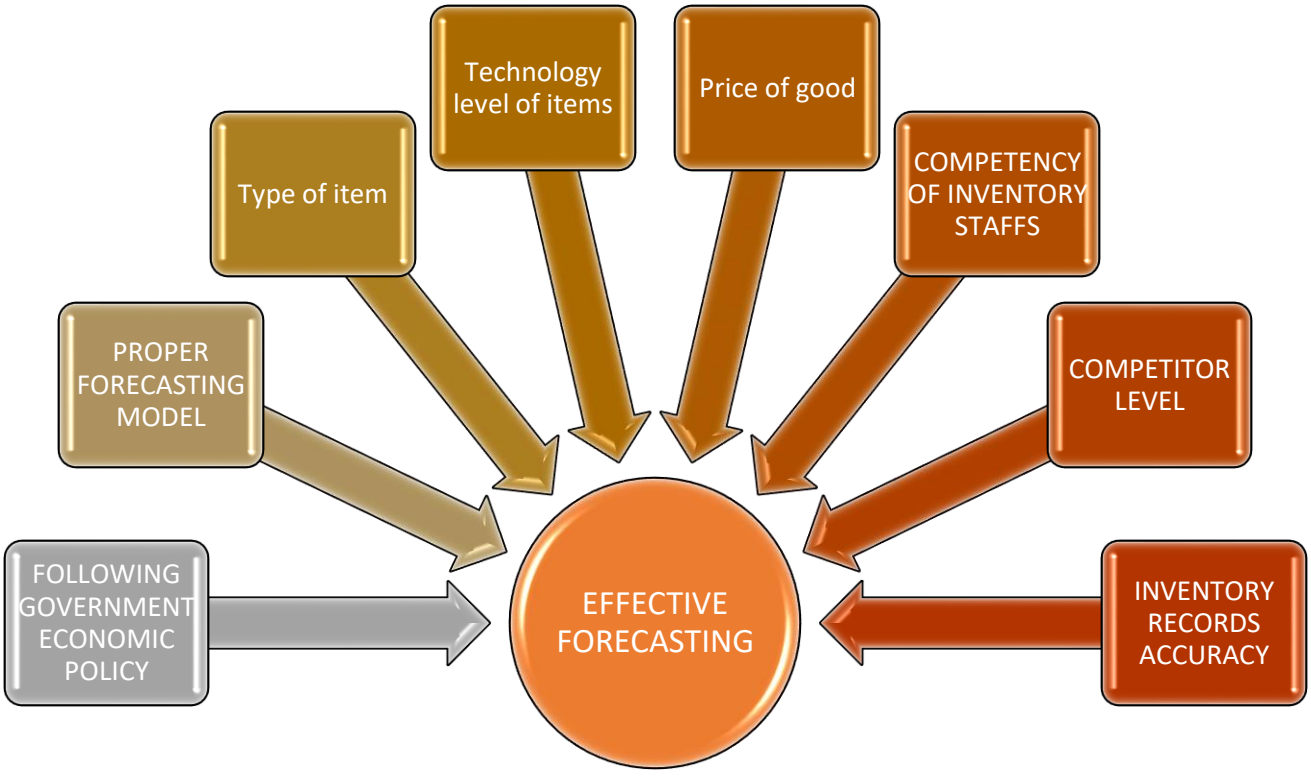


Figure 2-2 Conceptual Framework: Factor Affecting Forecasting

Proper Forecasting Model, Following Government Economic policy, Competency of Inventory

Staffs, Inventory Records Accuracy, Competitor Level are Independent variables. Also, Effective forecasting and customer satisfaction are dependent variables under a category of service delivery.

2.14. Research Gap

Generally, in all the above studies researchers shown forecasting studies by multiple researchers in different approaches, concerning inventory management, the assessment of forecasting model, internal control system and the role of inventory forecasting. These show that how forecasting is the key part of the inventory management functions to service renders company and any public enterprise. Effective forecasting plays a very significant role for any firm and business (Ackah & Ghansaha, 2016).However, since it goes high and holds without service instead of generating income it incurs cost. There are some researches done on overall inventory management in different problem areas but as far as the researcher finding, it was difficult to find a research focused on only the overall demand forecasting practice, especially in Ethiopia. Also, studies like Vitri,(2014), Rohaizan Ramlan, et.al.,(2012), Giacomo,(2014) and many other researches concerned on inventory control and forecasting assumes lead time demand follows a normal or Poisson distribution. This is often not the case in practice and leads to very unsatisfactory results because demands are sometime irregular or intermittent. Also, those studies described on the above are not assessed the main core areas of gaps of competitors level, economic viewpoint, inventory recording accuracy, the impact of forecasting model on inventory level together. So, the assessments of forecasting practice for the improvement of inventory management encompass those areas under Ethiopian Agricultural Business corporation. In this research the researcher tried to full fill the gaps listed above. Also, understanding and testifying problems clearly can lead to the half way to the finding of the solution. so, in this study the main factors of forecasting were sorted out and analyzed with respect to the case company and their joint impact was proofed.

CHAPTER- THREE

3. RESEARCH METHODOLOGY

In order to achieve the objective, a combination of literature review, data review, interviews, and brainstorming sessions will be used. The data sources consist of scientific literature and Ethiopian Agricultural corporation EABC (employees and databases) the following table presents an overview of the research subjects, their corresponding research methods and data sour**ces.**

Table 3-1 Overview of methods and data sources

	Subject	Methodology	Data sources
1	Collecting factors that influence planning decisions	Literature review, Interviews	Scientific literature, EABC (employees)
2	Defining metrics	Literature review	Scientific literature
3	Analyzing root causes of interventions	Interviews Data review, SPSS	EABC (employees and databases)
4	Presenting results and improvements	MS-word, SPSS, Brainstorm	EABC (employees)

The procedures that used in carrying out the research including research design, population and sampling techniques, and data collection methods and data analysis tools.

3.1. Research Design Approach and process

This research adopted both explanatory and descriptive view because it requires assessing and analyzing the existing conditions and problems of the company. This research apply mixed approach in analysis because of the data is both quantitative and qualitative in nature.

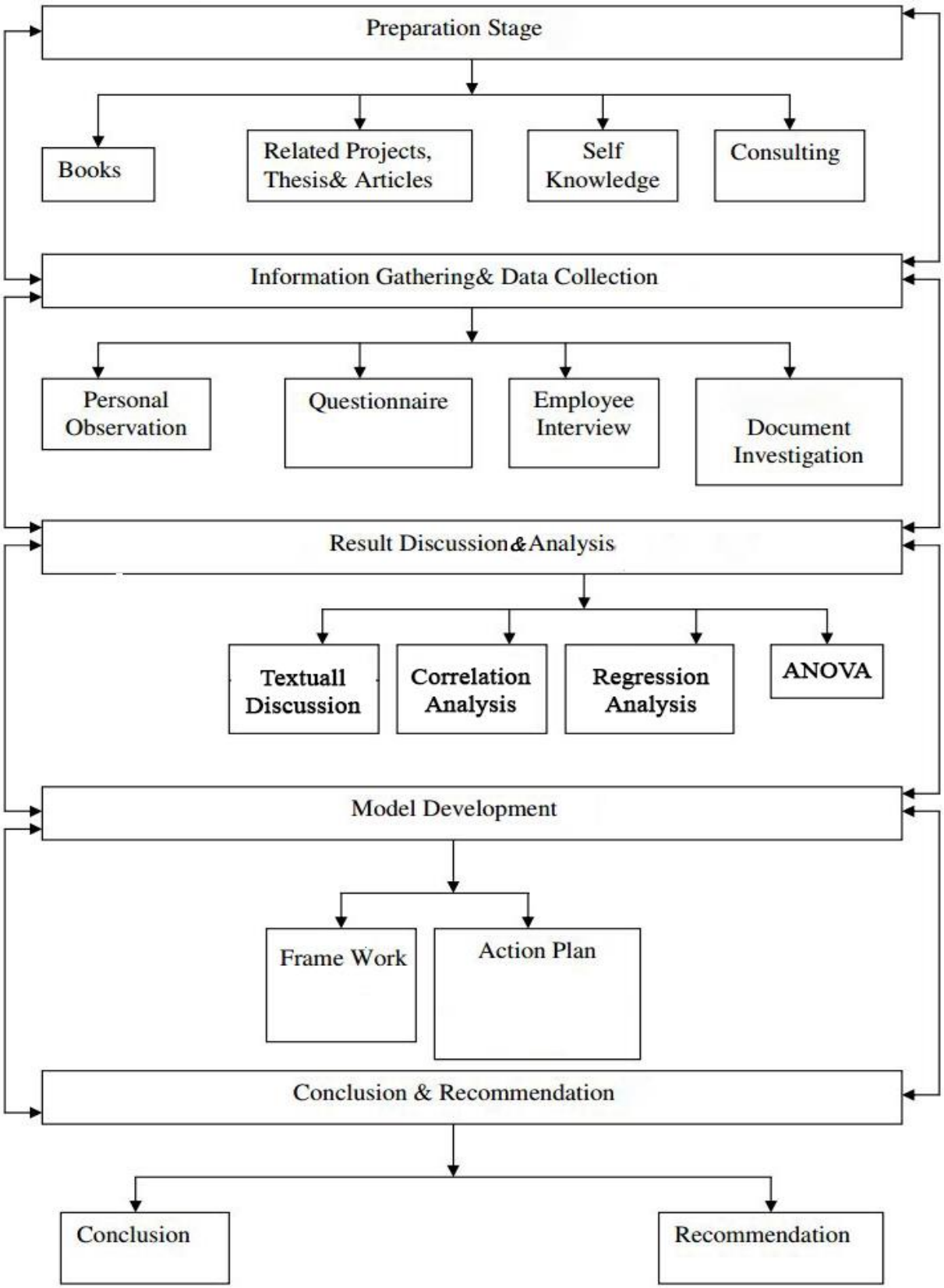


Figure 3-1 Organization of the thesis and summery of methodology

3.2. Population and Sample Procedure

The target population for this research was Ethiopian Agricultural business Corporation management and staff members. The researcher takes initial study data about the staff who involve directly and indirectly in demand forecasting and inventory management operation. Accordingly, active participants in the inventory operation among staff considering those who have high school certificate and above academic level mainly working at head office. These persons are expected by the researcher to have inventory management practices in the company and capable of giving ideas about forecasting and inventory management practices applied in the company. Also, because of it is easier to get a sample of subjects with particular characteristics purposive sampling technique was used. Based on this sampling technic 68 peoples are proposed to give information but only 49 of them are willing to give information and data because of numerous personal reasons.

3.3. Data Collection Methods

In this research numerous sources of data and methodology is used because it adopts case study research approach to evaluate and investigate company issue and problems. In principle, multiple source of evidence is possible for case study research (Gillham 2000). This is research uses both qualitative and quantitative approach as applied research part since it concerns with perceptions, attitudes and experience of staff as well using quantitative data to asses demand forecasting system. The data collection tools are questionnaire, interview guide, and document analysis guide. The first research methodology in collecting primary data is interview and questionnaire tools by addressing the management, seniors and technical personnel of company. In questionnaire data collection instruments, Structured and well-defined questions are developed wisely and distribute to the respondents physically.

Interviewing consisting of both structured and unstructured questions are undertaken by the researcher using telephone and physically contact for selected management and technical staff with applying purposive and convenience sampling method. In addition, Secondary data will be collected by evaluating the company's report and electronic data sources including internet.

3.4. Methods of Data Analysis

Descriptive statistics in the form of statistics, frequencies and percentages were used for analysis in the study. SPSS (statistical package for social sciences), Microsoft excel and word software is used to present and analyze data in charts, graphs and tables to display the relationship of variables, summary of questionnaires, interview and secondary data. The data obtained from questionnaire were coded and summarized on the SPSS and Excel table.

Qualitative data were analyzed using Content Analysis techniques that thematic contents was formulated and master list of themes were developed based on the research questions. The background information of the respondents such as education, age, working unit and others are included to portray their ability of respondents to give genuine and quality data for reliability and validity purpose.

3.5. Validity, Reliability and Ethical Issues

In this study much attention is made to eliminate researcher's bias and respondent's response without clearly grasp the questions by formulating clear procedure on the questions, and preliminary question testing and repetitively reframing the questions. The researcher has stated to the participants that they must participate in the research willingly. Moreover, the researcher tries to meet closely the respondents for any vague questions using contact the persons and telephone. Also, the researcher tries to triangulate the data found using several various questions directly and indirectly. In addition, secondary data from reports and interview questions are used to triangulate the result for attained soundness. To sustain ethical issues, respondents are well-versed about the objective of the study, not to tell their name in responding questions and to get the response result or the copy of study, to answer the questions fully or partially. Therefore, privacy of personal data is kept accordingly. Lastly, the researcher needs to acknowledge all materials and sources of data used in this research are for only educational purpose.

3.5.1. Cronbach's Alpha

Cronbach's Alpha is designed as a measure of internal consistency of items in the questionnaires. Total number of questions in the questionnaire were 44 testing variables and 7 items related to demographic variables, hence "N" of items in the below Cronbach's Alpha test is 44. Instruments are generally considered reliable and acceptable when they have an alpha level> .50 threshold on

a scale of 0 to1 (Tavakol & Dennick, 2011). The Reliability Statistics result in table 3.2 below shows that the value of Cronbach's Alpha is greater than 0.70. Hence, scales developed suggest good internal consistency.

Table 3-2 Cronbach's Alpha

Reliability Statistics		
Dimensions	***Cronbach's Alpha***	***N of Items***
Forecasting Factor	***.802***	***44***

Source: Own Compilation and SPSS output

A high coefficient indicates that the items are consistently measuring the same underlying construct. Therefore, those correlation values make data entered into SPSS safe for assuming reliability.

CHAPTER-FOUR

4. DATA ANALYSIS AND INTERPRERATIONS

4.1. The Response Rate of Questionnaires

Up to the end of the date a total of sixty-eight (68) copies of questionnaires were directed and distributed across 7 departments. Out of the total respondents, 49 of them give back the questionnaire as they properly filled and used in data analysis. This makes the response rate 72.05%. Mugenda (2008) states that a response rate of 50% is adequate, 60% is good and above 70% is perfect to represent the opinion of the entire population. As it can be seen in T*able 4.1* below, from the total of 68 questioners spread, 19 (27.9%) staffs had not given back the questionnaires. This leads the researcher to realize that these employees' rejection and unwillingness to filling questionnaire in its place they only look into their regular work schedule.

Table 4-1 The Response Rate of Questionnaires in different departments

No.	Departments	Questionnaires Administered	Questionnaires Returned	Rate of Respondent %
1	Finance	10	8	80
2	Internal Audit	8	8	100
3	Material management and stock Accounting	13	7	53.84
4	Procurement, Logistic &Warehouse	11	7	63.63
5	Engineering Office	15	10	66.67
6	Central warehouse	7	5	71.42
7	Corporate Planning and Risk management	4	4	100
Total		**68**	**49**	**72.05%**

Source: Field survey and SPSS output

As illustrated in Table 4.1, 100% of the respondents were from Internal Audit and Corporate Planning and Risk management which indicates that the response rate was high. Then again, Finance registered 80% response rate followed by 71.42% response rate of Central warehouse. While Engineering Office responded 66.67 %; Procurement, Logistic &Warehouse responded 63.63% and Material management and stock Accounting registered 53.84% response rate. This indicates that only two departments returned 100% and the rest departments returned on average more than 70% of the total questioners given to them. Furthermore, to the questionnaire given to employees of EABC, 8 closed ended questionnaires were distributed for 10 higher and middle management officers of Internal audit, Finance, Material management & Stock Accounting, Procurement, logistic & warehouse departments. From the 10 questioners given to these officers, the entire questioner has been answered.

4.2. Findings of Demographic Characteristics of Respondents

The demographic information in the study embraces: work position, marital status, service year, gender, age, department and educational background of the respondents. These variables given as insight about the sample characteristics that took part in this study. It also shows personal data of the respondents of forms given to them. The following details of the background data are shown in chart form.

4.2.1. Gender Characteristics of Respondents

Participating both genders which is male and female equally is the most advisable way of making a study. Actually, the majority of respondents work in EABC are males so it is a bit difficult to get equal number of both genders to respond the questionnaires.

Table 4-2 Gender Distribution

Sex	
Female	14
Male	35

Frequency distribution of findings in the Table 4.2 illustrates that out of the 49 responses

obtained, the majority of respondents 35(71.4%) were male and the remaining 14(28.6%) were females. This tells us many males partaken in the study and in most cases, it is supposed that they dominate in EABC's warehouse management and related positions.

4.2.2. Age Distribution of Respondents

The Figure bellow shows age distribution out of the 49 responses, the minimum age of the respondents is 25 and the extreme reaches above 60 years old. So, it can say that the study made both the old and new generation participate in it.

The figure below demonstrates that out of 49 responses obtained, most of the respondents were found to be older staff representing 34(69.38%) between 46 to 55 years old and followed by age groups 56 and above years old by 7 (12.24%.) response rate. This shows that the majority of the respondents were aged with long years' experience. While 4 (10.20%) of respondents were in the age group of 25 to 35 and 4 (8.16%) were between 36 to 45. The facts illustrate that most of the respondents are 46 and above years of old which infer that old aged employees are allocated in the extents which need additional hard work.

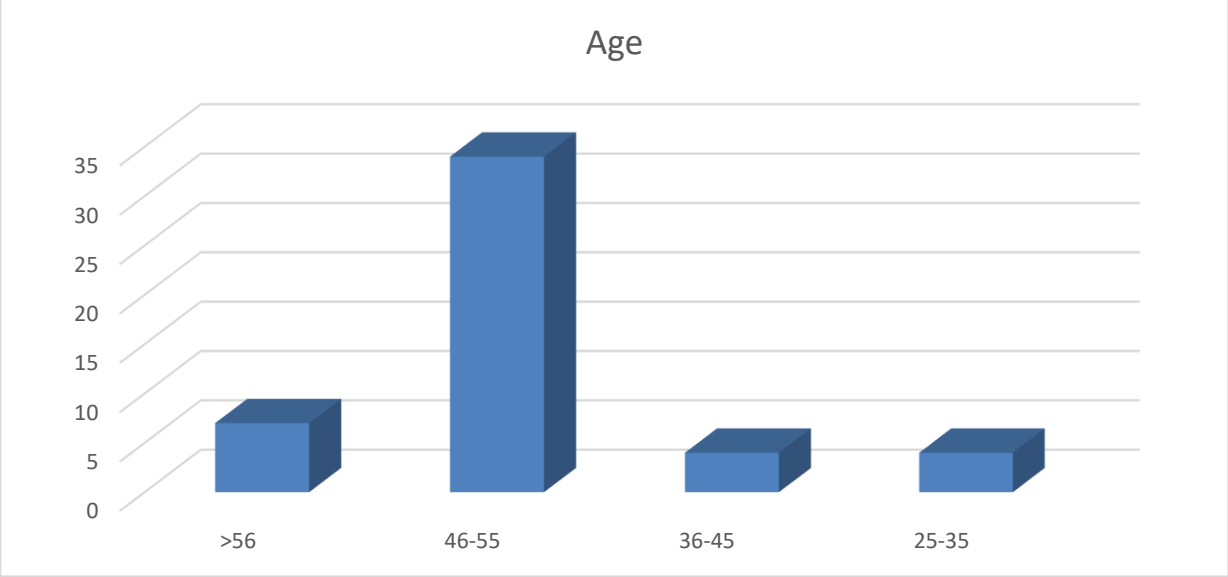


Figure 4-1 Age Distribution of Respondents

4.2.3. Work Experience of Respondents

The table below shows 4(8.16%) of the respondents have work experiences of less than 5 years. Respondents representing 6(12.24%) were between 5 to 10 years' experience. 6(12.24%) of the respondents have experience between 11 to 15 service years; 10(20.4%) of the respondents had served from 16 to 20 years; and finally, the largest grouping 23(46.9%) of the respondents have

experience of more than 21 years. It is held that respondents with high service years expected that they know how the company process of inventory management practices, policies and procedures, internal control system and the status of the demand forecasting.

Table 4-3 Work Experience of respondents

Work Experience	
Experience	**Year**
>21	23
16-20	10
11-15	6
5-10	6
<5	4

4.2.4. Educational Background of Respondents

Based on the data gathered and shown the figure below 28 (35.1%) of the respondents were 10/12 grade complete, 10(14.4%) were certificate, 2(23.7%) were college diploma holders, 7(20.6%) were first degree holders and 2(6.2%) were masters holders respectively. The respondent's educational background holding from lower to higher level infers that the data collected is good in this respect and can support the research to incorporate ideas from different perspectives. Most of the respondents 71(73.2%) were either 10/12 complete, certificate or college Diploma holders. Those participants who have lower educational background are expected to have little knowledge on the company procedure of inventory management and forecasting systems and are rarely have the capacity to inventory management techniques, poor documentation practice, and low responds to better customer service. It also showed that in EABC warehouse, qualification is not pre-requisite and coordinated with job requirements. Furthermore, it is thought that qualifications of most employees are not adequate enough to perform their work efficiently.

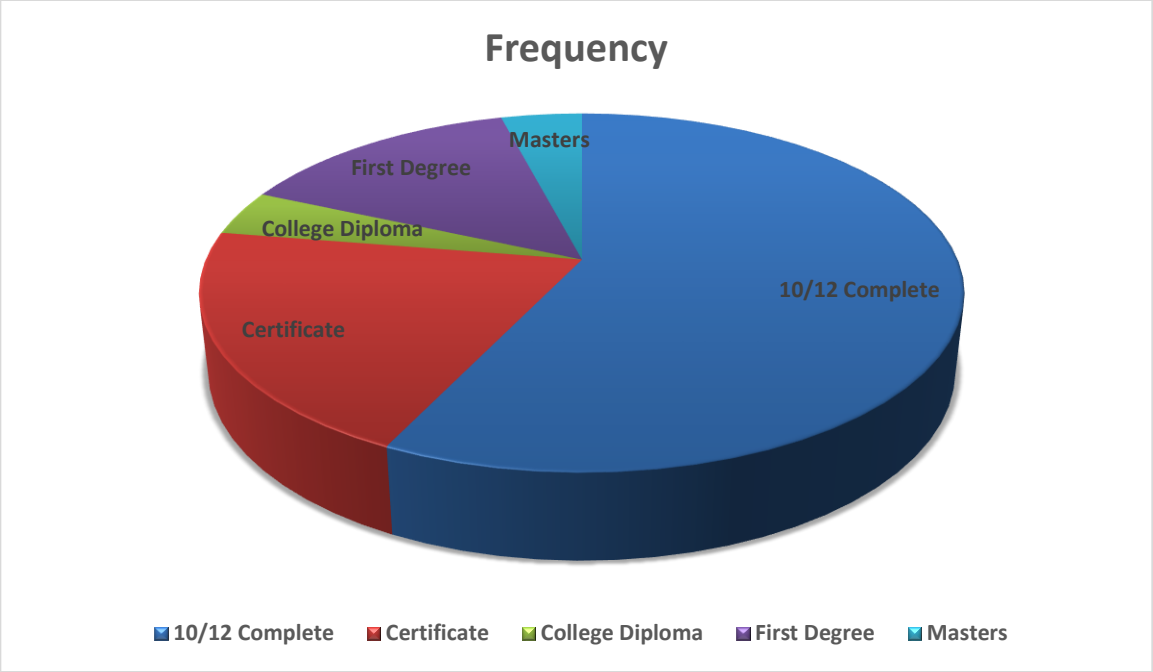


Figure 4-2 Educational Background of the Respondent

4.2.5. Work Position of Respondents

As it can be seen in table below, from the total 49 respondents only 26 respondents (53.06 %) were workers while 3(6.12%) were supervisors, 2(4.08%) were from junior management position and 18(36.7%) were from middle management position respectively. This infers that the most of the defendants who are employed in the warehouse and inventory management activities are workers. So, this is decent source of data that EABC's inventory management system is managed by less educated and lower level employees.

Table 4-4 Work Position of Respondent

Work position	Frequency
Worker	36
Supervisor	3
Junior Management	2
Middle Management	18
Total	49

4.3. Discussion and Findings of Open-Ended Questionnaire

Junior and middle managements got the chance of responding open-ended questionnaire to give a hint on overall inventory management in Ethiopian agricultural business corporation. eight open-ended questions had been provided to employees. Also, there was an open-ended question at the end of each questionnaire sub sections which is answered by employees. These employees are chosen in view of the fact that they have sufficient information, opinion and likely to be the best source of detail and reliable info for the case study. Their responses for each question are summarized as follows.

4.3.1. Types of item in inventory

As respondents stated items which can used as a substitution for other items are not encouraged to order in the corporation's inventory usually. Actually, the case is not the lack of encouragement or not, it is because of difficulty to adopt those new or substitute products to the local customers. So, it is very rare to import brand new kind of item and make available to sell. Also, respondents clarify that there is no a clear policy or procedure to forecast new and substitute item. Forecasting is done by only by rough and unreliable analysis. Lastly, they mentioned about the presence of good inventory item classification based on the type of the item.

4.3.2. Competitor Level

Most of respondents argued that there is no satisfactory practice of considering competitors while forecasting the demand and placing order. As some of the respondent remembered and explained, there is some consideration of the competitors only on forecasting the demand of spare parts. If some spare parts are very expensive and difficult to find for private companies to import, it is decided to increase the amount to be order those items. Also, if those private companies increase their price of item without any tangible reason EABC will place an order and import those items to regulate the market price. Also, as some other respondent revealed that, this competitors level consideration practice is very weakened through time and it can be said that there is no consideration of competitor level during demand forecasting with in recent five or six years.

4.3.3. Price of Goods

Employees and managers who involve in this research stated that the price of items does not show a rapid change in EABC inventory compared to other private retailers. But it cannot be concluded that there is no rapid price change at all. There are some national or local reasons to make a change

on the price which might happen rarely. As all respondents agreed the price of items sold in EABC is mostly are not expensive compared to the private retailers and this is why the company is stands for at the first place. Also, some management are stated, forecasters in EABC consider the change of price of an item during making of placing order and demand forecast. Because it can alter the ability of the customer to buy products and the capacity of the organization to order many items.

4.3.4. Level of Technology

According to the respondent's response the forecasting policy of the corporation gives a provision to not to order obsolete technology items for the next ordering period. And there is clear procedure which encourage forecasting and ordering new technology rather than forecasting and ordering older technology. But because of employee's weakness products which are obsolete technology are still forecasted and ordered. Also, respondents from management is argued that there is a good forecasting policy which supports considering the change in technology during forecasting and placing order because customers do not need products with old modeled and expensive.

4.3.5. Economic view point

As the respondent said the existing Ethiopian market system is not suitable to for some governmental organizations. Organizations like Ethiopian agricultural business corporation are not encouraged to facilitate their business in order to give a chance to private sectors. A couple of respondents are also mentioned that the current Ethiopian market system is difficult to starting just in time inventory system. Also, they stated that the demand of items is mainly affected by the national policy of the government. For instance, the availability of currency can affect the number of products to be order and forecasted. According to the respondent generalization, the forecasting policy of Ethiopian agricultural business corporation does not mention about considering the national policy of the government when making of demand forecasting. So, they suggest to see and update its forecasting policy.

4.3.6. Mathematical Forecasting Model

Most of respondents argued that EABC does not have known mathematical forecasting model. Forecasting is performed by simple crisscross mathematics. The previous annual of quarters average is taken with some variables and they declare any amount by unskilled managements.

4.3.7. Competency of staff

Most respondents believed that it is a major bottleneck for the effectiveness of forecasting the demand and overall managing activities the system. The respondent said that the management do not take in to consideration which item is mostly demanded and which is not. Ordering amount is determined by simple observation and analysis because of lack of skilled personnel and difficulty of demand prediction. A capable and professional staff to forecast the demand and manage the inventory is a big problem.

Most of respondents testified that there is lack of professional staffs in inventory. As the respondent believed the existing salary scale is not sufficient to attract new and talented personnel and retain the most talented skilled and experienced staffs. Also, low working morale among staff member was due to inadequate motivation for good performance. Because of oldness of the workers they can't even read papers easily. some respondent described that, as stock managers and employees get skilled and reach senior stages they are usually moved to other stations or leave the organization. Furthermore, workers who are assigned in inventory are not receptive to the change in customer demand and need. Also, they don't have sufficient knowledge and skill regarding to their duties and responsibilities. They stated that there is a great challenge to get professionals in this area. It was also observed that there is no pre or post-employment training on the area. They observed that staffs with inefficient background, inexperienced, staffs who are not challenging, undisciplined, demoted employees are assigned to inventory. The respondents believed that if skilled and competent employee deployment is refused, it will be one of the critical factors for the ineffectiveness of inventory management practice and demand forecasting of EABC. They also recommend that if EABC places skilled and competent employees and further provide the required pre and post employee training on inventory, EABC can achieve its objectives and provide effective customer service.

4.3.8. Inventory recording accuracy

As respondents are respond sub-sector does not cooperate and discuss each other when making decision such as preparing their requirement for work plan, readiness of budget and transferring to procurement department for more dealing out. Because of lack of enough information about the amount of the stock keeps during new ordering procedure inventory stock out and under stock is familiar also it is testified in annual inventory counting programs. There is absence of integrated

and networked inventory management system. The inventory system is not supported by automated system. In general, there is absence of up-to-date information technology application in the area. There is lack of innovation in the inventory and warehouse management. The existence of all the above difficulties implied that there is poor inventory recording practice which has a big effect on demand forecasting of EABC. They also described that stock out of the required materials, lack of organized and proper feedback system from internal or external stakeholders, poor practice of inventory management techniques, Lack of establishing optimized stock level techniques i.e., poor practice of minimum and maximum stock level are the major bottlenecks in EABC. This indicate that due to poor inventory recording system, EABC was unable to provide the expected service to its customers. So, it must be improved in order to get accurate data of inventory for effective forecasting and good service level.

4.4. Discussion and Findings of Documentary Review and Physical Observations by the Researcher

As reviewed by the researcher from annual planning documents, audit report and physical observation there was plenty of obsolete, damaged, unidentified and slow-moving items in the inventory which are kept for many years. This is because of lack of sorting and identifying critical or fast-moving items during forecasting and ordering new items. Even if the level of technology of items are considered during the forecasting process ordering plenty of items which are more than the enough, expose the inventory for high level of over stocking. The other problem any one can recognize in inventory is the aging of the inventory staff members. Most of them are a lack of moral and inability to perform tasks which need more physical movement and mental activity.

As observed from EABC inventory planning guidelines document, there is a good written procedure about considering the types of item during forecasting. But most forecasters in the organization do not even know it was written in this document. This shows a big red flag on the competency of inventory staff members. Also, the researcher observed, every activity in the inventory is done by manually So this leads to poor inventory record accuracy. Customers write their feedback on the suggestion box and most of them complained the intensity of stock out of critical items in the inventory and also, some of the customers mentioned about poor service delivery of the inventory because of the oldness of employees.

Generally, EABC has good policy or procedure about the consideration of types of items, price of goods and technology level of items during forecasting. But because of lack of competency of inventory staff these policies are hidden and couldn't apply in practice. Likewise, absence of proper mathematical forecasting model, excluding the idea of considering competitor level and economic viewpoints during forecasting are the result of the lack of competency of inventory management and employees.

4.5. Findings and Discussion of SPSS results

Descriptive research studies are designed to obtain pertinent and precise information concerning the current status of phenomena and whenever possible to draw valid general conclusions from the facts observed (Nassaji H., 2015). In this study, the descriptive statics specifically sought to test the level of the independent variable and dependent variable.

4.5.1. Correlation Analysis

Pearson correlation was used to establish the relationship between Competition level, price of good, Level of Technology, competency of inventory staffs, inventory recording accuracy, types of goods and economic viewpoint. Pearson correlation coefficients present the relationship between the variables while the significance values show the statistical significance of the relationships. The research findings were as presented in Table 4.5.

Table 4-5 Correlation Alpha

Variables (Pearson Correlation)	***Effective Forecasting***
Mathematical forecasting model	*.945***
Competition level	*.941***
Competency of Inventory Staffs	*.937***
Inventory recording accuracy	*.808***
Economic Viewpoint	*.703***
Price of good	*.612***
Level of Technology of items	*.601***
Types of Goods	*.594***
Sig. (1-tailed)	*.000*
N	***49***

Source: Own Compilation and SPSS Output, 2019

Correlation analysis results in table above; R=0.945; p=0.000 (<0.01) imply statistically

significant strong positive relationship between Mathematical forecasting model and effective Forecasting. This implies that having proper mathematical forecasting model is a significant determinant for good forecasting. R=0.941; p=0.000 (<0.01) imply statistically significant strong positive relationship between Competition level and effective Forecasting. This implies that considering competition level is a significant determinant for good forecasting. R=0.937 and p=0.000 (<0.01) imply statistically significant positive relationship between competency of inventory staffs and effective forecasting. The results therefore indicate that significant positive influence of competency of inventory staffs on effective forecasting. R=0.808 and p=0.000 (<0.01) imply statistically significant positive relationship between Inventory recording accuracy and effective forecasting. The results therefore indicate that significant positive influence of Inventory recording accuracy on effective forecasting. R=0.703 and p=0.000 (<0.01) imply statistically significant positive relationship between economic viewpoint and good forecasting. The results therefore indicate significant positive influence of economic viewpoint on effective forecasting of demand. R=0.612 and p=0.000 (<0.01) imply statistically significant positive relationship between Price of good and effective forecasting. The results therefore indicate that significant positive influence of price of good on effective forecasting. R=0.601 and p=0.000 (<0.01) imply statistically significant positive relationship between Level of Technology of items and good forecasting. The results therefore indicate significant positive influence of Level of Technology of items of items on effective forecasting of demand. R=0.594 and p=0.000 (<0.01) imply statistically significant positive relationship between Types of Goods and effective forecasting. The results therefore indicate that significant positive influence Types of Goods on effective forecasting. These findings reveal that all independent variables have significant positive influence on effective forecasting of Ethiopian agricultural business corporation.

4.5.2. Regression Analysis

Multiple regression analysis was conducted to establish the combined influence of Proper mathematical Forecasting Model, Considering economic viewpoint, Competency of Inventory Staffs, Inventory Records Accuracy, Competitor Level on effective demand forecasting of EABC.

Table 4-6 Regression analysis

Summary				
Model	**R**	**R Square**	**Adjusted R Square**	**Standard Error of the Estimate**
1	**0.932 a**	**0. 902**	**0.800**	**0.513**

Source: Own Compilation and SPSS Output, 2019;

a. Predictors: (Constant), Proper Forecasting Model, Following Government Economic policy, Competency of Inventory Staffs, Inventory Records Accuracy, Competitor Level.

As per the results on table 4.8, model 1 has a R^2 value of 0.902 meaning that 90.2% of the variation in the dependent variable is explained by the independent variables while 9.8% is explained by other variables outside the model. This indicated that the model is a strong predictor. The R- value of 0.932 indicates that there is a strong positive correlation between the dependent variable (demand forecasting) and the set of independent variables (Proper Forecasting Model, Following Government Economic policy, Competency of Inventory Staffs, Inventory Records Accuracy, Competitor Level).

4.5.3. Analysis of variance (ANOVA)

To test the significance of the relationship, ANOVA test was conducted. The findings were as presented in table below.

Table 4-7 Analysis of Variance

ANOVA[a]						
Model		***Sum of Squares***	***df***	***Mean Square***	***F***	***Sig.***
1	***Regression***	***70.019***	***45***	***1.750***	***7.9***	***.000[b]***
	Residual	***10.351***	***49***	***0.167***		
	Total	***80.37***	***94***			
Dependent Variable: Effective Forecasting						

Source: Own Compilation and SPSS Output, 2019

a. Predictor (Constant), Proper Forecasting Model, Following Government Economic policy, Competency of Inventory Staffs, Inventory Records Accuracy and Competitor Level

From Table 4.8, p=0.000 (<0.01) indicates that the collective impact of proper forecasting model, considering government economic viewpoints, competency of inventory staffs, inventory records accuracy and competitor level on effective forecasting is statistically significant. From the research findings, the following multiple regression model is developed;

Where; Y- effective forecasting

X1- Proper forecasting model

X2- Staff skill and competency

X3- Inventory record accuracy

X4- Competitor Level

X5- Economic Viewpoint

E-error term

$$Y= 1.001+1.41X_1+0.96X_2+0.82X_3+0.68X_4+0.75X_5 \quad (5)$$

The above model illustrates the linear relationship of research variables used in this study. The coefficients infer that variation in Proper mathematical forecasting model by one unit leads to increases effectiveness of demand forecasting by 1.41, change in Staff skill and competency changes effectiveness of demand forecasting by 0.96 and change in Inventory record accuracy leads to change effectiveness of demand forecasting by 0.0.82 percent. Change in competitor level leads to change demand forecasting by .68 percent. Also considering Economic viewpoints leads to Change effectiveness of demand forecasting by 0.75 percent.

4.6. Detailed Strategies to Solve the Main Factors

4.6.1. Inventory record accuracy

Inventory forecasting can only be kept efficiently with the accurate processes and with proper inventory management actions in place. Most demand forecasting problems arise from poor inventory control procedures and absence of proper procedures for reporting transactions happening in real time within the inventory. When an inventory problem crops up, many companies choose to act in a reactive manner rather than trying to solve the fundamental problem. The cleverest way to get good forecast is to have documented processes in place that nip forecasting problems earlier to the problems arise. As the respondent from EABC described the

inventory record accuracy and the documentation process must be improved in order to get accurate data of inventory for effective forecasting and good service level. By considering the actual condition and gathered data, the following ways are suggested in order to improve the documentation and recording accuracy of EABC's inventory.

The first way or step is maintaining a well-organized warehouse. The organization must make sure the inventory is prepared in systematized and orderly manner. The importance of this is many. So that products can simply be identified for sales orders and so that material headed inbound to the inventory can be received and stored in a well-organized manner. If the inventory isn't prepared in well-planned-out form the inventory crew couldn't find what they are looking for to fill an order isn't stored appropriately.

Having neat and simple-to-read plots of the inventory in appropriate places, and well-labeled inventory zones, with clear signage and product descriptions is vital to a well-organized inventory. Name and label even the places that presently have no item stock. It can be changed any time if required. Inventory position guides in the inventory have to be easy to read and unbiased, so the font and color of the lettering on the label need attentions, not just a "nice to have.". If possible, inventory labels are huge enough to be simply and quickly read from some meters away, and all the inventory location labels barcoded for automated location reads.

The second way which is suggested in order to assure inventory recording and documentation accuracy is establishing good inventory naming and labeling practice. Good inventory labeling goes beyond an organization's own inventory and has two parts. Within the inventory, each product needs to be named and tagged with specifics which completely describe the product and any special needs like expiration date and other. Preferably, the supplier will send stuffs using the same labeling desired in the receipt inventory either by synchronizing part numbers to use or by means of UPC codes. This can significantly support inventory associates in receiving the inventory properly. Also, other than clear labels, the naming convention used for product ID on the labels is also as significant. The unique ID of items is clearly the most vital here, but in addition to being unique, length and clarity have also been taken in to consideration. Item names shall be short and simple, usually using numbers and letters to recognize each item uniquely.

The third way will be defining and following efficient storage and receipt processes and policies. Even if the first two rules for inventory managing are applied, the inventory is only as effective as

its documented policies and actions. For well-organized inventory movement and precise data recording it's vital to describe all the action within the inventory. All process documentation should contain actions for physical communication, material handling, safety procedures, and condition of reporting. These guidelines must contain step-by-step procedures for the receipt and delivery of the items. The written processes should detail how the inventory will handled, checked, and put into storage areas. The documentations also need to include how to handle damaged inventory items. After this select few inventory crew members involved in in the inventory to go over the documentation formerly it gets spread to all employees. This make all process activities are documented. After all the reviewers come to an agreement, then the documentation can be speeded to the inventory members. The release of the documentation must be done through formal training with proper employees. The procedures may have to be reviewed and audited to make sure every activity documented is being followed. If some questions arise, make sure to apply a corrective action right away.

The fourth way is become using a cycle counting. Even though most organizations have methods to handle inventory much very well, this doesn't remove the requirement for cycle counting. Cycle counting is a means of counting inventory where less subsets of inventory are counted over an extended period of time. Unlike old-style physical inventory counting, where procedures break while all items are counted at the inventory at one time, cycle counts are less troublesome to daily operations. It also delivers an ongoing valuation of inventory precision and process implementation, and can be tailored to emphasis on products with higher value, higher movement volume, or that are serious to business activities. Cycle counting proves inventory accuracy and can aid in identifying the main sources of inventory faults.

The fifth way which is suggested in order to assure inventory recording and documentation accuracy is limiting and track access to inventory. An easy protection for supervising the inventory is to only have those members who essential to have inventory admittance metrics actually have admission to inventory and its data. If it is known the exact persons who has access and safeguard that, this small group of personnel is appropriately competent on the organization's inventory system and practices, it's much simpler to govern the system, minimize errors, and make alteration when needed.

The sixth way is using of the technology to own advantage. Now a days, technology plays an important role in every business process but EABC is still keeping track of inventory data with pen and paper or simple spreadsheets. So, the company is likely realized that inventory management software has the skill to make inventory control and organization much easy and more precise. Also, bar coding technology plays a significant role in any computerized inventory system. Bar code printers and readers are relatively cheap and can be utilized into inventory activities. It will greatly decrease manual data entry mistakes that arise in the inventory. Other technologies such as RFID (radio frequency identification) is also becoming very cheap and shall be take in to consideration for advanced value inventory.

4.6.2. Competency of Inventory Staffs

Having good, competent staff has positive impact on the organization's success. Good demand forecasting knowledge equips employees with the latest ideas and best practice methods of demand prediction. The research explored the impact of competency of inventory staffs on effective forecasting and customer satisfaction. From the hypothesis testing the conclusion discovered that Competency of Inventory Staffs has significant positive impact on effective forecasting. From this result, the study determined that competency of inventory staffs is significant cause of effective forecasting. As shown from the response of respondent from the interview skilled and competence staff is the most unnoticed issue in Ethiopian agricultural corporation inventory. All of the inventory crew members in Ethiopian agricultural corporation inventory have no good enough essential skills, competencies, knowledge and qualifications about stock administration, demand forecasting and inventory control system. It is decided that much of the crew involved in the above cited department are aged, undisciplined, demoted and labor that does not have good background.

On top of that, the numbers of workers are insufficient and incentive in this activity are not satisfactory. Therefore, to ensure effective demand forecasting and inventory management practice, it is important to hire and recruiting well qualified personnel to forecast the future demand with very minimum error. Also, four ways of improving the existing inventory crew members competency is suggested below. The first suggestion which needs to be considered when computing crew member of inventory staff is a professional training. Based on their responsibility proper employee training may be mandatory to make sure capability and even excellence of the

staff member. Form a knowledge body of important knowledge and good methods to pass on to new employees. It needs time at first but will pay off through time.

The second way is coaching and mentoring. Coaching may be such terrifying at initially. Especially for managers who are beginners and have no any work experience. But now a day's peoples need it more than just instructing them what to do. To get into coaching, anyone can start by questioning some easy questions every week. When organization's managers are deliberate about having the right discussions habitually take place, workers can reflect themselves on their activities, and leaders can help them in attaining their real potential. The third suggestion which needs to be considered when computing crew member of inventory staff is cross departmental training. Management must make each of their teams to enhance the overall health of the organization. Departments or team of employees should be encouraged to transfer any eligible information and data to other employees of the organization. This make the employees to upgrade their knowledge in every direction. The fourth suggestion will be about personal development. Employees do not just be in an expert capacity to oblige the company. They are just humans embraced of physical, intellectual and emotional involvements. Employees need emotional balance which can be raised by supportive managers. Also, intellectual growth and physical health very crucial for the personal development of employees.

4.6.3. Mathematical Forecasting model

According to the previous years annual report of ethipoian agricaltural corporation the demand is more likely intermittent and such a difficult to forecast. This results problem in safety stock by exposing it for stock out in some fast moving items and overstock in slow moving items.

Figure 4-3 Total Sales in EABC from 2011-2019

In addition to this because of lack of staff competency forecasters in the company do not know how to use mathimatical forecasting models. Intermittent demands are characterized by infrequent demand influxes interspersed by time breaks during which no demand occurs. Such demand patterns can characterize spare parts and any stock-keeping units within the variety of items at any level of a supply chain. There is a plethora of methods that have been originated in the academic fictions in the last decade to deal with the predicting of sporadic demands. With regard to the parametric forecasting method, most of the exploration work in the area of intermittent demand stays based on Croston's method. Opposing to Croston's method and SBA, TSB has been revealed to be hypothetically unbiased when considering a random point in time and can lead to low mean squared forecast mistakes.

In 2018 Babai proposed a new method of forecasting intermittent demand that is a modification of the SBA estimator. In periods with positive demand, it changes the demand sizes, intervals, and the estimator, similar to SBA, but at any time period if the actual demand interval becomes higher than the most current predicted demand interval, the update of the demand interval converts as is done for the chance of incidence in the TSB estimator that is in every period. Hence, the new technique takes benefit of TSB by arresting the risk of obsolescence and

updating in each period to decrease the bias and takes benefit of SBA by using the same estimator when there is no obsolescence, which has also exposed a high MSE empirical performance even under non-stationary demands.

The estimator of the modified SBA method is given by:

$$\boldsymbol{D'_t} = (\mathbf{1} - \frac{\boldsymbol{\beta}}{\mathbf{2}})\frac{\boldsymbol{z'_t}}{\boldsymbol{T'_t}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

Where

If > 0: $\boldsymbol{z'_t} = \boldsymbol{z'_{t-1}} + \alpha(z_t - \boldsymbol{z'_{t-1}})$ and $\boldsymbol{T_t} = \boldsymbol{T'_{t-1}} + \boldsymbol{\beta}(\boldsymbol{T_t} - \boldsymbol{T_{t-1}})$

Otherwise: $\boldsymbol{T'_t} = \begin{cases} \boldsymbol{T_{t-1}} + \boldsymbol{\beta T_t} - \boldsymbol{T'_{t-1}}, \text{ If } \boldsymbol{T_t} > \boldsymbol{T'_{t-1}} \\ \boldsymbol{T'_{t-1}}, \text{ If } \boldsymbol{T_t} \leq \boldsymbol{T'_{t-1}} \end{cases}$

$\boldsymbol{z'_t} = \boldsymbol{z'_{t-1}}$

Where

D_t = Demand for an item at time t

$\boldsymbol{z'_t}$ = Estimate of the demand size at time t

z_t = Actual demand size at time t

$\boldsymbol{T_t}$ = Actual demand interval at time t

$\boldsymbol{T'_t}$ = Estimate of the demand interval at time t

4.6.4. Economic Viewpoint

An economic perspective is when a subject is measured concentrating on how it is affected by the economy or by considering its influence on the economy. It is a view point based on economic impact **(Danner, 2019)**. Any forecasting policy is advised to consider any kind of economic perspectives. In the case of Ethiopian agricultural business corporation, it is testified and cross checked the absence of considering economic condition of the market and government during forecasting. The following points are suggested to the forecasters to consider:

- Local market difficulties
- Governmental Economic Policy
- International trade policy

4.6.5. Competitor Level

The last factor which affect the effectiveness of demand forecasting in Ethiopian agricultural business corporation is lack of competitors level consideration. The viable and obvious strategy to know the competitor level is performing the market study. In market study, questions like who is the competitor?, what do the competitors offer?, what can the corporation offer that is better than the competitors? must be answered.

Figure 4.4 diagram tries to recap the relation of dependent variable with independent variables with the detail strategies suggested to solve the main factors of the problem.

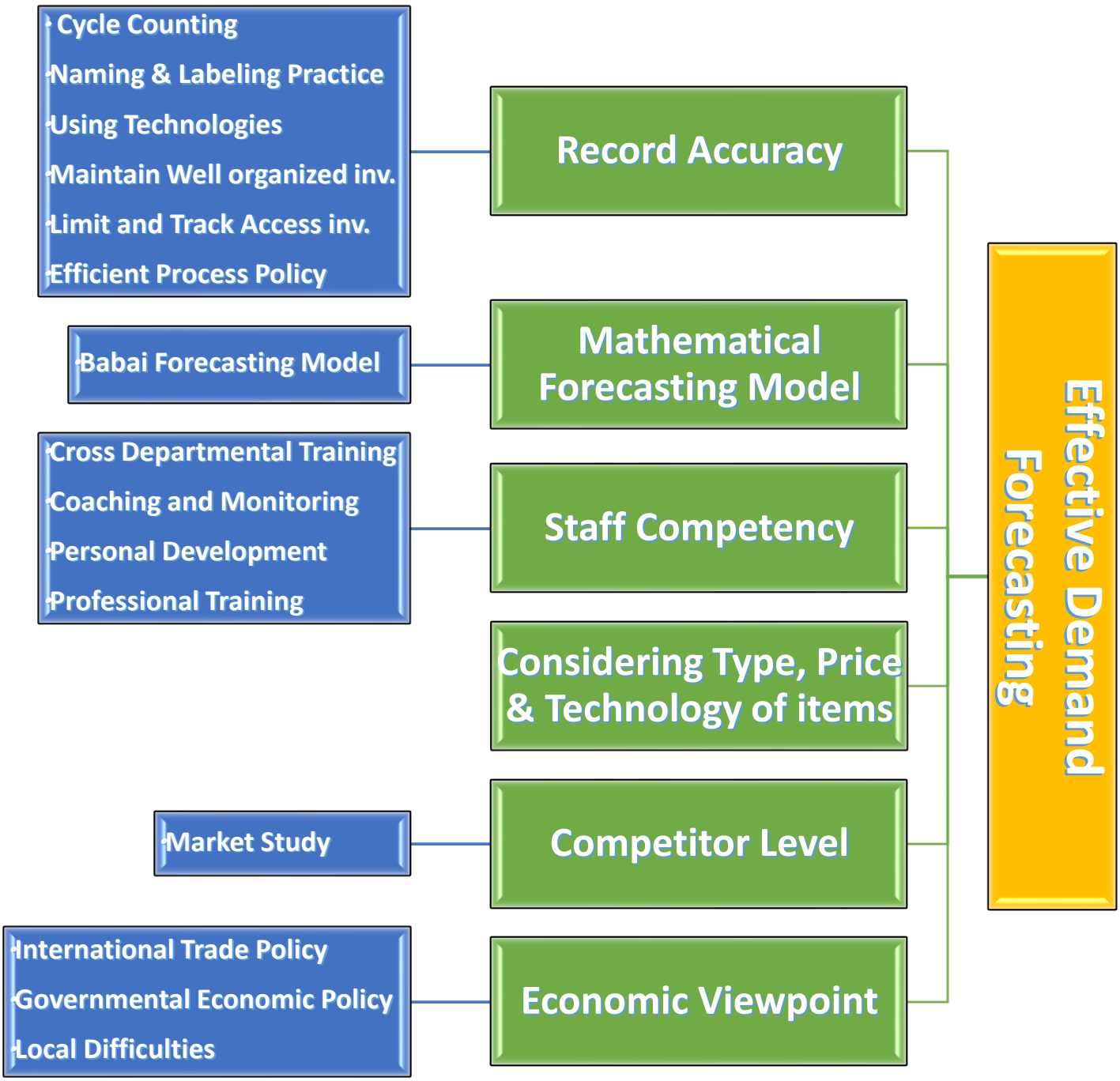


Figure 4-4 Model for effective demand forecasting

CHAPTER-FIVE

5. CONCLUSION AND RECOMMENDATION

5.1. Conclusion

In this paper factor that influence the effectiveness of demand forecasting was explored in the case of Ethiopian agricultural business corporation. As illustrated in the problem statement the number of customers which are successfully purchased the items they need is less the than those of the customer which are not successfully purchase the item they need because of stock out. So, it is clear that the corporation has an issue on forecasting the demand of items. Then from the finding of the study it was established that effective forecasting is significantly influenced by using proper mathematical forecasting model, competency of inventory staff, consideration of competitor level, economic viewpoint, the price, type and level of technology of items and the accuracy of inventory recording.

According to the regression analysis it is verified that 90.2% of effectiveness of the forecast is depends on the change of those factors listed above and the other 9.8% explained by other variables outside this research framework. If EABC follow and apply the findings described in this study, the total sales will be increased by 60.2% or more annually.

As illustrated in correlation analysis it is R=0.808 and p=0.000 for inventory record accuracy. so, it implies statistically significant positive relationship between Inventory recording accuracy and effective forecasting. The results therefore indicate that significant positive influence of Inventory recording accuracy on effective forecasting. An accurate records inventory enables EABC to recognize difficulties affecting its performance, such as items loss through damages, theft or unidentified means. Keeping an eye on the inventory records aids corporation to save money by noticing issues as soon as they occurred rather than at the end of the year during annual evaluation. Whether they are mistakes by the salespeople or procedures skipped in the warehouse or the field, an accurate records inventory helps identify these problems by using checks and balances to reconcile sales**.** Also, an updated records inventory warrants speed and accuracy when dealing with and responding to customers. For instance, when customers call in or inquire on inventory-related questions, company representatives can quickly find and issue answers. Knowing which records are available and where to find them supports customer service reps handle inquiries

promptly and fill orders efficiently, which gives customers a better impression of the corporation. If clients face interruptions and have to wait for answers, it portrays the company as incompetent and may lead clients to find alternative organizations or cancel orders. In EABC inventory because of non-accurate inventory record a lack of enough information about the amount of the stock keeps during new ordering procedure, inventory stock out and under stock is familiar. Also, it is testified in annual inventory counting programs. There is absence of integrated and networked inventory management system. A viable solution is suggested for those problems, which are maintaining a well-organized inventory, establishing good inventory naming and labeling practices, define and follow efficient storage and receipt process and policies, use cycle counting, limit and track access to inventory, use technology to own advantage.

The correlation analysis result of competency of staff members R=0.937 and p=0.000 imply statistically significant positive relationship between competency of inventory staffs and effective forecasting. The results therefore indicate that significant positive influence of competency of inventory staffs on effective forecasting. Having good, competent staff has positive impact on the organization's success. Good demand forecasting knowledge equips employees with the latest ideas and best practice methods of demand prediction. As well a feasible solution is suggested for those problems in this study, which are professional training, coaching and mentoring, cross departmental training and personal development.

Considering Competitor level, economic viewpoint, type, price and technology of items has impact on forecasting goods. The correlation and hypothesis analysis testified that those factors are statistically significant positive relationship on effective forecasting. According to the observation of the researcher and the responses of participants EABC has a good written policy on considering the types of item, technology level of items and price of goods. That is why much attention is not given for them in the study but it is good to know they can be the factor influencing forecasting the demand.

Applying proper mathematical forecasting model has an acceptable value of correlation analysis and hypothesis testing. Which implies statistically significant positive relationship between mathematical forecasting model and effective forecasting. The type of demand in EABC is more likely intermittent and the standard method of forecasting is not applicable because of the irregularity of demand. In this study the Babai forecasting model is suggested to tackle the

difficulty of demand analysis. The criteria used to choose this model is it has less error value compared to other method during simulation and its state-of art.

5.2. Recommendation

Ensuring accuracy of stock records and documentation provide EABC's managements with information which is used to insure accountability and timely decision making through annual stock taking and audit exercise. It is also necessary to provide satisfactory customer service, determine replenishment of individual items, analyze inventory levels and dispose of excess inventory. Therefore, EABC should ensure all inventory records kept are accurate and be compiled with receiving, issuing and delivering of materials.

To safeguard a good demand forecasting practices, procedures and policies has to be designed and implemented in an organization. EABC should have formally structured demand forecasting policy and procedures which can create accountability and responsibility up on staffs assigned in the inventory position. These policies and procedures potentially can make inventory staffs effective to implement inventory technique and to minimize forecasting errors existed in the corporation. Furthermore, these policies and procedures should be effectively communicated across all EABC departments and staffs.

Further study should be undertaken to consider other factors which might assist the forecasting process like: managing multi-item common vendor inventory system with random demands, Forecasting with Exponential Smoothing – finding the right smoothing constant.

REFERENCES

A. M. (2008). *Social Science Research. Theory and Principles. Applied research.*

A. R., & Ghansaha. (2016). Assessing Inventory Management on the Performance of the Production Sector in Ghana. *Dama International Journal of Researchers (DIJR)*.

A. T., C. S., & C. L. (2008). Introduction to Materials Management, Upper Saddle River, NJ: Pearson/Prentice Hall.

Amlod. (1998). Introduction to Material Management, 3rd Ed. Upper Saddle River Prentice Hill.

Anni Phillips. (2009). Overview of Competencies Used in the State of Georgia, state personnel administration.

Ato Fekeru Meshesha. (2018). *The 2011G.c Annual Plan of Ethiopian Agricultural Bussiness Corporation.* Addis Ababa: EABC.

Babai, S. A., & T. R. (2014). Intermittent demand forecasting: an empirical study on accuracy and the risk of obsolescence. Int. J. Prod. Econ. 157.

Bailey, P., & Farmer, D. (1982). Managing materials handbook. Aldershot: Gower Press.

Berhane (IFPRI), G., Dereje (EDRI), M., Minten (IFPRI), B., & Tamru (Licos) , S. (2017). The rapid - but from a low base - uptake of agricultural mechanization in Ethiopia: Patterns, implications and challenges. Retrieved from https://www.slideshare.net/essp2/the-rapid-but-from-a-low-base-uptake-of-agricultural-mechanization-in-ethiopia-patterns-implications-and-challenges

Bernard W. Taylor III, & Roberta S. Russell. (2011). *Operations Management.* United States of America: John Wiley and Sons, Inc.

Brown, , G. E. P., & Meyer, R. F. (1961). The Fundamental Theorem of Exponential Smoothing. Operations Research.

Brutus A. (2015). Assessment of Materials Management and Profitability, Journal of Policy and Development Studies Vol. 9, Industrial Management and Data System. 100(2). 51-60.

Chan, K.C., B.G. Kingsman, & H. Wong. (1999). The Value of Combining Forecasts in Inventory Management- A Case Study in Banking." European Journal of Operational Research.

D.Lewis, C. (2000). Demand Forecasting and Inventory Control. A computer aided learning approach-Woodhead Pub. in association with the Institute of Operations Management.

Danner, S. (2019, June 1). Retrieved from Quora: https://www.quora.com/What-is-economic-perspective-What-are-some-examples

Datta. (2003). Materials Management, 2nd Ed. Prentice -Hall of India PL. New Delhi.

Economics Discussion. (2019, April 28). Retrieved from http://www.economicsdiscussion.net/demand-forecasting/demand-forecasting-concept-significance-objectives-and-factors/3557

Essays, U. (2019, May 1). *Essays, UK.* Retrieved 2019, from Essays, UK.: https://www.ukessays.com/essays/commerce/literature-review-of-forecasting-and-definitions-business-essay.php?vref=1

Fitzsimmon J. A, & Fitzsimmons M. J. (2006). Operations,Stratagy and Information Technology 5th edition, Irwin/McGraw-Hill.

Frepple. (2019, May 10). Retrieved from https://frepple.com/blog/demand-classification/

Gadde L. E., & L. G. Mattsson. (1987). Stability and Change in Network Relationship, International Journal of Research in Marketing; Vol.4; pp.2.

Giacomo, M. (2014). Demand Forecasting Practices and Performance: Evidence from the GMRG Database.

Gourdin K N. (2001). Global logistics management. (A competitive advantage for the new millennium. BLACKWELL Business).

Groves, R. M, Fowler, F. J., Couper, M. P., Lepkowski, J. M., & Singer, E. (2009). Survey methodology (2nd ed). John Wiley & Sons.

Haksever C, Render B, Russel R. S, & Murdick R G. (2000). Service Management and Operation. 2nd edition. Upper Saddle River, New Jersey. Prentice-Hall, Inc.,.

Hyndman, R. J, & Athanasopoulos, G. (2014). Forecasting: Principles and Practice. .

Hyndman, R. J., Koehler, A. B.,, Snyder, R. D., & Grose, S. (2002). A State Space Framework for Automatic Forecasting Using Exponential Smoothing Methods.International Journal of Forecasting.

Kathryn. (2008). The definitions of staff competence, a journal of leadership.

Kenneth Lysons, & Brian Farrington. (2016). Purchasing and Supply Chain Management.

Korpela, & Tuominen. (1996). Inventory forecasting with a multiple criteria decision tool.

Korpela, J, & M. Tuominen. (1996). Inventory Forecasting With a Multiple Criteria Decision Tool.International Journal of Production Economics.

Kotler P., & Armstrong G. (2012). Principles of Marketing, (14th edn), [e-book]. New Jersey.

L. S., Taylor, & Moore. (2003). Management Science, 4th Ed, Allyn and Bacon, Needham.

Lee, Q. (2006). Strategic Guide to Cycle Counting & Inventory Accuracy. Kansas City: Strategos, Inc.

Lewis, C. (2012). *Demand Forecasting and Inventory Control.*

M.Z. Babai, Y. Dallery, S. Boubaker, & R. Kalai. (2018). A new method to forecast intermittent demand in the presence of inventory obsolescence.

Makridakis, & Wheelwright. (1989). Forecasting : methods and applications .

Matthew Lindsey, & Robert Pavur. (2016). A Comparative Evaluation of Intermitent Demand Forecasting with update smoothing constants.

Mentzer, J.T., & Moon. (2005). Sales Forecasting Management - A Demand Management Approach, 2nd ed. Thousand Oaks, CA: Sage.

Mohamed, e. (2016). A study on Relationship Between Inventory Management and Company Performance: a Case Study of Textile Chain Store, Journal of Advanced Management Science Vol. 4, No. 4,.

Mosich. (1989). Intermediate ate Accounting,6th Ed. University of North Carolina at Chapel Hill.

Naliaka, & Namusonge. (2015). Role of Inventory Management on Competitive Advantage among Manufacturing Firms in Kenya International Journal of Academic Research in Business and Social Sciences.

Nassaji H. (2015). Qualitative and descriptive research: Data type versus data analysis. Language Teaching Research,.

Nayambura T., & Mwangi W. (2015). The Role of Inventory Management on Performance of Food Processing Companies: A Case Study of Crown Foods Limited Kenya. *European Journal of Business and Social Sciences, Vol. 4, No. 04, July 2015. P.IUSRSLN*.

Ogbad, E. E. (2009). Profitability through effective management of material. Journal of Economics and International Finance.

Opeyemi, A. (2013). Design of a Computerized Inventory Management System for Supermarkets. International Journal of Science and Research.

Pandey. (2003). Finance Management 8th edition, vikas publishing house, PVT ltd, New Delhi.

R. J., & G. A. (2018). *Forecasting:Principles and Practice.* Australia: Monash University.

Randall, D. M, & Wol|, J. A. (1994). The time interval in the intention-behaviour relationship: Meta-analysis. British Journal of Social Psychology.

Reid, R, & Sanders, R. (2007). Operations Management: an integrated approach .3rd edition. New York: John Wiley & Sons.

Rohaizan Ramlan, Siti Anisah Atan, & Umol Syamsyul Rakiman. (2012). Demand Forecasting in SME's Inventory Managment.

Rohm, Catherine M.T. (2019, March 7). *Technology Evaluation Center*. Retrieved from https://www3.technologyevaluation.com/research/article/6-tips-for-perfect-nearly-inventory-accuracy.html#_Toc450831966

Schrady. (2006). Operational definitions of inventory record accuracy. Naval Research Logistics Quarterly.

Tavakol M., & Dennick R. (2011). Making sense of Cronbach's alpha. International Journal of Medical Education,.

Teunter R., Syntetos, A.A, & Babai, M.Z. (2011). Intermittent demand: linking forecast to inventory

obsolescence. Eur.J. Oper. Res 214.
Trigg, D., & Pitts, E. . (1962). The optimal choice of the smoothing constant in an inventory.
Verma. (2006). Empowerment, accountability and performance evaluation: the acquisition of competencies strategies, an international journal Vol 2.
Vitri, J. (2014). Demand Forecasting Process Design and Methods in Medium Sized Enterprise.
Vrat. (2014). Materials Management, Springer Texts in Business and Economics, .
Willemain, T.R, Smart, C.N, Shockor, J.H, & DeSautels, P.A. (n.d.). Forecasting intermittent demand in manufacturing: a comparative evaluation of Croston's method. Int. J. Forecast.

APPENDIX I

ADDIS ABABA UNIVERSITY -TECHNOLOGY INSTITUTE

DEPARTMENT OF MECHANICAL AND INDUSTRIAL ENGINEERING

QUESTIONNAIRES FOR EABC EMPLOYEES

Dear respondents,

As a partial fulfillment of the award of M.Sc. degree in Industrial Engineering at AAU technology faculty, I am conducting a research on "Improvement of inventory management: the case of Ethiopian agricultural businesses corporation". This questionnaire is intended to request your independent opinions. Because you are the one who can give a correct idea of forecasting practices in EABC inventory, I friendly need your full assistance to fill this questionnaire honestly. All information given shall be treated with utmost confidentiality and used for educational purpose. Please be free to answer questions without writing your name.

Thankyou in advance for your partaking.

Email: beimnet86@gmail.com, phone: 0934881922(Beimnet kinfe)

Part I – Demographic Facts

Instruction: Give your response by ticking (✔) once besides each choice.

1. Gender:

☐Male ☐Female

2. Marital Status:

☐Single ☐ Married ☐Divorced ☐widowed

3. Age:

☐less than 25 years ☐26 to 35 years ☐36 to 45 years ☐46 to 55 years ☐55 and above

4. level of Education:

☐10/12 grade completes ☐Certificate ☐College Diploma ☐1st degree ☐Masters

☐Others, please specify_____

5. Your Service years in the corporation:

☐less than 5 years ☐5 to 10 years ☐11 to 15 years ☐16 to 20 years ☐Over 21 years

6. Work position:

☐worker ☐Supervisor ☐Junior Management ☐Middlemanagement ☐Senior management

7. In which department are you working _____

Part II- Questionnaires about inventory management practice

Instruction: Rate the subsequent inventory management practices at EABC and kindly specify the level of your agreement with the statement below once as per the scales provided.

Level of Agreements				
Strongly Disagree	Disagree	Undecided (Neutral)	Agree	Strongly Agree
1	2	3	4	5

Questions related with Forecasting Practice					
I. Staff Skill and Computation	**Level of Agreement**				
	1	**2**	**3**	**4**	**5**
1. There are skilled and competent man powers in the corporation's warehouse that use inventory management tools properly.					
2. The numbers of staff involved in EABC's stock control activities are adequate.					
3. There are old aged employees who are assigned in areas which require extra energy and efforts of the warehouse.					
4. In EABC warehouse, qualification is a pre-requisite and matched with job requirements.					
5. The corporation's warehouse staffs are continuously trained on inventory management control systems.					
6. Do you have any additional point to mention regarding the warehouse staff knowledge and profession of EABC ?_____ _____ _____					
II. Types of Item in inventory	**Level of Agreement**				

	1	2	3	4	5
7. Items which can used as a substitution for other items are also encouraged to order in the corporation's inventory.					
8. New products of machineries or spare parts are usually imported and introduced in the inventory and available for market.					
9. In every order period the same number of products are ordered					
10. There is clear procedure to forecast and order new & substitute items					
11. There is a good practice of classification of items in EABC inventory					
12. Do you have any additional point to mention regarding the warehouse staff knowledge and profession of EABC ?_____ _____					
III. Competition Level	**Level of Agreement**				
	1	**2**	**3**	**4**	**5**
13. The competitors are considered during making forecasting of items in EABC inventory					
14. The forecasting procedure is very sensitive to make a change on ordering quantity because of competitors' information					
15. Competitors weakness are taken as an opportunity to get advantage of market share in EABC forecasting policy					
16. Do you have any additional point to mention regarding to the competition level in EABC? _____					

IV. Price of Goods	**Level of Agreement**				
	1	**2**	**3**	**4**	**5**
17. The price of items does not show a rapid change in EABC inventory compared to other private retailers.					
18. The price of items is less expensive compared to other private companies.					
19. Customers give a good feedback regarding to the overall price of items.					
20. Forecasters in EABC consider the change of price of an item during making of forecast					
21. Do you have any additional point to mention regarding to the price of goods EABC? _____					
V. Level of Technology	**Level of Agreement**				
	1	**2**	**3**	**4**	**5**
22. The forecasting policy of the corporation gives a provision to not to order obsolete technology items for the next ordering period					
23. Disposal of obsolete and scrap items at EABC store are effectively done on an annual basis with proper authorization and records					
24. There is a clear procedure which encourage ordering new technology rather than older technology					
25. EABC forecasting policy takes the technology change in to consideration during forecasting					

26. Do you have any additional point to mention regarding to Level of technology EABC?

_____

VI. Economic Viewpoint	Level of Agreement				
	1	2	3	4	5
24. The forecasting is always made according to the overall annual plan of the company					
25. The forecasting procedure consider national policy of the government					
26. The demand of items is mainly affected by the national economic status of the country					

27. Do you have any additional point to mention regarding Economic viewpoint EABC?

_____

VII. Inventory Recording and Documentation Practice	Level of Agreement				
	1	2	3	4	5
28. In EABC's Store Proper documentation and up-to-date records of stock are effectively practiced from the stage of, receipt, storage and issue of materials.					
29. There are discrepancies between the stock record and the result of physical verification/count of inventories at central warehouse.					
30. The current inventory recording system of EABC is satisfactory. (i.e. There are proper records, accurate inventory counts, accurate coding system and minimum errors in inventory records).					

31. Bin card, stock controlling card and inventory audit report documents reflect correct inventory level and materials.					
32. Receiving, issuing, accounting and storing responsibilities are properly segregated in the corporation's central warehouse.					
33. There are inventory items which do not counted annually at the store.					
34. EABC Inventory management periodically checks inventory reports / records and make immediate decisions based on the reports.					
35. Do you have any additional point to mention regarding the warehouse inventory records accuracy & documentation practice EABC? _____					

Challenges faced in inventory	**Level of agreement**				
	1	**2**	**3**	**4**	**5**
A) There are inventories which are overstocked or under stocked at the store.					
B) There is a problem in availability of the required materials with the right quantity, quality and at the right time.					
C) There is no mathematical demand forecasting model					
D) There are a large number of waiting customers for items					
E) Excessive amount of used, scrap, obsolete and slow-moving materials at the store.					
F) There is a problem in market survey					
G) There is a problem of foreign currency					

H) There is poor inventory management and weak inventory control.					
I) There is a proper and up-to-date fixed asset revaluation method.					

APPENDIX II

ADDIS ABABA UNIVERSITY -TECHNOLOGY INSTITUTE DEPARTMENT OF MECHANICAL AND INDUSTRIAL ENGINEERING

OPEN ENDED QUESTIONNAIRE FOR

EABC MANAGEMENT STAFFS

Dear respondents,

As a partial fulfillment of the award of M.Sc. degree in Industrial Engineering at AAU technology faculty, I am conducting a research on “inventory management and improvement: the case of Ethiopian agricultural businesses corporation”. This questionnaire is intended to request your independent opinions. Because you are the one who can give a correct idea of the impact of inventory management practices in EABC, I friendly need your full assistance to fill this questionnaire honestly. All information given shall be treated with utmost confidentiality and used for educational purpose. Please be free to answer questions without writing your name.

Thank you in advance for your participation.

Email: beimnet86@gmail.com, phone: 0934-88 19 22 (Beimnet Kinfe)

1. Does the corporation hire skilled and competent employees and further provide the required pre and post employee training on inventory demand forecasting in order to achieve effective demand prediction and customer service? _____

   _____

   _____

   _____

   _____

2. Is there an appropriate recording, supervisory and handling system for new and old items found in the inventory? If not why? _____

   _____

   _____

   _____

   _____

3. Do you think that the existing inventory management system of EABC provides Up to date information regarding each type of stock movement in the store? _____

   _____

   _____

   _____

4. Is there any mathematical forecasting model that the corporation uses as a tool to predict the demand of items? If yes, describe the model? If No, why?

   _____

   _____

   _____

   _____

5. Are there over stock, under stock, obsolete and inactive inventory items in the corporation warehouse? If yes, do you think that the corporation has effective demand forecasting practice? If not why? _____

   _____

_____

_____

6. Are the corporation follow and take in to consideration the government policy and strategies in its overall inventory management practice specially during ordering items and estimating sales? If Yes, How? If No, why? _____

_____

_____

7. Do you think that the price, performance and actual capacity of competitors are analyzed when deciding the amount of quantity of an item to order? If No, Why? _____

_____

_____

8. Please specify any additional comments on overall demand forecasting practice and its impact on the demand forecasting of the Ethiopian agricultural business corporation? _____

_____

_____

_____