Productivity Improvement through Inventory Management Practices for Printing Industry: The Case of Yekatit Paper Converting PLC.

By: Abedulsemed Kemal

Advisor: Dr. Kassu Jilcha

Co-Advisor: Mr. Haileluel Mamo

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This is to certify that the thesis prepared by **Abedulsemed Kemal**, entitled**: Productivity Improvement through Inventory Management Practices for Printing Industry: The Case of Yekatit Paper Converting PLC.** And submitted in partial fulfillments of the requirements for the degree of Master of Science (Mechanical and Industrial Engineering) complies with the regulations of the University and meets the accepted standards with respect to originality and quality.

Signed by Examining Committee:

Internal Examiner: Dr.-Ir. Eshetie Berhan Signature _____Date_____

External Examiner: Dr. Amare Matebu Signature _____Date_____

Advisor: Dr. Kassu Jilcha Signature _____Date_____

Co-Advisor: Mr.Haileluel Mamo Signature _____Date_____

School Dean: Dr.Yilma Tadesse Signature _____Date_____

Declaration

I hereby declare that the work which is being presented in this thesis entitled "**Productivity Improvement through Inventory Management Practices for Printing Industry**" is original work of my own and has not been presented for a degree of any other university and all the resources of references used for the thesis have been duly acknowledged.

_____ _____

Abedulsemed Kemal Date

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

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Dr. Kassu Jilcha Date

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Abstract

The purpose of this study was to investigate inventory management practices and organizational productivity in Yekatit Paper converting plc. And identify the challenges related to inventory management Practices to improve current productivity of the company. The major problems of the case company are shortage of skilled manpower, inability to implement inventory management practices, shortage of spare parts, and raw material, prolonged procurement procedures because of a lesser amount of foreign exchange, quality issues related with use of older technologies and human factor.

Besides, the limited available literatures were used as secondary sources and used primary data which was collected using a questionnaire and data was analyzed using descriptive statistics including mean and standard deviation by use of the relevant computer packages such as Microsoft Office Excel and Statistical Package for Social Sciences (SPSS) program and to analysis of existing productivity measures partial and total productivity measurement models are developed and applied to monitor the existing productivity status of the firm.

The finding of the study are total productivity of the current year is 66% and the total productivity index also showed that decline by 54% in the same period. And also the researcher identify ABC analysis, Materials Requirements Planning (MRP) and Just-in-Time (JIT) are currently the most popular inventory management technologies to improve current productivity, and the degree of the MRP and JIT implementation and integration has a positive relationship with the company performance and the hybrid MRP and JIT system, which create synergy and attains better performance of the company by a unit increase in (MRP) Inventory would lead to 0.486 and a unit increase in (JIT) Inventory would lead to 0.1933 increase in organizational productivity in YPC.

The researcher revealed that inventory management practices are highly impact on productivity of the organization and better production methods to minimize costs and wastages. The researcher recommends that the management should constantly expose its staff to training in order to improve their skills on inventory management practices and enable the employees to understand the current inventory systems which when used will help to improve productivity of the organization.

Key words: Productivity, Inventory Management, ABC analysis, MRP, JIT

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List of Abbreviations

(AFDB): African Development Bank

(AAiT): Addis Ababa University Institute of technology

(YPC): Yekatit Paper Converting plc.

(E.P.C): European Productivity Council

(I.L.O.): International Labor Organization

(MRP): Material Requirement Planning

(JIT): Just in Time

(IM): Inventory Management

(PPC): Production Planning and Control

(EOQ): Economic Order Quantity

(TOC): Theory of Constraints

(Pt): Total productivity

(MFPMM): Famous Multifactor Productivity Measurement Model

(WIP): Work-in-progress

(PPE): Partial Productivity of Energy Inputs

(PPX): Partial Productivity of Miscellaneous Inputs

(MRO): Maintenance, repair, and operating

(MPS): Master Production Scheduling

(CRP): Capacity Requirement Planning

(DF/OM): Demand forecasting/order management

(SFSC): Shop flow scheduling and control

(P/SM): Purchasing/supplier management

(EMM): Equipment maintenance management

(BDM): Basic data management

(SPSS): Statistical Package for Social Sciences

(PPH): Partial productivity of Human Inputs

(PPM): Partial Productivity of Material Inputs

(PPC): Partial Productivity of Capital Inputs

(OF): Total output of the company,

(OPC): Output of current period,

Chapter One

Introduction

1.1. Background of the Study

Historically, inventory management has often meant too much inventory and too little management or too little inventory and too much management. There can be severe penalties for excesses in either direction. Inventory problems have proliferated as technological progress has increased the organization's ability to produce goods in greater quantities, faster and with multiple design variations (Tersine, 1982). Since the mid-1980s the strategic benefits of inventory management and production planning and scheduling have become obvious. The business press has highlighted the success of Japanese, European, North American firms in achieving unparalleled effectiveness and efficiency in manufacturing and distribution. In recent years, many of the firms have 'raised the bar', yet again by coordinating with other firms in their supply chains. For instance, instead of responding to unknown and variable demand, they share information so that the variability of the demand they observe is significantly lower (Silver, Pyke, & Peterson, 1998).

Inventory management is a crucial aspect of managing a company successfully. According to (Wanke, 2011), inventory management involves a set of decisions that aim at matching existing demand with the supply of products and materials over space and time in order to achieve specified cost and service level objectives, observing product, operation, and demand characteristics. Inventory management permeates decision-making in countless firms and has been extensively studied in the academic and corporate spheres. Manufacturing industry arise questions for managing their inventory management seeks to answer are: when to order, how much to order and how much stock to keep as safety stock (Namit & Chen, 1999).

Inventory management as one of the key activities of business logistics, has always been a major preoccupation for the company's survival and growth. Every management problem is a decision problem, decision is an important task that all organizations have to take. The allocation of resource is a common issue to all organizations. Organizations have to acquire, allocate and control the factors of production which are necessary for the achievement of the business's objectives. The aim of inventory management is to hold inventories at the lowest possible cost, given the objectives to ensure uninterrupted supplies for ongoing operations and meet customers need. When making

decisions on inventory, management has to find a compromise between the different cost components, such as the costs of supplying inventory, inventory-holding costs and costs resulting from insufficient inventories (Hugo, Badenhorst, & Van, 2002).To ensure organizational growth and productivity, it is important that good inventory management be practiced since a substantial share of fund is invested in a firm's inventory (Rajeev, 2008). Better management of inventories would release capital for use elsewhere productively thus improving the productivity of an organization (Ghosh & Kumar, 2003).

Productivity is nothing but reduction in wastage of resources in the organization like men, material, machine, time, space, capital etc. It can be expressed as human efforts to produce more output and more with less and less inputs of resources so that there will be maximum distribution of benefits among maximum number of people. The International Labor Organization (I.L.O.) in its report summarizes the concept of productivity publication "Higher Productivity in Manufacturing Industries" has defined productivity as the ratio between output of wealth and the input of resources used in the process of production (Sanjay & Hukari, 2007).

And also the European Productivity Council (E.P.C) states that "Productivity is an attitude of mind". It is a mentality of progress of the constant improvement of that which exists. It is certainty of being able to do improve the operation or activity of the organization better than yesterday and continuously. Increased productivity results in increased revenue and the opportunity to expand the business, take on more work, or increase wages or new operation system develop. Make it a policy to review the processes regularly. New management system, materials, and techniques arrive all the time. And be prepared to adopt those that provide the most value for the organization.

1.2. Statement of the Problem

In every manufacturing industry production plays a key part in the realization of a given product. However numerous factors tend to affect the performance of this section. Factors such as personnel, operations management, planning and control systems, economics, market and continuous improvement are among the very few variables that affect the production system of the organization. Through effective management of these variables the optimum production levels of a manufacturing plant can be determined. From this effective managements are Inventory management is one of a challenging problem area in supply chain management. Companies need to have inventories in warehouses in order to fulfil customer demand, On the other hand, the firm

does not want to have too much inventory staying on hand because of the cost of carrying inventory mean while these inventories have holding costs and this is frozen fund that can be lost (Darya & Arkady, 2015).

In majority of manufacturing industries, inventory constitutes the most significant part of current resources. Manufacturing firms attain significant savings from effective inventory management which amounts between 50% - 60% of total costs. A potential 6% saving on total cost through effective inventory management is achievable (Chen, Murray, & Owen, 2005). Every management problem is a decision problem, decision is an important task that all organizations have to take. The allocation of resource is a common issue to all organizations. Organizations have to acquire, allocate and control the factors of production which are necessary for the achievement of the business's objectives. Planned lead time represents the amount of time allowed for orders to flow through the production facility in manufacturing industry. It plays an important role in the phasing principle of material requirement planning, that is, the planned order delivery date is offset by the planned lead time. The major problem of material requirement planning is the need to set planned lead time. Huge on his study found that the waiting time in queue can represent as much as 90 to 95% of the lead time (Huge, 1979). Effective inventory management allows a distributer to meet or exceed the customer's expectations of materials availability on time with the amount of each item that will maximize the organization net profit (Altekar, 2005). So, for any organization, managing and controlling inventories is directed to the success of profit making by inventory cost minimization, to insuring cash flow and to rendering quality service to customer.

The demand of Ethiopian printing and publishing industry is increasing from time to time, due to the population growth and dramatic expansion of education and business environment in the country. Current companies are not satisfying the local demand, this is indicated with the speed, quality, and underutilization of production capacity of most publishing companies. The industry is also challenged with regard to technology investment, unfair competition, management strategies and cost of printing and publishing (Fitsum, Ameha, Eshetie, & Daniel, 2017).

There is a huge market for the printing products in the country with the prevailing economic situation, but the industry have its own challenges. These include demand-supply mismatch, shortage of trained manpower especially lack of specialized institute on printing technology, foreign currency shortage for international purchase of raw materials and machinery, lack of

adequate paper suppliers and manufacturers in the county, capacity limitation to meet the required quality and quantity production (Frehiwot, 2017).

Printing company's lose high amount of money due to having high amount of inventory at hand, which brings cost of storage space, security, insurance, and working capital tied up in inventory. Having too low inventory faces ordering cost, which includes clerical cost of preparing purchase order, time spent, and mainly disrupted production when raw materials are unavailable. The conflicting natures of these types of costs bring in to being a decision problem what to order, how much to order and when to order. The major problems of most Ethiopian printing companies are facing regarding to inventory management strategies. It is the way of ordering, receiving and checking of materials against the purchase order. Based on the information and data receiving from the company users those problems leads to obsolescence and bottleneck in production system and it affect productivity of a company.

However the implementation of inventory management practices on the industry has its own opportunities and challenges. Therefore it is necessary to conduct research to study the opportunities and challenges of inventory management system on the case company.

Research Questions

1. What are the existing knowledge gaps related to inventory management practices contribution to the operational performance and productivity in printing industry?
2. How to measure the existing productivity level, and improve current productivity?
3. What are the characteristics of the firms that adopted the MRP and/or JIT in printing industry?
4. How to integrate the production technologies to improve the printing productivity?

1.3. General Objectives

The General objective of this research is to analyze and identify the challenges related to inventory management practices to improve productivity in the Printing industry. And integrate production technology's to improve the productivity of selected printing industries.

1.4. Specific Objectives

- To identify constraints in the manufacturing system of the Ethiopian printing industry and their effects regarding the capacity and production rate of the industries.
- To investigate the factors and types of inventory management practices contribute for productivity improvement in printing industry
- To measure the current productivity level and recommendation to use best tools for further productivity improvement.
- To obtain knowledge of manufacturing industry dynamics and the appropriate inventory management practices to be implemented.
- To investigate factors that contributes for the successful integration of MRP & JIT to improve the productivity and performance of the company.

1.5. Scope of the Research

The scope of this thesis work is to focus on the Ethiopian printing Industries from the inventory management practices view, in improving productivity and performance of the company. More emphasis will be given to the case study on inventory Management System of Yekatit paper converting company. The key variables that are covered by the study includes challenges experienced by the enterprise in relation to inventory management strategies, productivity of the company, manpower, supplies, factors that affect productivity and performance of the operation system, and different practices of inventory management system.

1.6. Ethical Consideration

The research participants are subject to any risk or exposure due to any improper methods of protecting privacy must be consider. The researcher obtained an authorization letter from the University (AAiT) and the company Yekatit Paper Converting plc. (YPC) became volunteers for the research work. Accordingly, the researcher undertook to consideration the following ethical issue: the target respondents were fully informed about the purpose, method, and intended possible uses of the research, what their participation in the research entails and what risks, if any, are involved; the confidentiality of information supplied and the anonymity of respondent is respected.

1.7. Limitation of the Study

The study has some limitations related to the research design, First of all, the data collection process was very difficult for the researcher, some respondents were not willing to fill the questionnaire, some of them were very late to return the questionnaire, due to this data collection process the study takes longer period of time than expected. The study also focused on the current level of productivity and inventory management system of the company, This is mainly explained by the need to focus on factors that affect the current and future performance of the company, challenges to get detailed information about some issues from the key informants, particularly the data of financial report of the company, those who work in the finance department of the company.

1.8. Organization of the Study

The study report has five chapters. The first chapter discusses the background of the study, the problem statement it intended to address, its objective, scope and limitations. Chapter two discusses the review of related literatures to give background and context to the study. The research methods used for the study are discussed in detail under chapter three while the major findings of the study are discussed in chapter four. The last chapter of the report presents the conclusions and recommendations made based on the findings of the study at chapter five.

Chapter Two

Literature Review

2.1. Introduction

This chapter explores relevant literature on productivity and inventory management practices that affect productivity of manufacturing industry. The review was undertaken to bring out the gaps and enhance knowledge for more understanding of manufacturing company productivity and its factors and also inventory management, types of inventory, empirical review and models of inventory management practices that supports the study analysis and efficient ways of managing inventory and improving the productivity of an organization.

2.2. General Terms of Definition

Inventory means a physical stock of goods kept in store to meet the anticipated demand. However, from materials management perspective, an appropriate definition of inventory is "a usable but idle resource having some economic value." This brings to the fore a paradox in the concept of inventory perceived as a "necessary evil." It is necessary to have physical stock in the system to take care of the anticipated demand because non availability of materials when needed will lead to delays in production or projects or services delivered. However, keeping inventory is not free because there are opportunity costs of "carrying" or "holding" inventory in the organization. Thus, the paradox is that we need inventory, but it is not desirable to have inventory. It is this paradoxical situation that makes inventory management a challenging problem area in materials management. It also makes a high inventory turnover ratio as a desirable performance indicator (Imaga, 2003).

The term 'productivity' means different meanings to different persons. As a phenomenon, it ranges from efficiency to effectiveness, to rates of turnover and absenteeism, to output measures, to measure of client or consumer satisfaction, to intangibles such as disruption in workflow and to further intangibles such as morale, loyalty and job satisfaction. The concept of productivity, generally defined as the relation between output and input, has been available for over two centuries and applied in many different circumstances on various levels of aggregation in the

economic system. It is argued that productivity is one of the basic variables governing economic production activities, perhaps the most important one (Singh.H, Motwani, & Kumar, 2000).

2.3. Theoretical Review

Theories are analytical instruments to understand the study, to elaborate and make assumption about the subject matter. It can also help us to compare the conceptual framework are evaluate and comment on the research gap of the given study (Mwangi & Nayambura, 2015). Different theories have been employed to help bring clarity to the study of the effects of inventory management practices on productivity of manufacturing firms.

2.3.1. Theory of Constraints

Theory of Constraints (TOC) is a management philosophy which is focused on the weakest ring(s) in the chain to improve the performance of systems. The difficulties in the theory of constraints are: very long lead times, large number of unfulfilled orders, high level of unnecessary inventories or lack of relevant inventories, wrong materials order, large number of emergency orders and expedition levels, lack of customers engagement, absence of control related to priority orders which implies on schedule conflicts of the resources (Goldratt, 2004). The theory emphasizes focus on effectively managing the capacity and capability of these constraints to improve productivity and this can be achieved by manufacturing firms applying appropriate inventory control practices. Theory of constraints is a methodology whose basis is applied to production for the minimization of the inventory (Cooper & Schindler, 2006).

2.3.2. Lean Theory

Lean theory is an extension of ideas of just in time. The theory eliminates buffer stock and minimizes waste in production process (Green, Inman, Laura, Dwayne, & et.al., 2014). Inventory leanness positively affects the profitability of a business firm and is the best inventory control tool. The theory elaborates on how manufacturers gain flexibility in their ordering decisions, reduce the stocks of inventory held on site and eliminate inventory carrying costs. Scholarly studies indicate that companies successfully optimize inventory through lean supply chains practices to achieve high levels of asset utilization and customer satisfaction leading to improved growth, profitability and market share (Matthew, Andrea, Brent, & et.al., 2008). Some businesses use a hybrid push-

pull method to properly manage inventory (Scutter.B, 2014). According to (Scutter.B, 2014), to be successful, companies require a sophisticated inventory control system to track products and supplies currently in stock with the ability to properly forecast future demand. This model is also known as a lean inventory strategy in which companies rely heavily on forecasting and constantly adjust inventory levels based on actual sales. (Stevenson, 2007), Defines lean operation as a highly coordinated system that uses minimal resources and produces high-quality good or service.

2.4. Productivity

The powerful competition within the manufacturing industry makes productivity a topic of high interest. The definition of productivity is simple and complex at the same time, and this is because it is both a technical and managerial concept (Thomas.W, 2004). Productivity is defined and analyzed in various ways. Various professionals from different fields of study, including economists, accountants, behavioral scientists, engineers, managers, etc.., define the term in relation to their own perspectives (Mohanty.R.P & Rastogi.S.C, 1986). But even within the same discipline, there are multiple definitions. (Tangen.S, 2005) Forwarded the definition of the frequently used terms 'Efficiency', 'effectiveness', 'productivity', 'profitability' and performance in relative ways

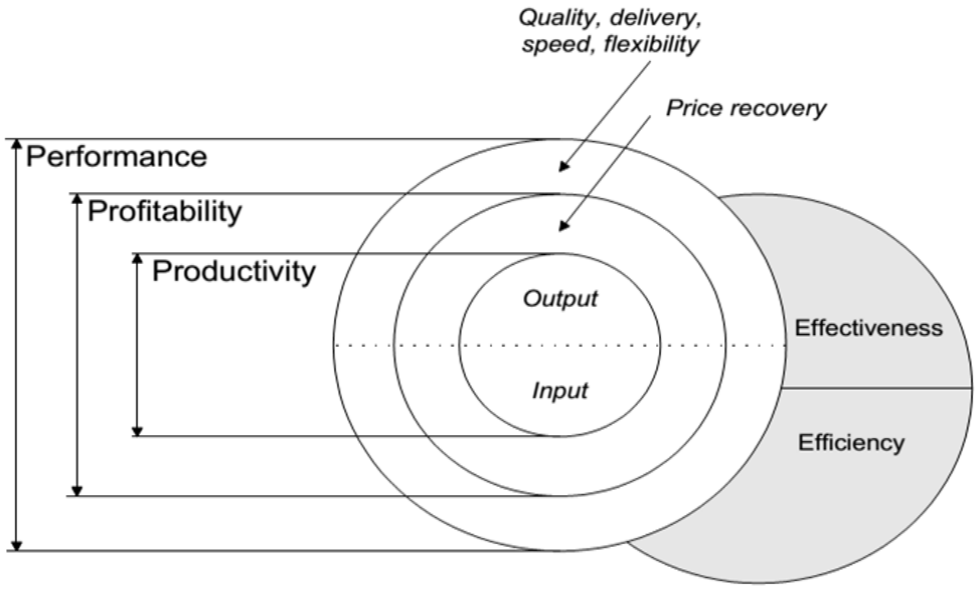


Figure 2.1: The relationship between Performance, profitability and productivity

In the words of (Hyder.S, 2011), productivity is the first test of management competence. This can be achieved through effective inventory management. Productivity is a measure of the efficiency of the transformation process. It is however possible to consider productivity in terms of various basic resources used in the industries and the total revenue accruing from total output of goods and services. From the above, inventory management can contribute to high productivity which will lead to cost and time reduction in production processes thus assisting the organization to achieve its objectives. Every organization must have a goal to achieve. Without setting a goal for an organization, it will be difficult to measure or evaluate productivity. Hence, according to Allison (2000) is an aid to performance.in every organization, inventory management is crucial to maintain corporate performance because without effective inventory management production will be affected which result to idle time and marketing unit will have less finished goods to satisfy customer demands. To measure performance involves ascertaining, the level of accomplishment of a given activity or goal and attempts made to determine the actual level of task accomplishment. Production and volume of sales can be measured to indicate the level of performance for the firm. How frequently measurement is done will depend on the organization.

According to (Jaja, 2004), to determine performance gap involves comparing measured performance against established standard. In this controlling task, actual performance computed will be expected performance to ascertain whether they match or they do not. Matching implies there exists no difference between set standards and performance. But, where they do not match, their difference constitutes the performance gap, which must be filled through the next plan. Constant inventory stocks and regular supplies are taken into consideration when setting performance standard in any organization. Good performance is an indication of the productivity of the firm.

However, at the same time as productivity is seen as one of the most vital factors affecting a manufacturing company's competitiveness. And also Productivity is in industrial engineering defined as the relation of output (i.e. produced goods) to input (i.e. consumed resources) in the manufacturing transformation process. The productivity and reliability of a printing system are key factors of success; however, evaluating and understanding productivity is a complex process (Kipphan, 2001). Productivity growth in the printing industry is very low. Multiple factors, explanations, and opinions for this problem have been collected from several sources. One of the

first comments found is that need a good management system, machinery, good operators. This sounds true; however, it is not as exciting or easy to implement as are other schemes. Maintenance is also part of the equation; it is believed to be "the first and foremost contributor to productivity" (O'Brien K. , 2000).

Table 2.1 definitions and concepts of productivity.

Concept	Computation/Implications	References
Average measure of efficiency of production	Ratio of output and inputs used in the production process	February 12, 2015
Measure of efficiency of person, machine, factory ,and/or system in converting inputs into useful outputs; Productivity may be a key determinant of cost efficiency	productivity may be evaluated by dividing average output per period by the total costs incurred	February 12, 2015, from http://www.businessdictionary.com/definition/productivity.html
Economic measure of output per unit of input; Inputs include labor and capital, there as output may be measured in revenues and other GDP components	Productivity measures may be examined collectively (across whole economy) or evaluated industry by industry to examine trends in wage levels, labor growth, and improvements in technologies	February 12, 2015, from http://www.investopedia.com/terms/p/productivity.asp
Productivity is the effective use of innovation and resources to increase the value-added content of products/services	Productivity is the true source of competitive advantage that creates long-term economic viability and a better standard of living	February 12, 2015, from http://www.hkpc.org/index.php.

Source @ (Snajay, Manish, & Abid, 2016)

2.4.1. Productivity Measurement Types

The central part in managing productivity is productivity measurement. Commonly speaking, productivity measurement is the quantification of both output and input resources of a productive system. Nowadays, the issue of productivity improvement, especially in developing countries, has become important for manufacturing firms' managers, strategic planners, government policy makers and it is becoming a key factor affecting the overall performance of firms (Arturo.L, 2004). The goal of productivity measurement is improvement of productivity, which involves a combination of increased effectiveness and a better use of available resources. For manufacturing firms characterized by low utilization of their resources (machines/ equipment's, human labor, materials, capital, energy, time and others), productivity measurement and improvement is not only desired but is also increasingly becoming a requirement for organizational survival (Wazed.M.A & Shamsuddin.Ahmed, 2008). According to Kendrick (Kendrick.J.W, 1961) productivity type has been classified in economic terms as:

1. Partial Productivity, that is, ratio of gross or net output to a single factor input. Partial productivity is further divided by the type of input as: labor productivity, capital productivity, material productivity, and energy productivity;
2. Total Factor Productivity, that is, ratio of gross or net output to total labor and capital input expressed in monetary equivalents.
3. Total Productivity, which is, ratio of gross or energy and others, all expressed in monetary equivalents.

2.4.2. Various Productivity Models

Productivity models are used to measure the Total factor productivity and partial productivities. Various models have been suggested by different authors so as to fit to different productivity measurement scenario such as business level, national accounts or industry level. However all of them should satisfy the basic productivity equation which is defined as

$$Productivity = \frac{Output}{Input} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

There are some well-known approaches / methods adopted for analysis of productivity. These are:

A) Kendrick-Creamer Model

Kendrick and Creamer (1955) introduced productivity indices at the company level in their book "Measuring company productivity". Their indices are basically two types; total productivity and partial productivity. It can be calculated as

$$\text{Total Productivity index given period} = \frac{Measured\ period\ output\ in\ base\ period\ price}{Measured\ period\ input\ inbase\ period\ price} \ldots\ldots. (2)$$

And partial productivity such as labor, capital or material productivity index can be calculated as;

$$Partial\ Productivity = \frac{Output\ in\ base\ period\ price}{Any\ one\ inpute\ in\ base\ period\ price} \ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

B) Craig-Harris Model .The next most impartment study using the index approach at the company level is of Craig and Harris (1972-75). They define total productivity measure.

$$Pt = \frac{Ot}{L+c+R+Q} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

Where Pt = total productivity, L = labor input, C = capital input,

R = raw material input and Q = miscellaneous input and Qt = total output.

C) American productivity center model

The famous Multifactor Productivity Measurement Model (MFPMM) that comprises nine components developed by America Centre of Quality and Productivity (Fig 2.2) is suggested to be a comprehensive and analytical model to measure changes in productivity (Wazed.M.A & Shamsuddin.Ahmed, 2008). It uses the techniques to break the total variation into price and productivity effects Productivity measurement models can be classified in many ways. (Singh.H, Motwani, & Kumar, 2000). Classified them as index measurement models, linear programming-based productivity models, and econometric productivity models.

American Productivity center has measured that productivity relates profitability and price factor.

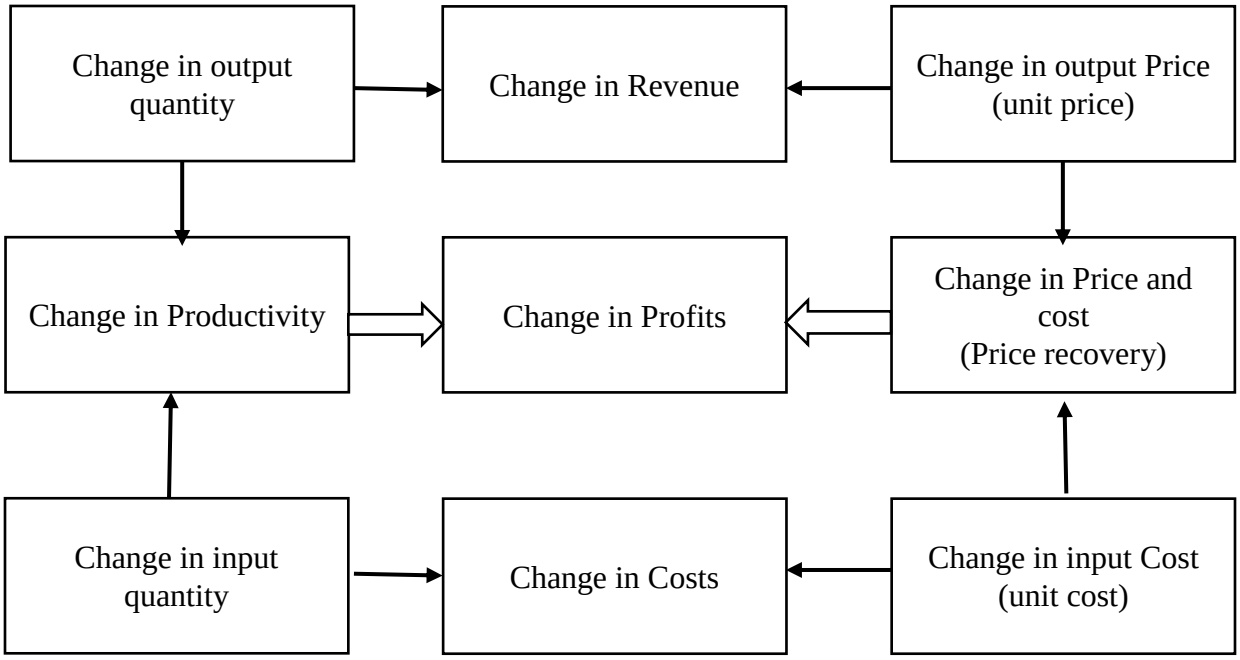
The measure is given by $Profitability = \frac{Sales}{Cost}$ ..... (5)

$$= \frac{(output\ quantity)*(Price)}{(input\ quantity)*(unit\ cost)}$$

$$= \frac{output\ quantity}{(input\ quantity)*\frac{price}{unit\ cost}}$$

$$= (productivity) * (price\ recovery\ factor)$$

Where: $Productivity = \frac{Output}{Input}$



Source at (Yitagesu.Yilma, Daniel.Kitaw, & Amare.Matebu, 2017)

Figure. 2.2. Nine basic components for the (MFPMM)

D) Productivity Accounting Model:

H. S. Davis introduced model, this model takes into account all possible outputs and inputs used, keep out external factors such as price rise etc. Here productivity means total productivity and partial productivity.

$$Total\ productivity = \frac{Monetary\ Value\ of\ production}{Monetary\ value\ of\ all\ input\ required\ for\ production} \ldots\ldots\ldots\ldots (6)$$

$$Partial\ productivity = \frac{Monetary\ value\ of\ production}{Monetary\ value\ of\ any\ input\ required\ for\ production} \ldots\ldots\ldots (7)$$

2.4.3. Factors Influencing Productivity

Factors influencing productivity can be classified broadly into two categories as examined by (Hyder.S, 2011; Telsang, 2010; Stevenson, 2007) , to include: the first one is Controllable or internal factors and the second categories Non-controllable or external factors.

Table 2.2 Factors Influencing Productivity

S/N	Controllable (Internal Factors)
1	Product
2	Plant & Equipment
3	Technology
4	Material
5	Human factors
6	Work Method
7	Management style
8	Financial factors
9	Sociological Factors
10	Workers Participation
11	Incentive Scheme
12	Quality Circle
13	Working Hour & Conditions
S/N	**Uncontrollable (External Factors)**
1	Structural adjustments (economic and social)
2	Natural Resources
3	Governmental Policy
4	Infrastructure

Source: (Hyder.S, 2011)

2.4.3.1 Controllable Factors (Internal Factors)

Product factor: productivity means the extent to which the product meets output requirements. Product is judged by its usefulness. The cost benefit factor of a product can be enhanced by increasing the benefit at the same cost or by reducing cost for the same benefit. Plant and **Equipment:** These play a prominent role in enhancing the productivity. The increased availability of the plant through proper maintenance and reduction of idle time increases the productivity. Productivity can be increased by paying proper attention to utilization, age, modernization, cost, investment etc.

Technology: Innovative and latest technology improves productivity to a greater extent. Automation and information technology help to achieve improvements in material handling, storage, communication system and quality control. The various aspects of technological factors to be considered are:

Table 2.3 Technological factors

S/N	Technological Factors
1	Size and capacity of the plant
2	Timely supply and quality of inputs
3	Production planning and control
4	Repairs and maintenance
5	Waste reduction
6	Efficient material handling systems

Source (Hyder.S, 2011)

Material and Energy: Effort to reduce materials and energy consumption bring about considerable improvement in productivity. The factors that are to be considered are; selection of quality material and right materials, control of wastage and scrap, effective stock control, development of sources of supply, optimum energy utilization and energy savings.

Human Factors: Productivity is basically dependent upon human competence and skill. Ability to work effectively is governed by various factors such as education, training, experience, aptitude etc. of the employees. Motivation of employees will influence productivity.

Work Method: Improving the ways in which the work is done (methods) improves productivity. Work study and industrial Engineering techniques and training are the areas, which improve the work methods which in term enhances productivity.

Management Style: Manager Leadership role in organizations can lead in different styles to choose human resources. Behavior patterns appropriate manager in each organization creates employee morale and motivation is strong and their satisfaction from their profession increases. This influences the organizational design, communication in organization, policy and procedures. A flexible and dynamic management style is a better approach to achieve higher productivity.

2.5. Inventory and Inventory Management

2.5.1. Inventory

Inventory is defined as a list of goods and materials which are available in stock for business (Drury, 1996). According (Kotler, 2000) inventory management refers to all the activities involved in developing and managing the inventory levels of raw materials, semi-finished materials (work-in-progress) and finished good so that adequate supplies are available and the costs of over or under stocks are low. In accounting inventory is considered as an asset. Inventory or stock (in common terms) is considered to be the central theme in managing materials. The inventory turnover ratio (ITR) is a barometer of performance of materials management function.

A firm requires inventory control system to successfully manage its inventory. Proper classification of materials with codification, material standardization and simplification should be done. and the advantage of inventory control were the operation of a system of internal check to ensure that all transactions related with material and equipment are checked by properly authorized and independent persons. And it also the operation of a system of imperishable inventory so that it is possible to determine at any time, the amount and value of each kind of material in stock. A suitable method for valuation of materials is necessary because it will affect the cost of jobs and the value of closing stock of materials.

2.5.1.1. Types of Inventories

(Telsang, 2010) Asserts that a manufacturing firm generally carries four types of inventories, the first one is Raw materials inventory as input to manufacturing system. Which is materials and components required for the use in making up a product. The basic inputs are required for the conversion to finished products through manufacturing process. Raw material are those inventories, which have been acquired and reserved for future production. The second one is Work-in-progress (WIP) or work-in-process inventory or pipeline inventory. Materials and components that have started their conversion to finished goods. Materials issued to the shop floor, which have not yet transformed into finished products are called as value added materials to the extent of labor cost incurred. The third type of inventory described by (Telsang, 2010) is finished goods inventory for supporting the distribution to the customers. A finished goods is a completed part that is ready to sale as per the customer order. These goods have been inspected and have passed for final inspection so that they can be transferred out to work-in-process and into finished goods. From this point, finished goods can be sold to end user, can be sold to retailers, can be sold to wholesalers, can be sent to distribution centers, or held in expectation as per the customer order. The fourth type of inventory is Maintenance, repair, and operating (MRO) supplies. These include spare parts, indirect Materials, and all other sundry items required for production/service systems .It may be noted that the basic definition of inventory being a "usable but idle resource" remains valid irrespective of the type of inventory being managed. (Tangen.S, 2005).

2.5.1.2. Costs involved in Inventory

Inventory cost to determine the appropriate lot size and its timing to minimize the total cost during the decision horizon and then it scrutinized the differences in rejection rates, demand, storage capacity and inventory holding cost on total cost. Every firm try to sustain their inventory depending upon the requirements and the other features for holding such inventory. (Davendra & Shankar, 2011). Some cost of inventory can be incurred there which are as follows:

Carrying Cost: This is the cost incurred in keeping or sustaining an inventory per unit of raw materials, work-in-process or finished goods. Here there are two basic cost involved.

$$\textit{Total carrying cost} = \textit{(carrying cost per unit) X (Average inventory)} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (8)$$

Cost of Storage: It includes cost of storing per unit of raw materials by the firm. This cost includes the storage of materials like spaces for rent occupied by stock, security of stock, cost of infrastructure, cost of insurance, warehousing costs, handling cost etc.

Cost of Financing: The cost includes the cost of funds that is invested in the inventories. It includes the required rate of return for the investments in inventory also including the storage cost. The carrying cost involves both real cost and opportunity cost related to the funds. The total carrying cost is entirely inconstant and rise indirectly proportional to the level of inventories carried.

Cost of Ordering: The cost of ordering includes the cost of asset i.e. inventories. It is the cost of producing and executing of an order including cost for paper work and contacting with the supplier. The ordering cost is inversely proportional to annual inventory of a firm. The ordering cost may have a fixed element, which is not affected by the order size and an inconstant elements, which changes according to the order size.

Total Ordering Cost = (No of orders) X (cost per order)..... (9)

Cost of Stock out: It is also known as hidden cost. The stock out is the situation where the firm does not have units of an item in stores but there is a demand for that item either by the customers or by the production department. The stock out introduce to zero level inventories so, there is a cost of stock out that the firm faces for a situation of lost sales or back orders.

Total Cost = (Cost of items purchased) + (Total Carrying and ordering cost)..... (10)

2.5.1.3. Factors Influencing Inventory Control

The factors that will influence the effectiveness of inventory management are inventory control planning, documentation/ store records, knowledge and skills of employees, and funding. The effectiveness of inventory management is to augment operations of the organization to make sure the flow of resources, services and products are running smoothly (Alles, Amershi, Datar, & Sarkar, 2000). Effective inventory control is one of the most important functions a business needs to master in order to boost efficiency, eliminate costs and enhance productivity.

However, if managers lose control over their inventory control operations then the business begins to suffer the consequences. Inaccurate stock levels set off a chain reaction of poor purchasing decisions, under-stocked warehouses, and customer service goals falling by the wayside. (Rajeev, 2013) On his study classified the possible factors that would influence inventory management (IM)

performance. He classified as technical factors, managerial factors, organizational factors and contingency factors. Under these four broad groups, 16 specific variables have been identified and all these variables which would possibly influence the IM performance in a manufacturing industry are considered equally important which are listed in the table 2.4 below.

Table 2.4. Possible factors that would influence IM performance

Technical factors	Raw material ordering frequency
	Demand forecasting frequency
	Purchasing effectiveness
	Lead time
	Inventory cost
Managerial Factors	IM practices pursued
	Safety stock planning of enterprise
	Employees training
	Management attitude
Contingency Factors	Capacity utilization level of enterprise
	Product type
	Demand variability of the product
Organizational Factors	Interaction with suppliers
	Interaction with customers
	Supplier empowerment
	Space limitation

Source: (Rajeev, 2013)

(Sarker & Parija, 1996) Present his study there are Two fundamental questions always arise in inventory control are: How much to buy at one time and when to buy this quantity? There are four factors that govern to answer these questions.

1. Requirements: This has to do with item, time, sales, forecasts and production schedule.
2. Quantity in stock order: This stores usually provide such information as inventory status through the stock ledger balances and unfulfilled purchase orders.

3. Procurement time or Lead-Time: This is the total length of time required to obtain the material. It consists of two parts – the administrative lead-time and the procurement time.
4. Obsolescence: There should be provision made for possible design changes or other factors which would make the material obsolete.

2.5.2. Inventory Management

The concept of Inventory Management has been visualized differently by different authors, academicians and researchers on the subject. In an attempt to gain an insight in inventory management, it is found imperative to know different opinions on the subject. (Morris, 1995) Stressed that inventor management in its broadest perspective is to keep the most economical amount of one kind of asset in order to facilitate an increase in the total value of all assets of the organization – human and material resources. The major objective of inventory management and control is to inform managers how much of a good to re-order, when to re-order the good, how frequently orders should be placed and what the appropriate safety stock is, for minimizing stock-outs, (Keth, Muhlemen, & Oakland, 1994). Thus, the overall goal of inventory is to have what is needed, and to minimize the number of times one is out of stock. Inventory management is about specifying the size and the placement of stocked inventory. Inventory management is essential for different locations or within multiple locations for a supply network to protect the regular and planned production against running out of materials or goods. The scope of inventory management also concerns with the fine lines between stocks up of lead time, carrying costs, forecasting of inventory, physical inventory, space available for inventory, quality management, stock up, returns of defective goods and demand forecast of inventory.

Inventory management deals with Active control program which deals with the management of sales and purchase department. And it also helps in providing good understanding of inventory and capacity to control financial cost and provide control over operating cost. Inventory management will help in identifying the inventory requirement, stock up techniques and actual and projected inventory status (Richard & Keith, 1978). The success of a supply chain business often relies on the effectiveness of its inventory strategy. Without a strong plan in place, companies may run shortage or end up with surplus inventory on hand. To increase efficiencies and meet customer demand, these business should educate themselves on which of the different models of inventory strategies available best meets their need (Dubois.J, 2016).This is an indication that

inventory management strategies could correlate to increase efficiencies and productivity improvement.

(Oksana, Vilmars, & Yuri, 2010) Proposed that inventory management is an important sector of logistics and economic spheres, company's growth and success is strictly dependent on it. Even empiric experience may help to manage inventory well, application of managerial theory allows analyzing future improvements. There is a variety of inventory management strategies all answering same questions, i.e. When to order? And how much to order? To answer them, different approaches can be applied namely inventory models, simulation, and optimization.

2.5.3. Inventory Management Strategies

For manufacturing industry many practices are available for effectively managing inventories. There are different inventory management practices such as Automatic Replenishment, ABC Inventory Model, Just-In Time (JIT) Inventory, Economic Order Quantity EOQ), Vendor Managed Inventory etc. The management of inventories has an important bearing on the financial strength and competitiveness of organizations due to the reason that it directly affects the working capital, production and customer services (Vergin, 2012). There are classical and non-classical inventory management strategies. The classical inventory management strategies are; Conventional Manufacturing Strategy (CMS), Economic Order Quantity (EOQ) and Economic Production Quantity (EPQ). The non-classical inventory management strategies are, ABC Analysis, Just-in-Time (JIT), Material Requirements Planning (MRP), and Hybrid Push-Pull (HPP) or Lean Inventory Strategies. (Amachree, et al., 2017).

However, it could be said that classical inventory management strategies are gradually being phased out by some manufacturing firms due to some limitations such as downtimes and idle capacity while waiting for replenishment of inventories or due to congestion as a result of inventory surpluses. Out of non-classical inventory management system identified for the study, Just-in-Time (JIT), Material Requirements Planning (MRP), and ABC Analysis were found from literature and data information from the company they are correlate each other with productivity improvement in printing industry.

2.5.3.1. ABC Analysis

ABC analysis is a simple and analytical management tool. ABC analysis is a technique of categorizing inventory items according to their substantial impact on the overall expenditure of an organization. It grants a solution to faulty inventory administration within the purchased items or availed services. It is based on the Pareto Principle which states that "80% of the overall consumption value is based on only 20% of total items". The breakdown suggests that the inventories are of different values; hence it necessitates different tactics and management controls. (Handanhal & Ram, 2014).The arrangement of categories is based on its anticipated value, ABC analysis is an "inventory categorization method" which entails the dividing items into three categories, A, B and C: "A" contains the "most valuable items" and "C" consists the "least valuable items", whereas "B" contains items ranging between "A" and "C" (Chase & Zahong, Inventory Policy for dense retail outlets., 2009). It aims to focus on the critical few (A-items) and not on the trivial many (C-items). In this analysis, various items are listed according to their total usage; unit cost and then total cost of items are calculated. Different parameters are listed in tabular format which make it easy for classifying items according to their cost and usage. This approach states that, when reviewing inventory, items should be rated among A to C by the firm, establishing its ratings on the following rules:

1. A-items: have the "highest annual consumption value" of goods i.e. 70%-80% of the annual consumption value of the company. Ironically, it accounts only 10%-20% of the total inventory items. They require stringent inventory control, more protected storage areas and improved sales forecasts, re-orders should be frequent, with weekly or even daily reorder; avoiding stock-outs on A-items is a priority.
2. B-items: are the interclass items, having medium consumption value i.e. 15%-25% of annual consumption value. It consumes around 30% of the total inventory items.
3. C-items: have the "lowest annual consumption value" of goods i.e. 10%-15% of the annual consumption value. On the contrary, it accounts for 50% of the total inventory items.

$$The\ annual\ consumption\ value = Annual\ Demand * Item\ cost\ per\ Unit \quad \ldots\ldots\ldots\ldots\ldots (11)$$

(Sayali & Amey, 2017).

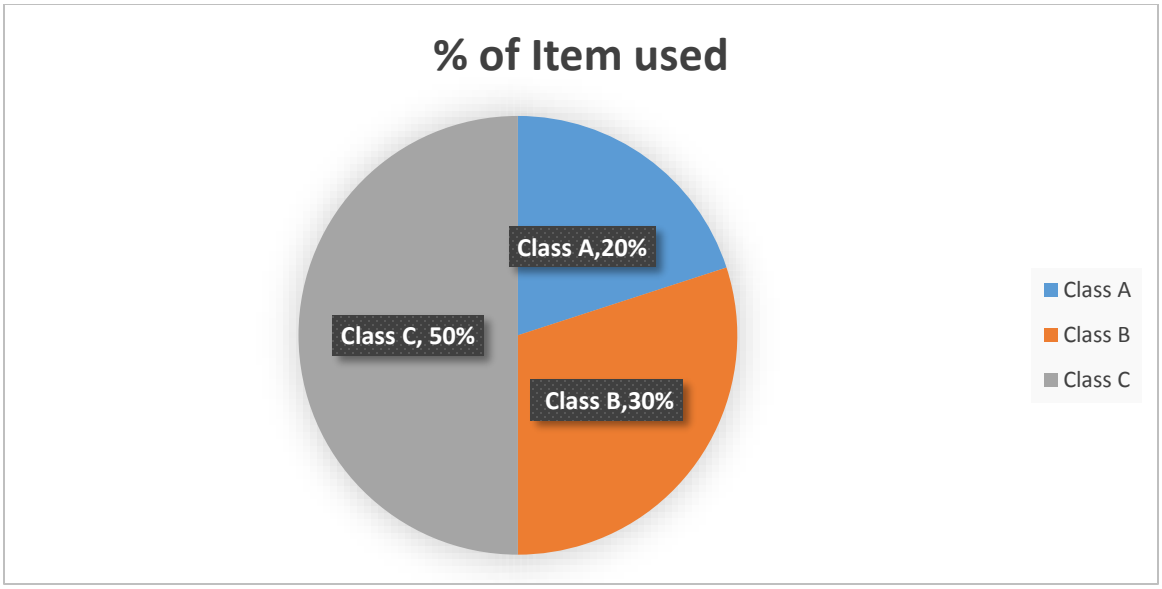


Figure 2.3. ABC analysis method

(Mandal, 2012) State that the following six steps are classification of items by ABC analysis:

1. The unit cost and the demand of each item is obtained over a given period.
2. Multiply the unit cost by the calculated annual usage to obtain the net cost.
3. All the items are listed out and arranged in a descending annual cost.
4. Sum up the cost and add up the number of items then, compute percentage on the total inventory of total cost and for total number of items consumed.
5. Draw a graph of percentage items vs percentage cost.
6. Mark from the curve the rational limits of A, B and C categories.

ABC analysis is beneficial in the different ways, it is a technique of allocating direct and overhead expenditures first associated with the critical activities of the firm. This process defines the areas generating maximum profit to the company in a better way. And it aids stringent and better controls of high-priority inventory, promotes efficient use of its resources to prioritize control of inventory over its impact on final outcome. In ABC analysis Resource allocation is more efficient during cycle counts. And its objective is to achieve economy by efficiently managing the materials by safeguards control over expensive items in which a substantial amount is invested.

However (Sayali & Amey, 2017) argue that ABC analysis have its limitations from these limitations are Conflict with other cost systems. It means ABC cost allocation differs from the traditional cost system allocation, this method needs more resources to maintain compared to the traditional costing systems. And also ABC analysis is a continuous process which needs added data measurement and collection of data needs periodical assessment and updating. This analysis is built on the monetary value of the materials in use.

2.5.3.2. Material Requirements Planning (MRP) Strategy

MRP has been a very popular and widely used in practice, it has attracted many researchers' interests. Materials requirements planning employ computer software applications to manage inventory. MRP applications break down inventory requirements into specific periods to keep production running smoothly while maintaining minimum inventory levels. Designed to answer what is needed, how much is needed and when it is needed, this model works backward from the planned finished product to determine the components and raw materials needed to create it. While costly to implement, MRP systems help manages plan for capacity needs and allocate production times. MRP is what (Scutter.B, 2014; Telsang, 2010) also described as Push inventory management strategy. Most companies have a better profit and satisfy customers when inventory managers develop an effective and efficient inventory management strategy such as JIT.

(Wilhelm & Son, 1998) Present an inventory control approach for an assembly system with several types of components. Their model focuses on a single finished product inventory, so the interdependence between inventory levels of different components is once again neglected. (Kanet & Sridharan, 1998) Examined late delivery of raw materials, variations in process lead times, interoperation move times and queue waiting times in MRP controlled manufacturing environment. To model such environment, they represented demand by inter arrival time rather than defined from the master production schedule.

(Axsater, 2005) Considers a multilevel assembly system where operation times are independent random variables. The objective is to choose starting times (release dates) for different operations in order to minimize the sum of the expected holding and backlogging costs. The performance of MRP can be divided into two types; those for improving the part explosion process and those for reducing MRP nervousness. These issues are interrelated, and the MRP nervousness used to be the

key problem to be resolved in MRP. Most previous studies attempted to solve this problem by the lot-sizing method. However, the lot-sizing method often needs to be tailored to the specific manufacturing environment involved and there is no guarantee that an optimal solution can be found. (Melnyk & Piper, 1985) Investigated the effect of different lot sizing rules on lead-time error. They examined the interaction between lot sizing rules and lead-time estimation methods. They believed that lot size and lead-time are two inter dependent functions. They found that PLT (planned lead time) inflation influences lot size effectiveness and vice-versa. And also they proposed a forecast method for the lead time which is issued from the used methods for random demand:

$$Planned\ lead\ time = lead\ time\ forcast + safety\ lead\ time \ldots\ldots\ldots\ldots\ldots\ldots (12)$$

Inventory records include information on the status of each item by time period or time buckets. This contains gross requirements, scheduled receipts, and expected amount on hand. It also includes other details for each item, such as supplier, lead time, and lot size policy. Changes due to stock receipts and withdrawals, cancelled orders, and similar events are also recorded in this file (Stevenson, 2007).

The general theme of MRP is to receive the right part, in the right quantity, and at the right time. MRP is most valuable to companies involved in assembly operations and least valuable to those in fabrication. One more point to be noted that MRP does not work well in companies that produce a low number of units annually. Especially for companies producing complex, expensive products requiring advanced research and design, experience has shown that lead times tend to be too long and too uncertain, and the product configuration too complex. Such companies need the control features that network scheduling techniques offer (Chan, Burns, & et.al, 2002). Based on the above author's literature and company current used MRP implementation system the following ten variables to measure MRP implementation degree selected. They are listed in table 2.5.

Table 2.5. Variables of MRP Implementation degree

S/N	Variables of MRP
1	Master Production Scheduling (MPS)
2	Materials Requirement Planning (MRP)
3	Materials Requirement Planning (MRP)
4	Capacity Requirement Planning (CRP)
5	Demand forecasting/order management (DF/OM)
6	Shop flow scheduling and control (SFSC)
7	Inventory management (IM)
8	Purchasing/supplier management (P/SM)
9	Equipment maintenance management (EMM)
10	Basic data management (BDM)

Source: Researcher (2018)

2.5.3.3. Just-in-Time (JIT) Strategy

The term JIT is used to refer to an operations system in which materials are moved through the system and services are delivered with precise timing so that they are delivered at each step of the process just as they are needed-hence the name just-in-time (Stevenson, 2007). Initially, the term JIT referred to the movement of materials, parts and semi-finished goods within a production system. Application of JIT could involve few important elements at organization such as production level, marketing level, engineering level and purchasing level. The application of JIT more focuses on management process. Therefore, JIT can be applied at varying process. (Canel & et.al, 2000). JIT is the concept of management that invented specially to avoid waste. This is in order to minimize the waste and increase the productivity and this will increase performance, reduces waste, and ultimately minimizes inventory management costs and lead time expenses. The elements of JIT include shared product design with suppliers and clients, movement in the

direction of unmarried sourcing proximate suppliers, reduced machine set- up times and overall preventive protection (Zhu & Meredith, 1995).

(Chase & Zhong, 2009) Argue that a just-in-time inventory system maintains stock tiers low via handiest generating for specific patron orders. The result is a massive discount within the stock investment and scrap expenses, though an excessive degree of coordination is needed. This technique differs from the extra commonplace opportunity of producing to a forecast of what patron orders is probably. By the use of simply-in-time concepts, there's a substantially decreased need for raw materials and work-in-system, at the same time as completed goods inventories should be near non-existent. Based on the above authors and other literatures review and company existing condition, the following ten factors or variables to measure the Just in Time (JIT) implementation degree.

Table 2.6 Variables of Just In Time (JIT)

S/N	**Variables of JIT**
1	Set-up time reduction
2	Quality circle and TQM
3	JIT purchasing
4	Pull production line
5	Cross-training and multifunction employee
6	'6S' activities: workplace organization and standardization
7	KANBAN system
8	Scheduling stability
9	Total production maintenance (TPM)
10	Small lot sizing

Source: Researcher (2018)

2.5.3.4. Integration of Material Requirement Planning (MRP) and Just In Time (JIT)

Material requirements planning (MRP) and Just in Time (JIT) production are two most prominent approaches for production management and inventory control in manufacturing firms. A number of research works have appeared which discuss the possible integration of MRP-JIT. In classifying existing literature on MRP and JIT integration studies, categorized in to four main groups: conceptual, analytical, empirical, and information systems. As the names suggest, conceptual studies offer a conceptual model of an integrated control system, whereas analytical research makes use of mathematical models and simulation to test the effectiveness of such hybrid systems, usually limited to the shop floor test of combined push-pull principles. Empirical integration research denotes research carried out in a case company. In this category hybrid control models are developed by taking the particular manufacturing environment in the company into account and developing specialized solutions. The final category, which is information systems research, deviates from the previous three in that the focus is not on suggesting exhaustive solutions, but rather high lighting the software aspects of integration.

Empirical Approach: Research in this category is especially valuable in that it provides us with concrete examples of the viability of the previously described conceptual models and gives further insights about integration problems and opportunities. For example, (Marques & Guerrini, 2012) present a case study about a Brazilian metallurgical company that produces agricultural machines, which provides an especially interesting perspective on MRP & JIT integration. The authors suggest that the case company does just the opposite of what the majority of American companies transitioning from a traditional MRP to a JIT MRP system do. The company began to implement an MRP system as part of the manufacturing planning and control in the company, which surprisingly until that time had completely relied upon lean production principles.

(Foo & Kinney, 1990) Also provide a case study where we meet the characteristics of the conceptual models that were presented in the combination studies (applied in a complex manufacturing environment). The case company is a telecom equipment manufacturer with a product variety which is almost limitless. In addition, demand variability is also quite high. The product and demand characteristics of the company seem to again have little room for the JIT practices imposed by a possible hybrid MPC tool.

However, as in the previous case, the conviction is that JIT techniques in general and pull shop floor control in particular could improve shop floor performance significantly.(Olhager & Ostlund, 1990) Proposed a three types of push- pull integrated model in relation to; customer order point, bottleneck resources, and the product structure. These approaches were applied to a medium-sized packaging company. The results included cycle time reduction to one week, inventory decrease by 75% and sales turnover increase by 10–15%.

From the literatures of inventory management practices identified inventory management practices variables to be investigated for interrelationship are indicated. The study would seek to establish how adoption of the independent variable, the inventory management practices can lead to realization of the dependent variable, firm's productivity. The ten performance measures of production planning control (PPC) act as dependent variables, while the degree of Just in Time (JIT) and Material requirement Planning (MRP) implementation degree serve as the independent variables and conceptual integration of those practices are shown in the figure 2.4.

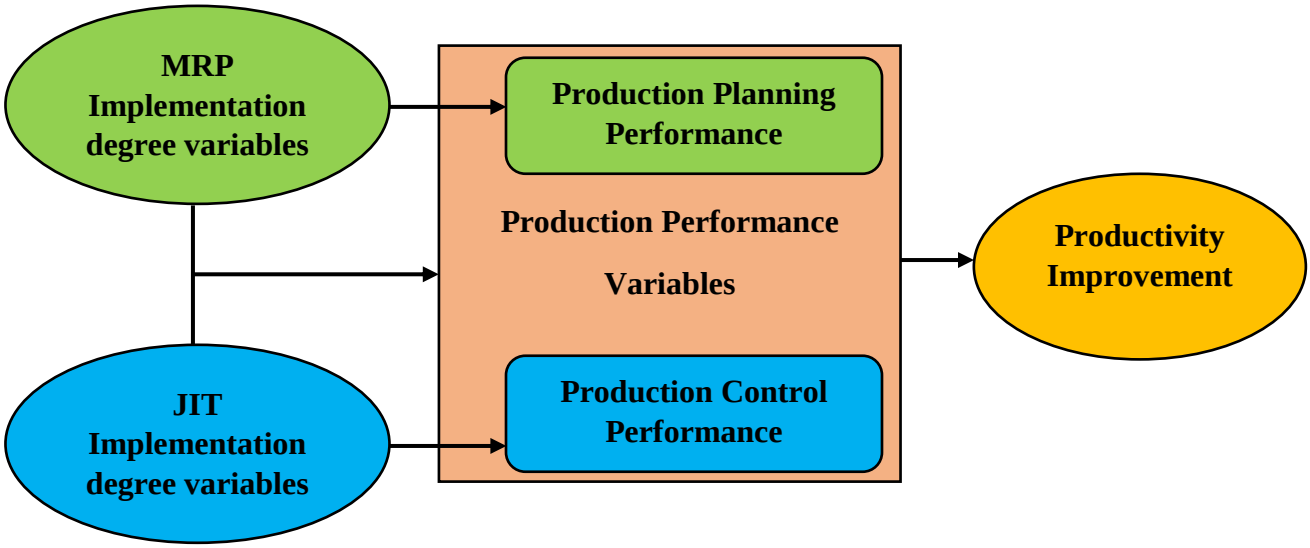


Figure 2.4 Conceptual integration Framework of IM practices.

2.6. Background of the Company

Yekatit paper converting plc. is one of Ethiopian largest printing and paper converting company, Yekatit paper converting plc is responsible for delivering quality products to meet the growing Ethiopian demand for paper consumables, printing and packaging. The foundations of Yekatit were laid in 1958 by foreign private investors. After many years of operations, nationalized in 1975 by the defunct government, the privatization policy of the existing government, the enterprise was acquired by the current owner Mr. Gobezayehu Zerihun in 2010. After acquisition, it was merged with Techno Printers that was also the property of the owner founded in June 2004, leading to the formation of Yekatit paper converting plc in September 2012. Over the years, generous investment from current owner has been growing the company and brought many breakthroughs that have continued to enrich it. Currently the company has got the annual turn Over is 18, 500, 000 birr. The main raw materials consumption of the factory; toilet tissue 1029,000 kg per year, paper box 2,285,657 kg per years, labels 1033,540 kg per years and wood free paper 5,254,000 kg per years (Yekatit Paper Converting, 2017).

Major Company Products:

- **Exercise & Note Books:** with different size high quality, good design and made of high quality materials. Elegant design in the cover, and more exquisite.
- **Food Containers & Packaging Boxes :** additional to different sizes and high quality, strong and add shimmer and flair to the products.
- **Sanitary Supplies:** these products are tear-resistant, highly absorbent, soft and fluffy sanitary paper products; such as: Product range, facial tissue, table napkins, paper towels, toilet paper, etc.
- **Labels*:*** attractive, easy-to-peel, tear-resistant and long-lasting labels, with variety pack of metallic silver, gold, pink and blue labels.

Figure 2.5: Yekatit Paper Converting plc. Sample products

Currently, to manufacture these products; some essential technologies are available at Yekatit Paper Converting Plc. Such as: exercise book manufacturing machines, printing presses (Kord, Flexo, MO, Speed master etc.), waste paper recycling machine, cut size sheeting (A4) and wrapping machines, folding machines, plate makers, stitching machine, perforating machine, cutting machine, Film camera and binding machines, web machine, self-adhesive label and metallic labels making machines are among the machine technologies that the company own. But most of the company machines are working a long period of time because of this they are frequently breakdown and interrupt the production process.

The company is engaged in three processes mainly which are printing, paper converting and exercise book manufacturing.

1. Printing Books and magazines, financial reports and prospectus, Letter heads and office stationeries, Invitation card, Catalogs and pamphlets, Broachers and hand bills, Posters, Labels, Booklets, Carbon less forms, Envelope, Flyers, Manuals and Postcards, Annual reports, Invoices, vouchers, calendars, diaries etc.
2. Paper converting: Paper boxes of different sizes, Packaging (food, cosmetics, detergent, drugs and other product), Cake trays, Napkins, Thermal paper cash register rolls, Tissues papers, kitchen towels and Box files.
3. Exercise books manufacturing: Exercise books of different numbers of leaves, note books with different sizes and Ruled papers.

Raw materials: paper to be imported from foreign countries, glue, chemicals, staples, different dyes, varnish, various chemicals and packaging materials.

Products books, magazines, broachers, wall and table calendars, posters, teaching-aids, business forms catalogs, labels, stickers, maps, Exercise book, packaging (food, cosmetics, detergent, drugs and other product), papers with different sizes and so on.

Production type: the production type they are using is a make to order. Whenever customer comes with an order they will review the order and decide on whether to accept or reject the request then they will notify the customer. After that they will check the raw material stock and if there is no stock they will purchase and start manufacturing, and starting to design per the customer requirement.

Customers: they have a lot of customers that give scheduled and unscheduled order, such as Fafa food factory package printing, Walia, Dashin, Bedele beer factories, Jolie juice package printing and for its own branded exercise book and etc.

Quality policy: the company has a quality assurance department and they inspect the process as well as the final products for non-conformities. But they have no inspection for raw material and on process printing papers. Product characteristics like viscosity, height, weight, color, temperature and packing material test are done randomly.

The printing and conversion processes encompass different activities and work flows so that realization of the final product is achieved in the best possible way. The production process at YPC is divided into three sections namely;

- The Pre-press section
- The press (Printing) Section
- Finishing section

The Pre-press Section:

This section is involved in the conception of the output product. That is, the design of the material to be printed is constructed. The section is consisted of the following activities.

Design: In this section the product is graphically designed and Parameters such as Colors and Dots that represent the design are determined.

Film making and editing; in this section the design is transferred to a film by separating the colors that make up the design and in film editing we make sure that the film has no deviations from the original design and that it is free from any errors.

Plate exposition: The design on the film is transferred to a plate. This is done by placing the film onto a plate and exposing it to high intensity light and upon exposing to light, the plate should be placed at a certain distance from the light source and the exposure time should also be controlled.

Plate development: Here, the plate is washed with a developer solution that is specific to the plate type and also the developer solution washes away the non-image area and leaves the image areas intact thus giving us a clear image that is ready to be printed. The workflow of the pre-press section can be represented as in the figure 2.6.

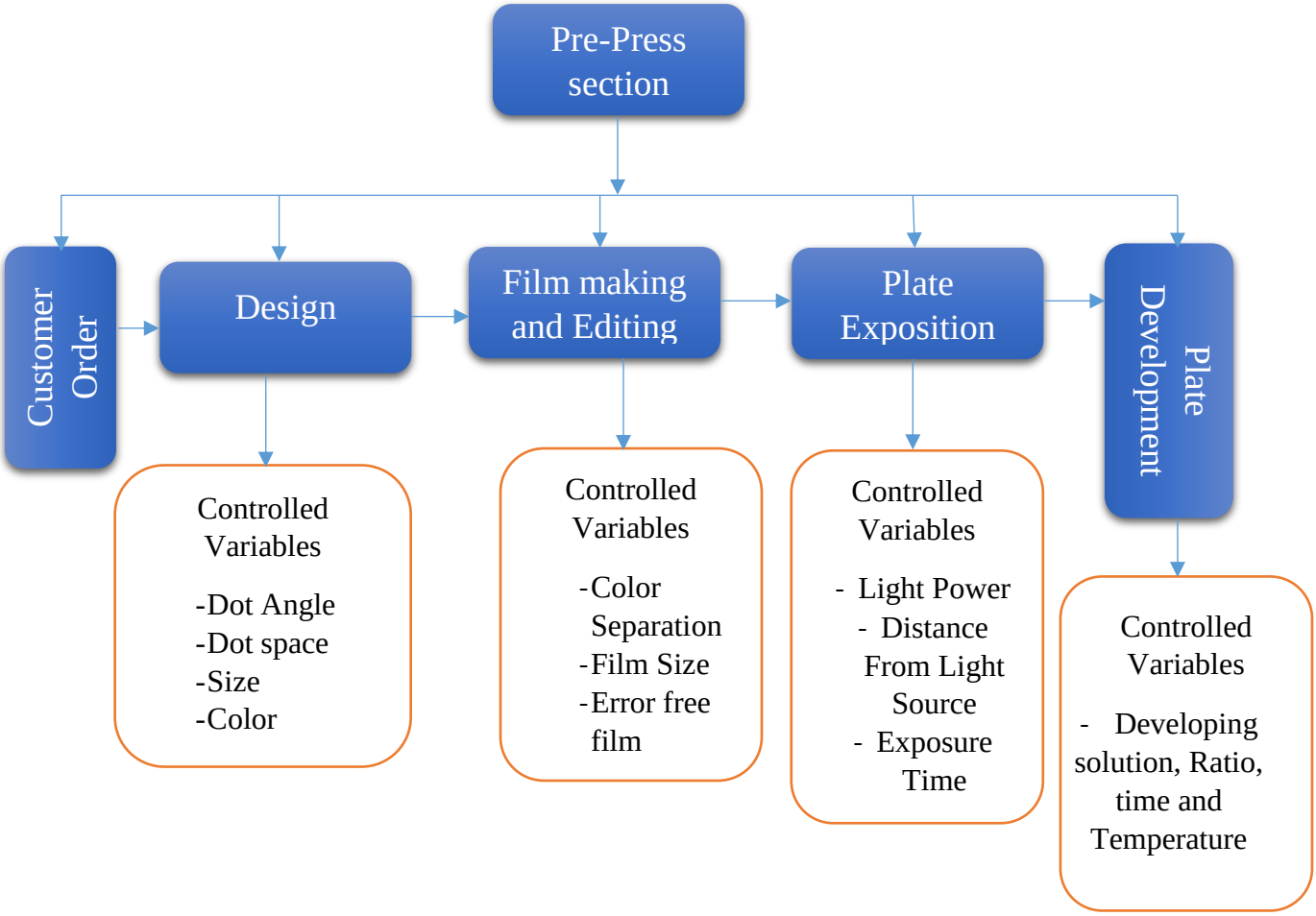


Figure 2.6. Workflow of the pre-press section

The Press (Printing) Section

After the plate is made in the pre-press section the next step is taking the plate to a press (printing) machine where it will be mounted to perform the job order. This is done by effectively following the undermentioned activities.

Job order:_The job order contains all the necessary information about the specific batch of production. It contains information about:_Size of the product, Paper type and gram, Machine Type, Printing and Finishing Sizes, Number of product,_Starting and Finishing times. After filling out all the necessary information about the product the next step is acquiring the raw materials and labor inputs necessary for the printing process. The necessary inputs required for the realization of the final output product are:

Ink: - Inks used at YPC are of two type. These are oil-based and water based inks. Oil based inks are used for offset press machines while water based inks are used for flexographic printing.

Paper: - We use a different kinds of papers which range from 17-500gsm. Generally, the printing industry operates with papers ranging from 17-100gsm. Also there are various types of papers based on their type. These include art paper, duplex paper, wood-free paper, manila, bank-paper, and metallic paper.

Skilled Labor: - Acquiring the right personnel for a given job is essential to the effective completion of the task at hand. This helps us get optimum product quality with minimal time and waste.

Right type of machine: - Machine choice is something that affects the delivery time and quality of the product. Certain presses are more effective than others although all machines can perform the job. Therefore, selection of the right type of machine is of great importance.

The heart of production section is the printing section where the design is transferred to the printing paper by the aid of the proper type of machine. At YPC mainly use three types of printing machine to form a wide range of products. These printers are:

- Offset press
- Flexographic press
- Rotex

Finally the various aspects of the printout product are checked and compared for conformance against the initial design. These aspects are ink weight, plate cleanliness, product conformance, and inking and dampening system checkup. All of the aforementioned activities in the press section can be summarized as in the figure 2.7.

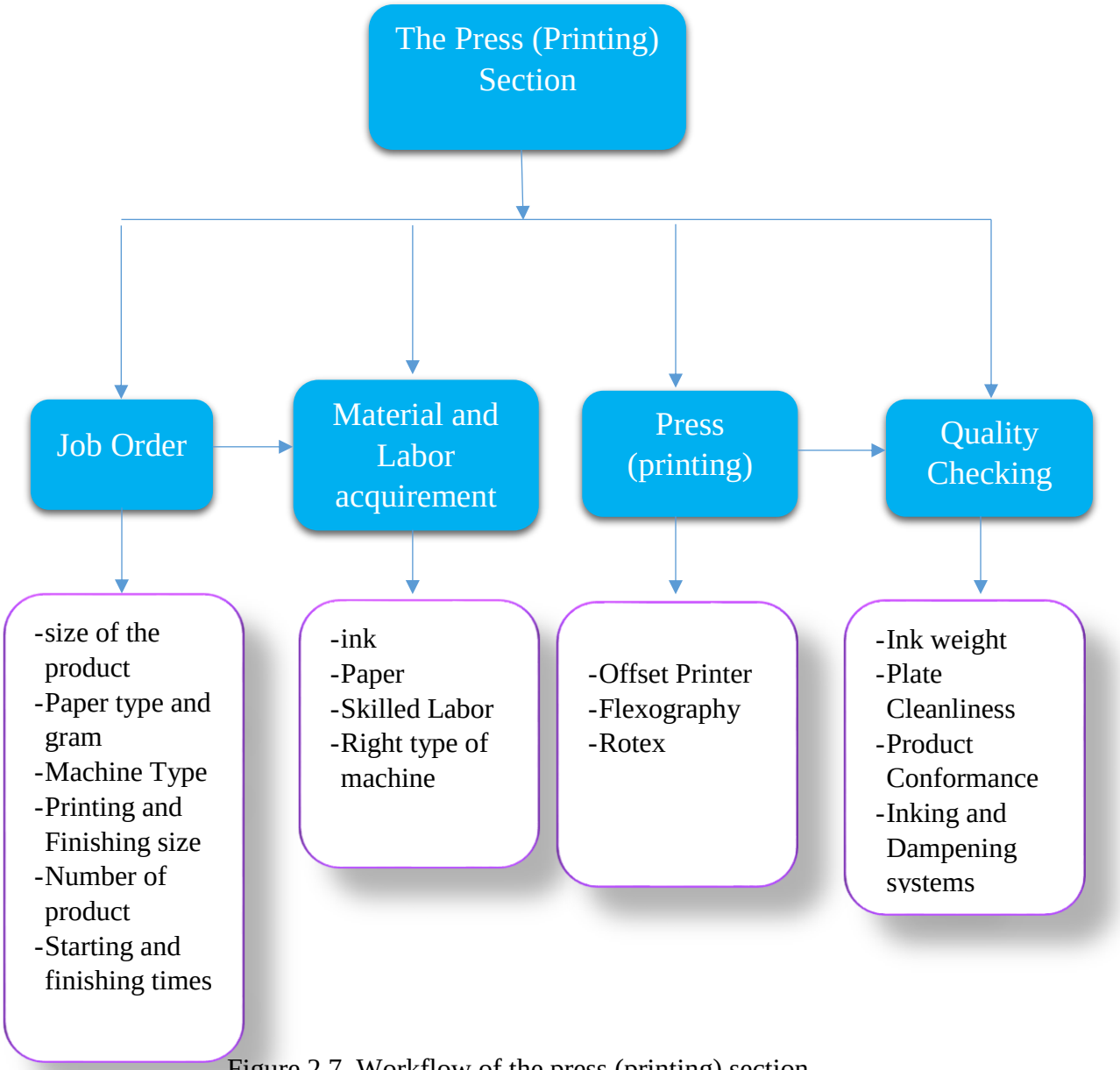


Figure 2.7. Workflow of the press (printing) section

The Finishing Section

The last section of the printing process is the finishing section. In this section final touches are put upon the product so that it would be ready for packaging. The finishing section undertakes the following activities.

Cutting: - Printed papers should be processed to give the final output products. One way to do that is by cutting the papers. Cutting is done through cutting machines called polars.

Converting: - After the papers are cut using polar machines, they are taken to the converting section so that the papers can be finished. The papers are creased and cut, glued, stitched, or folded depending on the type of products.

Packaging: - The final process in the finishing section is packaging. Products are counted and collated before putting them into packaging wrappers. Then these wrapper packs are labeled with numbers to indicate how many pieces are packed.

Delivery: - The final step in the finishing section is transporting the output products to the delivery unit so that customers can. The activity in the finishing section can be summarized as in the figure 2.8.

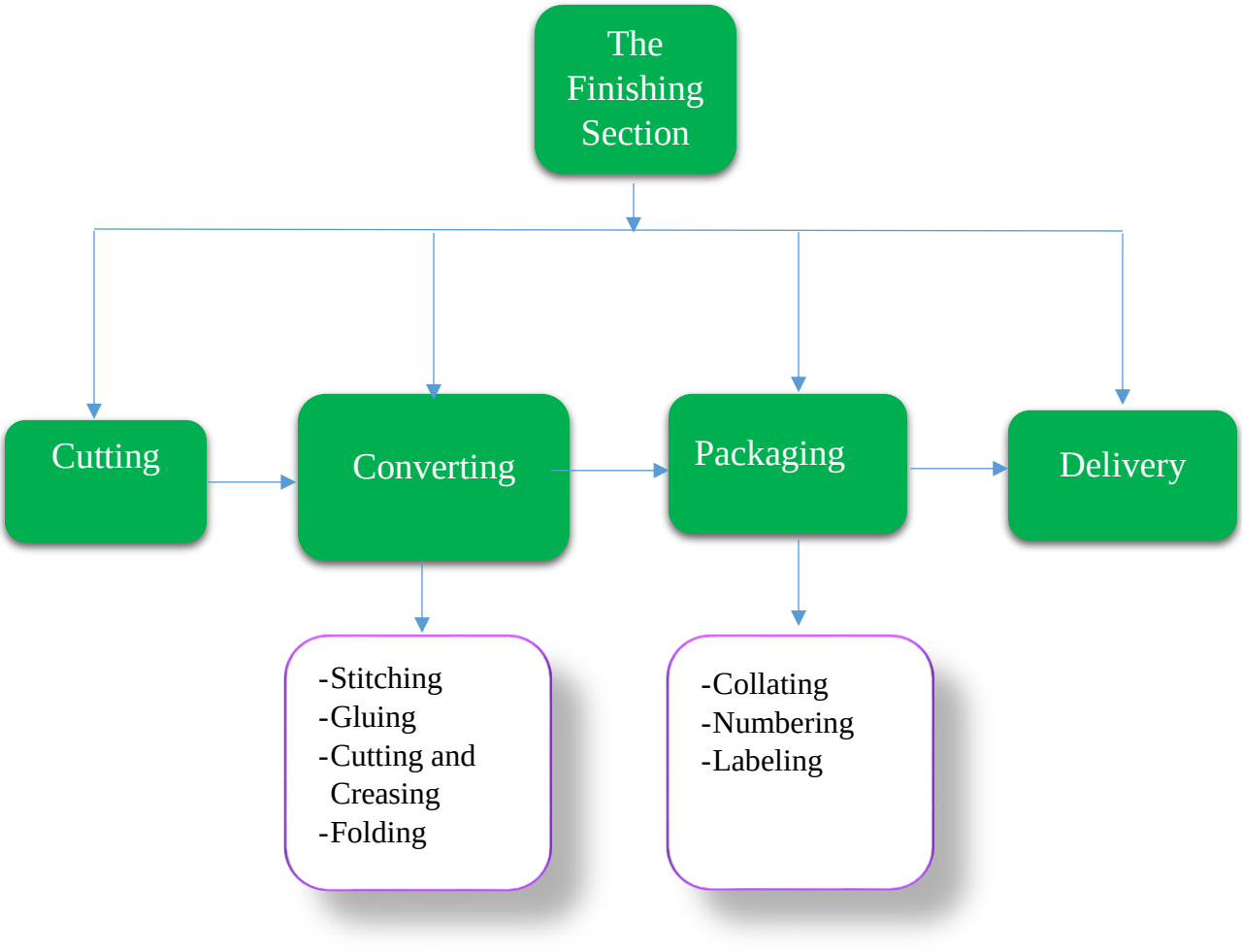


Fig 2.8. Workflow of the finishing section

The workflow of Production process

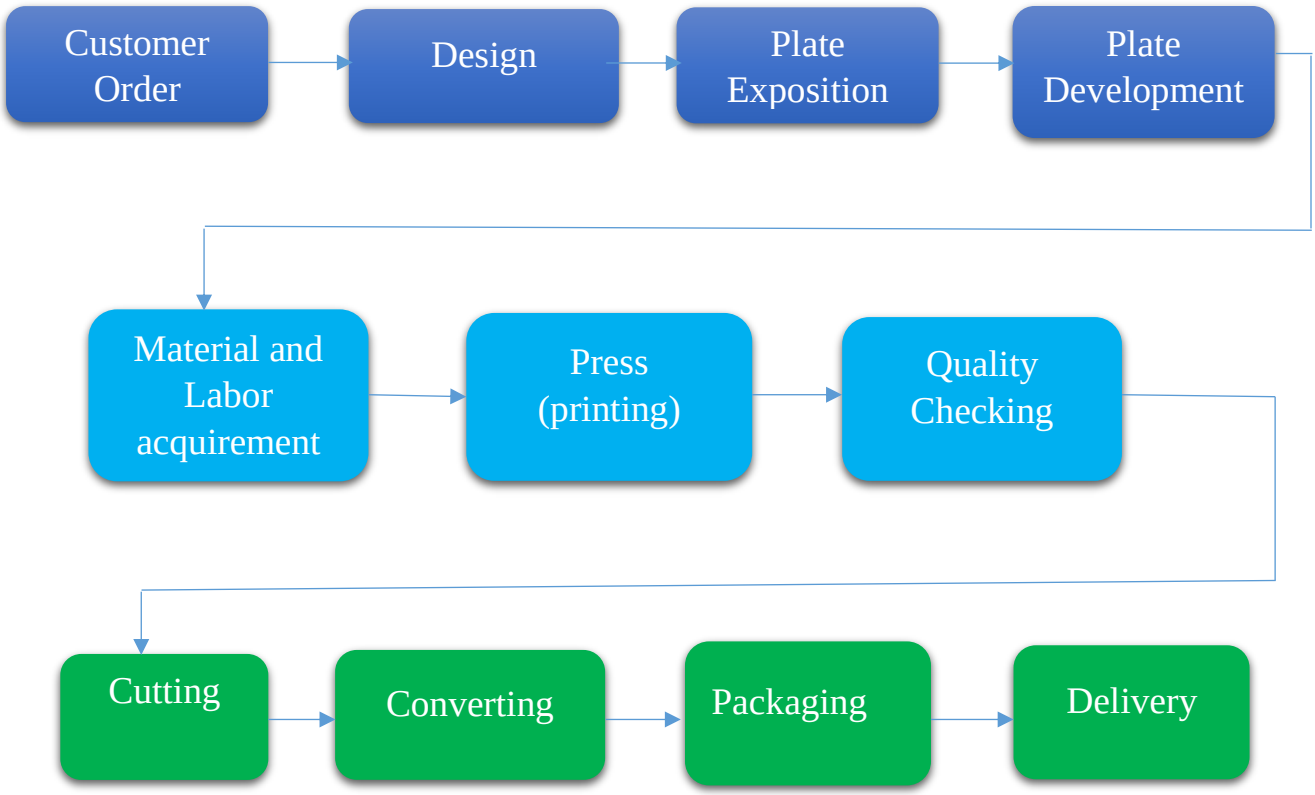


Figure 2.9. The workflow in the production process at YPC.

2.7. Summary of Literature Review

The concept of inventory management has been expounded both in literature as well as from the empirical studies done on the subject area. It is evident that management of inventory has become a common practice in manufacturing firms worldwide and this is due to the various benefits that accrue to a firm as a result of managing its inventories. One of the improvement of productivity method is Inventory management system. For any company is essential to fulfil customer demands on time and in cost effective manner, Selection and implementation of inventory management system for any company management is vital. In manufacturing industry, an organization requires to maintain a proper balance between critical stock-out and reducing inventory costs. Material cost sums up to be more than 50% of the total cost which demands for the need of managing materials. Firms manage inventory to determine and maintain an optimum level investment in inventory in

order to achieve required operational performance and firm's profitability. Firms have continuously managed their inventory in order to improve their productivity and meet customer demand. To meet customer demand, firms have to ensure that stock-outs are avoided without incurring high inventory costs.

Manufacturing industry to improve customer satisfaction and improve their profitability using a developed managerial system. The right choice of the inventory model is crucial for the success of inventory management and productivity improvement for manufacturing firms. Selective inventory management is necessary because indiscriminate rigor in inventory control for all items could be counterproductive. Inventory management practices system is to increase efficiencies and meet customer demand. From these inventory management strategies models are ABC analysis, Material Requirement planning and Just in Time are more preferred for these study and also by integration or combination method of inventory strategies improve productivity of the company, from these inventory management strategy tools are Material requirements planning (MRP) and Just in Time (JIT) production are two most prominent approaches for production management and inventory control in manufacturing firms. In the next table 2.7. The researcher review literature areas, concepts and findings of the authors related to the study.

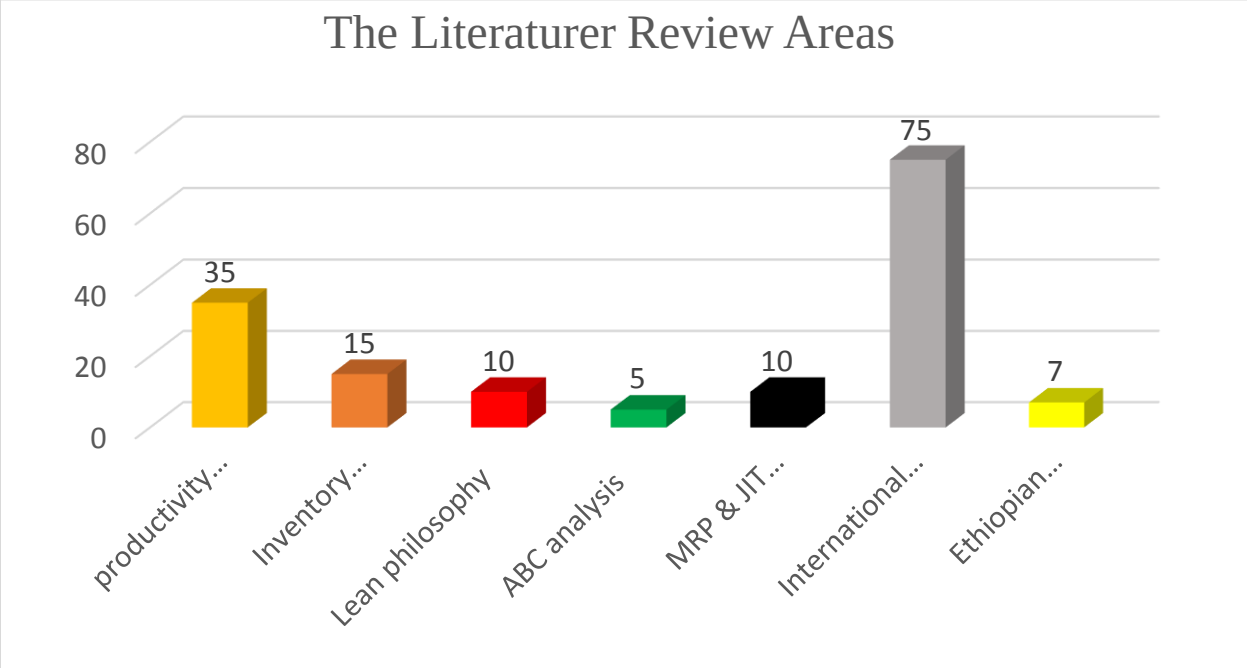


Figure 2.10. Research Areas and Ways of Literature Organization

2.8. Research Gap

Various studies are reviewed previously have not adequately indicated extensively the role played by inventory management practices in Ethiopian printing industry. Most of these previous studies are focus on productivity improvement in other manufacturing industry. These previous studies have limited to indicate the importance of inventory control planning, keeping inventory track, and procurement and inventory management strategy in Ethiopian manufacturing industry.

(Getnet & Admit, 2004),On their study thy discuss on considering the structure of Ethiopian economy and the level of poverty, it would be interesting to examine to what extent Ethiopia's industrialization effort has succeeded or failed in establishing internal and external competitiveness. They developed a composite index criteria taking into account contribution to the economy, factor and raw material base, resource use efficiency, and competitive advantage in order to inform manufacturing policy for selective priority interventions. But on this study they not regarded to productivity factors from inventory management. There is therefore great need to investigate further to get a solution. Inventory management practice has its own impact on the performance of the company because any manufacturing common need inventory either for the purpose of future production or for selling purpose. (Eliyas, 2018) On his study extensively discuss its effects on proper and effective management of the inventory practices were able to enhance a competitive advantage of the company and lead it to improved competitiveness. But his study only focus on theoretical concept of inventory management practices to enhance competitive advantage. The study not cover integration of this inventory management practices for better improvement of productivity in the organization. (Fitsum, Ameha, Eshetie, & Daniel, 2017) On their study more analyses and the paper aims are to make a review of continuous improvement strategies specifically JIT and TQM and evaluate the capability and trend of implementing the philosophies in Ethiopian printing industries. But on this study left out the inventory management system of the company, Inventory management has adversely affected the productivity of manufacturing firms.

However, the previous and other studies covered have not extensively delved into inventory management practices by using this tools of integration method in relation to the productivity of printing industries. As a result, this study sought to explore inventory management practices to improvement productivity and profitability in Ethiopian printing industry as a case study at Yekatit paper converting plc.

Chapter Three

Methodology

3.1. Data Collection Method and Research Methodology

This chapter discusses the research methodologies employed to meet general objective and answer the research questions of the study. The required data for this research purpose were collected through various appropriate sources. Both Primary and Secondary date collected, which were essential to investigate the current productivity measurement and analysis system of the selected case company, were gathered. The empirical data were collected through observation, interview, and review of documents and records. It describes the proposed research design, the target population, the sample design, data collection instruments and procedures, and the techniques for data analysis.

3.1.1. Research Design

The research adopted a descriptive survey research design in trying to focus on Ethiopian printing industry, in a case study at Yekatit paper converting plc. The design accurately describes an association between variables minimizing bias and maximizing the reliability of the data (Kothari, 2008). Descriptive studies provide simple summaries about the sample and the observations that have been made. This ensured that appropriate answers are obtained for the research questions.

1. **Literature Review:** different recently published journal articles, proceedings and books were surveyed in order to understand the concept, principle and benefit gained by the inventory management practices approach on productivity improvement of the manufacturing sector. Also the review process helpful to identify improvement strategies tools, physical factors and work procedure that affect production process and the performance of production.
2. **Primary Data:** direct data collection from the production line through direct observation, questionnaire, communication with department managers and production floor workers to get better understanding of the problem area.

I. **Direct Observation-**during visit of the case company necessary data gathered through careful observation of inventory system of the company, material handling, work station design, working environment and process flow of material and production area.

II. **Questionnaire-** structured questionnaires are used to get complete information about the company. The questionnaires are developed from ideas of different literatures which focused on productivity issues in manufacturing area. The questionnaire is translated from English to Amharic to make suitable for the operator respondent. The questionnaire was directed to Production managers and supervisors, quality department of the company, other department managers and production planning and control managers. The questionnaire format was found at the appendix part and Theses questionnaires are to be answered on the 5-point Likert-scale, corresponding to the degree of agreement with the statement.

III. **The interview: -** is prepared to collect primary data on the inventory management significances and its effect on the productivity improvement of the company by direct interview of selected department managers of the case company.

3 Secondary Data: secondary data used in this research includes different documents regarding to show the existing problems of productivity in the selected companies. Performing document and records review was the fundamental task in this research process. Therefore, the company's annual performance reports including production and technique annual performance, finance and accounting annual performance, human resource development, and marketing and sales annual performance were collected for different years.

3.1.2. Sampling Strategy

This section consist description about the target population, sample size and the sampling procedure used to evaluate and understand the current states of the case company.

3.1.2.1. Target Population

The population of the study in this research comprises of Ethiopian printing industry companies that are based in Addis Ababa. Based on data obtained from ministry of industry and Ethiopian Investment Commission, it is known that in Addis Ababa alone; more than 400 printing enterprises are available and more than 900 when considering national level (Fitsum, Ameha, Eshetie, & Daniel, 2017). This list incorporates all categories of printing companies (i.e. micro, small, medium and large) functioning in printing license. The popular printing companies are Birhanina Selam, Artistic, Yekatit Paper Converting plc and Bole printing enterprise are the highly produced and categorized to macro level manufacturing companies. These study focus on one of these highly impact contribute for national economy in printing sector is Yekatit Paper converting Plc. These enterprises are located in Addis Ababa and considered the population of the research at the highest level. The target population of this study includes operators, production managers and supervisors, department manageress. Totally the company has more than 600 workers, from which 400 employees are direct labors engaged in production and the remaining staffs are working in administrative area.

3.1.2.2. Sample Size

The size of the sample depends on various considerations, including population variability, statistical issues, economic factors, availability of participants, and the importance of the problem. To get a representative and reasonable sample size that supports the research findings, the following equations were used. Equation (13) is applied to compute the initial sample size. Since the population is finite (less than 50,000), Equation (14) is used to compute the new sample size according to (Othman.M.A, 2014).

$$no = \frac{Z2*p(1-p)}{c2} \quad \text{(13)}$$

$$nf = \frac{no}{1+\frac{no-1}{N}} \quad \text{(14)}$$

Where: no = Initial sample size

nf = Target sample size

Z= Z value for confidence level are (1.645 for 90% confidence level, 1.96 for 95% confidence level and 2.576 for 99% confidence level).

P = percentage picking a choice expressed as decimal 0.5 used for sample size needed

C = confidence initial expressed as decimal 0.08 = $\pm$ 8

N = population of the company = 600 workers.

$$no = \frac{1.96^2 * 0.5(1 - 0.5)}{0.08^2}$$

$$no = 150.063$$

$$nf = \frac{150.063}{1 + \frac{150.063 - 1}{600}}$$

$$nf = 120$$

3.2. Tool and Method of Data Analysis

The data was analyzed by taking the information from primary and secondary sources. And also data was analyzed using descriptive statistics including mean and standard deviation by use of the relevant computer packages such as Microsoft Office Excel 2013 and Statistical Package for Social Sciences (SPSS) program. This was done by tallying up responses, computing percentages of variations as well as describing and interpreting the data in line with the study objectives. Also it is used to present the result of the data through different charts, graphs, pie chart to illustrate percentage share of sections, bar graph to show the status of each parameter and pare-to chart to explain survey pattern between the five Likert scales. Two methods of data analysis were therefore adopted to enable the researcher conduct a comprehensive analysis. Objective one was analyzed through descriptive statistics in the form of frequencies and percentages; and regression analysis was used for objective two.

The following multiple regression equation used to show the relationship between inventory management practices and productivity of case company.

$$\mathbf{y = \alpha + \beta 1X1 + \beta 2X2 + \varepsilon} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ (15)$$

Where: y = Firm's Productivity

α = Constant; y intercept, that is, the value of y when x is equal to zero

β1and β2 = the slope representing degree of change in independent variable.

X1 = Materials Requirements Planning practices

X2 = Just-in time management practices

ε = error term

Finally the data analyses were done in three stages.

- The first stage is involved data collection for in order to assess the current inventory management system and productivity performance, and gain the knowledge to develop the exact area of weakness of the company.
- The second stage is about classification of material used in the company by using ABC analysis. ABC analysis is a technique of categorizing inventory items according to their substantial impact on the overall expenditure of an organization.
- The third stage is integration of the engineering tools of Material Requirement Planning (MRP) and Just in Time (JIT) by using empirical integration method to improve productivity of the company.

3.3. Research Framework

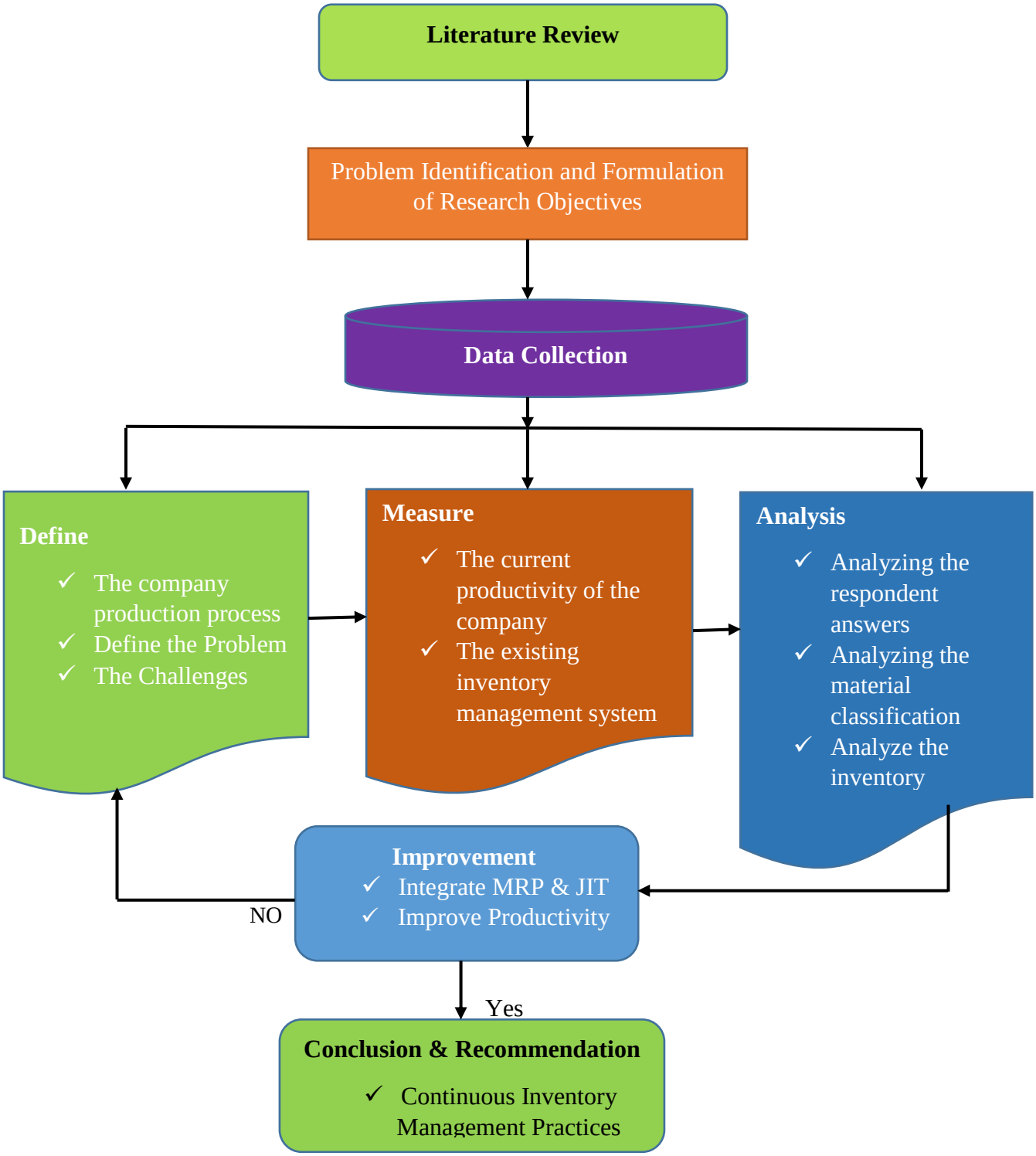


Figure 3.1 Research framework

Chapter Four

Data Analysis, Findings and Interpretation

4.1. Introduction

This chapter sought to establish the data analysis and interpretation of findings and also the relationship between inventory management practices and productivity of printing industry at Yekatit paper converting PLC, were presented. Descriptive and inferential statistics have been used to discuss the findings of the study and finally data interpretation by using multiple regression equation, the findings of the analysis based on the objectives of the study. Data was collected from the company by distributed formal questioners to different department managers, production supervisors and senior operators of manufacturing firm. The findings are presented in the following sections.

4.1.1. Response Rate

The study targeted a sample size of 120 respondents from which 94 filled in and returned the questionnaires in good time giving a response rate of 78.3%. This response rate was sufficient to make conclusions for the study as it acted as a representative. According to (Mugenda.O.M & Mugenda, 2003), a response rate of 70 % and over is excellent based on the assertion, the response rate was excellent.

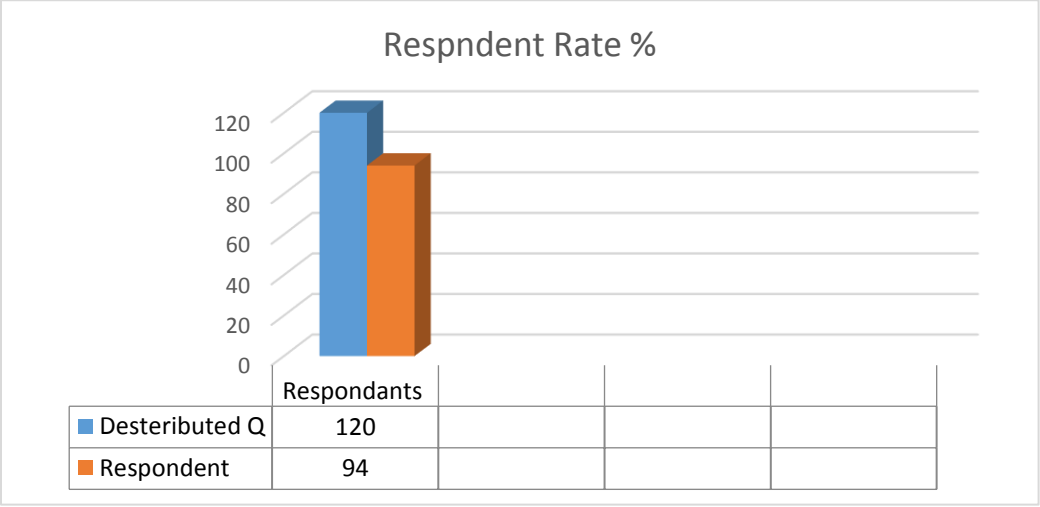


Figure 4.1 Respondent rate of distributed questioners

4.1.2. Respondents Profile

4.1.2.1 Job Description

Job position of the respondents and how long they had worked in that position in the organization ensured that the survey results were valid and reliable. Role of inventory management on productivity of printing industry and its application is relevant at certain levels. Respondents were asked to indicate whether they held the positions of inventory management, procurement manager or purchasing manager, production planning and control team, Quality department team, production supervisors and senior operators of the company. The findings are given in Table 4.1.

Table 4.1 Job Description of Respondent

Position of respondent	**Frequency**	**Percentage %**
Inventory Manager	2	2.12
Purchasing Department	3	3.2
PPC manager & team	6	6.4
Quality Control Team	6	6.4
Production Supervisors	10	10.6
Senior Operators	67	71.2
Total	94	100

Source: Research Data from Respondent.

From Table 4.1, majority (71.2%) of the respondents were senior operators, (10.6%) were production supervisors, (6.4%) were Quality control teams, (6.4%) were production planning control manager & teams, (3.2%) were purchasing managers and (2.12%) were inventory managers. This means that majority of the respondents were senior operators and production supervisors were in a good position to give relevant information on the effects of productivity and factors that affect productivity of the company.

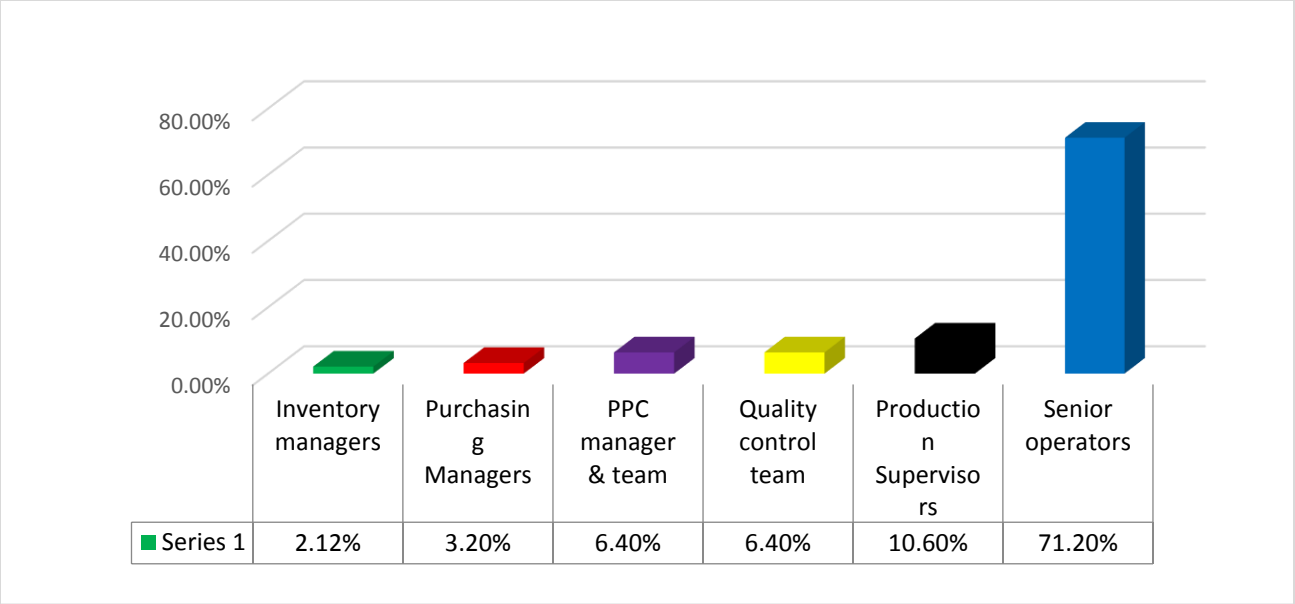


Figure 4.2 Respondent position vs percentage of response

4.1.2.2. Work experience in the company.

The respondent's working experience based on the number of years they had worked in that particular work position was useful for the study. The respondents were asked to indicate whether they had worked in that particular position for less than two years, 2-5 years, 5-10 years, or over 10 years. The findings are shown in Figure 4.3.

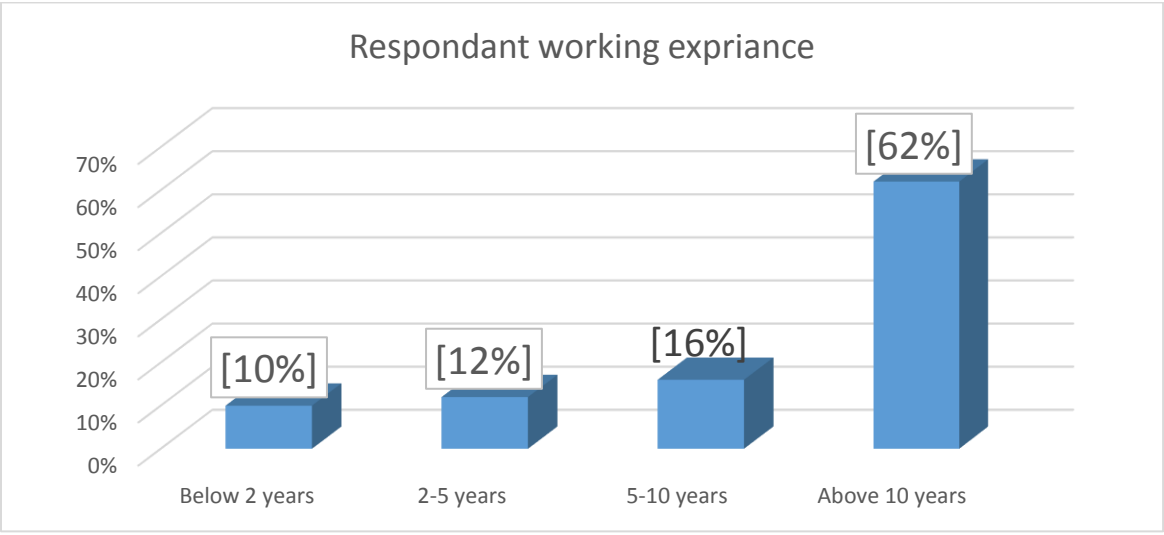


Figure 4.3 Respondent working experience

From Figure 4.3, the majority of the respondents were (62%) indicated to have worked in the organization for more than 10 years which are senior operators are high value consideration, (16%) indicated to have worked for a period of 5 to 10 years while (12%) indicated to have worked in the company for 2 to 5 years and (10%) were indicated to have worked not more than 2 years. This implies that majority of the respondents had worked for a considerable period of time and that they were in a good information relating to this research.

4.1.3. The major problem of the company

The respondents were asked to prioritized problem based on company frequently occurred major problems which are quality problem, customer satisfaction problem, Raw material shortage problem, skilled man power and financial problem. This question was distributed to the respondents of case company to prioritized problem. The findings of respondent are shown below in figure 4.4

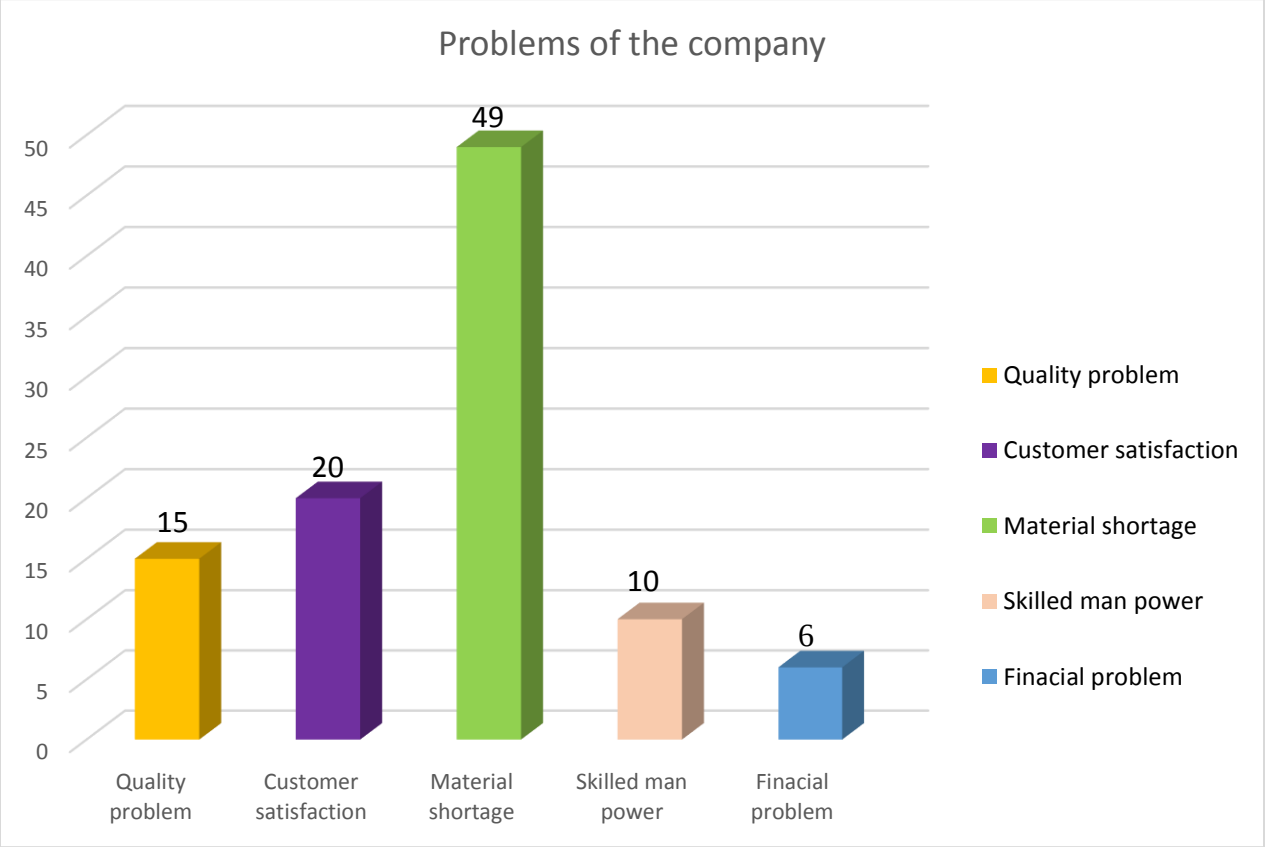


Figure 4.4 major problem of the company

From figure 4.4. the respondents were prioritized the major problems at yekatit paper converting company are (49%) were Raw material shortage, (20%) were customer satisfaction, (15%) were Quality problem, (10%) were skilled man power and (6%) were financial problem. From this result the company were high raw material shortage occurred and it affect the production process and the company profitability.

4.1.4. Major breakdowns or waste of time in the company

From the company recording data Major breakdowns or waste of time on production in the company which are setup time, cleaning time, machine breakdown, absenteeism of operator, raw material shortage and power shortage. The two consecutive year data were listed in the table 4.2

Table 4.2 major waste of time in the company**.**

S/N	Major waste of time	2016/17 G.C (in minute)	Percentage (%)	2017/18 G.C (in minute)	Percentage (%)
1	Setup time	958.96	12.52	853.01	10.80
2	Clanging time	1229.14	15.32	682.50	8.64
3	Machine breakdown	3,334.28	43.53	3,873.81	49.08
4	Absenteeism of operator	605.90	7.92	1,097.23	12.90
5	Raw material Shortage	1250.23	17.05	1114.74	15.12
6	Power Shortage	280.67	3.66	271.45	3.43
Total		**7,659.18**	100	**7,892.74**	100

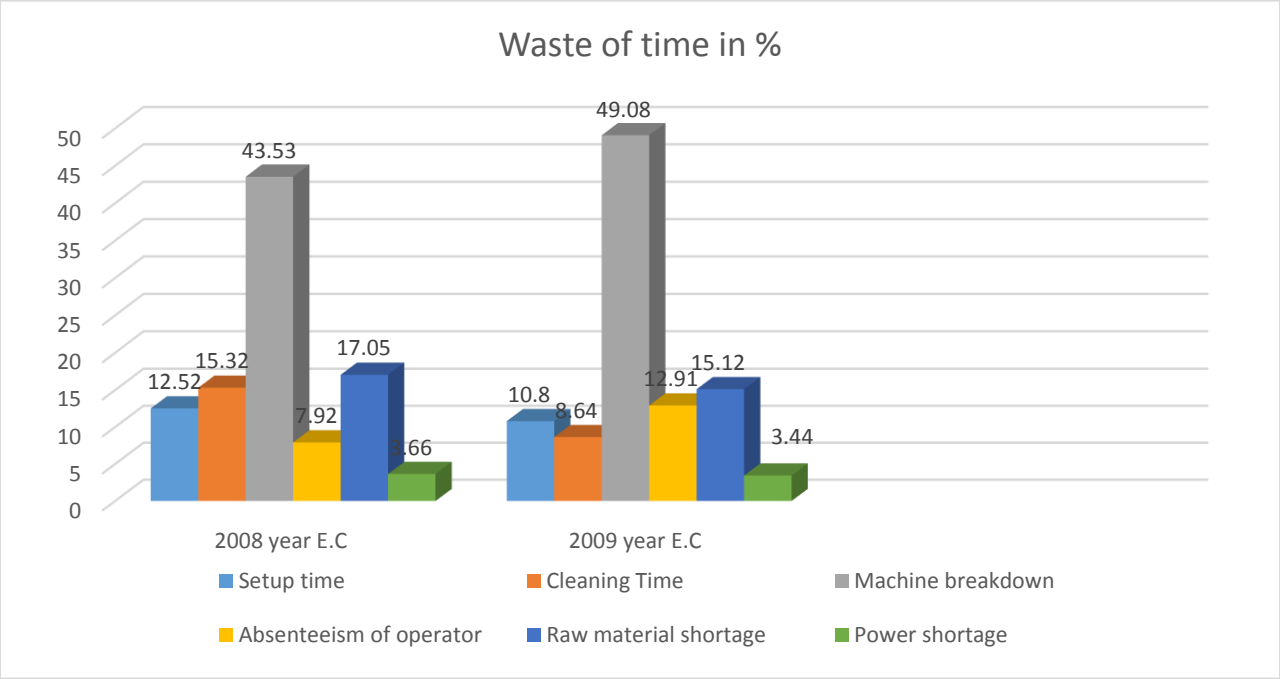


Figure 4.5 waste of time rate in the company

From figure 4.4. The case company have different breakdowns was happen in last two years. From these major breakdowns are highest value is machine breakdown (43.53% & 49.08%) in 2008 and 2009 respectively it is because of the company used those machine for a long period of time and they are technologically out of time. The other waste of time is material shortage which is (17.05% & 15.12%) in consecutive years. cleaning time were (15.32% & 8.64%), Setup time were (12.52% & 15.12%) and power shortage were (1.66 % & 3.44 %) was happen in last two consecutive year respectively.

4.2. The current production capacity, planned and actual products on the fiscal year 2017/18G.C

Table 4.3. Production Capacity, Planned Products & Actual products in 2017/18

Production Capacity, Planned Products & Actual products in 2017/18							
S/N	**Product Type**	**Unit**	**Capacity**	**Planned**	**Actual product**	**productivity with capacity in %**	**productivity with plan in %**
1	Label	Tone	11,025	10,351	7,274	65.977	70.273
2	Paper Box	Tone	3,600	3,160	2,528	70.222	80.000
3	Toilet Tissue	Tone	1,235	1,157	810	65.587	70.009
4	A4 Copier paper	Tone	4,857	3,245	2,271	46.757	69.985
5	Text Book	Tone	8,813	7,931	-	0.000	0.000
6	Exercise Book	Tone	8,017	7,695	9,298	115.979	120.832
7	Note Book	Tone	2,017	1,695	1,640	81.309	96.755
8	Voucher	Tone	2,186	1,816	1,271	58.143	69.989
9	Pass Book	Tone	1,124	974	682	60.676	70.021
10	Straps	Tone	1,893	1,594	1,116	58.954	70.013
Total			**44,767**	**39,618**	**26,890**	**60.067**	**67.873**

From the above table the general productivity of the company with annual production capacity is 67.87% and with Annual Machine capacity or planned capacity is 60.06%.This show that the company where not fully used their production capacity because of Financial problem, foreign exchange, Raw material shortage, Machine breakdown and some other problems was the challenges or bottleneck for meet their annual goal of the company.

4.3. Analysis of the Existing productivity of the Company

The analysis of existing productivity measures indicates that the current productivity level of the company. Yekatit paper converting plc, does not have proper and systematic productivity measures to monitor its productivity performance. The Company did not determine the resource (labor, material, machine, energy, etc.) utilization rate and considered productivity as a final output or sales value of the company. In this study Partial and Total productivity measurement models are developed and applied to monitor the existing productivity status of the company. On the literature review five partial productivities of measurement models are presented, they are:

1. Human inputs: these include the values of salaries and benefits of all employees of the company.
2. Material inputs: these include major raw materials,
3. Capital inputs: uniform annual cost of both fixed and working capital.
4. Energy Inputs: these include electrical power and water consumption.
5. Miscellaneous inputs: these include taxes, professional fees, advertisement cost, insurance, travel and per diem, etc.)

Implementing the measurement model requires gathering of the necessary data of the company, i.e., price or value of each input and output. Accordingly, the data of output and input values of five items for Yekatit paper converting plc, last four consecutive years were listed in the table 4.4.

Table 4.4. Four years of values of items for Yekatit paper converting plc.

Item	Fiscal year			
	2014/15	2015/16	2016/17	2017/18
Value of Human Input	17,819,861	18,869,431	23,344,415	22,680,651
Value of Material Input	64,535,181	52,286,035	101,701,703	124,889,687
Value of Capital Input	106,209,658	163,470,592	171,178,754	191,013,523
Value of Energy Input	134,647	145,422	231,326	279,983
Value of Miscellaneous Input	34,481,921	42,665,083	54,072,725	77,027,549
Value of Total Input	223,181,268	277,436,563	350,528,923	415,891,393
Value of Total Output	164,660,707	175,409,481	130,385,997	277,568,355

The base year for the calculation of the productivity growth in the company was defined to be the 2014/2015 fiscal year (FY), because this year got a relatively higher average performance and fully advocated by the interview result from the company's production manager. Implementing the measurement model requires gathering of any data's of the quantities, i.e., price or value of each input and output. Accordingly, the data of output and input values of the company for the fiscal years 2014/15 to 2017/18 were compiled as shown in the previous Table 4.4.

A. Five Basic Partial Productivities of a company for 2017/18 fiscal year

1. Partial productivity of Human Inputs (PPH): $PPH = \frac{OF}{IH}$ ……..……..(16)

$$\text{PPH} = \frac{277{,}568{,}355}{22{,}680{,}651}$$

$$PPH = 12.24$$

2. Partial Productivity of Material Inputs (PPM): $PPM = \frac{OF}{IM}$……...……....(17)

$$\text{PPM} = \frac{277{,}568{,}355}{124{,}889{,}687}$$

$$PPM = 2.22$$

3. Partial Productivity of Capital Inputs (PPC): $PPC = \frac{OF}{IC}$ ……..……(18)

$$\text{PPC} = \frac{277{,}568{,}355}{191{,}013{,}523}$$

$$PPC = 1.45$$

4. Partial Productivity of Energy Inputs (PPE): $PPE = \frac{OF}{IE}$ ……..……(19)

$$\text{PPE} = \frac{277{,}568{,}355}{279{,}983}$$

$$PPE = 991.375$$

5. Partial Productivity of Miscellaneous Inputs (PPX): $PPX = \frac{OF}{IX}$ ……(20)

$$\text{PPX} = \frac{277{,}568{,}355}{77{,}027{,}549}$$

$$PPX = 3.60$$

Where OF: Output of Fiscal year, IH: human input, IM: Material input, IC: Capital input
IE: Energy Inputs, IX: Miscellaneous inputs

Therefore, the partial productivities of the company for the fiscal year 2017/2018 with respect to each input factor are calculated using equation (**16- 20)**. Accordingly, the partial productivities for human, capital, material, energy and miscellaneous input factors of the process are 12.24, 2.22, 1.45, 991.375 and 3.60, respectively.

B. Five Basic Partial Productivity Indices of the Company for 2017/18 fiscal year.

The partial productivity indices of the different input factors of the firm for fiscal year of 2017/18 has been computed as the following equations (21-25):

1. Partial productivity index for human input factors: (PPH index): of the company for fiscal year of 2017/18 for human input factor.

$$PP_{Hindex} = \frac{OP_C * IP_{ib}}{OP_b * IP_{ic}} \quad \text{..... (21)}$$

$$PP_{Hindex} = \frac{277,568,355 * 17,819,861}{164,660,707 * 22,680,651} = 1.32$$

2. Partial productivity index for material input factors (PPH index): of the company for fiscal year of 2017/18 for human input factor.

$$PP_{Mindex} = \frac{OP_C * IP_{ib}}{OP_b * IP_{ic}} \quad \text{..... (22)}$$

$$PP_{Mindex} = \frac{277,568,355 * 64,535,181}{164,660,707 * 124,889,687} = 0.87$$

3. Partial productivity index for capital input factors (PPC index): of the company for fiscal year of 2017/18 for human input factor.

$$PP_{Cindex} = \frac{OP_C * IP_{ib}}{OP_B * IP_{ic}} \quad \text{..... (23)}$$

$$PP_{Cindex} = \frac{277,568,355 * 106,209,658}{164,660,707 * 191,013,523} = 0.94$$

4. Partial productivity index for energy input factors (PPE index): of the company for fiscal year of 2017/18 for human input factor.

$$PP_{Eindex} = \frac{OP_C * IP_{ib}}{OP_B * IP_{ic}} \quad \text{..... (24)}$$

$$PP_{Eindex}=\frac{277,568,355*134,647}{164,660,707*279,983} = 0.8106$$

5. Partial productivity index for miscellaneous input factors (PPX index): of the company for fiscal year of 2017/18 for human input factor.

$$PP_{Xindex} = \frac{OP_C * IP_{ib}}{OP_b * IP_{ic}} \text{ ..... (25)}$$

$$PP_{Xindex}=\frac{277,568,355*34,481,921}{164,660,707*77,027,549} = 0.7546$$

Where: OF = Total output of the company, OPC = Output of current period,
IG = (H, M, C, E, and X inputs), OPb = Output of base period, IPC = Input of current period
IPb = Input of base period.

C. Total Productivity Computation of the company for 2017/18 fiscal year.

To measure or to calculate the total productivity of the company two basic approaches are developed. Those methods are: Total productivity based on total outputs and total inputs, and total productivity based on five basic partial productivities of the company.

1. Total Productivity Based on Total Outputs and Inputs (TPOI)

The total productivity of the company for fiscal year 2017/18 as a function of its total outputs and total inputs has computed by using the following equation:

$$TP_{F2017/18} = \frac{OF}{IF} \text{ ..... (26)}$$

$$TP_{F2017/18} = \frac{277,568,355}{415,891,393} = 0.667$$

2. Total Productivity Based on Partial Productivities (TPP)

A. The total productivity of the company for the fiscal year 2017/18 was also computed based on five partial productivities by using equation (27) as follows:

$$TPF = \frac{1}{5}(W_{iH}PP_{iH} + W_{iM}PP_M + W_{iC}PP_{iC} + W_{iE}PP_{iE} + W_{iX}PP_{iX}) \text{..... (27)}$$

First, the weight factors for each input are computed as the following equation (28-32):

$$W_H = \frac{IH}{IF} \quad \text{..... (28)}$$

$$W_H = \frac{22{,}680{,}651}{415{,}891{,}393} = 0.054$$

$$W_M = \frac{IM}{IF} \quad \text{..... (29)}$$

$$W_M = \frac{124{,}889{,}687}{415{,}891{,}393} = 0.300$$

$$W_C = \frac{IC}{IF} \quad \text{..... (30)}$$

$$W_C = \frac{191{,}013{,}523}{415{,}891{,}393} = 0.459$$

$$W_E = \frac{IE}{IF} \quad \text{..... (31)}$$

$$W_E = \frac{279{,}983}{415{,}891{,}393} = 0.00067$$

$$W_X = \frac{IX}{IF} \quad \text{..... (32)}$$

$$W_X = \frac{77{,}027{,}549}{415{,}891{,}393} = 0.185$$

$$TPF = \frac{1}{5}(0.054 * 12.24 + 0.300 * 2.22 + 0.459 * 1.45 + 0.00067 * 991.375 + 0.185 * 3.6)$$

$$TPF = \frac{1}{5}(3.32)$$

$$\boldsymbol{TPF = 0.664}$$

B. The total productivity index of the company for the fiscal year 2017/2018, as a function of its total outputs and total inputs, was computed by using the following equation:

$$TPF_{Index} = \frac{OF_C}{OF_B} * \frac{IF_{Cb}}{IF_{CC}} \quad \text{..... (33)}$$

$$TPF_{Index} = \frac{277{,}568{,}355}{164{,}660{,}707} * \frac{223{,}181{,}268}{415{,}891{,}393}$$

$$\boldsymbol{TPF_{Index} = 0.90}$$

C. Total Productivity index of a company based on its five partial productivities has computed using the following equation:

$$\boldsymbol{TPF_{index}} = (W_{iH}PPH_{index} + W_{iM}PPM_{index} + W_{iE}PPE_{index} + W_{iX}PPX_{index} \ldots\ldots\ldots \text{(34)}$$

$$\boldsymbol{TPF_{index}} = 0.054 * 1.32 + 0.30 * 0.87 + 0.459 * 0.94 + 0.00067 * 0.8106 + 0.185 * 0.755$$

$$\boldsymbol{TPF_{index}} = \mathbf{0.901}$$

4.3.1. Partial & Total Productivity Analysis of the company

A partial and total productivity analysis was done at Yekatit paper converting plc by comparing the current partial and total productivity with the base period. Based on the data obtained for four consecutive periods (2014/15, 2015/16, 2016/2017, 2017/2018), the status of the current fiscal year 2017/18 was determined with the reference to the base year 2014/15.

A. Partial Productivities Analysis of the company

The partial productivities of the current fiscal year (2017/18) were computed in section 4.1.A. above accordingly, the partial productivities of human, and capital inputs showed a growth with an amount of 32.46 % and 1.677%, respectively. But the partial productivities of material, Energy and Miscellaneous inputs showed a decline with an amount of 12.9 %, 18.9% and 24.65%, respectively. Table 4.5. Shows the decline or growth of the partial productivities of the company in 2017/18 fiscal year:

Table 4.5. Comparison of Current Partial Productivities with in the base period.

Partial Productivity	Base period (2014/15)	Current period (2017/18)	Change (%)	Status
Human Inputs Productivity	9.24	12.24	32.46	Growth
Material Inputs Productivity	2.565	2.22	-12.96	Decline
Capital Inputs Productivity	1.55	1.45	1.667	Growth
Energy Inputs Productivity	1222.9	991.375	-18.9	Decline
Miscellaneous Inputs Productivity	4.778	3.6	-24.65	Decline

Source; Researcher (2018)

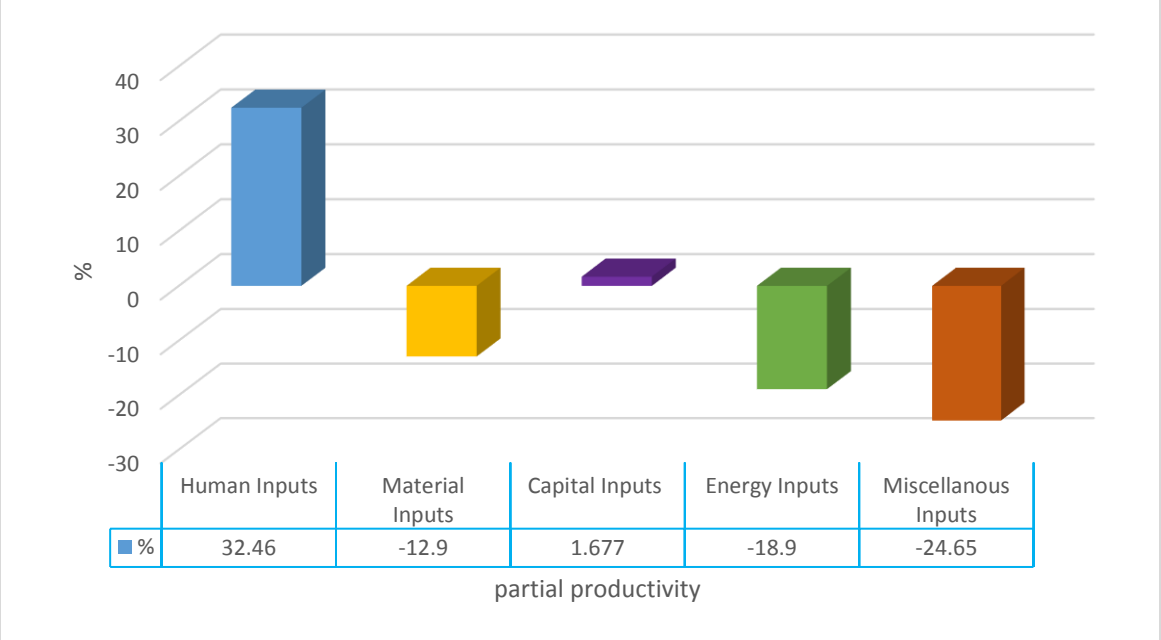


Figure 4.6. Decline/growth of Partial productivity for current Year 2017/18 against base period 2014/2015.

B. Total Productivity Analysis at Yekatit paper converting plc.

The total productivity index of the company for the current period (2017/18) was computed in previous section and it is 0.66. This indicates that the productivity of the company declined with an amount of 34 %. Hence, it is necessary to investigate the points where primarily poor productivity growth shows and make appropriate improvement initiatives for the firm. The other period of total productivity trend against with the base period on 2014/15 are presented in the next figure 4.6.

The developed productivity measurement methodology indicates not only the productivity growth or the decline of the firm but it also enables to investigate the productivity of the company at product level, operational level, and even at process input factors or parameters level. All partial productivity indices of the company during the period 2016/17 showed a decline as compared to the base period 2014/15 which is the lowest productivity in the specified period. The total productivity indices also showed the lowest (a decline by 63%). In general, one can observe the report format of the productivity trend analysis and could easily identify productivity status of the company.

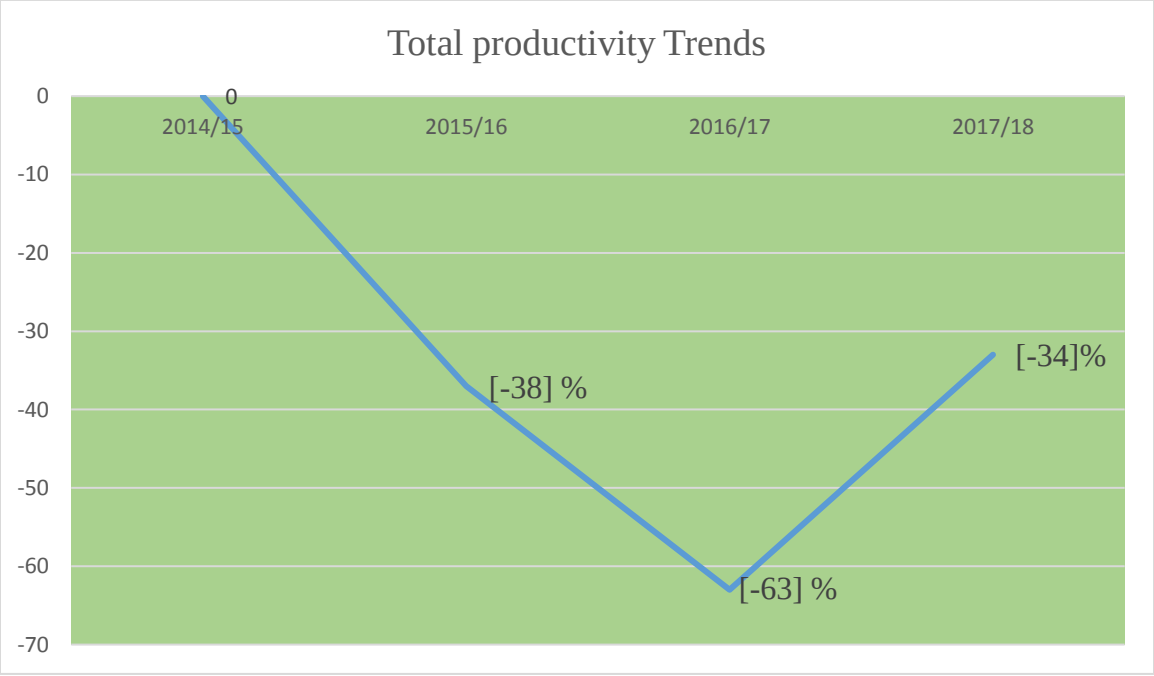


Figure 4.7. Total Productivity Trends: 2014/15 to 2017/18 against base period 2014/15

The productivity trend analysis is probably the most important step in the productivity-measurement stage of a firm's productivity program, because productivity figures are interpreted to trigger action-oriented management strategies. Hence, the productivity indices of Yekatit paper converting Plc Company were compiled in the form of a management summary report to indicate the percent changes in total and partial productivities for the specified periods (2014/15 to 2017/18) as shown in Table 4.6.

The partial and total productivity measurement results are helpful for the company to know the status of its performance and to identify the potential areas for improvement. Especially, the productivity index is important to tell the relative position of the current period with respect to the base period, and links to the actual productivity story of the company. Comparison of the productivity index value with the previous productivity history of the company will enable to dig out the critical productivity problems enables to point out the bottleneck areas and suggest the appropriate corrective actions and improvement actions that should be taken by the company. The summarized partial and total productivities and its indices are shown in Table 4.6.

Table 4.6. Partial and Total Productivity of YPC Company for four Fiscal Years

	Fiscal year				
Parameters	**2014/15**	**2015/16**	**2016/17**	**2017/18**	**Min. value**
TPF	0.737	0.632	0.37	0.667	0.37
TPFi	1	0.989	0.623	0.98	0.623
PPH	9.24	10.74	6.919	13.27	6.919
PPHi	1	1.16	0.74	1.43	0.74
PPM	2.55	3.87	1.59	2.41	1.59
PPMi	1	1.52	0.622	0.944	0.622
PPC	1.55	1.24	0.94	1.58	0.94
PPCi	1	0.799	0.608	1.016	0.608
PPE	1222.9	1393.59	698.31	1075.29	698.31
PPEi	1	1.14	0.57	0.88	0.57
PPX	4.77	4.75	2.98	3.91	2.98
PPXi	1	0.99	0.62	0.82	0.62

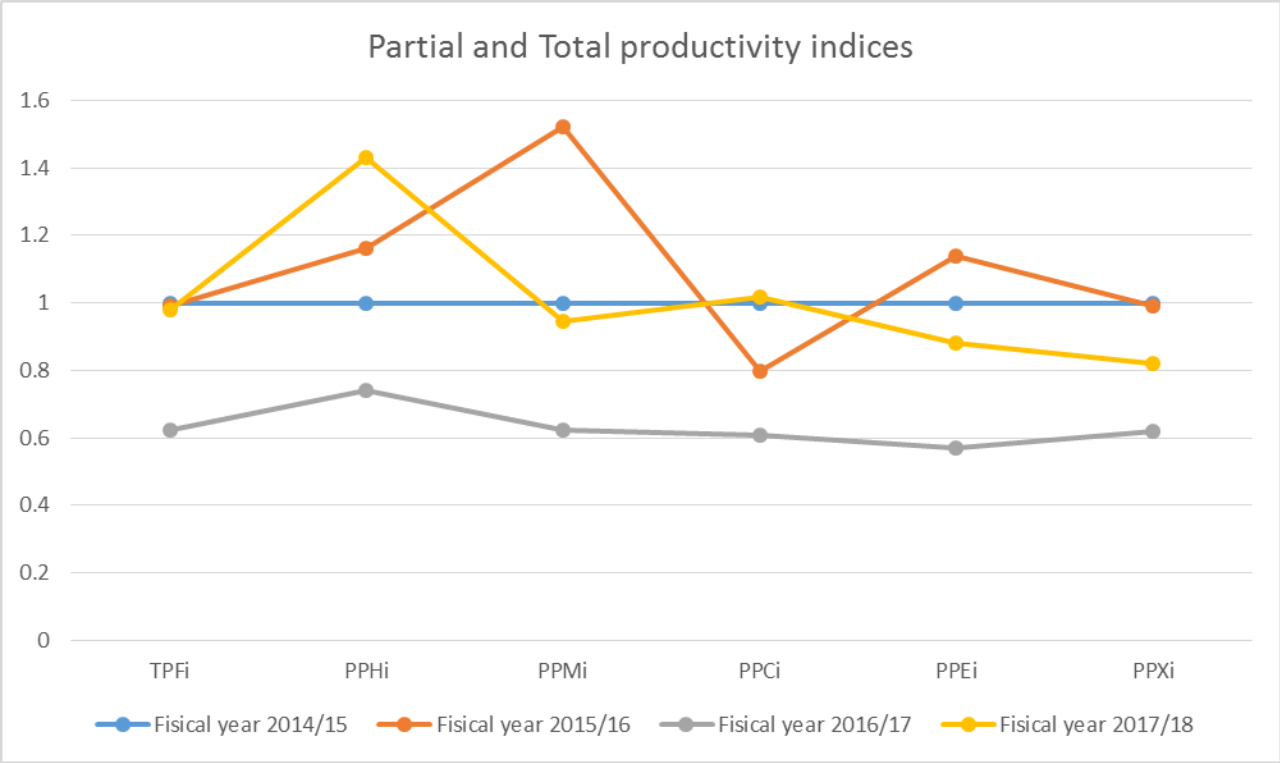


Figure 4.8. Partial and Total Productivity Indices for Yekatit paper converting plc against Base Period 2014/15

The productivity of the company for the specified periods (2014/15 to 2017/18) fluctuates from year to year. For instance, the total productivity indices of the company for the fiscal years 2014/15 to 2017/18 were 1, 0.97, 0.623and 0.98, respectively. Hence, the productivity of the current year (2017/18) is better than the other fiscal years as compared to the base year. On the other hand, it showed poor productivity during the period 2016/17.

A case study was performed at YPC PLC firm. It focused upon the shortcomings of the current productivity measures and the computation of partial and total productivities. Moreover, the partial and total productivity measurement models were tested considering the data of four consecutive fiscal years (20014/15 to 2017/18). Accordingly, the partial productivity indices of the company for the current year (2017/2018) as compared to the base year (2014/15) for each input factor (human, material, capital, energy and miscellaneous input factors) were 1.43, 0.944, 1.016, 0.88 and 0.82, respectively. The total productivity index of the current year was 0.98. Furthermore, the partial and total productivities analysis trends of YPC plc firm were computed for the fiscal years 2014/15 - 2017/18.

4.4. Current strategy of inventory management in the company

Most of the printing materials are ordered in terms of the production schedule since the printing of the products are customized by the customers and changed frequently. Both centralized and decentralized strategies are currently used for purchasing raw materials in Yekatit paper converting company. The company used different types of materials are acquired: Different strategies have been used for inventory control in terms of the actual situation of those materials. The most important raw materials, especially metallic paper, Art paper, wood free paper and printing ink is purchased or imported from outside the country mostly from India, China and European country. As a result, the company can lose economies of scale by using this model, because of the arriving date of material are not constant or late from on du date, it affect the production schedule and customer delivery date. Other components, such as some ink, spare parts and packaging materials, are controlled and purchased by the local procurement department. Most of those components and packaging are customized and changed frequently by the customers, so implementing a decentralized strategy can quicken the response.

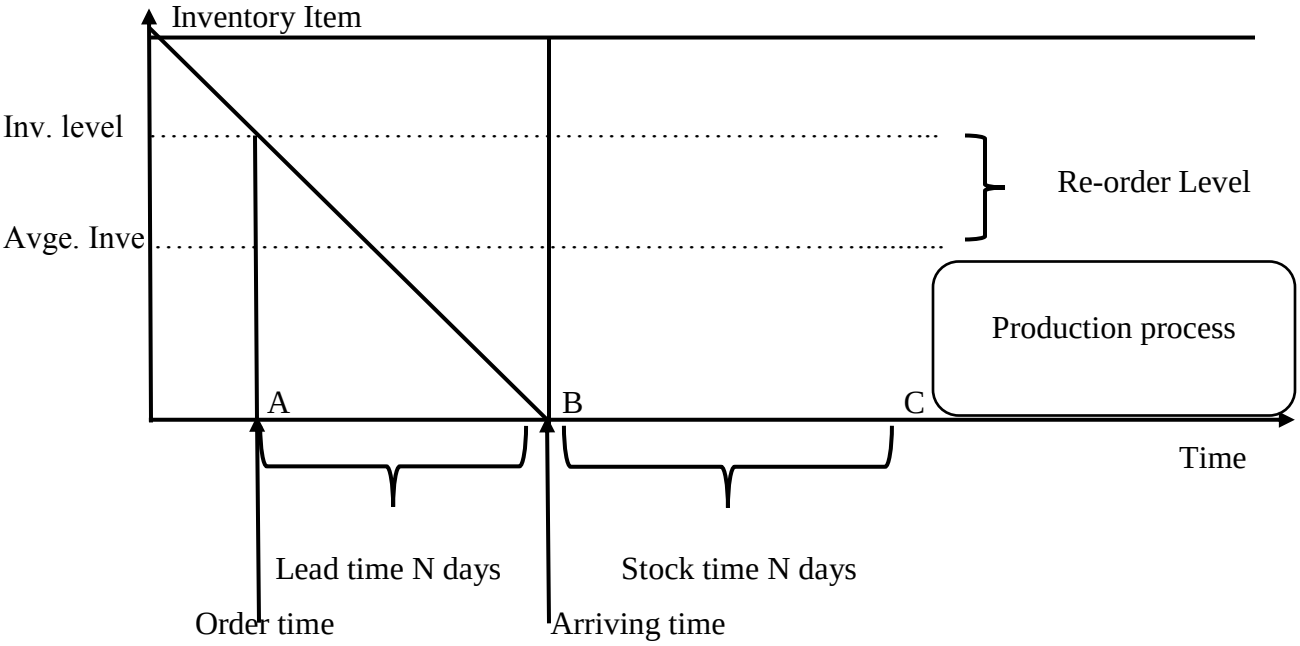


Figure 4.9. Inventory management system of YPC.

The procurement department places the order two periods of lead-time before the production time as the waiting of job order of some printing materials are unstable. Figure 4.9. Shows an example how the ordering process works. Suppose point C is the time for production, A is the order time and B is the arriving time of the material. The time between A and B is not equal to the time between B and C. If the materials are arrived at time B, then the stock time is N days from time B to C or waiting of job order. If the new job order arrived to sales department then the sales order to job for production department finally the raw material issued from the stock it means point B to C. This approach helps keep the production schedule stable but also produces high inventories. The Company used the re-order level model in some condition for ordering and receiving raw materials. That is the level where the minimum level is set if it reaches out there then they need to order the material so that the level can be kept full. The re-order level depends upon

1) Duration of time between the placing of an order and receiving the supply of inventory.
2) The inventory is constantly being used up that's why it is called as the usage rate.

The reorder level can be determined as follows:

$$\boldsymbol{R = M + TU} \quad \text{..... (35)}$$

Where: R = Reorder level. M = Minimum level of inventory

T = time gap/delivery time. U = Usage Rate

4.5. Analysis of Inventory Management Practices

4.5.1. ABC Analysis

ABC analysis is one of the most commonly employed inventory classification techniques. The classification scheme is based on the Pareto principle, or the 80/20 rule, that employs the following rule of thumb: "vital few and trivial many. "The process of ABC analysis classifies inventory items into A, B or C categories based on so-called annual cost usage. Annual cost usage is calculated by multiplying the cost out value per unit by the annual usage rate".

Table 4.7. Selected raw material and planned annual demand in 2017/18

S/N	Raw Material Type	Annual Demand in Tone	Demand in %	Cumulative % of material	Category
1	Wood free Paper (48-80)gm	5254	48.613	10	A
2	Duplex Paper (250-500)gm	2285	21.142	20	A
3	Toilet Tissue 16&17 gm	1029	9.52	30	A
4	Weight strength paper (68&70)gm	774.75	7.168	40	A
5	Craft Paper Yellow 38gm	450	4.16	50	B
6	Bank Paper 45gm	440	4.07	60	B
7	Balacron Paper	300	2.77	70	B
8	Metallic paper 68 gm	258.75	2.39	80	C
9	Water based Ink	12.15	0.11	90	C
10	Felxo Ink	4.07	0.0.7	100	C
	Total	**10807.72**			

Source: Researcher, (2018)

From the table 4.7. the amount of demand of selected raw material in the company and classification of those raw material based on the annual demand. The purpose of this classification is to ensure that purchasing staff use resources to maximum efficiency by concentrating on those items that have the greatest potential savings selective control will be more effective than an approach that treats all items identically. Eeach item should receive a treatment corresponding to its class.

A-items should have tight inventory control, more secured storage areas and better sales forecasts; reorders should be frequent, with planned reorder; avoiding stock-outs on A-items is a priority. From this materials of the company highly demand are: Wood free Paper (48-80) gm, Duplex Paper (250-500) gm, Toilet Tissue 16&17 gm and Weight strength paper (68 &70) gm.

B-items benefit from an intermediate status between A and C; an important aspect of class B is the monitoring of potential evolution toward class A or, in the contrary, toward the class C.in this classification type annual demand raw material of the company are: Craft Paper Yellow 38gm, Bank Paper 45gm and Balacron Paper categorized in to B type.

C-items is made less frequently, reordering only when an actual purchase is made; this approach leads to stock-out situation after each purchase which can be an acceptable situation, as the C-items present both low demand and higher risk of excessive inventory costs. From company planned annual demand data C type raw materials are; Metallic paper 68 gm, Water based Ink and Flexo ink are less annual demand.

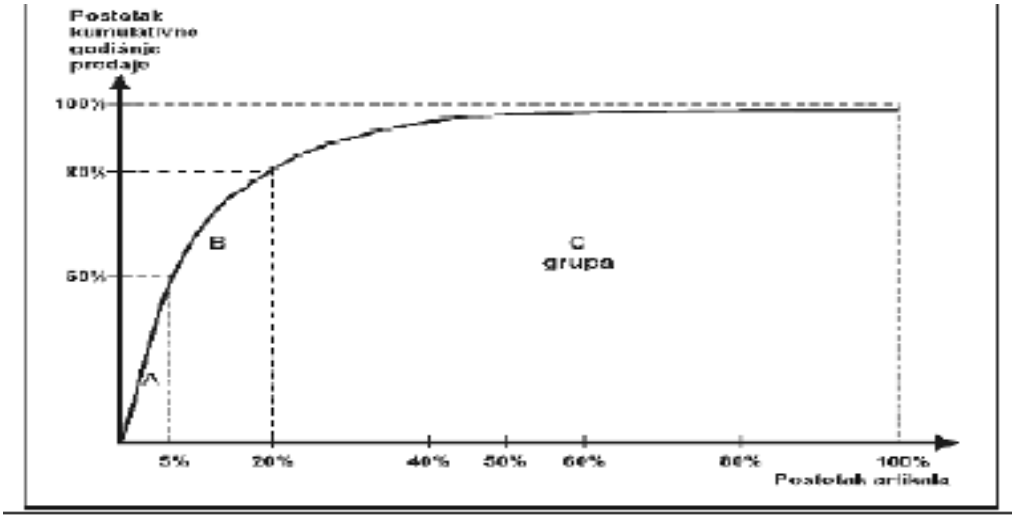


Figure 4.10 Graphical ABC analysis of raw material

4.5.2. Just-In-Time Management Practices

Just-in-time is one of the inventory management practices used in manufacturing firms for planned elimination of all waste and continuous improvement of productivity. The respondents were asked to indicate to what extent they agreed with the statement in relation to Just-in-time management practices in printing company and they responded to various aspects under the variable on a five-point Likert Scale 1) Not used, 2) seldom used, 3) sometime used, 4) often used, 5) always used.

Table 4.8. Just in Time variables and the values of mean and standard deviation.

S/N	Evaluation Questions	Mean	Standard deviation
1	Set up time Reduction	4.6	0.74
2	Small lot size	3.8	1.18
3	Quality circle & TQM	4.39	0.89
4	JIT purchasing	4.06	0.9
5	Cross-training & multifunction employee	4.05	0.89
6	pull production line	3.64	1.06
7	6S' and improvement activities	3.74	0.84
8	KANBAN system	2.94	0.91
9	Scheduling stability	3.67	0.74
10	Total production maintenance	3.63	0.73

Source: Researcher, (2018)

Table 4.8 shows that ($2.94 \leq mean \geq 4.6$) and ($0.73 \leq Std.d \geq 1.18$) the respondents indicated that they agreed to a great extent that the company must be creates items that arrive when needed, neither earlier nor later, they respond set up time reduction and quality circle activities are highly affect productivity and Kanban system are less value effect on production. The company applies Just-in-time practice to reduce lead time by reducing set-up times, and lot sizes, the firm is able to reduce the frequency of ordering, the firm manufactures products based on planned elimination of waste and continuous improvement of productivity, the firm has only the required inventory when needed, that the firm uses Just-in-time practice to timely replenish inventory.

The company reduces inventory and its associated carrying cost by using Just-in-time, the company makes what the customers need, when it is needed and in the quantity needed using the minimum resources, and that the firm uses Just-in-time practice to improve quality of products to zero defects. The regression coefficients demonstrate that the elements of JIT have different degrees of impact on the performance of productivity, The result of each element of Just in Time coefficients affect productivity were present in the regression analysis part 4.6.1.

These findings are in line with the findings of (Chase & Zahong, 2009) argue that a just-in time inventory system keeps inventory levels low by only producing for specific customer orders. The result is a large reduction in the inventory investment and inventory costs, though a high level of coordination is required. By using just-in-time concepts, there is a greatly advantages to control and manage the need for raw materials and improve customer satisfaction and profitable of the organization.

4.5.3. Materials Requirements Planning Practices

Materials Requirements Planning is one of the inventory management practices used in manufacturing industry. That results to relatively low inventory levels and reduced warehousing and material handling costs. The respondents were asked to indicate to what extent they agreed with the statement in relation to Materials Requirements Planning practices in the company and they responded to various aspects under the variable on a five-point Likert Scale 1) Not used, 2) seldom used, 3) sometime used, 4) often used, 5) always used.

Table 4.9. The resultant means and standard deviations of the MRP variables.

S/N	Evaluation Questions	Mean	Standard deviation
1	Demand forecasting/order management (DF/OM)	3.86	0.68
2	Master production scheduling (MPS)	3.85	0.63
3	Rough-cut capacity planning (RCP)	3.91	0.69
4	Materials requirement planning (MRP)	3.94	0.69
5	Capacity requirements planning (CRP)	3.95	0.77
6	Shop flow scheduling and control (SFSC)	3.98	0.57
7	Inventory management (IM)	4.13	0.63
8	Purchasing/supplier management (PSM)	4.08	0.58
9	Equipment maintenance management (EMM)	4.08	0.59
10	Basic data management.(BDM)	4.02	0.56

Source: Researcher, (2018)

Table 4.9 shows that (3.85≤mean≥4.13) and (0.56≤ St.d ≥ 0.77) the respondents indicated that they agreed to a very great extent that Materials Requirements Planning assists the detailed planning of production and inventory management for the company, the respondent also agree that the elements of MRP are affect productivity in different values. The regression coefficients demonstrate that the elements of MRP have different degrees of impact on the performance of productivity, The result of each element of MRP coefficients affect productivity were present in the regression analysis part 4.6.2. The firm uses Materials Requirements Planning to reduce inventory level, warehousing costs and material handling cost by doing these requirement the company will be advantages by improved inventory problems and increases company productivity. This finding is in line with the (Saunders, 1997) study that Materials Requirements Planning inventory system is very useful to manufacturing firms since it results to relatively low inventory levels and significantly reduced holding and handling costs. MRP enables the firm to move the right supplies at the right time to manufacturing points, and also it enables the firm to achieve efficiency of information flow, and that the firm makes available assemblies just before they are required by the next stage of production or for delivery.

4.5.4. Production performance strategies Practices

The researcher identified ten response variables for measuring the production planning control (PPC) performance or productivity of the company. The first five variables are correspond to the production planning measure or match with material requirement planning (MRP), while the last five variables are correspond to the production control (PC) measure or related to just in time (JIT). Those variables are dependent correlation with productivity measurement of the firm. The reliability of these variables was tested using Cronbach's α, which shows how well a set of variables measure a single unidimensional latent construct, for example, how well the first five variables measure the production planning (PP) performance. Cronbach's alpha tests to see if multiple-question Likert scale surveys are reliable. These questions measure latent variables, hidden or unobservable variables. Cronbach's alpha will tell you if the test you have designed is accurately measuring the variable of interest. The formula for Cronbach's alpha is in equation (36).

$$\alpha = \frac{K*mean(ri)}{1+mean(ri)*(K-1)} \quad \ldots\ldots\ldots\ldots\ldots\ldots (36)$$

Where: K = the number of items.

ri = average covariance between item-pairs.

The respondents were asked to indicate to what extent they agreed with the statement in relation to Production performance strategies Practices in the company and they responded to various aspects under the variable on a five-point Likert Scale 1) Not used, 2) seldom used, 3) sometime used, 4) often used, 5) always used.

Table 4.10. Production Performance Variables

S/N	**Production Performance Variable**	**Mean**	**Standard deviation**
1	Effectiveness of production planning (EPP)	4.11	0.86
2	Accuracy of demand forecasting (ADF)	4.23	0.84
3	Information sharing degree of cross-function (ISCF)	4.07	0.77
4	Flexibility of production planning (FPP)	4.06	0.78
5	Data accuracy of production planning (DAPP)	4.03	0.74
6	Accuracy of completing production plan (ACPP)	4.17	0.77
7	level of WIP Reduction (LWR)	4.32	0.77
8	Degree of on-time delivery (DOTD)	4.34	0.63
9	Satisfaction degree of quality (SDQ)	4.38	0.64
10	Operations cost (OC)	4.32	0.66

Source: Researcher, (2018)

The finding from respondent are (4.03≤ mean ≥4.38) and (0.63 ≤ St.d ≥0.86) it means Materials Requirements Planning variables and just in time variables are best practices for controlling production planning performance for a case company. The respondents agreed to a very great extent that Materials Requirements Planning and just in time coordination is highly control production process and inventory management in the company.

From Table 4.10, the ten variables have appropriately formed a single latent construct in measuring the production performance. For example, a company might give a productivity survey to their employees. High reliability means it measures productivity, while low reliability means it measures something else (or possibly nothing at all). Cronbach's α will be low if data show a multidimensional structure; this then requires factor analysis to determine which variables load highest on certain dimensions. Since Cronbach's α is relatively high. From the respondent questioners Cronbach's α reliability measures for production planning and production control implementation degree are 0.86 and 0.85, respectively. The correlation analysis also demonstrates that all dependent variables within each set are highly correlated. This indicates that the chosen production planning control performance variables are reliable and reasonable.

Table 4.11 correlation value of the production performance strategy or dependent variables

	EPP	*ADF*	*ISCF*	*FPP*	*DAPP*	*ACPP*	*LWR*	*DOTD*	*SDQ*	*OC*
EPP	1									
ADF	0.525	1								
ISCF	0.388	0.510	1							
FPP	0.370	0.670	0.605	1						
DAPP	0.332	0.48	0.592	0.421	1					
ACPP	0.539	0.514	0.461	0.531	0.348	1				
LWR	-0.003	-0.06	0.038	-0.019	0.093	-0.046	1			
DOTD	0.011	0.030	-0.008	-0.065	0.068	0.076	0.211	1		
SDQ	-0.055	0.110	0.265	0.057	0.064	-0.024	0.147	-0.033	1	
OC	0.015	0.172	0.120	0.167	0.177	0.018	0.454	0.278	0.241	1

Table 4.11. Provides additional evidence to show that the variables are measuring the same underlying construct, since the correlations among variables are relatively high, and both variables show a positive relationship on each other. The benefits include lower costs, shorter lead times, better quality, lower transportation cost, eliminating wastages of various kinds such as inventory waste from the Processes and reductions in floor space and finally improve productivity of the company.

Table 4.12. Correlation Value of Independent Variables

	STU R	*SLS*	*QC& TQM*	*JIT P*	*CT&ME*	*PRL*	*5S&IA*	*KS*	*SCHS*	*TPM*
STU R	1									
SLS	0.042	1								
QC&TQM	0.360	0.193	1							
JIT P	0.226	0.243	0.195	1						
CT&ME	0.447	0.232	0.630	0.354	1					
PRL	-0.391	-0.266	-0.248	-0.110	-0.374	1				
5S&IA	-0.154	-0.040	-0.016	0.036	-0.123	0.373	1			
KS	-0.216	0.197	-0.131	-0.255	-0.270	0.364	0.285	1		
SCHS	0.249	-0.072	0.247	0.193	0.237	0.233	0.340	0.132	1	
TPM	0.301	-0.107	0.291	0.166	0.243	0.175	0.168	0.273	0.445	1

From table 4.12. The correlation analysis demonstrates that independent variables within each set are correlated. This indicates that the chosen MRP and JIT variables are reliable and reasonable. The first five variables are the elements of material requirement planning while the next five variables are the elements of Just in Time. While both of them are independent relationship with productivity.

4.6. Regression Analysis

In Previous section data was analyzed using descriptive statistics including mean and standard deviation by use of the relevant computer packages such as Microsoft Office Excel and Statistical Package for Social Sciences (SPSS) program. This was done by tallying up responses, computing percentages of variations as well as describing and interpreting the data in line with the study objectives. The information was displayed by use of bar charts, graphs, pie charts and tables to search for any correlation between the variables.

In this section the respondent data was analyzed by using a multiple regression analysis, so as to integrate the inventory management practices tools of Material Requirement Planning (MRP) and Just in Time (JIT), the output of regression analysis are to show they are a positive relationship of each tools each other and to proof if they affect productivity improvement in manufacturing firm. The researcher applied the statistical package for social sciences (SPSS) to code and evaluate the mean and standard deviation of variables, and compute the measurements of the multiple

regressions equation for the study. The following regression equation used to show the relationship between inventory management practices tools and productivity in a case company.

$$Y = \alpha + \beta X1 + \beta 2X2 + \varepsilon \text{ ……... (37) (Zhixiang \& Jennifer.S, 2008)}$$

Where: Y = Firm's Productivity

Y: intercept, that is, the value of y when x is equal to zero

α = Constant;

β1….β2 = the slope representing degree of change in independent variable by one unit variable

X1 = Materials Requirements Planning practices

X2 = Just-in-Time management practices

ε = Error term

In the multiple regression analysis equation the researcher used the dependent and independent variables, the ten performance measures of production operation performance control (PPC) act as dependent variables, while the degree of Just in Time (JIT) and Material Requirement Planning (MRP) implementation serve as the independent variables, they are listed in table 4.9.

In Previous section the value of mean and standard deviation value of the dependent variables in table 4.10 and independent variables (JIT and MRP) table 4.8, and 4.9 respectively was presented. In addition to the above mean and standard deviation the researcher used regression model, to analyze the relationship between the implementation degree of each MRP, JIT and the combined production performance on productivity of the company. In this section to analyses the impact of each element of MRP and JIT on the production performance control were analyzed by multiple regression models equations.

Table 4.13. Dependent and independent variables

S/N	Dependent variables	Independent Variables	
	Production performance control (PPC) Variables	MRP Implementation degree variables	JIT Implementation degree variables
1	Effectiveness of production planning	Demand forecasting/order management	Set up Reduction
2	Accuracy of demand forecasting	Master production scheduling	Small lot size
3	Information sharing degree of cross-function	Rough-cut capacity planning	Quality circle & TQM
4	Flexibility of production planning	Materials requirement planning	JIT purchasing
5	Data accuracy of production planning	Capacity requirements planning	Cross-training & multifunction employee
6	Accuracy of completing production plan	Shop flow scheduling and control	pull production line
7	level of WIP Reduction	Inventory management	6S' and improvement activities
8	Degree of on-time delivery	Purchasing/supplier management	KANBAN system
9	Satisfaction degree of quality	Equipment maintenance management	Scheduling stability
10	Operations cost	Basic data management.	Total production maintenance

Source: Researcher, (2018)

4.6.1. Regression Analysis of JIT Elements with Production Performance control (PPC)

Multiple regression models equation (37) are used to analyses the impact of each element of JIT on the performance. In the regression models, if the coefficient is positive, the researcher conclude that the higher implementation degree of JIT, the better system has a positive association with the JIT implementing degree. The results are shown at the bottom of Table 4.14.

$$Y_{PPC} = \beta^{JIT} + \sum_{1}^{10} JIT\, X^{JIT} + \varepsilon \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (37)$$

Table 4.14 Regression Analysis of JIT Elements.

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	2.772656792	0.271303939	10.21974	2.41E-16
STU R	0.058557667	0.023875975	2.452577	0.016279
SLS	0.023496224	0.021750705	1.080251	0.283159
QC& TQM	0.010150401	0.025020882	3.203342	0.001927
JIT P	0.040013291	0.023654716	1.691557	0.094482
CT&ME	0.061718322	0.024600289	0.069851	0.944481
PRL	-0.018285454	0.023467704	-0.77918	0.438092
6S&IA	0.028491522	0.024836546	1.147161	0.254611
KS	-0.027620111	0.025082434	1.101173	0.274004
SCHS	-0.009296991	0.026943462	2.189659	0.031356
TPM	0.055072138	0.018477923	2.980429	0.003775

The observed levels of significance at the center of Table 4.14 are all zeros, indicating that each of the multiple linear regression model about PPC, is significant. The regression coefficients demonstrate that the elements of JIT have different degrees of impact on the production performance. For example, activities such as set-up time reduction (0.058), cross-training and multifunction employee (0.06), '6S' and improvement activities (0.028), JIT purchasing (0.040) and TQM (0.080) have significant positive impacts. The exception here is that TPM (0.016)) and small lot sizing (0.02) has a little impact and KANBAN system (-0.027) has a negative relationship with operational performance with regards to PPC; this suggests firm's performance deteriorates when implementing this JIT element. Scheduling stability (-0.009) and the Pull Production Line (-0.018), are not significant. The average implementation degrees of Scheduling stability and the Pull Production Line are much lower than the total average level of implementation degree of the JIT system.

4.6.2. Regression Analysis of MRP Elements with Production Performance control (PPC)

Similar to the testing models for JIT elements in pervious, the regression models analyses the impact of each element of MRP has a positive association with the production performance. The better the performance that is, the production performance of the manufacturing system has a positive association with the MRP implementing degree. Models (38) were used for such test and the results are shown at the bottom of Table 4.15.

$$Y_{PPC} = \beta^{MRP} + \sum_{1}^{10} MRP\, X^{MRP} + \varepsilon \ldots\ldots\ldots\ldots\ldots\ldots (38)$$

Table 4.15 Regression Analysis of MRP Elements with

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	3.288414564	0.32626165	10.07907	4.58E-16
DF/OM	0.037353281	0.031195104	3.197408	0.023456
MPS	0.030212846	0.028629909	2.055291	0.029435
RCP	-0.012305644	0.029588024	-0.04158	0.037857
MRP	0.002492636	0.028141136	4.088576	0.009232
CRP	0.014936076	0.027936633	2.534641	0.029327
SFSC	0.060905157	0.03496833	1.741723	0.085262
IM	0.055003641	0.031016514	1.773366	0.079836
PSM	-0.010401306	0.033905073	-0.30678	0.759781
EMM	-0.009453943	0.032593102	-0.29006	0.772494
BDM	-0.020585992	0.033871196	-0.60777	0.544998

The regression coefficients revealed that demand and order management (0.03), and Capacity Requirement Planning (CRP) (0.0123) had significant positive relationships with PPC. Inventory management (0.055), MRP (0.0024), and Master Production Scheduling (MPS) (0.030), and purchasing management (0.085) modules are a little significant. Basic data management (-0.020), equipment management (-0.009) and Rough Cut Capacity Planning (RCCP) (0.-0123) is an exception that reveals a negative relationship with PPC performance. RCCP is a module not often used by manufacturing company.

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.845450127
R Square	0.714785916
Adjusted R Square	0.708517475
Standard Error	0.086739823
Observations	94

Adjusted R squared is the coefficient of determination which explains the extent to which changes in the dependent variable can be explained by changes in the independent variable or the percentage of variation in the dependent variable. From Table 4.16, the value of Adjusted R Square was 0.708 and indication that there was a variation of 0.708 percent on equitable Firm's Productivity due to changes in the independent variable (Materials Requirements Planning and Just in Time practices).

This shows that 70.8 percent changes in equitable firm's productivity could be accounted to inventory management practices (MRP and JIT). R is the correlation coefficient which shows the relationship between the study variables. From Table 4.16, it is notable that there exists a strong positive relationship between the study variables as shown by the value of 0.845 or 84.5% strong relationship each other.

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	1.715866405	0.857933	114.02929	1.62285E-25
Residual	91	0.68466551	0.007524		
Total	93	2.400531915			

Analysis of Variance (ANOVA) consists of calculations that provide information about levels of variability within a regression model and forms a basis for tests of significance. The "F" column provides a statistic for testing that all $\beta = 0$ against the null hypothesis that $\beta \neq 0$ (Weisberg, 2005). From the findings the significance value (p- value) is .004 which is less than 0.05 thus the model is statistically significance in predicting how Just-in-time and Materials Requirements Planning, practices affect the productivity of manufacturing firms.

The calculated value at 5% level of significance was 3.8442. Since the calculated value is greater than the critical value (3.8442>1.622), this shows that the overall model was significant and that Materials Requirements Planning and Just in time practices all have a positive effect on the firm's productivity.

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	3.270356155	0.235526755	13.88529	3.36698E-14	2.802511189	3.7382011
MRP	0.486898237	0.083507676	3.583058	0.056129674	0.11718792	0.2145676
JIT	0.193390941	0.074802458	2.585355	0.011316996	0.04480504	0.3419768

Where; $P \leq 0.05$

$$Y = \alpha + \beta 1X1 + \beta 2X2 + \varepsilon$$

The coefficient value of α = 3.27, MRP = 0.486 and JIT = 0.19339

$$Y = 3.27 + 0.486X1 + 0.19339X2$$

The findings of multiple regression equation presented also shows that taking all other independent variables at zero; that means a unit increase in Materials Requirements Planning practices will lead to a 0.486 increase in productivity of the case company; and a unit increase in just in Time practices will lead to a 0.1339 increase in productivity of the company. All the variables were significant as their significant value was less than 0.05 (p-value <0.05). The regression equation has established that taking all factors into account (Materials Requirements Planning and Just-in-time) constant at zero, productivity of manufacturing firms will be increased by 3.27 value.

The implementation degree of MRP & JIT significantly affects the performances of production planning control (PPC) with coefficients of 0.486 and 0.1933. The significant with *p*-values less than 0.0001. This suggests that the greater the implementation degree of JIT & MRP system, the better the operational performance. Combined MRP & JIT strategies, JIT effectively becomes the base for implementing MRP (including MRPII or ERP). It lays the foundation to ready the MRP implementation. (Rabinvich & Evers, 2002) Suggests that MRP and JIT are substitutes for each other. A JIT imbedded MRP system is a much more efficient system in manufacturing industry specially for controlling inventory management system.

The effective inventory management has become a critical issue for firms' productivity. Inventory management is essential in the operation of any business that wishes to achieve efficiency in production Relationship between Inventory Management Practices and Productivity of the company. The study revealed that that inventory management practices improvements employee work morale, enhances continuous production and reduces resource wastage, likewise, the respondents agreed that inventory management practices minimizes scrap and rejects. And also the respondents agreed that inventory management practices reduces production costs and reduces delivery lead time. Finally, respondent agreed that inventory management practices prevents shortages and stock out costs and minimizes machine down time.

Chapter Five

Conclusion and Recommendation

This chapter presents the summary of the study findings, conclusion and recommendations drawn from the study findings. The chapter is based on the study objectives, which were to improve productivity through inventory management practices. And to determine the relationship between inventory management practices and productivity in printing industry a case study at Yekatit paper converting plc.

5.1. Conclusion

Inventory management is essential to every manufacturing industry, Companies need to have stock, but in such amount to avoid out-of-stock and overstock situations. Inventory management can improve company's inventory control existing situation and decrease costs of the company. Most Ethiopian manufacturing firms have a long way to go in terms of effective and efficient inventory management. Another challenge faced by manufacturing firms is lack of enough cash to employ in inventory management with well managed database systems. It becomes very expensive for these firms to adopt inventory management practices.

In this paper, the existing inventory management situation and current productivity of case company yekatit paper converting plc. (YPC) is analyzed by using appropriate model of each case, and apply a better management practices to improve productivity of the company and with the aim to decrease company's inventory level and holding costs by avoiding overstocks and improve productivity of the organization. Use of ABC analysis, Just in Time and Material Requirement Planning practices have enabled in printing company to classification of material and estimate how much of an item should be ordered and when it should be ordered. The company orders that optimal quantity for an item of stock that minimizes cost. The study also concluded that manufacturing firm's use Materials Requirement Planning Just in Time has contributed to making available either purchased or company manufacturing assemblies just before they are required by the next stage of production or for delivery. And company is therefore based on planned elimination of all waste and continuous improvement of productivity.

The next step of the present research application of multi linear equation, to prove empirical evidence about the impacts of the implementation degree of inventory management practices (JIT& MRP) on the productivity performance. It can be concluded that the integration of inventory management practices are achieved better results of demand forecasts, safety stock, and west minimization and reorder points. The researcher concluded that the implementation degree of the MRP & JIT system has a positive association with operational performance and effectively applying both technologies will give firms a competitive edge. Based on the study findings, it is concluded that a significant and a positive relationship exists between inventory management practices and productivity of printing industry.

5.2. Recommendation

The study recommends that the organizations adopt the inventory management practices keeping method that best suits their operation. Here, ABC analysis, Material requirement Planning (MRP) and Just-in-time (JIT) method could be considered as an option as it has been proven to be effective in improving current productivity. The study also recommends that the management should constantly expose its staff to training in order to improve their skills on inventory management and enable the employees to understand the current inventory systems which when used will help the organization reduce on costs associated with holding inventory. The reason is obvious as most organizations inventory control programmers failed to achieve the intended objectives due to lack of skilled and trained professionals to manage it. In the present day advancement in technology inventory control management has been made easier with the use of software. In fact, the era of manual control of inventory has phased out. Especially, with increasing volume of inventories in organizations, computer based inventory systems and integration of inventory practices implementation will prove more effective than manual based inventory control system.

Suggestion for Further Studies

Based on the findings, the study suggests that further studies should be conducted on the effects of Inventory Management practices on the productivity improvement in other Ethiopian manufacturing industry and also studies other types of inventory management practices on the effects of productivity.

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Appendix

ADDIS ABABA UNIVERSITY

ADDIS ABABA INSTITUTE OF TECHNOLOGY (AAiT)

School Of Mechanical and Industrial Engineering

Graduate Program in Industrial Engineering

Survey Questionnaire on Yekatit Paper Converting PLC.

I. Part one - General Information

1. Indicate your responsibility in your company

   Operator [ ] Supervisor [ ] Quality control [ ]

   Other: Please specify it----------

2. Your work experience in this company

   Below 1year 1-2 year [ ] 2-5 year [ ]

   5-10 year [ ] more than 10 year [ ]

3. Sex male [ ] female [ ]
4. The major problem of the company

   a. Quality problem b. Customer satisfaction problem c. Raw material shortage problem

   d. Skilled man power problem e. financial problem

5. The major cause of defects or waste of the product

   a. Raw material cause

   b. Machine cause

   c. Human factor or skilled man power cause

6. Production type

   a) Job shop b) Medium size c) Large batch size

7. Production strategy:

   a) Make to Order (MTO) b) Make to Stock (MTS) c) Mix of MTO & MTS

II. Part two

For Managers Use only

This interview is prepared to collect primary data on MRP and JIT's significances and its effect on the inventory management functions of the company. In addition, I would like to express the confidentiality of the information and that is required only for conducting study.

1. What are the impacts of proper management of materials on the company efficiency?

   _____

2. Does the current storage system reduce wastage?

   _____

3. What do you think about Material Requirement Planning (MRP) and Just-in-time (JIT) System?

   _____

4. What are the major opportunities and challenges of the Material Requirement Planning (MRP) and Just-in-time (JIT's) system?

   _____

5. Do you have anything to add about your company inventory management system?

   _____

III. Part three

Measuring the degree of JIT, MRP and PPC Variables

The components and factors of just in time (JIT) are often perceived differently (Fullerton & McWatters, 2001). Based on the literature review, chosen the following ten factors to measure the JIT implementation degree. If your company has implemented JIT system, please indicate the degree of implementation in your company using five scales. 1) Not used, 2) seldom used, 3) sometime, 4) often used, 5) always used. By using the symbol of √ on the box

N.O	Evaluation Questions		Rating					Total
			5	4	3	2	1	
1	Set up Reduction	Frequency						
		Percent						
2	Small lot size	Frequency						
		Percent						
3	Quality circle & TQM	Frequency						
		Percent						
4	JIT purchasing	Frequency						
		Percent						
5	Cross-training & multifunction employee	Frequency						
		Percent						
6	pull production line	Frequency						
		Percent						
7	5S' and improvement activities	Frequency						
		Percent						
8	KANBAN system	Frequency						
		Percent						
9	Scheduling stability	Frequency						
		Percent						
10	Total production maintenance	Frequency						
		Percent						

Modules employed in MRP vary considerably. Based on MRP software functions and literature (Chan & Burns, "Benchmarking maufacturing planning and control(MPC)system an emperical study", 2002; Zhao & Young, 2002). From these literature chose ten variables to measure MRP implementation degree. If your company has implemented MRP system, please indicate the degree of implementation in your company using five scale 1) Not used, 2) seldom used, 3) sometime used, 4) often used, 5) always used. By using the symbol of √ on the box.

N.O	**Evaluation Questions**		**Rating**					**Total**
			5	4	3	2	1	
1	Demand forecasting /order management	Frequency						
		Percent						
2	Master production scheduling	Frequency						
		Percent						
3	Rough cutting capacity planning	Frequency						
		Percent						
4	Material Requirement planning	Frequency						
		Percent						
5	Capacity requirement planning	Frequency						
		Percent						
6	Shop flow schedule & control	Frequency						
		Percent						
7	Inventory management	Frequency						
		Percent						
8	Purchasing supplier management	Frequency						
		Percent						
9	Equipment maintenance management	Frequency						
		Percent						
10	Basic data management	Frequency						
		Percent						

The respondents were asked to indicate to what extent they agreed with the statement in relation to Production performance strategies Practices in the company and they responded to various aspects under the variable on a five-point Likert Scale 1) Not used, 2) seldom used, 3) sometime used, 4) often used, 5) always used.

S/N	Evaluation Questions		Rating					Total
			5	4	3	2	1	
1	Effectiveness of production planning (EPP)	Frequency						
		Percent						
2	Accuracy of demand forecasting (ADF)	Frequency						
		Percent						
3	Information sharing degree of cross-function (ISCF)	Frequency						
		Percent						
4	Flexibility of production planning (FPP)	Frequency						
		Percent						
5	Data accuracy of production planning (DAPP)	Frequency						
		Percent						
6	Accuracy of completing production plan (ACPP)	Frequency						
		Percent						
7	level of WIP Reduction (LWR)	Frequency						
		Percent						
8	Degree of on-time delivery (DOTD)	Frequency						
		Percent						
9	Satisfaction degree of quality (SDQ)	Frequency						
		Percent						
10	Operations cost (OC)	Frequency						
		Percent						