INVESTMENT IN PRODUCTION TECHNOLOGY AND PRODUCTIVITY OF SUGAR MANUFACTURING FACTORIES IN UGANDA

CASE STUDY: LUGAZI SUGAR CORPORATION LTD

ANYIPO SARAH

REG. No. 2012-B022-20057

Date: April, 2015

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Submitted by

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A DISSERTATION SUBMITTED TO THE FACULTY OF BUSINESS ADMINISTRATION AND MANAGEMENT IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE AWARD OF BACHELOR DEGREE OF BUSINESS ADMINISTRATIONAND MANAGEMENT OF UGANDA MARTYRS UNIVERSITY

April, 2015

DEDICATION

I humbly dedicate this noble piece of Work to my Dad, Mum and my brothers for their guidance, financial and parental support through this time of study and in a special way to Okot mike for sponsoring my studies.

ACKNOWLEDGEMENT

I do thank God for his guidance during the process of study and for having enabled me to attain this academic study.

In a special way I thank Mr. Kibrai Moses my supervisor and lecturer for the academic and personal guidance, valuable time, rendered to me during the research period however busy he was.

I also thank the management and employees of Lugazi Sugar Corporation for the time they sacrificed to answer my questionnaires.

I further thank my friends; Modi Samuel, Okullo Denis, Owilli Deo, Okullo Clement Ogwang, Ayot Melinda, Ssebunya Mike and Mukasa Joachim for all the academic support rendered to me especially during the time for research.

God Bless you all!

ABBREVIATIONS

CBS	Central Bureau of Statistics
GDP	Gross Domestic Product
ISO	International Labor Organization
ISO	International Standard Organization
S TS	Science and Technology Studies
SPSS	Statistical Package for Social Scientists
U.S	United States
UMU	Uganda Martyrs University

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ABSTRACT

This study examined the relationship between investment in technology and the productivity of manufacturing firms in Uganda.
The dimensions of the independent variable include; production processes, production chemicals and production machinery whereas the dependent variables are; output, quality and lead time.

The study had three objectives;

To examine the relationship between production processes and sugar productivity of a sugar manufacturing industry, to assess the relationship between production chemicals and sugar productivity of a sugar manufacturing industry and to evaluate the relation between production machinery and sugar productivity of a sugar manufacturing industry.

The study used a case study research design and also adopted a quantitative approach for the sample size for the study was determined by the Krejcie and Morgan (1970) table which obtained a sample size 52 respondents and closed ended questionnaires were used to collect data.

The study findings revealed that; all sugar processes impact on the productivity of sugar, consistent application of production chemicals enhances quality sugar production, and that application of new technology for evaporation intended to improve the capacity of energy saving improves on productivity.

It can be concluded from the findings that there is a positive relationship between investment in production technology and the productivity of sugar manufacturing factories.

The researcher recommends that the organization should be dynamic in its process to adapt to changes in technology.

CHAPTER ONE

GENERAL INTRODUCTION

1.0 Introduction

This study was be made to assess the investment in technology and the productivity of sugar manufacturing industries in Uganda with the case study being Lugazi sugar corporation ltd. Uganda has been experiencing large swings in technology in the past decades just like in Indian manufacturing firms, this therefore has provided study grounds on Investment in Technology and productivity of manufacturing industries in Uganda with the focus in Lugazi sugar corporation Ltd.

Fermndes and Pakes (2008) as cited in Abhay (2010), productivity has been affected by the problem of slow-down even in the Indian manufacturing firms in 1990s.In Lehman and koelling (2004), productivity has been understood in reference to efficiency, effectiveness, labor and performance in the field of service research. During the last decade, the significance of manufacturing industries to the prosperity of modern economies has been widely recognized (Vuorinen et al, 1998). Productivity, although critical for the sustained success of manufacturing organizations, has received relatively little manufacturing specific attention as different from the more general occurrence of productivity as the input to output relation (Johnston & Jones, 2004). Generally, the productivity of a process is related to how effectively input resources are changed into value for customers. Productivity isn't everything, but in the long run it is almost everything, because the country's ability to improve its standard of living over time depends almost entirely on its ability to raise its output per worker now compared with the problem of slow productivity growth making all the other long-term economic concerns like foreign competition, the industrial

base, lagging technology and failing infrastructure, minor issues. Or more accurately, they matter only to the extent that they have an impact on the productivity growth (Cole et al, 2005, Gregorio, 2006 Szirmai, 2008).

This study was devoted to taking steps toward closing three significant gaps in the literature on productivity, in terms of output, quality, and lead time and its contribution to manufacturing research.

Many theories of technology like the critical theories state that, investment in technology has a positive impact on the productivity in any organization or firm (Lehman and Koelling,) and that, technology is the systems of knowhow, methods and capital equipment that are used in production of economic output. Technology differs from science in that science is an understanding of natural principles. Technology does not necessarily imply knowledge of why a process works, but what works and sometimes, what does not. Explanations of why processes worked the way they did was an important contributor to the development of science. For example, some principles of chemistry were noticed from smelting and assaying of metals and ores. Productivity improving technologies are those technologies that lower the traditional factors of production of land, labor capital, materials and energy, which go into the production of economic output. Increases in productivity are responsible for the increase in per capita living standards (Ahmadabad, 2009).Therefore; the addition of these two variables (technology and productivity) would provide the insight into Uganda's manufacturing firms.

1.1 Background to the study

Brynjolfsson and Yang (1996) state that, one of the core puzzles in economics is the productivity slowdown that began in the early 1970s. They point out that, labor productivity growth dropped from about 2.5% per year for 1953-1968 to about 0.7% per year for 1973-1979. They insist that, multi-factor productivity growth, which takes into account changes in capital, declined from 1.75% a year to 0.32% in agreement with (Baily, 1986). They also point out that the sharp drop in productivity roughly coincided with the rapid increase in the investment in technology.

Jorgenson and Stiroh's (1995) cited by (Brynjolfsson and Young, 1996), confirm this trend. This shows that average multifactor productivity growth dropped from 1.7% per year for 1947-73 periods to about 0.5% for the 1973-1992 periods. At the same time, the gradual increase in productivity at the time when investment in technology was on going.

Although productivity growth, there is a rebound especially in manufacturing sector somewhat. Recently, the overall negative correlation between economy-wide productivity and the investment in technology drives many arguments proposing that technology has not helped world especially the U.S. productivity or even that technology investments have been counter-productive (Baily, 1986).

This link was made more explicit by (Roach's 1987, 1988) research focusing specifically on information workers, regardless of industry. Brynjolfsson and Young (1996) have in essence isolated America's productivity shortfall and shown it to be concentrated in that portion of the economy that is the largest employer of white-collar workers and the most heavily gifted with high-tech capital."

Roach's productivity analysis approach provides quantitative support for widespread reports of low office productivity.

On the other hand, Productivity is said to have been impacted on positively through the training of workers, automation of processes, upgrades in existing technology, infrastructure, hardware, software, firm's structure and strategies employed in carrying out businesses in especially in the service industries (Brynjolfsson, 1993).Brynjolfsson and Young (1996) continued to say that, both academics and the business press have periodically revisited the so called "productivity paradox" of technology and that, the U.S economy has increased by more than two orders of size in the past two decades. Though productivity, especially in manufacturing sector, seems to have stagnated despite the enormous promise of technology to effect "the biggest technological revolution men have known" (Snow, 1966).

Disappointment and even frustration with the technology are evident in statements like "No, technology do not boost productivity, at least not most of the time" (Economist, 1990) and headlines like "Computer Data Overload Limits Productivity Gains" (Zachary, 1991).Productivity inconsistency, as it has become known, has created a significant amount of research although researchers analyzed statistics extensively, they found little evidence that production technology significantly increased productivity in the 1970s and 1980s (Yang, 1991). These studies have fueled a hot debate, primarily because they have failed to document large productivity improvements attributable to technology investments.

Researchers such as (Brynjolfsson and Hitt, 1993, 1995), and (Lichtenberg, 1995), found firm-level evidence that, technology investments earned substantial returns, though the media pendulum has swung in the opposite direction.

While one study shows a negative correlation between total factor productivity and high share of high-technology capital formation during 1968-1986 periods (Berndt and Morrison, 1995), another study suggests that technology capital contributes to growth more than ordinary capital

during the similar period (Jorgenson and Stiroh's, 1995).Due to lack of consistency on various studies on productivity , (Brynjolfsson and Young, 1996) in their study measured the productivity growth by using of index number approach which does not require direct estimating of the underlying technology and therefore of not requiring econometric specification and estimation of technology. Hitt and Brynjolfsson (1994), report positive effects of technology based on product consistency and consumer surplus measures while (Landauer, 1995) on the other hand disagrees. At this stage, the academic research results are inconsistent on a number of dimensions, including measures of performance, methodologies, and data sources.

Technology according to (Short, 1976) has gone through a lot of changes right from the time of industrial Revolution where new manufacturing processes in the period from about 1760,1820 and 1840 were innovated. This transition in technology included going from hand production methods to machines, new chemical manufacturing and iron production processes, improved efficiency of water power (Roderick, 2005), leading to improved ways of living**.** Therefore it's clear that investing in specifically the technology of a sugar manufacturing has a relationship with the sugar productivity of a firm which this study intends to find out while focusing on Lugazi sugar corporation Ltd.

1.2 Statement of the problem

Brynjolfsson and Hitt (2009) state that, the employment of advancing technology like the modern sugar production processes, sugar production chemicals and sugar production machinery have the positive effect on the productivity like in output, quality and lead time of the sugar factory. Its explained by many researches that investing in the technology is aimed at increasing productivity, however, this statement remains generic due to the fact that the factories employee

new technologies in different dimensions in respective manufacturing industries. Therefore this study focused in investigating if investment in technology explains the productivity in sugar processing industries in Uganda with Lugazi being the case study.

1.3 Broad objectives of the study

To investigate the relationship between investing in production technology and productivity of sugar manufacturing industries in Uganda.

1.4 Specific objectives

i) To examine the relationship between production process and sugar productivity of sugar manufacturing industry.

ii) To assess the relationship between production chemicals and sugar productivity of manufacturing industry.

iii) To evaluate the relationship between sugar production machinery and the productivity of sugar manufacturing industry.

1.5 Research questions;

i) What is the impact of production processes on the sugar productivity of sugar manufacturing industries?

ii) How do production chemicals affect the sugar productivity of Lugazi sugar manufacturing industries?

iii) Is there relationship between the production machineries with the sugar productivity of sugar factories?

1.6 Research hypothesis

There is a relationship between investment in technology and sugar productivity in sugar manufacturing industries.

1.7 Study scope

The study was intended to get the information that relates with technologies effect on the productivity of Lugazi sugar Corporation.

1.8 The content scope of the study

The study was intended to investigate the relationship between investing in production technology and productivity of sugar manufacturing industries in Uganda and the case study will be Lugazi Sugar Corporation.

1.9 Geographical scope of the study

The study was carried out in Lugazi sugar Corporation Limited (SCOUL) in Buikwe along Jinja-Kampala road. It's surrounded by a number of schools, hospitals, good infrastructure the climate is favorable for sugar plantation this is so because of being near the Owen falls dam and the fresh air from the Mabira forest. The Company's complex at Lugazi, spread across nearly 10,000 hectares, is one of the "pride and joy" projects of East Africa. A totally integrated unit that grows sugarcane, manufactures white sugar, and converts the molasses byproduct into industrial alcohol. The corporation owns and operates the only distillery in Uganda the corporation gainfully employs more than 7300 people directly and is amongst the largest employers in East Africa.

1.10 Time scope

The study covered the period of five years that is to say from 2011-2015. This Period allowed the researcher to find out enough information on the effects of technology to the productivity of Lugazi sugar Corporation, as technology tends to evolve at almost after every end of five years.

1.11 Justification of the study

With sugar being one of the necessities for living, there was need to carry out this research because it would help the management to know the forms of technology necessary for increased productivity that can sustain the demand of 550 billion people hence sustaining the standards of living of the local people and the world as a whole. Also it was necessary so as to sustain employment opportunities of the people (Olego, 2014) **.**For economic and environmental reason, there was constant need for re-construction of sugar factories. The dominant trend is to increase the production rate and take advantage of advances in sugar technology and environmental protection technology.

In the daily monitor of 2013, there is high demand of Lugazi sugar compared to the other sugar producers. This therefore calls upon response to the public demand so as to stabilize the economy.

1.12 Significance of the study

There was need to carry out this study because it would help the management of the factory to be able to design and adjust the existing policies so as to achieve the prior set objectives in the most simplified way. The researcher will also benefit from this study after its completion hence leading to her award of the bachelor's degree in business administration and management.

The gaps that shall be found in the study can be used for future researchers.

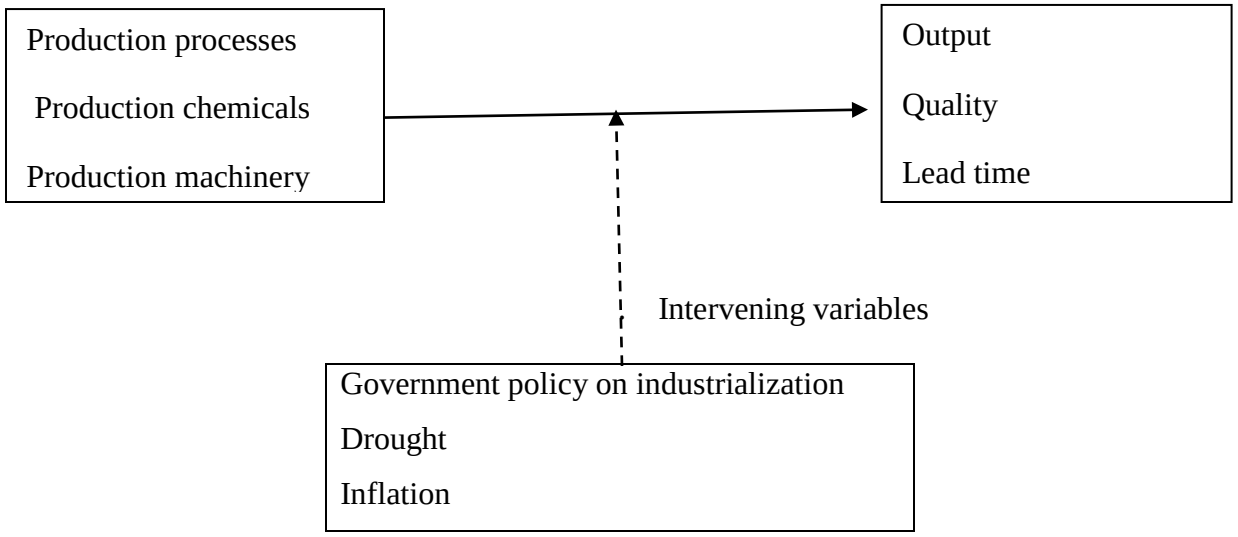
1.14 Conceptual framework

Miles and Hurberman (1994) as cited by (Vaughan, 2008) define conceptual framework as a visual or written products, which explains either graphically or in a narrative form, the main things to be studied- the key factors, concepts or variables- and the presumed relationship among them. Technology involves the dimensions of the society which include; cultural cap italic refers to elements like knowledge or taste as a form of wealth often to distinguish oneself from others and gain access to elite circles and opportunities.

Sub culture system of norms materials artifact and other cultural elements shared by the minority of persons and society making them distinguishable from others, material culture and physical artifacts for example weapons tools adornments and building including ways they are produced by d society. The study by (Atim, 2009**)** revealed that the use of technology dimensions like infrastructure, training and knowledge usage level has positive impact on the productivity of the producing factory.

Independent variable **dependent variable**

Investing in technology **productivity of manufacturing firms**



Source: developed from the review of literature (Roderick, 2003).

The frame work illustrated that technology doesn't rely on productivity but instead it influences the productivity of the sugar factory like Lugazi if subjected to variable and its dimensions the frame is trying to illustrate the impact of each variable of technology to the productivity in case of subjection to different dimensions, in the same way, productivity shall be impacted on when its exposed to the intervening variables in that they always will be a stumbling block to its success at the expected time.

1.15 Definition of operational terms and concepts

Technology

This is the application of scientific knowledge for practical purposes, especially in a factory. It can also be referred to as the advances in computer technology. Machinery and equipment developed from the application of scientific knowledge. It's also looked at as the branch of knowledge dealing with engineering or applied sciences.

Production processes

Mechanical or chemical steps used to create an object, usually repeated to create multiple units of the same item. They generally involve the use of raw materials, machinery and man power to create a product (Schulumberger, 2014). These are stages involved in sugar production.

Production chemicals

These are the solutions for all of the countless problems hindering maximum production, processing and transporting of manufactured products. They protect the asset integrity, efficiency, hence increasing production and product quality. Chemicals keep maximum production flowing through pipelines through suppression of confusion at the pipe wall boundary. These are substances or solutions that are used so as get quality sugar out of the production processes**.** Chemicals are solid foundation for solving the problems in the most complex environments, including the ultra-deepwater.

Production machinery

The raw materials and means of labor like, tools, machines, equipment.

Collections of machines, tools and equipment used in the factory to processes sugar cane to produce raw or white sugar turn the liquid form of a chemical into gaseous form by evaporation and drying sugar after evaporation has taken place (Morrison and Berndt, 1991).

Productivity

May be defined in terms of overall recovery or in terms of maintenance of throughput under adverse conditions, always taking into account the cost factors (Paul, 2006) and (Jeff, 2008).

Output

It's the amount of something produced by a person, machine, or industry.

Output in economics is the "quantity of goods or services produced in the given time period, by a firm, industry, or country." This is the end product obtained from a production process (Jashap, 2006). Economic output is one of the most important measures of the country. It's the total value overall goods and services produced in an economy it's a regular tool used in macroeconomic analysis to determine whether an economy is growing or contracting by comparing different points in time. Output is also used to compare the relative output between different countries.

The gross domestic product (GDP) is the primary measure used to measure national economic output. According to U.S. Department of Commerce Bureau of Economic Analysis, GDP are the final good and services produced by labor and property located (Shawn, 2014)

Quality

In manufacturing, it's a measure of excellence or a state of being free from effects, deficiencies and significant variations. It's brought about by strict and consistent commitment to certain

standards that achieve uniformity of a product in order to satisfy specific customer or user requirements. Isobeth (1986) defines quality as "the totality of features and characteristics of the product or service that bears its ability to satisfy the stated or implied needs" (Dulberger, Ellen1987). Having the required attributes to perform the designated use (Wajcman, 1985), structure and systems. Quality needs to managed totally so as to transcend the product quality and the approach to do this involves everyone in the organization and encompasses its every function like administration, communications distribution, manufacturing, marketing planning and training.

For the firm to realize quality there is also a need to involve the highest –level of executives in setting quality goals and policies, allocation of resources and monitoring of results.

Changing needs of both internal and external and stakeholders should be understood and satisfied in the cost effective manner. Quality comes about when leadership is instituted in place of mere supervision so that every individual performs in the best possible manner to improve quality and productivity hence continually reducing total costs.

Barriers between people should be eliminated so as to as to encourage team work hence achieving objectives. Quality can holistically be looked at as a long term aspect that views at continuous improvements in all organizational aspects as process and not as short term goal.

It aims at to radically transform the organization through progressive changes in the attitude practices (Young, 1990).

Lead- time

It's the time between the initiation and completion of a production process. It's the amount of time that elapses between when the process starts and when it's completed.

It’s examined closely in manufacturing, supply chain management and project management as companies want to reduce the amount of time it takes to deliver products into the market

In business lead-time is normally preferred. It’s broken into several components of; preprocessing, processing and post processing. Pre-processing involves determining resource requirement, and initiating the steps required to fill an order. Processing involves the actual manufacturing or creation of an order. Post processing involves delivery of goods to the market .Companies always look at each component and compare it against bench marks to determine where slowdowns are occurring. The period between placing an order and delivering the product (Makenzie, 1985)

Government policy on industrialization this is a guideline set by the government regarding the operations of an industry.

Drought

An insidious hazards of nature, it’s often referred to as a “creeping phenomenon/’ and its impacts vary from region to region. Drought can therefore be difficult to define, because what may be considered a drought in one region may be confirmed in another region.

Generally drought originates from a deficiency to precipitation over an extended period of time usually a season or more resulting to water shortage for some activity or group or environment sector. It’s the prolonged period of dryness in a given area.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

Mackenzie (1985) states that, the potential for productivity improvement in the cane sugar industry by application of new technology is very important. And that, the short-term benefits are gained primarily by application of Knowledge based technologies for design and process optimization rather than by introduction of new processes and these benefits are applicable throughout the industry. Productivity improvements with these technologies will be critically impacted by their efficient integration into the whole factory process, though the sugar industry has been inclined to think of its technology as distinct and special and to develop in isolation. Productivity may be defined in terms of overall recovery or in terms of maintenance of throughput under adverse conditions; by not forgetting to take into account the cost factors (Paul, 1992). Productivity increases will be achieved by utilizing the developments that are taking place in other major processing industries, especially the chemical processing industries.

Technology is the application of scientific knowledge for practical purposes, especially in an industry or it can be the advances in computer technology Machinery and equipment developed from the application of scientific knowledge; it's the branch of knowledge dealing with engineering or applied sciences (Curley and Pybum 1992**).** Technology according to (Siegel and Grillches et al,, 1994) is an aspect of employing mechanical tools of production and operations management which help in the improvement of performance in the sugar manufacturing industry.

Technology according to (Curley and Pybum, 1999) is a social process of for providing access to and support for technology equipment like processing machines to be used in diverse activities such as manufacturing and processing in the industry. There are a number of theories attempting to address technology relationship with productivity which tend to be associated with the disciplines of science and technology studies (STS) and communication studies. Most generally, the theories attempt to address the connection between technology and society and on time questions about group, determinism which can be and categorized as social and group theories (descriptive and critical theories).

Descriptive theories of technology attempt to address the definition and matter of technology, the ways it has emerged, changed and its relation to the human - community. More substantively it addresses the extent of which technology is independent and how much force it has in determining human-social structure (Wajcman, Morrison et al, 1983, 1995).

Technology according to Mackenzie (1984) is not the determinant of human action, but that human action shapes technology. Technological objects are culturally constructed and interpreted by this it's meant not only that there is flexibility in how people think of or interpret objects but also that there is flexibility in how objects are designed. Wider context, technology deals with the socio cultural and political situation of social groups, shapes, its norms and values, which in turn influence the meaning given to an artifact (Mackenzie and Wajcman, 1985) and (Paul, 1992).

Latour (1992) and (Callon, 1999) argue that technology is made by humans, a replacement for the actions of humans, and shapes human action. The chain and gradient of actors' actions and

competences, and the degree to which humans choose to have figurative representations is most important.

Structuration theory of technology states that, technology is not made as an object, but instead examines how people, as they interact with a technology in their ongoing practices, pass structures which shape their growing and located use of that technology (Berman, 1994) .

In Systems theory of technology the historical development of technology and media with an emphasis on inertia and heterogeneity is considered while stressing the connections between the object being built and the social, economic, political and cultural factors surrounding it. With the concepts that, reverse relevant elements of a system lag in development with respect to others, in differentiation, operational closure and autopoietic autonomy (Hughes, 1992 and Luhmann, 2000). Technology regarding values in design stresses that, technology is all about how we ensure a place for values in hand with technical standards such as speed, efficiency, and reliability as criteria by which humans judge the quality and acceptability of information systems including how values such as privacy, independence, democracy, and social justice become integral to conception, design, and development, not merely retrofitted after completion (Nissenbaum, 2001).

Gordon, (1988) considers technology as text in order to assess the sociology of scientific knowledge as applied to technology and to distinguish between three responses to that idea of instrumental response (interpretive flexibility), the interpretative response (environmental/organizational influences), and the reflexive response. (Pfaffenberger, 1992) treats technology as drama to argue that a recursive structuring of technological objects and their social structure indirectly regulate the technological construction of political power.

A technological drama is a talk of technological "statements" and "counterstatements" within the processes of technological regularization, changes, and reconstitution.

An important philosophical approach to technology has been taken by Stiegler whose work has been influenced by other philosophers and historians of technology including Gilbert Simon don and André Leroi-Gourhan. In the Schumpeterian and Neo-Schumpeterian theories technologies are critical factors of economic growth Baily et al, 1988). Propose a general technology theory consisting of the causal structures of agency (technological, organizational, imperative, emergent), its structure (variance, process), and the level (micro, macro) of analysis. While (Allen and Thomas, 1992) notes that previous conceptualizations of technology typically differ over scope and sought to know,

i) Whether technology is more than hardware and role?
ii) Whether technology is an external objective force, the interpreted human action, or an impact moderated by humans?

These questions prompted him to identify three models;

i) Technological imperative which focuses on organizational characteristics which can be measured and which permits some level of emergency.
ii) Strategic choice which looks at on technology is influenced by the context and strategies of decision-makers and users.
iii) Technology as a trigger of structural change viewing technology as a social object.

DeSanctis and Poole, (1994) similarly write of three views of technology's effects:

i) Decision-making, the view of engineers associated with positivist, rational, systems rationalization, and deterministic approaches.
ii) Institutional school: technology is an opportunity for change, focuses on social evolution, social construction of meaning, interaction and historical processes, interpretive flexibility, and interplay between technology and power.
iii) An integrated perspective (social technology): soft-line determinism, with joint social and technological optimization, structural symbolic interaction theory.

Bimber (1998) distinguishes between the Normative (an independent approach where technology is an important influence on history only where societies attached cultural and political meaning to it e.g., the industrialization of society), and Nomo logical (a naturalistic approach wherein an inevitable technological order arises based on laws of nature e.g., steam mill had to follow the hand mill), so as to address technology effects. In Barlaks (1980), states that technology has Unintended consequences, that technology is subject (for instance, a car is faster than a horse, but unknown to its original creators that it can become a major source of pollution.

2.1 Production processes

Mechanical or chemical steps used to create an object, usually repeated to create multiple units of the same item. They generally involve the use of raw materials, machinery and man power to create a product (Schulumberger, 2014).These are stages involved in sugar production.

2.2 Production chemicals

These are the solutions for all of the countless problems hindering maximum production, processing and transporting of manufactured products. They protect the asset integrity, efficiency, and hence increasing production and product quality. Chemicals keep maximum production flowing through pipelines through suppression of confusion at the pipe wall boundary. These are substances or solutions that are used so as to get quality sugar out of the production processes**.** Chemicals are solid foundation for solving the problems in the most complex environments, including the ultra-deepwater (Sahayog, 2014).

2.3 Production machineries

These are raw materials and means of labor which include tools, machinery and equipment.

Collections of machines, tools and equipment used in the factory to processes sugar cane to produce raw or white sugar turn the liquid form of a chemical into gaseous form by evaporation and drying sugar after evaporation has taken place. Generally workers do not work in isolation, but as teamwork and it is a key part in any business. All workers have dependencies on the outputs of other employees in order to get their own work done and it is only achieved by efficiently establishing day-to-day operational processes and programs (Fuedenberg and Tirole, 1985).

2.4 Productivity

Generally, productivity is looked as ability to conduct business operations more efficiently in terms of using as little resources as needed, and effectively in terms of meeting customer requirements (Markland et al, 1995).

It is concerned with managing the process that converts inputs (in the forms of materials, labor and energy) into outputs (in the form of goods and services). Productivity is the most common measure of competitiveness (Russell and Taylor, 2000). Productivity is therefore defined as the ratio of what is produced by an operation to what is required to produce it (Slack et al, 2007). The predominant input in productivity calculation is labor hours. According to the Bureau of Labor Statistics, even though labor is the only factor of production clearly considered, comparisons of productivity over time totally reflect the joint effects of many other factors, including technology, capital invest capacity utilization, energy use and managerial skills. Thus, productivity statistics provided in government reports typically measure changes in productivity from month to month, quarter to quarter, year to year or over a certain period (Russell and Taylor, 2000). Operations management assumes that improving quality by reducing defects will increase outputs and reduce input. In fact, virtually all aspects of quality improvement have a favorable impact on different measures of productivity.

Improving product design and production process, improving the quality of materials and parts, improving job design and work activity, they will all increase productivity (Russell and Taylor, 2000). The difficulty in this context is the general approach towards productivity as an umbrella concept including efficiency and effectiveness. Productivity concerns the relationship between outputs and inputs (Vuorinen et al. 1998). Technical efficiency may be considered synonymous with productivity as a ratio between outputs and in-put, although efficiency has sometimes been defined as the inverse to productivity. When efficiency is defined in value terms, one tries to make friendly the effects of various inputs and output factors in the production process (Grönross and Ojasalo, 2004). This interpretation has led to formulations in which efficiency is seen as

costs per product. Technical efficiency and productivity may be defined as distinct concepts by taking the standard of comparison as a frame of reference:

In the case of a productivity ratio, the aim is to compare the output-input ratios across units and time, whereas in the case of an efficiency ratio, the comparison is made against a predetermined standard or ideal. If a meaningful interpretation can be given to ideal performance, it is reasonable to perceive an efficiency ratio as an indicator of the extent to which actual performance has achieved the ideal level (overall efficiency) or the best observed performance (Frei and Harker, 1999). According to the basic principle of economic rationality, the purpose is to achieve a given result with minimal resources or to get the maximum result with a given set of resources. However, given the variety of definitions that describe performance in the production of services, it's assumed that comprehensive understanding is needed. Given the importance of the productivity concept to scholars and service organizations, there is a need to summarize present knowledge about this concept as the foundation for setting the stage for further advances therefore, Productivity is the ratio of inputs and outputs (Williamson, 2006).

Productivity may be defined in terms of overall recovery or in terms of maintenance of output under adverse conditions; always taking into account the cost factors (Paul, 2006). Productivity is an average measure of efficiency of production which can be expressed as the ratio of outputs to inputs used in the production process (Grant, 1990).Productivity is the measure of efficiency of a person machine factory system in converting inputs into useful output (Stigler, 1978).productivity is about the effective and efficient use of all resources including people, time knowledge, finance, equipment space and energy (Scot, 1991).

Productivity is the fundamental measure of a technology's contribution. While major success stories exist, so do equally impressive failures (Kemerer and Sosa, 1991) and (Schneider, 1987).

In productivity calculations, output is defined as the number of units produced times their unit value, substituted by their real price (Love man, 1994).

Productivity is commonly defined as a ratio of a volume measure of output to a measure of input use. Among other productivity measures such as multi-factor productivity or capital productivity, labor productivity is particularly important in the economic and statistical analysis of a country. Labor productivity is a revealing indicator of several economic indicators as it offers a dynamic measure of economic growth, competitiveness, and living standards within an economy. It is the measure of labor productivity (and all that this measure takes into account) which helps explain the principal economic foundations that are necessary for both economic growth and social development (Diewert and Smith 1994).

Although the ratio used to calculate labor productivity provides a measure of the efficiency with which inputs are used in an economy to produce the output (goods and services), it can be measured in various ways. Labor productivity is equal to the ratio between a volume measure of output (gross domestic product or gross value added) and a measure of input use (the total number of hours worked or total employment). Productivity is volume measure of output / measure of input use (Freemen, 2008) cited in (Diewert and smith, 1994).

2.5 Output

It's the amount of something produced by a person, machine, or industry. Output in economics is the quantity of goods or services produced in the given time period, by a firm, industry, or country (Kemerer and Sosa 1991). It's the total value overall goods and services produced in an economy, it's a regular tool used in macroeconomic analysis to determine whether an economy

is growing or contracting by comparing different points in time. Output is also used to compare the relative output between different countries.

The gross domestic product (GDP) is the primary measure used to measure national economic output. According to U.S. Department of Commerce Bureau of Economic Analysis, GDP are the final good and services produced by labor and property (Shawn, 2014).

The measure of input usage reflects the time, effort and skills of the workforce. Denominator of the ratio of labor productivity, the input measure is the most important factor that influences the measure of labor productivity. (Freeman, 2008).Labour input is measured either by the total number of hours worked of all persons employed. There are both advantages and disadvantages associated with the different input measures that are used in the calculation of labor productivity. It is generally accepted that the total number of hours worked is the most appropriate measure of labor input because a simple headcount of employed persons can hide changes in average hours worked, caused by the evolution of part-time work or the effect of variations in overtime, absence from work or shifts in normal hours. However, the quality of hours-worked estimates is not always clear. In particular, statistical establishment and household surveys are difficult to use because of their varying quality of hours-worked estimates and their varying degree of international comparability (Denison and Edward, 1989).

Dunne (2011) argues that, gaining productivity improvements in the workplace requires analyzing the gaps in employee know how and knowledge and quality, the employees' maximum level of usage, the kind of environment that works better and the use of correct rewards to motivate staff. He continues to say that, Strategy and productivity improvements can only improve when done in a more concentrated manner, which involves the study of several areas and the use of many techniques.

2.5 Quality

In manufacturing, it's a measure of excellence or a state of being free from effects, deficiencies and significant variations. It's brought about by strict and consistent commitment to certain standards that achieve uniformity of a product in order to satisfy specific customer's needs.

(ISO, 1986), defines quality as the totality of features and characteristics of the product or service that bears its ability to satisfy the stated or implied needs having the required attributes to perform the designated use (Wajcman, 1985), structure and systems.

Quality needs to be managed totally so as to go beyond the product quality and the approach to do this involves everyone in the organization and encompasses its every function like administration, communications distribution, manufacturing, marketing planning and training(Dulberger and Ellen 1987).

For the firm to realize quality there is also a need to involve the highest level of executives in setting quality goals and policies, allocation of resources and monitoring of results. (Dunne, Abhay, 2006, 2011).

According to (Fermndes and Pakas, 2008) maximum quality is by changing needs of both internal and external needs of the stakeholders should be understood and satisfied in the cost effective manner. Quality comes about when leadership is put in place to carry out supervision so that every individual performs in the best possible manner to improve quality and productivity. They also state that barriers between people should be eliminated so as to encourage team work.

Holistically quality is a long term aspect that views at continuous improvements in all organizational aspects as process and not as short term goal (Russell and Taylor 2000) state that the actual work place environment one works in plays a big part on how one feels about the daily tasks.

Dunne (2011) also states that, the more effective training of employees receive the better and more productively she can work and that gaps in employees knowledge of the products and equipment being used at the firm should be filled so as to avoid affecting the quality of products with knowledge variation. He stresses that, the key is to provide training or mentoring processes to help accelerate the employees' knowledge right from the start. As profitable business ideas go, investing in staff knowhow is something that can really pay off. According to him, establishing a new joiner program which trains employees with regard to the processes being used in-house as well as specific products, tools, well-defined product roadmaps and services with high quality.

2.6 Lead-time

It's the time between the initiation and completion of a production process. It's the amount of time that elapses between when the process starts and when it's completed. It's examined closely in manufacturing, supply chain management and project management as companies want to reduce the amount of time it takes to deliver products into the market in business lead-time is normally preferred. It's broken into several components of; preprocessing, processing and post processing. Preprocessing involves determining resource requirement, and initiating the steps required to fill an order. Processing involves the actual manufacturing or creation of an order.

Post processing involves delivery of goods to the market (Davenport and Thomas, 1993).

It refers to the period between placing an order and delivering the product (Mackenzie, 1985).

It is the time between order placement and delivery to be increase on productivity in any organization, the workers should be ready to work willingly at any time so as to beat the deadlines this creates repeat customers because the firms appears to be more efficient, and reliable. Therefore, firms need to motivate well their employees so as to make them feel more

dedication, loyalty and desirous to work. The basic rewards that provide the sort of motivation involve wages and bonuses.

(Brynjolfsson and Young, 1996) states that including work-life balance incentives such as flexible work hours and rewarding performance with extra vacation time, making employees feel like they have a greater involvement/responsibility in their work, allowing involvement in planning and decision-making as well as providing two-way communication channels up the chain of command and also providing a way for employees to broaden their skill set so that they cannot be restricted in one specific skill influences workers to perform Similarly keeping job performance standards and bonus reviews as objective and transparent as possible helps in performance of workers.

2.7 Impacts of sugar production processes on the productivity of Sugar Corporation

Short (1976), states that as technology has its processes its necessary for manufacturing firms to have the production processes such as; sugar cane pressing, juice boiling, crystals spinning, raw sugar shipping and filtration to remove color to enhance higher output.

Palm (2010), states that, step by step refining of sugar cane for processing increases productivity but its best when done in one continuous process without the raw sugar stage. The sugar beets are washed, sliced and soaked in hot water to separate the sugar containing juice from the beet fiber. The sugar-laden juice is then purified, filtered, concentrated and dried in a series of steps similar to cane sugar processing.

2.7.1 Production process

According to (Florida et al, 1985), Sugarcane once harvested cannot be over stored because of sucrose rotting. For this reason, cane sugar is generally produced in two stages, manufacture of raw sugar taking place in the cane-growing areas and refining into food products occurring in the sugar-consuming countries. Sugar beets, on the other hand, can be stored and are therefore generally processed in one stage into white sugar.

2.7.2 Harvesting process

Sugarcane is generally harvested in the cooler months of the year, although it is harvested year-round in Cuba, the Philippines, Colombia, and other prime areas. As much as two-thirds of the world's cane crop is harvested by hand, using long machetes. Since the 1940s, however, mechanical harvesting has increased. Before or after harvest, the cane is burned in order to drive out rodents and snakes and to burn off leaves and trash that dull knife blades, but environmental considerations are leading to the harvesting of whole unburned cane in several areas (Florida et al, 1985).

2.7.3 Transportation process

In order to achieve a higher output, harvested cane should be transported to the factory by many means, ranging from manual haulage to oxcarts, trucks, railway cars, or barges. The usual economic distance between field and factory is 25 kilometers (15 miles). This minimizes the time between cutting and processing resulting to the reduction of the amount of cane deterioration (Clarke, 1985).

2.7.4 Weighing and analysis process

The output from cane is directly realized at the time cane is weighed and sampled for analysis Cane is stored in smaller amounts and for shorter a time as possible in the mill yard. Factories run around the clock, stopping in some areas for only one or two days per month for cleaning. Although payment is usually based on weight and sucrose content, quality factors such as moisture, trash, and fiber content also are included. Payment is generally split, with 60 %- 65% going to the grower and 35% - 40 % going to the processor. Sugarcane processing processes are practiced in many variations, but the essential process consists of the following steps (Margret, 2010).

2.7.5 Juice extraction process

After weighing, the loading of sugar cane by hand or crane onto a moving table wastes time. The table carries the cane into one or two sets of revolving knives, which chop the cane into chips in order to expose the tissue and open the cell structure, thus readying the material for efficient extraction of the juice. Frequently, knives are followed by a shredder, which breaks the chips into shreds for finer cane preparation. The chipped and shredded cane then goes through the crusher, a set of roller mills in which the cane cells are crushed and juice extracted. As the crushed cane proceeds through a series of up to eight four-roll mills, is forced against a countercurrent of water known as water of maceration or imbibitions streams of juice “extracted from the cane, mixed with maceration water from all mills, are combined into a mixed juice called dilute juice cane should mechanically be loaded to save time (Davenport andThomas1993).

2.7.6 The alternative to extraction by milling is extraction by diffusion process.

(Denison, 1948), alleges that cane prepared by rotating knives and a shredder is moved through a multi-cell, countercurrent diffuser where sugar extraction is higher by diffusion but extraction of non sugars is also higher this necessitates the use of chemicals. Diffusion, therefore, is most used where cane quality is highest for example in South Africa, Australia, and Hawaii. Occasionally a smaller "bagasse diffuser" is used in order to increase extraction from partially milled cane after two or three mills leaving the residual cane fiber, after juice (bagasse) to be removed. Disposal of the large amounts of water used by diffusers is a costly environmental problem, as cane factories that practice diffusion must operate their own primary, secondary, and tertiary water-treatment systems.

2.7.7 Clarification process

Mixed juice from the extraction mills or diffuser is purified by addition of heat, lime and flocculation aids. The lime is a suspension of calcium hydroxide, often in a sucrose solution, which forms a calcium saccharine compound. The heat and lime kill enzymes in the juice and increase pH from a natural acid level of 5.0–6.5 to a neutral pH. Control of pH is important throughout sugar manufacture because sucrose inverts, or hydrolyzes, to its components glucose and fructose at acid pH (less than 7.0), and all three sugars decompose quickly at high pH (greater than 11.5) (Martin, 1996). Juice is Heated to 99°–104° C (210°–220° F), the neutralized juice is inoculated, if necessary, with flocculants such as polyacrylamides and pumped to a continuous clarification vessel, a large, enclosed, heated tank in which clear juice flows off the upper part while mud settle below. This settling and separation process is known as defecation. Mud is pumped to rotary vacuum filters, where residual sucrose is washed out with a water spray on a

rotating filter. Clarified juice, meanwhile, is pumped to a series of three to five multiple-effect evaporators presentation by (Elsevier 2013).

2.7.8 Concentration process

In the multiple-effect system, developed for the American sugar industry in 1843, steam is used to heat the first of a series of evaporators. The juice is boiled and drawn to the next evaporator, which is heated by vapor from the first evaporator. The process continues through the series until the clarified juice, which consists of 10–15 % sucrose, is concentrated to evaporator syrup, consisting of 55–59% sucrose and 60–65% by weight total solids. Non sugars deposit on the walls and tubes of the evaporators, creating scale deposits and reducing the efficiency of heat transfer. Scale removal often forces the entire factory operation to shut down if another set of evaporators is not available (Margate, 1995).

2.7.9 Cane storage process

Cane sugar is the name given to sucrose, a disaccharide produced from the sugar cane plant. In the production scheme for cane sugar, the cane cannot be stored for more than a few hours after it is cut because microbiological action immediately begins to degrade the sucrose. This means that the sugar mills must be located in the cane fields. The raw sugar produced in the mills is the item of international commerce. Able to be stored for years, it is handled as a raw material shipped at the lowest rates directly in the holds of ships or in dump trucks or rail road cars and pushed around by bulldozers. There are another category of cane sugar called direct – consumption (white sugar) and non centrifugal sugar. The principal by product of cane sugar production is molasses. Final molasses is about 35 – 40% sucrose and slightly more than 50% total sugars, used to produce alcohol and spirits

2.7.10 Sugarcane preparation and juice extraction process

Washing system is used to remove excessive amounts of soil, rocks and trash delivered with the sugarcane before entering the extraction system. Sugarcane is prepared using rotating knives and shredders that reduce the cane fed to the mill into small pieces suitable for the subsequent extraction process. Juice extraction system separates the bagasse and the juice by compression of the sugarcane. The bagasse is used as fuel at the cogeneration system and the raw juice produced is delivered to the treatment system.

2.7.11 Juice treatment process

Some non sugar impurities are separated by the addition of some chemical reactants as Sulphur, lime, among others, being juice heating necessary for the purification reactions. After that, the juice passes through a flash tank, before entering the clarifier. The precipitate formed into the clarifier is separated from the clarified juice and directed to filters. After filtration, part of the juice returns to the process ahead the clarifier, and filter cake is rejected. The clarified juice can be then directed to the evaporation system. Treatment of juice for ethanol and sugar production can be very similar deferring on the Sulphur addition step, used exclusively for sugar production.

2.7.12 Juice evaporation process

Juice for sugar production is concentrated in a multiple-effect evaporator. Exhausted steam from the cogeneration system is used as thermal energy source in the first evaporation effect, separating part of the water presented in the juice that is used as heating source for the next evaporation effect. The system works with decreasing pressure due to a vacuum imposed in the last effect, producing the necessary difference of temperature between each effect. Vapor bleed can be used to attend heat requirements of other parts of the process, as the juice treatment heaters and sugar

boiling system. Part of the juice for ethanol production is concentrated in five effects evaporation systems to reach the concentration necessary for the fermentation process. The other part of the juice for ethanol is by-passed to the fermentation process, to be mixed with concentrated juice and molasses for the mash preparation Osha (2012).

2.7.13 Sugar boiling, crystallization, centrifugal separation and sugar drying processes

Syrup is boiled in vacuum pans for crystal formation and then directed to crystallizers to complete crystal enlargement. After that, sugar crystals are separated from molasses using centrifugals. Sugar dryer consumes exhaust steam to reduce the moisture content of the sugar.

2.7.14 Fermentation process

Integrated sugar and ethanol plants use a mixture of molasses and juice for mash preparation. Part of juice is concentrated to reach optimum solid content level necessary for the fermentation process. Good quality water is also needed during the mash preparation and for Carbon dioxide scrubber. Fermented liquor produced has around 8% of ethanol concentration in mass basis and is directed to the distillation system to be separated from the water.

2.7.14 Distillation process

Ethanol produced at the fermentation process is recovered by distillation. Before entering the first distillation column, fermented liquor is heated to reach the adequate temperature for the distillation process. Hydrous ethanol is obtained by stripping and rectification stages. In order to remove the remaining water and obtain the anhydrous ethanol, dehydration process is required. A large amount of silage is produced and must be handled as an effluent with high biochemical and chemical oxygen demand's Condensates tank and water cooling system, the condensate tank receives all the condensates generated in the process excluding the exhaust steam condensate

which returns to the cogeneration system. Separate tanks are used for hot condensates storage, like those originated with in the condensation of vapors from 1st, 2nd, 3rd and 4th effects of evaporation, being used as imbibitions water in the juice extraction system and washing water in sugar and molasses centrifugal separation and in the juice treatment filter. The water cooling system is composed by spray ponds that reduce condensate water temperature to be re-circulated in the process as cooling water for fermentation, distillation, sugarcane washing and vacuums system. (Florida et al, 1999).

2.8 Effects of sugar production chemicals on the productivity of Sugar Corporation

Premium quality sugar industry chemicals like hydrous.c.s lye.hcl. and etp chemicals are immensely used in sugar industry for the purpose of improving the sugar color and reducing the sugar losses. This chemical is added to the crystals so as to add the color and reduce the loss of sugar during the process of crystallization hence increasing sugar quality and the productivity as larger tones of sugar are realized daily (Renukeshwara, 2015).

Mill sanitation is an important step in the sugar manufacturing process. Certain bacteria like leuconostoc can lead to sucrose loss in the juice by inversion besides slime formation and bad odour. Use of mill sanitation Sugar Mill Biocide chemicals is impaired due to lack of proper methodology to evaluate its efficiency however when effectively used is capable of improving the quality and productivity of a sugar factory that uses it (Jaegher, 2001)

Sugar mill sanitation biocide; SH-401 is a caramate based micro biocide specially formulated to inhibit growth of bacteria and fungi in cane sugar mills these chemicals are highly effective against acid producing bacteria and fungi found in sugar mills. It also improves sugar recovery

from stored sugar by reducing bacterial sugar inversion. SH 401 also inhibits enzyme action for the time between crushing of cane and lime neutralization hence eliminates the odor that could below the quality of the sugar produced hence improved productivity Improved heat transfer (Hughes, 2005).

Powerful active agent in Maxtreat-4000 keeps heat transfer surfaces improve the capacity of evaporation. This rapid action always results into improved quality of sugar produced if well applied (Roderick, 2005) clean and free from excessive deposition. Maxtreat-4000 contains a sequestering agent which keeps calcium and magnesium salts as water soluble complexes preventing them from scaling. Depending upon the nature of scale forming compound, dosage of Maxtreat-4000 can be adjusted to produce quality sugar.

Flocculants; Canefloc is a highly effective coagulant for separation of suspended solids in sugar juice. This product is use in the sugar juice clarifier and for sugar mud filtration. A high charge density anionic polymer, it helps in flocculation of suspended matter forming dense, easy setting flocs. The anionic nature and higher molecular weight of Canefloc helps in formation of dense flocculation. Therefore, the volume of mud generated is reduced and solids in clarifier bottom increase. The higher molecular weight of Canefloc helps in formation of tough flocs, which improves filterability of mud and loss of juice in mud is reduced (Doghlar, 2002).

Viscosity reducer; Maxtreat 4025 helps in improving centrifugation efficiency and sugar color better exhaustion of molasses; reduction of sugar losses & improving recovery by reducing surface tension, Maxtreat 4025 improves boiling efficiency, crystallization, centrifugation and exhaustion of molasses, resulting in improved sugar crystals and sugar recovery. This improves fluidity, reduces boiling time and improves circulation (Thumpton, 2006). Productivity in the

sugar factory is realized not only by using the sugar process chemicals but by joint effort of both the client and the distributors of chemicals in that the client follows instructions correctly as directed by the distributor and uses them effectively in Sugar Process. Since these chemicals are used in processing of sugarcane in sugar industry, they do not contain any type of harmful ingredients that assure safety. Hence their action is rapid in increasing the productivity and the quality needed of a sugar factory because they are highly effective and give quality performance (Ghantali, 2014).

2.9 Impact of machinery on the productivity of Sugar Corporation

Paul (2009), as quoted by International Society of Sugar Cane Technologists, pages pp. 106-116, in Guatemala, states out that the usage of primary technology like the sugar mills increases the productivity in a sugar corporation but he rather argues that so as to double up the productivity, Secondary technology need to be used in the sugar production so as to be able to double up the productivity. And the example of this secondary technology is Manufacturing Information Technology. Whose goal is to use the information available in the optimum manner in all aspects of process, from design through training of operators to business decision making as they apply the technology. (Roderick, 2005) states that so as to have a 'virtual productive factory the technology used to design equipment should be of the combination between the traditional approach factors which is essential when control is understood and Modern design technologies be for the factory is built because its equipment design involves empirical safety of operations and manual process of handling computer controls, piping and instrument diagrams, flow schemes and even virtual realities that can be walked' through. Maximize the throughput hence increasing

performance leading to high productivity levels**.**

The aim of sugar processing both beet and cane is to minimize the formation of color and effectively remove non-sugar impurities. The emergence of these two stages of sugar milling to co-currently be done increases the rate of productivity by 20% of the original. This, refined white sugar, which is 99% sucrose which increase the affluence in the sugar producing tropics due to increased demand for refined sugar products, driving a trend toward combined milling and refining. As in many other industries factory automation has been promoted heavily in sugar refineries in recent decades. The production process is generally controlled by a central process control system, which directly controls most of the machines and components. Only for certain special machines such as the centrifuges in the sugar house decentralized places are used for security reasons.

According to Bryianfold's presentation (2012) as cited in (Florida et al, 1999), on effective technology for sugar manufacturing in Guyana, she states that, so as to increase the productivity of a sugar factory, there is need for the application of the new technology for evaporation which is intended to improve the capacity of existing equipment and to improve energy efficiency. Essential to these goals is an adequate understanding of the thermodynamics of evaporation and its application to control systems, she added that, an example of the A model has been developed as a simulation tool for evaporator designers and operators and tested against experimental data to improve the model. This model can be used to simulate performance under varying conditions, including changes in tube size and material and scale formation. There have been several differing reports on recently installed falling film evaporators with data indicating that they are easy to operate, control and clean to problems in achieving the expected results with this evaporator.

According to (Hizternbery, 2009), subtle differences in evaporator design have major positive impact on performance hence productivity. He argues that, the use of multiple effect evaporators promotes high productivity both in terms of output and resources because the multiple evaporators is capable of carrying out several sugar processes related with steam evaporation at once unlike the use of ancient process for obtaining sugar which consisted of boiling the juice until solids formed as the syrup cooled**.**

The use of combined evaporators like falling film evaporators, raising evaporators, plate evaporators, forced circulation evaporators, compact evaporators, natural evaporation, increase the productivity highly in that, the different processes that could be done separately can now be done at ago this causes the processing output to be at a higher rate per hour (Rogers, 2007).

The use of multi-stage processes of evaporation and crystallization machinery is of greater positive impact to the productivity of the sugar factory. Because they ease the crystallize a samonohydrate from water or as or as anhydrous glucose from ethanol or warm water which facilitates the process of separating the decanter making it easily to be dried in the a v ibrofluidizer resulting into a product of 92-98% hydrolyzed starch making it easy to obtain glucose as a total sugar hence resulting into the productivity in production as costs are reduced Scientific paper by (Zakargo, 2006).

The effective use of a sugar drier increases the productivity in that when syrup is boiled in vacuum pans for crystal formation and then directed to crystallizers to complete crystal enlargement, those sugar crystals are separated from molasses using centrifugals leaving the Sugar dryer to consumes exhaust steam so as to reduce the moisture content of the sugar**.** Application of the developed model increases productivity because it predicts the color of sugars

from various crystallization schemes and good agreement is achieved between the predictions and actual factory performance and it also predicts the impact of variations in operating conditions. Material, energy and color balances are used to predict that replacement of A-B-crystallizing machines by a back-boiling system will not increase sugar quality as in color. Models for use in crystallization processes should be dynamic and should include factors such as crystallization kinetics, inversion kinetic, color development rate, and the impacts of purity changes in feed materials, pan circulation rate, and others because the adjusted handles a lot more conditions and processes needed for sugar crystallization at once hence increase in productivity (Curley and Pybum, 1982).

Abigal (2012), in her research finds out that the sugar industry is a data rich but information poor industry. For example, much work has been done on crystallization kinetics which for sure increases productivity but it is rare that this information is used in design and even less in operations. In the end individuals must make decisions but the better the information and insight available, the better will be the productivity gains. For the goal to be achieved it is essential to take information and knowledge away from being the personal property of key individuals and transfer this to corporate or institutional memory that can be accessed by all who need to know.

CHAPTER THREE

RESEARCH METHODOLOGY

3.0 Introduction

This chapter presents the methodology and techniques that will be used in the study. It highlights the research design and procedure that are employed in data collection. This chapter further presents the study population and area, the sample size and sampling techniques, the data collection methods and instruments, data analysis which basically encompasses both qualitative and quantitative approaches. The other sections covered in this chapter include the study limitations and ethical considerations.

3.1 Research Design

3.1.1 Study design

The researcher used case study design to collect data required with Lugazi Sugar Corporation as the study firm. The researcher employed a case study design since it is good for studying unusual circumstances where large samples of the same characteristics are not available and also challenges certain assumptions. The researcher mainly used quantitative data collection method which was aimed at obtaining extensive, reliable, and logically applicable conclusions to the findings of the research.

The researcher also used cross sectional study approach to collect the required data since the study is short term and meant to produce a single report and so it was reliable to use this approach and as well it is quick and simple to use during data collection (Eric and Rea, 2001).

3.2 Area of the study

The study is to be conducted at Lugazi sugar corporation in Lugazi Buikwe district**,** Lugazi is one of the most prominent sugar manufacturing corporations in Uganda producing a total of 60,00 metric tones per annum which contributes to the country's GDP by 14%. It is bordered by another sugar corporation Madhvani, Kakira sugar works in the east. It also has a salt green house; spirit packaging's which has provided employment to the locals in the area. The area under investigation however encompassed other out growing sites that provide the prompt supplies of cane for processing.

3.3 Study population

Mugenda and Mugenda (1999) define study population as the group of people that the research targets to investigate. The Central Bureau of Statistics (CBS, 1997) indicated that population can be classified into demographics, age and sex composition, economic levels, education status among others. Lugazi Sugar Corporation human resource office reveals that the population of workers is around 7300 people; the study population for this study is majorly 60 people with a sample size of 52 people which included a portion of workers operating the machines, workers carrying out sugar weighing, packaging, and quality assurance or chemists and the manager productions

Table 1: Study population and Sample size

Department	Population	Sample
Quality assurance	10	5
Machine operations	15	14
Packaging and branding	10	10
Production	15	14
Weighing	10	9
Total	**60**	**52**

Source; primary data, 2015 (Human Resource Manager)

3.5 Sample size

A sample is a selection of a small group, individuals, objects or even units representing a bigger portion or a whole. During the study the sample size that represents the rest of the factory members will be 60 respondents and it is determined by (Krejcie and Morgan, 1970) table.

3.6 Sampling techniques

During the study the researcher will use simple random sampling and purposive sampling techniques. This is because simple random sampling is when samples are obtained in such a way that samples of the same size have the equal chances of being selected.

Purposive sampling is a technique where the researcher selects the respondents who are expected to be having the necessary information. Gives the respondents in a sample equal chances of being selected therefore it eliminates chances of getting biased information since all respondents then have equal chances of being selected. Purposive sampling is also ideal in this research

because it aims at targeting the real people with the relevant information; it eases data judgment, it is also a good sampling technique because it reduces time that would have been wasted on respondents that actually do not have the data needed (Amin,2005).

3.7 Data collection methods

3.7.1 Questionnaires

James (1997) considers a questionnaire to be a means of eliciting feelings, experiences, beliefs, attitudes and perceptions. Questionnaires were used in data collection because they help the researcher capture the respondents' attitudes as well as their habits and they can also be used to capture more information in the shortest time since they are self administered. The questionnaire are always comprised of easy questions and can easily help the research get information that the respondents may not be willing to give to the research directly especially when the data needed is considered to be confidential to some respondents, for example the age brackets of the respondents.

The questionnaires have standards measurements that are easy to be analyzed by the research for example; the yes, no or not sure analysis gauge. The other standard measurement was the five point valuing scale which is of the form of 1=strongly disagree, 2=disagree, 3=not sure, 4=agree, 5=strongly agree. This scale is easy to understand by both the researcher and the respondents and can easily reveal the opinions of the respondents to the researcher. Questionnaires made data control easy because the there is maintained uniformity and standardization in the questions asked since the respondents receive the same questions with the same wording as well as phrases, the data was easily controlled because the researcher controlled the condition under which the questions were answered.

3.8 Quality control

3.8.1 Validity

Data collection methods was given keen attention so as to maintain validity throughout the study; that is to say the questionnaires were reviewed, standardized and made uniform by the review of the supervisor so as to make data analysis and comparison easy. Sampling is done well therefore there are no chances of double sampling that may result into biased results. All instruments that were used in this study were well edited following the instructions of the research supervisor allocated to me.

3.8.2 Reliability

The questionnaires were planned, tested and re-tested thoroughly by sampling a few respondents from the sample so as to generate the closeness or variations in the findings, geared towards getting proper and valid data that is relevant to the subject under investigation.

3.9 Data analysis and Presentation

At the end of collecting data, the researcher edited the findings in order to achieve accuracy, consistency and coherence. Codes were then attached to the data that was edited in terms of frequencies, mean and standard deviation. The data was processed and presented using tables, that clearly explained the outcomes of the results, this was done with the help of computer application software that is to say Microsoft excel, Microsoft word and general analysis was done by the Statistical Package for Social Sciences (SPSS 21.0).

3.8 Data Analysis

Amin (2005) defines data analysis as a component of research that leads to data reduction, display of data, drawing of conclusions and making the necessary verification for the intended purpose of the study. In this study data was presented using quantitative method.

John (2006) defines quantitative data analysis as counts and measures of things, John (2006) adds that quantitative analysis is measurable and objective in nature; it is an important tool of data analysis since it offers the research with an opportunity to interpret numerical data such that it gives easy and meaningful information to both the researcher and other stakeholders. Numerical data was translated into tables that explain trends or tendencies and size of one variable against another, with the aid of computer application software especially Microsoft word, Microsoft excel and the Special Package for Social Sciences (SPSS 21.0) IBM.

3.9 Ethical Considerations

During the study the researcher ensured that the ethical issues that are advocated for are maintained for purposes of a good image between the researcher and the participants. The respondents are not to be coerced to deliver information and or given money to give data or information in turn. The researcher held the responsibility of keeping the data of the respondents confidential, in terms of the respondents' bio data like their age and health status. This was achieved by the way the research methods were designed that is to say no requirement for the respondents to indicate their names. The researcher did not subject the participants to any kind of mental stress like asking questions that are detrimental to their self interest that are likely to cause psychological disorders and thus depriving them of their rights.

The use of the references in the work was applied so as to appreciate other people's work. The researcher also introduced herself to the firm in a formal way.

3.10 Limitations of the Study

Since the sample size was quite small there were higher chances of errors in the findings and that the case study requires only the study of one firm and a few sections, there were also chances that the firm under study is not properly compared with other related firms.

The researcher employed a cross sectional study which meant that the study was short term which might have led to wrong conclusions made to the findings of the study.

CHAPTER FOUR

DATA ANALYSIS, PRESENTATION AND INTERPRETATION

4.0 Introduction

This chapter deals with the general findings of the study. It deals with the presentation of the background of the respondents and their responses analysis and interpretation of the data collected on the investment in technology and the productivity of the sugar production industry in Uganda with the case study being Lugazi sugar corporation Limited. The presentation of the data is based on the study objectives which are then presented in tables.

The study was carried out among the employees of Lugazi Sugar Corporation. This included both males and females with different age groups from selected departments of production, packing and branding, machine operators and processing, quality assurance and weighing departments. These departments make up 60 people and the researcher used stratified random and purposive sampling to acquire the respondents.

Table 2: Gender of respondents

Gender	Frequency	Percent
Male	38	73.1
Female	14	26.9
Total	**52**	**100.0**

Source; Primary data, 2015

Results table 4:1 above it shows that there were more male respondents with 73.1% than females who constituted 26% of the respondents.

Table 3: Age group of respondents

Age group	Frequency	Percent
18-24years	2	3.8
25-30 years	3	5.8
31-34 years	20	38.5
35-40years	19	36.5
41 years and above	8	15.4
Total	**52**	**100.0**

Source; Primary data, 2015

From table 4.2 above, results show that the majority of the respondents are between the age group of 31-34 years (38.5%) followed by 35-40 years, 36.0%, 41 years and above 15.4%, 25-30 years and the least was 18-24 years having 3.8% response rate.

Table 4: Educational level of respondents

Level of education	Frequency	Percent
Certificate or diploma	2	3.8
Degree	14	26.9
Post graduate	28	53.8
Others	8	15.4
Total	**52**	**100.0**

Source; Primary data, 2015

Table 4.3 above shows that 53.8% of the respondents had post graduate level of education, 26.9% had bachelor degree, 15.4% had other qualifications and the least was certificate and diploma with 3.8% response rate.

Table 5: Duration worked by respondent in the firm

Duration	Frequency	Percent
Less than a year	10	19.3
1-2 years	19	36.5
3 years and above	23	44.2
Total	**52**	**100.0**

Source: Primary data, 2015.

Results in table 4.4 above show that 44.2% of the respondents have worked for 3 years and above at Lugazi Sugar works. 36.5 have taken 1-2 years and only 19.3% have worked for less than a year.

4.2 Descriptive statistics on production processes

The production processes used by Lugazi Sugar works were computed using mean and standard deviation from statement categorized under impact on productivity, step by step refining, over storage and stages of production. The analysis is provided in the table below.

Table 6: Mean standard deviation for production processes

Statement	N	Mean	Std. Dev
All sugar processes impact on productivity	52	4.10	.891
Step by step sugar refining increases productivity	52	3.69	1.380
Overstoring of sugar cane degrades sugar	52	3.75	1.281
Productivity increase starts from initial stages	52	3.46	1.275

Source; Primary data, 2015

4.2.1 All sugar processes impact on productivity

Results in table 4.5 above show that a majority of the respondents agree to the statement that all sugar processes impact on the productivity of sugar as shown by the mean value of 4.10 and standard deviation of 0.891. Respondents have different understanding about the statement which is shown by the variation they provided to the statement. This seems to be in agreement with (Curly and Pybum, 2000) whose study found that models for use in crystallization processes should be dynamic and should include factors such as crystallization kinetics, inversion kinetic, color development rate, and the impacts of purity changes in feed materials, pan circulation rate, and others because the adjusted handles a lot more conditions and processes needed for sugar crystallization at once hence increase in productivity.

4.2.2 Step by step sugar refining increases productivity

Table 4.5 above reveals that respondents agree that step by step sugar refining increases productivity with a mean value of 3.69 and standard deviation of 1.380. Respondents have different understanding about the statement which is shown by the variation they provided to the statement This seem to be in agreement with (Palm, 2010), who states that step by step refining of sugar cane for processing increases productivity but its best when done in one continuous process without the raw sugar stage.

4.2.3 Over storing of sugar cane degrades sugar

As presented in table 4.5 above, results show that respondents agreed that over storing of sugarcane degrades the quality of output sugar having a mean of 3.75 and standard deviation of 1.281. Respondents have different understanding about the statement which is shown by the variation they provided to the statement. This agreement seems to be supported by (Florida et al, 1985) Sugarcane once harvested cannot be over stored because of sucrose rotting. He further states that Sugar beets on the other hand can be stored and are therefore generally processed in one stage into white sugar.

4.2.4 Micro-biological action degrades sucrose

Results in table 4.5 above show that respondents agreed to the statement that micro-biological action degrades sucrose as shown by the mean value 3.46 and standard deviation value 1.275. Respondents have different understanding about the statement which is shown by the variation they provided to the statement. Their agreement seems to be supported by the study of (Davenport and Thomas, 1993) which reveals that sugar cane cannot be stored more than a few

hours after cutting because micro-biological action immediately begins to degrade the sucrose which reduces the productivity in terms of output.

4.3 Descriptive statistics on production chemicals

The production chemicals used at Lugazi Sugar works were computed using mean and standard deviation using qualities like; improving sugar color, consistent application, effective and efficient use and separation of suspended solids.

Table 7: Mean standard deviation for production chemicals

Statement	N	Mean	Std. Dev
Production chemicals improve on sugar color	52	3.75	1.454
Consistent application of production chemicals	52	3.96	1.313
Efficient and effective use of chemicals	52	3.88	1.338
Chemicals ease the separation of suspended solids	52	3.88	1.308

Source; Primary data, 2015

4.3.1 Production chemicals improve on sugar color

Table 4.6 above shows that a majority of the respondents agree that production chemicals improve sugar color as shown by the mean of 3.75and standard deviation value 1.454. Respondents have different understanding about the statement which is shown by the variation they provided to the statement. This seems to be in agreement with (Renukeshwara, 2015) who states that chemicals are added to the crystals so as to add the color and reduce the loss of sugar

during the process of crystallization hence increasing sugar quality and the productivity as larger tones of sugar are realized daily.

4.3.2 Consistent application of production chemicals

Results in table 4.6 show that the respondents agree that consistent application of production chemicals enhances quality sugar production with a mean value of 3.96 and a standard deviation value of 1.313. Respondents have different understanding about the statement which is shown by the variation they provided to the statement. Their agreement seem to be supported by (Ghantali, 2014) whose research found that, application of the developed model increases productivity because it predicts the color of sugars from various crystallization schemes and good agreement is achieved between the predictions and actual factory performance and it also predicts the impact of variations in operating conditions.

4.3.3 Efficient and effective use of chemicals

As presented in table 4.6 above, results show that the respondents agree to the statement that efficient and effective use of chemicals reduce the loss of sugar during the production processes as shown by the mean value of 3.88 and standard deviation of 1.338. However, respondents have different understanding about the statement which is shown by the variation they provided to the statement. This response seems to be in agreement with (Jaegher, 2001) whose study revealed that Mill sanitation is an important step in the sugar manufacturing process. Certain bacteria like leuconostoc can lead to sucrose loss in the juice by inversion besides slime formation and bad odor. Use of mill sanitation Sugar Mill Biocide chemicals is impaired due to lack of proper methodology to evaluate its efficiency however when effectively used is capable of improving the quality and productivity of a sugar factory that uses it.

4.3.4 Chemicals ease the separation of suspended solids

Results in table 4.6 above reveal that the respondents agree that chemicals help to ease the separation of suspended solids in the sugar juice as shown by the mean value of 3.88 and standard deviation of 1.308. Respondents have different understanding about the statement which is shown by the variation they provided to the statement. This seems to be in agreement with (Doghlar, 2002) who states that Canefloc which is one of the chemicals is a highly effective coagulant for separation of suspended solids in sugar juice. This product is use in the sugar juice clarifier and for sugar mud filtration. A high charge density anionic polymer, it helps in flocculation of suspended matter forming dense, easy setting flocs. The anionic nature and higher molecular weight of Canefloc helps in formation of dense flocculation. Therefore, the volume of mud generated is reduced and solids in clarifier bottom increase. The higher molecular weight of Canefloc helps in formation of tough flocs, which improves filterability of mud and loss of juice in mud is reduced.

4.4 Descriptive statistics on production machinery

The production machinery used at Lugazi Sugar works were computed using mean and standard deviation using statements like; models tools, multiple effect evaporators, processing equipments and new technology for evaporation.

Table 8 Mean and standard deviation for production machinery

Statement	N	Mean	Std. Dev
The use of simulation model tools	52	3.56	1.392
Multiple effect evaporators	52	3.77	1.198
Both old and new sugar processing equipments	52	3.63	1.299
Application of new technology for evaporation	52	3.53	1.501

Source; Primary data, 2015

4.4.1 The use of simulation model tools

Results in table 4.7 above show that the respondents agreed to the statement that the use of simulation model tools of new technology increase output with a mean of 3.56 and standard deviation 1.392. Respondents have different understanding about the statement which is shown by the variation they provided to the statement. Their agreement seems to be supported by Bryianfolds presentation (2012) as cited in (Florida, 1999), which states that, so as to increase the productivity of a sugar factory, there is need for the application of the new technology for evaporation which is intended to improve the capacity of existing equipment and to improve energy efficiency. Essential to these goals is an adequate understanding of the thermodynamics of evaporation and its application to control systems, she added that, an example of the A model has been developed as a simulation tool for evaporator designers and operators and tested against experimental data to improve the model. This model can be used to simulate performance under varying conditions, including changes in tube size and material and scale formation.

4.4.2 Multiple effect evaporators

Table 4.7 above reveals that a majority of the respondents agree that multiple effect evaporators promote increase in productivity with a mean value of 3.77 and a standard deviation of 1.198. Respondents have different understanding about the statement which is shown by the variation they provided to the statement. This appears to be in agreement with Hizternbery (2009) who states that subtle differences in evaporator design have major positive impact on performance hence productivity. He argues that, the use of multiple effect evaporators promotes high productivity both in terms of output and resources because the multiple evaporators is capable of carrying out several sugar processes related with steam evaporation at once unlike the use of ancient process for obtaining sugar which consisted of boiling the juice until solids formed as the syrup cooled.

4.4.3 Both old and new sugar processing equipments

As presented in table 4.7 above, respondents agree that multiple effect evaporators promote increase in productivity having a mean of 3.63 and standard deviation of 1.299. Respondents have different understanding about the statement which is shown by the variation they provided to the statement. This agreement seems to supported by (Roderick, 2005) who states that so as to have a virtually productive factory the technology used to design equipment should be of the combination between the traditional approach factors which is essential when control is understood and Modern design technologies allows even more fast production of sugar.

4.4.4 Application of new technology for evaporation

Table 4.7 above reveals that the respondents agree to the statement that application of the new technology for evaporation intended to improve the capacity energy saving improves on productivity as shown by the standard deviation value of 3.53 and standard deviation value of 1.501. Respondents have different understanding about the statement which is shown by the variation they provided to the statement. This appears to be in agreement with (Bryianfolds research, 2012) as cited in (Florida, 1999) who states that effective technology for sugar manufacturing in Guyana, she states that, so as to increase the productivity of a sugar factory, there is need for the application of the new technology for evaporation which is intended to improve the capacity of existing equipment and to improve energy efficiency.

4.5 Descriptive statistics on output

Output of Sugar at Lugazi sugar works was computed using mean and standard deviation under the qualities like; employees knowledge gap, staff performance, conducive environment and staff involvement and commitment as shown in the analysis table below.

Table 4.8 Mean and Standard deviation for output

Statement	N	Mean	Std. Dev
Output is by filling employees knowledge gaps	52	3.65	1.312
Correct rewards motivate the staff performance	52	3.63	1.401
Conducive environment stimulates performance	52	3.40	1.390
Staff involvement and commitment	52	4.02	1.180

Source; Primary data, 2015

4.5.1 Output is by filling employees' knowledge gaps

Table 4.8 above shows that a majority of the respondents agree to the statement that output is by filling employees' knowledge gaps with a mean of 3.65 and a standard deviation of 1.312. Respondents have different understanding about the statement which is shown by the variation they provided to the statement. This seems to be in agreement with Dunne (2011) who states that the gaps in employee know-how and knowledge and quality, the employees' maximum level of usage, the kind of environment that works better for employees.

4.5.2 Correct rewards motivate the staff performance

As shown in table 4.8 above, results show that respondents agree that correct rewards motivate the staff performance as evidenced by the mean value of 3.63 and standard deviation 1.401. Respondents have different understanding about the statement which is shown by the variation they provided to the statement and this appears to be in agreement with Dunne (2011) who further states that the use of correct rewards to motivate staff performance and that, Strategy and productivity improvements can only improve when done in a more concentrated manner, which involves the study of several areas and the use of many techniques.

4.5.3 Conducive environment stimulates performance

Results in table 4.8 above show that the respondents agree to the statement that a conducive environment stimulates performance of employees as shown by the mean 3.40 and standard deviation 1.390 but however, respondents have different understanding about the statement which is shown by the variation they provided to the statement. This seems to be in agreement with (Russell and Taylor, 2000) the actual workplace environment one works in plays a big part

on how one feels about the daily tasks. Working in a dark, cold and unsafe place will actually make workers less effective.

4.5.4 Staff involvement and commitment

Table 4.8 above shows that the respondents agree that staff involvement and commitment in the factory leads to the production of quality sugar having a mean value of 4.02 and standard deviation 1.180. Respondents have different understanding about the statement which is shown by the variation they provided to the statement. This seems to be in agreement with (Russell and Taylor, 2000) who states that including work-life balance incentives such as flexible work hours and rewarding performance with extra vacation time, making employees feel like they have a greater involvement/responsibility in their work, allowing involvement in planning and decision-making as well as providing two-way communication channels up the chain of command and also providing a way for employees to broaden their skill set so that they cannot be restricted in one specific skill influences workers to perform Similarly keeping job performance standards and bonus reviews as objective and transparent as possible helps in performance of workers.

4.6 Descriptive statistics for quality

The quality of sugar products at Lugazi Sugar firm was computed using mean and standard deviation under the qualities like; Employee training, setting standards, staff involvement in planning and continuous improvement as shown by the analysis in the table below.

Table 9 Mean and standard deviation for quality

Statement	N	Mean	Std. Dev
Employees training impacts on production	52	3.92	1.202
Being consistent to set standards promotes quality	52	3.73	1.285
Staff involvement in planning	52	3.92	1.230
Continuous improvements promotes quality	52	4.48	.852

Source; Primary data, 2015

4.6.1 Employee training impact on production processes

Results in table 4.9 above show that the respondents agree to the statement that Employees training impact on production processes of sugar improves on the quality of sugar having a mean value of 3.92 and standard deviation of 1.202. Respondents have different understanding about the statement which is shown by the variation they provided to the statement. Their agreement appears to be supported by (Brynjolfsson, 1993; and Brynjolfsson and Young, 1996) whose study reveals that productivity is said to have been impacted on positively through the training of workers, automation of processes, upgrades in existing technology, infrastructure, hardware, software, firm's structure and strategies employed in carrying out businesses in especially in the service industries continued to say that, both academics and the business press have periodically revisited the so called "productivity paradox" of technology and that, the U.S economy has increased by more than two orders of size in the past two decades.

4.6.2 Being consistent to set standards promotes quality

Results in table 4.9 above show that the respondents agreed that being consistent to set standards promote quality of products, as shown by the mean value of 3.73 and standard deviation 1.285. Respondents have different understanding about the statement which is shown by the variation they provided to the statement. They seem to be in agreement with (Dunne, 2011) who states also that quality is brought about by strict and consistent commitment to certain standards that achieve uniformity of a product in order to satisfy specific customer requirements.

4.6.3 Changing needs of internal and external stakeholders lead to quality maximization.

As shown in table 4.9 above, the results reveal that the respondents agree to the statement that changing needs of both internal and external stake holders leads to quality maximizations shown by the mean 3.92 and standard deviation of 1.230. Respondents have different understanding about the statement which is shown by the variation they provided to the statement. This appears to be in agreement with (Fermndes and Pakas 2008) whose study reveals that maximum quality is by changing needs of both internal and external needs of the stakeholders should be understood and satisfied in the cost effective manner. Quality comes about when leadership is put in place to carry out supervision so that every individual performs in the best possible manner to improve quality and productivity

4.6.4 Continuous improvements promotes quality

Results in table 4.9 show that, the respondents agree that continuous improvements promote quality, as shown by the mean value of 4.48 and standard deviation value 0.852. Respondents have different understanding about the statement which is shown by the variation they provided

to the statement. This appears to be in agreement with (Young, 1990) whose study reveals that quality can holistically be looked at as a long term aspect that views at continuous improvements in all organizational aspects as process and not as short term goal. It aims at to radically transform the organization through progressive changes in the attitude practices.

4.7 Descriptive statistics for lead time

The lead time taken for delivery of products at Lugazi was computed using mean and standard deviation under the qualities like; willingness to work, well motivated employees, reduced time for processing and proper arrangement of production processes.

Table 10 Mean and standard deviation for lead time

Statement	N	Mean	Std. Dev
Workers willingness to work at any time	52	3.48	1.260
Well motivated employees are dedicated to work	52	4.21	.915
Reduced time of processing	52	3.85	1.289
Proper arrangement of production processes saves time	52	3.92	1.384

Source; Primary data, 2015

4.7.1 Workers willingness to work at any time

Results in table 4.10 above reveal that a majority of the respondents agreed that Workers' willingness to work at any time helps workers the corporation to capture bigger market share as shown by the mean 3.48 and standard deviation 1.260. Respondents have different understanding about the statement which is shown by the variation they provided to the statement. This appears

to agree with (Mackenzie, 1985) whose study states that the workers should be willing to work at any time to beat the deadlines because the firm appears to be more efficient and reliable.

4.7.2 Well motivated employees are dedicated to work

As shown in table 4.10 above, respondents agree to the statement that well motivated employees are dedicated to work as shown by the mean value of 4.21 and a standard deviation of 0.915. Respondents have different understanding about the statement which is shown by the variation they provided to the statement. Their agreement seems to be supported by (Mackenzie, 1985) whose study further reveals that firms need to motivate their employees so as to make them feel more dedicated, loyal and desirous to work.

4.7.3 Reduced time of processing

Results in table 4.10 above show that the respondents agreed to the statement that reduced processing time helps the organization meet deadlines as shown by the mean value of 3.85 and standard deviation 1.289. Respondents have different understanding about the statement which is shown by the variation they provided to the statement. This seems to be in agreement with (Brynjolfsson and Hitt, 2009) who state that, the employment of advancing technology like the modern sugar production processes, sugar production chemicals and sugar production machinery have the positive effect on the productivity like in output, quality and processing time of the sugar firm.

4.7.4 Breaking production processes into several components in business is preferred

Results in table 4.10 above show that respondents agreed to the statement that breaking of production processes into several components in business is prefers because it save time as shown by the mean value of 3.92, standard deviation 1.384. Respondents have different understanding about the statement which is shown by the variation they provided to the statement. This seems to be in agreement with (Davenport and Thomas, 1993) who state that, it's broken into several components of; preprocessing, processing and post processing.

Preprocessing involves determining resource requirement, and initiating the steps required to fill an order.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.0 Introduction

This chapter presents the summary, conclusions, summary and recommendations on investment in production technology and the productivity of sugar manufacturing industries in Uganda basing on the findings from the study.

The summary, conclusions and recommendations were to assess how investment in production technology influences the productivity of sugar manufacturing industries in Uganda.

Data was analyzed inform of tables to test the relationship between the independent variable and the dependent variable of the study.

5.1 Summary of findings

5.1.1 Production processes and Sugar productivity

While evaluating production processes, various qualities of production processes such as; sugar productivity, step by step refining of sugar cane, overstoring of sugarcane and productivity increase.

Findings from the study revealed that a majority of the respondents agreed that production processes enhance sugar productivity in sugar manufacturing industries for example, production processes become dynamic, reduced action of micro-biological action and faster production of sugar as well as increased output.

5.1.2 Production chemicals and Sugar productivity

While examining production chemicals, the researcher used variables like; chemicals improve on sugar color, consistent application, efficient and effective use of chemicals and that chemicals ease the separation of suspended solids.

Findings from the study revealed that the respondents agreed that production chemicals used at Lugazi Sugar Corporation increases the productivity of sugar by; improving on sugar color, fast production processes, easy separation of unwanted materials from the sugar crystals and that there is consistent application of chemicals to all production processes at the manufacturing plant.

5.1.3 Sugar production Machinery and sugar production

Production machinery was assessed using qualities like; simulation model tools, multiple effect evaporators, old and new sugar processing equipments and application of new technology for evaporation.

Study findings therefore showed that the respondents agreed that production machinery impact of Sugar production at Lugazi Sugar Corporation in a number of ways like; increased sugar productivity capacity, carrying out several production processes concurrently and that both old and new machinery improve energy saving capacity of the firm.

5.2 Conclusions

The study was aimed at assessing the investment technology on the productivity of sugar manufacturing firms in Uganda at Lugazi Sugar Corporation.

As per the results of the study, the researcher was capable to make conclusions on the influence of investment technology on sugar production industries in Uganda as below;

Production processes enhance reduced action of micro-biological bacteria, there are dynamic production processes and there is adoption of faster and efficient means of production which is evidenced by the responses summarized under the qualities such as; sugar productivity, step by step refining of sugar cane, overstoring of sugarcane and productivity increase.

Production chemicals help Lugazi Sugar Corporation to produce quality sugar products by separating the sugar from unwanted materials, increased rate of production and that there is consistency in the quality and quantity of sugar produced. It is also found that production chemicals allow long storage of the sugar.

Production machinery used at Lugazi Sugar corporation increases sugar production capacity, carrying different production processes at the same time and that there is improve energy saving capacity of the corporation.

As observed from the above it can be concluded that investment in production technology improves the productivity of sugar production at Lugazi Sugar Corporation as shown by the assessment of the different objectives of the study and the different variable of both the independent and dependent variables.

5.3 Recommendations

Basing on the findings of the study, the researcher found it very important to make some recommendations which thinks are important to act as a guide to the readers and other stakeholders and that it may help Lugazi Sugar Corporation improve its productivity.

From the study findings, it is relevant that Lugazi Sugar Corporation carry out continuous research to come up with new investment technology so as to have a competitive edge in the sugar production industry.

Lugazi Sugar Corporation should carry out employee training to equip them with the new technology that is introduced so as to enhance continuous and increased productivity.

The researcher also recommends that the Sugar Corporation should carryout frequent upgrade of their machinery to avoid stoppages in the production process or reduction in the quality and quantity of their sugar products.

5.4 Suggested areas for further study

The impact of environmental conditions on the productivity on the productivity of Sugar manufacturing industries in Uganda.

The role of organizational structure and the performance of Sugar manufacturing industries in Uganda.

The role of Sugar cane out growers on the performance on the performance Sugar manufacturing industries in Uganda.

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APPENDIX

APPENDIX I: QUESTIONNAIRE

Dear sir/ madam;

I am Anyipo Sarah student of Uganda Martyrs University pursuing Bachelor of Business Administration and Management.

This is purely an academic research aimed at establishing the effect of technology on the productivity of a sugar manufacturing factory with the case study being Lugazi Sugar Corporation (SOUL). You have been chosen as a respondent because you are a member/staff/part of management of Lugazi sugar corporation (SCOUL). I therefore request that you spare your valuable time and answer these questions. I promise as a researcher that the information you provide will be treated with utmost confidentiality and anonymity.

SECTION A: BACKGROUND INFORMATION

1. Gender

a) Male ☐ b) Female ☐

2. Age group (years)

a) 18 -24 ☐ b) 25-30 ☐ c) 31-34 ☐ d) 35-40 ☐

e) 41 and above ☐

3. Education level

a) Certificate or Diploma ☐ **b)** Degree ☐

c) Postgraduate ☐ **d)** Others, specify ☐

4. Duration you have been in Lugazi sugar corporation (SCOUL)

a) Less than a year ☐ b) 1-2years ☐ d) over 3 years ☐

SECTION B: sugar production processes;

Please tick your appropriate choice in the space provided using the keys given below;

1. S.D- Strongly Disagree **2. D**- Disagree **3. N.S**- Not Sure **4. A**- Agree **5. S.A**- Strongly Agree

Statement	**1**	2	**3**	4	**5**
1 Old sugar processes impact on the sugar productivity					
2. Step by step refining of sugar cane increase productivity					
3. Overstoring of sugarcane before processing degrades sugar					
4. Productivity increase starts right away from production stage, harvesting transportation and processing					

SECTION C: sugar production chemicals

Statement	**1**	2	3	4	5
1.The use of production chemicals help in improving on sugar color					
2.Consistent application of production chemicals enhances quality sugar production					
3.effecient and effective use of chemicals reduce the loss of sugar during the production processes					
4.chemicals help to ease the separation of suspended solids in the sugar juice					

SECTION D: production machinery;

Statement	1	2	3	4	5
1. The use of simulation model tools of new technology increases.					
2. Multiple effect evaporators promote increase in productivity.					
3. Both Old and new sugar processing equipments increase productivity.					
4. Application of the new technology for evaporation intended to improve the capacity energy saving improves on productivity.					

SECTION E: Productivity analysis

Statement	1	2	3	4	5
a) Output					
1. Output is by filling employees knowledge gaps					
2. correct rewards motivate the staff performance					
3. Conducive environment stimulates performance					
4. Staff involvement and commitment in the factory leads to the production of quality sugar					
b) Quality					
5. Employees training impact on production processes of sugar improves on the quality of sugar					
6. Being consistent to set standards promotes quality					
7. Changing needs of both internal and external stakeholders increases quality					
8. Continuous improvements promotes quality					
c) Lead time					
9. Workers' willingness to work at any time helps workers the corporation to capture bigger market share					

10. Well motivated employees are dedicated to work					
11. Reduced time of processing helps in beating deadlines					
12. Breaking production processes into several components in business is preferred					

APPENDIX II: KREJCIE AND MORGAN TABLE

N	S	N	S	N	S	N	S	N	S
10	10	100	80	280	162	800	260	2800	338
15	14	110	86	290	165	850	265	3000	341
20	19	120	92	300	169	900	269	3500	246
25	24	130	97	320	175	950	274	4000	351
30	28	140	103	340	181	1000	278	4500	351
35	32	150	108	360	186	1100	285	5000	357
40	36	160	113	380	181	1200	291	6000	361
45	40	180	118	400	196	1300	297	7000	364
50	44	190	123	420	201	1400	302	8000	367
55	48	200	127	440	205	1500	306	9000	368
60	52	210	132	460	210	1600	310	10000	373
65	56	220	136	480	214	1700	313	15000	375
70	59	230	140	500	217	1800	317	20000	377
75	63	240	144	550	225	1900	320	30000	379
80	66	250	148	600	234	2000	322	40000	380
85	70	260	152	650	242	2200	327	50000	381
90	73	270	155	700	248	2400	331	75000	382
95	76	270	159	750	256	2600	335	100000	384

Note: "N" is population size

"S" is sample size.

From: Krejcie, Robert V., Morgan, Daryle W., "Determining Sample Size for Research Activities", Educational and Psychological Measurement, 1970.