INNOVATION AND PRODUCTIVITY OF FLOUR MILLERS IN KENYA

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DECLARATION

I declare that this research is my original work and has not been presented for the award of any degree in any University.

Signature ..... Date: 29/10/2022

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This research has been submitted for examination with my approval as University Supervisor Onserio Nyamwange.

Signature…….. Date 07/11/2022

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DEDICATION

This research project is dedicated to my family for all the support they gave me, knowingly and unknowingly. I couldn’t do this without you.

Thank you.

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LIST OF ABBREVIATIONS AND ACRONYMS

FMCG	Fast Moving Consumer Goods
FTE	Full Time Employees
GDP	Gross Domestic Product
GMA	Grain Millers Association
R&D	Research and Development
SFP	Single Factor Productivity
TFP	Total Factor Productivity

ABSTRACT

This study sought to investigate the relationship between innovation and productivity of flour milling companies in Kenya. The researcher collected data from all the large-scale millers in Kenya. Questionnaires were used for data collection, administered using online forms and emails. Data analysis was carried out using statistical tools such as measures of central tendencies and regression analysis. The results of this research were presented using tables. The study found out that there was a significant positive relationship between innovation and productivity of flour milling companies in Kenya. It also revealed a positive significant relationship between the individual explanatory variables and the explained variable. The study showed that flour millers invested significantly into research and development and innovative activities, encouraged their employees to be more innovative and also were proactive in registering patents and trademarks to secure their intellectual properties. There is need for improvement on innovation in Kenya. Flour millers relied on purchasing most of their innovative technologies from international suppliers and therefore there is need for intervention to boost local production.

CHAPTER ONE

INTRODUCTION

1.1 Background of The Study

The manufacturing sector in sub-Saharan Africa accounts for only 13% of the Gross Domestic Product (GDP). Most of the sub-Saharan states have very limited scope of export-oriented manufacturing (World Bank, 2020). Kenya is the most developed country in the Eastern African region. The average contribution of the manufacturing sector in Kenya to its GDP, over a 50-year period up to 2019, is 10.22%. The lowest contribution was observed in 2019 at a low of 7.54% with the highest recorded in 2007 at a record of 12.79% (Global Economy, 2020). In Kenya, the manufacturing sector is a key pillar that will ensure rapid industrial growth, improve export capacity, provide employment and diversify the technology base of the country (Walter, 1991).

The Government of Kenya has attempted to boost its manufacturing sector by significantly investing in initiatives that boost the manufacturing capabilities of the country. Successive governments have come up with long term strategies to enhance the country's manufacturing sector. The President Kibaki led government rolled out a vision 2030 plan with three key pillars, that is an economic and macro pillar, a social pillar and a political pillar. The economic and macro pillar targeted to increase the GDP by 10% per annum and included manufacturing, tourism, agriculture and livestock, trade, information technology services and financial services (Government of Kenya, 2006). Science, technology and innovations are the foundation of the economic and macro pillar in the Vision 2030. Several projects have been completed under this pillar, key among them, the standard gauge railway from Mombasa to Naivasha, thousands of kilometers of tarmacked roads and electricity connectivity, that boost the manufacturing sector (National Treasury and Planning, 2020). In 2017, the President Uhuru led government launched an ambitious Big 4 agenda with manufacturing being listed as one of the four pillars, besides healthcare, housing and food security. The aim is to achieve 15% contribution to GDP from manufacturing (Government of Kenya, 2019).

The main backbone of the manufacturing sector is technology. Technology is defined as a state of knowledge applied in transforming resources into outputs. Technology can be in terms of processes or products that can be applied in efficient transformation of inputs and resources into

outputs. The outputs considered can be either new products introduced into the market, improved processes that streamline services offering or new approaches in social services (Korres, 2012).

Economies are interdependent and therefore more open. One technology will fully rely on another technology for relevance, for example, an android application is based on the existence of smart gadgets. Emergence of new technologies is as a result of innovation. Innovation is a major driver to gain competitive advantage and increase a firm's productivity (Canh et al., 2019). Innovation is integral in improving the living standards of a population, in advancing the objectives of firms and in improving the economies of countries. It is imperative therefore that policy makers understand the impact innovation has in achievement of the goals set out by an organization (OECD & Eurostat, 2018). The world is changing fast and therefore there is an urgent need for firms to build their innovative capacity. Innovation capacity is in terms of both product and process innovations (Canh et al., 2019). Product innovation deals with introduction of a new product or service that is an improvement of the previous offerings by the firm in order to gain competitive advantage. New products are required to gain new market and also to retain the existing markets. Process innovation on the other hand is the adoption of a new process by a firm that replaces or improves an older process, thereby increasing efficiency in delivering the objectives of the firm. This helps a firm cut down on their costs and gain competitive advantage in pricing of their final goods and services and in profit realizations (OECD & Eurostat, 2018).

1.1.1 Innovation

OECD defines innovation as either a new or an improved product or process that is significantly different from the preceding products or processes that a business unit or entity uses to gain competitive advantage (OECD & Eurostat, 2018). The United States small business association defines innovation as a process that begins with invention and then the development of this invention into a new product or a new process that fills a gap in the market place. Innovations can be viewed from the perspective of 'new to the firm' innovation or 'new to the market' innovations (Hall, 2011). Innovations can be for goods, products and services offered by a firm or innovations that improve the business processes of a firm. Innovation is perceived to be a key driver behind the productivity of a firm and due to this, firms in general embark on innovative strategies to gain competitiveness. Over the recent years, there have been many studies done to understand the relationship between innovation and firm productivity (Peters & Peters, 2008).

Product innovations can be classified broadly into two; technologically new products and technologically improved products. Products or services are considered to be technologically new if they are completely new offerings that are characteristically different from the previous offerings by a firm and whose intended use is also significantly different. These innovations are as a result of completely new technologies or a combination of existing technologies to come up with new products and services. Technologically improved products or services are existing offerings that have their performance improved to meet more needs through innovation. They can be complete systems that have one of their modules enhanced for better performance or a general upgrade of a component or a system that improves its functionality. This aims mostly to improve the functionality of the technology or to lower the cost of the technology (Korres, 2012). In order to consider a technology as an innovation, the resulting product must have at least one or more characteristics that is significantly better than the previous products that the firm offered. As a result, the new product should either address a gap in the market or should improve the functionality of the current product to work more efficiently.

The innovation activities of a firm are dependent on various firm characteristics. One factor is the internationalization of the firm. A firm that covers the global market and is present in several locations globally can make use of vast knowledge that would otherwise be hardly accessible to firms with a local outlook. This knowledge is held by the customers, competitors, foreign governments, employees from other locations among others. Another factor is the availability of resources. Innovations require huge capital investments in research and development (R&D), and firms with adequate funds to invest are better positioned to engage in innovation activities. The innovation capability of a firm is also another key factor into the ability of a firm to innovate. Firms with dedicated R&D departments are more likely to innovate. Similarly, different fields of technology offer different opportunities in innovation. Some fields hold higher innovative potential than others. Diversification is also another key aspect that influences the innovation activities of a firm. A firm with a wide offering of products and services will have higher chances of innovation than firms with limited scope of offerings. Finally, the ownership structure of a firm can also influence the innovative capacity of a firm. A conglomerate will easily access capital to innovate from a different branch of a business. A good case is when a company is venturing into a different business and sets aside capital from its existing businesses to fund the research into the new businesses. To note is that governance structure will not always bring innovation closer to the

firm level. In some instances, where a company is a multinational, innovation through R&D is at times only limited to the main headquarters and there is little or no innovation activities at branch levels in the different countries (Peters & Peters, 2008).

Larger firms have more incentives to innovate. They have more access to capital and can therefore undertake risky investments into innovations. Due to their sizes, the innovations also have better economies of scale. Their innovations will have more reach in the market than smaller firms, for a similar investment. The innovative activities are also complimentary to the management function of larger organizations (Peters & Peters, 2008).

1.1.2 Productivity

Productivity of a firm is a measure of the quantity of outputs of a firm compared to the inputs of the firm. A presumption in this definition is that the level of inputs of the firm are efficiently utilized to give the current outputs of the firm (Hall, 2011). Firms intend to maximize on outputs from inputs by increasing efficiency. This, in turn, increases their competitive edge. For profit making organizations, shareholder wealth is improved (Badaracco et al., 1991). Previous studies have defined a production function that relates the inputs of a firm to its outputs.

$$Q = AC^{\alpha}L^{\beta},$$

Where Q is the output, C is capital stock level, A is the level of productivity which varies per firm and L is labour. It can be noted that the productivity level for different industries will be different since not the same level of labour and capital will always give the same outputs for the different industries (Hall, 2011). To model this relationship, the study considers firms engaged in similar commercial activities. This study will focus on the large-scale tier one millers. From above equation, to increase productivity, one needs to increase the outputs while lowering the inputs. Innovations in the processes of production can lead to decreased inputs and increased outputs, thereby improving the firm productivity (Korres, 2012).

1.1.3 Flour Milling Industry in Kenya

The flour milling industry in Kenya constitutes both maize and wheat milling. The maize and wheat milling industries have a lot of similarities. The technologies involved are quite similar, with little specializations depending on the desired end product. There are 29 large scale millers,

considered as Tier I millers out of a total of 103 millers (Miller Magazine, 2021). These tier 1 millers, engage in both maize and wheat milling. Some millers also venture into the animal feeds industry since the by products from flour milling form key ingredients in the animal feed preparation (Dhakad et al., 2002). However, in this paper, the focus will be on the flour milling industry.

Kenya's staple food is Ugali, a traditional meal, that is prepared using maize flour. On average, the annual consumption of maize meal in Kenya is 2.7 million tonnes (Khamila et al., 2019), with Tier I millers, accounting for 1.77 million tonnes of this capacity (Miller Magazine, 2021). The maize flour production process has evolved over time, from the traditional pounding of maize in a mortar, to small posho mills, to the modern mills consisting of arrays of machines. Modern flour mills consist of tens of machines that work concurrently to dry, add moisture, degerm and grind the maize seeds, then sift the flour produced and eventually pack it with cutting edge technologies that can produce up to 432 tonnes of maize flour per day (Maize Milling, 2021) (Maize and Wheat Flour Market in Kenya, 2016). It is during this degerming, grinding and cleaning process that millers can customize their products to specific target markets. In 2012, the government of Kenya, introduced mandatory regulations on fortification of staple foods to meet the nutritional targets of the population. Maize flour was specifically chosen due to its wide spread consumption by the Kenyan population. To meet these government requirements on fortification, they have set up laboratories that formulate proper recipes through R&D for their fortification processes to meet the regulatory requirements (Khamila et al., 2019).

Kenya grows an average of 350,000 metric tonnes of wheat annually which only accounts for 33% of the market demand (Gitau et al., 2010). The country significantly relies on imports to meet the market requirements. Consumption trends show that wheat products are mostly consumed for breakfast, such as chapatti, bread, mandazi. The production of wheat flour relies heavily on the large-scale Tier I millers (Nzuma & Kirui, 2021). Tier 1 millers have invested millions of dollars in wheat milling plants that operate between the capacity of 150 tonnes per day to 750 tonnes per day per single milling line. To gain competitiveness, millers customize their products into special purpose flours such as home baking flour, chapati flour, self-rising flour among others to address the specific market needs. It is this specialization that really shows the innovative capacity of a wheat milling company (Wheat flour, 2021).

Flour milling also depends on the flour extraction levels. This influences the profitability of the business. The recommended extraction levels are 78%. This is determined by the level of grinding and sifting of the flour. An inefficient process may go as low as 70% which in effect means that for a production of 300 tonnes per day, the miller loses 8% of the production, translating to a loss of 24 tonnes of flour daily. Millers ensure continuous improvement of their production processes, using emerging technologies, to optimize their extraction levels while maintaining the flour quality and production costs at optimum levels. Flour millers achieve this by employing innovative millers, conducting R&D and acquiring innovative technologies from their suppliers (The BC Cook Articulation, 2015).

1.2 Research Problem

Innovation is believed to be a driving force for growth and competitiveness, at firm level and even at national level (Peters & Peters, 2008). Innovation is now, more than ever, more pertinent because there is increasing international competition, the markets are becoming more challenging and technologies are changing rapidly (Ngugi & Karina, 2013). Innovation is majorly concerned with the ability of a firm to improve on the existing products and services or introducing new products and services efficiently. The net effect of these practices is lowering the cost of production while increasing the output levels of an organization, thereby increasing the overall productivity. This will in turn increase the organizations competitive advantage (Canh et al., 2019).

The flour milling sector has seen a lot of competition and therefore, the need to adopt innovative technologies. Over time, trends in the milling sector have changed. Millers need to be adaptive to the changes in market dynamics in order to meet the market needs and to be competitive. Consumer preferences have seen millers produce prime maize flour brands that are pure white in color, at higher costs of production and specialized wheat flours, optimized for different applications such as baking. Government regulations on fortification have also made millers change their fortification processes to improve the quality of the flour. To meet these requirements, millers have to adapt innovative technologies and employ innovative employees who can integrate the market needs into the production process. Once they achieve the desired product outputs, the millers then invest in securing their intellectual properties by means of patents and trademarks. Using these trademarks, millers then release the products into the market and invest in unique branding and marketing of their products in order to enlarge their market share.

This study will measure the productivity of the firms that arise as a result of these innovation activities by analyzing ratio of turnover of the firm against the capital and operational expenditures (Korres, 2012). For these firms to survive in the competitive markets, they need to consistently innovate. They need to continuously improve their existing products and services and apply more innovations to release new products and services.

Several researches have been conducted locally and globally, that investigate the relationship between innovation and productivity. Griliches (1985) focused on Japanese manufacturing firms and studied the impact innovation had on the productivity of the firms. The research only looked at R&D as the only variable for innovation, but did not account for the other variables that account for innovation. The study concluded that there existed a strong positive relationship between the innovation of a firm and its productivity. Mairesse and Jacques (1991) focused their study on R&D too as the innovation variable that influences the productivity of the firm. The study failed to take into account the time period effects of innovative activities since some innovations take time to materialize into tangible outputs. The study found out that the more the firms engaged in R&D, the higher their productivity. Crépon, Duguet and Mairesse (1998) focused their research on innovation and productivity at firm level with a specific focus on French firms. In their study, they found out that to get an accurate model, the firms under study would need to be engaged in the same commercial activity at the same scale. This study showed the importance to study firms engaging in similar activities and on similar levels of operations. Their study concluded a positive correlation between firm productivity. Hall (2011) focused on innovation and productivity by analyzing secondary data held by governments in Europe and the United States of America. The study concluded that they process innovation had an ambiguous impact on revenue productivity but product innovation had a strong positive impact on revenue productivity for the firms under study. The study concludes that despite the fact that innovative activities of a firm are not very well measured, they still increase the ability of the firm to generate revenue from its inputs. Ngugi and Karina (2011) studied the effect of innovation on the performance of banks in Kenya and concluded that the strategy of the firms dictated the kind of innovative activities the firms engaged in. According to the study, the innovation activities of the banks directly affected the profitability of the banks. Njogu (2014) focuses on effects of innovation on productivity of small and medium enterprises. The shortcoming in the research is that firms engaging in different activities will have different levels of innovations and different outcomes from their innovation activities. The study

concluded that there was a strong coefficient of determination that showed a large percentage of financial performance could be explained by innovation.

The studies discussed focused on the relationship between R&D as the indicator for innovation and productivity. The studies covered different sectors, with some covering the manufacturing field in an entire country and others the small and medium enterprises in a country. There was no study conducted that narrowed down into a single manufacturing field, comparing firms with similar interests and similar operations, and therefore there exists a knowledge gap. Our study addressed this gap by addressing the relationship between innovation and productivity in the flour milling industry in Kenya.

1.3 Research Objective

The objective of this research was to investigate the relationship between innovation and productivity of flour milling companies in Kenya.

1.4 Value of the Study

The findings of this research add value to the existing knowledge regarding the relationship between the level of innovation of a flour milling company to the productivity of the manufacturing firm by investigating this relationship with respect to the flour milling industry in Kenya. Scholars can use the findings of this research to build on future research and add more knowledge in this field.

Tier one millers invest tens of millions of dollars in their production processes and therefore it is quite imperative that they gain maximum returns from their investments. In an ever-changing world, there is stiff competition and market demands change rapidly, therefore millers need to be adaptive to change. It is becoming more evident by the day that product differentiation and improving one's product portfolio plays a very critical role in gaining competitive advantage. Our study looks at how innovative activities will help a firm to differentiate their products by improving them and coming up with new products and services. Before a mill owner invests in any innovative activity, they will require a forecast on the expected increase in sales and profitability as a result of the innovation. This research enables a mill owner see the potential return on investments and guide them on the level of investment into innovation related activities. This research also shows the importance of acquiring innovations promptly. The mill owner will be heavily relying on their

equipment manufacturer to customize their processes, meaning the source of innovation will not always be in house. This research shows the importance of having an R&D department or having employees engage in R&D during their day-to-day activities in the company. It also shows the importance of securing intellectual property by means of patents and trademarks.

Finally, this study also contributes to the body of research which tries to investigate the relationship between innovation and productivity in manufacturing firms.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This literature review relates to the relationship that exists between innovation and firm productivity with an inclination towards manufacturing companies. It covers previous studies conducted across different markets and countries. It also reviews the research gap that exists on the relationship between innovation and firm productivity.

2.2 Theoretical Framework

2.2.1 Schumpeter Theory of Innovation

Schumpeter, in the Economic development theory, describes development historically as a process that is driven sustainably by innovation. The study categorizes these innovations into launch of new products or services or a launch of a new variation of an existing product or service, venturing into a new market where the firm had no representation at all before, reorganizations and restructurings of an organization for example devolving from a monopoly, acquisition of new sources of supply of inputs such as raw materials and semi-finished goods and application of new production methods or new methods sales not yet proven in the target market (Schumpeter, 1934).

The researcher further argues that to make profits, one must innovate. The researcher also believed that innovation is a key driver for competitive advantage at firm level (Porter & Stern, 1999) and is center of economic change at national level (Schumpeter & Swedberg, 2014). It therefore follows from the research that innovation is a process of transformation of the industry by destroying the old economic structure and creating a new one (Croitoru, 2017). Schumpeter divided the innovation process into the four dimensions that are involved. These dimensions include invention, innovation, diffusion and imitation (Burton-Jones, 2003). At the core of these four dimensions is the entrepreneur (Śledzik, 2015), in our case, the mill owner. The mill owner is now responsible to create new opportunities for growth, investment and employment, and in overall improving firm productivity. The first two dimensions of innovation, invention and innovation have a small impact on the productivity of a firm but diffusion and imitation greatly influence firm productivity (Dore, 1988). Schumpeter concludes that innovation is the only

function that is critical to ensuring sustained productivity of a firm and is a key function that falls under the responsibility of the entrepreneur (Croitoru, 2017). Hence, it follows that for a mill owner to be productive and gain competitivity, they need to engage in innovation activities at firm level. This paper studies the relationship that exists between the innovation and productivity of the flour manufacturing firms in Kenya.

2.2.2 Rogers' Diffusion of Innovations Theory

Roger's theory is a theoretical framework that is widely used to explain technology diffusion and adoption (DooleyPh.D., 1999). Roger's states that most research towards innovation diffusion involves technological innovations and therefore interchangeably uses technology and innovation in the research framework. Roger views technology as a combination of software and hardware, with the hardware having higher adoption rates due to tangibility (Sahin, 2006).

Roger's theoretical framework defines four main elements in the diffusion of innovations. The first element is innovation which deals with the introduction of a new idea to the consumer. The new product or service could have been invented a while back, but will be new to the end user at the time they receive it. The next element is the communication channels where participants will create information and effectively share it among all concerned parties with an aim to reach a mutual understanding. The third element is time, where Rogers stipulates that it is imperative to consider the time frame when an innovation is released. This is to meet the consumer needs at the appropriate and required time. It greatly influences the success of the innovation. Finally, the fourth element as the social system. The diffusion of the innovation takes place in the social system and therefore critical in categorizing adopters (Rogers, 1983).

The theory also captures the five-step innovation decision making process. The five steps are knowledge, persuasion, decision, implementation and confirmation (Sahin, 2006).

The theoretical framework then classifies the adopters into five categories, that is, the innovators, the early adopters, the early majority, the late majority and laggards. Innovators are deemed as willing to experiment with new ideas and are therefore willing to cope with the uncertainty of the innovation (Rogers, 1983). Early adopters are mostly members of the society in leadership positions. They society will mostly come to them for advice on whether to accept or reject an innovation and therefore act as a stamp of acceptance on an innovation (Light, 1998). Early

majority follow after the early adopters. They adopt the innovation before their peers and have extensive inter-personal networks that will influence how people adopt the technologies. Late majority form a third of the population. They are skeptics majorly but peer pressure and necessities force them to adopt the new innovations and finally laggards are the most skeptic. They will not adopt a technology until they ascertain that it is successful by reviewing how other members of the society adopted. They basically also lack basic knowledge and are quite unaware when it comes to the innovations (Rogers, 1983) (Sahin, 2006).

Many other studies have been conducted using this framework; including Medlin (2001) who used the framework to study the factors that can influence adoption of technologies in classrooms by the teaching institutions. Surendra (2006) used this framework to study the acceptance of web technology by lecturers in a university. Al-Alwani (2005) also used Roger's theory to study the implementation of IT into a learning curriculum.

2.3 Innovation Practices

Innovation activities, are the scientific, technological, organizational, financial and commercial steps which are intended to lead to the implementation of technologically new or improved products and processes (Korres, 2012). R&D is one of these indicators and is carried out throughout the lifecycle of the innovation activity. It can serve both as the driver to new inventions coming to market or as a technology that can be called upon at any point during implementation of the innovation activity. R&D can also be viewed from the perspective where a firm acquires a technology that will suit its needs and assist in gaining some competitive advantage. More often than not, after this acquisition, R&D is again applied to complete the innovation to suit the firm's portfolio. Besides R&D, another important indicator is the registration of patents and trademarks. These are set up to protect the intellectual property of a firm that is usually as a result of their innovations (Merrill et al., 2004). Intellectual property is defined by the Oslo manual as creations of the mind that comprise of inventions; literary and artistic works; and symbols, names and images used in commerce (OECD & Eurostat, 2018).

This paper analyzed innovation indicators in a firm with a focus on activities relating to R&D and patents. These two parameters are preferred, since according to research done, they are easily measurable and therefore, data is available (Hall, 2011). R&D is viewed as a cost, measured in terms of the amount of money spent by a firm on creating innovations or acquiring innovations. It

is a conscious management decision that is agreed upon when the management of a firm decides to what extent they are willing to invest in innovations. The number of employees a firm has who have dedicated their resources to innovation also plays a part in this cost, with employees who are working part time on innovations billing their hours to the R&D budget (Korres, 2012). The number of patents and trademarks registered by a firm in a certain period can also be a measure of the innovation activities of a firm. They are considered to be a measure of invention success and therefore a measurable outcome of an innovation activity of a firm (Hall, 2011).

2.3.1 Research and Development

Quantifying innovation has not been an easy task and researchers have put in a lot of work to define parameters that can correctly assess the innovative activities of a firm. A general consensus however exists that research and development is the main innovation indicator in a firm, for example, the R&D expenditure and the engagement of employees into innovative activities. The benefit is that this gives easily quantifiable data. However, there are some short comings that arise when assessing the relationship between the innovation of a firm and its productivity (Peters & Peters, 2008). Additionally, no two innovations are the same and therefore the impact of the inputs that quantify the innovation are not similar. An innovation may need a radical change in the product offering and be a game changer or it may be an improvement on an existing technology to improve competitiveness (Hall, 2011).

Some researchers argue that the R&D input does not directly affect the productivity of a firm, but rather, it is the R&D output that influences productivity. However, there are no quantifiable methods of calculating the R&D outputs (Peters & Peters, 2008). It is also argued that sampling of firms for study may bring in a bias since not all firms are engaged in R&D (Heckman, 1979). Not all firms also have the same capabilities to invest in R&D. The factors that influence the level of investment in R&D include the availability of capital based on the ease of access of capital from financial institutions; economies of scale that influence the R&D function of a firm, where larger firms can dedicate a R&D team to work on an array of innovations; the innovation capital cost where large firms will spread the cost over their wide range of portfolios and finally the fact that R&D is a management decision which is complimentary to other activities carried out by the firm (Kortum, 1993).

2.3.2 Patents and Trademarks

Patents are viewed as a measure of the innovation activities of a firm (Evenson, 1984). Companies are adopting different ways to secure their innovations, including secrecy, non-disclosure agreements, ensuring they are the first to the market and using their marketing and communication models to validate the perceptions of their innovations in the market while discrediting imitators. The main leader in this being pharmaceutical companies (Cohen et al., 2000).

A significant constraint faced in using patents as a measure of innovation is the fact that one patent may require several R&D activities and some patents may require way less and therefore both patents will not be a representation of equal innovation effort (Griliches, 1990). It is also increasingly expensive to register patents and time consuming (Kortum, 1993).

Increasingly, companies are also registering trademarks in order to secure their intellectual properties. The trademark distinguishes the product of a firm from its competition and signifies exclusive ownership by the firm. It protects the owner from other entities that may attempt to imitate their product (Kenya Industrial Properties Ltd, 2017).

2.4 Analysis of Productivity

Several factors influence productivity at firm level. Human labour and capital investments as key inputs to productivity have been extensively examined by researchers. However, productivity could not be entirely be attributed to the two factors only. It then became clear that capital and labour only explained a fraction of the output of a firm (Triplett, 1999) (Kendrick, 1976). These researchers found that an increase in the headcount of a firm didn't necessarily correspond to an increase in the performance of the firm. Griliches (1998) then went on with further research and found that technological advancement, in terms of innovations, was a major source of productivity, both at firm level and national level. Energy also played a very crucial role in determining the level of productivity of a firm. As the firm grows, energy consumption grows significantly, however, with introduction of innovations, the consumption of energy goes down and therefore improving the overall firm productivity (Korres, 2012).

The productivity function, as described in the introduction is a relationship that denotes the maximum output that can be obtained from a specified number of inputs (Hall, 2011).

$$Q = AC^{\alpha}L^{\beta},$$

Equation 2.3.1

The Cobb Douglas production function then introduced a factor K that denoted knowledge capital as an input to the overall productivity of the firm. Equation 2.3.1 is then expounded to become;

$$Q = AL^{\alpha}C^{\beta}M^{\delta}K^{\gamma}e^{u}.$$

Equation 2.3.2

Where K denoted the knowledge capital and M denoted the material capital. An error term, u is also introduced to take care of the unpredictable systematic shocks in production that would otherwise not be accounted for by the variables Cobb Douglas considered (Peters & Peters, 2008).

Partial, or single factor productivity (SFP) is the relationship between one input and the overall output of the firm. For example, a SFP of labour would be measured as the ratio Q/L, a SFP of capital would be measured as the ratio of Q/C (Korres, 2012). According to Griliches (1990) knowledge capital is measured by R&D capital stock. From equation 2.3.2, we find derive the SFP of knowledge to be Q/K. Productivity therefore is a function of R&D. Crépon et al. (1998) improved this model further by proposing to use the R&D input as a parameter that influences productivity, thereby simplifying the above 2.3.2 to state that A=f(K) where; A is output of the firm divided by the inputs of the firm.

Further studies then developed the model further to use innovation input, comprising of R&D investments, patents and trademarks registrations as variables in determining firm performance (Lööf & Heshmati, 2002).

2.5 Empirical Studies

There have been several researches conducted to investigate the relationship between innovation and productivity. Early researchers like Adam Smith found out that productivity was easily increased by increasing the skill set of the workers, saving the times spent in task switching and invention of higher capacity machines with greater capabilities (Huggins & Izushi, 2007). Further research was conducted by economists and results showed that the technological and organizational innovations play the biggest role in the productivity and growth of a company (von Tunzelmann, 1995). It was seen that labour and capital, which were perceived as the main inputs to trigger productivity were classified as internal frameworks and technological innovations were

classified as external frameworks that influenced the productivity of a firm (Schumpeter & Swedberg, 2014). In the mid 1980's researchers found that R&D played a critical role in defining the innovation activities of a firm. The result of these innovative activities directly influenced the output of the firms and therefore it was observed that the productivity of these firms increased (Romer, 1986).

Brownwyn Hall conducted studies to investigate the relationship between innovation and productivity. In the study, the researcher denotes that capital and labour could not independently explain productivity of American firms and that there was a residual factor that Hall attributed to technological change. The study was conducted in America and European countries with data being obtained from the government databases. The study revealed a positive relationship between innovation and productivity and these resolves were beneficial to firms in incorporating innovations into their competitive strategies. The challenge faced with this research however, was that the diverse markets posed different effects of similar variables and therefore recommended further studies focusing on similar markets to model similar environments of operation (Hall, 2011).

Innovation was also seen to influence productivity through a research by George and Drakopoulos (2009). The study covered the influence of innovation on productivity with a focus on national level economics. R&D was seen to be a major driver of economic growth. The R&D capital was estimated as a percentage of GDP across several countries and it was observed that countries with a higher expenditure as a percentage of GDP showed better economic growth compared to their counterparts. In their study though, they mention that R&D cannot be the only indicator of innovation and that there was need for further studies to study the other factors of innovation that would drive productivity and to also narrow it down to firm level.

Another study by Pardis Nabavi in four papers, also detailed the relationship that exists between innovation and productivity. The studies were carried out in Sweeden with a focus on manufacturing firms. With data obtained from firm level data provided by Statistics Sweeden, the research was able to model a relationship between innovation and productivity. The study covers the entire population. The innovation input in the study is measured according to the level of R&D employed in each firm and the patents registered by each firm and by using multiple linear regression, the research found there exists a positive relationship. In their summary, they

recommend future research to be specific to individual sectors so that the sensitivity of the results is higher (Nabavi, 2015).

The Economic Social and Research council also conducted a study to model the relationship between innovation and productivity. They attempted to address the gap that exists in describing the aggregate productivity of a firm as a factor of the innovation of the firm. The study looks at knowledge as the foundation of R&D which brings about innovations. It also critically examines the role of the entrepreneur as the innovation's leader of any organization. The paper does exploratory research and concludes that firms that engage in innovations and where the owners are the leaders in implementation of innovative strategies are more productive than the counterparts. In their recommendations, the researchers see need for further research to investigate the role of the human resource of a company in driving innovations as behavioral practices (Higgins, 2018)

The banking sector in Kenya has also leveraged on innovation to increase the productivity. According to a research by Ngugi and Karina, they were able to relate the innovation strategies of a banking institution to the performance of the bank. In their conceptual framework, they check the market, product, process and technology innovation strategies as drivers of innovation. They employ regression data analysis techniques to analyze the raw data obtained through questionnaires. They however do not relate the innovation activities to their source and therefore recommend that further studies are conducted on the sources of the innovations (Ngugi & Karina, 2013)

2.6 Conceptual Framework

A conceptual framework is defined as a representation that conceptualizes the relationship between the variables under study. The relationship is represented visually in graphical or diagrammatic form. The conceptual framework designs the research questions that seeks to address your problem statement, thereby addressing the issues that the researcher identified as the research gap (McGaghie et al., 2001).

The independent variables in this study were the capital invested into R&D and innovation, engagement of employees in R&D and innovation and the registration of patents and trademarks by the company. The capital invested is broken down into the amounts spent in house on research and the amount spent to acquire new technologies. The dependent variable is the productivity of the firm measured as a ratio of the turnover from the sales to the overall capital and operational inputs by the company over a specified period.

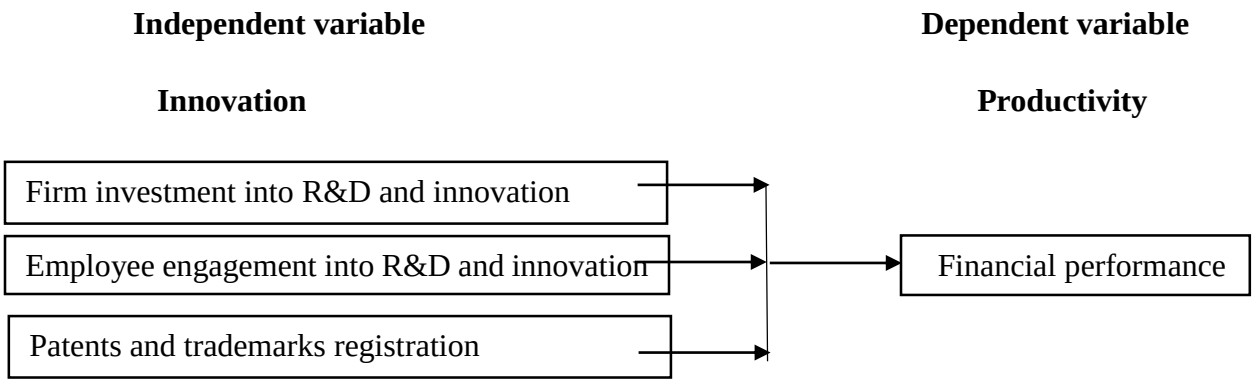

Figure 2.6: Conceptual framework

Where productivity in a specified period = total turnover over the period / total expenditures during the same period.

CHAPTER THREE

RESEARCH METHODOLOGY

This chapter defines the methods used to conduct this research. It defines the research design, the targeted population, the data collection techniques that were applied and the data analysis methods.

3.1 Research Design

This research was conducted through a descriptive research design. A descriptive design collects information and reports it as it is (Mugenda & Mugenda, 2003). The descriptive research design was therefore the most suitable to analyze the relationship that exists between the independent and dependent variables (Kothari, 2004). The study focused on productivity of flour millers in Kenya.

3.2 Target Population

The research targeted Tier 1 millers in Kenya. According to the Grain Millers Association (GMA), Kenya has 103 registered millers with Tier 1 millers only being 29 but taking up 65-70% of the market production (Miller Magazine, 2021). The study took the entire population of the Tier 1 millers. The study restricted the respondents to tier I millers since firms with different scales of operations would have different output effects from similar inputs, therefore the study was able to accurately assess the impact of the independent variables uniformly across the population (George & Drakopoulos, 2009).

3.3 Data Collection

The data that was used in this research will be primary data, collected using a questionnaire that was administered to the respondents electronically by email. The questionnaire method was preferred since the data required was already in existence and held by the firms considered in this study. A questionnaire was able to collect the required data from the respondents in a short span of time and in a cost effective manner (Kothari, 2004). This data was sourced from the milling companies directly. The questionnaire was addressed to the mill general manager and captured general information about the company, financial information about the company such as its turnover, total expenditures and expenditures on R&D, employee data related to their R&D practices and company practices with respect to patents and trademarks.

3.4 Data Analysis

The research used descriptive methods of statistics to analyze the data collected. Data was analyzed using measures of central tendencies and measures of dispersion to give a good analysis of the characteristics of the respondents. The data was then analyzed using measures of relationship, in this case, regression analysis. This analysis helped investigate the existence of a relationship between the independent variables and the dependent variable. The multiple regression model that was used to analyze the data collected was as follows:

$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \varepsilon$

Where;

Y = Firm productivity (dependent variable)

β_0 = Constant variable

X_1 = Investment into R&D innovation

X_2 = Employee engagement into R&D and innovation

X_3 = Patents and trademarks registration

β_{1-3} = coefficients of the independent variables X

ε = Error term

CHAPTER FOUR

DATA ANALYSIS, RESULTS AND DISCUSSION

4.1 Introduction

This chapter presents the findings of the study on the relationship between innovation and productivity of flour millers in Kenya, the interpretation of results on the objective of the study and a summary discussion of the findings.

4.2 Response Rate

The study targeted 29 grain millers dealing in both maize and wheat farming and complete data was obtained from 21 respondents. The response rate is therefore 72.4%. According to Mugenda & Mugenda (2003), a response rate of 50% is deemed as adequate, 60% as good and 70% as very good. The researcher therefore found that the responses were sufficient to proceed with the study.

Table 4.1: Analysis of rate of response

	Frequency	Percentage %
Completed responses	21	72.41
Incomplete/unreturned responses	8	27.58
Total	29	100

4.3 Demographic Analysis

The study in the table below shows that 38% of the respondents have between 50 and 100 employees and that 76% of the respondents have been in operations for more than 10 years. We also see that 5% of the respondents have more than 200 employees and 5% have been in operations for less than 3 years.

Table 4.2: Demographic data analysis

Number of employees	Response rate	Percentage %
50 or less	4	19.05
50 – 100	8	38.10
100 – 150	4	19.05
150 – 200	4	19.05
Above 200	1	4.76
Total	21	100.0

Duration in business (years)	Response rate	Percentage %
Less than 3	1	4.76
3-10	4	19.05
Above 10	16	76.19
Total	21	100

4.3.1 Annual Turnover

The results from the respondents as compiled on table 4.3 show the three-year average annual turnover of the respondents. Majority of the respondents at 38.1% have an annual turnover averaging between five hundred million to one billion Kenya shillings.

Table 4.3: Annual turnover in million Kenya shillings over the last 3 years

Turnover (million Kshs)	Frequency	Percentage %
Below 500	3	14.29
500-1000	8	38.10
1000-1500	4	19.05
1500-2000	3	14.29
Above 2000	3	14.29
Total	21	100.00

4.3.2 Annual Expenditures

The results from the respondents as compiled on table 4.4 show the annual expenditures of the respondents over the last three years. Majority of the respondents at 38.1% have annual expenses averaging between five hundred million to one billion Kenya shillings.

Table 4.4: Annual expenditures in million Kenya shillings over the last 3 years

Total expenditures (million Kshs)	Frequency	Percentage %
Below 500	6	28.57
500-1000	8	38.10
1000-1500	4	19.05
1500-2000	3	14.29
Above 2000	0	0.00
Total	21	100.00

Source: Research findings

4.4 Firm investment into R&D and Innovation

The study on table 4.5 aimed at examining the extent of investment into R&D and innovation practices to the productivity of a flour milling firm in Kenya. The study showed that majority of the respondents ensured they produced superior quality products than their respondents with a mean score of 4.67 and SD of 0.48. The study also showed that the respondents had the least mean of 2.71 a standard deviation of 1.01when it came to ensuring that they had a dedicated budget for research and development for process innovations.

Table 4.5: Extent of investment into R&D and innovation

Investment into R&D and innovation	Mean	SD
In product innovation, our company does more product innovation than the competition.	3.00	1.14
We have a dedicated R&D budget for product innovations	2.86	1.46
We are always first to release new and improved products into the market.	2.71	1.35
Our new products released lead to an increase in turn over.	2.81	0.93
Improvement on existing products released leads to an increase in turn over.	3.67	1.11
New products are perceived as the best by customers.	3.38	0.80
We are able to respond to market demands with new and improved products.	4.05	0.67
In process innovation, our company is better than the competition.	3.05	1.16
We have a dedicated R&D budget for process innovations.	2.71	1.01
We invest in training our personnel to be conversant with the latest milling processes.	3.48	1.47
It is important to us to acquire the latest technologies from our equipment suppliers.	4.05	1.07
Our efficiency is increased with improved processes.	4.57	0.51
Improved processes often lead to increased profitability.	4.24	1.00

Our processes ensure we produce superior quality products.	4.67	0.48
In marketing innovations, our company is better than the competition.	2.76	1.64
We consider social media and digital marketing as an important tool in our marketing strategy.	2.90	1.67
We have engaged part of our marketing team to be dedicated to carry out research on market demands.	3.48	0.81
We have dedicated members to work on our digital marketing strategy.	3.00	1.70
We maintain a strong online presence to interact with our customers.	3.10	1.79
We are quick to jump on current trends in social media as part of our advertising tactics.	3.00	1.48
We have the latest technologies in our marketing strategy.	2.86	1.56
We respond to customer suggestions and complaints promptly and to their satisfaction.	4.62	0.67

4.5 Engagement of Employees into Research and Development

The study on table 4.6 aimed at examining the extent of engagement of employees into research and development practices on the productivity of a flour milling company in Kenya. The results showed that it was important to the respondents that their staff generally understood the importance of being innovative and carrying out innovative practices in their day to day at a mean of 3.86 and standard deviation of 1.35. The respondents also had the least mean of 1.71 with a standard deviation of 0.96 on having a reward scheme in place to motivate their employees to innovate.

Table 4.6: Extent of employee engagement into R&D and innovation

Employee engagement into R&D and innovation	Mean	SD
Our employees engaged in R&D and innovation activities.	3.76	0.70
We consider it important to have employees dedicated to R&D and Innovation on full time basis.	3.38	1.50
All our departments engaged in R&D activities.	3.29	1.45
Our staff generally understand importance of being innovative and carrying out innovative practices in their day to day.	3.86	1.35
We send our employees to seminars, workshops and conferences to acquire skills.	3.81	1.08
We have a policy to encourage employees on the need for innovation.	3.00	1.10
We have a reward scheme to motivate your employees to innovate.	1.71	0.96
We receive ideas from our general employees that would lead to innovations.	3.24	1.30

4.6 Patents and Trademark Registration

The study on table 4.7 aimed at examining the extent of patent and trademark registration on the productivity of a flour milling company in Kenya. The respondents strongly agreed that it was very important to them to secure their intellectual property by means of patents and trademarks. The mean result for this was 4.81 with an SD of 0.40. The respondents similarly had the least mean of 2.0 with an SD of 1.41 when it came to patent and trademark registrations in response to new market approaches in products and pricing.

Table 4.7: Extent of patents and trademarks registration

Patents and trademarks registration	Mean	SD
It is important to secure our intellectual property using patents.	4.81	0.40
We have a dedicated budget for patent registrations and renewals.	3.71	1.45
We have a target on the number of patents registered by our company each year.	2.52	1.66
It is important for us to register new trademarks for each product released.	2.48	1.86
We have a dedicated budget for trademarks registrations and renewals.	3.48	1.54
We have a target on the number of trademarks registered by our company each year.	2.62	1.53
We register new trademarks to respond to new market approaches in terms of pricing and products.	2.00	1.41
We are proactive in assessing the market demands and coming up with new products.	4.24	0.70
We are first in the industry to release new products to the market.	2.24	1.09
New products significantly increase our revenue earnings.	3.10	1.41

4.7 Relationship between Innovation and Productivity

Inferential statistics are used to draw conclusions from data collected from a population. This can be demonstrated by using regression analysis and analysis of variance (ANOVA) (Trochim, 2022).

Regression analysis was used to determine if there existed a relationship between the independent variables of innovation and the dependent variable of productivity. The independent variables were measured by the investment into R&D and innovation, engagement of employees into innovative activities and patent and trademark registrations. The dependent variable of productivity was measured as a ratio of the total revenue of a company versus the total expenditures of the same company.

The degree to which the investment into R&D and innovation, the employee engagement into innovative activities and the patent and trademark registration is related to the productivity of a flour milling company in Kenya was modeled to give a positive correlation coefficient (R) of 0.829 and coefficient of determination (R^2) of 0.687. This means that 68.7% of the changes in the productivity of a flour milling company in Kenya can be attributed to investment into R&D and innovation, the employee engagement into innovative activities and the patent and trademark registration. The adjusted R square result of 0.631 shows that 63.1% of the variance in the productivity of the firm can be attributed to the investment into R&D and innovation, the employee engagement into innovative activities and the patent and trademark registration.

Table 4.8: Regression summary

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.829a	.687	.631	.07757
a. Predictors: (Constant), Investment into R&D and innovation, Employee engagement into R&D and innovation, Patents and trademarks registration				

4.8 Significance of the Relationship between Innovation and Productivity

The findings on table below show the analysis of variance that was used to test the significance of the overall model. The significance level of 0.000 is lower than 0.05 which means that the model is significant, which means that there is a significant impact of the investment into R&D and innovation, the employee engagement into innovative activities and the patent and trademark registration to the productivity of a flour milling company in Kenya.

Table 4.9: Analysis of variance

ANOVA						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.224	3	.075	12.411	.000b
	Residual	.102	17	.006		
	Total	.326	20			
a. Dependent Variable: Productivity						
b. Predictors: (Constant), Investment into R&D and innovation, Employee engagement into R&D and innovation, Patents and trademarks registration						

The results on table below were used to analyze the significance of each independent variable to the dependent variable. The constant variable gave a p-value of 0.490 which is higher than 0.05 and therefore it was considered insignificant in this study. The investment into R&D and innovation gave a p-value of 0.005 which is lower than 0.05 and therefore the variable is significant in the model. Employee engagement into innovative activities gave a p-value of 0.01 which is less than 0.05 and therefore the variable is also significant to the model. Patent and trademark registration gave a p-value of 0.001 which is also less than 0.05 and therefore significant to the model.

The findings are based on the regression model:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \varepsilon$$

Where;

Y = Firm productivity (dependent variable)

β_0 = Constant variable

X_1 = Investment into R&D and innovation

X_2 = Employee engagement into R&D and innovation

X_3 = Patents and trademarks registration

β_{1-3} = coefficients of the independent variables X

ε = Error term

The study shows the extent to which investment into R&D and innovation, the employee engagement into innovative activities and the patent and trademark registration predict the productivity of a flour milling company in Kenya.

Table 4.10: Coefficients of determination

Coefficients						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.156	.221		.705	.490
	Investment into R&D and innovation	.119	.037	.471	3.220	.005
	Employee engagement into R&D and innovation	.114	.039	.543	2.882	.010
	Patents and trademarks registration	.159	.039	.731	4.080	.001
a. Dependent Variable: Productivity						

From the results of the study, the regression model now becomes;

$Y = 0.119X_1 + 0.114X_2 + 0.159X_3 + \varepsilon$

The coefficients are positive therefore meaning the independent variables positively influence the dependent variable. A unit increase in the investment into R&D and innovation, the employee engagement into innovative activities and the patent and trademark registration causes an increase of 0.119, 0.114 and 0.159 respectively in productivity of the flour milling company.

The results of the study indicated that the overall model was significant and that the independent variables influenced the dependent variables. A p-value of 0.000, that is lower than 0.05 is indicative that the regression model was significant. The R^2 value of 0.687 indicated that 68.7% of changes in the productivity of the firm could be attributed to the independent variables. The adjusted R square of 0.631 also gave the interpretation that 63.1% of the variation of the dependent variable around the mean is explained by the independent variables.

The relationship between the productivity of a flour milling company in Kenya, and investment into R&D and innovation is significant and positive. This is reflected by a positive coefficient of 0.119, which means a unit change in investment into R&D and innovation will cause a 0.119 increase in the overall productivity of the company. This variable is also significant as indicated by the p-value of 0.005. The results agree with the findings of Hall (2011) who found out that investment into R&D was a significant driver into the productivity of the firm. In addition, the findings also showed the importance that flour millers in the Kenya showed when it came to dedicating capital that would be invested into R&D and innovation. Njogu (2014) also found out in a study that innovation played a significant role in the productivity of companies. The increase in productivity as a result shows that investment into R&D and innovation is a strategic tool for a firm to gain competitiveness.

There is also a positive relationship between the productivity of a flour milling company in Kenya and employee engagement into R&D and innovation. This is reflected by a positive correlation coefficient of 0.114 which means a unit increase in employee engagement into R&D and innovation with cause a 0.114 increase in the productivity of a flour milling company in Kenya. The variable is also significant with a p-value of 0.01. These results agree with previous research done by Cristini & Pozzoli (2010) which showed that engagement of employees to motivate them to take part in R&D and innovation improved the firm performance. It therefore emphasized on the need for management to introduce structures and incentives that would motivate employees to engage in R&D and innovation practices.

There is also a positive relationship between the productivity of a flour milling company in Kenya and patent and trademark registration. This is reflected by a positive correlation coefficient of 0.159 which means a unit increase in patent and trademark registration will cause a 0.159 increase in the productivity of a flour milling company in Kenya. The variable is also significant with a p-value of 0.001. These results agree with previous research by Griliches (1990) who found out that securing intellectual property by registering patents and trademarks was an indicator of the performance of a firm. Securing intellectual property enabled a firm to commercialize their offerings without imitations and therefore opened new markets, in turn increasing the performance of the firms.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

The purpose of this chapter was to present a summary, present the conclusions, present the recommendations for policy, present suggestions for further studies and present the limitations of the study which was to analyze the effect of investment into R&D and innovation, the employee engagement into innovative activities and the patent and trademark registration to the productivity of a flour milling company in Kenya.

5.2 Summary

The study targeted large scale millers in Kenya, who were all issued with questionnaires. Out of the 29 issued questionnaires, 21 responded, representing a response rate of 72.4%, which could be used to model the entire population of large scale millers. The study focused on investment into R&D and innovation, the employee engagement into innovative activities and the patent and trademark registration as the independent variables and the productivity of the flour milling company as the dependent variable.

The study established that there exists a strong positive relationship between the of investment into R&D and innovation and productivity of the firms under study. This investment ensured that the companies produced superior quality products with a mean score of 4.67. We could also see that it was important to the companies to acquire the latest technologies into their processes of production, to promptly respond to market needs and that improved processes due to innovations increased the efficiencies of these companies. The significance of this independent variable could be seen from the regression results where the significance value stood at 0.005. This independent variable also predicts the dependent variable positively as could be seen by the positive coefficient of 0.119. A unit increase in investment into R&D and innovation caused a 0.119 increase in the productivity of a flour milling company in Kenya.

The study also established that there existed a strong positive relationship between the engagement of employees into innovative activities and the productivity of a flour milling company in Kenya. It was important to the companies that their staff understood the importance of being innovative

and carrying out their day-to-day activities in an innovative way, at a mean of 3.86. The companies also sent their employees to seminars, workshops and conferences to acquire skills. In turn, this improved the productivity of these companies. The significance of this independent variable could also be seen from the regression model, where the significance value stood at 0.01. This independent variable also predicted the dependent variable positively as could be seen by the positive coefficient of 0.114. A unit increase in engagement of employees into innovative activities caused a 0.114 increase in the productivity of a flour milling company in Kenya.

The study established that there also existed a strong positive relationship between patent and trademark registration and the productivity of a flour milling company in Kenya. At a mean score of 4.81 it was considered very important for the companies to secure their intellectual properties by means of patent and trademark registrations. It was also found out to be important to the companies to assess market demands and come up with new products that would fill in the gaps in the market. These new products would be secured to them using patents and trademarks and would therefore give them exclusivity and in turn increase their productivity. The significance of this independent variable could also be seen from the regression model, where the significance value stood at 0.001. This independent variable also predicted the dependent variable positively as could be seen by the positive coefficient of 0.159. A unit increase in patent and trademark registration caused a 0.159 increase in the productivity of a flour milling company in Kenya.

The study also showed that the overall regression model was significant with a p value of 0.000 and a positive correlation coefficient (R) of 0.829 and coefficient of determination (R^2) of 0.687. This meant that 68.7% of the changes in the productivity of a flour milling company in Kenya can be attributed to investment into R&D and innovation, the employee engagement into innovative activities and the patent and trademark registration.

5.3 Conclusions

This study concluded that innovation positively and significantly affected the productivity of a flour milling company in Kenya.

Investment into R&D and innovation by a flour milling company in Kenya affects its productivity positively. The more a company invests into R&D and innovation, the more the increase in productivity. Flour millers are therefore keen to set aside finances in their budgets to drive

innovative activities. They are also keen to ensure they acquire the newest technologies and are first to market with new and improved products. Any issues raised by their customers as regards to their quality and offerings are handled promptly to ensure the market is satisfied at all times.

Engagement of employees into innovative activities by a flour milling company also affects its productivity positively. The more a company engages its employees in innovative activities, the more the increase in the company's productivity. Flour millers are therefore keen to ensure that their employees are always engaged in innovative activities in their day-to-day tasks. These companies also ensure they take their employees to conferences, seminars and workshops to acquire skills that would aid them in working more efficiently. As a result, these companies consistently receive ideas from their employees that when implemented, lead to innovations.

Patent and trademark registrations by a flour milling company affects its productivity positively. The more a company registers its trademarks and patents, the more the increase in its productivity. Patent and trademark registration is means for a company to secure its intellectual property. It limits imitations from competitors and therefore gives a company some exclusivity to reap benefits from a new offering they release or a new technology they implement. These companies therefore deem it very important to secure their intellectual property.

In conclusion therefore, the study showed that investment into R&D and innovation, the employee engagement into innovative activities and the patent and trademark registration significantly and positively affect the productivity of a firm, with coefficients of 0.119, 0.114 and 0.159 respectively. 68.7% of the productivity of the firm can be attributed to these factors as per the regression model.

5.4 Recommendations

In order for firms to increase their productivity, they have to increase their innovation practices. Currently there is an over reliance on foreign companies for technology and a shift to in-house and local supply of technologies will significantly improve productivity. The flour milling sector is unique in every country. The markets in different countries demand different qualities of flour, in terms of granulation, nutrition, color and additives. As common practice, the millers are proactive in assessing the requirements of the market and then relying on foreign manufactures to deliver a process that meets these requirements. Since this is an iterative process, the cost of delivering the

right process eventually becomes too high and eats into the potential returns of the miller. Local governments should work on setting up research laboratories that would make local production of some standard technologies possible within the country.

The government also need to set up policies that govern the quality of maize and wheat grown in the country. Different qualities offer different extraction levels and this in turn forces millers to have very adaptive technologies to deal with the different qualities of raw materials that they receive. Standardization of the raw material will mean that more effort by the miller is put on the production process in order to differentiate the finished product, resulting to more focus on healthy eating options and reducing of carbon foot prints by the flour millers.

5.5 Limitations of the Study

The conclusions from this study cannot be generalized to the entire manufacturing sector. This is because the flour milling industry is a very specific sector of manufacturing and the practices in these companies are not general to the entire manufacturing sector. However, the study gives a good overview of the flour milling sector.

This research, based on tier one flour millers in Kenya, highlights many features of innovation practices by the companies. A wide study on all the innovation practices, involving millers from all production tiers of the industry, will shed more light and will explain the totality of innovations in Kenya.

Some respondents were not willing to share their information for fear of their confidential information being made public. Most of these companies are not publicly listed and are therefore not obligated to release their financial data. The researcher assured them of confidentiality of the data requested for and some complied.

5.6 Suggestions for Further Studies

It is recommended to study the complete flour milling industry in a stratified research based on the tier levels of the companies. This will give a very clear picture of the complete industry including the levels of innovation in each tier.

This study largely relied on primary data and could be further enriched by secondary data that would give the study to give a deeper view of the objectives of the study. It is therefore recommended that in future the researchers can complement the primary data with secondary data.

Finally, the study focused on three aspects of innovation practices, that investment into R&D and innovation, engagement of employees into innovative activities and patent and trademark registration. It is recommended that in future more variables that relate to innovative activities are included to widen the research.

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Appendix: Questionnaire

The purpose of this questionnaire is to collect data that can be used in analyzing the relationship between innovation and productivity in the flour milling industry in Kenya. This data is solely for academic purposes and will be treated with utmost confidence. Your cooperation is highly appreciated. Do not indicate the company name as the information is strictly confidential.

NB: Kindly consider the flour milling operations of your business only in this questionnaire.

Section 1 : Firm Information

Name of company: …….

Location: …….

Address: …….

How long has the business been in operation?

Less than 3 years ( ) 3-10 years ( ) More than 10 years ( )

What is your total installed flour milling capacity? ……

What other businesses are you engaged in? ……

How many permanent employees do you have?

50 or less ( )

50 – 100 ( )

100 – 150 ( )

150 – 200 ( )

Above 200 ( )

Kindly fill in the below table with respect to your maize and wheat milling operations?

YEAR	Annual turnover	Annual expenditure	Number of patents and trademarks registered
2021			
2020			
2019			

Section 2 : R&D Data

To what extent does the firm engage in the below innovation activities? (1 = strongly disagree, 2 = disagree, 3 = nor disagree nor agree, 4 =agree, 5 = strongly agree; X = do not know)

	1	2	3	4	5	X
In product innovation, our company does more product innovation than the competition.						
We have a dedicated R&D budget for product innovations.						
We are always first to release new and improved products into the market.						
Our new products released lead to an increase in turn over.						
Improvement on existing products released leads to an increase in turn over.						
New products are perceived as the best by customers.						
We are able to respond to market demands with new and improved products.						
In process innovation, our company is better than the competition.						
We have a dedicated R&D budget for process innovations.						
We invest in training our personnel to be conversant with the latest milling processes.						

It is important to us to acquire the latest technologies from our equipment suppliers.						
Our efficiency is increased with improved processes.						
Improved processes often lead to increased profitability.						
Our processes ensure we produce superior quality products.						
In marketing innovations, our company is better than the competition.						
We consider social media and digital marketing as an important tool in our marketing strategy.						
We have engaged part of our marketing team to be dedicated to carry out research on market demands.						
We have dedicated members to work on our digital marketing strategy.						
We maintain a strong online presence to interact with our customers.						
We are quick to jump on current trends in social media as part of our advertising tactics.						
We reach all our target customers with our marketing strategy.						
We respond to customer suggestions and complaints promptly and to their satisfaction.						

Section 3 : Employee Data

Personnel Practices	1	2	3	4	5
Our employees engaged in R&D and innovation activities.					
We consider it important to have employees dedicated to R&D and Innovation on full time basis.					
All our departments engaged in R&D activities.					
Our staff generally understand importance of being innovative and carrying out innovative practices in their day to day.					
We send our employees to seminars, workshops and conferences to acquire skills.					
We have a policy to encourage employees on the need for innovation.					
We have a reward scheme to motivate your employees to innovate.					
We receive ideas from our general employees that would lead to innovations.					

Section 4 : Patents and Trademarks

Kindly fill in below information to give insight into your firm's practices with respect to patents and trademarks (where, 1 is least and 5 is highest)

	1	2	3	4	5	X
It is important to secure our intellectual property using patents.						
We have a dedicated budget for patent registrations and renewals.						
We have a target on the number of patents registered by our company each year.						

It is important for us to register new trademarks for each product released.						
We have a dedicated budget for trademarks registrations and renewals.						
We have a target on the number of trademarks registered by our company each year.						
We register new trademarks to respond to new market approaches in terms of pricing and products.						
We are proactive in assessing the market demands and coming up with new products.						
We are first in the industry to release new products to the market.						
New products significantly increase our revenue earnings.						