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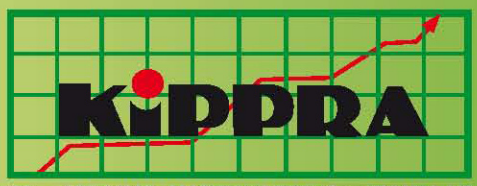

The KENYA INSTITUTE for PUBLIC
POLICY RESEARCH and ANALYSIS

Technology Acquisition and Innovations in Kenya's Informal Sector

Brian Nyaware

DP/225/2019

THE KENYA INSTITUTE FOR PUBLIC POLICY
RESEARCH AND ANALYSIS (KIPPRA)

YOUNG PROFESSIONALS (YPs) TRAINING
PROGRAMME

Technology Acquisition and Innovations in Kenya's Informal Sector

Brian Nyaware

Kenya Institute for Public Policy
Research and Analysis

KIPPRA Discussion Paper No. 225
2019

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Published 2019

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ISBN 9966 817 28 0

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Abstract

Despite Kenya's high innovation ranking, there are low levels of innovations in her informal sector. The informal sector plays a key role in Kenya's economy, while technology and innovations both have the potential to spur economic growth and development. The existing policies do not clearly highlight non-governmental innovation and technology sources and the different types of innovations present in the country. This study examines the innovation types, factors affecting innovation and technology sources in Kenya's informal sector. A dataset having 17,895 Kenyan informal firms was used. Cross tabulations and probit were utilized to analyze the data. The study shows that micro, small and medium enterprises (MSMEs) were the main sources of technology-machines and equipment. Other sources include: non-MSMEs, importation, inheritance, manufacturing themselves and through business transactions. It was established that product, process and marketing innovations exist in the informal sector of Kenya. Sector, ownership structure, education level, gender of owner(s), firm age and presence of technological advice were found to be factors that significantly influence an informal firm's propensity to engage in product, process or marketing innovation. From the study, implications of findings may lead to a more detailed Kenyan innovation database and increased use of technology and innovations in Kenya's informal sector.

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1. Introduction

1.1 Overview

The informal sector has a large footprint in Kenya as it accounts for about 75 per cent of Micro, Small and Medium Enterprises (MSMEs). The sector encompasses unregistered economic activities that are legal, unregulated and whose incomes are not taxed (World Bank, 2007; KNBS, 2016), and is mostly associated with lack of finances, slow growth, low education levels and low productivity (World Bank, 2016). However, Kenya is highly ranked in terms of innovations. Kenya was ranked third in Africa in the Global Innovation Index (GII), after South Africa and Mauritius, respectively (Cornell University et al., 2018). The GII uses 80 indicators to provide a metric that shows how 126 countries around the world are performing in terms of innovation. Kenya performed well on the Global Competitive Report, where she was ranked the second most innovative country in Sub-Saharan Africa and 37th worldwide (WEF, 2017). In the report, over 100 world economies were assessed in an index comprising 12 pillars, among them technological ability and innovation. The government's use of technology in service delivery and the research and development levels were key contributors to Kenya's good ranking. *Innovation* is defined as the application of an advanced marketing approach, advanced organizational technique in business procedures, workplace organization or external alliances, a new or significantly improved procedure, or product (good or service) (OECD, 2005). Market, process, product and organization innovations are incorporated in this definition. *Technology* is defined as the hardware (machinery, equipment and tools) or software (technical knowledge) integrated in the conversion of input resources to output products and services (Burrati and Penco, 2001).

The role of technology and innovations has been, and is, key in spurring economic growth and development in countries worldwide. This was evident in the first and second industrial revolutions across Europe and the United States of America. The Sustainable Development Goal 9 (SDG 9) aims at promoting innovations and technology in developing countries, which in turn could help in achieving the other SDGs, such as SDG 1 and 8 that target economic growth and poverty reduction. In most cases, the use of technology and innovations in any firm improves efficiency and quality, reduces work time and increases production (Mendi, 2007).

Over the years, Kenya has strived to promote Science, Technology and Innovations (ST&Is) through policies, and giving ST&Is high priority in the development agenda. This has led to major changes in Kenya's innovations and technological environment. The implementation of some of these policies facilitated the establishment of key institutions to spearhead the sector.

The National Council for Science and Technology (NCST) and the Kenya Industrial Research and Development Institute (KIRDI) were established by Science and Technology Act (Cap 250) (Government of Kenya, 1979). NCST was mandated to advise the government on science and technology issues, policies and priorities. Sessional Paper No. 5 of 1982 on Science and Technology for Development (Government of Kenya, 1982) pinpointed the industry's weak research capacity and the huge potential of Kenyan MSEs in the technology and innovations' arena. The National Research Fund was also proposed as a fund to support advancement of scientific research, inventions, innovations, research and development (R&D). KIRDI has a mandate of undertaking research and development of technologies that are to be transferred to MSEs and large industries. Research and technology transfer took prominence in Sessional Paper No. 2 of 1996 (Government of Kenya, 1996). Patent access and foreign input through investment were some of the mechanisms suggested as ways of acquiring technology. The 1970-1974 and 1984-1988 development plans both shine a spotlight on ST&I's pivotal role in Kenya's social economic development.

The Sessional Paper No. 2 of 1992 on Small Enterprises and *Jua Kali* Development in Kenya (Government of Kenya, 1992) provided a policy framework that enabled MSEs to play a vital part in the development of technology and innovations. KIRDI had the role of modifying foreign technologies to suit local MSEs. The Industrial Property Act 2001 (Government of Kenya, 2001) established the Kenya Industrial Property Institute (KIPI) whose core function is to administer property rights. Sessional Paper No. 2 of 2005 on Development of Micro and Small Enterprises for Employment Creation for Poverty Reduction (Government of Kenya, 2005) gave a clearer policy direction with regard to MSEs and technology, focusing on easing access to information pertaining to technology, technology adoption and adaption, technological institutions support, and skills development on technology.

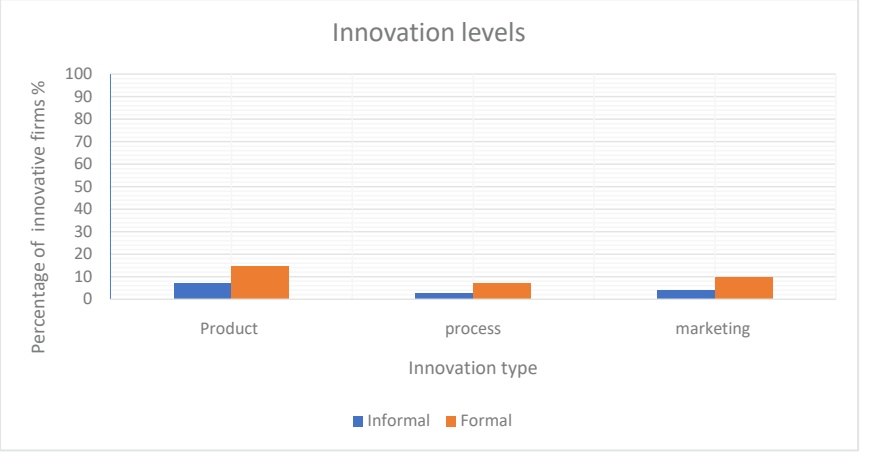
The Vision 2030 (Government of Kenya, 2007) aims to have Kenya become an industrialized and middle-income country. Use of technology and innovations in different economic sectors, including the informal, to enhance productivity and spur industrialization is key. The Kenya Vision 2030 has ST&I as its foundation in seeking to make Kenya a knowledge-based economy. The *Buy Kenya Build Kenya* strategy aims to increase production and consumption of Kenyan-made goods, which will in turn hopefully improve the manufacturing sector, increase innovations and technology use in local industries, and create more decent jobs. The enactment of the Science, Technology and Innovation Act No. 28 of 2013 (Government of Kenya, 2013) established the National Innovation Agency (KENIA), the National Research Fund (NRF) and National Commission for Science, Technology and Innovation (NACOSTI) and re-established KIRDI. KENIA has the core functions of: providing incubators for innovative ideas, awareness of

intellectual property rights among innovators, scouting and nurturing innovative ideas, and establishing an innovation database in collaboration with other relevant bodies. NACOSTI regulates and assures quality in the sector dealing with ST&I.

Under the "Big Four" agenda of affordable housing, the government is looking at innovative ways of closing the 200,000 housing deficit using new technology and innovations in making cheaper construction materials. In the Medium-Term Plan (MTP) III of the Kenya Vision 2030, there is emphasis on the importance of Science, Technology, Engineering and Mathematics (STEM) in Kenya's educational institutions to help build the ST&I capacity in the country. The coordination of technology and innovation commercialization programme in MTP III seeks to establish innovation parks such as Konza to encourage the establishment of ST&I-based firms. The county technology and innovation delivery services programme aims to avail innovations advisory, and coordinate technology transfer and adoption at county level. The development of the Science, Technology and Innovations Policy, the National Intellectual Property Policy and National Innovation Policy are also in the MTP III.

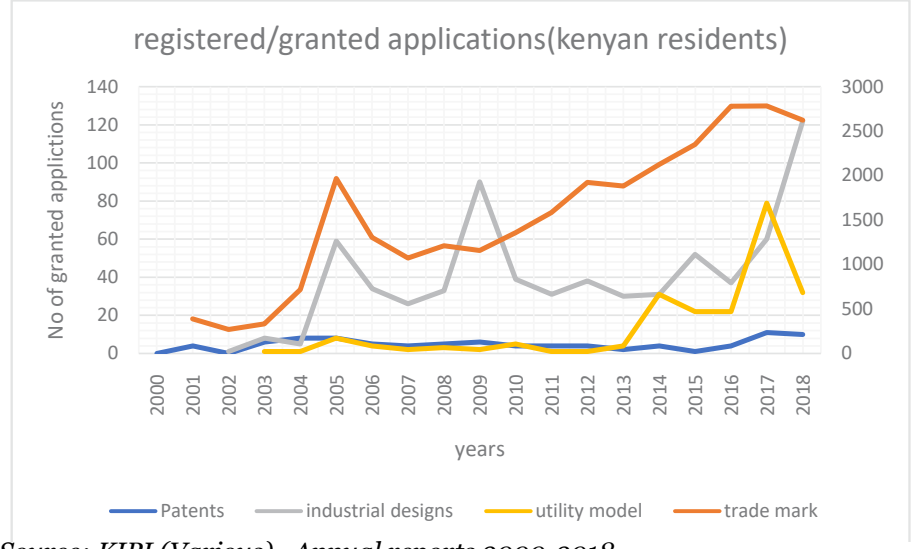
Despite Kenya's existing policy and institutional framework, the use of innovations and technology is not widespread in firms, with lower usage in the informal sector compared to the formal (Figure 1.1). This is further shown going by the number of registered patents, trademarks, utility models and industrial designs over the years (Figure 1.2) and the low registration of innovations among informal firms (7%) (KIPPRA, 2019) as seen in Figure 1.3.

Figure 1.1: Innovation levels in formal and informal sectors



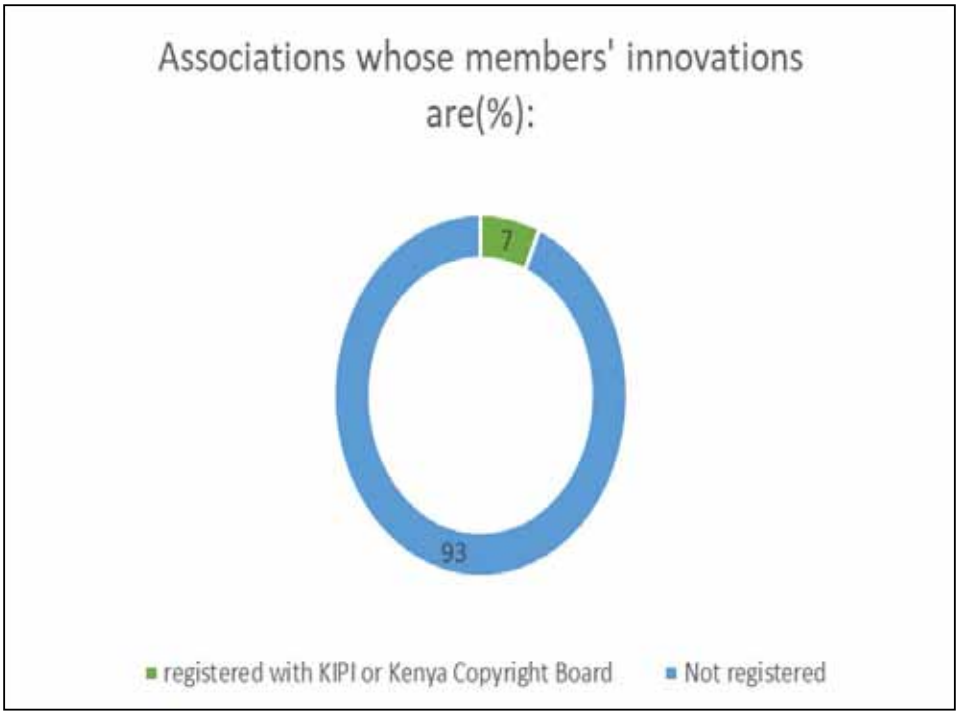
Source: Author's construction using KNBS (2016), MSME Survey

Figure 1.2: Patent applications and granted applications in Kenya



Source: KIPI (Various), Annual reports 2000-2018

Figure 1.3: Registration of innovations



Source: KIPPRA (2019), Ease of doing business indicators for MSEs KIPPRA.

Among the reasons given by firms for not registering innovations were: inaccessibility to the relevant offices, high cost of registering, cumbersome procedures and lack of information. Limited technology levels and institutional capacity are among the impediments to innovations and technology absorption in Kenyan firms (Government of Kenya, 1992; 2005). Inadequate appropriate technology, capacity for innovations and low application of technology are challenges identified in MTP III. Having gone through Kenya's policy interventions, it is important to note the following gaps: Kenya lacks an exclusive innovation and technology policy relating to the informal sector; non-governmental innovation sources are not clearly highlighted; and the different types of innovations, their characteristics and needs are not stated in any of the policy documents (Moyi et al., 2018).

Most studies have focused on determinants of innovation and technology use in firms, whereas very few focus on Kenya's informal sector – the acquisition of technology, types of innovations, and the factors influencing innovation in the informal sector. These factors are: access to finance (Ayyagari, et al., 2007), human skills, managerial experience age, size and external linkages (Robson, et al., 2009; Dutz and O'Conell, 2013 and Hossain, 2015). This study will solely focus on the informal sector because it is a major employer of Kenya's working population (employs 83.1% of Kenya's labour force, KNBS, 2017)) and contributor to the GDP. In 2015, 34 per cent of Kenya's GDP was contributed by MSMEs, most of which are in informal (KNBS, 2016: MSME Survey). Given this background, research on the acquisition of technology, types of innovations and factors affecting innovation in the informal sector is important.

This study will examine how firms acquire technology, the existing kinds of innovations and their determinants in the informal sector.

1.2 Objectives

The overall objective is to study technology acquisition, and innovations in Kenya's informal sector. The specific objectives in this study are:

1. To find out how the informal sector players acquire technology and engage in innovations.
2. To examine the existing types of innovations and factors affecting innovations in the informal sector

2. Literature Review

2.1 Theoretical Review

The technology acceptance model (TAM) is used to predict the use of technology and acceptance by firms, organizations or people (Davis, 1989). The perceived ease of use and usefulness are two important factors in this model. The probability of new technology or system to enhance one's job or performance is what is defined as perceived usefulness, whereas the extent to which the new system or technology will reduce the effort put in is what is referred to as perceived ease of use. External variables such as cultural, social and political factors may influence one's likelihood towards use of technology.

There are various theories that explain the use of innovation at different levels. There are adoption and diffusion theories. Adoption theory looks at why a person rejects or accepts an innovation and the person. Diffusion theory describes how innovation spreads out (Straub,2009). Diffusion of innovations can be defined as the way through with innovations spread out to members of a particular social setting over time. There are various sources of the diffusion of innovations theory across a number of disciplines (Rogers et al., 2003). A person must first adopt, before diffusion can happen. The adopter categories based on time are: innovators, early adopters, late early majority, late majority and laggards – those who are last to adopt – respectively. Innovation adoption can be influenced by five main factors. In the case of each of adopter categories, particular factors are at play to a distinct degree. The factors are relative advantage, compatibility, complexity, triability and observability (Rogers, 1995). Some of the key elements in diffusion research are innovations, adopters, time, communication channels and the social system (Meyer, 2004). Interactions within and outside firms can influence innovation adoption and diffusion (Rogers, 1971). Based on this theory, the diffusion of innovations in the informal sector may be low due to poor communication channels, weak systems, the innovation complexity, and sector players often being in the late majority or laggard's categories.

2.2 Empirical Review

There has been a surge of technology hubs, with over 117 technology hubs in Africa (World Bank, 2016). The growth has been driven mainly by donors, multilateral institutions and governments with the aim of increasing economic growth (Kelly and Firestone, 2016). Hubs spur innovations, entrepreneurship and social change. Littlewood et al. (2018) explore hubs in the Kenyan context: their nature, location, role and potential. The study takes a descriptive approach with interviews being

carried out with different hubs at various locations. Whereas hubs face numerous challenges such as duplication, lack of engagement with state actors and business framework, they have the potential to nature innovations and have a great social impact. Coordination among hubs, policy formation and implementation and better engagement with state actors could make Kenya get the maximum potential from hubs. The study identifies hubs as potential sources of innovations.

Mendi et al. (2017) seeks to explain the impact of informality on innovation in Kenya. There are various variables that affect the probability of innovation in an informal firm. Such include: number of employees, exports, firm age, education level, types of goods and membership in any business group. Access to funds has been identified as a major challenge to informal firms engaging in innovations. Despite the positive relation between human capital and innovation, Uden (2016) with the use of Probit and Bivariate models, have findings showing that the introduction of innovations to informal firms does not always have a positive effect. Their study was carried out in Kenya, Tanzania and Uganda with data from the World Bank (2013) Enterprises Survey. Logistic regression is used to examine the effect of the independent variables on the likelihood of innovation in a firm. Better incentives and policies could promote use of innovations to make informal firms more competitive. Groups and SACCOs could also help in access of information and finance in the sector. Higher levels of education among employees increases the probability of innovation in a firm. Abdu and Jibir (2017) have almost similar findings. Research and Development (R&D), a firm's size and formal training positively drive a firm's innovative propensity. The study focuses on Nigeria and used the logit and probit models to analyze World Bank Enterprise Survey data. Education and the age of a firm negatively influence innovation. Market, organization, product and process innovations all had R&D, sector, type, trainings and size as factors significantly affecting them.

In some cases, countries or firms adopt technologies from world technology leaders to improve productivity (Liao and Wang, 2012). The technology transfer and technology absorption capacity of any firm heavily impacts on its productivity (Loko and Diouf, 2009). A study on Sub-Saharan Africa shows the important roles technology transfer and absorption play in improving productivity (Danquah, 2016). Panel data from 78 countries and Stochastic Frontier Analysis (SFA) are used in this study. The variables used include trade openness, machinery imports, human capital, relative R&D, human capital and GDP. Among the key findings were that the variables positively affect technology transfer and absorption. Lack of policies that focus on development of domestic capacity to absorb technology and manpower were some hindrances to technology absorption by informal firms. Amoah et al. (2018) also find skills gaps and cost implications as being bottlenecks to innovation absorption, thus affecting labour productivity.

Uptake of innovations and technology is different in the formal and informal sector. This is because of the different nature of the environments and how they affect innovation propensity and technology uptake. Fu et al. (2017) sought to determine the impact innovation has on productivity in both the formal and informal sectors in Ghana. The data used is from 501 manufacturing firms and is analyzed by Crépon-Duguet-Mairesse (CDM) structural model and the Probit model. After comparing various types of innovations, technological innovations have a greater impact on productivity than managerial innovations. Competition, capital, education level, size, ages, skilled workers, market type, and membership to groups are some of the factors affecting innovation propensity and technology absorption. These factors are mostly higher in formal firms, making their absorptive capacity greater that of informal firms. Kabecha (1999) takes a descriptive approach to show that Kenya's informal sector is not technologically stagnant despite the challenges it faces. These challenges could either be internal (management, entrepreneurship) or external barriers (exploitation by large enterprises, access to resources, hostile environment, etc). Due to lack of skills for technology adoption in the informal sector, there should be relevant training or education geared towards increasing the technological capability and innovativeness.

The increasing competitiveness of the global market has forced firms in Kenya and beyond to change to remain competitive. Firms adopt new technology and innovations to enhance productivity to survive, given the high quality of products in the global market (ILO/UNDP, 2000). Moyi and Njiraini (2005) explore the existing technology environment in Kenya. The study takes a descriptive approach with analysis being done on the theories, policies and regulations. Case studies from various aspirator countries are also observed. All these contribute to them coming up with an ideal theoretical technology model that addresses the gaps. Competition patterns, knowledge of economic trends, policies and subsidies are some factors that affect technological learning – a phase in the technological learning cycle. Institutions involved with technology transfer and innovation adoption include: research institutions, government, international cooperations, NGOs and the private sector. The proposed technological model assigns government institutions with duties aimed at filling in the gaps and enhances technological adoption. They propose financial institutions be developed as technological institutions, and enhancement of better collaboration between technology users and creators by setting up technology parks and incubators. World Bank (2013) shows the types of innovation in the informal sector as being: product, organizational, process and marketing. It also suggests that innovations can spark from collaborations of firms with: domestic firms or a domestic-owned parent firm, foreign firms or a foreign-owned parent firm, domestic and foreign academic or research institutions, private consulting companies or individuals

and the government. Knowledge of technology and innovations can be transferred though trainings, research and development, internships, apprenticeships or other learning channels and institutions.

Njiraini (2018) examines the factors that influence innovations among MSMEs in Kenya. The authors use a probit model to analyze these factors using the 2013 World Bank (2013) Enterprise Survey. The findings from this study are that human capital skills and a firm's resource capability positively influence innovation. The managers' experience and foreign ownership of a firm were found to negatively affect innovativeness. Among the factors considered to affect a firm's decision to innovate or not were: firm size, education level, capital, firm age and access to finance. The gaps identified were need for strategies at firm and policy levels to improve technical skills. Moyi and Gitonga (2018) also seek to get the determinants of innovation in MSMEs in Kenya, focusing on information and communication technologies. The data used is from the MSMEs Survey 2016 (KNBS, 2016). The study uses both probit and logit models for analysis. The study shows that ICT applications, such as computers and mobile phones, positively influence innovation. However, ownership of a television set and a fax machine do not have a significant correlation to innovation.

Gebreeyesus (2009) examines the factors that may either positively or negatively influence innovation using logit estimation. The data used was collected from a survey done in Ethiopia in 2003, with 1,000 enterprises being interviewed. The survey focused on enterprises located in major towns and that had ten or less employees only. The innovation extent varied across the different sectors, with the manufacturing sector having the highest innovation propensity. Education, size and age had positive impact on innovation. However, after a number of years, age has a negative impact on innovativeness. The study identified gender as being a factor affecting innovation, with female owners being less innovative than male owners. The suggested reasons to this as given by the study are that females are risk-averse, family oriented and face more constraints. World Bank (2019) has almost similar findings with data collected from Kenya, Togo, Mozambique and Uganda showing that women are less likely than men to introduce a new service or product. Some causes for this are: unwillingness to take risks, lower education levels among women, lesser confidence and little innovation space. However, in large firms (five or more workers), gaps were not as evident, thus showing that these constraints can be overcome and women have the potential to be more innovative.

3. Methodology

3.1 Conceptual Framework

Use of technology and innovations affects the process of production in a firm as shown in Figure 3.1. They cut down on time, improve efficiency and increase the production rate. Innovation can affect technology and vice versa. Use of a specific innovation can necessitate technology use, and use of a specific technology can lead to innovations. Therefore, the need of making the production more effective by either technology or innovations can make a firm engage in innovations or acquire technology. Firm characteristics, the environment and the sources of technology and innovations are the independent variables that affect the technology acquired and innovation used in a firm. These variables are equivalent to the external variables in TAM.

3.2 Analytical Framework

The study will use data from the Micro, Small and Medium Enterprises Survey (KNBS, 2016). The MSMEs Survey has firms that are randomly sampled over the 47 counties, thus giving the data a national outlook. The sampling masterframe contains 5,360 clusters split into four equal sub-samples. There are 24,164 observations in total. The informal sector data is extracted by focusing only on unregistered firms, resulting to 74.06 per cent (17,895 observations) of the firms captured in the survey. Firms having product, process, marketing innovations and use technology are also captured in this survey.

We use cross tabulations and descriptive analysis to find out how the informal sector players acquire technology, engage in innovations and the kinds of innovations. Probit and logit regression models have been used by a number of previous studies that examine the factors affecting innovation (Abdu and Jibir, 2017; Uden et al., 2016 and Njiraini (2018). In the data set, innovation presence was captured and took a binary (0/1) form. Since we assume normal distribution of innovations in our study, we use probit to analyze the factors that may influence a firm's decisions to engage in each of the types of innovation. Factors common from literature captured in the survey include: firm's age, education level, size and ownership structure (Dutz and O'Conell, 2013 and Hossain, 2015). We shall examine other variables captured in the survey to determine whether they affect innovation. These other factors include: the sources of technological advice, the owner's gender and the sector a firm is operating in.

The various factors that may affect a firm's decision to engage in a type of innovation (product, process or marketing) will be analyzed using equation 1, that

applies the probit model for each of the innovation types. The model analyzes the binary choice of whether a firm innovates or does not innovate for each of the three innovation types with the multiple independent variables. This means that the model will be run three times to analyze the three types of innovations captured in the survey.

$$y_{0i} = \begin{cases} 1, & if\ y_{0i}^{*} = X_{0i}\beta_0 + \varepsilon_{0i} > 1 \\ 0, & if y_{0i}^{*} = X_{0i}\beta_0 + \varepsilon_{0i} \leq 1 \end{cases} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ (1)$$

For the firms that reported to have introduced product, process or marketing innovation between the years 2013 to 2015, the value of y^{*}_{oi} is one. If the firm reported not to have innovations, takes the value of zero. Therefore, y^{*}_{oi} is the variable that captures a firm's decision to innovate or not. The variable includes firm size, age, gender of owner(s), ownership structure, sector, source of technological advice and level of education. The external unknown factors that affect innovations are represented by vector β_o. The error term is represented by ε_{oi}

3.3 Data and Variables Descriptions

Dependent variables

To measure innovation, we find out whether or not an enterprise is engaged in innovations by using three questions. The respondents were asked whether they introduced new or significantly improved goods or services, method of manufacturing or marketing between the years 2013 and 2015 in three separate questions. The questions represented product, process or marketing innovation, respectively. In each of the questions, the answers given by the respondents were either yes or no. Yes, coded as "1", meant the enterprise had engaged in that type of innovation and no, coded as"0", meant they did not engage in innovation.

Independent variables

Sector: The enterprises were categorized into four sectors of MSMEs as stated in the MSME Act of 2012 (Government of Kenya, 2012) and the grouping was based on the activities they engage in. The four sectors are: agri-business, manufacturing, trade and services. The activities were assessed by asking what activity the enterprise is engaged in.

Gender of the owner(s): This was captured by the ownership structure by gender. From the sample, there are single-owned firms, whose owners are either male or female and are labelled as "male only" or" female only". A firm can also

have more than one owner. In this case, the owners are partners. If all the owners are male only or female, then we refer to these as "male-male partners" or" female-female partners", respectively. In the case of multiple partners comprising of both male and female, then they are "male-female partners".

Level of education: This was measured by asking the highest education qualification acquired by the owner(s). The level acquired was then categorized into the main levels of education: primary, secondary, vocational/ polytechnic/ college and university. For those who did not acquire any form of formal education, they were categorized as "none".

Ownership structure: This was measured by asking the type of ownership structure. Since the study focused on the informal sector, enterprises with ownership structures considered as formal such as private companies and cooperatives were excluded. This left three structures to be used for this study: sole-proprietors; family and group.

Firm size: The firm sizes are grouped into three (micro, small and medium) using the number of employees in an enterprise. The definition of the three groups is as follows: micro (0-9 employees); small (10-49 employees); and medium (50-99 employees), (MSME Act of 2012). The respondents were asked the total number of employees in their enterprise and this was used to determine the firm size.

Firm age: This describes the number of years the firm has been in operation since the date it was started or acquired. The age is measured by asking the date which the firm was started or acquired and getting the difference between that year and the year during which the survey was undertaken. Firms in the informal sector are known to go under within the first 5 years of operation. It is because of this that we categorize the firms' ages in groups of 5 years.

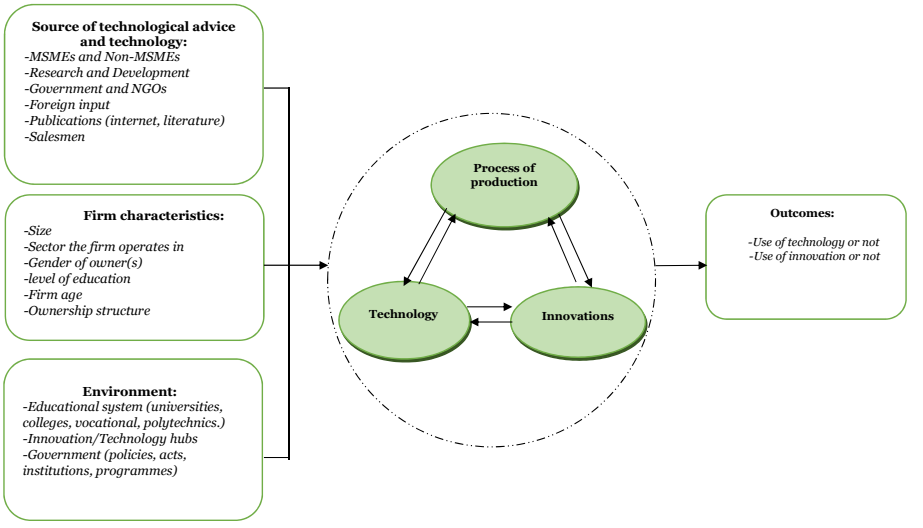
Sources of technological advice: This is measured by asking firms that received technological advice to indicate the source of technological advice.

The following data is envisaged.

Table 3.1: Variables

	Variables	Dimensions	Source
Dependent	Innovation	Implementation of; product innovation (Yes=1, No=0) Process innovation (Yes=1, No=0) Market innovation (Yes=1, No=0)	KNBS (2016) MSME Survey
Independent	Sector Gender of owner Level of education Ownership structure Firm size Firm age Source of technological advice	(1-Agri-business,2-Manufacturing, 3-Trade and 4-Services) (1-Male, 2-female, 3-Male-male, 4-Female-female and 5-Male-female) (1-None, 2-Primary, 3-Secondary, Vocational/ polytechnic/college, 4-(University) (1-sole proprietors, 2-family, 3-group) (1-micro, 2-small and 3-medium) (1. 0-5 years, 2. 6-10 years, 3. 11-15 years, 4. 16-20 years and 5. Over 21 years) (0-None, 1-Government institutions, 2-research institutions, 3-NGOs, 4-MSMEs, 5-Non-MSMEs, 6-Salesmen, 7-Publications)	

Figure 3.1: Conceptual framework



4. Results and Discussions

4.1 Technology Acquisition and Innovations

From the data set, informal firms use various forms of technology: ICT equipment, the internet, machines and equipment. Mobile phones, computers, tablets, radios, cameras, fax, television sets, photocopiers and printers were among the ICT equipment being used. Some 13,449 out of the 17,895 informal firms (or 75%) acknowledged to using at least one of the ICT equipment. 16,750 of the 17,895 informal firms (or 94%) used a computer for official purposes only in the year 2015. Out of these, the main uses of computers were as follows: printing (16%), scanning (0.4%), data storage (19%), data processing (2%) and internet (60%). Only 324 of the 17,895 informal firms (2%) had an active website in 2015.

Out of the 17,895 informal firms, 3 per cent had a landline telephone and 42 per cent a mobile telephone meant only for business purposes in 2015. Similarly, 42 per cent of the informal firms also used mobile money in the same year. This could be translated to mean that those who had access to mobile phones used mobile money.

Since one objective of this study is to find out how technology is acquired, we focus more on machines and equipment as they are the only forms of technology whose sources are captured in the survey. 98 per cent of the informal firms use machines and equipment (Table 4.1). Among the machines and equipment used in the informal sector, 68 per cent are electrically operated, 19 per cent human powered, 11 per cent use fuel and 0.4 per cent are animal powered.

Table 4.1: Number of firms having machines and equipment in the informal sector

	Machines and equipment						
	electrically operated	**human powered**	**fuel using**	**animal powered**	**Firms with machines and equipment.**	**Firms without machines and equipment.**	**total informal firms**
Total	12,206	3,358	1,891	64	17,519	376	17,895
%	68	19	11	0.4	98	2	100

Source: KNBS (2016), MSME Survey 2016

Most of the human and animal powered machines and equipment are found in the trade sector at 45 per cent and 66 per cent, respectively. The services sector has the highest per cent of fuel using and electrically operated machines and equipment at 39 and 45 per cent, respectively, as shown in Appendix 1.

These machines and equipment are gotten from various sources. Most firms get their machines and equipment from MSMEs. Out of the firms having electrically operated, human powered, fuel using and animal powered technology, 76, 79, 73 and 30 per cent of each, respectively, get their technology from MSMEs as illustrated in Appendix 2. Other sources include: non-MSMEs, importation, inheritance, manufacturing themselves and through business transactions.

Firms get support in form of technological advice from various sources. This support can lead to firms deciding to acquire technology or engage in innovations. From the sample, 82 per cent of the informal firms do not have a source of technological advice (Appendix 3). From the informal firms that receive advice, their sources are: the government, NGOs, MSMEs, publications, salesmen and research institutions.

Of those sampled, 14 per cent of the informal firms were innovative. This is on the lower side compared to 31 per cent of the formal firms. In both sectors, most of the innovative firms engaged in product innovation, with 7 per cent in the informal and 15 per cent in the formal. The data shows both formal and informal firms that engaged in innovations between 2013 to 2015 (Table 4.2).

Table 4.2: Distribution of innovative firms in the informal and formal sectors (No. of firms (%)

	Type of innovations			Total		
	Product	**Process**	**Marketing**	**Innovative firms**	**Non-innovative firms**	**Total firms**
Informal	1,314 *(7)*	487 *(3)*	697 *(4)*	2,498 *(14)*	15,397 *(86)*	17,895 *(100)*
Formal	925 *(15)*	437 *(7)*	601 *(10)*	1,963 *(31)*	4,306 *(69)*	6,269 *(100)*

Source: KNBS (2016), MSME Survey

4.2 Types of Innovations

Informal firms engage in product, process and marketing innovations as shown in Table 4.2. We assess the different levels of innovation across the various variables only among the 2,498 innovative informal firms.

The innovative firms in the informal sector have different ownership structures. Sole proprietorships have the highest innovation levels-product (71%), process (76%) and marketing (67%) innovations (Table 4.3). The difference in innovation levels may be attributed to ease of decision making and management within the different ownership structures. The process of making the decision to acquire technology or engage in innovation may be shorter and easier for sole proprietorships compared to the other firms with different ownership structures.

Table 4.3: Ownership structures of innovative informal firms (%)

	Product Innovation	Process Innovation	Marketing Innovation
Family	28	24	32
Sole Proprietor	71	76	67
Group	1	0	1
Total	100	100	100

Source: KNBS (2016), MSME Survey

Firms whose employees/owner(s) have high education levels tend to be more innovative. The informal sector is known to have low education levels among its players. Table 4.4 shows that a higher percentage of innovative firms have owners with their highest level of education being secondary-product innovation (41%), process innovation (38%) and marketing innovation (41%). Owners with higher level may be less in this sector due to the fact that they tend to operate in the formal sector.

Table 4.4: Owners' highest level of education achieved (%)

	Product Innovation	Process Innovation	Marketing Innovation
None	1	1	2
Primary	23	25	22
Secondary	41	38	41
Vocational, Polytechnic or College	24	24	22
University	10	10	11
Total	100	100	100

Source: KNBS (2016), MSME Survey

Table 4.5 shows the gender distribution of the owners of the innovative informal firms. There are more male-only owned innovative firms – product (42%), process (48%) and marketing (41%) innovations than female-only owned – product (31%), process (30%) and marketing (31%). The same trend is witnessed with male-male partners and female-female partners. The reason for these disparities could be that there are generally more male-owned firms than female-owned in the informal sector, hence the same being reflected in the gender distribution of innovative firms.

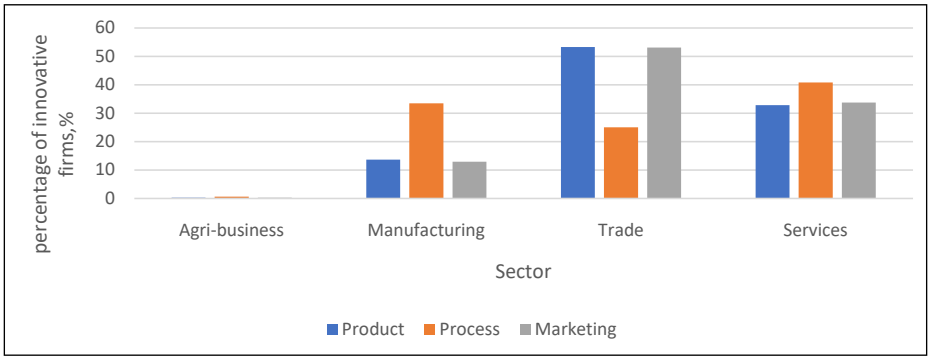
Table 4.5: Gender distribution of firm owners (%)

Gender of owner	Product Innovation	Process Innovation	Marketing Innovation
Male only	42	48	41
Female only	31	30	31
Male-Male partners	3	4	5
Female-Female partners	1	1	2
Male-Female partners	24	17	21
Total	100	100	100

Source: KNBS (2016), MSME Survey

Different sectors tend to have different types of innovations due to the characteristics of these sectors. Figure 4.1 shows that product and marketing innovations are mostly in the trade sector, both at 53 per cent. We can infer that this is because of the nature of the trade sector: competitiveness, quality of products and marketability of the products. Most firms engaging in process innovation are in the services sector (41%) and this can be alluded to the nature of the services sector, given that most of their products are intangible. Appendix 4 shows the distribution of the innovative firms in the various sections within the sectors.

Figure 4.1: Sector distribution of innovative informal firms



Source: KNBS (2016), MSME Survey

According to a number of studies, younger firms tend to be more innovative as compared to older firms. Table 4.6 illustrates that the younger firms tend to be more innovative than the older ones. 0- 5 year-old firms have the most product (45%), process (40%) and marketing (43%) innovation. This could be because they are trying to adopt into the market as they are still new.

Table 4.6: Age of informal innovative firms (%)

	Product Innovation	Process Innovation	Marketing Innovation
0-5 years	45	40	43
6-10 years	31	31	32
11-15 years	11	14	11
16-20 years	7	8	8
over 21	6	7	6
Total	100	100	100

Source: KNBS (2016), MSME Survey

The size of a firm is one of the determinants of innovations. From Table 4.7, we can see that micro firms are more innovative. Zemplinerova and Eva (2012) had similar findings that small and micro firms are more innovative than larger firms.This may also be because about 95 per cent of the firms sampled are micro (Appendix 5), hence the micro firms have more innovations.

Table 4.7: Size of innovative informal firms (No. of firms (%)

	Product Innovation	Process Innovation	Marketing Innovation
Micro	1,220 (92.9)	438 (90.3)	626 (90.2)
Small	88 (6.7)	46 (9.5)	66 (9.51)
Medium	5 (0.4)	1 (0.2)	2 (0.29)
Total	1,313 (100)	485 (100)	694 (100)

Source: KNBS (2016), MSME Survey

4.3 Factors that Affect Innovation

Table 4.8 shows the probit model results on factors that affect all the three types of innovation (product, process and marketing) in the informal sector. While running this regression, we assume that all the innovation types are affected by the same factors, but to different extents due to their different characters.

Firms in the services and trade sectors are 0.356 times and 0.77 times less probable, respectively, to engage in process innovation than a firm in the manufacturing sector. Abdu and Jibir (2017) had similar findings of the services and retail sectors being less likely than manufacturing to engage in process innovation. This may be because manufacturing involves the process of production. One has to have an efficient and effective production process to get maximum quality products. This compared to the trade sector where more emphasis is put on marketing and

selling of the products. The results for group structure of ownership in process innovation was marked as 0 because there were no group owned informal firms engaging in process innovation.

Family-owned firms are 0.177 times more probable to engage in marketing innovation than sole proprietors. This may be due to the higher number of owners, hence making marketing a distributed function among the family members.

Owners with any form of formal education are more likely to engage in product, process and marketing innovations than those without education. For all the three types of innovation, the probability to innovate increases as the level of education increases. The more educated the owner of a firm is, the higher the probability of him/her innovating. The cause of this could be that education exposes the firm owner to more ways of gaining the maximum profit, getting higher sales and making better products using efficient processes.

Firms owned by a female are 0.11 times more likely to engage in product innovation than those owned by a male sole proprietor. This is supported by a World Bank (2019) report that highlights the potential of female-owned business overcoming barriers and closing the gender gap in innovation. These findings, however, contradict some studies (Gebreeyesus, 2009) that portray female owners to be less innovative compared to male owners due to factors such as education, them being family oriented, less of risk takers and facing more challenges in the business environment. Multiple-male owned firms have 0.608 and 0.72 higher probability to engage in process and marketing innovations, respectively, compared to male sole proprietorships. Multiple-female owned firms have a higher probability of 0.329 and 0.613 to engage in product and process innovation, respectively, compared to male sole proprietorships. These can be explained by increase in firm size expanding the knowledge resource base and other firm characteristics that significantly influence innovations (Zemplinerová, 2012).

Young firms aged 6-15 years have a high probability to engage in all the types of innovations compared to young firms aged 0-5 years. This may be because older firms have more experience and understand the processes, product and market more, making it easier for them to innovate. Gebreeyesus (2009) has similar findings described as a non-linear relationship between innovation and firm age. As a firm starts out, the likelihood of innovation tends to increase but after a certain point/age, the likelihood decreases. Firms over 21 years have a 0.164 higher probability of engaging process innovation compared to 0-5 years old firms. This could be due to the firms need to adopt to new production methods so as to remain competitive.

Small firms are 0.229 times less likely to engage in process innovations and 0.232 times more likely to engage in marketing innovations than micro firms. Small firms may be more likely to engage in marketing innovation than micro firms because they have a larger market for their products. The medium firms' results for both process and marketing innovations are zero (0) because there were only 1 and 2 firms engaging in each, respectively. These numbers were too low to be considered in the regression.

Firms that receive technological advice have a higher probability of engaging in innovation compared to firms that do not. Firms getting the advice from research institutions, NGOs, MSMEs, sales people and publications have a higher probability of engaging in product innovation by 0.282, 0.374, 0.228, 0.18 and 0.405 times, respectively. Publications have the highest probability and this could be because they are easy to access. Firms whose sources are government institutions, MSMEs, sales people and publications are 0.53, 0.272, 0.216 and 0.336 more likely to have process innovation compared to firms getting no advice. Government institutions have the highest probability and this may be because the government has the capacity and expertise to give relevant effective advice. Firms getting advice from the government have a 0.364 higher probability of engaging in marketing innovation compared to those that do not get any advice. 48 out of the 1,314 product-innovative firms (3.7%), 23 out of the 487 process-innovative firms (4.7%) and 21 out of the 697 marketing-innovative firms (3%) stated that the most important training they received was on technical advice. The difference in innovation propensity across the innovation can be explained by the trainings received, firms having the highest probability to engage in marketing innovation as they received most training. This translated to more interactions outside the firms, and thus higher innovation propensity (Rogers, 1971). Abdu and Jibir (2017) and World Bank (2013) found that firms that receive trainings are more likely to innovate compared to those that do not receive.

Table 4.8: Factors that affect innovation

	Variables	Product	Process	Marketing
Sector	2.Trade	-0.026	-0.77***	0.002
		(0.046)	(0.058)	(0.057)
	3.Services	-0.019	-0.356***	0.003
		(0.05)	(0.057)	(0.063)
	4.Agri-business	-0.157	-0.087	-0.144
		(0.342)	(0.345)	(0.432)
Ownership	2.Familly	-0.024	-0.039	0.177**
		(0.051)	(0.074)	(0.059)
	3.Group	0.173	0	-0.02
		(0.178)	0	(0.232)
Education level	2.Primary	0.545***	0.212	0.262*
		(0.106)	(0.148)	(0.112)
	3.Secondary	0.663***	0.301*	0.4***
		(0.105)	(0.146)	(0.11)
	4.Vocational/ Polytechnic/College	0.747***	0.399**	0.45***
		(0.108)	(0.15)	(0.114)
	5.University	0.772***	0.413*	0.581***
		(0.118)	(0.165)	(0.126)
Owner's gender	2.Female only	0.11**	0.052	0.112*
		(0.036)	(0.051)	(0.044)
	3.Male-male partnerships	0.2	0.608**	0.72***
		(0.192)	(0.213)	(0.168)
	4.Female-female partners	0.329*	0.613**	0.305
		(0.173)	(0.226)	(0.195)
	5.Male-female partners	0.167**	0.055	-0.067
		(0.057)	(0.084)	(0.068)
Firm's age	2.6-10 years	0.135***	0.115*	0.139**
		(0.036)	(0.053)	(0.045)
	3.11-15 years	0.119*	0.185**	0.139*
		(0.052)	(0.071)	(0.063)
	4.16-20 years	0.035	0.086	0.104
		(0.061)	(0.084)	(0.072)

	5.Over 21 years	0.089	0.164*	-0.006
		(0.071)	(0.095)	(0.092)
Firm size	2.Small (10-49 employees)	0.069	0.229*	0.232*
		(0.083)	(0.101)	(0.091)
	3.Medium (50-99 employees)	-0.438	0	0
		(0.422)	(0)	(0)
Source of techn. advice	2. Government inst.	0.224	0.353*	0.364*
		(0.142)	(0.175)	(0.155)
	3.Research inst.	0.282*	0.26	0.001
		(0.141)	(0.189)	(0.191)
	4.NGOs	0.374*	0.34	-0.009
		(0.173)	(0.24)	(0.243)
	5.MSMEs	0.228***	0.272**	0.07
		(0.064)	(0.086)	(0.084)
	6.Non-MSMEs	0.199	0.048	0.066
		(0.137)	(0.209)	(0.178)
	7. Salespeople	0.18**	0.216*	0.087
		(0.069)	(0.1)	(0.087)
	9. Publications	0.405***	0.336***	0.222
		(0.066)	(0.089)	(0.083)
	Constant	-2.238***	-1.925***	-2.317***
		(0.113)	(0.153)	(0.123)

Base categories are: sector-manufacturing, ownership-sole proprietorship, education level-none, owner's gender-male only, firm age – 0-5 years, source of technological advice – none and firm size – micro (0-9 employees).

5. Conclusion and Policy Recommendations

In this study, we have found that most innovative businesses in the informal sector are male-owned, sole proprietorships, micro, are in the trade sector, have secondary education level, do not receive technological advice and are young (0-5 years old).

Most machines and equipment in the informal sector are acquired from MSMEs. MSMEs are also the largest sources of technical advice to informal firms. This shows the importance of strengthening linkages with firms in the informal sector so as build collaborations that may promote exchange of knowledge on innovations and technology. This can be done through trainings and other interactions. However, the bigger part of the informal sector does not receive any technical advice.

The gender of the owner of an informal firm affects innovations. Firms owned by females are more likely to engage in process innovation compared to male-owned firms. Currently, however, a larger per cent of male-owned firms compared to female owned firms are innovative. This can be attributed to more men owning business compared to females, lower education and confidence levels among women, and women being more family-oriented than men.

The informal sector has product, process and marketing innovations. Product innovation is most common among the three. Firm size, age, level of education, sector, access to technical advice and ownership structure affect innovation in the informal sector. The trade sector has the most firms engaging in product and marketing innovations, whereas the services sector has the most process innovative firms. Therefore, various types of innovations are more probable in various sectors due to the nature of the sectors.

In most policy documents, only government-related agencies are highlighted in the role of developing innovations and technology. Only government research agencies and hubs are mentioned as potential sources of innovations and technology, while non-governmental sources are not well documented. There is also a general reference to innovations with no specific attention given to the various types of innovations and the institutions mandated to promote them.

Having analyzed the study's findings, the following suggestions are recommended:

- As a way of promoting female innovation and entrepreneurship, there ought to be more pro-women (marginalized groups) innovations and technology programmes and policies. Part of the National Research Fund can be targeted to research on MSMEs that women and/or marginalized groups mostly engage in or own.

- Development of policies, programmes and institutions meant for specific types of innovation (product, process and marketing). For example, programmes can be set up to help scout and nurture marketing and product innovations in the trade sector and process in services, where they thrive most, and help in spreading out these innovations across the country.
- The government could promote more interactions within the informal sector that may encourage the exchange of ideas and nurturing of innovation and technology. This can be done by annual regional exhibitions and trainings where firms can learn from each other, like the annual EAC *Jua Kali - Nguvu Kazi* Exhibition. Incentives such as government sponsorships can be offered to encourage people to be more innovative.
- Sources of innovation and technology within the informal sector could be identified and more efforts be put in nurturing these sources. The sources could be incorporated in the innovation database that is to be set up according to the ST&I Act of 2013.

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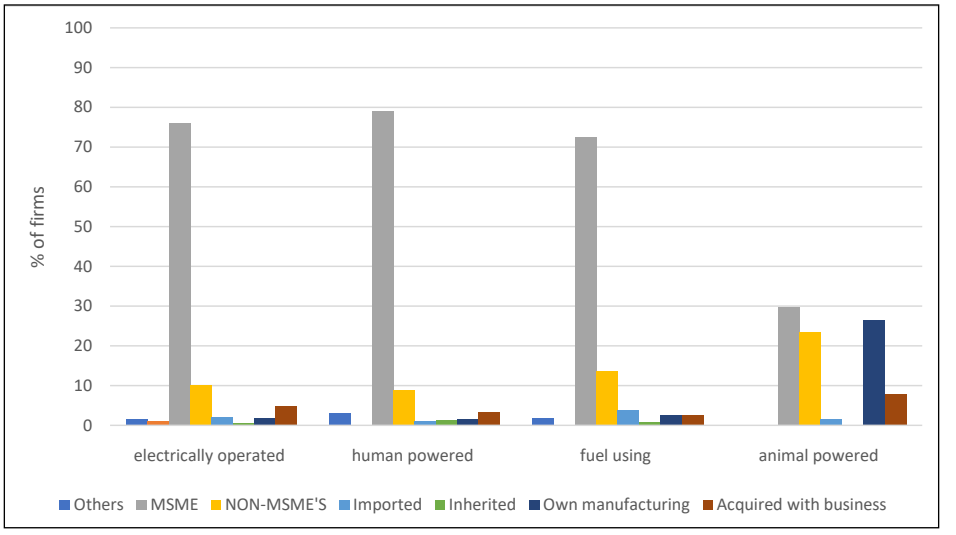
Appendices

Appendix 1: Sector distribution of machines and equipment

	Machines and equipment			
	electrically operated	**human powered**	**fuel using**	**animal powered**
Sector	%	%	%	%
Agriculture, forestry and fishing	0.08	0.06	0.26	
AGRI-BUSINESS	***0.08***	***0.06***	***0.26***	
Mining and quarrying	12.32	0.45	0.21	
Manufacturing		31.51	27.34	17.19
Electricity, gas, steam and air conditioning supply	0.03		0.05	
MANUFACTURING	***12.35***	***31.96***	***27.6***	***17.19***
Wholesale and retail trade; repair of motor vehicles and motorcycles	43.01	45.24	33.05	65.63
TRADE	***43.01***	***45.24***	***33.05***	***65.63***
Construction	0.34	0.33	0.48	
Water supply; sewerage, waste management	0.03	0.03	0.11	
Transportation and storage	0.37	0.21	2.22	
Accommodation and food service activities	14.93	9.05	21.73	1.56
Information and communication	1.52	0.42	0.63	
Financial and insurance activities	3.07	1.43	0.69	
Real estate activities	0.06	0.03	0.05	
Professional, scientific and technical activities	0.86	0.42	0.26	
Administrative and support service	2.73	0.92	0.9	
Public administration and defense; compulsory social security	3.28	1.73	6.87	12.5
Education	1.27	1.04	1.06	
Human health and social work activities	1.76	1.37	1.48	
Arts, entertainment and recreation	14.33	5.78	2.59	3.13
SERVICES	***44.56***	***22.75***	***39.08***	***17.19***
Total	100	100	100	100

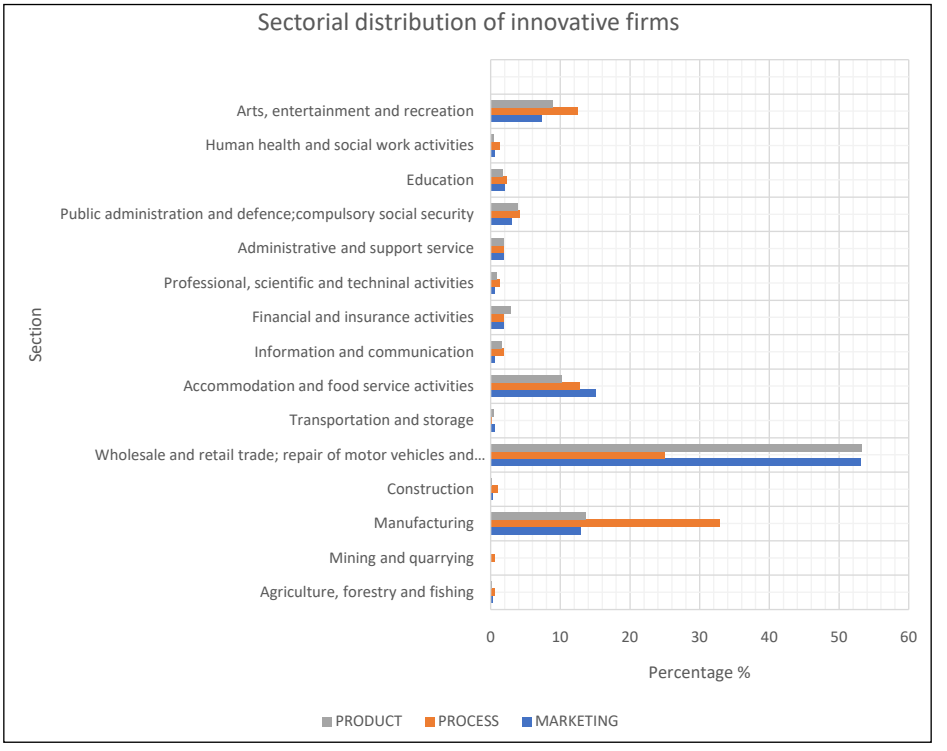
Appendix 2: Sources of technology



Appendix 3: Sources of technological advice

	Frequency	Percentage
Others	304	2
None	14,624	82
Government Institutions	181	1
Research Institutions	164	1
NGO	107	1
MSME	871	5
Non-MSME	188	1
Salesmen	769	4
Publications	687	4
Total	**17,895**	100

Appendix 4: Sector distribution of informal innovative firms



Appendix 5: Firm size of innovative firms

Firm size	n.	Per cent
Micro (0-9 employees)	17,032	95.3
Small (10-49 employees)	785	4.4
Medium (50-99 employees)	56	0.3
Total	17,873	100

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. probit product_inn i.sector i.Ownership i.educ_lev i.gender i.firm_agegrp i.firm_size i.tech_source

Iteration 0:   log likelihood =  -3998.418
Iteration 1:   log likelihood = -3902.2507
Iteration 2:   log likelihood = -3898.8251
Iteration 3:   log likelihood = -3898.8145
Iteration 4:   log likelihood = -3898.8145

Probit regression                                 Number of obs   =      15099
                                                  LR chi2(26)     =     199.21
                                                  Prob > chi2     =     0.0000
Log likelihood = -3898.8145                       Pseudo R2       =     0.0249
```

product_inn	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
sector						
Trade	-.0260182	.0457315	-0.57	0.569	-.1156502	.0636138
Services	-.0189911	.0502098	-0.38	0.705	-.1174005	.0794184
Agri business	-.156988	.3415679	-0.46	0.646	-.8264487	.5124727
Ownership						
Family	-.0237831	.050719	-0.47	0.639	-.1231905	.0756243
Group	.1725008	.1781295	0.97	0.333	-.1766265	.5216281
educ_lev						
Primary	.5447253	.106177	5.13	0.000	.3366222	.7528284
Secondary	.6626109	.1045576	6.34	0.000	.4576818	.8675399
Vocational Poly or college	.7467568	.1075973	6.94	0.000	.5358699	.9576436
University	.771884	.1179963	6.54	0.000	.5406155	1.003152
gender						
female only	.1103314	.035899	3.07	0.002	.0399707	.1806921
male male partnerships	.1995838	.1915078	1.04	0.297	-.1757645	.5749321
female female partnership	.3289713	.1730153	1.90	0.057	-.0101325	.6680751
male female partnership	.1674581	.0565381	2.96	0.003	.0566455	.2782707
firm_agegrp						
6-10 years	.1352152	.0364467	3.71	0.000	.063781	.2066494
11-15 years	.1191939	.0517404	2.30	0.021	.0177846	.2206032
16-20 years	.0347866	.0604465	0.58	0.565	-.0836863	.1532596
Over 21 years	.0889226	.0706154	1.26	0.208	-.049481	.2273262
firm_size						
Small (10-49 employees)	.0687229	.0826258	0.83	0.406	-.0932207	.2306666
Medium (50-99 employees)	-.4380739	.4221118	-1.04	0.299	-1.265398	.3892501
tech_source						
Govt_Institutions	.22413	.1420718	1.58	0.115	-.0543256	.5025857
Research_Inst	.282466	.1407489	2.01	0.045	.0066032	.5583288
NGOs	.3742057	.1728798	2.16	0.030	.0353675	.713044
MSMEs	.2281762	.0640462	3.56	0.000	.1026479	.3537046
Non-MSMEs	.1986112	.1370933	1.45	0.147	-.0700869	.4673092
Sales_people	.180493	.0689035	2.62	0.009	.0454447	.3155413
Publications	.4052851	.0655854	6.18	0.000	.27674	.5338303
_cons	-2.238197	.1134877	-19.72	0.000	-2.460628	-2.015765

Appendix 6: Probit regression results

```
. probit process_inn i.sector i.Ownership i.educ_lev i.gender i.firm_agegrp i.firm_size i.tech_so
> urce

note: 3.Ownership != 0 predicts failure perfectly
      3.Ownership dropped and 94 obs not used

note: 3.firm_size != 0 predicts failure perfectly
      3.firm_size dropped and 39 obs not used

Iteration 0:   log likelihood = -1900.5173
Iteration 1:   log likelihood = -1763.1978
Iteration 2:   log likelihood = -1754.2194
Iteration 3:   log likelihood = -1754.1848
Iteration 4:   log likelihood = -1754.1848

Probit regression                                 Number of obs   =      14962
                                                  LR chi2(24)     =     292.66
                                                  Prob > chi2     =     0.0000
Log likelihood = -1754.1848                       Pseudo R2       =     0.0770
```

process_inn	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
sector						
Trade	-.7703462	.0576261	-13.37	0.000	-.8832913	-.657401
Services	-.3556369	.0572996	-6.21	0.000	-.4679421	-.2433316
Agri business	-.0866734	.3454313	-0.25	0.802	-.7637062	.5903595
Ownership						
Family	-.0388717	.0735178	-0.53	0.597	-.1829639	.1052205
Group	0	(empty)				
educ_lev						
Primary	.212283	.1483228	1.43	0.152	-.0784244	.5029903
Secondary	.3008652	.1460806	2.06	0.039	.0145524	.587178
Vocational Poly or college	.3989131	.1497416	2.66	0.008	.1054249	.6924013
University	.413089	.1653451	2.50	0.012	.0890185	.7371595
gender						
female only	.0516677	.0510408	1.01	0.311	-.0483704	.1517058
male male partnerships	.6076557	.2126734	2.86	0.004	.1908234	1.024488
female female partnership	.6127667	.2258783	2.71	0.007	.1700535	1.05548
male female partnership	.0551829	.0841879	0.66	0.512	-.1098223	.2201882
firm_agegrp						
6-10 years	.115175	.0530622	2.17	0.030	.011175	.219175
11-15 years	.1850679	.0712354	2.60	0.009	.0454491	.3246867
16-20 years	.0857108	.0842931	1.02	0.309	-.0795008	.2509223
Over 21 years	.1642735	.095114	1.73	0.084	-.0221466	.3506935
firm_size						
Small (10-49 employees)	.2287109	.1011046	2.26	0.024	.0305495	.4268722
Medium (50-99 employees)	0	(empty)				
tech_source						
Govt_Institutions	.3525118	.1751766	2.01	0.044	.0091719	.6958517
Research_Inst	.2595009	.188682	1.38	0.169	-.1103091	.629311
NGOs	.3395939	.2397214	1.42	0.157	-.1302513	.8094392
MSMEs	.2722583	.0860596	3.16	0.002	.1035846	.440932
Non-MSMEs	.0484346	.20885	0.23	0.817	-.3609038	.457773
Sales_people	.2158639	.0998639	2.16	0.031	.0201341	.4115936
Publications	.3355816	.0892134	3.76	0.000	.1607304	.5104327
_cons	-1.924986	.1532906	-12.56	0.000	-2.22543	-1.624542

```
.
```

```
. probit marketing_inn i.sector i.Ownership i.educ_lev i.gender i.firm_agegrp i.firm_size i.tech_
> source

note: 3.firm_size != 0 predicts failure perfectly
      3.firm_size dropped and 39 obs not used

Iteration 0:   log likelihood = -2480.2094
Iteration 1:   log likelihood = -2422.5501
Iteration 2:   log likelihood = -2419.8553
Iteration 3:   log likelihood = -2419.8485
Iteration 4:   log likelihood = -2419.8485

Probit regression                                 Number of obs   =      15063
                                                  LR chi2(25)     =     120.72
                                                  Prob > chi2     =     0.0000
Log likelihood = -2419.8485                       Pseudo R2       =     0.0243
```

marketing_inn	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
sector						
Trade	.002101	.0572064	0.04	0.971	-.1100215	.1142234
Services	.0026461	.0626208	0.04	0.966	-.1200885	.1253807
Agri business	-.1443547	.4328804	-0.33	0.739	-.9927846	.7040753
Ownership						
Family	.1770791	.058949	3.00	0.003	.0615412	.2926169
Group	-.0196168	.2322501	-0.08	0.933	-.4748185	.4355849
educ_lev						
Primary	.2618442	.1124546	2.33	0.020	.0414373	.4822512
Secondary	.3995443	.1097681	3.64	0.000	.1844028	.6146858
Vocational Poly or college	.44995	.1143004	3.94	0.000	.2259253	.6739747
University	.5807758	.1264129	4.59	0.000	.3330112	.8285405
gender						
female only	.1119233	.0440705	2.54	0.011	.0255467	.1982998
male male partnerships	.7195264	.1679067	4.29	0.000	.3904354	1.048617
female female partnership	.3047764	.1948049	1.56	0.118	-.0770341	.686587
male female partnership	-.0671864	.0682265	-0.98	0.325	-.2009078	.0665351
firm_agegrp						
6-10 years	.1388738	.0448476	3.10	0.002	.050974	.2267736
11-15 years	.1386438	.0630374	2.20	0.028	.0150928	.2621947
16-20 years	.1040884	.0716955	1.45	0.147	-.0364323	.2446091
Over 21 years	-.0060165	.0918145	-0.07	0.948	-.1859695	.1739366
firm_size						
Small (10-49 employees)	.2315458	.0913548	2.53	0.011	.0524937	.4105979
Medium (50-99 employees)	0	(empty)				
tech_source						
Govt_Institutions	.3640933	.1550545	2.35	0.019	.060192	.6679947
Research_Inst	.0008072	.1907133	0.00	0.997	-.3729839	.3745984
NGOs	-.0094317	.2432077	-0.04	0.969	-.4861099	.4672465
MSMEs	.0698356	.0840724	0.83	0.406	-.0949433	.2346146
Non-MSMEs	.0659066	.1776227	0.37	0.711	-.2822275	.4140406
Sales_people	.0877569	.0872876	1.01	0.315	-.0833237	.2588375
Publications	.2221434	.0832302	2.67	0.008	.0590152	.3852715
_cons	-2.316699	.1231555	-18.81	0.000	-2.558099	-2.075299

ISBN 9966 817 28 0

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