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# Technology Transfer Assistance to Enhance Knowledge Exchange and Technology Transfer between Small and Medium Enterprises and Higher Education Institutions in Nairobi Innovation Ecosystem in Kenya

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**Abstract**
This survey was conducted as part of a project that seeks to develop a technology transfer assistance model that can effectively bridge the gap existing between technology sources like Higher Education Institutions (HEIs) and technology users like Small and Medium Enterprises (SMEs) and other firms operating in the Nairobi innovation ecosystem. The project team at the Technical University of Kenya (TUK) was one of the grantees in the Research and Innovation Systems for Africa (RISA) program for the year 2023 that was implemented between January, 2023 and December, 2023. The RISA program was funded by the UK Foreign, Commonwealth and Development Office (FCDO) that aims to strengthen research and innovation ecosystems in Africa. The study was anchored on the Theory of Change. The project commenced with a research phase which took place between January and March 2023, with a survey of 1200 SMEs operating within the targeted geographical region. This was followed by in-depth interviews with a cross section of stakeholders from higher education institutions, research institutes, and managers from funding organizations, Non-Governmental Organizations (NGOs), and advocacy groups to obtain insights on technology development and transfer within the Nairobi innovation ecosystem. The findings of the study indicate a gap in the access and assimilation of new technologies by SMEs, driven by factors that have organizational, regulatory and institutional perspectives. The project team held three stakeholder engagement workshops to disseminate the findings of the survey, deliberated on challenges encountered on technology transfer and knowledge exchange between SMEs and HEIs. As part of capacity building at the Technical University of Kenya, the project team in the month of June 2023 conducted a four day Training of Trainers (TOTs) for forty faculty members on Research to Commercialization (R2C). The TUK faculty trained as TOTs facilitated in training three hundred SMEs who were invited to a six day capacity building training. The SME training covered introduction to innovation and entrepreneurship, business planning and strategy, communication and marketing, digitalization and new product development, business finance, and human resource management. The project team prepared a policy brief, and is championing the creation of a model regional technology hub at TUK, to host incubators, accelerators, crosscutting partnerships and collaborations using a quadruple approach strategy that involves four components of a functional innovation ecosystem; people, technology, capital, and infrastructure.
**Keywords:** Knowledge exchange and technology transfer, higher education institutions, small and medium enterprises, Nairobi innovation ecosystem.
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## 1. Introduction

In today's knowledge based economy, it is widely acknowledged that technology is the key driver of economic

 

growth of countries, regions and cities. Technological progress allows for the more efficient production of more and better goods and services, which leads to prosperity and development. Technology innovations are driven by technological progress of a country and they in turn drive the biggest socioeconomic gains; by allowing more efficient production systems and development of more transformative products (OECD, 2018). Most countries in the developing world like Kenya often lack capabilities for enhanced Research and Development (R&D) to develop new technology and often depend on technology transfer processes to acquire new technology. However, the technology transfer systems in these countries have been found to be weak and disjointed, which often limits technology from local producers like Higher Education Institutions (HEIs) and research institutes to reach users like Small and Medium Enterprises (SMEs). The SMEs which are considered to be the engine for growth and constitute sometimes up to 98% of the economy (CBK, 2020), in most cases lack capabilities to identify and absorb potential transformative knowledge capital, which often ends up remaining underutilized in the knowledge based institutions. While concerted efforts have been made in the Science, Innovation and Technology policies to enhance the ability for these SMEs to acquire new technology and adopt it for own commercial gains; studies reveal that most of the SMEs have not been successful due to very low allocation of funds for implementation (Lundvall, Joseph and Chaminade, 2011).

The economic development agenda of Kenya is defined under the Kenya Vision 2030 blueprint, whose main objective is to transform Kenya into a middle income industrializing nation by the year 2030. This is expected to be achieved through accelerated Gross Domestic Product (GDP) growth, driven by innovation and investments in entrepreneurship and industrial development (GOK, 2010). In Kenya, the Micro, Small and Medium Enterprises (MSMEs) sector is a vibrant segment of the economy and constitutes 98% of businesses that contribute significantly to job creation, GDP growth and poverty reduction (CBK, 2020). Higher Education Institutions (HEIs) are recognized globally as the primary sources of new knowledge creation through research, inventions and innovation. Facilitating technology transfer between Small and Medium Enterprises (SMEs) and HEIs has the potential to lead to valuable partnerships in commercialization of new research findings and the development of valuable new products, services, and processes that can transform markets and the society at large.

Kenya experiences a challenge of low capability of SMEs adopting and assimilating potential transformative knowledge capital, which has remained underutilized in knowledge based institutions like universities, polytechnics, technical institutes, and research institutes. Research studies have shown that most SMEs in Kenya face structural weaknesses such as inability to manage technology as a strategic weapon, (Were, 2016), low access to funding (Chege and Wang, 2020; Mgendi, Shipping and Xiang, 2019). These among other barriers have lead to a cycle of unsustainable, low-tech SMEs that cannot realize their full potential in growth and competitiveness. It is against this backdrop anchored on the Theory of Change that this project sought to champion a technology transfer assistance model, based on a quadruple helix approach strategy that involves four components of a functional innovation ecosystem; people, technology, capital, and infrastructure, to enhance the level of interaction and collaboration between SMEs and HEIs within the Nairobi innovation ecosystem.

### *1.1. Objectives of the Study*

The objectives of the study were;

a) To find out if limited interaction and collaboration between Small and Medium Enterprises, and Higher Education Institutions hinder technology transfer in the Nairobi innovation ecosystem in Kenya.
b) To establish whether regulatory and institutional bottlenecks hinder smooth transfer of technology and knowledge between Small and Medium Enterprises, and Higher Education Institutions in the Nairobi innovation ecosystem in Kenya.
c) To find out whether intellectual property concerns and lack of funding hamper technology transfer initiatives and collaborative commercialization between Small and Medium Enterprises, and Higher Education Institutions in the Nairobi innovation ecosystem in Kenya.

### *1.2. Research Questions*

The study set out to answer the questions;

a) Do limited interaction and collaboration between Small and Medium Enterprises, and Higher Education Institutions hinder technology transfer in the Nairobi innovation ecosystem in Kenya?
b) Do regulatory and institutional bottlenecks hinder smooth transfer of technology and knowledge between Small and Medium Enterprises, and Higher Education Institutions in the Nairobi innovation ecosystem in Kenya?
c) Do intellectual property concerns and lack of funding hamper technology transfer initiatives and collaborative commercialization between Small and Medium Enterprises, and Higher Education Institutions in the Nairobi innovation ecosystem in Kenya?

 

### *1.3. Assumptions of the Study*

The assumptions of the study were;

a) The targeted SMEs and HEIs have technology bases that are aligned as explained by the absorptive capacity view. This view notes that technology transfer is a cumulative process and that firms are only able to absorb technology from sectors that already have a base.
b) The technology generated in the HEIs and other research institutes are useful to SMEs who will then have the aspiration to absorb and assimilate them for own commercial ends, which would otherwise result in costly training to build new capacity.

### *1.4. Literature Review*

Previous policy interventions to aid technology transfer in developing countries have failed due to resource constraints which often lead to very low allocation of funds to research as a percentage of GDP, less than 0.5% (Lundvall, Joseph and Chiminade, 2011). This is contrary to the scenario obtaining in developed world with better resources, where up to 2% or more of GDP is allocated is allocated to research and development. According to Muturi, Gesimba and Kithinji (2014) the factors that influence transfer of technology among Micro and Small Enterprises in Kenya need to be understood and addressed to ensure that the SMEs benefit from the available technology.

There is lack of alignment between policy and constituents to which the policy interventions are sought, in this case the SMEs. Most SMEs in developing countries suffer structural weaknesses; such as poor ability to manage technology as a strategic weapon, due to lack of professionals with technical skills and poor managerial competencies (Were, 2016). The Kenya Government through the Bottom-up Economic Transformation Agenda (BETA) approach has anchored the BETA strategy on 5 pillars, these pillars are Agricultural `Transformation; Micro, Small and Medium Enterprise (MSME) Economy; Healthcare; Housing and Settlement; and Digital Superhighway and Creative Industry, (Parliamentary Budget Office, 2023). According to Ndemo, and Weiss, (2016) an entrepreneurial revolution was in the making towards digitization.

Most entrepreneurs are necessity driven, with low financial bases and thus have low propensity to risk that comes with adoption of new technology. The challenges facing SMEs need to be addressed through evidence based policy interventions that address core challenges rather than the current top bottom approaches that most often address symptoms rather than the disease. In order to enhance technological transfer within an innovation ecosystem, there is need not only for supportive policies, but also need for concerted efforts to enhance close, repeated interactions between firms and a wide range of stakeholders; who collectively form the economic externalities required for effective technology transfer and its effective assimilation for innovation, as enshrined in the national systems of innovation literature (Edquist, 2000; Lundvall, 2002, 2009; Freeman, 2004). This systematic approach focuses on building viable national frameworks and conditions to support knowledge transactions; with scholars increasingly pointing out that successful innovation depends not only on the capabilities of individual firms, but to a great extent on viable institutions; the core of which is an innovative framework that guides collaborative and cooperative efforts with other institutions such as universities, public research laboratories and the entire industry.

Kenya like most developing countries suffers weak technology transfer systems, hindering its socio economic and industrial development (Ngungi, Mcorege and Muriu, 2013, 2016). Deliberate and concerted measures need to be taken to provide opportunities for technology transfer interventions.

## 2. Methodology

This methodology section provides the research approach that was adopted, sampling strategy and sample size, data quality control, training of research assistants, criteria for selecting SME respondents, and data collection and dissemination of results.

### *2.1. Research Approach*

The research phase of the project involved a baseline survey that provided a critical reference point on the technological base of local SMEs and HEIs and determined how knowledge exchange occurs between them and other organizations within the Nairobi innovation ecosystem. In undertaking the survey, both quantitative and qualitative approaches were used; this commenced with a survey of about 1200 SMEs operating within the targeted geographical region, followed by focus group discussions with selected groups of SMEs to obtain more detailed insights on issues arising in the initial 7phase with specific regard to technologies in use. The information that was obtained was used to bring out areas of technological overlap, barriers and potential opportunities for collaboration between SMEs and HEIs also with other stakeholders in the innovation ecosystem. The qualitative section of the research employed explanatory sequential method. Quantitative data was collected in the field using mobile phones integrated with the Open Data Kit (ODK) suite of tools that allowed data collection using Android mobile devices and data submission to an online server; this was able to operate even without internet connection at the time of

 

data collection. The qualitative component constituted a case study approach that involved several data collection methods that included in-depth interviews with a cross section of ecosystem players including SME owners and managers, HEIs representatives, Science and Technology and Innovation (STI) officers and policy makers and also document analysis and media sources. These helped in empirically analyzing the nature of the partnerships and ecosystem relations that were in place at the time of the study which underpinned scientific and technological progress in Kenya and their manifestation in the development of new products, services and processes as part of innovation.

### *2.2. Sampling Strategy and Sample Size*

The sampling strategy involved, first purposive sampling to ensure at least 30% of the targeted 1200 SMEs were representative in terms of Gender Equality and Social Inclusion (GESI). This included SMEs led by women, Persons with Disabilities (PWDs), youth, ethnic and religious minorities, indigenous people, and LGBTQI. This was followed by random sampling in targeting the SME respondents to ensure that results obtained could be generalized. Since the population is finite, the sample size was 1200 which was computed as $n_0 = \frac{Z\alpha/_2\,(1-p)p}{e^2}$, and then modified using the formulae $n = \frac{n_0}{1+\frac{(n_0-1)}{N}}$. For maximum variability, p was taken to be 0.5 with 95% confidence and estimated error of 2%. The structural questionnaire had both closed-ended and five-point Likert Scale items that were developed through consultation with the project Gender Equality and Social Inclusion (GESI) specialist.

### *2.3. Data Quality Control*

The study adhered to the national guidelines on research that involves human subjects by applying for a permit from the National Commission for Science Technology and Innovation (NACOSTI), which is the government agency that is mandated to regulate and assure quality in STI sector in matters related to research. In the process of developing research instruments that is, the questionnaire and interview questions, a wide range of stakeholders were consulted including specialists in GESI, and monitoring and evaluation. To enhance consistency of responses at the group level, the study computed measures of internal reliability, namely the Chrobach's Aipha score. Additionally, to enhance reliability, respondents who provided many inconsistent responses were removed from the data set. For accuracy and correctness of answers, the study assessed the group-level correctness of data by examining whether the data was related to similar constructs (convergent validity) and dissimilar from constructs not related to (discriminant validity) and advocated for completeness of responses (research assistants were trained on this) as well as manipulation check of the main outcome measures. To enhance respondent credibility and honesty, the study compared the effect of size of specific manipulations to those previously obtained with other samples. These measures were used to detect overly positive or negative self-presentation to a variety of measures.

Further quality was assured by ensuring that there was consistency across questions being asked and the questions carefully planned according to the goals of the study. Once created on the ODK survey tool, the questionnaire was tested on a range of devices to help mitigate any technical difficulties that the research assistants could encounter while in the field. Questions were pre-tested on a small group of SMEs in advance, in a pilot survey which helped in evaluating the strength of the survey questions which allowed improvement before commencement of the survey.

### *2.4. Training of Research Assistants*

All eight research assistants that were contracted to collect data in the study were university scholars at the level of Graduate Assistant and above, with a Masters degrees, which means they had been involved in data collection previously. The research assistants were thoroughly trained by the core project team for two days before they went to the field. The training was on both on the technical aspects of data collection; how to effectively administer survey questionnaires and conduct effective interviews and also on competent use of the data collection tools and analysis tools. This not only ensured consistency in the data that was collected, but also got everyone working to the same standards. As part of the training process, the team also appraised the "why" behind what was being done which ensured that the research assistants felt included in the overall aim of the project; which made them to be more motivated towards realizing a common goal.

### *2.5. Criteria for Selecting SME Respondents*

In the project, the criteria for selecting participants included;

a) The business needed to qualify to be defined as an SME in the Kenyan context, where SMEs are defined as enterprises that have 10-99 employees. Micro enterprises have less than 10 employees; small enterprises have 10-49 employees, while medium sized enterprises have 50-99 employees.
b) The SMEs should be located in Nairobi. This was the designated area of study, which targeted

 

the local innovation ecosystem.

c) The SME was expected to be technology enabled, that is, have some level of technology in place the SME could seek to upgrade for improved productivity and competitiveness.
d) The SME was expected to have been in operation for at least three (3) years, since according the entrepreneurship literature a business that has survived three years is considered mature and sustainable in the long run.
e) Businesses led by women, Persons with Disabilities, youths, all religions, indigenous people and LGBTQI were purposely selected to meet inclusive goals.

### *2.6. Data Collection and Dissemination of Results*

The methodology for data collection began with a quantitative survey of about 1200 SMEs operating within the targeted Nairobi innovation ecosystem region. The Nairobi innovation ecosystem was mapped into eight areas namely Embakasi, Kamukunji, Kasarani, Lang'ata, Roysambu, Ruaraka, Starehe, and Westlands. This was a representative sample of women, persons with disabilities, youth, ethnic and religious minorities, indigenous people, and LGBTQI. This was followed by qualitative interviews with a cross section of industry players. The qualitative component constituted multiple case study approach that involved several data collection methods, including in-depth interviews with a cross section of ecosystem players including SME owners and managers, HEIs and Science Technology and Innovation (STI) policy makers and also document analysis and media sources, while incorporating all aspects of Gender Equality and Social Inclusion (GESI). This was followed by a stakeholder engagement phase, where a quadruple-helix approach was used to bring together a wide range of stakeholders including; representatives from the industry, with a good representation from women, persons with disabilities, youth, ethnic and religious minorities, indigenous people, and LGBTQI, the government, public sector players and knowledge based institutions like research institutes, and HEIs which engaged, learnt from each other and came up with proposals that can help in guiding the development of evidence based strategic policy interventions, that can be tested in the form of a regional technology hub at the Technical University of Kenya.

## 3. Results and Discussions

The survey was carried out during the month of February 2023 and March 2023. Initially eight (8) research assistants had been trained on both quantitative and qualitative data collection and were taken through the questionnaire as well as the interview schedule. Thereafter, the survey form was coded into ODK software and NACOSTI permit obtained License No: NACOSTI/P/23/23979 of 23/February/2023. The project team wrote to the Nairobi County Director of Education, Nairobi County Commissioner, and County Governor of Nairobi to inform them regarding the survey as per the NACOSTI Permit. At the end of data collection, one thousand, two hundred and fifteen (1215) questionnaires had been completed and sixteen (16) interviews had been conducted. Out of the 16 interviews, eleven (11) were males and five (5) were females. To get more insight into the results obtained from the quantitative data gathered, a further twelve (12) interviews were conducted of which five (5) were females and seven (7) were males. The quantitative data collection was face-to-face and was conducted to SMEs operating within the Nairobi innovation ecosystem, clustered into eight regions namely; Embakasi, Kamukunji, Langata & Kibra, Roysambu, Ruaraka, Starehe, Westlands & Dagoreti, and Kasarani. The categories of SMEs include Financial Services, Information Communication and Technology, Manufacturing (Including Jua Kali), Transport and Infrastructure, Agriculture, Tourism, Hospitality and Entertainment, Real Estate and Construction, Healthcare, Education, Retail (Supermarket, Distributor etc.), Waste Management and Garbage, Fashion Design, Beauty, Barbershop, Interior Decor, Photo and Video, Consultancy, Electronic Repairs, Mechanics and Garage.

### *3.1. Types of Businesses*

The size and structure of the SMEs play a critical role in their ability to access technology transfer and knowledge exchange from HEIs. A high proportion 82.37% of the sampled businesses was micro-enterprises as shown in Figure 1.

 

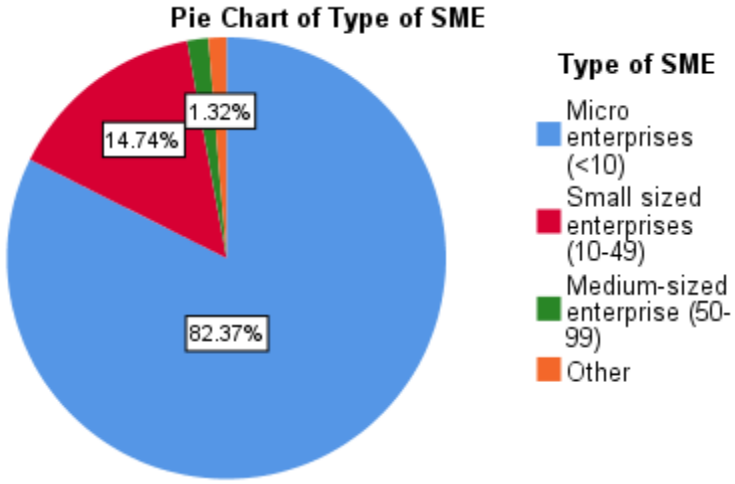


***Figure 1: The Type of Businesses/SMEs***

It is possible that micro-enterprises may lack the resources and infrastructure to implement new technologies, while larger MSMEs may have greater capacity but face organizational barriers to adopting new approaches.

### *3.2. Description of the Respondents*

The inclusive population sampled was made up of business owners 64.77%, managers 16.38%, other employees 16.21%, and directors 2.63%, of which sixty percent (60%) were male and forty percent (40%) were female; with ages ranging from below 20 to above 60 years old. A higher proportion 40.41% of the respondents were between 31-40 years old, and 36.46% of them were between 21-30 years old (See Table 1).

***Table 1: Respondent's Age Group (Years) by Gender***

| | | Respondent's Age Group (Years) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Below 20 | 21-30 | 31-40 | 41-50 | 51-60 | Above 60 | Total |
| Gender of respondent | Male | 1.0% | 33.4% | 40.8% | 19.2% | 4.7% | 1.0% | 100.0% |
| | Female | 1.2% | 41.0% | 39.8% | 13.6% | 3.5% | 0.8% | 100.0% |
| Total | | 1.1% | 36.5% | 40.4% | 17.0% | 4.2% | 0.9% | 100.0% |

A young population of SMEs aged 20-40 can bring several advantages to knowledge transfer from HEIs since they are Technology Savvy, have a diverse range of transferable skills, such as adaptability, creativity, and collaboration, and are often at the forefront of new trends and developments in their respective fields. This, besides offering a fresh and relevant perspective]e on current research and practices to help HEIs stay up-to-date with the latest knowledge and trends in their fields, their skills can help bridge the gap between theory and practice.

The respondents from diverse backgrounds and experiences represented varied industries, as illustrated in Figure 2 (a) and 2(b). This brings diversity to knowledge transfer, thus helping HEIs to gain a broader perspective on their research and practices and identify new and innovative approaches to their work.

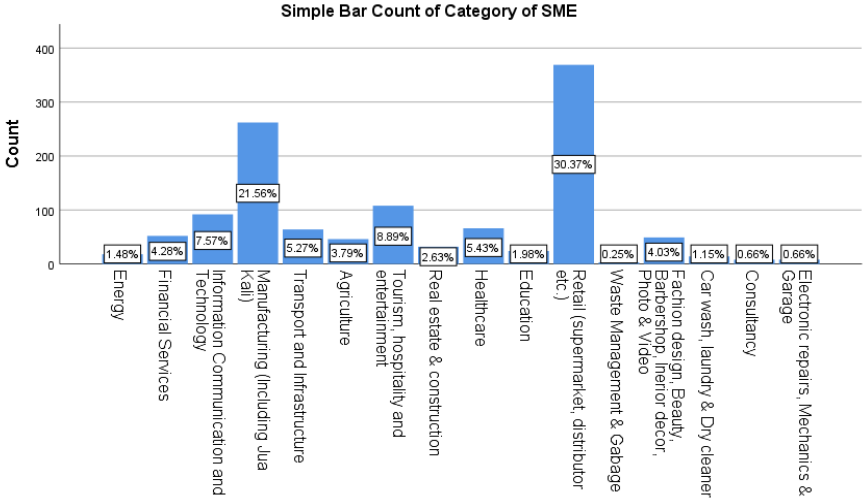


***Figure 2(a): MSMEs Distributed by Industry Categories***

 

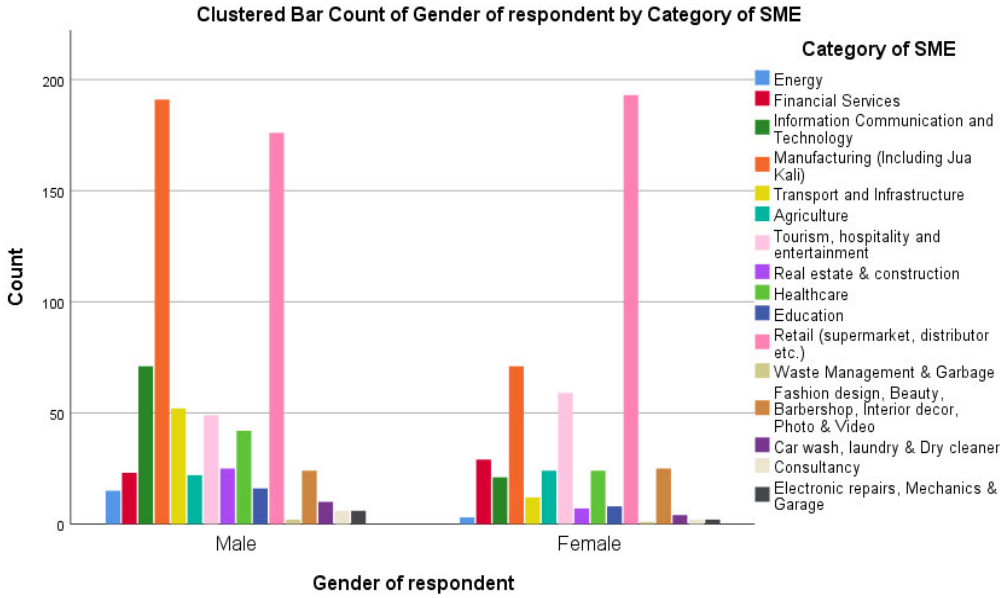


***Figure 2 (b) SMEs Gender Distribution by Category***

### *3.3. Key Thematic Areas*

Key thematic areas were considered to map out the technology base of SMEs and examine the key factors that hinder effective knowledge transfer between MSMEs and Higher Education Institutions (HEIs). These include: Human Resource Management, Technology Infrastructure, Knowledge Management and Intellectual Property, Industry-Specific Factors, Collaborative Culture, and Funding and Resources.

#### *3.3.1. Human Resource Management*

In general, a high proportion of the respondents have some level of education, with a bigger majority 36% of the respondents holding a certificate/diploma as their highest level of education, followed closely by secondary school education 27.7% and undergraduates 26.1%. This observation is critical since MSMEs personnel with higher levels of education may be better positioned to collaborate with HEIs, such as through research partnerships or joint projects, thus facilitating knowledge exchange and creating opportunities for MSMEs to access new knowledge and resources. Additionally, MSMEs may be better equipped to understand and apply new information/ knowledge from HEIs to their work, due to increased receptiveness to knowledge, and ability to apply knowledge. The respondents' highest level of education is distributed as shown in Table 2.

***Table 2: Highest Level of Education***

| | %Male | %Female | %Total |
|---|---|---|---|
| Primary | 9.7 | 3.5 | 7.2 |
| Secondary | 27.8 | 27.6 | 27.7 |
| Certificate/Diploma | 33.6 | 40.0 | 36.1 |
| Undergraduate] | 27.1 | 24.5 | 26.1 |
| Postgraduate | 1.6 | 2.9 | 2.1 |
| Other | 0.1 | 1.4 | .7 |
| Total | 100 | 100 | 100.0 |

Table 3 shows a positive correlation between male and female MSME employees, implying that both men and women are equally represented in the workforce of the MSME sector. Pearson correlation gave a Sig. (2-Tailed) value is .000, implying that there is a statistically significant correlation between male and female employees. That is, increases or decreases in male employees do significantly relate to increases or decreases in female employees. The different skills, experiences, and viewpoints presented by males and females in the MSMEs workforce can create a more diverse, innovative, and inclusive workforce, which can positively impact technology and knowledge exchange.

 

***Table 3: Pearson Correlations on the Number of Male and Female Employes***

| Correlations | | | |
|---|---|---|---|
| | | Number of male employees | Number of female employees |
| Number of male employees | Pearson Correlation | 1 | .696** |
| | Sig. (2-tailed) | | .000 |
| | N | 1215 | 1215 |
| Number of female employees | Pearson Correlation | .696** | 1 |
| | Sig. (2-tailed) | .000 | |
| | N | 1215 | 1215 |
| **. Correlation is significant at the 0.01 level (2-tailed). | | | |

It was evident that businesses did not require specific technical skills for a particular gender as reported by 93.83% of the respondents. However, 66% of the male respondents and 59.6% of the female respondents reported having employees with technical skills relevant to the business. A focus on the portion of the sampled population that owned businesses revealed that 63.3% of the male-owned businesses and 35.5% of female-owned businesses had employees with technical skills relevant to the businesses (See Table 4).

***Table 4: Gender of Owner vs Employees with Technical Skills Relevant to the Business***

| | | Gender of owner | | | |
|---|---|---|---|---|---|
| | | Male | Female | Other | Total |
| Have employees with technical skills relevant to the business | Yes | 61.3% | 35.5% | 3.1% | 100.0% |
| | Not sure | 59.8% | 40.2% | 0.0% | 100.0% |
| | No | 56.9% | 42.0% | 1.1% | 100.0% |
| Total | | 59.9% | 37.8% | 2.3% | 100.0% |

Qualitative data analysis showed that women-owned businesses had fewer employees with technical skills relevant to the business since women have lower technical capacities thus female-owned businesses give less focus to technical jobs, women are less risk-takers, and do not embrace and adopt new technology/innovation at a pace similar to their male counterparts. This, besides other gender-related issues such as historical biases that associate businesses with men, and other cultural norms that limit females from accessing the technology required or financing to hire skilled labor was highlighted.

Besides bridging the digital divide that is, the gap between those who have access to technology and those who do not, social inclusion can empower marginalized communities to participate in technology and knowledge exchange activities. In this study, a minimal percentage of businesses demonstrated an attempt to create opportunities for Persons with Disabilities (PWDs), as shown in Figure 3.

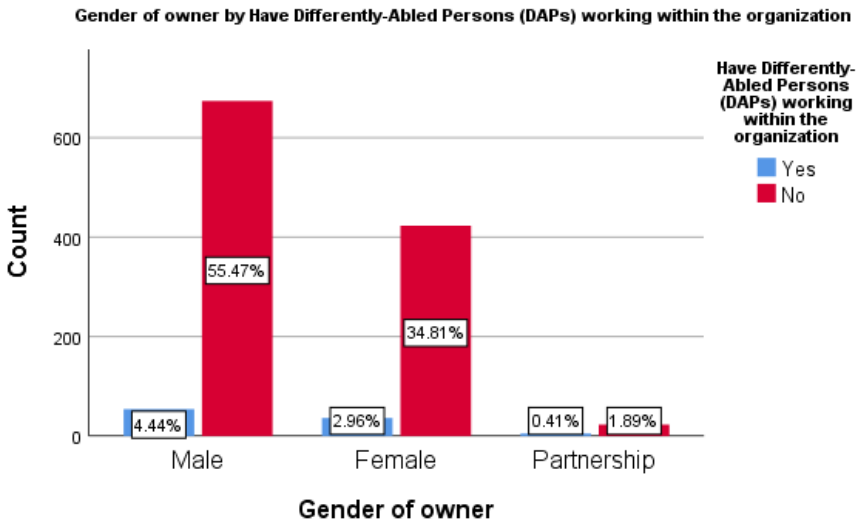


***Figure 3: Relationship between Business Ownership and Engagement of PWDs***

### *3.3.2. Technology Infrastructure*

This study showed that 59.43% of the sampled MSMEs operate in a physical space, and the mode of business operation for 25.11% of the MSMEs is both online and physical (See Figure 4).

 

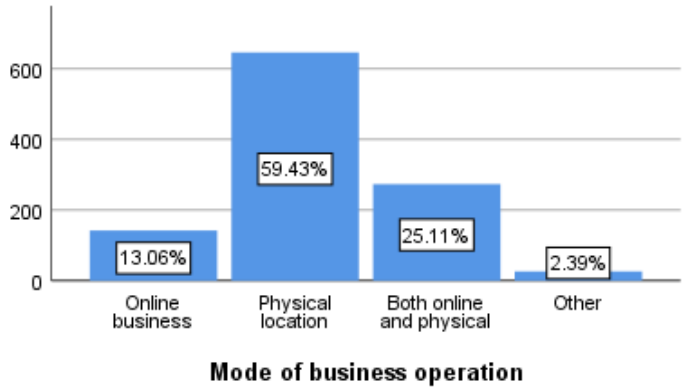


*Figure 4: Mode of Business Operation*

Quantitative data showed that only 31.28% of male and 21.73% of female-owned businesses reported using computers in their businesses (Figure 5). Further to these, qualitative analysis revealed minimal knowledge and use of online platforms to improve businesses. The use of computers can help MSMEs to communicate and share data with HEIs in real-time, thus speeding up the research process and leading to more efficient technology transfer. The use of Computer use in businesses can also provide MSMEs with up-to-date knowledge and insights that can be used to improve their business operations.

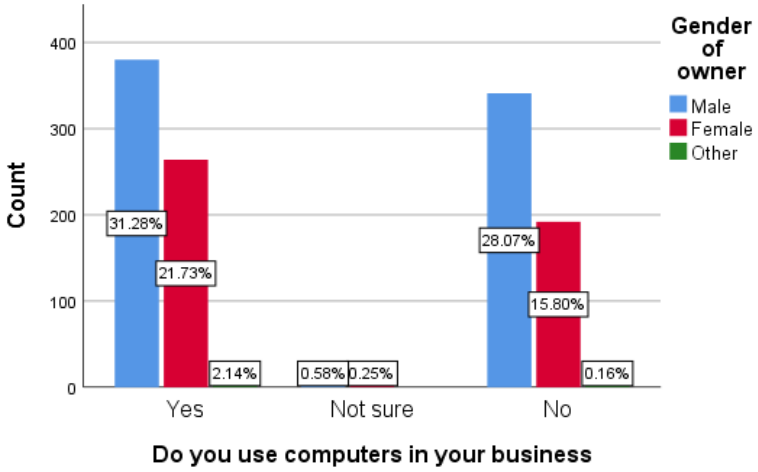


*Figure 5: MSMEs Use of Computers in Businesses*

Despite this, the respondents reported that they are open to any online training opportunity that could present itself, for it will be a game changer in their business. In relation to product development, the study showed that a proportionate percent (72.6%) of the businesses have not developed new products nor implemented new ways of doing things within the last 2 years as illustrated in Figure 6.

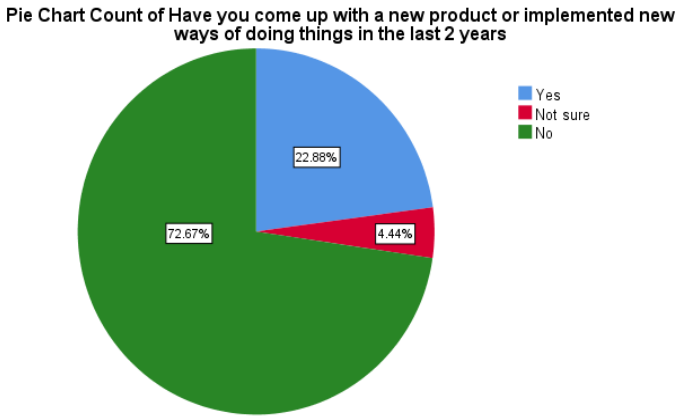


*Figure 6: Development of New Products*

 

Respondents argued that HEIs are building capacity on how to be employees but not how to be employers, they do not spearhead new areas and new ways of doing things. The respondents identified the main factors that limit SMEs from coming up with new products and implementing new ways of doing things as follows;

a) Inadequate capabilities (technical, financial, and market) to compete with mega businesses.
b) Limited/no access to training, mentorship, and inadequate role models.
c) Legal and regulatory requirements to patent new products.
d) Failure to understand market trends, and unwillingness to adapt to changing trends.
e) Capital-intensive nature of the innovation process.

A reflection on the 22.88% of businesses reported to have developed new technology and implemented new ways of doing things, showed that the majority (57.9%) of these were male-owned businesses, 37.8% were female-owned, and 4.3% were partnerships.

***3.3.2.1. Respondents' Perception of the Technological Infrastructure of SMEs***

Both male and female respondents gave high ratings to men, women, and youth in their access, reception, and utilization of new technology in business. However, a high proportion of the respondents rated PWDs as low in access, reception, and utilization of technology in business. Qualitative analysis attributed the low level of access to technology by PWDs to issues of discrimination and biases, which result to:

a) Inadequate opportunities created for PWDs to interact and learn.
b) Many businesses and companies don't have the capacity to handle PWDs.
c) Technology development and training do not factor in the needs of the PWDs.

While the respondents perceived that men, women, and youth, have a high rating in their willingness to cope with modern technology, mastering of digital transformation, competence with modern ICT, and willingness to flexible work arrangements in business, PWDs were rated low to moderate in the same attributes (See Figure 7).

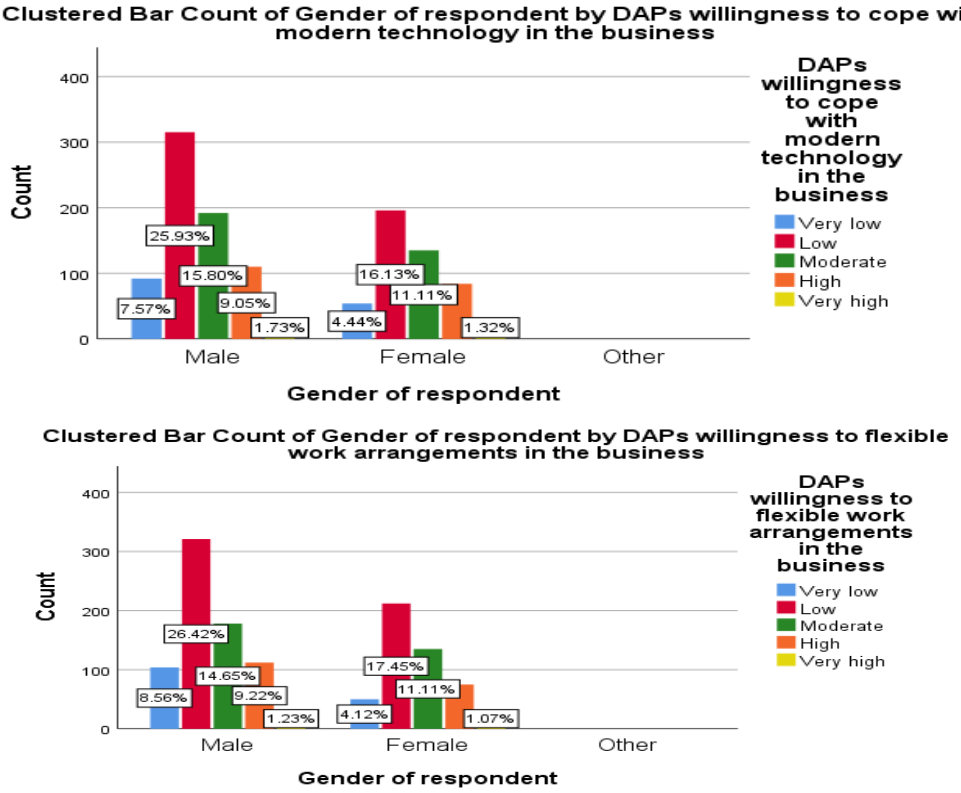


***Figure 7: Ratings of Differently Abled Persons/ PWDs by Male and Female***

While the willingness to interdisciplinary work in the business was rated low for PWDs by both male and female respondents, the willingness by youth, men, and women was said to be high. To increase the willingness of DAPs to cope with technology, the respondents suggested that HEIs should: Provide free and appropriate training for PWDs/DAPS, encourage business owners to have strategies on how to handle PWDs/DAPs, provide them with the necessary equipment to help them manage technology. Additionally, educators need to be well-trained on how to deal with PWDs/DAPs.

Assessing the readiness to adopt new technology, further probing showed that businesses look forward to engaging and adopting new technology, including ICT in business, automation of machines, and upgrading their connectivity, among others to enhance their efficiency. To quote one of the respondents in the qualitative interview, who said: "*I have a five-year projection to automate the business and make it mass production, acquire new*

 

*technology for mixing, packaging which will make mass production efficient-to full commercialize and make it convection".* Another respondent said he is saving towards getting training on these technologies,

### *3.3.3. Knowledge Management and Intellectual Property*

Knowledge Management and Intellectual Property (IP) are important in managing and protecting MSMEs' valuable information assets and maintaining a competitive advantage.

#### *3.3.3.1. Knowledge Management*

While it is expected that MSMEs would be capturing, storing, sharing, and utilizing knowledge assets to support decision-making, problem-solving, and innovation, 50% reported to have attended training; and out of which, 82.8% reported that their previous training was not effective in equipping them with skills relevant skills to their business (See Table 5).

***Table 5: Impact of Training on Business***

| Did your former training equip you with new skills relevant to your business | | | |
|---|---|---|---|
| | | Frequency | Percent |
| | Yes | 209 | 17.2 |
| | No | 1006 | 82.8 |
| | Total | 1215 | 100.0 |

Further to this, qualitative analysis revealed that internet connectivity plays a key role in keeping MSMEs abreast with new information in their field and up scaling their skills. The use of smart phones for Google search engines and other social media platforms help to access and share information related to their businesses, products, and services on YouTube, Instagram, and WhatsApp statuses, among other online marketing spaces such as Jumia. This also helps to keep in touch with their suppliers and end users. Despite having no access to online training one respondent indicated that she was proactive to use and learn from websites that showcase her business, and individuals'/ organizations' updates on the status online of new technology, products, and services. This presents an opportunity for HEIs to collaborate with MSMEs in the systematic management of MSMEs' knowledge assets, including explicit and tacit knowledge, to help them create value, improve performance, and gain a competitive advantage.

Some respondents reported belonging to professional networks and business owners' groups where they interact and exchange knowledge with other stakeholders in relation to their products, services, and markets, and in addition, they also get updates from journals and books and watch TV channels-discovery. Some have adopted role models locally and in the virtual space, who are their pacemakers. As much as the respondents indicated the importance of a technology hub in knowledge sharing, 93.1% reported that they have had no access to a technology hub in any institution of higher education as illustrated in Table 6.

***Table 6: SMEs' Access to a Technology Hub in HEI***

| | | Frequency | Percent |
|---|---|---|---|
| | Yes | 84 | 6.9 |
| | No | 1131 | 93.1 |
| | Total | 1215 | 100.0 |

#### *3.3.3.2. Intellectual Property*

In the context of knowledge management, intellectual property rights can play an important role in protecting MSMEs' intellectual assets, such as proprietary information, trade secrets, and innovations, from unauthorized use or infringement. It was observed that a larger proportion 77.10% of MSMEs did not develop any new products in the last two years and that a negligible percentage 1.4% of MSMEs protects their knowledge assets through patenting, as shown in Figure 8.

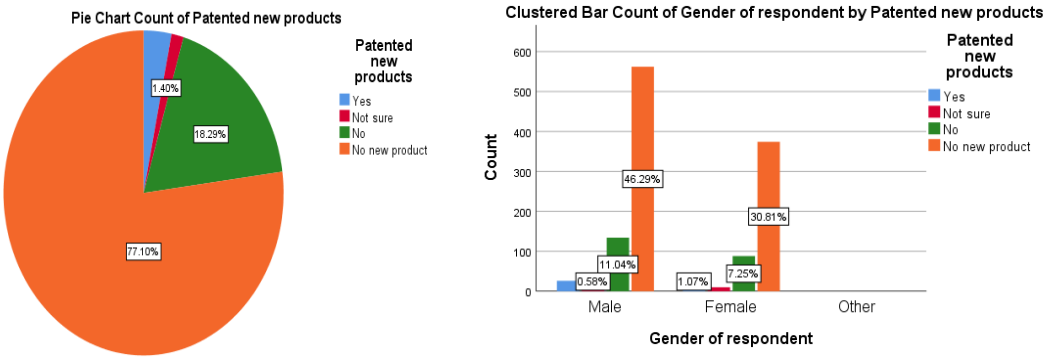


***Figure 8: Patented New Products by SMEs Disaggregated by Gender***

The MSMEs revealed that awareness/knowledge, resources, and other regulatory requirements are key limitations to patenting of their products. Qualitative interviews observed that government policies and regulations

 

are not friendly to manufacturers and new ventures.

### *3.3.4. Industry-Specific Factors*

Industry-specific factors play a significant role in determining the extent to which MSMEs can access technology transfer and knowledge exchange from HEIs and thus presents an opportunity for HEIs to provide targeted support and resources to MSMEs based on their specific industry and organizational factor. The study showed that a high percentage of SMEs access their raw materials/inputs 70.37% and market 79.51% locally, as observed in Figure 9.

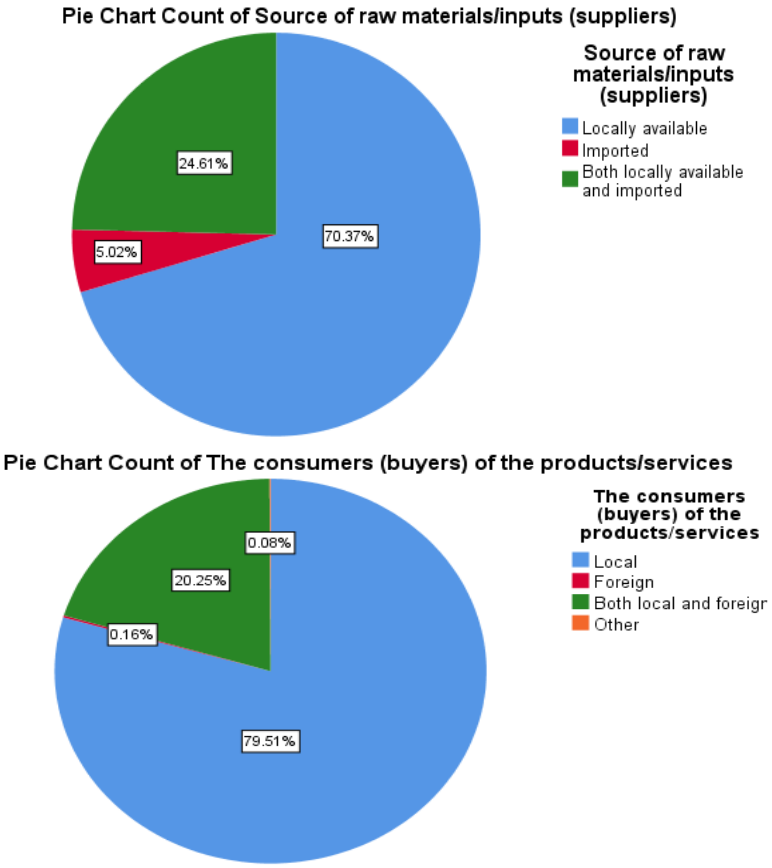


***Figure 9: Business Inputs and Outputs***

It was revealed that 86.7% of the businesses do not receive any form of support from any organizations in business development, and 90.9% of MSMEs have not received any other support from non-financial partners, as illustrated in Tables 7 and 8.

***Table 7: Support in Business Development***

| | Frequency | Percent |
|---|---|---|
| Yes | 161 | 13.3 |
| No | 1054 | 86.7 |
| Total | 1215 | 100.0 |

***Table 8: Any other support from non-financial partners***

| | Frequency | Percent |
|---|---|---|
| Yes | 110 | 9.1 |
| No | 1105 | 90.9 |
| Total | 1215 | 100.0 |

Government requirements, including policies, regulations, taxes, licensing, and business registration were identified as the second greatest barriers to the expansion of businesses, after funding. This notwithstanding, the business owners reported a lower awareness of policy regulations and guidelines that deal with technology, as illustrated in Table 9.

 

***Table 9: Awareness of Policy Regulations and Guidelines by Business Owners***

| | | Gender of owner | | | |
|---|---|---|---|---|---|
| | | Male | Female | Other | Total |
| The business is aware of policy regulations and guidelines that deal with technology | Yes | 59.9% | 36.6% | 3.4% | 100.0% |
| | Not sure | 58.7% | 37.0% | 4.3% | 100.0% |
| | No | 60.2% | 38.9% | 0.9% | 100.0% |
| Total | | 59.9% | 37.8% | 2.3% | 100.0% |

Thus, to increase business awareness of policy regulations and guidelines that deal with technology, SMEs suggested the following;

a) The HEIs should go beyond the institutions to hold forums for awareness creation
b) Policymakers and implementers, to enhance civil education using internet services and social media, consistent pass of information.
c) Conduct training on policies, develop and scale up more products and promote digital marketing.
d) All courses integrate entrepreneurship and business development in their curriculum.
e) Provide tax incentives for young entrepreneurs to encourage them to be more competitive locally and internationally.
f) Promote evidence-based decision-making and public participation in policy development.

The greatest barriers to business to the expansion of business were ranked by female and male respondents as follows: Funding and governments requirements were considered the main limitations to business by both male and female respondents as shown in Figure 10.

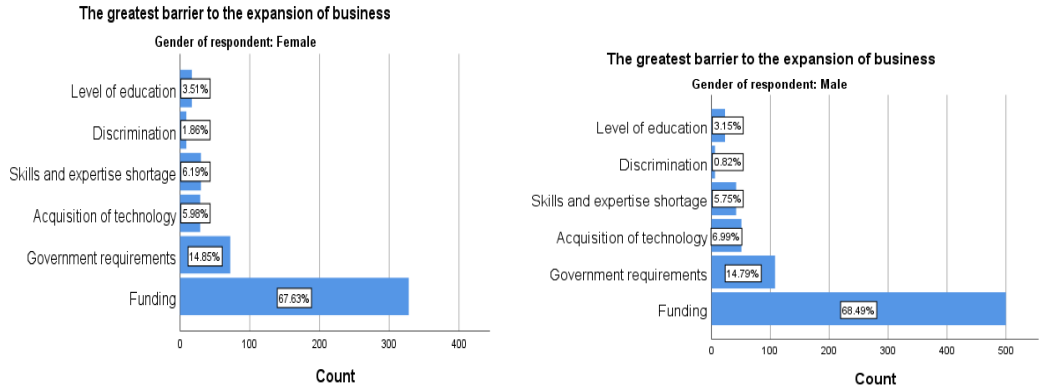


***Figure 10: Ranking of barriers to expansion of business by Female and male respondents***

### *3.3.5. Collaborative Culture*

Qualitative data showed that a number of businesses collaborate with input suppliers, other producers and product distributors, and markers. However, Table 10 reveals that a large proportion of businesses have had no collaboration with a higher education institution such as University/College/Technical Training Institute (TTI) 92.8%, Non-Governmental Organization (NGO) 93.7%, nor with County Government 94.7% in their business.

***Table 10: Businesses' Collaborative Ventures***

| **Collaboration with** | **Yes** | | | **No** | | |
|---|---|---|---|---|---|---|
| | **Male** | **Female** | **Total** | **Male** | **Female** | **Total** |
| HEI | 8.1 | 5.8 | 7.2 | 91.9 | 94.2 | 92.8 |
| NGO | 6.3 | 6.2 | 6.3 | 93.7 | 93.8 | 93.7 |
| County Government | 6.2 | 4.1 | 5.3 | 93.8 | 95.9 | 94.7 |
| National Government | 7.3 | 5.4 | 6.5 | 92.7 | 94.6 | 93.5 |

Despite this, 66.1`% of the business indicated a willingness to collaborate with Institutions of Higher Learning and in designing technology relevant to their businesses, and 52.9% a willingness to collaborate with the National Government. The main areas of collaboration were identified as information technology and accounting, training, research, and data science, Technology transfer, funding, Sales and Marketing, product development, innovation and patenting, outsourcing skills, research, and exchange programs. Further to this, respondents suggested that HEIs take responsibility to support student's placement, mentorship, and internship programs.

It was evident that the participation of SMEs in government, private sector, or donor-funded projects in the past was low. However, one SME reported to have been involved in various government and private donor projects from 2012-2013, secured a tender by European Union to install Jikos in 90 schools in schools in Kajiado, and Moyale, and also collaborated with the government in a Constituency Development Fund (CDF) project in 2019-2020-2021 to supply stoves in over 20 schools in Keiyo North. In 2016-2017, he was also involved in the TU-K

 

Biodiesel project to run Tuk-Tuk in partnership with Kenya Industrial Research and Development Institute (KIRDI), and US Aid.

### *3.3.6. Funding and Resources*

Funding was reported as the greatest barrier to the expansion of the businesses as illustrated in Figure 10 above. Despite this, only 34% of respondents reported having had challenges in accessing funding for a new idea or product line (See Table 11).

***Table 11. Funding Challenges for a New Idea or Product Line***

| | | Frequency | Percent |
|---|---|---|---|
| | Yes | 413 | 34.0 |
| | No | 802 | 66.0 |
| | Total | 1215 | 100.0 |

The initial source of capital for sampled businesses was majorly from MSMEs' own savings, as reported by male 61.08% and female-owned 52.82% businesses. Table 12 indicated that the main financiers to MSMEs are their own savings 52.4% followed by earnings from the businesses 31.9%. Loans accounted for only 9.8% with minimal family support 4.3%, these findings are in line with a study by (Lundvall, Joseph and Chiminade, 2011) which found that firms have low access to business funding.

***Table 12. Main Financier of the Business***

| | | Male | Female | Total |
|---|---|---|---|---|
| | Own savings | 53.8 | 50.3 | 52.4 |
| | Family support | 4.5 | 3.9 | 4.3 |
| | Loan from financial institutions | 10.1 | 9.3 | 9.8 |
| | Grants | 0.7 | 1.0 | .8 |
| | Share sale (offer) | 0.1 | 0.4 | .2 |
| | Ploughing back the profit (retain earnings) | 30.1 | 34.6 | 31.9 |
| | Other | 0.5 | 0.4 | .5 |
| | Total | 100 | 100 | 100.0 |

From the respondents, 86.8% of the business reported that they do not receive any form of support from other institutions. Access to technology transfer and knowledge exchange from HEIs can provide MSMEs with valuable resources and expertise to help them develop new products, processes, and services. These results were uniform across the two genders as indicated in Table 13.

***Table 13: MSMEs Sources of Support by Gender***

| | Male | Female | Total |
|---|---|---|---|
| Private corporate organizations | 6.2 | 3.7 | 5.2 |
| NGO/religious organizations | 1.2 | 2.9 | 1.9 |
| Government | 0.5 | 0.6 | .6 |
| Institution of higher learning including universities/research institutes | 0.4 | 0.2 | .3 |
| Bank | 0.3 | 0.4 | .3 |
| No support | 87.0 | 86.6 | 86.8 |
| Private corporate organisations & Institution of higher learning including universities/research institutes | 0.3 | 0.4 | .3 |
| Private corporate organisations & NGO/religious organizations | 1.0 | 0.4 | .7 |
| Private corporate organisations, NGO/religious organisations & Government | 0.4 | 0.6 | .5 |
| Private corporate organisations, NGO/religious organisations & Institution of higher learning | 0.3 | 0.8 | .2 |
| Private corporate, NGO/religious, Government & HEI | 0.3 | 0.2 | .5 |
| Government & Institution of higher learning including universities/research institutes | 0.1 | 1.6 | .2 |
| Private corporate organisations & Government | 1.0 | 0.4 | 1.2 |
| NGO/religious organisations & Government | 0.4 | 0 | .4 |
| Private corporate organisations, Government & HEIs | 0.3 | 0 | .2 |
| NGO/religious organisations & HEIs | 0.3 | 0 | .2 |
| Chama | 0.1 | 0.8 | .4 |
| **Total** | | | **100.0** |

## 3.4. Qualitative Results

In the first set of interviews, there were a total of sixteen (16) interviewees of which eleven (11) were males and five (5) were females. The following Table 14 summarises the results

 

***Table 14: Summarised Interviews***

| *Participant Code* | *Gender* | *Type of business* | *Product/service developed* | *External players* | *Participated in a funded project* | *Any mentor?* |
|---|---|---|---|---|---|---|
| JI | Female | Selling in a kiosk (General vendor) | No product developed | Suppliers | No | Yes |
| J2 | Male | Vehicle Mechanic | Spare shop | Buyers | No | No |
| J3 | Male | Vendor of sneakers | No product developed | Customers | No | Yes |
| J4 | Female | Offers cleaning services | None | Client's needs | Yes (workshop by KEPSA) | Yes |
| M1 | Female | Runs a bakery | Came up with own recipe | Customers | No | No |
| M2 | Male | Film making for corporate/ marketing business | Made best video for Nice and lovely | Customers & Partner with production companies | Worked with UN intermediaries | Yes |
| M3 | Female | Skin care products | Manual mixture & weighing machine | Partnership | Yes & also training, awarded grants to get certified, customer connection | Yes |
| M4 | Male | Online marketer | None | Customers | No | Yes |
| O1 | Male | Workshop of clothes making | None | Customers | No | No |
| O2 | Male | Mechanical engineering services | None | Customers | No | No |
| O3 | Female | Re-usable manufactured pads | Yes, quality products with environmental friendly packaging | Customers | I got grant to start my business | Yes |
| O4 | Male | Quality furniture manufacturer | King size beds | Customers | Yes, once by government | No |
| C1 | Male | Repair machines, spare parts | None | Customers | No | No |
| C2 | Male | Installation of modern energy savings Equipment | Products that use less fuel and environmentally friendly | Clients | Yes, in various government and private donor projects | Yes |
| P2 | Male | Wine and spirit | None | Market | No | No |
| P3 | Male | Deal with animal products, feeds, veterinary services and consultancy | Ratio of animal feed input combination | Customers | No | Yes |

 

| Participant Code | Attended training/ workshop | Require any Technology? | How do you keep abreast of new information | Upscale your skills | undertaken an online course/ training |
|---|---|---|---|---|---|
| JI | No | Online sales, | Phone | Reading | No |
| J2 | No | latest machine | You tube | Online | No |
| J3 | Yes | Internet, adopt Ecommerce to link customers and clients | Social network | In touch with end users and suppliers | No |
| J4 | Yes | Modern refrigerator to store perishable goods | Net working with other people with similar interests | Networking with key players | Yes |
| M1 | Yes | Commercial ovens | Internet (Instagram) | Internet, social media | Yes |
| M2 | No | Better internet speed, to sell products | Observing pace setters in the market | Market leaders | Yes |
| M3 | Yes | Stable marketing skills | Social media (face book) | Market leaders & watching | No |
| M4 | No | Delivery App | Look at the market leaders | Online | Yes |
| O1 | No | New machines, computers | New designs | | No |
| O2 | No | Digitalized machines to improve production | No | Students on attachment | Yes |
| O3 | No | Automatic machine | Reading, watch TV | | Yes |
| O4 | No | Good machines to improve production | Learn new technologies | | No |
| C1 | Yes | Online marketing to display the products | Training | Online | |
| C2 | Yes | | Journals, TV | Websites | |
| P2 | No | Getting 5G to process customers claims very fast and round clock- | Colleagues | You tube | Yes |
| P3 | | | Internet | Attending seminars and conferences | Yes |

***Note: All persons interviewed mentioned that they were on track to advancement in the next 5 years***

## 4. Conclusion and Recommendations

### *4.1. Conclusion*

The level of education of majority SMEs, position them well to collaborate with Higher Education Institutions (HEIs) through partnership and joint projects to facilitate knowledge exchange and create opportunities. The main factors identified by SMEs, that limit them from coming up with new products and implementing new ways were cited as: inadequate capabilities (technical, financial, and market) to compete with mega businesses; limited/no access to training, mentorship, and inadequate role models; stringent legal and regulatory requirements to patent new products; failure to understand market trends, and unwillingness of some of them to adapt to changing trends and the capital-intensive nature of the innovation process. Lack of inclusion of Persons with Disabilities (PWDs) resulted to inadequate opportunities for them hence low level of access to technology transfer. SMEs indicated willingness to collaborate with Institutions of Higher Learning (HEIs) in areas of technology, including product development, marketing, patenting, exchange programs and mentorship. Lack of innovation and entrepreneurship

 

skills, inadequate business planning skills and strategy, communication and marketing, digitization and new product development and accessing to funding opportunities were pointed out as areas where SMEs lack knowledge. It was also found that SMEs keep abreast of new information and get new skills through social media, networking with other people with similar interests and observing pace setters in the market. Very few read and watch Television to upscale their skills. Finally, to enhance adaptability and creativity, HEIs should teach relevant transferable skills and collaborate with all players in the innovation ecosystem to identify new and innovative technology transfer approaches.

### *4.2. Recommendations*

Based on the findings and conclusion of the survey, the study recommends that;

a) Since majority of the SMES in Nairobi ecosystem are in manufacturing and retail sector approximately 52% more emphasis should be placed on these sectors to enable them get knowledge, upscale their skills and be innovative in solving their current challenges, embracing new opportunities in matters of incubation and commercialization of their ideas/innovations.
b) Marginalized communities including Different Abled Persons (DAPs) should be empowered equally to participate in technology and knowledge transfer exchange activities. Thus HEIs should tailor make entrepreneurship training programmes to suit people with disabilities hence foster inclusive growth.
c) To access wider market, SMEs should go beyond operating in the physical space and explore online (digital) marketing; this will be a game changer in their businesses.
d) Higher Education Institutions (HEIs) should integrate entrepreneurship and business development in their curriculum, foster collaboration and partnership with SMEs for them to tap into the knowledge and technologies generated by HEIs as well as facilitate networking among SMEs, Higher education institutions, government agencies and other stakeholders within the innovation ecosystem.
e) There is need for linkages and connectivity, through technology hubs and Marker Spaces to aid learning, explore and share high tech to no tech tools, enhance critical skills in the relevant fields, provide hands on learning, help with critical thinking skills and even boost self-confidence. The link should extend to funding opportunities available to the SMEs.
f) Both National and County Governments should be sensitized on the impact of policies and regulations affecting SMEs, since these were reported not to be friendly to new startups and SMEs in general. Taxes, licensing and business registration were identified as the main barriers that hinders SMEs from up scaling apart from lack of funds and limited relevant skills and knowledge.

### *4.3. Limitations of the Study and suggestion for Further Research*

The survey used a questionnaire and Interview guide that were administered by the research assistants which relied upon the integrity and competence of the research assistants. The sample of the study comprised diverse groups of women led SMEs, all religious groups, persons with disabilities, youth and members of LGBTQI across different types of businesses which allowed for generalization of the findings of the study. There still remain issues with integrity of respondents and the geographical area. The researchers nevertheless believe that the training that the research assistants went through and the ethical considerations undertaken during the study, the data was reliable and valid. The project team suggests that future studies could consider self-administered questionnaire and more disaggregated groups in different geographical regions. This can enable analysis of data to be disaggregated based on specific groups, sectors, SME categories, and geographical regions to assist in adopting technology transfer interventions aligned to appropriate innovation ecosystems for effective assimilation and sustainability.

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2. Dr. Pamela Mreji – Principal Investigator and Project Lead, is an innovation Mnagement and Technology Management specialist seconded to the Kenya National Innovation Agency as a champion to help design strategies for technology transfer and technology commercialization within higher education institutions in Kenya. Dr. Mreji also sits in the Science, Technology and Innovation Committee at Technical University of Kenya, where she advices on business incubation, IPR policies and technology commercialization. She is the current SSA project lead for the British Council Innovation for Africa Universities (IAU project) and has handled other donor funded projects for IDRC, Open-air network of Canada and collaborative partnerships as a Senior Research Fellow at Africa Center for Technology Studies (ACTS) and also as a Senior Research Fellow at the University of Johannesburg within the DST/NRF Newton Fund Trilateral Research Chair in Transformative Innovation, 4IR and Sustainable Development.
3. Prof. Levi Ng'ang'a Mbugua Co-Principal Investigator and Project Research Lead is an Associate Professor of Statistics and Director, School of Mathematics at the Technical University of Kenya. Prof. Mbugua has for the last twenty years been creating, sharing, using and managing knowledge processes. His contribution to development of new pathways for knowledge exchange and technology transfer was timely. He has run several projects as the Principal Investigator including recently a project on accelerating accessibility and uptake of health micro insurance among the informal sector in Kenya funded by International Development Research Council (IDRC) and is currently consulting for the United Nations Development Programme (UNDP) on Human Development in the COVID-19 Era: Envisioning the Recovery in Kenya for Social-Economic Development and is also working on a project on up scaling access to surgical protection gears by healthcare facilities in Kenya funded by IDRC. He has won several awards including Science, Technology and Innovation Competitive grants for Ph.D. and African Mathematics Millenium Science Initiative Scholarship.
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Administration and Entrepreneurship at the Technical Un9iversity of Kenya. Prof. Sagwa has a wealth of experience in university-industry partnerships and has had major roles in identifying and mapping out stakeholders for partnership engagement at the Technical University over the last twenty years. He has sat in Research Committee guiding policy and institutional frameworks for integration and collaboration, designed programs for facilitation of access of the university to small business communities surrounding the university as well as programs for leading students to commercialization of emerging technologies. He is currently involved in championing the establishment of an innovation and technology Hub at the Technical University of Kenya.