EXTERNAL LINKAGES AND PRODUCT INNOVATION IN FOOD PROCESSING EQUIPMENT FABRICATING MSEs IN NAIROBI

BY

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DECLARATION

I, K'Ochupe N. Peter, declare that this research project is my original work and has not been submitted to any college, institution or university other than the University of Nairobi for academic credit.

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This project paper has been submitted for examination with our approval as the University Supervisors.

……. ……

Prof. Dorothy McCormick **Date**

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DEDICATION

I dedicate this work to my loving wife Caroline and children Chris and Cindy for their unwavering love, encouragement and support throughout the challenging study period.

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While recognising the invaluable contributions of different people to this work, the views expressed in this paper are solely mine. I therefore take full responsibility for any errors and omissions.

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LIST OF ACRONYMS AND ABBREVIATIONS

EAC	East African Community
FE	Further Education
HEIs	Higher Education Institutes
KAM	Kenya Association of Manufacturers
KEBS	Kenya Bureau of Standards
KIPI	Kenya Intellectual Property Institute
KIRDI	Kenya Industrial Research and Development Institute
MIT	Massachusetts Institute of Technology
MoI	Ministry of Industrialization
MSEs	Micro and Small Enterprises
NGO	Non-Governmental Organization
SMEs	Small and Medium-size Enterprises
OECD	Organization of Economic Cooperation and Development
R&D	Research and Development
SAFIC	Successful African Firms and Institutional Change
SPSS	Statistical Package for the Social Sciences
UK	United Kingdom
US	United States

ABSTRACT

An open innovation model underscores the importance of external sources of innovation ideas to enterprises. The case is particularly true for Micro and Small Enterprises (MSEs) facing financial and technological constraints for internal research and development (R&D. MSEs, therefore, largely rely on the environment for innovation knowledge and opportunities. However, past studies on innovation focus more on the high-technology sectors in the developed economies than on the low-technology sectors such as equipment fabrication. Further still, past studies examine both external linkages and product innovation in a rather general than specific manner. To deepen our conceptual understanding of external search processes, the present study analysed the effect of dimensions of external linkages on type and novelty of product innovation in MSEs in a developing country context. The study argued that external partners possess different innovation knowledge which impact differently on aspects of product innovation.

The study surveyed sixty five MSEs involved in fabrication of food processing equipment in Nairobi. Primary data from MSEs were supplemented by secondary data collected from key informants including officials of Kamukunji Jua Kali Association, Kenya Industrial Research Institute (KIRDI), and Kenya Intellectual Property Institute (KIPI) among others. Both quantitative and qualitative data were collected by use of a pre-coded structured questionnaire and interview guides respectively. Data from respondents were analysed using Statistical Package for the Social Sciences (SPSS) while data from key informants were analysed thematically.

The study found that enterprise age, product diversification and proprietor's education level and relatedness to fabrication work positively affected type of innovation. On the other hand, proprietor education and relatedness of work experience to fabrication correlated positively to degree of novelty. It also established that MSEs implemented innovations involving use of alternative materials; material saving measures; producing products capable of using varied energy sources; and producing products capable of multiple functions. These innovations were driven mainly by market and cost considerations. The correlation between extending product range and type of innovation was both positive and significant while meeting customer specification and replacing out-dated products negatively affected degree of novelty. The study also revealed multiplicity of linkages and sources of innovation ideas. The effect of sourcing ideas from personal contacts on novelty was both negative and significant. Linking with competitors and technical consultants significantly correlated with type of innovation. Generally, MSEs tended to adhere to and draw deeply from a small number of external links for novel innovations but used many links to make significant product improvements. Nature of link with competitors and R&D organizations significantly correlated with type of innovation while nature of link with customers was significant for novelty. Generally, a proactive search of ideas had a positive effect on product innovation. In particular, a directed search of personal contacts was significant for type of innovation.

The study concludes that external linkages and product innovation in food processing equipment fabrication sector are pervasive. However, in spite of their realities, MSEs largely innovate in an unsupportive environment. The study recommends that government (through its agencies) and other actors in innovation need to perform facilitative and intermediary roles. Accordingly policies aimed at enhancing innovativeness in the sector should seek to promote linkages between the MSEs and other actors in the national system of innovation.

CHAPTER ONE
INTRODUCTION

1.1 Background to the Study

The ability to develop and implement innovation is increasingly important for firms in all sectors to survive competition. Some authors have argued that innovation is the elixir of life for firms, regardless of their size or other attributes (Littunen, 2010). However, research interest has disproportionally concentrated on studying innovative behaviour of the so-called high-technology industries (such as electronics) rather than the low-and-medium-technology industries (such as equipment and machinery manufacture) (Hirsch-Kreinsen *et al*., 2005; Westhead and Storey, 1995). One possible explanation for the dearth of research interest in the innovation behaviour of low-and-medium-technology firms is the dominance of the linear model of innovation which emphasizes the role of formal internal research and development (R&D) capacities as the main locus of innovation and disregards other behaviours such as establishing linkages with external actors (Hirsch-Kreinsen *et al*., 2005). Contrary to innovation in the high-technology sectors which relies on the latest scientific knowledge, innovation in low-and-medium-technology firms often involves experimenting with and adapting technologies and learning. In other words, this category of enterprises seems to rely on alternative sources of innovation ideas rather than on formal R&D (Hirsch-Kreinsen *et al*., 2005).

Recent theoretical and empirical works on innovation highlight the importance of external linkages to improve the innovation potential of firms. Indeed, there is growing awareness of the potential value of external innovation inputs to the extent that even in the large firms, the innovation process has become partly externalized resulting in increasing connectedness among diverse innovation agents (Chesbrough, 2003a). This perspective is supported by a number of empirical studies that identify potential role of different external actors in the innovation process (Cohen *et al*., 2002; Laursen and Salter, 2004; Von Hippel, 1988). In particular, these studies emphasize the interactive and spatially differentiated nature of technology development such that innovation knowledge

can be implemented far away from where it was created. Therefore, locating and linking with different external partners can be an important process in innovation.

However, networking has been directed particularly at the small enterprises. The overarching reasoning here is that networking helps small firms to mitigate internal resource constraints while preserving their behavioural advantage (Rothwell, 1987). In essence, owing to the systemic nature of most products, there is growing recognition that few firms can innovate in isolation, and that those firms that engage in innovation-related linkages are likely to be more successful innovators (De Jong and Hulsink, 2012). In light of the foregoing, the current paper was concerned with addressing two broad but related issues. In the first instance, it was interested in mapping the presence of innovation-related linkages and the extent to which this varies with type and novelty of product innovation. In so doing, the study observed patterns of innovation-related linkages involving a variety of external partners. Second, it was concerned with delineating the contribution of different external linkages to product innovation. Through a survey of food processing equipment fabricating Micro and Small Enterprises (MSEs), our study investigated the effect of external linkages on product innovation in a developing country context, Kenya.

1.2 The Study Context

Although Kenya relies largely on imported equipment and machinery (Kenya, 2011), there exists a local equipment and machinery sector whose origins can be traced back to the late 1940s when a resolute minority of Asian entrepreneurs who had served their engineering apprenticeship in the Railways workshop in Nairobi established fabrication businesses (Mathews, 1985; Mathews, 1991). In the beginning, repair and service of imported transport and agricultural equipment was predominant, while in the later years, fabrication of agricultural machinery such as sugarcane crushers, ploughs, tea and coffee machinery evolved. It was after independence that large British machinery manufacturers established local fabricating units. Currently, there are about 177 manufacturers of machinery and electrical appliances (Kenya, 2012b).

However, the growth of the industry has been constrained by a number of challenges particularly regarding technology development. The sector operates in an environment characterized by lack of a comprehensive technology and innovation framework, restricted levels of technology, limited transfer of modern technology, and inadequate capacity to support adaptation and absorption of technological skills (Kenya, 2005). Other constraints include stiff competition from high quality imported machinery, constant low demand, high energy and material costs and technological constraints (Mathews, 1991; Kenya, 2012a). The resilience of the machine industry in the face of these challenges deserves an explanation which was the thrust of this study. While many factors may account for the survival of the sector, the current study focused on product innovation that stems from linkages with external actors.

1.3 Statement of Research Problem

Recent theoretical and empirical contributions in the innovation literature have accentuated the importance of external linkages to improve the innovation potential of firms. Theoretical papers acknowledge that innovation is an outcome of increase in a firm's knowledge base and that firms can grow their knowledge either by investing in internal knowledge enhancement or by acquiring external knowledge bases (Cohen and Levinthal, 1989; Mytelka, 1991; Osborn and Hagedoorn, 1997). Theoretically, therefore, external links represent important sources of information for innovation and thus a positive relationship between reliance upon external linkages and innovation should exist (Chesbrough, 2003b). Equally, some empirical works suggest that innovation emerges from a continuous interaction between diverse partners including suppliers, customers, competitors and knowledge centres (Archibugi and Iammarino, 2002; Arku, 2002). Some writers further suggest that establishing external linkages is important in the low-and-medium-tech industries where innovation often involves learning, experimenting with and adapting technologies which are not necessarily rooted in formal R&D (Hirsch-Kreinsen *et al*., 2005). To a large extent, this reasoning has informed public policies and programmes that encourage inter-firm linkages especially between small firms and large firms (Kenya, 2005; Nelson, 2007).

Despite all the work carried out on innovation linkages and patterns of innovation, important questions still remain. For instance, although the complexity of innovation activity requires firms to draw upon several sources of innovation information and knowledge, literature has generally examined external linkages in a manner which provides a rather simple view of the innovation process. Consequently, little is known about the various combinations in which external linkages and information sources are used by enterprises to implement a specific innovation project. Similarly, we know little about the prevalent types of innovation-related partners and their attendant contributions to product innovation in the food processing equipment fabricating sector. To gain insights into the role of external linkages in the innovation process, this study considered that firms may simultaneously use many sources of innovation ideas and also link with different actors to implement product innovation. Subsequently, dissimilar innovative knowledge possessed by external partners may affect the type of product innovation implemented by the knowledge acquiring firm.

1.4 Objectives of the Study

The overall objective of this study was to investigate the effect of external linkages on product innovation in food processing equipment fabricating MSEs in Nairobi. Specifically, the study sought to achieve the following objectives:

1. To identify the characteristics of food processing equipment fabricating MSEs in Nairobi.

2. To examine the nature and types of product innovation undertaken by the food processing equipment fabricating MSEs.

3. To investigate the nature and types of external linkages food processing equipment fabricating MSEs in Nairobi engage in.

4. To establish how external linkages affect product innovation in the food processing equipment fabricating MSEs in Nairobi.

1.5 Research Questions

The overall question for this study was: How do external linkages affect product innovation in food processing equipment fabricating MSEs in Nairobi? To answer the main research question, the following specific research questions were posed:

1. What are the characteristics of food processing equipment fabricating MSEs in Nairobi?

2. What are the nature and types of product innovation undertaken by the food processing equipment fabricating MSEs in Nairobi?

3. What are the nature and types of external linkages food processing equipment fabricating MSEs in Nairobi engage in?

4. How do external linkages affect product innovation in food processing equipment fabricating MSEs in Nairobi?

1.6 Justification for the Study

This study was informed by the broader Successful African Firms and Institutional Change (SAFIC) research project being conducted in Kenya, Tanzania and Zambia. The overall objective of the SAFIC project is to investigate how and why African firms manage to gain competitiveness and grow successfully under challenging market and institutional conditions. Although the broader Kenyan study looks at food-processing and the manufacture of food processing equipment and machinery, this study focused on the latter with the hope of contributing to knowledge on product innovation in food processing equipment fabricating MSEs in Nairobi.

While empirical works confirm the benefits of linkages in the tourism, transport, construction, clothing, metal products and vehicle repair sectors in Kenya (Alila and McCormick 1997; Kinyanjui and Kamau, 2007; McCormick and Kimuyu, 2007; Okech *et al*., 2007; Oyelaran-Oyeyinka and McCormick, 2007), there is scanty information

regarding the nature of linkages in the food processing equipment fabrication sector. Notably, the question of how various external linkages affect product innovation in the sector remains inadequately addressed by literature. The primary motive of this study was therefore to fill this knowledge gap by deepening our understanding of the existence and nature of external linkages and the attendant effect on product innovation. Findings of the current study therefore broaden our understanding on external linkages as alternative source of information and knowledge in product innovation process. Subsequently, the study findings may inform policies that seek to promote linkages as a way of improving innovation in the sector.

CHAPTER TWO
LITERATURE REVIEW

2.1 Theoretical Literature

Innovation is defined differently in literature. Some writers even posit that there is no universally shared conceptualization or operationalization of the term innovation (Amara and Landry, 2005). There are two archetypical differentiating types of innovation on the basis of the object and on newness (Littunen, 2010; Schumpeter, 1934). Based on this classification therefore, innovation can be categorized into process, product, market and organizational (Schumpeter, 1934). While enterprises may implement any of the above categories of innovation, the current study focuses only on product innovation defined as the commercialization of either a new or significantly improved product (OECD, 2005). Similarly, the study expands the use of "new" to capture both radical and incremental modifications on products. In this context therefore, new products include those that are new to the world, new to the market or simply new to the enterprise.

Until fairly recently, it was common practice for economists and, indeed, organization theorists to view firms as islands of hierarchical control embedded in market structure and interacting with each other (solely) through the price mechanism (Teece, 1996) or simply as islands of planning in a sea of market relations (Freel and Harrison, 2006; Richardson, 1972). In such a world, the boundaries of the firm are clear and rest upon the balance of transaction costs. In circumstances of high costs of managing contracts, high degree of asset specificity and concerns over the firm's ability to appropriate returns on investment, firms will tend to carry out technological and innovation activities in-house, rather than contract for them in the market place (Angel, 2002). Following this logic, one would expect large, extensively integrated firms to be the standard institutional form and to dominate industrial innovation activities (Chandler, 1990). Indeed, the innovation process as understood in the context of a linear model suggested that development of innovations follows a straight research-to-market trajectory and that firm's innovation performance was mainly seen as a consequence of R&D investment (Svetina and Prodan, 2008).

However, the linear model of innovation was challenged by findings that revealed successful innovation in a number of small and medium-size enterprises that had limited resources for in-house R&D (Svetina and Prodan, 2008). In contrast to the pre-eminence of standardized output practices during the immediate post-war period, some writers believe that the efficient organization of production is increasingly associated with vertical disintegration and flexibility (Piore and Sabel, 1984). In many industries the requirement now is to manufacture small batches of standard products for increasingly demanding specialized customers (Freel, 2002), to such an extent that standard, internal scale economies are unlikely to obtain.

Accordingly, both scholars and practitioners have tried to reveal the forces behind small and medium-size firms' innovativeness. There is increasing recognition that innovation is a distributed activity and that new knowledge is not only developed in R&D departments but also in connection with other actors through the interactive learning process (Eriksson, 2005; Lundvall, 1992; Rothwell, 1991; Tether, 2002). In this way, the old debates about firm-size, market structure and innovation are becoming outmoded as the boundaries of the firm are becoming increasingly indistinct (De Jong and Hulsink, 2012; Tether, 2002). Instead, a more elemental consideration is the view that successful innovation relies upon accessing external knowledge, rather than information (Rothwell and Dodgson, 1991). The emphasis on knowledge for which arm's-length contacts are insufficient, underpins the conception of innovation as interactive, cumulative and cooperative phenomenon, in which interactive learning is fundamental (Lundvall, 1995; Svetina and Prodan, 2008).

Moreover, the tacit and idiosyncratic nature of innovation knowledge may require firms to embed in dense linkages to tap external knowledge and entail learning by doing rather than rely on arm's length contacts (Gulati, 1998; Rigby and Zook, 2002; Utterback and Afuah, 2000; Wolfe, 2000). To this end, open, cooperative and interactive external linkages create a superior mechanism for disclosing vital technological information which is crucial for innovation (Dodgson, 1993).

On the other hand, cooperative and interactive dimensions of innovation have been developed. Evolutionary theorists argue that innovation is a process of continuous interactive learning between an enterprise and the various agents surrounding it (Edquist, 1997; Lundvall, 1992). In other words, innovation is seen both as a technical and social process based on the complex interaction between enterprises and their environment (Asheim and Isaksen, 1997). Similarly, innovation network theorists such as Hakansson (1989) maintain that enterprises rarely innovate on their own but rather build strong links with external agents. According to innovation network perspective, high costs of internal production, uncertainty in markets and specialization at various stages of production necessitate formation of linkages (Scott, 1991).

Chesbrough (2003a) further developed the open innovation model which emphasizes the significance of external ideas in innovation process. The open model argues that internal R&D is no longer a strategic asset and that even enterprises spending little on R&D can successfully innovate by drawing in innovation knowledge from diverse external sources. However, benefiting from external sources of knowledge requires reconfiguration of the boundary between the enterprise and its surrounding environment, making them more porous and embedded in loosely coupled networks of different actors (Gassmann and Enkel, 2004).

Building on the foregoing discussion, the current study adopted the open innovation model as the theoretical framework. Although some earlier works emphasized the idea of integrating internal and external knowledge (Edquist, 1997; Lundvall, 1992), the open model was made more explicit by later studies. Chesbrough (2003a) defines open innovation as the process through which enterprises use purposive inflows and outflows of knowledge to accelerate internal innovation. This perspective recognizes that, to innovate, firms need to search, identify and tap useful innovation knowledge from diverse external sources. In other words, innovation ideas can be implemented further away from the locus of knowledge creation.

Literature conceptualizes open innovation in three dimensions namely the outside-in, the inside-out and the coupled (Chesbrough, 2003b; Gassmann and Enkel, 2004). The outside-in dimension describes the process by which firms increase innovativeness by integrating external knowledge to augment own knowledge base. The inside out dimension on the other hand refers to the process by which internal ideas which no longer fit a firm's business exit to be used by other firms while the coupled dimension connotes the combination of external ideas and internal ideas to achieve innovation (Chesbrough, 2003a; Gassmann and Enkel, 2004). Although all the three core dimensions may represent an open innovation orientation, they are not equally important for every firm (Chesbrough, 2003a). In other words, not all firms choose the same core open innovation process or have integrated all three processes to the same degree. Each firm therefore chooses one primary process, but also integrates some elements of the others. For this reason, our study focused on the coupled process by which a firm enriches its internal knowledge base by integrating external innovative knowledge. Accordingly, enterprises need to adopt porous boundaries to facilitate inflow of external innovation knowledge from the environment (Chesbrough *et al*., 2007).

2.2 Review of Empirical Literature

2.2.1 Enterprise Characteristics and Proprietor Entrepreneurial Background

Although MSEs are defined variably in literature, the MSME Bill of 2011 provides a legal definition of MSEs in Kenya using number of employees and turnover. However, for enterprises in the manufacturing sector, the definition takes into account the investment in plant and machinery as well as the registered capital (Kenya Law, 2011) While a definition combining employment, capital and turnover is theoretically best, unavailability or unreliability of capital and sales figures force researchers to use employment only (McCormick, 1993; OECD, 2005). Consistent with analytical works (Rammer *et al*., 2009), the current study used employment figures and defined MSEs as follows: Micro enterprises employ less than 10 people while Small enterprises employ between 10 and 49. The choice of MSEs was informed by the need to capture alternative sources of innovation ideas and knowledge in enterprises that carry little or no formal internal R&D (OECD, 2005).

Empirical literature identifies a number of enterprise characteristics as well as proprietor entrepreneurial attributes that affect innovation. Some of the enterprise characteristics include size, age, absorptive capacity, intramural R&D efforts as well as the geographical market served (Cassiman and Veugelers, 2006; Laursen and Salter, 2006; Rammer *et al*., 2009). On the other hand, some findings suggest that proprietor entrepreneurial background such as level of education, occupational background and work experience also affect innovation (Akoten and Otsuka, 2006; Goedhuys and Sleuwaegen, 2000; Littunen, 2010; McPherson, 1996; Ramachandran and Shah, 1999).

Although enterprise size has been found to affect innovation, there is no agreement in terms of empirical evidence. One stream of literature suggest that large firms exhibit greater innovation because they have access to a wide range of financial, human and technological resources (Rogers, 2004; Teece, 1986). On the other hand, there are findings noting that the probability of collaboration and drawing upon informal sources of information from all actors except suppliers and customers increases with size (Freitas *et al*., 2011). Similarly, some writers posit that small enterprises may possess innovation advantage, seem faster at recognizing opportunities and have greater flexibility and adaptability making it easier to adjust employee incentives to provide optimal innovative effort (Rothwell, 1984). Yet still, some studies find size to be insignificant while others find an inverted U-type relationship between size and innovation (Bogliciacino *et al*., 2012). In light of the inconclusive findings regarding enterprise size and innovation, our study investigated the possible effect of size on innovation in Micro as well as Small Enterprises.

Enterprise age is a variable used to measure firm experience and learning in empirical studies of innovation (Kumar and Saqib, 1996). Conventionally, age is measured as the number of years since the enterprise was founded (Rammer et al., 2009; Santamaria *et al*., 2009). Empirical findings suggest that innovation varies with age such that it is stronger at the beginning of an enterprise life and declines afterwards (Bogliciacino *et al*., 2012). Acknowledging that innovation may entail experience and learning on the part of an enterprise, the current study focused on MSEs that are at least five years old.

Moreover, young enterprises may introduce some bias because almost all their products can be described as new which suggests greater product innovation. For this reason,

Equally important to innovation is the concept of absorptive capacity. Some studies (Cohen and Levinthal, 1990; Cohen *et al*., 2002) emphasize the importance of pre-existing stock of knowledge in identifying, assimilating and exploiting external knowledge. Accordingly, some analytical works maintain that the effect of external knowledge sources on innovation performance depends on the internal capabilities of the firm in terms of the skills possessed by the employees and capacity to undertake internal R&D (Caloghirou *et al*., 2004; Cohen *et al*., 2002; Rothwell, 1992). In other words, firms with greater internal capabilities are more successful in using external knowledge to improve innovation performance. This reasoning is supported by studies which find a positive association between technical qualifications and innovation (Bala, 2005; Freel, 2000b; Gospel, 1991; Hill, 1992). In this way, employing workers with higher technical training not only raises competency levels but also signals an attitude more conducive to innovation.

Conversely, in a survey of South African firms, weak association between skilled workers and innovation was reported (Bogliciacino *et al*., 2012). Similarly, earlier studies in the machine building sector in Kenya highlighted the lack of importance attached to formal higher education qualifications with the notable exception of Asian proprietors (Mathews, 1991). According to Mathews (1985; 1991), machine builders hired workers with solely high school certificates and trained them on the job (apprenticeship). While this was the case in the 1990s, it is of value to investigate the changes that may have occurred with regard to graduate employment in the sector generally, and the effect it may have on external linkages and innovation in particular. The current study sought to advance knowledge on the effect of proprietor level of education on product innovation.

Finally, a number of analytical works underscore the link between market orientation and innovation and suggest that enterprises serving export markets seem to be more innovative than those serving local markets (Karlsson and Olsson, 1998; Laursen and

Salter, 2006). Similarly, enterprises whose largest market is international were found to have a relatively higher propensity to interact with public research organizations (universities) and with customers (Freitas *et al*., 2011). In line with this stream of literature which suggests that innovative firms are likely to exhibit greater external focus, the current study investigated the effect of export activity on product innovation in the equipment fabricating MSEs in Nairobi.

Literature also reveals the difficulty in demarcating the boundary between the proprietor and the enterprise especially in small firms. For example, North and Smallbone (2000) reported that owner-managers not only played a central role in the initiation and development of innovations, but were also the only persons involved in the innovation process. Moreover, some writers argue that concentration of power and decision-making in the proprietor makes it difficult to differentiate between enterprise and firm innovativeness (Littunen, 2010).

Some works have provided further empirical basis for exploring proprietor characteristics. In particular, Schultz (1975) note that formal schooling is important when making decisions in a dynamic context. This finding is corroborated by other studies that found formal education as well as work experience in the formal sector as the key in achieving multifaceted product quality improvements (Sonobe *et al*., 2011). Conversely, according to some writers, low levels of education do not deter entrepreneur creativity (Kinyanjui, 2007). Instead social networks in clusters and the value for self-development, self-initiative, hard work and co-existing with other entrepreneurs jointly play a critical role in knowledge and technology transfer. In line with this stream of literature, the current study investigated certain aspects of proprietor entrepreneurial attributes which bear on product innovation. Specifically, owner entrepreneurial background, education level, and relatedness of experience to fabrication were investigated.

2.2.2 Nature and Types of Product Innovation

Generally, innovation in the equipment and machinery subsector has been described as predominantly incremental deriving from problem-solving applications, modifying and adopting foreign machinery, and developing appropriate designs in response to local demands and conditions (Mathews, 1991). In other words, local conditions, user needs and foreign technology may be key drivers of product innovation in the Kenyan machinery sector such that equipment designs tend to incorporate both user specifications as well as features of imported machinery and equipment. According to Mathews (1991), two main reasons account for the incremental modifications in the local machinery sector. Firstly, the requirement that local machinery and equipment be both strong and simple to assure durability and ease of use by operators who possessed only a modicum of technical understanding regarding operating speeds and maintenance. Secondly, is the need to ensure the machines were cheap to buy and maintain. According to this perspective, product innovation involves eliminating unnecessary gadgets to reduce costs and also to get rid of parts that made the machines prone to breaking down.

Although literature gives important insights regarding innovation in the equipment and machinery fabricating sector by identifying some of the incremental innovations on the local machinery, this evidence relates more to the general agricultural machinery rather than the food processing equipment and machinery. Moreover, much of the evidence dates back to the early 1990s such that little is known about drivers of product innovation in the food processing sector. In light of the above, our study set out to determine the current situation as well as to investigate the changes that may have occurred over the years.

2.2.3 Nature and Types of External Linkages

Literature recognizes that in-house learning is not sufficient for generating innovation hence firms need to supplement internal knowledge with knowledge acquired outside the firm (Fukugawa, 2006; Svetina and Prodan, 2008). Consistent with past works (Castellani and Zanfei, 2006), the current study defined external linkage as both formal and informal cooperative inter-firm relationships in which certain ownership-specific resources

including core advantages, technical knowledge and operating resources are externally transferred and actors have obligations regarding their future behaviour. Accordingly, enterprises may acquire knowledge for innovation from diverse actors including personal contacts (namely friends and relatives), customers (such as end-users, food processors), competitors, suppliers, knowledge institutions, professional and trade associations and movement of staff from one enterprise to another (Kinyanjui, 2007; Shrolec and Verspahen, 2008; Zeng, 2007).

Some studies such as Alila and McCormick (1997), Hill (1985) and Okech *et al*., (2007) have noted a number of informal linkage mechanisms such as overlapping directorships, spin-offs, or movement of employees. Contrary to formal linkages, informal linkages entail a great deal of trust and consequently promote the use of richer communication mediums such as *ad hoc* face-to-face interactions allowing firms to expand significant organizational resources beyond what is specified contractually (Freitas *et al*., 2011). Kinyanjui (2007) particularly explored the role of personal contacts in innovation and found that mutual trust rather than competition among informal technicians facilitated technological spill-over and learning processes through knowledge sharing. In other words, peer learning networks (comprising friends, relatives and recognized *Jua Kali trainers)* which evolve after long periods of interaction, facilitate informal joint action in product design and production. There is also considerable exchange of knowledge and technology through movement of staff between the formal and informal fabricating enterprises (Kinyanjui, 2007) such that workers laid off by formal firms become members of a virtual learning network which allows informal artisans to imitate and copy products from competitors.

In the same way, customers can be vital sources of knowledge and technology. Indeed, a number of studies underscore the importance of user involvement in product design and development process (Evangelista, 2000; DeJong and Marsili, 2006; Pavitt, 1984; Salter and Martin, 2001; Von Hippel, 1977). According to these writers, users are increasingly regarded not only as potential sources of inspiration, but also as co-creators who may also develop their own innovations which producers can imitate. That is, continuous users

contribute to innovation by identifying innovation opportunities, new uses and new users and bring product designs to the fabricators who use their own intuition to create custom-made products (Freel, 2000a; Kinyanjui, 2007; Svetina and Prodan, 2008). The perspective of user innovation is corroborated by a study of semi-conductor fabricating and electronic sub-assembly that found that users developed up to 77 percent of innovative products (Urban and VonHippel, 1988; Von Hippel, 1977). To the best of my knowledge, other than a study of the Kamukunji Cluster by Kinyanjui (2007), the extent of user-involvement in product innovation particularly in food processing equipment remains less researched in Kenya.

Some studies also found that linking with suppliers of materials, components, machinery and professional software can bring important insights regarding cost reduction and improved efficiency (Geenhuizen, 1997; Rothwell, 1991; Sako, 1996). Equally important also, is linkage outside the supply chain as a way of complementing and supplementing internal innovation (Rothwell and Dodgson, 1991). Freel (2000a) anticipated that the most innovative firms are significantly more likely to have engaged in some form of innovation-related collaboration with firms outside the vertical value chain. Findings of a study of firms in the Cambridge region further corroborated this view by suggesting that majority (76 percent) of firms had close links with competitors (Keeble *et al*., 1998).

Similarly, the role of knowledge institutions such as universities, research institutes and science parks in technology creation, dissemination and application, has also been highlighted (Elfring and Hulsink, 2003; Evangelista, 2000; Gunasekara, 2006; Zeng, 2007). Besides providing qualified technical graduates and scientific research inputs for innovating firms, such institutions also help translate academic codified knowledge into practical and accessible know-how (Gambarotto and Solari, 2004; Keeble and Wilkinson, 2000). Other works have established the important role of knowledge institutions in African countries such as Ghana, Uganda and South Africa (Wood and Kaplan, 2005). However, to the best of my knowledge, little work has been done on the existence and effect of such linkages on product innovation in the food processing equipment fabrication sector in Kenya.

However, there seems to be no agreement regarding the contribution of knowledge drawn from sources such as government agencies and university on innovation. On one hand, some studies find evidence of either weak or non-existent linkages with the knowledge institutions (Mathews, 1991; Oyelaran-Oyeyinka *et al*., 1996), while others note that such knowledge is not only typically less targeted to a firm's requirements but also requires more expertise from the firm to exploit efficiently (Cohen and Levinthal, 1990). Moreover, Kinyanjui (2007) found that not only were the graduates in Kamukunji cluster too few to constitute a critical mass that would affect technology and knowledge development in the sector, none of the graduates had links with their previous institutions implying little evidence that these institutions influence technology and knowledge dynamism. Against this background, our study investigated both the existence and effect of such linkages on product innovation.

In particular, external linkages were explored in five dimensions namely type, volume, duration, strength, and directedness. Regarding linkage type, three main categories of external partners were investigated namely informal contacts (friends, relatives), direct business contacts (customers, competitors, suppliers, consultants), and knowledge and research institutions.

Linkages were also expressed in terms of the number of external partners that become involved in innovation projects. This dimension is consistent with literature which highlights the importance of volume of linkages (DeJong and Hulsink, 2012; Freel, 2003; Tether, 2002). In the same vein, some analytical findings suggest that it is not the amount of linkages *per se*, but rather the diversity of the linkages that influences innovation (Ebersberger *et al*., 2011; Oyelaran-Oyeyinka *et al*., 1996). In other words, innovative firms seem to engage in multiple linkages and rely on a broader customer and supplier base (Ahern, 1993; Arku, 2002). The current study therefore anticipated that both the volume and diversity of linkages will affect type of innovation implemented such that some types of product innovations may involve linkages with many external partners while others involve only a few links.

Similarly, diffusion studies have investigated external linkage in terms of strength. While strong ties are characterized by a "combination of the amount of time, emotional intensity, intimacy (mutual confiding) and reciprocity" (Granovetter, 1973, p. 1361), weak ties are ephemeral (DeJong and Hulsink, 2012; OECD, 2005). However, there seems to be no agreement in the findings regarding the effect of linkage strength on innovation. Some writers suggest that innovators need wide-ranging, weak ties across distant worlds to be inspired to innovate (Ahuja, 2000). Indeed, Granovetter (1973) note that whatever is transmitted through weak ties can reach a larger number of people than diffusion through strong ties. Further empirical support of this is provided by Ruef (2002) who found that start-ups composed exclusively of family members, friends or former work colleagues (strong ties) were slightly less innovative than those consisting of acquaintances or a mix of family, friends and colleagues (weak ties), who in turn were slightly less innovative than teams involving no prior relationships. On the other hand, some writers found that strong ties were less prevalent among innovative Dutch firms (DeJong and Hulsink, 2012). Our study therefore extended the discussion on linkage strength by focusing on non-start-up MSEs.

Finally, external linkages have also been explored in terms of the degree of directedness. Ruef (2002), defines a directed linkage as one in which a partner is searched for and included in a network principally for the sake of innovation. In other words, directed linkage precedes a social relationship as it "involves unilateral monitoring of discourse and activities on the part of other actors" (Ruef, 2002, p. 431). Accordingly, the current study explored directedness of external linkages. The logic here was that, to innovate, enterprises may need to pro-actively extend their search for innovation ideas beyond existing networks.

2.2.4 External Linkages and Product Innovation

Innovative activity does not take place in a business world in which firms are isolated from each other and from other organizations. Indeed, industrial innovation can be understood as a process that involves search for information and interaction with different partners (Salter and Martin, 2001). These interactions usually entail some form of

information and knowledge exchange between the partners involved. Given the complexity of innovation and diversity of partners, we should expect that innovation ideas acquired from external linkages differ in terms of content (Swann, 2002). Accordingly, an important aspect regarding external linkages and product innovation entails choosing an appropriate mix of external partners. As a consequence, firms may choose to interact with specific actors in order to introduce specific innovations (Freitas *et al*., 2011). Theoretical papers have argued that external actors represent important sources of information for innovation and thus a positive relationship between the extent of reliance upon external linkages and firm innovation performance should exist (Chesbrough, 2003a). Consistent with past studies such as Cohen *et al.* (2002), Laursen and Salter (2004) and Von Hippel (1988), the current study explored the nature of external linkages. In other words, our study distinguished linkages as sources of information and linkages as partners in innovation projects.

Understandably, the role of external linkages in fostering innovation is well documented. A number of studies note the importance of open behaviour by firms in their search for innovative opportunities (Ahuja, 2000; Chesbrough, 2003b). Some authors seem to suggest that external linkages are of particular importance to small firms as a way of alleviating internal resource constraints (Barber *et al*., 1989). In this way, firms enhance innovation performance by supplementing internal knowledge with knowledge acquired outside the firm (Svetina and Prodan, 2008). This view is empirically corroborated by findings of a survey of Small and Medium-size Enterprises (SMEs) in the United Kingdom (UK) which noted that the active pursuance and creation of external linkages was an important component of strategies employed by most successful and innovative firms (Beesley and Rothwell, 1987; Dodgson and Rothwell, 1989). That is, to successfully innovate, the indispensable and compelling need is for small firms to seek external advice and information to fill the gap in management and resources (Adams, 1982).

Past studies recognize that external partners possess different innovative information which eventually determines the type of innovation implemented by the acquiring firm.

For instance, user-producer interaction is widely acknowledged as crucial for implementing product innovation (Balderbos *et al*., 2004a; Von Hippel, 1988). Such interactions identify re-innovation opportunities, new uses and new users which may boost product innovation (Belderbos *et al*., 2004; Shaw, 1991). In other words, user-producer interface not only allow fabricators to access technical skills in users, but also engenders a strong relationship which may result in user feedback and associated product improvements (Rothwell and Gardiner, 1985).

Indeed, a number of studies provide corroborative evidence to user-producer linkage. A survey of firms in Scotland and Northern England found that 42 percent of novel innovators were engaged in innovation-related cooperation with customers compared with 27 percent of incremental innovators (Freel and Harrison, 2006). Another study found that out of the 48 percent of innovators which had cooperative links with customers, 39.4 percent involved customers in new product development or improvement (Freel, 2000b). Similarly, Vega-Jurado *et al.,* (2010) noted that cooperation with customers was important especially for Spanish firms pursuing more radical innovation. In Kenya, Kinyanjui (2007) found that customers were a source of knowledge and technology by bringing in product designs to the *Jua Kali* entrepreneurs who in turn use their own intuition to create custom made products.

Similarly, product innovation may require linking with suppliers (Reinchstein and Salter, 2006; Pavitt, 1984). Indeed, some commentators argue that the extent of supplier contribution to product design and development affects the scope for innovation (Sako, 1996). A study of Small West Midlands fabricating firms found that 51.5 percent of innovative firms had some form of collaborative arrangements with their suppliers while 44 percent of innovators involved suppliers in new product development or improvement compared to only 22 percent of non-innovators (Freel, 2000b). However, existing evidence seem to suggest that supplier relationships is significantly associated with novel process rather than product innovation (Freel and Harrison, 2006; Reinchstein and Salter, 2006; Rothwell, 1991). Our study investigated the effect of supplier innovation inputs on product innovation.

Besides linking with market-based partners such as end-users and suppliers, linkages with firms outside the vertical value chain have also been identified. Evidence suggests that innovative firms are significantly more likely to engage in some form of innovation-related linkages with competing firms (Freel, 2000b). In particular, findings seem to suggest that linking with competitors is associated with incremental innovations based on an imitation strategy (Baldwin *et al*., 2002; Cabagnols and Le-Bas, 2002). Although the importance of collaborative links outside the vertical value chain has been emphasized, the most striking feature is the relatively low number of firms involved in formal collaboration with competitors. Freel (2000b) found that only 14.1 percent of innovators linked with competitors compared with 47.5 percent and 51.5 percent who linked with customers and suppliers respectively. This finding serves to highlight the greater relative frequency of value chain linkages. Although the low levels of formal linkages with competitors may be understood in terms of trust and ability to fully appropriate benefits, the dearth of horizontal collaboration in previous studies offered impetus for our study which investigated both formal and informal linkages with competitors.

The impact of firm-university linkage on innovation is well documented. For instance, the success of industrial clusters such as Route 128 Boston and Silicon Valley in the United States (US), has been partially attributed to their proximity to Massachusetts Institute of Technology (MIT) and Stanford University respectively (Acs, 1993). One principal reason that underpins the importance of university links on small firm innovative capability is that university research is a source of significant innovation-generating knowledge which diffuses initially through personal contacts to adjacent firms (Acs *et al*., 1994). In this way, small firms can alleviate internal resource deficiencies by accessing university resources and networks (Westhead and Storey, 1995). Similar studies also maintain that links between small firms and Higher Education Institutions (HEIs) are likely to have a positive effect on innovation (Johnson and Tilley, 1999). Undeterred by finding no relationship between science park location and innovation, some writers still suggest that the focus of policy has to actively promote links between HEIs and technology-based firms (Westhead 1997).

More empirical support to this perspective is offered by a number of studies. For example, a study of European SMEs found that 90 percent of the most innovative technology-based firms had formal links with a university (Wilkinson *et al*., 1996) and that British process innovators tend to use universities both as source of information and as R&D partners when compared to product innovators (Swann, 2002). But these findings are reversed for Further Education (FE) college links where least innovative firms (19 percent) appeared more likely to have consulted an FE college in connection with an innovation-related activity than do their more innovative peers (13 percent) (Freel, 2000b). This evidence suggests that innovators are more likely to have a longer-term relationship with a university, but less likely to have been involved in a recurring relationship with an FE college. Freel and Harrison (2006) found that 13.7 percent of novel innovators, compared with 6.7 percent of incremental innovators collaborated with university. This finding is consistent with earlier discussion. The greater propensity for the least innovative firms to have had recurring contacts with FE colleges rather than university, may relate partly, to the role of colleges in the provision of functional skills training or in the delivery of low-level consultancy (Freel, 2000b).

Conversely, some works give little support for university industry-linkage. Cohen and Levinthal (1990) posit that knowledge drawn from government and university is not only typically less targeted, but also requires more expertise from the firms to exploit. Similarly, Vega-Jurado *et al.,* (2010) found that cooperation with universities has no significant effect on product innovation. Further still, a study of Kamukunji Jua Kali Enterprise Cluster found that none of the graduates employees in the cluster had links with their previous institutions (Kinyanjui, 2007) suggesting little evidence that learning institutions influence technology and knowledge in the cluster.

Acknowledging the possibility of a positive correlation between establishing one specific linkage and pursuing a specific type of innovation is just one part of the whole picture. Innovation is a complex phenomenon and typically firms tap several sources of information at the same time. Some findings point to innovators making greater use of external linkages of certain types and in particular directions such as the preponderance

of vertical value chain linkages (Freel, 2000a; Freel and Harrison, 2006). Building upon the findings that external linkages facilitate innovation, efforts that foster inter-firm linkage have been suggested in Kenya (Kenya, 2005). However, such interventions may require knowledge of the types of external linkages in existence and how the linkages affect innovation, which is currently lacking particularly in the food processing equipment fabrication sector. By recognizing that the type of innovation implemented may depend largely on the nature of external knowledge sourced from diverse partners, the current study sought to gain an understanding of the contributions of diverse external linkages to product innovation.

2.3 Conceptual Framework

The current study conceptualized that MSEs may need to source innovation ideas and link with a variety of external actors. Some of the potential external actors include personal contacts (friends and relatives), business contacts (such as customers, competitors), suppliers, technical consultants, knowledge institutions (universities, polytechnics) and R&D organizations. While the main purpose for such linkages may be access and extract useful ideas for product innovation, our study argued that link between external ideas and product innovation was not linear. In other words, these potential external partners possess differentiated innovative knowledge which may eventually affect the nature and type of product innovation implemented by the knowledge acquiring enterprise. Moreover, the contribution of external knowledge to product innovation may also depend on certain dimensions of external linkages including the type of partner, nature of linkage, number or volume of linkages, duration and strength and the search strategy for the external link. Our study, therefore, investigated how the above dimensions of external linkages affect the introduction of new or significantly improved products by food processing equipment fabricating MSEs in Nairobi. Further still, the current study recognized a number of factors such as enterprise age, enterprise size and absorptive capacity that may also influence product innovation in an enterprise. These factors were treated as control variables in our study. See Figure 2.1 for graphical representation of the conceptual framework.

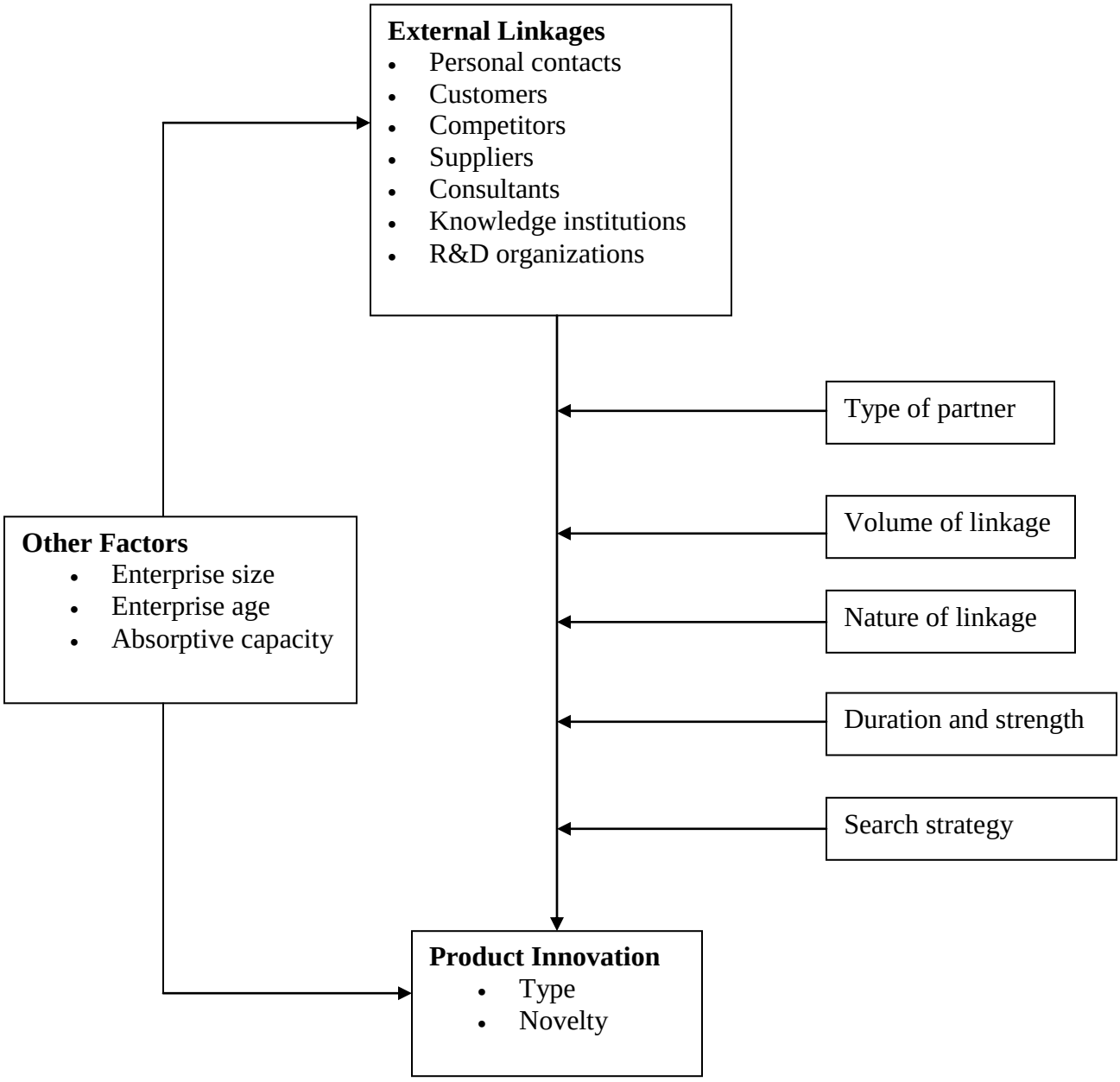


Figure 2.1: Conceptual Framework (Author's Conceptualization)

CHAPTER THREE
METHODOLOGY

3.1 Research Design

As mentioned earlier in section 1.5, this study was part of a larger SAFIC research project which sought to explore sources of success for Kenyan food processing and food processing equipment and machinery firms under challenging market and institutional conditions. Although the researcher took part in a mapping exercise in June 2012 that created a sampling frame for the broader study, for this particular study, the researcher compiled own list of firms, collected and analysed own data.

The objective of this study was to investigate the effect of external linkages on product innovation in food processing equipment fabricating MSEs in Nairobi. Consistent with the nature of the specific research questions posed, the study triangulated quantitative and qualitative research strategies. Specifically, the study used cross-sectional research design which involved the collection of data on more than one case and at a single point in time. In other words, a body of quantitative or quantifiable data in connection with two or more variables were collected and examined to make comparisons between sub-groups and test the associations between two or more variables (Bryman, 2004; Fink, 2003). The appropriateness of cross-sectional design was informed by the fact that the study sought to determine patterns of association between external linkages and product innovation rather than attempt to draw causal inferences. Similarly, open-ended questions were posed to key informants to elicit rich qualitative data which in turn provided meanings and interpretations to the quantitative responses. Additional qualitative data were captured from elaborations provided by the primary respondents.

3.2 Study Site

This study was conducted in the informal metalworking clusters in Nairobi, the capital city of Kenya and home to about 56 percent of all fabricating enterprises in the country ranging from micro to large ones (Kenya, 2006; McCormick *et al*., 2009). Due to the spatial location of equipment fabricating enterprises, besides primarily targeting well known clusters of Kariobangi and Kamukunji, snowballing technique was used to

identify similar enterprises in other places within the city. The choice of the clusters was purely purposive due to the high concentration of equipment fabricating MSEs. Other considerations for cluster selection were proximity, accessibility, and saving on travel time and cost. Similarly, the choice of study site allowed easy access to key informants who are also located in the city.

3.3 Unit of Analysis, Population and Sampling Procedure

The unit of analysis in this study was the equipment fabricating MSE with the enterprise owner being the target respondent. From this time, enterprise and firm will be used interchangeably in this paper. The exact population of food processing equipment fabricators in Nairobi cannot be established from official records. According to official statistics, there were a total of 177 manufacturers of both electrical and non-electrical machinery in 2012 employing 4,972 employees (Kenya, 2012b). However, this figure fails to give a breakdown in terms of the number of food processing equipment manufacturers.

For this reason, a fairly reasonable list of enterprises was constructed from a variety of sources. To start with, the researcher conducted key informant interviews with officials from the Ministry of Industrialization (MoI), and the Kenya Industrial Research and Development Institute (KIRDI) not only to familiarize with the activities of the food processing equipment and machinery sector, but also to obtain their lists of firms. Other possible sources such as a list of registered businesses of the City Council of Nairobi (CCN), the official directory of Kenya Association of Manufacturers (KAM) and the Kenya Postal Directory were also explored. The list from the City Council was however dropped as it lacked crucial information on the nature of activity and firm size. Similarly, the KAM directory was less useful as it listed mainly large firms rather than the MSEs which were the focus of this study.

In order to supplement the list of firms obtained from aforementioned sources and ensure inclusion of as many MSEs as possible, the researcher physically visited some of the industrial clusters known for fabrication works namely Kariobangi Light Industries,

Kamukunji, Ruaraka, and Nairobi's Industrial Area. Preliminary discussions with enterprise workers and owners during the visits provided the much needed referrals on the location of similar enterprises. Further still, the researcher visited equipment retail shops and supermarkets with a view to identify more enterprises from the labels on products indicating manufacturer details. A major limitation of this effort was the lack of product branding making it impossible to trace the fabricators. In the end, the researcher identified sixty nine equipment fabricating MSEs. The final data set used in the analysis comprised information from sixty five MSEs after excluding data from four enterprises that were used to pre-test the survey instrument. While the researcher attempted to identify as many enterprises as possible for the survey, the final list of sixty nine MSEs constitute, at best, only a sample rather than the entire population of food processing equipment fabricating MSEs in Nairobi. In other words, there is a higher likelihood that similar enterprises in other locations may have been excluded from the survey.

In recognition of a possible time lag between acquisition and translation of innovation knowledge into new or significantly improved products (Belderbos *et al*., 2004a), the current study restricted analysis to MSEs that had been in existence for at least five years. Following this approach, responses from relatively young MSEs that may suggest a more innovative behaviour than older firms were excluded. Additionally, a screening question was used to restrict the study to innovating MSEs only. Specifically, proprietors were asked whether their enterprises have, during the two years preceding the study, introduced a new or significantly improved product or both. A positive answer to one of these questions classified them as innovators. This selection criterion is consistent with the Oslo Manual that governs public innovation surveys of Organization of Economic Cooperation and Development member states (OECD, 2005) and is used to restrict final analysis to innovator firms that were allowed to answer the full questionnaire. Key informant interviews were also conducted to generate rich qualitative data that helped to supplement and contextualize the survey data. The selection of key informants was purposive based on their knowledge of the sector in general and issues affecting product innovation in the food processing equipment sector in particular.

3.4 Data Sources and Collection Methods

This study used both primary and secondary sources of data. Primary data were gathered from both the owners of MSEs and key informants by use of a questionnaire and interview guides respectively (see Appendix IV and V). On the other hand, secondary data were collected from published and unpublished works including books, academic journals, project papers, theses and reports among others. Secondary data sought to contextualize the research questions and identify knowledge gaps regarding external linkages and innovation. Data for this study was collected between September and November 2013.

At this point it may be important to describe the literature search process for the current study. Secondary literature was searched from a variety of sources namely books, project papers and theses, Google Scholar, electronic journals (mainly EBSCO and JSTOR) and the University of Nairobi Library repository. The researcher first conducted a broad search to obtain electronic articles on the areas of innovation, externalization of innovation and inter-firm linkages. This was followed by a search for articles dealing with technical links and technological innovation. The search criterion was then narrowed down to external linkages and product innovation in the machinery fabricating sector.

Collection of primary data proceeded as follows: A pre-test of the survey questionnaire and key informant interview guide was done to assure clarity and completeness of the questions. To this end, four firms and two key informants were randomly selected for the exercise. A review of the pre-tests provided useful insights that were used to restructure the data collection instruments. For instance, it was detected that many respondents were reluctant to disclose sales figures relating to innovative products, either for fear of taxation or inadequate record keeping. Accordingly, an additional question on percentage of sales attributed to innovative products was introduced in the survey instrument. The pre-test also pointed to the need for an agreed upon translation of certain terms (such as linkages, innovation) in the questionnaire into Kiswahili for easy understanding by most of the respondents. Due caution was taken to ensure that the translations communicated the questions as originally intended.

The actual enterprise survey followed the pre-test. A survey questionnaire administered by the researcher was used to gather both quantitative and qualitative data on the specific research questions. Although the questionnaire preparation largely adapted the guidelines of the Oslo Manual (OECD, 2005), appropriate adjustments were made to include linkages with personal contacts and other sources of innovation ideas such as catalogues, and internet. The survey instrument comprised both open and close-ended questions. The responses to the close-ended questions were largely drawn from literature while the open-ended questions accorded the respondents freedom to give as much information as possible without the constraints of pre-determined responses. In many cases, respondents were further asked to qualify their responses thereby eliciting rich qualitative data.

Each interview took between forty-five minutes and one hour. These variations were caused by the need not to interrupt some of the respondents who seemed willing to volunteer as much information as possible. Supplementary data were also collected through observation of the artisans at work, the organization of the production line, the quality of raw materials used and the types and quality of products. During survey in the clusters, a security officer seconded by the officials of the Jua Kali Association, acted as a tour guide for the researcher. Apart from ensuring easy navigation across the many sheds, the tour guide introduced the researcher to the respondents assuring their cooperation and participation in the study in the knowledge that the study has been approved by the officials.

The researcher also conducted six key informant interviews with officials from the Ministry of Industrialization (MoI), Kenya Industrial Research and Development Institute (KIRDI), Kenya Bureau of Standards (KEBS), Kenya Intellectual Property Institute (KIPI), the Faculty of Agriculture at the University of Nairobi and the Kamukunji Jua Kali Association. Although the selection of key informants was purposive based on their knowledge of the sector in general and issues affecting innovation, the key informants also provided specific information. In particular, the officer from MoI provided information that helped to familiarize the researcher with the activities of the sector while KIRDI provided information on linkages and industrial innovation. Similarly, KEBS and

KIPI provided an overview of the role of standards in product innovation as well as information on the state of invention and patenting respectively. Finally, the Faculty of Agriculture gave information on university-industry linkage while the Jua Kali Association gave useful insights on the trajectory and state of innovation in the sector. In order to provide background and context of the study, key informant interviews preceded the actual survey. The key informant interview guide focused on the growth of and the challenges facing the equipment fabrication sector, external sources of innovation ideas, and product innovation.

3.5 Operational Definitions and Description of Variables

3.5.1 Independent Variable

The independent variable for the current study was external linkages, defined as both formal and informal cooperative inter-firm relationships where two or more partners contribute knowledge and skills to agreed complementary aims (Tyler and Steensma, 1995). This definition emphasizes interdependence and mutual commitment of the partners to on-going arrangement where they mutually share their expertise and output for purposes of innovation. To obtain information on the independent variable, respondents were asked to indicate and rank important external sources of innovative information on a four item Likert scale (not important=1, somewhat important=2; important=3; very important=4). Another question required respondents to state whether they had any innovation related linkage with the various external partners namely personal contacts, customers, suppliers, competitors, university and polytechnics, and R&D organizations. Additional variables were constructed to capture the volume, duration, strength and search strategy of external partners utilized for product innovation. For instance, to capture volume of linkage, each of the sources of innovative ideas were coded as a binary variable, 0 for absence of a link and 1 for presence of a link. Thereafter, the links were summed up so that each firm got 0 in case of no innovation linkage reported, and a value of 6 when all linkages were used for product innovation.

3.5.2 Dependent Variable

The dependent variable in this study was product innovation operationally defined as the creation, development, and implementation of a new or significantly improved product to create added value (Rogers, 1998). This definition highlights some important elements. The 'new' product includes products which are new to the firm or market but not necessarily new to the world. Similarly, only incremental modifications of existing products which significantly improve functionality or user friendliness constitute product innovation. In addition, product innovations must be commercialized in order to add value to the firm.

Data on the dependent variable were gathered by asking MSE owners to state whether their firms introduced new or significantly improved products during the two years preceding the survey. The reported product innovations were further categorized depending on the degree of novelty namely new only to the firm, new to the industry, or new to the world. Similarly, respondents were asked to describe the nature of product innovations their enterprises implemented in terms of new features, new components and materials, new uses or user friendliness (OECD, 2005). All product innovations were self-reported and assumed a value of 1 in case product innovation was reported, otherwise 0. Furthermore, to capture the commercial significance of product innovations, respondents were asked to report the percentage of turnover in 2012 relating to products new to the world, products new to the industry, products new to the firm, products significantly improved, and products that were largely unchanged.

3.6 Data Analysis

Data analysis can be viewed as the categorization, the aggregation into constituent parts, and the manipulation of data to obtain answers to the research questions underlying a research project (Grover and Vriens, 2006). Simply put, data analysis entails making sense of the responses received during data generation in order to generate patterns of associations, and develop meanings. Due to the nature of research questions posed, this study used both quantitative and qualitative data analysis methods. During the data collection exercise, all completed questionnaires and key informant interview notes were

reviewed and cleaned on a daily basis to ensure accuracy, clarity and completeness of responses. Given that the closed-ended questions were already pre-coded, only responses to the open-ended questions needed sorting and coding into emerging themes. Analysis of responses to the open-ended questions proceeded as follows. First, all the responses were listed on a separate sheet in order to identify the emerging themes. The responses were then grouped into thematic areas and later used to contextualize and affirm some of the quantitative aspects in the study.

Upon completion of the coding exercise, data was done using Statistical Package for the Social Sciences (SPSS). During data entry, the level of measurement for each variable was specified in order to determine the appropriate statistical analysis (Walliman, 2006). Initial data cleaning tabulation was performed by running frequency analyses on each variable column to identify outlier codes, missing data and other indications of coding and data entry errors. Similarly, non-response and missing data were assigned a special code (99) and were excluded from all analysis.

Quantitative data analysis also proceeded in stages. In the first stage, Statistical Package for the Social Sciences (SPSS) was used to enter the pre-coded responses. During data entry, the level of measurement for each variable was specified in order to determine the appropriate statistical analysis (Walliman, 2006). Secondly, initial data tabulation was performed by running frequency analyses on each variable column to identify outlier codes, missing data and other indications of coding and data entry errors. To this end, non-response and missing data were assigned a special code (88) and were excluded from all analysis.

Thirdly, SPSS was used to generate descriptive statistics (frequencies and percentages) on selected variables such as number of employees, firm age, and volume of linkages. Similarly, measures of central tendency such as arithmetic mean were calculated for some of the quantitative variables. The aim here was to quantify the characteristics of the enterprises and present them in form of frequency tables, cross-tabulations and charts. Additional data analysis entailed performing non-parametric statistical tests to establish

the strength and direction of association between the independent and dependent variables (Walliman, 2006). The choice of non-parametric tests was informed by the small sample size (N=65) and the failure by the data to meet stringent assumptions of normality, linearity and homoscedasticity required for parametric tests (Pallant, 2005). Particular attention was given to the significance of the statistical correlations. Further statistical analysis involved performing partial correlations to test for associations between variables by controlling for certain variables (D'Cruz and Jones, 2004). Accordingly, partial correlations were run to measure the relationship between external linkages and product innovation by controlling for other variables such as firm size, age and internal R&D efforts. Finally, two-tailed test of significance at a probability value of 0.05 was performed to establish whether the reported associations between independent and dependent variables were occasioned by chance (Huizingh, 2007). A two-tailed test was appropriate because assumptions regarding the direction of the relationship external linkages and product innovation could not be made.

3.7 Limitations of the Study

The current study recognizes some limitations against which the claims of reliability, significance and generalizability of our results need to be tempered. Firstly, the total number of MSEs surveyed represents only a sample and not the population of equipment fabrication firms in Nairobi. Moreover, due to the cross-sectional nature of the current study, the causal direction portrayed in the results should be treated with caution because of the possibility of reverse causality. Secondly, our analysis regarding implemented product innovations and degree of novelty relied on self-reported data. We acknowledge that judgments regarding these aspects of innovation could be biased. Thirdly, our study gathered data from MSE owners who, given their position in the enterprises, may be biased regarding the state of product innovation. We therefore acknowledge that different results would have been obtained if employees had been interviewed. Finally, we treated customers in a general rather than specific manner. We recognize that different customers such as end-users and food processors may make varying contribution to product innovation.

CHAPTER FOUR
STUDY FINDINGS

4.1 Introduction

This chapter reports findings of the study thematically according to the four research objectives outlined in chapter one. The first part looks at both enterprise and proprietor characteristics followed by an examination of the nature and types of external linkages. The third part focuses on the nature and types of product innovation implemented by the enterprises surveyed while the final section looks at the relationship between external linkages and product innovation. Wherever appropriate, tables, figures and charts have been used to illustrate the study findings.

4.2 Enterprise Characteristics and Proprietor Entrepreneurial Attributes

The first objective of this study examined the characteristics of food processing equipment fabricating MSEs. In recognition of the blurred boundary between enterprise and owner characteristics (Littunen, 2010), this study sought information on both enterprise characteristics and owner entrepreneurial background. Some of the enterprise attributes considered included year of establishment, location, number of employees, ownership type, main activity and products, extent of diversification, and main market. Similarly, the study investigated proprietor entrepreneurial attributes such as age, gender, education level and relatedness to equipment fabrication, length and relatedness of previous work experience to fabrication, and the main motivation for starting the enterprise.

4.2.1 Age of Enterprise

Literature informs that age of an enterprise has a significant effect on product innovation (Bogliciacino *et al*., 2012). The current study, therefore, asked respondents to indicate the year of enterprise establishment. All ages were calculated as at December 2012. The youngest enterprise was 5 years while the oldest was 37 years. The age category with the highest percentage (21.5 percent) was found to be 5 – 10 years; 11 – 15 years and 16 – 20 years (20 percent each); 21 – 25 years (15 percent); and 26 – 30 years (17 percent). Only a few enterprises (6 percent) were above 31 years of age. The nonexistence of enterprises

below 5 years of age was partly due to the selection criteria adopted by the study which focused on enterprises at least 5 years of age. The study also found a higher mean age of 18.1 years and a median age of 18 years respectively. While it is probable that the selection criteria adopted by the study partly accounts for the high mean age, it may also suggest high survival rates of enterprises in the sector occasioned by investment in skills and equipment which may deter exit. This suggestion remains a conjecture because the current study could not provide any validation.

Although not statistically significant, non-parametric correlation tests showed that the effect of enterprise age was positive for type of product innovation but negative for degree of novelty (see Appendix I). Consistent with past studies (Bogliciacino *et al*., 2012), this finding may suggest that young enterprises were more likely to introduce new or significantly improved products which were new to the industry than old firms.

4.2.2 Enterprise Location

Even though existing works regard Kamukunji and Kariobangi as the main informal industrial clusters for fabrication enterprises, the study adopted an open approach to enterprise location in anticipation of other enterprise locations. The study established that over two thirds of the enterprises surveyed were located in the two main clusters of Kamukunji (37 percent) and Kariobangi (31 percent). Our study also established existence of other locations for equipment fabrication such as Rikana, Hamza, Ziwani, Umoja and Tena. The latter finding suggests a dispersed rather than concentrated location of equipment fabrication enterprises MSEs.

The study also sought information on the reason for the dispersed location of fabricating MSEs. The findings established that a good number (40 percent) of enterprises had changed site of operation due to various factors. One of the notable reasons for change of operation site was demolition of sheds in Buru Buru occasioned by a land ownership dispute forcing many enterprises to find alternative sites. Interestingly, none of the evicted enterprises opted to secure space in the established clusters for fear of imitation.

Instead, they moved to new sites in Ziwani, Hamza and Tena. The excerpt below further corroborates this observation:

"Since I began this work (equipment fabrication), I have moved from one site to another for reasons such as congestion in the established clusters. I am new to this site (Ziwani). We used to work at a location in Buru Buru, a site known for high quality products. Unfortunately, our sheds were demolished because of a land ownership dispute and a good number of us decided to move here in order to continue helping one another. We also wanted a location that would minimize other fundis (artisans) from poaching our ideas and that is the reason we did not go back to the known clusters". (Respondent 22, 13 October, 2013).

4.2.3 Employment and Size of Enterprise

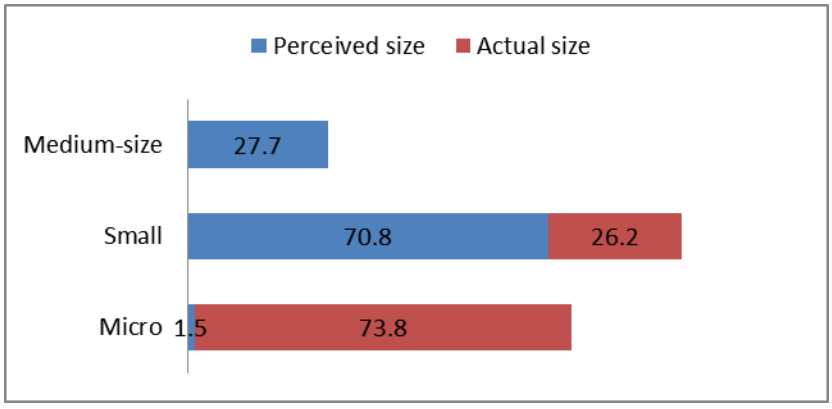
Questions on employment and size of enterprise related to number of employees, employment by gender, and employment of apprentices and family members. Consistent with literature that suggests that the size of an enterprise affects product innovation (Rothwell, 1984), this study sought to establish the employment levels in the enterprises surveyed. In this case, the number of employees was used as a proxy for size of enterprise. The respondents were also asked to carry out a self-assessment and state their perceived size category as well as the basis for the supposed size.

The actual total number of employees ranged from a minimum of 3 to a maximum of 30 while the mean total employment was 8.2. The study findings showed that majority (73.8 percent) of the enterprises surveyed were micro enterprises with less than 10 employees while 26.2 percent were small enterprises. The dominance of micro-enterprises in metalworking is consistent with past studies (Kinyanjui, 2007). However, there were marked variations regarding perceived and actual enterprise size categories (see Figure 4.1). Interestingly, most proprietors perceived their enterprises as larger than they actually were. For example, while majority (73.8 percent) of the enterprises was grouped as micro based on employment level, only 1 enterprise was perceived as micro by the owner. On the other hand, majority (70.8 percent) of the proprietors perceived their enterprises as small, while only 26.2 percent were actually so. This finding points to the limitation of using employee-only measure for enterprise size, a problem that the MSME

Bill 2011 has tried to solve by incorporating both number of employees and other proxies such as investment in plant and machinery in the case of manufacturing firms.

Further still, some respondents even perceived their enterprises as medium-size while actually none was considered so. The tendency by MSE proprietors to perceive their enterprises as small or medium-size rather than micro was particularly interesting. Partly, this finding may denote a sense of enterprise growth rather than stagnation on the part of the proprietors, an assertion that the current study could not corroborate further. However, the finding suggests the weakness of an employment-only measure of enterprise size. This limitation has been addressed by the MSME Bill of 2009 that uses a composite of indicators including number of employees, annual turnover, registered capital and investment in machinery.

Figure 4.1: Perceived versus Actual Enterprise Size



Source: Survey Data, 2013.

The respondents also gave varied reasons for perceived enterprise size. The main basis for own size category was the number of employees (53.8 percent), capital investment (23.1 percent), and turnover (16.9 percent). Although reported by only a small minority (6.2 percent) of the respondents, qualitative response regarding location as an important basis for size classification was provided as stated:

"Just look around and you will tell with ease the kind of enterprises located here. Our location has all the negative attributes…it's overcrowded, lacks water and sanitation facilities. Who else would locate here, if not us - the small and barely surviving enterprises" (Respondent 32, 29 October, 2013).

In terms of employment by gender, the study found that only a small minority (18.5 percent) of the enterprises had female workers compared with a large majority (81.5 percent) which employed only male workers. The level of female employment accounted for only 3 percent of total employment in the enterprises surveyed. The study further observed some level of gendered task differentiation where female workers engaged in tasks demanding less physical energy such as sales, and paintwork while male counterparts carried out the more physical and skill-intensive tasks such as product design, cutting, folding and welding.

The study also established preponderance of apprentices in over three quarters (77 percent) of the enterprises compared with employment of family members which was reported in about a half (49.2 percent) of the enterprises surveyed. In terms of proportion, apprentice presence accounted for 33 percent of total employment. The latter observation was entirely unsurprising given that most people join the sector first as apprentices learning from the more experienced artisans. The finding also supports past studies that note the importance of experiential learning particularly in economic contexts where traditional craftsmanship, often acquired through apprenticeship, predominates (Oyeyinka, 2004). Further still, past works have viewed apprenticeship both as an important feature of informal clusters and a medium of transferring intergenerational knowledge and skills (Kinyanjui, 2007).

In terms of statistical association, our study revealed that enterprise size has a negative effect on both type and novelty implying that micro-enterprises were more innovative than the small ones (see Appendix I). Similarly, the effect on novelty was negative for presence of apprentices but positive for family employment. While the finding regarding apprentices may be partly due to their low stock of skills, the effect of family employment contradicts previous studies (DeJong and Hulsink, 2012; Ruef, 2002) which noted the preponderance of family employment among innovative enterprises.

4.2.4 Main Activity of the Enterprise

This study sought information on the main activity of the enterprise, product line and product diversification. Although many MSEs were involved in more than one activity, in this particular case, the respondents were asked to state only their most important activity. The study found that 61.2 percent of the enterprises engaged in fabrication of both equipment and machinery while about one third (32.3 percent) were involved in equipment fabrication. Further still, only a small minority (6.2 percent) of the enterprises fabricated machinery suggesting that machinery manufacturing requires high-level technical skills and technology that is presently lacking in the sector.

Regarding the product lines, the study established five broad categories namely snacks;, bakery, fruits juices, grain milling and dairy. These categories are similar to the SAFIC project (discussed earlier in Section 1.6). Consistent with other previous works (Sonobe *et al*., 2011), the study findings further revealed some degree of product line diversification with almost half (46.2 percent) of the enterprises found to produce other products (see Table 4.1) beside food processing equipment. Although this study could not establish the reasons for such product diversification, the current boom in the building and construction sector may partly explain the shift towards production of block making machines, steel windows and doors, all of which seemed popular among the respondents.

Table 4.1: Main Product Lines

Category	Products
Grain Milling	Maize mill; rice mill; Maize huller; Maize rolling mill; Maize crusher; Rice thresher; Maize sheller; Dryers;
Snacks	Popcorn machine; Roaster; Cutters; Peelers; Fryers; Warmers; Dryers;
Bakery	Baking tins; Racks; Ovens; Dough mixer; Nut cracker; Slicers; Cookers;
Dairy and beef	Meat chiller; Meat mincer; Slicers; Pasteurizer; Meat roaster; Sausage making machine; and Butter making machine.
Fruit juices	Mango pulper; Blenders;
Other	Soap and Candle making machine; Chaff cutters; Feed mixers and feeders; Block making machine; Metal doors and windows; Bill boards; Molding machine; Sinks; Plastic crusher; Weighing scales; Incinerator; and Boilers

Source: Survey Data (2013)

In terms of statistical associations, product diversity was found to have a positive effect on type of innovation but negatively impacted novelty (see Appendix I) implying that while artisans may apply techniques learnt from fabricating diverse products to make significant product changes, improving novelty of innovations requires focusing largely on technically related products to allow integration of skills.

4.2.5 Main Markets

Respondents were asked to name the main markets for their products. The reasoning here was that enterprises with external focus could be more innovative (Karlsson and Olsson, 1998; Laursen and Salter, 2006). The results indicate that Nairobi and environs was the main market for almost three quarters (72.3 percent) of the enterprises while other parts of the country accounted for just over a quarter (27.7 percent). The study further established that one third (33.8 percent) of the MSEs engaged in export albeit indirectly through middlemen. East African countries such as Rwanda, Uganda, Tanzania, South Sudan, and Democratic Republic of Congo were the main export destinations. Only 2 of the 22 exporting MSEs reported having exported to markets outside the region such as Morocco and Zambia. A possible explanation for the majority of enterprises exporting within East Africa could be the exhibitions organized by the East African Community member states. Such exhibitions offer artisans an opportunity not only to show case their products but also to learn from others in the sector as illustrated by the excerpt below:

"The Ministry of Labour through our association (Jua Kali Association) usually organizes shows (exhibitions) for us. They cater for all the transport expenses for those who attend. The shows give us opportunity to market and sell our products. We also learn about (new products) innovations developed elsewhere. For example, I learnt how to make a maize rolling machine at an exhibition I attended in Arusha about three years ago". (Respondent 18, 28 September, 2013).

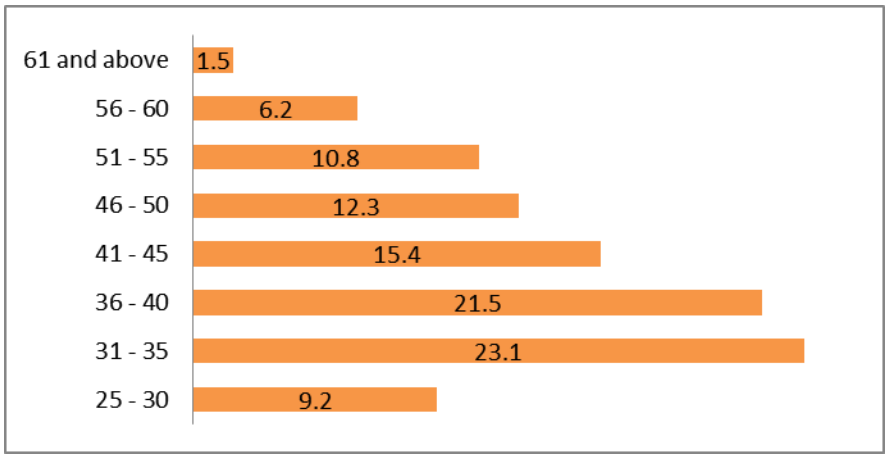
Contrary to past studies (Karlsson and Olsson 1998; Laursen and Salter 2006) which emphasize the role of export activity in enhancing innovativeness, correlation tests for the current study showed that engaging in export negatively affects both type and novelty of innovation (see Appendix I). Arguably, the use middlemen may deny the fabricators direct feedback from foreign customers except during the regional exhibitions.

4.2.6 Age and Gender of Enterprise Owner

The age of MSE owners showed some variation. The findings revealed a wide age gap with the youngest proprietor being 27 years while the oldest was 62 years. The mean age of the enterprise owners was 41 years while the median age was 40 years (see Figure 4.2 for distribution of proprietor age categories). The highest number (23 percent) of enterprise owners was in the age bracket 31 and 35 years followed by 36 – 40 years at 21.5 percent. The study further established that 15.4 percent of the owners were within the age bracket 41 – 45 years while those who were 46 – 50 years of age accounted for 12.3 percent. There were few proprietors within the age brackets 56 – 60 years (6.2 percent) and above 60 years (1.5 percent). The age distribution shows few proprietors within the age bracket 25 – 30 years (9.2 percent), the number then rises and peaks at 31 – 35 years before steadily declining thereafter.

The few enterprise owners within the age bracket 25 – 30 years may be explained by the fact that people entering the sector undergo some practical training under the skilful hands of a more experienced artisan before they can set up their own enterprises (Kinyanjui, 2007). The focus of the study primarily on enterprise owners may have locked out a good number of young artisans from the study even though they were already engaged in the sector. The manual nature of fabrication work and its requisite demand of physical energy could explain the fact that only one of the MSE owners was above 60 years of age. It may therefore be expected that the old proprietors would leave the sector to engage in other lighter work within or outside the sector. The findings of our study could not however validate this assertion.

Figure 4.2: Age of MSE Owners



Source: Survey Data, 2013.

In terms of statistical association, relatedness of previous work experience significantly correlated with degree of novelty while other owner attributes were found to be not significant (see Table 4.2). Further still, most proprietor characteristics were negatively related to novelty except relatedness of previous work experience suggesting that accumulating considerable stock of skills and knowledge in a related field may drive generation and implementation of novel innovations. Conversely, most proprietor attributes correlated positively with type of innovation except the years of experience in the fabrication sector.

Table 4.2: Non-parametric Correlations for MSE Owner Characteristics

Variable		**Type of Product Innovation**	**Sig. (2-tailed)**	**Degree of Novelty**	**Sig. (2-tailed)**
Age of Proprietor	Correlation Coefficient	.003	.979	-.190	.130
Education Level	Correlation Coefficient	.002	.990	-.106	.401
Academic Relatedness to Fabrication	Correlation Coefficient	.017	.895	-.016	.897
Years of Experience in Sector	Correlation Coefficient	-.001	.994	-.095	.450
Relatedness of Work Experience	Correlation Coefficient	.010	.938	.280*	.024

N=65 *. Correlation is significant at the 0.05 level (2-tailed)

Source: Survey Data, 2013.

4.2.7 Education Level and Relatedness to Equipment Fabrication

Implementing product innovations using innovation ideas gathered from diverse external linkages may entail a great deal of learning, absorption and adaptation of external technology. To this end, both the level and relatedness of educational background of the enterprise owner may play a fundamental role (Littunen, 2010). Our study findings compare favourably with previous studies (Kinyanjui, 2007) and show a mix of entrepreneurs with varying education levels. About a third (31 percent) of enterprise owners had attended a youth polytechnic, secondary (17 percent), primary and college diploma (15.4 percent each), and college certificate (7.7 percent). The finding that nearly a quarter (23 percent) of the entrepreneurs had attained post-secondary education may suggest the attractiveness of fabrication business to such graduates. Although the findings on educational attainment were consistent with previous studies (Kinyanjui, 2007), the non-existence of entrepreneurs with either university education or skill certification from Directorate of Industrial Training in the current study was a notable point of difference.

The fact that nearly a third (31 percent) of enterprise owners had attained youth polytechnic training was particularly important supported suggestions regarding the role of such institutions to the sector. Generally, youth polytechnics are considered post-primary institutions offering low skill but practical courses which are attractive to people with either full or less than full primary education. Some of the courses (such as welding, general fitting) provide a basic foundation and entry point for fabrication related activities as illustrated by the following excerpt:

"…during the early days (1980s), youth polytechnics were quite vibrant and imparted practical skills that gave some of us a head start in fabrication work. After failing to continue with secondary education, I attended a village polytechnic and took a course in General fitting which included panel beating and welding. These are the very skills needed in the sector. Unfortunately, the government no longer pays attention to these important institutions (youth polytechnics), a move that seriously disadvantages youth from poor families. Equally disturbing is the conversion of technical institutes and polytechnics into universities". (Respondent 28, 16 October, 2013).

In addition to educational level, the study also sought information on relatedness of such education. Training on technical courses such as welding, general fitting, and engineering

(mechanical, production and electrical) were considered related to fabrication work. The study established that majority (68 percent) of the MSE owners had unrelated educational background compared to nearly a third (32 percent) who had related backgrounds. Some of the unrelated courses included business management, and sales and marketing. The collapse of youth polytechnics around the country may offer partial explanation to the latter finding.

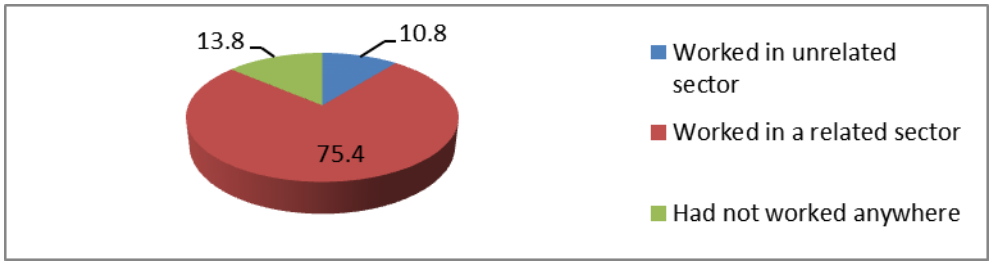
As shown in Table 4.2, correlation tests for the effect of education level and relatedness on product innovation revealed that both level and relatedness of proprietor education had a positive relationship with novelty but negatively affected innovation type. The finding is consistent with past studies (Schultz, 1975; Sonobe *et al*., 2011) which emphasize the importance of formal education in achieving multifaceted product innovations but contrasts other works which noted that low education levels do not deter entrepreneur creativity particularly in clusters where social networks are predominant (Kinyanjui, 2007). Nonetheless, this finding may imply that possession of some technical training background increases the likelihood of implementing novel innovations.

4.2.8 Previous Work Experience and Relatedness to Equipment Fabrication

In addition to obtaining information on relatedness of educational background, the study sought information on duration and relatedness of work experience to equipment fabrication. Duration of work experience ranged between 7 and 39 years. The mean years of experience in fabrication work was 21.4 years while the median stood at 22 years. The study found that slightly over a quarter (26.2 percent) of the respondents had experience of between 5 – 10 and 11 – 15 years each in fabrication work; 26 – 30 years (18.5 percent); 21 – 25 years (13.8 percent); and 16 – 20 years (10.8 percent). Only a one of the sixty five entrepreneurs reported experience of more than 30 years. The findings on length of experience suggests both a late entry into food processing equipment fabrication work by young artisans and an early exit from the sector by the old artisans. The fact that only two entrepreneurs had experience of less than 5 years was particularly not surprising given that the study primarily targeted enterprise owners who may have acquired some years of experience before setting up own enterprises.

Apart from duration of work experience, the study also investigated the relatedness of such experience to equipment fabrication. The reasoning here was that such relatedness may enhance ability to innovate through build-up of necessary skills. The study found that three quarters (75.4 percent) of the respondents had worked in related sectors compared to only a few (13.8) percent who had worked in unrelated sector. Interestingly, another 10.8 percent of the respondents had not worked anywhere prior to engaging in equipment fabrication (see Figure 4.3). Some of the related sectors mentioned included work either in large steel fabricating enterprises in industrial area or restaurants. These findings were consistent with previous studies (Kinyanjui, 2007; Sonobe *et al*., 2011). A notable observation was the strong entrepreneurial drive as shown by 13.8 percent of the proprietors who joined the sector to exploit the opportunities even without any prior experience in fabrication.

Figure 4.3: Relatedness of Previous Work to Equipment Fabrication



Source: Survey Data, 2013.

Correlation results showed that duration of work experience negatively affect both type and novelty of innovation while relatedness of work experience had a positive relationship with type and novelty of innovation (see Table 4.2). In other words, related work experience in a formal enterprise enhances innovativeness while long years of experience alone may result in a technology lock-in and less motivation to introduce innovations as rightly put in the quote below:

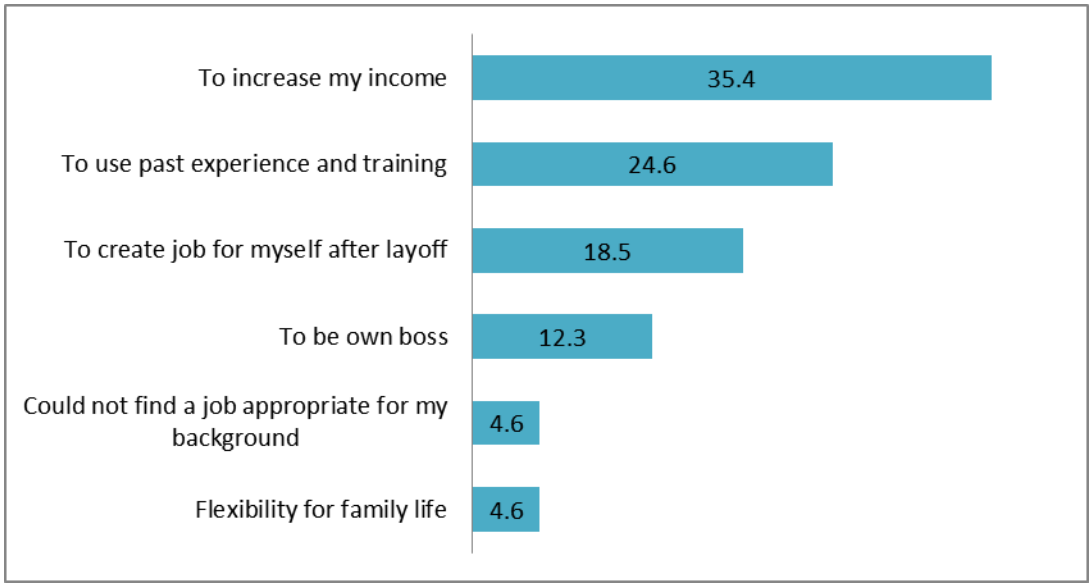
"…I have been in fabrication business for thirty years now and over the same period, my product looks pretty much the same. Of course there are many factors explaining the situation such as mastery of the work which improves quality of finished product…but I largely blame our training…it is the major constraint. Once trained in making an item, you are locked in that for the rest of your life…" (Respondent 61, 6 November, 2013).

4.2.9 Motivation for Starting Enterprise

The study also investigated the entrepreneurial background of the owners of equipment fabricating MSEs by asking respondents to state the main motivation for starting fabrication enterprise. As shown in Figure 4.4, over one third (35.4 percent) of the respondents reported increasing own income as the main motivation followed by use of past experience and training (24.6 percent), create job for self after layoff (18.5 percent), and to be own boss (12.3 percent). Only a small minority (4.6 percent) of the respondents cited flexibility for family life or inability to find a job appropriate for background. The desire to increase income by majority of respondents is unsurprising due to the low wages paid to artisans as aptly put by a respondent:

"*In this kind of work (equipment fabrication), you never desire to be employed. We don't pay for our training (apprenticeship) so we earn virtually nothing during apprenticeship. Even after training, the employer takes the bigger percentage of the proceeds…so the only way out of this situation (low wages) is to start your own business soon after training and enjoy all the benefits".* (Respondent 5, 5 September, 2013).

Figure 4.4: Main Motivation for Starting Enterprise



Source: Survey Data, 2013.

In addition to investigating the main motivation for starting fabrication enterprise, respondents were also asked to state the manner in which they started the fabrication

enterprise. The study found that two thirds (67.7 percent) of the enterprises were first time businesses while 16.9 percent were existing businesses that later started equipment fabrication (spin-offs). Another 9.2 percent of the enterprises were buy-offs while a few (6.2 percent) of the enterprises were inherited. The finding that a good number of enterprises were first time enterprises may suggest existence of a strong entrepreneurial drive as supported by previous studies which note that Kamukunji cluster serves as a springboard of new entrepreneurs (Kinyanjui, 2007). Regarding the spin-offs, the study observed that some of the enterprises started as either suppliers of materials or sellers of finished products before embarking on fabrication work as illustrated by the excerpt below:

"I used to be a fundi (technician) in a big hotel in town (Nairobi). As the one in-charge of maintenance, I learnt a lot from the fundis who came to carry out installation and repair of equipment at the hotel. So when I lost my job, I ventured into supplying materials and selling the finished products. Later on, I began fabrication work at my workshop to ensure my customers got products of high quality compared to what others produce". (Respondent 9, 16 September, 2013).

4.3 Nature and Type of Product Innovation

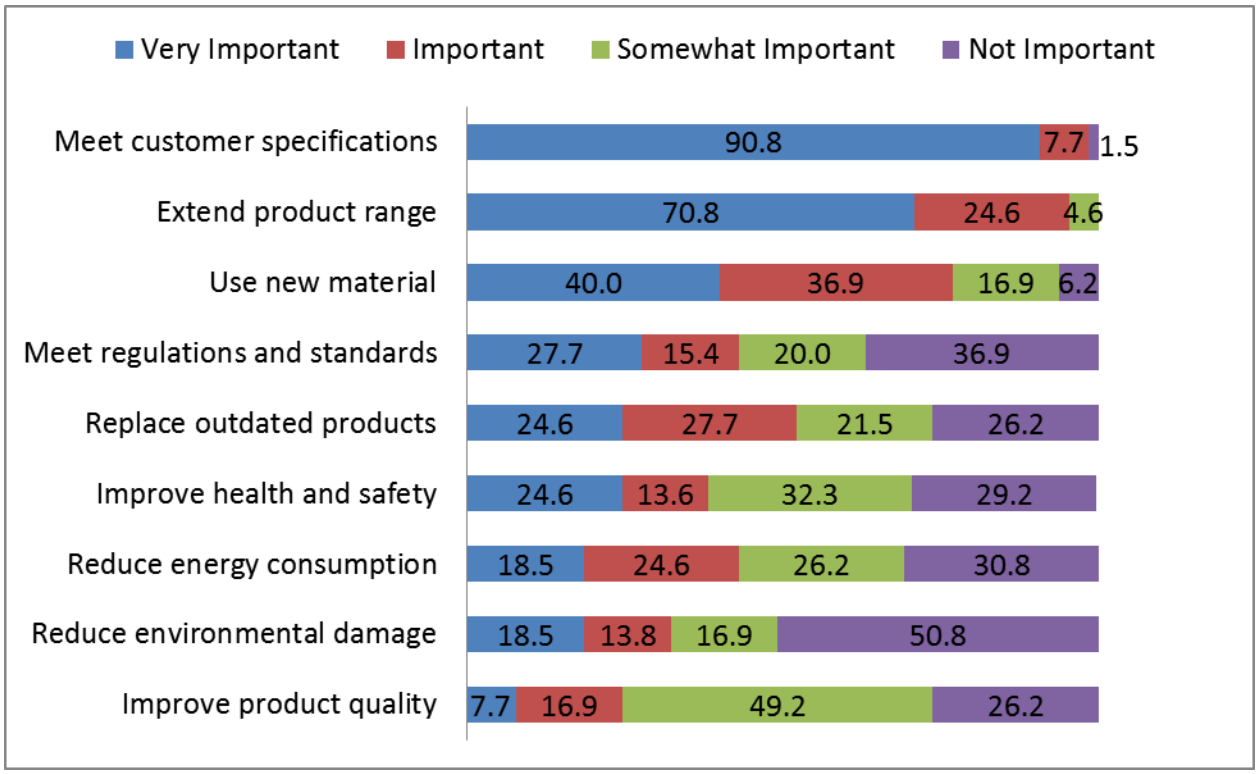
The second objective of our study was to examine the nature and type of product innovation implemented by equipment fabricating MSEs. Information was therefore gathered on purpose, type, novelty and description of innovation, distribution of sales attributable to innovation, and attempted innovation.

4.3.1 Objectives of Product Innovation

Respondents were asked to state and rank the important objectives driving their product innovations. The findings established that product innovations did not just happen but were driven by clear objectives. In particular, product innovations were largely in response to market and cost related factors. As depicted in Figure 4.5, a leading majority (90.8 percent) of the enterprises undertook product innovation to meet customer specifications while another 70.8 percent regarded extending product range as very important. Further still the need to use alternative materials was regarded as very important by 40 percent of the enterprises. Surprisingly, only a minority (7.7 percent) of

the respondents ranked improving product quality as very important while slightly over a half (50.8 percent) of the respondents regarded the objective of reducing environmental damage as not important. Similarly, other objectives such as to meet regulations and standards (36.9 percent), reduce energy consumption (30.8 percent), and to improve health and safety (29.2 percent) were ranked as not important. Although enforcement of product quality and safety standards was expected to contribute to product innovation, the weak linkage with research and standards agencies (discussed in Section 4.4) as well as the unawareness of product standards may partly explain the poor ranking of regulations and standards as purposes of product innovation.

Figure 4.5: Important Purpose of Product Innovation



Source: Survey Data, 2013.

Correlation measures were calculated to establish the association between innovation objective and aspects of innovation. Generally, all stated objectives had a positive relationship with innovation type. However, only the objective to extend product range had a statistically significant correlation at the 0.05 level (see Table 4.3). Conversely, the

objectives to replace out-dated products, meet customer specification, and improve safety of use all had a negative effect on novelty. The latter finding suggests that meeting these objectives entails largely minor incremental modifications rather than significant changes on products.

Table 4.3: Non-parametric Correlations for Objective of Product Innovation

Variable		Type of Innovation	Sig. (2-tailed)	Degree of Novelty	Sig. (2-tailed)
Replace Out-dated Products	Correlation Coefficient	.064	.193	-.018	.887
Extend Product Range	Correlation Coefficient	.310*	.012	.054	.668
Improve Product Quality	Correlation Coefficient	.011	.931	.071	.575
Customer Specification	Correlation Coefficient	.180	.150	-.102	.418
Product Regulations and Standards	Correlation Coefficient	.147	.241	.014	.912
Health and Safety of Use	Correlation Coefficient	.148	.241	-.014	.913
Versatility in Energy Use	Correlation Coefficient	.126	.318	.171	.173

N=65 *. Correlation is significant at the 0.05 level (2-tailed)

Source: Survey Data, 2013.

4.3.2 Type of Product Innovation

Regarding type and nature of product innovation, respondents were asked to state whether their enterprises introduced new or significantly improved products in the two years preceding 2012 (the survey year). Additional information was also sought on whether the product innovations were new to the firm, new to industry or new to the world. Other questions related to the description of the nature of product innovations, the percentage of total sales in 2012 attributable to product innovations and attempts at innovation. In order to ascertain attempts at innovation, the study sought information relating to product innovation projects that were never fully implemented and the various reasons behind non-implementation.

Although only enterprises that reported introducing either new or significantly improved products were considered eligible for the survey, the findings revealed variations regarding the type of product innovation. Slightly over a third (36 percent) of the enterprises had introduced a new product, 35 percent had introduced significantly improved product while another 29 percent introduced both new and significantly

improved products. Notably none of the enterprises had introduced radical product innovation (in other words, products that were considered new to the world). The study further established that a good majority (80 percent) of the new product innovations were considered new to the firm compared to only 20 percent which were viewed as new to the market. Consistent with literature (Oyelaran-Oyeyinka *et al*., 1996; Robson *et al*., 2009) which reported preponderance of incremental innovations against a dearth of radical innovations, none of the new products were considered new to the world. The findings on type of product innovations point at an imitation strategy employed by some equipment fabricators. Equally important was the finding that some enterprises not only introduced new products but also made significant improvements on the same products. This particular finding suggests that enterprises are able to learn and make improvements on products to suit customer needs and local conditions for use.

Another equally important finding was the absence of innovation partnering and subcontracting arrangements given that all the reported innovations were developed independently by the enterprises. According to some respondents, middlemen eliminates possibilities of learning from large contractors as well as ability to organize joint production lines in response to a large order. An excerpt below further elaborates:

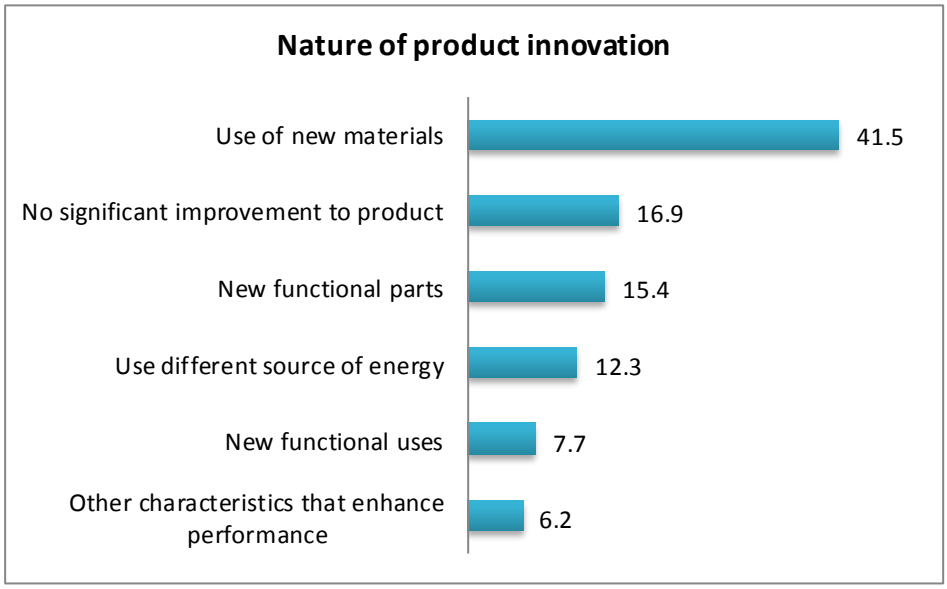
*"…some time back, we used to get large orders which most enterprises could not meet without partnering. For this reason, enterprises would come together and contribute to the order. Such arrangements provided good learning opportunities because the contractors would assist us to meet the design and quality specifications. Some large buyers would even train us on technical aspects of the job and only enterprises capable of meeting the design specifications were approached. Nowadays, such direct orders are quite rare given the large number of brokers (middlemen) who have invaded the business. After securing large orders, the brokers simply buy products from different artisans denying us the opportunity to learn". (*Respondent, 60, 8 November, 2013).

4.3.3 Nature and Purpose of Product Innovation

The study also made enquiries on the nature and purpose of reported product innovations. As shown in Figure 4.6, the most common product innovation related to use of new materials (41.5 percent), new functional parts (15.4 percent), use different sources of

energy (12.3 percent), and new functional uses (7.7 percent). Only a minority (6.2 percent) of the enterprises implemented innovations to enhance product performance. Another notable finding was that 16.9 percent of the MSEs introduced products that were new but without any significant modification suggesting a desire to imitate and produce products similar to those of other enterprises.

Figure 4.6: Nature of Product Innovations



Source: Survey Data, 2013.

Product innovations relating to use of new materials were driven largely by cost considerations. For instance, while stainless steel is the most preferred material for food processing equipment due to its non-rust, easy to clean and durable qualities, the study found that the high price of stainless steel led to adoption of alternative and cheaper materials such as magneto, galvanized steel and zinc with more or less the same qualities. The study further established use of recycled aluminium and mild steel in potato cutters. Material saving innovations involving the use of ordinary steel to make the frame of potato cutters and the use of fibre glass instead of clay on *jikos* mainly for durability and heat retention were also revealed. The innovations on materials may suggest a need to cater for local consumers who prefer durable but cheaper products.

Innovations regarding introduction of new functional uses and parts were also observed. For example, processing of snacks such as crisps, *bhajia* and chips require that potatoes are cut into different shapes and thickness. For this reason, potato cutters were accompanied with different cutters which are affixed depending on the desired use. Yet still, some equipment such as popcorn machines and sausage warmers were fitted with parts that enable mobility for vending purposes. There were also innovations involving the introduction of potato handling machines capable of handling multiple tasks including peeling, washing, and cutting. Although not so widespread (already introduced by one enterprise and in trial in two other enterprises), this particular innovation aimed to automate potato handling processes. Furthermore, it may cost less to buy a single machine rather than purchase many machines for different tasks. Similar innovations were also noted on grain milling equipment. For example, besides the conventional posho mill, some enterprises reported introducing grain milling equipment capable of shelling and grinding to produce sifted maize meal. Other enterprises had also introduced milling equipment capable of splitting and rolling maize for feeds and oil extraction respectively.

Finally, our study established a number of innovations relating to energy use and efficiency. One particular innovation in this regard was the introduction of a modified popcorn machine operating on three switches as opposed to the conventional popcorn machines which operate on a single switch. The idea behind the innovation was to ensure efficiency in energy use. Unlike the single switch machine where light bulb, element and mortar run simultaneously, in the modified version, the switches are operated independently. For instance, the switch for the light bulb operates only at night while the switch operating the mortar is put on only after the corn is fully cooked and ready to be pushed up into the collecting container. This ensures energy is not only saved but also efficiently used. Other energy related innovations included manually operated dough mixer and potato cutters intended for use in areas without electricity connection, deep fryers fitted with automatic temperature control devices, and food warmers capable of using varied energy sources such as charcoal, gas, or electricity.

In line with the definition of product innovation adopted by this study, data was sought on the contribution of innovation products to total turnover in 2012. The findings showed that products that were only marginally modified accounted for about a half (50.5 percent) of the turnover followed by significantly improved products at 41.6 percent. The contribution of new products to turnover was modest at only 19.57 percent on average. On one hand, the prevalence of slightly improved products may indicate predominance of an imitation strategy, it may also suggest a lack of incentive to invest time and resources to introduce significantly improved products that are soon copied by other MSEs. Nonetheless, MSEs may stay ahead of competition by introducing highly differentiated products.

4.3.4 Efforts at Innovation

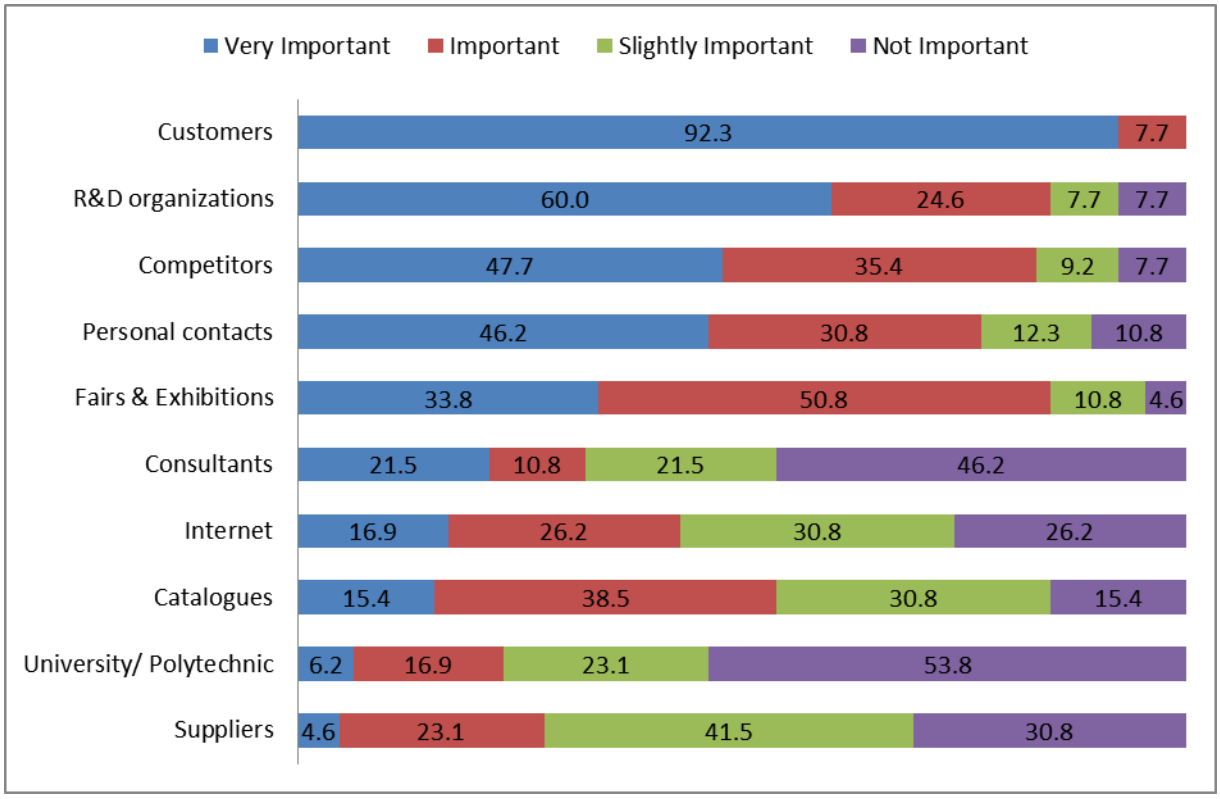
This study also sought information on incomplete innovation projects as a way of establishing efforts at innovation. The study found that 44.6 percent of the enterprises reported incomplete innovations in various categories. Almost a half (48.2 percent) of the incomplete innovations was abandoned at initiation stage (never started), 31 percent abandoned along the way while 20.7 percent took longer time than anticipated. The study also established varied reasons for the state of incomplete innovations. Insufficient technical know-how was cited as the main reason by 44.8 percent of the respondents, financial constraints (27.6 percent), and limited demand (17.2 percent). Another 10.3 percent of the respondents cited withdrawal of support for innovation by a Non-Governmental Organization (NGO) and loss of a key skilled worker behind the project as constraining factors. The findings on incomplete innovation projects not only point to some of the innovation-related constraints MSEs face, but also possible intervention areas by government and stakeholders.

4.3.5 Sources of Innovation Ideas

Regarding external sources of innovation ideas, respondents were asked to rank the various sources of innovation ideas in terms of importance. According to the findings, the five very important sources of innovation ideas were Customers (92.3), R&D organizations (60 percent), Competitors (47.7 percent), Personal Contacts (46.2 percent),

and fairs and exhibitions (33.8 percent). Although ranked modestly, the respondents also cited internet (16.9 percent) and catalogues (15.4 percent) (see Figure 4.7). The study also established some of the sources that were ranked lowly in terms of importance such as knowledge institutions (53.8 percent); technical consultants (46.2 percent); and suppliers (30.8 percent). More importantly, the finding regarding use of multiple information sources confirms past studies (Amara and Landry, 2005).

Figure 4.7: Important Sources of Innovation Ideas



Source: Survey Data, 2013.

Further correlation tests on source of idea and product innovation revealed some interesting observations. Regarding type of innovation, the effect of sourcing ideas from customers, competitors, consultants, R&D organizations, Exhibitions and Catalogues was positive (see Table 4.4). On the other hand ideas from personal contacts, suppliers, knowledge institutions and internet negatively correlated with innovation type. In terms of degree of novelty, ideas from competitors, technical consultants, knowledge institutions, fairs and exhibitions and internet had a positive effect. This finding supports

past studies (Littunen, 2010) which found that freely accessible information from fairs, exhibitions, media and internet were positively associated with introduction of novel product innovations. In particular, North and Smallbone (2000) posit that lack of suitable network partners and innovation support services forces firms to rely on the generally available information sources. Conversely, sourcing ideas from personal contacts, customers, and R&D organizations had a negatively correlation. In particular, the effect of ideas from personal contacts on novelty was negative but significant at the 0.01 level (see Table 4.4).

Table 4.4: Correlations for Important Sources of Innovation Ideas

Variable		Type of Innovation	Sig. (2-tailed)	Degree of Novelty	Sig. (2-tailed)
Personal Contacts	Correlation Coefficient	-.002	.876	-.355**	.004
Customers	Correlation Coefficient	.118	.351	-.144	.251
Suppliers	Correlation Coefficient	-.040	.753	-.071	.576
Competitors	Correlation Coefficient	.067	.596	.115	.363
Technical Consultants	Correlation Coefficient	.161	.200	.023	.856
University/ Polytechnic	Correlation Coefficient	-.018	.888	.050	.695
R&D Organizations	Correlation Coefficient	.034	.787	-.051	.684
Fairs and Exhibitions	Correlation Coefficient	.077	.544	.156	.213
Internet	Correlation Coefficient	-.020	.874	.065	.608
Catalogues and Magazines	Correlation Coefficient	.157	.211	-.118	.348

N=65 **. Correlation is significant at the 0.01 level (2-tailed)

Source: Survey Data, 2013.

4.4 Nature and Type of External Linkages

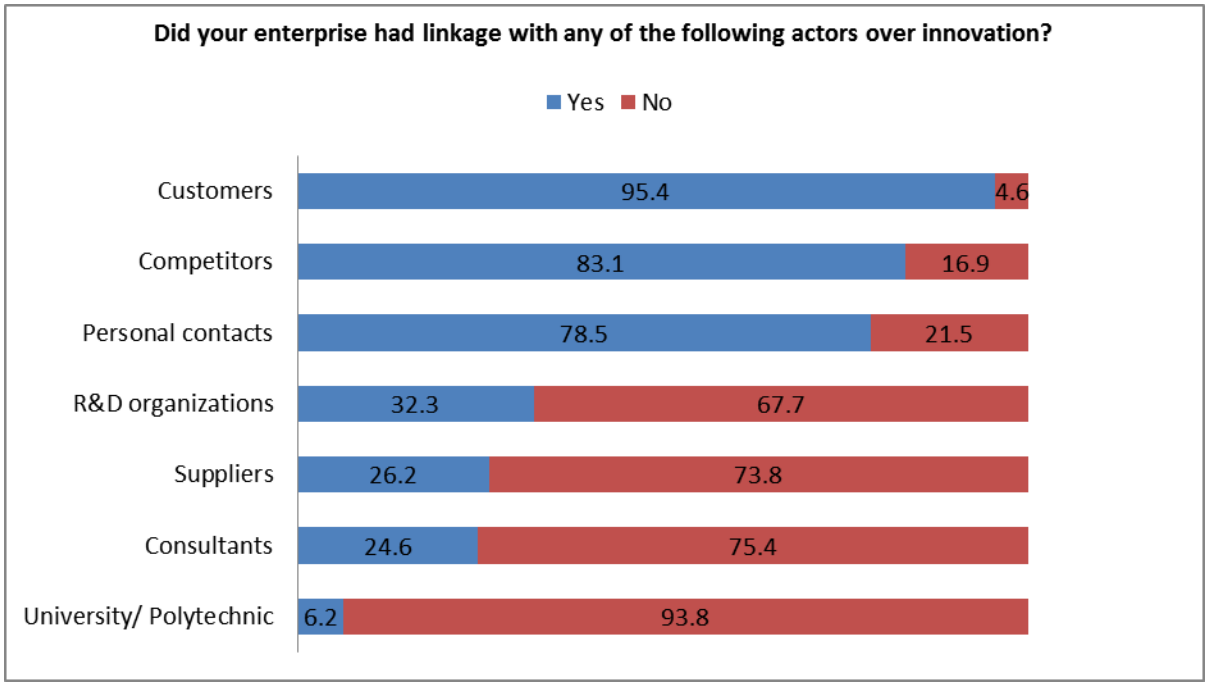
The third research objective was to investigate the nature and type of external linkages. Information on type, perceived importance, total number of linkages, use of linkage, duration and strength of linkage, and search strategy were sought.

4.4.1 Types and Importance of External Partners

The respondents were asked to state the various external partners with whom they had innovation related linkages. As shown in Figure 4.8, majority (95.4 percent) of the respondents reported linkage with customers followed by competitors (83.1 percent). Over two thirds (78.5 percent) of the respondents had linkages with personal contacts

while about a third (32.3 percent) linked with R&D organizations. The study also revealed fewer linkages with suppliers and technical consultants at 26.2 percent 24.6 percent respectively. Moreover, only a small number (6.2 percent) of respondents reported linkages with knowledge institutions such as technical institutes, polytechnics and universities. The latter finding largely supports earlier studies (Kinyanjui, 2007; Oyelaran-Oyeyinka *et al*., 1996; Mathews, 1991).

Figure 4.8: External Linkage by Type of Partner



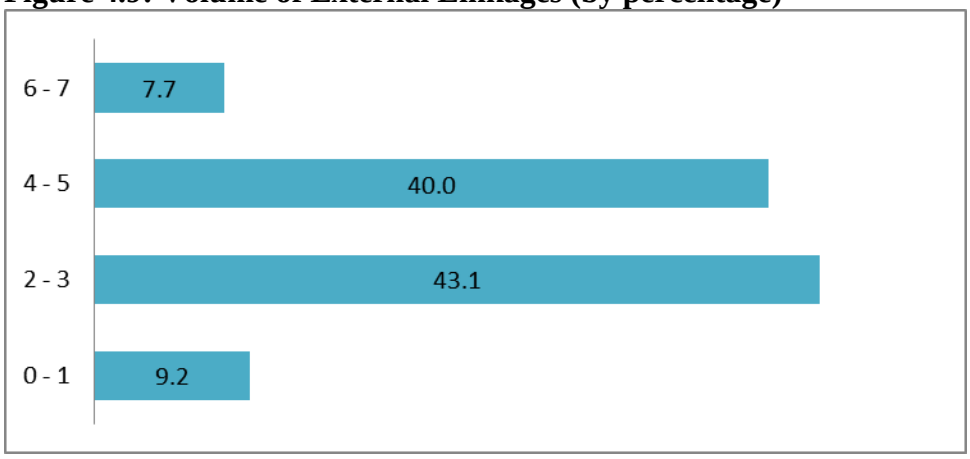
Source: Survey Data, 2013.

4.4.2 Volume of External Linkages

Regarding the number of external linkages, the study established that the minimum number of external linkages was 0 while the maximum was 6. The average number of linkages was 3.5. Regarding the distribution of number of linkages, majority (43.1 percent) of respondents had 2 – 3 external linkages followed by 40.0 percent with 4 – 5 linkages. The number of enterprises with more than 5 external linkages was modest at only 7.7 percent (see Figure 4.9). This finding points to the existence of multiple linkages in majority of the enterprises. The need for flexibility and desire to gain diverse technical knowhow is one possible explanation for this inclination although the study findings

could not however validate this position. Correlation test further revealed that the number of external linkages positively associated with type of innovation on one hand, but negatively correlated with degree of novelty on the other hand. The current study could not however find support for past studies (Laursen and Salter, 2006) which found that the breadth of the firm's external search strategies is beneficial only up to a certain level.

Figure 4.9: Volume of External Linkages (by percentage)



Source: Survey Data, 2013.

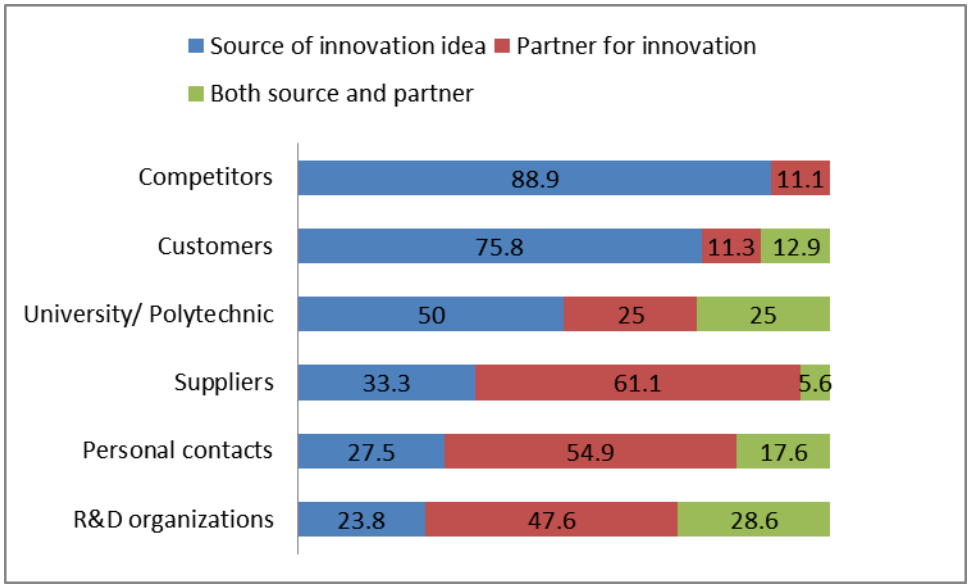
4.4.3 Use of External Linkages

Respondents were asked to state how they used the various external linkages. Competitors were used by a good majority (88.9 percent) of enterprises mainly as sources of innovation idea, customers (75.8 percent), and R&D Organizations (50.0 percent). Other sources of innovation ideas were suppliers (35.3 percent), personal contacts (27.5 percent), and knowledge institutions (23.8 percent) (see Figure 4.10). None of the enterprises sourced innovation ideas from technical consultants. Consistent with literature (Evangelista, 2000; DeJong and Marsili, 2006; Freel, 2000b; Salter and Martin, 2001), customer suggestions and complaints regarding use and performance of food processing equipment provided useful insights for further modification and re-innovation. Surprisingly, only a few customers participated in product innovation beyond contributing ideas for innovation. Notably, the respondents used a variety of informal ways to extract innovative ideas from competitors including visiting their showrooms and

purchasing products from competitors to explore possibilities of reverse engineering. The excerpt below further illustrates this observation:

"..to succeed in fabrication work, one must have a keen eye on what competitors are doing. Although our linkage with competitors is informal, the benefits are enormous. In particular, Chinese products offer us with an opportunity to imitate and produce products which are more durable and affordable to the local clientele. I frequently visit their showrooms to look keenly at their products before I come back to my workshop to produce a similar one (product)". (Respondent 55, 24 November).

Figure 4.10: Use of External Linkage



Source: Survey Data, 2013.

Regarding partners for innovation, the findings showed some variations. As shown in Figure 4.10, suppliers were the most preferred partner for innovation (64.7 percent) followed by personal contacts (54.9 percent), and consultants and R&D organizations (50.0 percent each). Only a modest number (11.9 percent) of enterprises used competitors and customers (11.3 percent) as partners for innovation. This latter finding was particularly important in that while competitors and customers were the most preferred sources of innovation ideas, very few firms partnered with them for product innovation. A possible explanation could be the fact that even though customer complaints may suggest improvements on products, customers lack the knowhow required in the

implementation of the suggested innovations. Likewise, issues of imitation may encourage enterprises to informally extract valuable innovation ideas from competitors rather than engage in structured collaboration over innovation. In this case, linkages with actors largely seen as non-competitors (such as suppliers, consultants, knowledge institutions, and R&D organizations) were preferred. Further still, some external linkages were used both as source of innovation idea and partner for innovation. In this regard, consultants and knowledge institutions were the most preferred by a half (50.0 percent) and 28.6 percent of the respondents respectively.

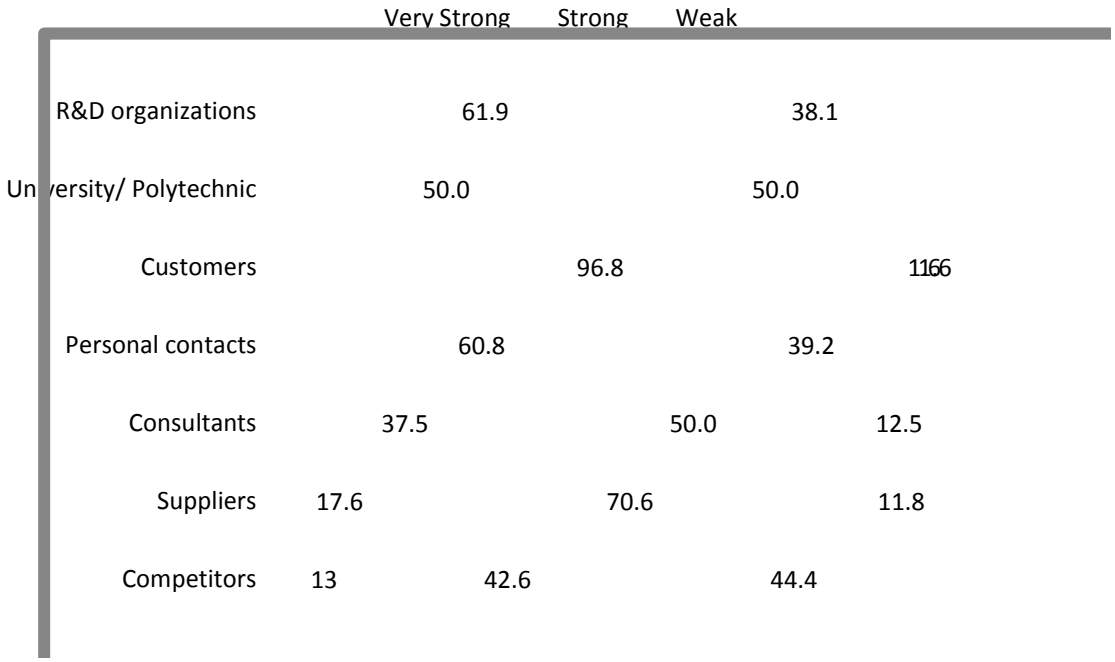
4.4.4 Duration and Strength of External Linkages

Study findings on the duration of external linkages showed that the duration of linkage varied from one external partner to another. On average, linkage with personal contacts had the highest mean duration of 20.9 years, customers 18.2 years, competitors 12.3 years, suppliers 10.7 years, and R&D organizations 9.1 years. The mean duration of linkage with knowledge institutions and technical consultants was the shortest at 6.8 years and 4.5 years respectively.

Regarding strength of linkage, majority (96.8 percent) of the respondents reported linkage with customers as very strong followed by personal contacts (60.8 percent), consultants (37.5 percent), and suppliers (17.3 percent). Conversely, a half (50.0 percent) of the respondents considered linkage with knowledge institutions as weak followed by competitors (44.4 percent) (see Figure 4.11). Although a weak linkage with knowledge institutions was anticipated (Kinyanjui, 2007), the finding regarding R&D organizations was of particular interest given that the supposed primary function of some of these agencies (such as KIRDI) is to advance and disseminate industrial research in the sector. The weak linkage therefore may suggest a limited reach of these public agencies. Indeed, some of the respondents viewed KIRDI as a competitor rather than collaborator as illustrated by the excerpt below:

"…I am aware of public agencies financed to help us (MSEs) to develop and upgrade technologically. Unfortunately this has never happened, at least to the best of my knowledge. For example, although product standards can ensure that we fabricate high quality products; KEBS seems to serve the interests of large firms in Industrial Area. Majority of us are neither aware of existing equipment standards nor possess the knowhow to meet them. Likewise, KIRDI has abandoned their primary function of simplifying high technologies for us and we have no working relationship with KIRDI. Instead, their products compete with us in the market". (Respondent 46, 18 November, 2013).

Figure 4.11: Strength of Linkage



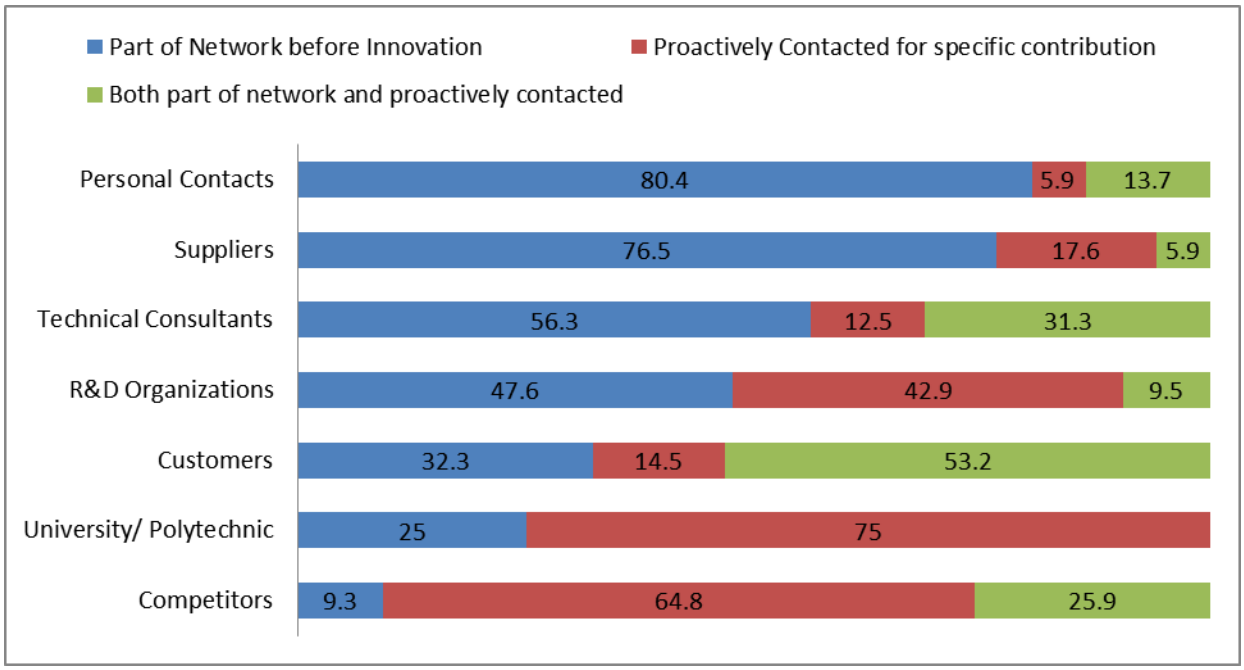
Source: Survey, 2013.

4.4.5 Search Strategy for External Linkages

Respondents were asked to state the search strategy for external linkages. The reasoning here was that enterprises with a more proactive search strategy would be more innovative than those who rely mostly on existing networks (Ruef, 2002). Our study found that majority (80.4 percent) of personal contacts were already part of the network compared with suppliers (76.4 percent), and consultants (56.2 percent). In terms of a proactive search for linkage, knowledge institutions had the highest percentage (75.0 percent), competitors (64.8 percent) and R&D organizations (42.8 percent) (see Figure 4.12). This

finding was particularly important as it suggested a strong urge by enterprises to identify and extract valuable innovation knowledge from linkages outside the supply chain and existing networks.

Figure 4.12: Search for External Linkage



Source: Survey Data, 2013.

4.5 External Linkage and Product Innovation

The fourth objective of the study was to establish the effect of external linkages on product innovation. To this end, non-parametric correlation tests were calculated to measure both the strength and direction of the association between the external linkages variables and the various aspects of product innovation. External linkages were explored in terms of type of partner, volume of and use of linkage, duration and strength, and search strategy while product innovation was investigated in terms of type and degree of novelty.

4.5.1 External Linkage and Type of Product Innovation

The study conceptualized type of innovation in terms of whether an enterprise introduced a new, significantly improved or marginally modified product. Non-parametric

correlations were then established for each innovation variable against dimensions of external linkages.

The results of correlation analyses established that linking with competitors and technical consultants had a positive and significant (at the 0.05 level) association with type of innovation (see Table 4.5). The other external partners such customers, knowledge institutions and R&D organizations, although not significant, also positively correlated with type of innovation. Although this finding supports past works (Arku, 2002; Freel, 2000b; Keeble *et al*., 1998; Rothwell and Dodgson, 1991), in particular, it contrasts previous studies that found knowledge drawn from knowledge institutions as less targeted to a firm's requirements (Cohen and Levinthal, 1990). The correlation for volume of linkage was positive for type of innovation but negative for novelty suggesting that enterprises that engaged in linkages with multiple external partners were more likely to introduce new or significantly improved products than enterprises engaged in few linkages. The finding on effect of volume of linkages on innovation were largely in line with previous studies (DeJong and Hulsink, 2012; Freel, 2003; Tether, 2002).

Table 4.5: Correlations for Type of External Linkage

External Partner		**Type of Innovation**	**Sig. (2-tailed)**	**Degree of Novelty**	**Sig. (2-tailed)**
Personal Contacts	Correlation Coefficient	-.087	.491	-.206	.100
Customers	Correlation Coefficient	.166	.186	.110	.383
Suppliers	Correlation Coefficient	-.176	.160	-.123	.331
Competitors	Correlation Coefficient	.274*	.027	-.082	.516
Technical Consultants	Correlation Coefficient	.269*	.030	.071	.572
University/ Polytechnic	Correlation Coefficient	.098	.438	.192	.125
R&D Organizations	Correlation Coefficient	.009	.941	.066	.603
Volume of Linkages	Correlation Coefficient	.077	.540	-.085	.503

N=65 *. Correlation is significant at the 0.05 level (2-tailed)

Source: Survey Data, 2013.

Statistical relationships were also established between type of innovation and whether the partners were used as source of idea or partner in innovation. The study found that the nature of linkage with R&D organizations and competitors had a significant (at the 0.05

level) but negative correlation with innovation type (see Table 4.6). The association between nature of link with R&D organization and innovation type was particularly strong. Conversely, nature of linkage with customers, suppliers, consultants and knowledge institutions positively affected innovation type. In particular, nature of linkage with suppliers had the strongest positive effect.

Table 4.6: Correlations for Nature of External Linkage

Variable		N	Type of Innovation	Sig. (2-tailed)	Degree of Novelty	Sig. (2-tailed)
Personal Contacts	Correlation Coefficient	51	-.172	.226	.136	.340
Customers	Correlation Coefficient	62	.206	.108	.257*	.044
Suppliers	Correlation Coefficient	18	.299	.228	-.139	.582
Competitors	Correlation Coefficient	54	-.313*	.021	-.017	.904
Technical Consultants	Correlation Coefficient	16	.104	.702	.289	.278
University/ Polytechnic	Correlation Coefficient	4	.056	.944	-.236	.764
R&D Organizations	Correlation Coefficient	21	-.538*	.012	-.349	.121

*. Correlation is significant at the 0.05 level (2-tailed)

Source: Survey Data, 2013.

Regarding the effect of linkage duration, the study established a negative association between type of innovation and duration of linkage with most partners except suppliers and knowledge institutions (see Appendix II). In particular, there was a large, although not significant correlation between duration of linkage with knowledge institutions and type of innovation suggesting a strong association between the variables. The finding further implies that enterprises need a long time to apply knowledge sourced from learning institutions and hence the need for long-term linkages. Conversely duration of link with competitors had the weakest but negative relationship with type of innovation suggesting the preference of short-term or even informal extraction of ideas from competitors in the absence of a linkage.

Moreover, the effect of the perceived strength of linkage on type of innovation was also negative for most external partners except for R&D organizations (see Appendix III). In particular, the correlation was largest for knowledge institutions suggesting a strong negative although not significant relationship between the two variables. Strength of linkage with competitors had the least effect on type of innovation implying the ability of

enterprises to informally extract innovative ideas from competitors without the need for strong linkages.

The study also established the effect of a proactive search of external partners on type of innovation. In particular, only a proactive search for personal contacts had a significant (at the 0.05 level) and positive correlation with type of innovation (see Table 4.7). Indeed a proactive search for most external partners positively associated with innovation type except knowledge institutions which was negative. The significant relationship between search of personal contacts and innovation type may suggest the need for MSE proprietors to expand their search beyond existing informal networks of friends and relatives. There was however no association between search of suppliers and type of innovation. The latter finding accords enterprises freedom to engage even with suppliers within established networks without necessarily affecting product innovation.

Table 4.7: Correlations for Search Strategy of Linkage

Variable		N	Type of Innovation	Sig. (2-tailed)	Degree of Novelty	Sig. (2-tailed)
Personal Contacts	Correlation Coefficient	51	.322*	.021	-.212	.135
Customers	Correlation Coefficient	62	.045	.727	-.041	.755
Suppliers	Correlation Coefficient	17	0	1	-.201	.439
Competitors	Correlation Coefficient	54	.265	.053	-.058	.676
Technical Consultants	Correlation Coefficient	16	.317	.232	-.176	.515
University/ Polytechnic	Correlation Coefficient	4	-.544	.456	-.577	.423
R&D Organizations	Correlation Coefficient	21	.059	.799	.327	.147

*. Correlation is significant at the 0.05 level (2-tailed)

Source: Survey Data, 2013.

4.5.2 External Linkage and Degree of Novelty

The study also considered the relationship between dimensions of external linkages and degree of novelty (whether the product innovations were new to the firm, new to the industry or new to the world). First, respondents were asked to state the perceived effect of ideas from various sources on innovation novelty. The reasoning here was that extraction of ideas from external sources may happen even in the absence of a linkage. In

this regard, the study revealed that only ideas from competitors, consultants, knowledge institutions, exhibitions and internet seemed to contribute positively to novelty (see Table 4.4). This finding is consistent with earlier works (Littunen, 2010) that noted the importance of ideas from freely accessible sources (such as fairs, exhibitions and internet) to the introduction of novel product innovations. On the other hand, sources of ideas such as personal contacts, customers, suppliers, and catalogues negatively affected novelty. In particular, the sourcing of ideas from personal contacts had a significant (at the 0.01 level) effect on novelty.

Regarding the effect of external linkages on novelty, study findings revealed that linking with personal contacts, suppliers and competitors negatively affected degree of novelty (see Table 4.5) suggesting that enterprises engaging with these partners introduce products largely new only to the firm through an imitation strategy. In particular, link with personal contacts had the greatest negative effect on novelty. On the other hand, linkage with customers, consultants, knowledge institutions and R&D organizations positively affects novelty. The link with knowledge institutions had the strongest positive effect on novelty. Further still, the volume of linkage was found to negatively affect novelty suggesting that enterprises need to draw innovation ideas deeply from only a few external links to improve the likelihood of implementing high degree product innovations.

In terms of the association between nature of linkage and novelty, the study established that nature of link with personal contacts, customers and technical consultants to be positive (see Table 4.6) suggesting that novelty increases when these partners are used as both source and partner in product innovation projects rather than simply sources of innovation ideas. In particular, the correlation between novelty and nature of link with customers was strongest and statistically significant at the 0.05 level. Conversely the effect on novelty was negative for nature of link with suppliers, competitors, knowledge institutions and R&D organizations implying that these actors contribute to novelty only when used as sources of ideas. This particular finding may suggest the inability of enterprises to translate the largely tacit innovation knowledge possessed by these partners

into novel product innovations. Instead, enterprises apply such knowledge incrementally rather than radically.

The study also established relationships between duration of linkage and novelty. Although not significant, the correlations suggest that the effect of duration of linkage on novelty was negative for most external partners except for knowledge institutions (see Appendix II) implying that the prevalence of long-term linkages with most external partners limit introduction of novel innovations. Indeed duration of link with knowledge institutions had the strongest positive effect on novelty implying that enterprises require long-term linkages with knowledge institutions in order to benefit from transfer of tacit technical know-how inherent in such interactions.

Regarding the effect of strength of linkage, the study established that degree of novelty appeared to decrease with increase in strength of linkage for customers and suppliers but increased for personal contacts, competitors, technical consultants and R&D organizations (see Table Appendix III). There was however no correlation between novelty and strength of link with knowledge institutions implying the possibility of benefiting from such institutions without necessarily cultivating strong links.

Further still, the study investigated the effect of search strategy (whether external partners were proactively contacted) on novelty. The correlations were negative for most partners except for R&D organizations (see Table 4.7) suggesting that novelty seems to only increase when innovation ideas are extracted from proactively contacted R&D organizations rather than using only existing networks. In other words, only a deliberate search for research output from R&D organizations improves novelty of innovations.

CHAPTER FIVE
SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

The previous chapter presented the study findings for the four research questions. It has also demonstrated how the current research findings connect with extant literature, practice and theory. This chapter gives a snapshot of the different aspects of the project paper, reviews the main findings, and discusses the implications thereof. Further still, the chapter draws conclusions based on the study findings and propose recommendations for policy and further research.

5.2 Summary of the Findings

This study revealed a number of food processing equipment fabricating MSEs characteristics worth noting. In terms of size, there was preponderance of micro enterprises in the sector and a tendency of proprietors to perceive their enterprises as small or medium rather than micro. There was also evidence of a strong entrepreneurial drive in the sector as shown by a good number of enterprises established either as first time businesses or spin-offs. The study also established task differentiation based on gender in MSEs with female employees.

Training in the sector was mainly experiential through apprenticeship which was also the mode of mode of intergenerational transfer of knowledge and skills. Similarly, findings that a third of the proprietors had youth polytechnic training may give considerable credence to the role of such institutions in the development of requisite foundational skills for the sector. Moreover, some respondents view the collapse of such institutions as detrimental to the sector. In terms of market and marketing, MSEs sell unbranded products mainly the domestic market as revealed by the lack of labels on products. The study revealed that exportation to the regional market was mainly through middlemen making it difficult to ascertain the actual number of MSEs engaged in direct importation. Moreover, regional exhibitions appeared to facilitate access. Qualitative information from

respondents suggests that the use of middlemen eliminates the possibility of extracting useful innovation ideas directly from customers for purposes of innovation.

The study established a number of innovations introduced by enterprises such as material saving techniques; use of alternative material; and versatility in functionality and energy use. Importantly, these innovations did not just happen but were driven by market and cost considerations such as producing cheap versions of products for the low-end market or products capable of performing multiple functions. Similarly, proprietors pursued different innovation objectives. In particular, extending product range had a significant effect on type of innovation. Other notable innovations included introducing manually operated or power driven products to target users in locations without electricity; fitting products with parts for mobility and hence allow vending; and introducing products capable of performing multiple functions. In particular, customer specifications, extending product range and use of alternative material were the main considerations. Indeed, extending product range had a positive and statistically significant correlation with innovation type while replacing out-dated products and meeting customer specification both had a negative effect on novelty. Contrastingly, meeting standards and regulations, improving product quality were largely considered not important.

Study findings revealed the tendency of enterprises to tap innovation ideas from multiple sources including internet, exhibitions, and catalogues. In particular, ideas from personal contacts negatively, but significantly affected degree of novelty. Some of the sources proprietors regarded as important were customers, R&D organizations and competitors. Suppliers, knowledge institutions and catalogues were however least used as sources of innovation ideas. However, only ideas from competitors, consultants, knowledge institutions, exhibitions and internet seemed to contribute positively to novelty. In particular, there was a significant and negative correlation between ideas from personal and novelty.

The study revealed the prevalence of multiple linkages such that majority of enterprises linked with between two and five external partners. Linking with competitors and

technical consultants significantly correlated with innovation type. Although the effect of in-direct linkages to formal enterprises through employee movement was not significant, qualitative responses established their importance. In other words, that such links provide a conduit for transfer of knowledge and skills to the sector.

Regarding the importance of number of linkages, qualitative information gave some support. Generally proprietors tended to link with and draw deeply from only a small number of key sources to implement novel innovations. On the other hand, making significant improvements on products may require ideas residing in a variety of external sources. Consequently enterprises need to scan across a wide variety of sources for new permutations of existing knowledge. This finding implies that while introducing product innovations may require enterprises to establish multiple linkages, novelty only increases when ideas are deeply drawn from a few external links hence the need for strategic differentiation between simply being innovative or improving novelty.

The study also established variations in the use of external linkages. Specifically, the nature of link with competitors or R&D organizations significantly correlated with type of innovation while the nature of link with customers significantly affected novelty. The finding suggests potential innovation benefits arising out of partnering with competitors and customers for innovations. Proprietors may therefore need to change the current tendency to use customers merely as source of ideas, to collaborating with them in implementing the suggested improvements.

Our study also draws a number of observations regarding duration and perceived strength of external linkages. The study found a variation in the mean duration of linkage by type of external partner. In particular, the duration of linkage was highest for personal contacts and customers compared to technical consultants and knowledge institutions which seemed to be a more recent phenomenon. Similarly, enterprises perceived strength of their linkage to be strongest for customers and personal contacts but weakest for knowledge institutions and competitors. Although weak linkage with knowledge institutions was anticipated, that of R&D organizations was of particular importance

noting their role in the advancement and dissemination of industrial research output in the sector. This finding may suggest either a lack of understanding of the role of these public agencies or inability of enterprises to access their services. In some instances, some enterprises perceived KIRDI as a competitor rather than a collaborator.

The duration of linkage with suppliers and knowledge institutions had a negative effect on type of innovation. In particular, duration of linkage with knowledge institutions had the strongest effect on type of innovation. The tacit nature of knowledge possessed by these institutions partly explains the need for long-term linkages as opposed to one-off links. The effect of perceived strength of linkage on type of innovation was negative for most partners except R&D organizations which had the strongest positive effect. This finding may call for ways of fostering closer working relationships with public research and standards agencies such as KIRDI and KEBS as a way of boosting product innovation. Conversely the strength of linkage with competitors had the least negative effect on type of innovation suggesting the ability of enterprises to informally extract ideas without necessarily building strong links with competitors.

Regarding novelty, the effect of duration of linkage was negative for most partners except knowledge institutions. Consequently, the prevalence of long-term linkages observed hinder introduction of novel innovations. Novelty also seemed to decrease with increase in perceived strength of linkage especially with customers and suppliers but improves for personal contacts, competitors, technical consultants and R&D organizations. There was however no correlation between strength of linkage with knowledge institutions and novelty allowing enterprises to benefit even from weak linkages.

The study further established that enterprises used a mix of proactively searched linkages and existing personal networks. Notably some enterprises exhibited an open orientation towards seeking ideas from outside existing networks. Personal contacts, suppliers and consultants were mainly from existing networks while ideas from knowledge institutions, competitors and R&D organizations were proactively sought. On the one hand, a deliberate search of ideas from majority of external partners was found to positively

affect type of innovation. In particular, only the correlation between a proactive search of personal contacts and type of innovation was statistically significant suggesting the need for enterprises to seek innovation ideas beyond established personal networks. Similarly a proactive search of ideas from R&D organizations had a positive effect on novelty.

5.3 Conclusions

This study came up with a number of observations on the effect of external linkages and product innovation in equipment fabricating MSEs. Study findings not only confirmed some of what theory and literature say but also highlighted further insights particularly on aspects of external linkages which impact type and novelty of innovation. Firstly, the study revealed a number of innovation activities as well as the pervasiveness of external linkages in the equipment fabrication sector. In other words, enterprises tend to rely more on the environment than internal sources for innovation ideas and knowledge. Secondly, the effect of external linkages differ markedly for innovation type and novelty and hence the need for studies to clearly distinguish the two related aspects of innovation. Thirdly, actors in the national system of innovation such as knowledge institutions, R&D and standards organizations need to play a more active role in areas of research, technology brokering and technical assistance than currently observed in the sector. Finally the current conversion of many middle-level technical institutes into universities is negative to development of practical skills for the sector.

5.4 Recommendations

The findings of this study have imperative implications for the improvement of interventions geared towards encouraging innovation in MSEs in general and equipment fabrication sector in particular. Potential areas for further research in the field of innovation in MSEs are also suggested.

5.4.1 Recommendations for Public Agencies and Policymakers

Based on the study, some general and specific policy implications could be drawn, but they are by no means uniformly applicable across enterprise-size spectrum.

Consequently, the policy design and implementation have to be well-thought through to fit into the specific contexts. Some of the recommendations include:

First and foremost, the unawareness of most enterprises about numerous innovation opportunities stemming from expired patents needs to be addressed. KIPI should create more awareness about their services and develop a working relationship with the sector as a way of deepening knowledge about how such innovations opportunities can be exploited. Similarly, KIRDI should activate linkage with the sector to change being perceived by MSEs as a competitor rather than a collaborator. To this end, KIRDI should intensify research geared towards the technological needs of the sector and share research output with MSEs. Interventions in the areas of industrial training and incubation programmes are recommended. Moreover, this is consistent with their mandate towards industrial research and development.

Product standards and regulations can trigger product innovation in the fabrication sector. However, the low awareness regarding these standards and weak linkages jointly negate this important association. Consequently, with many proprietors perceive product standards as a constraint rather than a facilitator of innovation. To this end, KEBS may consider developing local standards for food processing equipment and offer technical assistance towards compliance.

The study also revealed over-reliance on experienced artisans for training and intergenerational transfer of skills. Although this model seemed to have filled an important gap in technical skills acquisition, it potentially locks the apprentices into performing certain tasks only. Efforts should therefore focus on lifelong training of these trainers of upgrading their stock of knowledge and keeping them informed about new techniques. In this regard, interventions should also focus fostering close linkages between knowledge institutions and public agencies such as Directorate of Industrial Training. Students in learning institutions may also be encouraged to undergo internship and carry out projects tuned towards the unique needs of the sector as a way of integrating the learning processes in the sector with learning institutions. Specifically,

these interventions need to augment rather than replace existing peer-learning networks in the sector.

Currently, the regional market is the single most important export market. However, access to export markets is still a challenge to most MSE owners who depend on limited sponsorship opportunities to attend the regional exhibitions. Moreover, access to these markets is through middlemen which potentially limit innovation opportunities. The study recommends interventions not only aimed at organizing more local and international exhibitions but also expanding sponsorship opportunities for local enterprises to allow proprietors tap into and adapt foreign technologies into the local contexts. On the other hand, proprietors need to exploit marketing opportunities stemming from product branding.

Study findings also point towards the need for re-orientations of institutional regime particularly in the areas of product quality and standards enforcement. Currently, most proprietors view standards and regulations as innovation constraining rather than innovation enhancing factor. Standards enforcement agencies should take cognizance of the challenges of MSEs regarding compliance and put in place measures aimed at offering the requisite technical assistance. Similarly interventions should also focus on building capacity of *Jua Kali* Associations to orient them towards entrepreneurial concerns. They should also be encouraged to have linkages with other local private sector associations. The current placement of the sector under the Ministry of Labour rather than Industrialization and Enterprise Development requires attention.

Finally, enterprises are constrained by lack of or poor delivery of basic services such as water and sanitation, access roads, lighting and power. Interventions should focus on improving the physical landscape of the clusters as a way of attracting more investors as well as customers. The government needs to designate more space for the artisans while development agencies and private sector collaborate to provide modern equipment that can be used jointly by the artisans at an affordable fee.

5.4.2 Recommendations for Further Research

Although the findings of this study provide useful insights regarding the effect of external linkages and product innovation, it also revealed gaps in knowledge which future research may seek to address. Importantly, the current study focused on the experiential level. Future studies may look into the more processes involved in translating external ideas into innovation knowledge and products. Similarly, while this study acknowledges the importance of internal sources of innovation knowledge, it only investigated the external linkages which may appear to downplay internal sources. Future studies integrating both internal and external sources of innovation knowledge are welcome.

Finally, although the current study recognizes a dispersed location of fabricating enterprises outside of the known clusters, it only focused on product innovation in MSEs located in only a few areas in Nairobi. It is therefore recommended that future research should focus on a wider survey of enterprises across the size spectrum to give a broader perspective capable of generating inferential generalizations. Future studies should also look at both product and process innovation; look at customers in a disaggregated manner; and investigate factors responsible for the weak linkages with certain external actors.

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APPENDICES

Appendix I: Correlations for Enterprise Characteristics *(Spearman's rho)*

Variable		Type of Product Innovation	Sig. (2-tailed)	Degree of Novelty	Sig. (2-tailed)
Age of Enterprise	Correlation Coefficient	.003	.979	-.085	.500
Total Number of Employees	Correlation Coefficient	-.044	.725	-.024	.851
Presence of Apprentices	Correlation Coefficient	.219	.080	-.183	.145
Number of Apprentices	Correlation Coefficient	-.022	.879	.098	.501
Presence of Female Employees	Correlation Coefficient	.007	.958	.040	.754
Number of Female Employees	Correlation Coefficient	.093	.773	-.256	.422
Employment of Family Members	Correlation Coefficient	-.150	.234	.031	.808
Product Diversification	Correlation Coefficient	.204	.102	-.077	.541
Engagement in Export	Correlation Coefficient	-.094	.457	-.049	.700

N=65 except for Number of Apprentices and Number of Female Employees where N=50 and N=12 respectively.

Appendix II: Correlations for Duration of Linkage

Variable		N	Type of Innovation	Sig. (2-tailed)	Degree of Novelty	Sig. (2-tailed)
Personal Contacts	Correlation Coefficient	53	-.017	.903	-.119	.396
Customers	Correlation Coefficient	62	-.033	.796	-.074	.566
Suppliers	Correlation Coefficient	17	.383	.129	-.093	.721
Competitors	Correlation Coefficient	55	-.006	.962	-.128	.353
Technical Consultants	Correlation Coefficient	16	-.044	.872	-.016	.954
University/ Polytechnic	Correlation Coefficient	4	.738	.262	.447	.553
R&D Organizations	Correlation Coefficient	23	-.275	.205	-.208	.341

Appendix III: Correlations for Strength of Linkage

Variable		N	Type of Innovation	Sig. (2-tailed)	Degree of Novelty	Sig. (2-tailed)
Personal Contacts	Correlation Coefficient	51	-.102	.478	.015	.916
Customers	Correlation Coefficient	62	-.233	.069	-.134	.300
Suppliers	Correlation Coefficient	17	-.444	.074	-.046	.859
Competitors	Correlation Coefficient	54	-.050	.717	.178	.199
Technical Consultants	Correlation Coefficient	16	-.222	.409	.035	.899
University/ Polytechnic	Correlation Coefficient	4	-.943	.057	0	1
R&D Organizations	Correlation Coefficient	21	.301	.185	.208	.365

Appendix IV: Survey Questionnaire

Hello. My name is Peter K'Ochupe, a post graduate student at the Institute for Development Studies (IDS) of the University of Nairobi. I am carrying out research on the ***Effect of external linkages on product innovation in food processing equipment fabricating SMEs*** and your enterprise has been selected for the survey. I would appreciate if you spare about 40 minutes to answer some questions. Your identity and the information you volunteer will remain confidential. The findings of the study will be used in an M.A. Project Paper and therefore your cooperation is highly appreciated.

A. **BASIC DETAILS OF THE RESPONDENT**

1	Name of respondent	
2	Position in the enterprise	
3	Number of years with the enterprise	
4	Gender	
5	Age of respondent	
6	Highest level of education attained	
7	Date of interview	

B. GENERAL INFORMATION ABOUT THE ENTERPRISE

8	Name of the enterprise	
9	Year of establishment	
10	Number of years the business has been operational	
11a	Location of the enterprise at start-up	
11b	Current location	

12 a) **How would you describe the size of this enterprise**? *1= Micro* *2= Small* ☐ *3= Medium-size* ☐ *3=Large* ☐

b) **What is the basis for your size categorization above?**

1= Number of employees ☐ 2= Capital invested ☐ 3= Total sales ☐

4= Other (*specify*) ☐

13. **Indicate the total as well as the number of different staff in this enterprise in 2012.**

Type of staff	**Number of staff**	**Gender**		*Tick as appropriate*	
		Male	Female	1=Local	2=Expatriate
1. Owners					
2. Management					
3. Administrative					
4. Technical					
5. Production (*supervisors, skilled & unskilled labourers*)					
6. Trainee/ Apprentices					
TOTAL					

14 a) **Are there family members employed in this enterprise?** 1= Yes ☐ 2= No ☐

b) **If YES, state the number and their positions in the enterprise**

Position in the enterprise	**Relationship**	**Number**
TOTAL		

15**. How would you describe the ownership status of this enterprise?**

1. Sole proprietorship ☐
2. Partnership (*state number of partners*) ☐
3. Independent Private Limited Company ☐
4. Independent Public Limited Company ☐
5. Part of an enterprise group ☐

16. **How did you begin this business?**

1. Established by self ☐
2. Bought from another person ☐
3. Bought from another business ☐
4. Inherited (*specify generation*)_____ ☐
5. Spin-off (*specify*)_____ ☐
6. Other (*specify*)_____

17. **Which of the following activities is the most important to your enterprise?**

1. Fabricating equipment ☐
2. Fabricating machinery ☐
3. Fabricating both equipment and machinery ☐
4. Other (*specify*)_____

18. **Indicate the products that this enterprise produces and their main market outlets.**

Product	**Product use**	**Main market**			
		1=Nairobi & environs	2=Other parts of Kenya (*specify*)	3=Export (*name countries*)	4=Both Kenya & export

C. PROPRIETOR ENTREPRENEURIAL BACKGROUND

19. **Gender of the owner** *1= Male* ☐ *2=Female* ☐

20. **Age of owner** (*state in years)* _____

21. **What is the highest education level attained?** *(Tick only one)*

Level of education	*Tick as appropriate*	**Level of education**	*Tick as appropriate*
1. No formal education		6. College certificate	
2.Less than full primary		7. College diploma	
3. Completed primary		8. University bachelors	
4. Some secondary		9. University masters	
5. Youth Polytechnic		10. Other (*specify*)	

22. **How would you describe your professional experience in this sector?**

1. Unrelated academic background (*specify*) _____
2. Related academic background (*specify*) _____
3. Work experience in the field (*state in years*) _____
4. A combination of academic and work experience _____

23 a) **How long have you been in the food processing equipment and machinery sector?**
(*state in years*) _____

b) **How would you describe your previous work experience before getting into this sector?**

1. Worked in unrelated sector (*specify*) _____
2. Worked in a related sector (*specify*) _____
3. Was made redundant (*specify*) _____
3. Had not worked anywhere _____

24. **Identify the main reason for deciding to engage in this business?**

1. To be own boss ☐
2. To use my past experience and training ☐
3. To create job for myself ☐
4. Flexibility for family life ☐

5. Could not find job appropriate for my background ☐
6. To increase my income ☐
7. *Other (specify)* _____

D. NATURE AND TYPE OF PRODUCT INNOVATION

25. **Describe the nature of product innovations introduced by this enterprise between 2011 and 2012 under the following sub-headings:**

Product	**Type of innovation** 1= New 2= Significantly improved	**Degree of novelty** 1= New to firm 2= New to industry 3= New to world	**Developed by** 1= Your enterprise 2= Other enterprises 3= Jointly	**Nature and purpose of innovation** (*probe in terms of new functional uses; use of new materials; new functional parts; other characteristics that enhance performance*)

26. **Indicate the total as well as the distribution of sales realized in 2011 and 2012 among the following product categories:** *(state in Kenya shillings)*

Product category	**Sales in Kshs**	**Percentage of total sales**
New products		
Significantly improved products		
Products that were unchanged or only marginally modified		
TOTAL SALES		**100%**

27. **Between 2011 and 2012, did this enterprise have any product innovation activities under the following categories?**

Product innovation activity	**Status** 1= Abandoned 2= Prolonged 3= Not even started 4= Other (*specify*)	**Reason responsible for the status**

E. OBJECTIVES AND SOURCES OF INNOVATION

28. **State the main objective behind each of your product innovations between 2011 and 2012.**

Product innovation	**Main objective for the innovation** (*probe for specific details*)

(*Probe under the following categories:* 1= Replace out-dated products 2= Improving product quality 3= Extend product range 4= Meet customer specifications 5= Open up new markets 6= To meet government regulations/ standards 7= Increase production capacity 8= Improve health and safety 9= Reduce materials consumption 10= To change from imported to local raw material 11= Reduce energy consumption 12= Reduce labour costs 13= Reduce environmental damage

29. **Between 2011 and 2012, did this enterprise have linkages with any of the following external partners and for what reason?**

Source of innovation idea	**Existence of linkage** *1= Yes 2= No*	**Reason for linkage**
1. Personal contacts		
2. Customers		
3. Suppliers		
4. Competitors		
5. Technical consultants		
6.Universities/ polytechnics		
7. R&D Organizations		
8. Other (*specify*)		

30. **Describe the following sources of innovation ideas in terms of usage and relative importance to product innovation in this enterprise.**

Source of innovation idea	**Usage by enterprise** *1= Yes 2= No*	**Relative importance to product innovation** *0= Not important at all 1= Slightly important 2= Important 3= Very important*
Personal contacts		
Customers		
Suppliers		
Competitors		
Technical consultants		
Universities or polytechnics		

R&D Organizations		
Fairs and exhibitions		
Computer databases/ internet		
Journals, magazines, catalogues		
Other (*specify*)		

31. **For each product innovation introduced by your enterprise, describe external linkages under the following subheadings:**

External partner 1= Personal contacts 2= customers 3= Suppliers 4= Competitors 5= Technical consultants 6= Universities/ Polytechnics 7= R&D Organizations 8= Other	**Geographical location** 1= Within Nairobi 2= Other parts of the country (specify) 3= Other countries (Specify)	**Duration of linkage in years**	**Strength of linkage** 1= Weak 2=Strong 3= Very strong	**Search process** 1= Already part of network 2= Proactively contacted for specific contribution	**Source of innovation impetus** 1=Enterprise 2=External partner 3= Jointly

F. RESOURCES DEVOTED TO INNOVATION ACTIVITIES IN 2011 AND 2012

32. **Which of the following innovation activities did this enterprise engage in during 2011 and 2012?**

Innovation activity	**Details of the innovation activity**
Intramural R&D (*estimate financial resources used*)	
Extramural R&D (*estimate financial resources used)*	
Acquisition of machinery and equipment for innovation (*name the machinery, cost and source*)	
Acquisition of external technology for product innovation (*name the technology, cost and source*)	
Training directly linked to product innovation (*specify training, number of personnel trained and agency)*	
Other (*specify*)	

33. **Does this enterprise have a specific, formal innovation strategy (a structure and process for making innovation happen)?** *1= Yes* ☐ *2=No* ☐

34. **Does this enterprise have a department/ unit for innovation projects?**
1= Yes ☐ *2=No* ☐

35 a) **Does this enterprise have technical staff responsible for innovation projects?**
1= Yes ☐ *2=No* ☐

b) **If YES, indicate the number and qualifications of the staff in the department.**

Staff position	**Number**	**Academic and professional qualification**
	TOTAL	

36 a) **Did this enterprise receive any support for innovation activities in 2011 and2012?**
1= Yes ☐ *2=No* ☐

b) **If YES, what were the source, form and magnitude of the support received?**

_____
_____
_____

THE END

THANK YOU FOR TAKING YOUR TIME TO PARTICIPATE IN THIS STUDY!

Appendix V: Key Informant Interview Guides

My name is Peter K'Ochupe, a post graduate student at the Institute for Development Studies of the University of Nairobi. I am carrying out research on the effect of external linkages on product innovation in food processing equipment and machinery manufacturers in Nairobi. I would appreciate if you spare about thirty minutes to answer some questions. Your identity and the information you provide will remain confidential and the information gathered will provide an important background and context for an M.A. Project Paper.

Key informant 1: Ministry of Industrialization

1. What is the role of the Ministry of Industrialization?
2. Describe the contribution of the Ministry to the development of local food processing equipment fabrication? (*i.e. what drives growth and challenges*)
3. What are the drivers and sources of innovation in the sector?
4. In what ways does the Ministry link with the sector?
5. How do these linkages contribute to innovation in the sector?

Key informant 2: Kamukunji Jua Kali Association

6. What is the role of the Association in general?
7. What is the current membership and what specific services does the Association provide to members?
8. Describe the origin and growth of local food processing equipment fabrication sector.
9. What kinds of linkages exist between the Association and other public and private agencies?
10. How do these linkages contribute to product innovation in the sector?

Key informant 3: Kenya Industrial Research and Development Institute (KIRDI)

11. What is the role of KIRDI?
12. What are the functions of KIRDI to the local food processing equipment sector?
13. What are the drivers and sources of innovation in the food processing equipment and fabrication sector?
14. What types of linkages exist between KIRDI and the local food processing equipment fabrication sector?
15. How do these linkages contribute to product innovation in the sector?

Key informant 4: Kenya Bureau of Standards (KEBS)

16. What is the role of KEBS in general?
17. What are the functions of KEBS to local food processing equipment and machinery sector?
18. In what ways does KEBS link with local food processing equipment and machinery sector?
19. How do these linkages contribute to product innovation in the sector? *i.e. what is the role of standards in product innovation?*

Key informant 5: Kenya Intellectual Property Institute (KIPI)

20. What is the role of KIPI in general?
21. What are the functions of KIPI to food processing equipment and machinery sector?
22. Describe the drivers and status of product innovation/ invention in food processing equipment and machinery sector? *(probe the state of patenting in the sector)*
23. In what ways does KIPI link with local manufacturers of food processing equipment and machinery?
24. How do these linkages contribute to product innovation in the sector?

Key informant 6: Faculty of Agriculture, University of Nairobi

25. What does the course in Food Engineering Systems entail? *(Describe in terms of target market)*
26. What are the common food processing equipment and machinery manufactured locally and how are they categorized?
27. What are the drivers and sources of innovation in the sector?
28. What types of linkages does your department have with the food processing equipment and machinery enterprises?
29. How do these linkages contribute to product innovation in the sector?

THE END

Thank you for participating in this study.

Name of officer: Designation:

Institution/ Organization: _____ Date of interview: _____