MODERN TECHNOLOGY ADOPTION TRENDS OF SMALL AND MEDIUM ELECTRICAL/ELECTRONICS MANUFACTURING ENTERPRISES REGISTERED IN NAIROBI.

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DECLARATION

This thesis is my original work and has not been presented for a degree in any other university or any other award.

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SUPERVISORS APPROVAL

We confirm that the work reported in this thesis was carried out by the candidate under our supervision.

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DEDICATIONS

I dedicate this work:

- First To my late mother, Zipora Wairimu Magu, whose love for and faith in me always made me want to achieve for her.

And

- To my family (my wife Njeri, my daughters Wairimu and Waithira, and my son Magu) whose resources and time I diverted to this study.

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ABBREVIATIONS AND ACRONYMS

CBS	Central Bureau of Statistics
CNC	Computer Numerical Controls
COMESA	Common Markets for East and South Africa
DIT	Directorate of Industrial Training
DRC	Democratic Republic of Congo
FDI	Foreign Direct Investment
FKE	Federation of Kenya Employers
FTZs	Free Trade Zones
GCG	Ghana Cyber Group
GDP	Gross Domestic Product
GOK	Government of Kenya
IBMA	International Batteries Manufacturing Association
ICEG	International Centre for Economic Growth
IEEE	International Electric and Electronics Engineers
IPC	Investment Promotion Centre
ISIC	International Standard Industrial Classification
ISO	International Standards Organization
KAM	Kenya Association of Manufacturers
KBS	Kenya Bureau of Statistics
KEREA	Kenya Renewable Energy Association
KIRDI	Kenya Industrial Research Development Institute.
KMES	Kenya Manufacturing Enterprise Survey
MLEs	Medium and Large Enterprises

MSEs	Micro and Small Enterprises.
MTI	Ministry of Trade and Industry
MVA	Manufacturing Value Added
NCBD	Nairobi Central Business District
NDCs	Newly Developed Countries
NGO	Non-Governmental Organisation
NICs	Newly Industrialized Countries
NYS	National Youth Service
R & D	Research and Development
RPED	Regional Program on Enterprise Development
SMEs	Small and Medium Enterprises
SMEEMEs	Small and Medium Electrical and Electronic Manufacturing Enterprises.
SWOT	Strengths &Weaknesses, Opportunities & Threats
TF	Technology Foresight
TNCs	Transnational Corporations
TQM	Total Quality Management
UNCSTD	United Nations Commission of Science and Technology Development
UNCTAD	United Nations Conference on Trade and Development
UNIDO	United Nations Industrial Development Organisation.
UON	University of Nairobi
USA	United States of America

DEFINITION OF TERMS.

i) Technology.

The *Foundations Of Technology Education* 44^{th} *Year Book,* (Bensen, 1995) defines technology as a body of knowledge and actions, used by people, to apply resources in designing, producing and using products, structures and systems to extend the human potential for controlling and modifying the natural and human made environment.

Specifically, in this study, the focus is on product and process technologies. Product technology entails the ingredients, formulas and make up of products, while process technology is about methods and equipment used in the manufacture.

ii) Modern technology.

In the electric and electronic sub-sector there are two apparent generations of products. The new generation products are the high potential computation, transmission and communication machines and peripherals. Their application is across many sectors and they are based on microelectronics technology. For the purpose of this study, this technology will be referred to as modern technology. All other products outside the above classification in the electric and electronic sub-sector; are in the old generation and technologies involved in their manufacture will not be taken to be modern.

iii) Technology adoption.

Technology adoption in this study refers to a shift from simple to more advanced and efficient technologies.

iv) Manufacturing.

Manufacturing is defined for the purpose of this study as the application of technical know-how and process equipment (embedded knowledge) in alliance with capital and labour to the transformation, with clear value addition, of locally available or imported raw materials and/or intermediate inputs into final or intermediate products for the domestic and/or export market.

v) Electrical products.

These are products of or concerned with electricity. They may be; users of electricity power, used for carrying an electric current to an appliance, produced by electricity, or producing electricity (Alan , 1990).

vi) Electronic products.

Refers to products of control, communication and computing devices that rely on the movement of electrons in circuits containing semi-conductors, thermionic valves, resistors, capacitors and inductors (Alan , 1990).

vii) Small Electric And Electronic Manufacturing Enterprises.

These were business enterprises carrying out manufacturing activity of electric/electronic nature, which employed a minimum of ten (10) and a maximum of forty nine (49) workers.

viii) Medium Electrical And Electronic Manufacturing Enterprises.

These were business enterprises carrying out manufacturing activity of electric/electronic nature, which employed a minimum of ten (50) and a maximum of forty nine (249) workers.

ix) Entrepreneurs.

Entrepreneurs were the owners of the business firms. All the SMEEMEs were private limited companies and the owners identified and interviewed had taken up director positions.

x) Managers.

Managers are employees of the firms who are assigned management tasks in the firms.

ABSTRACT.

Growth in the manufacturing sector is widely considered a great vehicle for economic development, a fact taken up by Kenyan policy makers by setting a policy of ensuring industrialization by the year 2020. However, as evidenced by the case of newly developed countries, meaningful industrial development is preceded by technological advancement. In Kenya, performance of the manufacturing sector has been on a decline in the last decade. This has been attributed to lack of adequate technical and entrepreneurial skills coupled with inadequate research and development, which constrained technological advancement. In the Electric and Electronic sub-sector, most of the enterprises have engaged in production of traditional electrical products such as electric cables, lamps, electrodes and fans. Only a few have been involved in the manufacture of the more modern and high growth potential products such as computation, automation and communication equipment. Yet, studies in more successful economies, such as USA and South Korea, have shown manufacture of modern and dynamic electric and electronic products to be the growth vessel in the sub-sector. This study focused on modern technology adoption efforts by the Small and Medium Electrical and Electronics Manufacturing Enterprises (SMEEMEs) in Nairobi. The main objective was to find out how the SMEEMEs in Nairobi, and by extension, Kenya, can build up their technological capabilities which would in turn raise their product quality, productivity, product variety and engage in production of the modern high growth potential products. The study was carried out between May and December 2004, in Nairobi industrial area, Parklands and Baba Dogo road, among fourteen electric and electronic manufacturers that employed between 10 and 249 workers. The researcher, through face-to-face interviews, conducted data collection with the entrepreneurs, using interview guides. Descriptive statistics were used for data analysis and presentations. All the SMEEMEs were found to be engaged in the manufacture of the earlier generation products, except 14% who were also manufacturing the modern generation products. Though some firms in the manufacture of the earlier generation products were equally doing well as those in both the earlier and the modern generation, it came out clearly that those firms that were encroaching on modern technology practices as indicated in the status of their machinery, their new products, their product development methods and their skills upgrading approaches, were thriving and had high plans and hopes for future growth. However, 43% of SMEEMEs showed little or no tendency towards improved technological activity and were just coping and others struggling in the globalized market where 'survival for the fittest' bluntly applies. Of the constraints facing the SMEEMEs, competition from imports was cited as the number one most severe constraint by 85.7% of the SMEEMEs, while lack of adequate financial resources was ranked second by a similar percentage. Poor utilities were ranked third by 71.43% of the firms. However, 14% of the SMEEMEs that were more technologically advanced highlighted the problems of lack of markets for the high technology products and lack of trained manpower. Taking the sub-sector as a whole, the study found out that the technology upgrading methods that had spurred tremendous growth in the sub-sector in the newly developed countries, such as joint ventures, foreign direct investment and hire of technical licenses/contracts, were hardly exploited. Most of the firms emphasized on research and development, and acquisition of hardware for their new technology requirements, which were in turn limited by the constraints mentioned above. Recommendations from the study were that, first, further improvement of the enabling environment be done, especially through macro-economic interventions, and establishment of more deliberate technology upgrading initiatives such as a national technology foresight programme and establishment of technology parks. Secondly, individual firm initiatives are required to take advantage of the enabling environment and following conventional best manufacturing practices such as new product development and agility.

CHAPTER 1: INTRODUCTION.

1.1 BACKGROUND.

Growth in the manufacturing sector has long been considered instrumental for economic development. This stems from the belief that the sector is, among other things, a potential engine of modernization, a creator of skilled jobs, and a generator of several positive spillover-effects (Tybout, 2000). Historically, the growth in output has been a key element in the successful transformation of most economies that have seen sustained rises in their per capita incomes, the most recent example being of the Newly Industrialized Countries (NICs), and their success in exporting manufactures (UNIDO, 2001). The last twenty years have seen remarkable expansion of manufactured output and exports from developing countries. Most of the developing countries showed significant growth trend for manufactures. These include China, India, Indonesia and Pakistan among others. However, there are a large number of countries whose growth in manufactured output and exports has been limited and sporadic. All the sub-Saharan economies appear to belong to this later group, as do most Latin American countries (UNIDO, 1995).

A paper by UNIDO on *Technology, Manufactured Exports And Competitiveness* in 1995 reported that technological change plays an important part in the growth of manufactures and exports, higher factor productivity and attaining international competitiveness. This is supported by the cases of Korea, Singapore, China Indonesia, Malaysia, Pakistan and Thailand (UNIDO, 1995). These countries experienced average growths of manufactured exports of between 10% and 25 % between 1970 and 1991. Such countries with high productivity growth, in many cases, have shown shifts in production away from the technologically simple (and generally labour intensive) sectors towards technologically more sophisticated production, in sectors like electrical machinery (including electronics) and nonelectric machinery. Higher rates of productivity have been associated with shifts in production to sectors where value added per worker is not only higher than in the less sophisticated sectors, but also tend to grow faster. The former governor of Central Bank of Kenya put it this way: "the day of old-fashioned, first generation technologies is past, and in order for Kenya to take its place among newly industrialized countries, the focus must be on modern, highly efficient technology" (Mullei and Bokea, 1999).

Nevertheless, high manufactured export growth rates are just as much associated with low productivity growth as with high. There are countries that have experienced high manufactured export growths and low productivity growth such as Mauritius, Sri Lanka and several Latin American countries (UNIDO, 1995). Mauritius and Sri Lanka experienced manufactured exports growths of between 22% and 26% in the period 1970 to 1991 but both experienced negative growths in value added per worker in the same period. These countries focused their export development 'on sectors in which they had established strong static comparative advantages' (natural resource based industrialization) (UNIDO, 1995). However, these later cases have been more of the exception rather than the norm. An important reality is that those developing countries that have not experienced manufactured export growth in a significant way show little sign of growth in productivity.

Majority of developing countries experiencing low manufactured output and exports growth show little sign of growth of productivity in manufacturing. The Kenyan manufacturing sector falls in this category. Between 1980 and 1990 the sector experienced a decline of 1.8% in manufactured exports and value added (MVA) per worker grew by 1.42% (UNIDO, 2001). This is very poor compared with a growth of 9.7% in manufactured exports and a MVA per worker of 6.1% in Korea over the same period. According to the Kenya Manufacturing

Enterprise Survey (KMES) fielded in October and November 2000, performance in the sector over the last decade has been poor. In 1999, manufacturing accounted for 11% of the GDP (UNIDO, 2001), which is quite low.

The above scenario is repeated in the electrical and electronic sub-sector. Internationally, the sub-sector has grown in leaps and bounds, especially in the developed and Newly Developed Countries (NDCs). Manufacturing production index of office, accounting and computing machinery grew by 1,051% in USA and by 739% in South Korea (UNIDO, 2002) between 1990 and 1999. The two countries also experienced a growth of 355% and 62%, respectively, in manufacturing production index of electric motors, generators and transformers in the same period. It is noteworthy that there is a big difference in growth rates in the two different classes of products. The latter, (electric motors, generators and transformers) is representative of the earlier generation electrical and electronic products. This class has been growing at a much lower rate than that of the more modern technology (office, accounting and computing machinery) products.

Within the manufacturing sector, there are interesting trends that distinguish manufactured goods of different technology intensities (NACI, 2002). As referenced in NACI (2002), Professor Sanjaya Lall of Oxford, showed that over the period 1985 to 1998, high technology intensity industries of developing countries grew at over 20%, with electronic items dominating this category. He further explained that medium and low technology intensity industries in these same countries grew by between 10% and 15%, while resource based industries grew at just over 5%.

However, the Kenyan case has not been as promising. Its manufacturing production of electrical machinery and apparatus fell from Ksh.242,520 million in 1996 to Ksh.82,080 million in 1999 (UNIDO, 2002). The manufacturing production quantity index for the sub-sector went up to 195.5 from 188.4 between 1999 and 2002, a growth of only 3.8% over four years (GOK, 2004). Further, the production reporting is not differentiated into the earlier and modern technology products as per the current International Standard Industrial Classification (ISIC), unlike in the developed and NDC countries. It is possible that one of the reasons Kenya is doing poorly in this sub-sector is the failure to embrace production of the modern technology goods.

The object of this research is to asess the case of technology upgrading in the Kenyan manufacturing sector. The sector being very wide, the researcher zeroed in on the electric and electronic manufacturing sub-sector for the reason that it is almost the single area exhibiting dynamic growth technologically world wide. In this sub-sector, the researcher initially targeted the Micro and Small Enterprises (MSEs), which are considered to have a great potential as a growth vessel in the country. However, field data proved that there were hardly any manufacturers in this sub-sector falling in the micro (0 – 9 workers) classification. The target group, therefore, was changed to that of Small and Medium Electric and Electronic Manufacturing Enterprises (SMEEMEs)

1.2 PROBLEM STATEMENT.

The small and medium electric and electronic manufacturing enterprises (SMEEMEs) find it increasingly difficult to compete with bigger, often multinational, companies under liberalized trade regimes. This is mainly due to their low factor productivity, poor quality goods and a thin product variety. This, in turn, is a result of use of rudimentary technology. Many SMEEMEs specialised in production of the traditional electrical products (Naresh, 2004) such as electrical cables, dry cell batteries and electric bulbs. Few have taken up production of the modern high growth potential electronic goods such as cell phones, computers and calculators. They have not taken up the new production technologies that yield the topnotch modern products that are making the big sales the world over. Among other measures, to improve productivity and quality, and therefore access local, national and international markets on favourable terms, the SMEEMEs need to upgrade their technologies. No record was found documenting any empirical research conducted in Kenya on efforts being made towards modern technology adoption in the SMEEMEs sub-sector. It was therefore not clear what mechanisms were being put in place towards this desired end. This study focused on the assessment of modern technology adoption trends in the SMEEMEs sub-sector.

1.3 OBJECTIVES.

Main Objective:

To assess trends in technology upgrading among the SMEEMEs in Nairobi.

Specific Objectives:

i) To find out the demographic and operational characteristics of the SMEEMEs in Nairobi.

ii) To find out the SMEEMEs efforts in acquisition of modern manufacturing technologies.

iii) To find out the constraints facing SMEEMEs in their efforts to build technological capabilities.

1.4 RESEARCH QUESTIONS.

The study was geared to answering the following questions:-

i) What are the demographic and operational characteristics of SMEEMEs in Nairobi?

ii) What efforts are being made by the SMEEMEs in Nairobi in acquisition of modern technologies and skills upgrading of both owners and employees?

iii) What constraints are the SMEEMEs in Nairobi experiencing in their modern technology adoption efforts and how can they be overcome?

1.5 JUSTIFICATION.

This study provides a general road map for the current and potential SMEEMEs investors by suggesting various technology adoption options suitable for the sub-sector and that will give the sub-sector players a market edge, both locally and in the East and Central African region. The study promises both direct and indirect benefits to the SMEEMEs. Direct benefits will come in form of improved output, sales and market share for those that take up modern process and product technology. Indirect benefits regards to better business environment created by the government and other stakeholders as recommended by this study. This is mainly in the areas of provision of utilities, especially electricity, and financial resources.

The study also comes up with useful information for the government and other stakeholders. It outputs suggestions of various possible interventions (both policy and operational) by the government and other stakeholders (such as donors, NGOs, etc.) that are required to improve the technological capabilities of the SMEEMEs and the manufacturing sector at large.

CHAPTER 2. LITERATURE REVIEW

2.1 Introduction.

There is a great deal of literature on manufacturing industry and manufacturing firms in general in Kenya and the world at large. Publications like National Micro And Small Enterprise Base Line Survey 1999, the Kenya Economic Surveys for years 2002 and 2003, Kenya Government Statistical Abstracts for 2002 and 2003, National Development Plans, the International Year Book of Industrial Statistics 2002 and others give the manufacturing production trends, product ranges, Manufacturing Value Added (MVA) of various manufacturing sub-sectors and countries, different manufacturing strategies adopted by different nations and even constraints facing different manufacturers.

However, information on the electric and electronic sub-sector is a bit scanty. This is more so in the Kenyan case, especially on the question of adoption patterns of manufacturing technology in the electric and electronic sub-sector.

This chapter reviews the available information on the characteristics of the Small and Medium Electric and Electronic Manufacturing Enterprises (SMEEMEs), both demographic and operational. In addition the technological adoption efforts of the SMEEMEs so far captured, and the constraints facing the SMEEMEs especially in their technology upgrading efforts are examined.

2.2 Demographic and Operational Characteristics of SMEEMEs.

2.2.1 Magnitude and distribution of SMEEMEs

According to the *Government of Kenya Checklist of Manufacturing Enterprises in Kenya of 2000* (GOK, 2000) there were 73 manufacturing firms in Kenya in the electrical and electronics sub-sector by September 2000, each employing between 1 and 441 workers. Of these manufacturers, 60 were based in Nairobi, 2 in Kisumu, 7 in Mombasa, 2 in Limuru, 1 in Nakuru and 1 in Gilgil. Among those in Nairobi, 33 employed between 1 and 9 workers while 27 employed between 10 and 241 workers; the later group making the SMEEMEs as per that time. The total employment by the SMEEMEs then was 1,685 workers.

According to the Ministry of Trade and Industry there were 39 firms at the end of 2003 in the electrical and electronics sub-sector in Nairobi (MTI, 2004). Six more firms were reported by Bhusan (2001) and KAM (2004). This gave a total of 45 firms that comprised SMEEMEs in Nairobi, as at the end of 2003. The bulk of the SMEEMEs were situated in Nairobi industrial area except 5, which were situated around the Nairobi central business district according to the physical addresses given in the Ministry of Trade and Industry's list.

However, these three sources did not give the number of workers per firm. The workers classification as to their gender or work position/description was also not provided. It was therefore hard to say how many workers were employed by the SMEEMEs at that time and the composition of the work force then.

2.2.2 Products Range and Performance of SMEEMEs.

The main products of the electrical and electronic sub-sector, as detailed in the 1997 *Directory Of Manufacturing Industries In Kenya* by KIRDI (KIRDI, 1997), included PVC electrical conduits, fire detection panels, radios, radiograms, TV and allied equipment, solar water heaters and automotive batteries & components. Others were welding rods, electrodes, electric cables, switch boards, motor control towers, centre power conduits, recording tapes, fans, driers, refrigeration equipment, electrical lighting fittings, tungsten, lamps, speakers, telecommunications overhead line components, generator field coils, switch gears, 2 way H.F. transmitters/receivers, V.H.F. transmitters/receivers and transformers.

Internationally the electric and electronic sub-sector has grown tremendously. Table 1.1 shows production indices of USA, South Korea and Kenya of the sub-sector between 1988 and 1999. It can be observed from the table that production in USA and S. Korea has been steadily growing. In USA, manufacturing in office, accounting and computing machinery production index grew 1,051% (from 100 to 1151) between 1990 and 1999 (UNIDO, 2002). The same index for S. Korea grew 739% (from 100 to 839) in the same period. These were representative of the first and second worlds. It is also good to note the production growth in USA and S. Korea was about three times more in the emerging technology areas such as the manufacture of computation, transmission and communication equipment than growth in nanufacture of the traditional electrical products such as electric motors, generators and ansformers.

he other hand Kenyan production growth rate in the sub-sector has been extremely low. nanufacturing production index of electrical machinery and apparatus grew by only 15% 100 to 115) in the period 1990 to 1999. Actual production of the sub-sector in Kenya w ling Khs.242,520 million in 1996, Ksh.100,340 in 1997, Kshs.78,840 in 1998 and Ksl 80 in 1999 (UNIDO, 2002). The trend in these four years was a story of gloom for the s tor, which has largely been blamed on the cheap imports let loose on the Kenyan market wing the economy's liberalization.

Table 1.1 Production indices Electrical and electronics

Country	Year / Code	'88	'89	'90	'91	'92	'93	'94	'95	'96	'97	'98	'99
USA	3000	92	102	100	101	123	150	187	260	371	518	730	1151
	3110	94	98	100	102	114	125	150	189	236	300	366	455
S. Korea	3000	75	89	100	105	112	140	190	265	334	398	406	839
	3110	83	83	100	108	116	121	137	161	170	170	127	162
	3220	92	92	100	115	125	136	167	218	269	329	448	657
Kenya	3830	98	98	100	134	130	116	117	131	138	110	115	*

Source: UNIDO (2002)

Code	**Products**
3000	Manufacture of office, accounting and computing machinery
3110	Manufacture of electric motors, generators and transformers
3220	TV and radio transmitters and apparatus for line telephony and line telegraphy.
3830	Classified as manufacturing of electrical machinery and apparatus.
*	Not reported.

In summary, the SEEMEs in Kenya were few and their production growth rates have been low and sometimes declining. As compared with more developed economies, the sector has low productivity and a short product range. Most of the enterprises were engaged in production of the less competitive, traditional and low potential products.

2.3 Modern Technology Adoption Efforts By SMEEMEs

For African firms, the most important investments in new technology are made in the form of importation of new foreign equipment, research & development, purchase of foreign technical licenses, foreign direct investment, and hire of technical assistance experts (Commonwealth Secretariat, 1985). However, all this requires prior investment in higher education and technical training for effective technology upgrading. This is especially so in the electric and electronic sub-sector which heavily depends on formal and specific training. All these, as discussed bellow are common indicators of modern technology adoption.

2.3.1 Education And Training.

There is a generally recognized need for high priority to be given to human resource development, through education and training in order to make effective use of new technologies. This provides the much needed technology awareness and scientific literacy, broad awareness of the possibilities of new technologies and the scientific principles underlying (Parker & Torees, 1994). An American manufacturer emphasized thus; "When it comes to providing a well-built product, our strength lies in our people. They represent a vast fund of knowledge, experience and creative ideas- resources that meet or create demand in the market" (Kinni, 1996).

The quality of workers a firm is able to recruit is dependent on the formal education levels of the immediate population. The general indicators here are adult literacy rate, educational attainment of target populations, and enrollment in vocational education and stocks of technical and scientific personnel. Africa lags behind the rest of the world in these parameters (RPED, 1995). The low levels of education increase substantially the requirement for supervision of workers in factories, which has detrimental effects on production costs and therefore competitiveness. On the contrary, in Japan formal education system produces a very high level of general literacy in the work force such that workers are capable of following very detailed and complex written instructions (Commonwealth Secretariat, 1985). This means that a lot of learning is based on informal production of job specifications and procedures manuals written out by supervisors and used as teaching materials for self-teaching by new comers to a job. In Africa very little of this type of learning take place, because the level of general literacy is low. Kenya's percentage rate of primary enrollment, secondary enrollment, tertiary enrollment and adult illiteracy in 1990 of 94%, 23%, 2% and 31% respectively (RPED, 1995), collaborate with this view. Thus a focus on high literacy and numeracy in the school system can lower the cost of firm's investment in training and productivity improvement.

According to a study by Regional Program on Enterprise Development (RPED) (1995), training in manufacturing mainly involves management and technical training. The training can be conducted formally or informally and will be conducted either in-house or externally. According to the study, there were four common training schemes by manufacturing enterprises in Africa. The first one is 'entry-level, in-house training for new entrants, in which many of the enterprises tends to include a combination of some formal training and some informal, on-the-job training. The second one is 'apprenticeship', which is largely training-by-working, working alongside an experienced person. It generally involves little or no further formal education and is geared towards transferring relatively simple manufacturing skills. Apprenticeship has been identified in many studies as appropriate for the informal sector, for example, in a research study on Indigenous metalwork enterprises in Kenya (Ofafa, 1999).

Third is 'continuous training of existing, experienced workers to maintain and up-grade skills and/or to impart new skills'. The training can be conducted formally or informally, and is geared largely to the specific production requirements of the firm. Small enterprises were found to do very little in-house continuous training and when they do, it was generally training-by-watching on the job. According to the RPED study of 1995, more firms in

Zimbabwe engaged in continuous in-house training of workers than in Kenya. This reflects to its' higher level of industrial development, its' large firm sizes and the complexity of its' product mix. The last training scheme is 'external training in local technical schools and technical colleges or sometimes abroad'. The extent of external training depends importantly on availability of local institutions providing industry-specific courses. The RPED study found out that, both large and small firms engage more on external training than in in-house training.

The effectiveness of training in a firm and its impact on learning will depend on the firm-specific assets it can employ in the learning process and on the external learning sources it can draw upon. The firm's assets include the quality of the workers and the training methods they can effectively utilize, as well as the commitment of management to developing a "learning organization", including the incentives it can provide workers to learn. For example, paying for off the job learning time and linking newly gained qualifications with marginal pay boosts. To supplement the firm's efforts are external resources such as availability of industry-specific technical courses, linkages with other firms in business, interaction with buyers and suppliers and direct support services from government and business associations. According to the RPED study of 1995, in Africa the quality of workers is poor, there is a shortage of resources and technical personnel, inadequate management skills and lack of cooperation and support services. There is therefore an extremely ill-educated industrial labour force. This was supported by the Kenyan firms, interviewed in 1993, that chose employee training as their top priority of the highly desired support services (CBS, 1999).

In 1995, among MSEs owners in Kenya, three-quarters had primary-level or no education (Danlels et al, 1995). A similar fact applied to training. Yet trends in technological advancement in the world today demand a certain basic level of literacy and training (ICEG, 1999). With these levels of education and training, the range and levels of technologies that the MSEs could adopt might be very limited.

The modern technology areas like electronics depend heavily on formal and specific training (Commonwealth Secretariat, 1985). The microelectronics revolution has created a set of demands for a skilled workforce. This has given rise to the need for basic software training; electronics-related coursework in higher education; specialized programmes for programmers, managers and designers; on-the-job training for manual workers who are required to operate electronically controlled devices; and repair and maintenance capability training.

One of the members of the sub-sector reported; “Kenya is blessed with a pool of qualified engineers and other graduates” (Naresh, 2004). However, the private sector should be aided by reducing the burden of engineering and technical training. That it was necessary to establish a cost sharing system whereby the government and industries share the established salary of a fresh graduate, for the first three years after graduation, to provide practical experience, which has constrained their employment at present.

A new development in this area was the launch of an Industrial Attachment Pilot Project by the Directorate of Industrial Training on 22nd September 2004 (DIT, 2004). The project outlined the measures necessary for improvement of the training of personnel engaged in industry, through the implementation of a well-coordinated and supervised industrial attachment programme. It was meant to provide the practical bridge between theoretical knowledge gained from institutions of learning and the practical skills required by industries in the day-to-day activities. The project was to address problems of previous attachment schemes and that of industry having to retrain graduates before they can fully employ them. The projects target was to influence the quality and efficiency of training to ensure an adequate supply of well-equipped manpower with problem solving skills, technical-know-how, correct attitude and social skills as well as appropriate work ethics and culture. This project was at its initial stage and no record on its implementation and effects were available.

2.3.2 Direct purchase or acquisition of technologies

Much technological know-how can be gotten free or is freely available from numerous technical and trade journals and manuals, as well as amongst lapsed patents and unpatented inventions (Commonwealth Secretariat, 1995). In the electric and electronics industry, some enterprises in developing countries have been able to obtain most of their technology royalty-free from component manufacturers, machinery makers and material suppliers, while some producers of consumer electronic goods have been given the necessary technologies by United States mass merchandisers seeking to lower their prices. However, this is an option of limited application, as it requires a strong base in information collection and other supporting infrastructure. Nevertheless, with the advent of the World Wide Web (www), information highway, a lot of technological know-how could be accessed from the web, either for free or for a fee (Nicola, 2000). The Kenyan SMEEMEs sub-sector's initiatives in acquisition of technological know-how documentation were hard to find and was addressed in this study.

2.3.3 Purchase of imported hardware.

Technology is embodied in machines and will usually be imported in this form. This should not only be accompanied by some operator training but also underlying know-how and expertise to improve and adapt the imported techniques (Commonwealth Secretariat, 1985). In rare cases a machine or system may be imported once, mastered and thereafter maintained, adapted and replicated domestically. The later case has been successfully used in Japan (Commonwealth Secretariat, 1985).

However, adoption of new technologies must support the business objectives of quality, agility and productivity (Kinni, 1996). There were many manufacturing companies in USA that installed production lines featuring every imaginable bell and whistle, only to create more problems than products. Best plants build quality, agility and productivity into their manufacturing equipment. This is supported by a serious Kenyan manufacturer in the Electric and Electronic sub-sector who said "in this millennium, sustainable competitive advantage will come much more from process technology and re-engineering and much less from new product technology" (Naresh, 2004). In Kenya, use of machines among the MSEs was low and most of those that were in use were human-powered (CBS, 1999). In general, the tradition has long been to passively import relatively simple technologies and use them at relatively low levels of technical efficiency, most often with the help of expatriate skills (UNCTAD, 2003b). There is high propensity to start with used equipment and most firms have machinery over ten years old.

According to the National Micro And Small Enterprise Baseline Survey of 1999, of the MSEs which had purchased some equipment or plant in 1999, 48.2% of them bought used ones, while 37.8% purchased new ones (Gichira, 1997). In the electric and electronics sub-sector, many of the manufacturing companies in Kenya had invested in old technology for manufacturing by 1995 (Naresh, 2004). None, but one, had been able to acquire the best available technology such as machines using CNC (computer numerical controls) technology. Some of the factors attributed to this status included reluctance of machine suppliers abroad to quote or answer enquiries from Africa. They were afraid of bad publicity and poor image if their machines were to stay idle and unserviceable. Other hindrances were foreign exchange controls, absence of venture capital funds, import licensing restrictions, and banks unwillingness to finance such machines of high technology in fear of inability to dispose such assets in case the company defaulted. However, about all these drawbacks are today non-existent, especially after 1993 (Gichira, 1997) when the Kenyan economy was liberalized. For example, tariffs on imported capital equipment have come down to 5-10%. In 1999 the Kenyan imports of capital equipments amounted to 19.6% of total imports of $3,301.8 million (UNCTAD, 2003b). Of these 6.6% comprised of electric and electrical equipment. Other than this, it is not clear how the electric and electronics sub-sector has responded in technology acquisition, especially hardware.

2.3.4 Foreign Direct Investment (FDI).

Foreign investors, usually the Transnational Corporations (TNCs), are seen as transferring technology directly to their subsidiaries or indirectly in various ways: through backward linkages with local suppliers; by making demands on local firms for enhanced skills to provide maintenance and repair facilities; and by competition with local firms, so compelling them to up-grade their skills and standards (Commonwealth Secretariat, 1985). Direct investment is said to be attractive because it is usually relatively fast, reduces the need for investment in indigenous R&D, and technological and financial risks fall on the foreigners (Commonwealth Secretariat, 1985).

Foreign direct investment is an efficient way of transferring technology (UNCTAD, 2003a). It can directly increase technology stocks by providing machinery and equipment, as well as technical assistance and know-how. It is an efficient way of transferring technology since it often carries commitments by the interest of skills, information and brand name technologies, in addition to capital. For many new technologies, these internalized transfers are the only means of transfer since innovators resist their transfer to unrelated parties. Being part of a TNC system, therefore, can develop wide-ranging competences and establish, build and deepen local industrial capabilities and skills. Such competences and skills include technical skills for production, distribution and control, as well as management and subsidiary service skills such as marketing and financial services. FDI has been found to have the effect of promoting employment, quality and skills of the local labour force (UNCTAD, 2003a). It also promotes the development of non-traditional exports, thereby enabling economic diversification. Further, FDI may introduce and promote competition in an economy, stimulating efforts to improve efficiency among local competitors in the host economy.

However, the above benefits are not always realized. This is usually for the reason that the objectives of the TNCs and those of the host developing country often diverge, and bargaining is required to reach a compromise between the two. The TNCs may often invest in developing countries for advantages of low-cost physical and human resources, more permissive legislation and fiscal and financial incentives, to make short-term profits and quarterly earnings. They may not necessarily invest heavily in developing the technological capabilities of their subsidiaries, which become outsource centers for simpler and more labour-intensive work. On the other hand, the host countries have multiple of investment objectives that will only be achieved in the long term. Reconciliation of interests is therefore imperative.

Internationally there is competition for FDI among developing countries and it is the onus of individual governments to attract foreign investors to their respective countries. Measures to promote FDI may include liberalization of the FDI and investment network, regulatory and institutional reform, investment promotion agencies and incentives for investors. Best practices for investment promotion agencies include provision of information, marketing and support services; active investigation of investment opportunities and targeting of investors; and a 'one-stop' liaison services. Financial incentives for investors include tax holidays, capital allowances, custom duty exemptions and other inducements like the Free Trade Zones (FTZs).

In Kenya, the above role was played by the Kenyan government, through the Kenya Investment Promotion Centre (IPC). FDI inflows in Kenya were reported to amount Ksh. 37.8 million in 1996, Ksh. 51.5 million in 1997 and Ksh. 34.5 million in 1998 (UNCTAD, 2003b). However, there was an encouraging report by UNCTAD that Africa did much better than most of the rest of the world in terms of FDI inflows in 2003 (UNCTAD, 2005). FDI inflows in Africa grew by 28% to US $ 15 billion. However, most of the flow was into the natural resources projects. In Kenya, Djibout, Madagascar and Malawi, inflows were at least twice higher in 2003 than in 2002.

Nevertheless, there was a case reported of a foreign investor in the electric electronic sub-sector who relocated to South Africa after operating in Kenya for only one year (Wandera, 2004). The managing director claimed the firm relocated to escape a new 2.5% excise and duty tax. The new tax measures made the company to spend an additional Ksh. 6,000,000 in less than a year. In addition to the cash outlay, the company had to wait for more than six weeks to clear goods due to the new documentation and products inspection requirements associated with the new duty imposed. The director said that in Kenya tax accounts for up to 25% of gross profits in the highly competitive computing and electronics sector. She concluded that lack of predictability was the biggest obstacle to inflow of new investment in Kenya. Of course this does not sound very promising for FDI in Kenya.

2.3.5 Licensing or technical cooperation agreements.

Another key channel for technology transfer is licensing and arm's length purchase of know-how, patents, licenses and blue prints (UNCTAD, 2003a). Licensing is an agreement to transfer the exclusive rights to use technology from the innovator to the licensee in exchange for payment of royalty and license fees. The package may include industrial technology and also service sector purchases of know-how, brand names and franchises. Japan successfully used the licensing system in the 1960s to import technologies and develop indigenous capabilities without recourse to foreign direct investment (Commonwealth Secretariat, 1985). However, acquisition of technological blueprints through licensing is unlikely to prove successful unless local technological capabilities are in place to master and adapt abstract technological blueprints obtained through licensing.

A study undertaken in Kenya in 1995 (RPED, 1995) indicate that only 5% of MSEs held foreign technology licenses and only 17% had signed technical assistance contracts. UNCTAD reported that Kenya license payments (for royalties and technical fees) in 1997 amounted to $39 million as compared to $258 million, $2,413 million and $543 million for South Africa, Korea and China, respectively (UNCTAD, 2003b). It was comparatively very low and this may mean most of the Kenyan firms had not taken up these modes of technology adoption. Though no documentation of the electric and electronic sub-sector's application of these modes of technology acquisition as a whole was found, there were reports on individual firms. Several manufacturing firms in this sub-sector had forged alliances or partnered with the principals they represent in Kenya (Naresh, 2004). However, the nature of alliance or partnership was not elaborated.

2.3.6 Joint ventures.

This is where foreign companies help local enterprises to set up production through minority shareholding. A joint venture is a business arrangement in which two or more parties undertake a specific economic activity together (Unz & Co., 1998). The companies compliment their resources and skill sets, and agree to share profit, loss and control. It can turn under-utilized resources into profit, create a new profit centre, and help enter into untapped markets quicker and at a less cost than trying it alone.

In international joint ventures, host country laws may require that, a certain percentage, (often 51% or more), of the manufacturing operations be owned by the nationals of that country. This is to ensure that control of the venture remains with the locals. Joint ventures are popular methods of expanding business. This is attractive to the recipient country and firms because they achieve technology faster and gets access to foreign markets without losing indigenous control (Commonwealth Secretariat, 1985). How much this practice had taken root in this country and in the SMEEMEs sub-sector was hard to tell, and no documentation on it was found.

2.3.7 Hire of technical experts.

This can take various forms. First, a firm can use foreign consultants in, say, systems design and other technology-intensive activities. This would help build domestic technological capacity by applying measures that will raise local consultancy capabilities, e.g., by gradually increasing the share of public contract work given to local consultants (Commonwealth Secretariat, 1985). A second way is through use of management and service contracts. This is where a firm will hire management and other expert skills, especially where new technology hardware requires complex establishment, operating and maintenance skills. To be effective, this method should be coupled with counterpart training and the gradual phasing-in of local management. Another way is by use of technical assistance, whereby aid donors, at rates below market rates, provide experts to perform operational, training or advisory roles, incorporating technology transfer. Though this is a cheap way of technology transfer, it is necessary to ensure technology diffused is appropriate.

2.3.8 Research And Development.

The needs and wants of our changing society require that manufacturers introduce new products and improve existing ones (Harms and Kroon, 1992). They need to offer consumers products that are unique, competitive with other products and that will make profits for the company. The companies have to find out how to achieve these through research and development (R&D). Many people will be committed in R&D. Some will be involved in coming up with new product ideas, others determine product acceptance in the market place, and still others develop new materials and processes. In fact, two of the indicators of measuring national technology activity are the expenditure on R&D as a percentage of National Income and the number of scientists and engineers engaged in research and development (UNCTAD, 2003b).

Research and development on new technology can be carried out formally in laboratories or by small-scale adaptations in the field. When successful, this leads to technological innovations, which in turn bring market success. This was the case in the progress of India in utilizing low-grade coal and metallic ores, in upgrading the leather industry, and in developing a multipurpose food additive (Commonwealth Secretariat, 1985). Similar cases were the use of indigenous plants in Mexico and development of ethanol-powered motor vehicles using sugar cane in Brazil (Commonwealth Secretariat, 1985). However, among developing countries there has been a common problem. That very limited funding was available for research and development. As a rough rule of thumb, UNCSTD had set a minimum target of 1% of GNP for developing countries to spend on R&D, which was not attained by 1985 (Commonwealth Secretariat, 1985). Since most technology was imported from advanced countries, in Africa not much innovation oriented research and development was done.

According to a survey by RPED in 1995, only 15% of Kenyan manufacturing firms studied did any R&D activity in 1992 (RPED, 1995). As reported by Naresh (2004), a manufacturer in the Small and Medium Electrical and Electronics sub-sector in Kenya, research and development (R&D) in Kenya is not actively promoted. Incentives are lacking to promote R&D in the local industrial sector. Technical dynamism is low: the private sector invests little in research and development, and has few links with the official technology infrastructure (UNCTAD, 2003b). In the newly industrialized countries such as Malaysia, Korea and Indonesia, R&D is actively promoted both by the government and by business enterprises, especially the transnational corporations. For example, expenditure on R&D comprised 2.71% of GNP of the Republic of Korea in 1995 for example (UNCTAD, 2003a).

The main industrial research institute in Kenya is Kenya Industrial Research Development Institute (KIRDI). It was established in 1979 with the mission “to enhance the national industrial innovation process through the development of a sufficient national capacity in disembodied and embodied industrial technologies for the attainment of a self-sustaining industrialization process" (UNCTAD 2003b). The institute has, until the mid-1990s, been focused on food processing and chemicals. However, its work has had little impact on industrial technologies in use. As a result there have been efforts to revamp it; to reorganize and reorient it to make it more useful to industry. Nevertheless, in its endeavour of industrial support, which has been mainly on resource-based activities, it has neglected the more dynamic and technology-intensive areas of manufacturing, such as machinery and electronics (UNCTAD 2003b). The institute does not offer much technical competence, particularly in modern electronics and information technologies. This implies that any R&D that could have taken place in the electric and electronics sub-sector was most likely private initiative by the firms.

2.3.9 Development of new products.

Manufacturing firms are faced, in the market place, by constant and unpredictable change (Kinni, 1996), which require them to be agile. They require an ability to create constant and unpredictable solutions to challenges and opportunities that change brings. The needs and wants of our changing society require that manufacturers introduce new products and improve existing ones (Harms and Kroon, 1992). The product that sells well today might loose popularity tomorrow. Technology is used in product development process in many ways, from facilitating research to creating models to complex engineering needed for most modern products (Franson, 1998). For the actual process of designing the product and turning it into something that can be manufactured reliably in volume at minimum cost, there is no substitute for modern technology.

Successful manufacturers will seize competitive advantage in the market place by using technological advances to create innovative new products and services. The product development process stretches from research to product design and modeling, product planning, product creation and finally marketing and distribution (Kinni, 1996). In some instances it is the operational improvements realized by technological applications that allow the plants to create these products and services. In others, it is the study of new advances in technology for the specific purpose of creating products that dominate their markets. This implies that the new products a manufacturer produces are a reflection of technological adoption practices. Among the SMEEMEs in Nairobi there was no record found detailing their new product development patterns.

As can be witnessed in the above discussion, by and large, documentation on modern technology adoption efforts by the SMEEMEs in Kenya is hard to find and this study endeavoured to establish the initiatives by the sub-sector in this direction.

2.4 Constraints the SMEEMEs are Experiencing in Acquisition of Modern Technology.

There have been various constraints cited to afflict modern technology adoption initiatives by the MSEs (which partly make up the SMEEMEs) in general. These can be classified into low modern technology adoption capacity, unavailability and in accessibility of relevant technologies, non-enabling environment and others.

2.4.1 Low modern technology adoption capacity.

There has been low capacity of MSEs to make use of available technologies due to low levels of education and training of both entrepreneurs and workers, lack of financial resources to acquire available technologies, high cost of available technologies and lack of utilities and power, particularly electricity *(ICEG, 1999)*. There was lack of capacity among MSEs to identify, seek and use appropriate new technologies in their production (Aduda and Kaane, 1999). This has been attributed to:

i) Limited access to technological information. Information on where and how to source available technologies was hardly available to MSEs. There were no networks in place between MSEs and the developers of technology and policy makers. Industrial and extension services were frequently weak or ineffective. These coupled with ineffective communication ways, presents a major constraint to access to information.

ii) Low levels of education and training, both of entrepreneurs and workers. This made it hard for the MSEs to interpret the little information that may have been available to them. Most of the entrepreneurs did not even read daily newspapers, which were often used as the medium for announcing new programmes and opportunities. The language used, mainly could be a constraint.

iii) Lack of financial resources to acquire available technologies. The amount of embodied technologies produced in Kenya was limited (Aduda and Kaane, 1999). This implies that most technologies had to be imported and hence cost a lot in terms of money and time. Yet the MSEs were faced by a shortage of own resources and access to credit (CBS, 1999). This compromises the MSEs access to available technologies. Small and Medium Enterprises (SMEs) have less access to international financing, and hence rely more on domestic capital and public spending (Metz et al, 2004). They are faced by lack of capital, poorly developed banking systems and lack of appropriate financing mechanisms. Further there is lack of knowledge (both within the industrial and financial sectors), technical risks, and management unwillingness to borrow funds. These barriers reduce the availability of capital, stimulating investors to keep investment costs low, which may result in the purchasing of second-hand equipment, or equipment without modern controls and instrumentation. This may lead to low quality products, higher operating costs and environmental impacts. Lack of access to capital and credit is seen as the strongest barrier to development of SMEs.

2.4.2 Unavailability and inaccessibility of relevant technologies.

Most of the MSEs used outdated and inappropriate technologies. This has been attributed to three main factors:

i) Low investment on research and development of new technologies and products *(ICEG, 1999)*. Though considerable efforts had been made at KIRDI and some public universities, an assessment indicated that the magnitude and thrust of such efforts had been insufficient for the needs of the sector.

ii) Poor linkages between R&D institutions and the MSEs. A functional innovation system is key to socioeconomic development of any nation (Adunda and Kaane, 1999). This process ensures that market based ideas on new products and processes are translated into actual products and processes in the market. These requires strong national institutions that put in place a complete cycle of the idea from the market to R&D based technology development, through respective engineering and industrial enterprises, to physical goods on the market. Such strong institutions were lacking and where the institutions existed, there were very weak linkages between them and the MSEs. Moreover there were no fiscal or monetary incentives for the few and isolated breakthroughs that had been witnessed.

iii) Weak linkages between MSEs and Medium and Large Enterprises (MLEs). The experience of industrialized countries has shown that the most effective and practical way of technology transfer to MSEs comes from direct partnership with

MLEs (Adunda and Kaane,1999). Such partnership may take the form of subcontracting, joint ventures, licensing of or franchising, or leasing or hire. There were very few such partnerships among the local enterprises.

2.4.3 Non-enabling environment.

The enabling environment for MSEs development was constrained by inappropriate physical infrastructure, cumbersome laws and regulations, among other problems.

i) Poor physical infrastructure. Significant evidence had accumulated that physical infrastructure constrained the growth and development of MSEs in Kenya (Bokea and Mullei, 1999). The MSEs were faced by inadequate legally demarcated land for operations, insecurity of tenure for worksites and frequent harassment by local authorities. They had limited access to services accruing from public utilities such as electricity, running water and sewer facilities, which inhibit manufacturing. They were also faced by poor roads and poor telephone connections, which made transportation and communication poor and expensive. This was translated into higher costs of goods produced by MSEs, making it difficult to attract customers both locally and internationally.

ii) Cumbersome and restrictive laws. Excessive regulatory constraints inhibit business competitiveness worldwide (Karingithi, 1999). They impose costs and inflexibilities that frustrate enterprises, hamper innovation, deter investment and minimize opportunities for employment creation. In Kenya, MSEs were particularly inhibited by cumbersome laws and regulations, most of which were out of tune with current development realities. There had been several laws that hindered some business practices and ownership of certain category of assets. Most of this laws had since been repealed but some restrictions still stood, such as on higher of technical experts from outside, use of high technology communication equipments, licensing of some business types, for example, radio/TV stations, internet services and others. Most of these laws were restrictive and large businesses may have had the capacity and resources to go around the regulations when necessary, but the operations of the MSEs, which had fewer financial resources and less management depth, could have been severely hampered.

iii) Other constraints facing MSEs in general included poor security, inadequate access to government procurement schemes and monopolistic practices of marketing boards. They also experienced difficulties in protection of their property rights and financial investment. Innovators in the sector had only up to 3 weeks to re-coup their product development costs before their innovations became widely copied by others (Gichira, 1997).

iv) There is also lack of vision in technology evolution. The idea of seeking and speedily adopting the newest technologies has not really taken root in Kenya (Aduda and Kaane, 1999). It is not unusual to read even in the most recent policy documents statements advocating labour intensive technologies. There seems to be a fear of new technologies among policy makers and planners. In Kenya today, industry lack guidance on the way forward in matters pertaining to technology development. This has been traced back to the lack of a national system for technology monitoring and forecasting.

All the above constraints generally had affected the MSEs in their efforts to up-grade their technology capabilities and most likely applied in the SMEEMEs case. However, the magnitude of their impact on the SMEEMEs sub-sector was hard to tell, as no information was available on each of the problems and their reflection on the sub-sector.

Nevertheless, some constraints were specifically identified to hamper the sub-sector. They included:

i) High costs of R&D and production of electronic products such as semi-conductors, mainframe, mini, and even microcomputers (commonwealth Secretariat, 1985).

ii) Influx of imports of electrical and electronic appliances mainly from the Far East and China, which continued to hamper growth in the electrical and electronic machinery sub-sector (GOK, 2003). Most of the imported products were sub-standard and were therefore offered at cheap prices, making it hard for local manufacturers to match their prices. As reported by Mugo (2005), a director of one of the local firms, "influx of cheap sub-standard products from the Far East has thrown a spanner into the works".

iii) In the past, the SMEEMEs suffered various drawbacks in their endeavours to import technology. One problem was that many companies declined to quote or answer an enquiry from Africa (Naresh 2004). Manufacturers were afraid of bad publicity and poor image if their machines were to stay idle and unserviceable. Another problem was that of foreign exchange constraint due to a foreign currency control regime, such that firms could not buy machines from outside until they were given authority to buy foreign currency. Related to this was the problem of import licensing, which was also limiting.

The next problem was that of absence of venture capital funds from which entrepreneurs could borrow from to enable them purchase machinery from outside. Related to this was the fact that banks were not willing to lend finance for high technology machinery due to the fear of inability to dispose such high technology assets in case the company failed to perform. However, most of these problems are no longer in play. In the nineties the Kenyan economy underwent a transformation. It became liberalized and open to imports from various parts of the world. Tariffs were reduced and foreign exchange was made available in the open market. Venture capital also is easily available today. The above-mentioned constraints have therefore been eased.

iv) A more recently cited constraint was that of differential duty levies on Kenyan goods in Uganda and Tanzania, which would make the Kenyan goods less competitive (Mugo, 2005).

v) A highly publicized constraint was that of high cost and poor quality of electricity. The Chairman of the Kenya Association of Manufacturers claimed that the Kenyan manufacturers pay the highest power tariffs in the region (Devani, 2004). He said, "we are paying three times more than our competitors in Egypt and South Africa". Kenya charges a tariff of $0.69 per kilowatt-hour, compared to $0.35 in Uganda, $0.216 in Egypt and $0.2 in South Africa (Wahome, 2004). Between 8% and 15% of the total cost of production in the Kenyan manufacturing sector is taken up by power. These greatly erode the competitiveness of the local manufacture.

These were the few constraints that were specifically associated to the SMEEMEs. However, as is apparent from the above discussion, barriers to technology transformation were not primarily technological, but were instead part of the social, economic, political, and cultural milieus in which technologies are developed, diffused and used (Metz et. al, 2000). Market incentives, the structure of regulations, the content and quality of research and education, and social values and preferences all determined technological trajectories.

2.5 Conclusion.

It is explicit from the above discussions, that there is limited and scanty information on technology adoption efforts by MSEs in Nairobi. The situation is worse when you get to the SMEEMEs sub-sector whereby almost no records is available on the magnitude of the SMEEMEs, their modern technology adoption efforts and the constraints facing them. This study was an assessment of the modern technology adoption efforts by the Small and Medium Electrical and Electronic Manufacturers registered in Nairobi (SMEEMEs). This was occasioned by the contention that most of these manufacturers continue to embrace old technology of manufacturing (Naresh 2004), in contrast to the conventional trend in successful economies where modern technologies of manufacturing have led to blooming electric and electronic sub-sectors. Products from these other economies have flooded the local market, creating severe competition and threat for survival for the local manufacturers. It was therefore important to find out what the local manufacturers are doing about this phenomenon; find out their current operational status, their initiatives to embrace the modern technologies of manufacturing and the constraints they may be facing in this endeavour.

CHAPTER 3 METHODOLOGY

3.1 Introduction

A census of the SMEEMEs was conducted between June and November 2004 and this chapter describes how the study was conducted. It details the research design, population size, instrumentation, data collection procedures and data analysis.

3.2 Research design.

The study was a census in which a combination of qualitative and quantitative approaches were used for complimentarity. The qualitative design was used to get a "thick description" (Worthen, et al, 1997) of the SMEEMEs sub-sector, while a quantitative analysis was done of the narrative components. This made it possible to attain the objectives of the study of capturing 'real', 'rich', and 'deep' data and explanations of; i) the demographic and operational characteristics of the SMEEMEs in Nairobi ii) the efforts being made by the SMEEMEs in Nairobi in adopting modern technology and iii) the constraints the SMEEMEs in Nairobi are experiencing in their modern technology adoption efforts.

The researcher conducted the key activities of gathering and analyzing data. No assistants were used for the reasons that the area of coverage was manageable; there was need for quality first-hand observations, and to cut costs. The researcher used interviews and unstructured observations as data collection methods. An interview guide, as the research instrument, was prepared and a pilot study was conducted with four SMEEMEs to test the suitability of the interview guide, the understanding of entrepreneurs of questions and concepts in the interview guide, and to ensure a smooth flow of the questions in the guide. This exercise went on well and the instrument was found to be satisfactory.

3.3 Population

The target population for this study was all Small and Medium Electrical and Electronics Manufacturing Enterprises (SMEEMEs) in Nairobi. The study therefore targeted electrical and electronic manufacturers in Nairobi, employing between ten (10) and two hundred and forty nine (249) workers, including working owners.

The research started in early April 2004 when the researcher visited institutions that could give information on the electric/electronic manufacturers. These were the Ministry of Trade and Industry (MTI), Kenya Association of Manufacturers (KAM), Kenya Industrial Research Development Institute (KIRDI) and Federation of Kenya Employers (FKE). From these institutions the researcher got three lists that were used to compile one list of forty-five firms classified as electric/electronic manufacturers. There were three sources of this information. The first was a census report by the Ministry of Trade and Industry (MTI), on a census conducted by the ministry on all manufacturing concerns in the country at the end of 2003 (MTI, 2004). The second source was a list of manufacturers of electric and electronic products who were members of the Kenya Association of Manufacturers (KAM) by 22nd April 2004 (KAM, 2004). The last source was a list of electrical machineries and apparatus manufacturers, and supplies in the Kenya Factbook 2000 – 2001, 16th Edition (Kul , 2002). Details of the firms got included their names, physical addresses, mailing addresses and telephone numbers. Further, those in the KAM list had the products they manufacture and names of some of their top executives included.

The list from the ministry of Trade and Industry was taken as the primary source, for being a recent census findings and being very inclusive, but was supplemented by the other two. Out of the three, researcher came up with a list of 45 SMEEMEs. The researcher therefore started the data collection exercise with a target population of 45 firms. However, as it is explained here below, only fourteen of these firms turned out to be actual manufacturers of electric and electronic products. All the firms were visited and enquiries conducted with the proprietors or their appointees except for six (6) of the firms, which were found to have ceased operations, while one (1) firm had relocated to South Africa and two (2) firms whose respondents, were not cooperative. Of the 36 enterprises visited, researcher found out that four (4) of the firms used to manufacture electrical and electronic products but for some reason they now no longer manufacture. Instead they were now engaged in trade, installations, maintenance and repair of electrical and electronic products.

Another five (5) firms were involved in manufacturing, but they did not manufacture the electrical/electronic components of their final products. They imported the electrical/electronic components of their products from their principals, fabricated the mechanical components and assembled the final product. The principals were foreign-based companies that appointed the local firms as their representatives or collaborators in the local market. An example was in the manufacture of electronic scales. The local manufacturer imported the electronic meter when complete, only to fabricate the metal casing and then assembled the scale. Others engaged in manufacturing that had little or nothing to do with electrical/electronic technology, such as manufacture of radiators, grinding stones and gaskets.

It was found that a further twelve (12) firms were not engaged in manufacturing at all, though listed as so. They only dealt in products and undertook works of electrical/electronic nature. They did trade, installations, maintenance, repairs and a few assemblies. They therefore did not add value in terms of technology adoption. Yet all these firms had been classified and listed as manufacturers of electric/electronic goods.

One of the firms was manufacturing electric and electronic goods, lead batteries and solar panels in particular, but it was a large enterprise. It therefore did not fall under the SMEEMEs, as it employed more than 250 workers.

The last fourteen firms were found to engage in manufacturing of electrical/electronic goods, as per this study's specifications, and interviews were conducted with their owners and/or managers. Therefore, the findings that are hereafter forwarded and discussed in this study are appertaining to these fourteen (14) firms, which made the population of the study, as well as research subjects.

3.4 Sample and Sampling Technique.

The study was a population census and thus no sampling was required. This was because the population was small and easily accessible within the study area as detailed in section 3.2.

3.5 Research Instruments.

An interview guide was used for data collection. The interview guide is presented in Appendix III. A letter of authorization to conduct the study was always shown to the visited subjects at the introduction stage. The interview guide was chosen because in-depth information was required. Interviews allow clarification and probing, which was good for such requirements. The interview guide comprised of five parts with structured questions, both open and close-ended. Where necessary various possible answers to a question were suggested. As much as possible the language of the questions and interactions was kept at the level of the respondents.

The first part of the guide contains questions on personal and business characteristics. They covered areas like the name and location of the business, when started, age group of the owner, products they manufacture and the number of workers employed. The second part was on education and training, both of owners and workers. Part three sought to capture the technology adoption efforts of the SMEEMEs. It had questions on the SMEEMEs' manufacturing machinery, any new products they had developed and the sources of their new product development technology. Part four raised questions on constraints facing SMEEMEs, both in modern technology adoption and in general growth. The last part of the guide inquired on various strategies that the SMEEMEs suggest for better technology upgrading in the sub-sector.

3.5.1 Reliability and validity.

The reliability of the interview guide was assessed. This is the degree to which it yields consistent results of data after repeated trials (Mugenda and Mugenda, 2003). First the guide was used during the pilot study with four entrepreneurs. The four were interviewed using the same guide, between two and four weeks later, during the data collection, and the responses from the two occasions were almost a replica of one another.

The researcher also took great concern on the validity of the study findings. This is the degree to which results obtained from the analysis of data actually represent the phenomenon under study (Mugenda and Mugenda, 2003). This being a study on technology development, the researcher relied on an experts meeting report on "key drivers for technology development" (UNCTAD, 2003). The experts meeting of 16th – 18th July 2003 came up with six key drivers for technology development. These were:

i) Skills (manifested in education and training)

ii) Technological effort (through research and development)

iii) Internalised technology transfer (through foreign direct investments)

iv) Externalized technology transfer (through licensing and arms length purchases)

v) Infrastructure (telephone, internet, electricity, clean water, etc.)

vi) Financial and fiscal measures (eg, targeted grants, subsidies, collective funds and insurance arrangements, preferential and advantageous tax rates, etc.)

The researcher made these drivers the key variables in assessing the case for modern technology adoption by SMEEMEs.

3.6 Pilot Study.

A pilot study was conducted among four of the SMEEMEs to test whether the research instrument would enable the researcher obtain the desired results. It was also necessary to help identify any mistakes in the instrument that would need correcting. The four firms were selected through random convenient sampling. The convenience was the immediate availability of the respondents. To contact the entrepreneurs, the researcher first made telephone calls to the firms to book appointments with the entrepreneurs. A major constraint here was that many of the telephone numbers gotten earlier were not working. Most of them had been changed and operational ones had to be looked for. Another constraint here was accessing the entrepreneurs. Many of them would be out of office and others out of the country. In addition, to get the four respondents, the researcher had to visit ten of the targeted SMEEMEs. This was because some of those visited turned out to be non-manufacturers.

On getting to the respondents, interviews were conducted with them, the researcher fielding the questions, carefully gauging respondents' answers for relevance and understanding of the questions, assessing the smoothness of the flow of the questions and putting down the responses. Questions that seemed not clear were noted while some of the questions in the first part, on General Personal and Business Characteristics, were found to be unnecessary and irrelevant as per the research objectives. Other than these, the interview guide was found to be flowing and extracting the desired information. Minor adjustments were made by elaborating questions that needed to be, and eliminating those general questions found to be unnecessary. By the end of the first week of May 2004 the pilot study was complete and the interview guide duly amended.

3.7 Data Collection.

The data collection exercise was conducted in the study area, Nairobi, between June and November 2004. It was conducted among the electric and electronic products manufacturers. Most of the firms were located in the Nairobi industrial area, along and off Mombasa road, Enterprise road, Likoni road, Lusaka road, Kitui road, Kampala road, Dunga road, Factory Street, Lunga Lunga road and Dare-salaam road. A few were out of the industrial area and were found in Parklands area and along Baba Dogo road. A map of this geographical area is presented in Appendix IV.

Data was mainly collected from primary sources to provide information on demographic and operational characteristics of SEEMEs, their modern technology adoption habits and the constraints they experience. This was mainly through getting responses from the entrepreneurs on the issues mentioned above using interview guides. Face-to-face interviews were conducted with the business directors/managers by the researcher at the respondents' convenient time.

The procedure used in the pilot test was followed in all the other interviews. Always started with telephone contact to book appointments, followed by interviews, always at entrepreneurs' premises. The researcher, as the interviewer, would ask and probe, where necessary, and put down responses. Most of the interviews were very short. This was because most of the thirty-six (36) firms visited were not manufacturing electric/electronic goods as alleged. It was only seventeen (17) of the interviews that went to the great details desired for this study. However, three of these interviews revealed the respondents could not fit as SMEEMEs. Two were manufacturing products that do not fit the description of electric/electronic manufacturing as explained earlier, while the other one employed more than 249 workers, and was therefore in the size of large manufacturer. This exercise stretched from June to November 2004. Though the population was not that big, the exercise took that long because many of the respondents were hard to find/locate. Some were out of the country and took two to three months to come back and give appointments. Some firms were also not easy to find. This was due to the fact that some had relocated from the indicated physical addresses, others had changed their names and yet others were using more than one name. Therefore, though the respondents were generally in close proximity of one another, it took time to get them and conduct the interviews.

Observations were made to confirm respondent's answers, on areas like range of products and machines in use, where possible. They were also used in capturing respondents' reactions, other than verbal ones, such as their enthusiasm or disinterest when asked about modern technology products or even their competition.

Very limited secondary data was used, as there were very limited sources. All the same some information was got from KAM on membership status to manufacturing associations of some firms and the benefits to the firms of such membership. Various articles were used to clarify points or issues raised by the respondents, such as on medium/large-scale integration and renewable energy. These were articles from journals, newspapers and the Internet, for example, Wandera (2004), Wahome (2004), Nicola (2000) and Naresh (2004).

3.8 Data Analysis.

Descriptive statistical analysis techniques were used to capture the education, training and technology adoption trends of the SEEMEs. SPSS version 10.0 for Windows package was used for data analysis. The data variables were defined, which were all string variables. Further the data was coded into descriptive variable labels and variable value labels, which were used in the statistical reports and charts. For example, in analyzing the responses on the methods of adopting new technology, descriptive variable labels included direct purchase, research and development, hire of technical experts, etc. The descriptive value labels were *yes* or *no* for all cases with the values *n* for *no* and *y* for *yes*.

After entering and coding the data, the researcher made use of the Analyze procedure from the Data Editor menu. From the Analyze menu, researcher made use of the Descriptive statistics sub-menu from which the frequencies procedure was selected. This procedure was preferred as it helps to obtain counts and summary statistics that were imperative for this study. The next step involved selecting the data variables to be processed by the procedure and finally executing. Outputs of this exercise were tables, pie charts and bar graphs. Most of the analysis of the data comes up with tendencies of the SMEEMEs expressed in frequencies and percentages. The findings of the data collection exercise were analysed, interpreted and discussed; and are presented in the subsequent chapters.

CHAPTER 4 RESULTS AND DISCUSSIONS.

4.1 Introduction.

This is a study of modern technology adoption by small and medium electric and electronic manufacturing enterprises in Nairobi. It specifically focuses on the operational and demographic characteristics of the SMEEMEs, their modern technology adoption efforts and the constraints they face in their operations. The research was conducted among fourteen (14) SMEEMEs in Nairobi by way of face-to-face interviews with the business owners or managers/directors, making use of interview guides. The data obtained was analyzed by use of descriptive statistics and SPSS version 10.0 to come up with the presentations in this chapter.

This chapter comprises the research findings of this study coupled with analysis and discussions of the results. This comprise mainly of descriptions, statistical summaries and graphic presentations of the characteristics of SMEEMEs, their technology adoption patterns and the constraints they face, followed by interpretations and explanations of the research results. They are presented in sections and sub-sections as per research objectives.

4.2 Demographic and Operational Characteristics of SMEEMEs in Nairobi.

As was explained in the previous chapter, the SMEEMEs were found to be quite few in Nairobi. Despite the many (45) classified as electric and electronic manufacturers by the Ministry of Trade and Industry, only fourteen (14) actually fitted the description. This section will report on the size of the SMEEMEs by employment, their distribution in the research geographical area, their registration status, their products range, their target markets and the competition they face.

4.2.1 Magnitude of SMEEMEs.

4.2.1.1 Employment size of SMEEMEs in Nairobi.

The size of a firm was here measured with the number of workers that it employed. The SMEEMEs employed between ten (10) workers and two hundred forty nine (249) workers each. Firms were classified as Small enterprises if they employed between ten (10) and forty-nine (49) workers, and Medium enterprises if they employed between 50 (fifty) and two hundred and forty nine (249) workers. This is illustrated in table 4.1 below.

Table 4.1 Total employment by SMEEMEs by gender.

Small firms				Medium firms			
Firm	No. of workers			Firm	No. of workers		
	Male	Female	Total		Male	Female	Total
1	27	5	32	1	202	33	235
2	23	3	26	2	47	9	56
3	42	5	47	3	79	11	90
4	13	2	15	4	208	38	246
5	48	2	50	5	57	3	60
6	13	1	14	6	200	48	248
7	40	2	42	7	71	7	78
Total	**206**	**20**	**226**	**Total**	**864**	**149**	**1,013**

Seven of the research subjects fell under small enterprises, employing between 10 and 49 workers each, and a total of 226 workers. They comprised what is commonly known as the "missing middle" (Gichira, 1997). The other seven, employing between 50 and 249 workers each, were classified as medium and employed a total of 1,013 workers. This shows the contribution of the small electric and electronic manufacturing enterprises in employment was very small. It was approximately a fifth of the medium electric and electronic manufacturing enterprises. The small electric and electronic manufacturing enterprises (employing 10 – 49 workers) are referred to as the 'missing middle', due to their few numbers and little contribution to employment and output (Ferrand, 1996) as compared to micro or medium enterprises. Concerning employment, the above result was a confirmation of this phenomenon in the electrical and electronic sub-sector. This portrayed a grim picture for the future growth of the sub-sector since the small enterprises are the ones expected to grow into medium enterprises. However, there was a very encouraging case of a single manufacturer. The firm started as a micro enterprise in 1982 with a capital of Kshs. 30,000/= and a staff of two. By the time of this study it was on the edge of the medium enterprises heading for large, employing 248 workers. It was an ideal case of the business metamorphosis model of start-up, survival, growth and expansion.

Table 4.2 shows employment levels by the SMEEMEs by firm size and by gender. Total workers employed by the SMEEMEs in Nairobi were 1,239 of which 18.24% (226) were by the small firms and 81.76% (1,013) by the medium firms. Of the total workers, 1,070 (86.36%) were men and the rest 169 (13.64%) were women. Men workers overwhelmingly exceeded their female counterparts. Furthermore, virtually all female workers were engaged in non-technical duties in the SMEEMEs. They were mainly in secretarial, clerical, sales, accounts and casual engagements. This could be explained by the fact that the sub-sector is a very technical one. That being the case, it was a specialized scientific area, and women in Kenya have been known to shun away from scientific careers (GOK, 1991). This could have manifested itself into this employment pattern in the SMEEMEs.

Table 4.2 Employment by firm size and gender.

Firm size	Number of workers			Percentage
	Men	Women	Total	
Small	206	20	226	18.24
Medium	864	149	1,013	81.76
Total	1,070	169	1,239	100
Percentage	86.36	13.64	100	

The SMEEMEs workers were classified in accordance with the permanency of their engagement and also in accordance with their job description. They were classified as, either family members, permanently hired, part-time, casual or apprentice. Twenty-three (23) of the total workers were family members (of the proprietor's core family). One thousand, one hundred forty six (1,146), i.e., 92.49%, of the workers were permanently employed, 24 (1.94%) were part-time workers, 37 (2.99%) were casual workers and 32 (2.58%) were apprentices. These classification of employees is illustrated in table 4.3

It is a clear observation here that, generally the SMEEMEs workforce was permanently engaged. This can be pretty obvious considering that the sub-sector requires skillful workers, who for consistency and efficiency sake, need to be maintained for reasonably long periods. However, considering the importance of increasing the size of quality human capital in the sub-sector, the percentage of apprentices was found to be low. This is particularly so because the apprentices have no direct charge on the firms' profitability. The firms are not obliged to give the apprentices any remuneration and/or employment. They just expose them to industrial experience and impart in them skills that will greatly build the necessary human capital for the sub-sector.

Table 4.3 SMEEMEs workforce classification by employment type.

Terms	No. of workers	Percentage
Permanent	1,146	92.49%
Part-time	24	1.94%
Casual	37	2.99%
Apprentice	32	2.58%
Total	1,239	100.0%

Further the workforce can be classified as falling under the descriptions of director, manager, supervisor, technician, other (include office workers such as secretaries, accounts personnel, sales force, messagers, drivers and clerks) and apprentices. Twenty-eight (2.26%) of the total workforce were directors, forty four (3.55%) were managers, ninety (7.26%) were supervisors, eight hundred twenty eight (66.83%) were technicians (includes all technical experts such as engineers, technicians, technical assistants, machine operators, etc.), two hundred seventeen (17.51%) were other categories, and 32 (2.58%) were apprentices. The bulk (77.64%) of the workers were, as expected, the technical people namely engineers, technicians and technical assistants. This is an explicit demand by sub-sector requirements.

4.2.1.2 Distribution of the SMEEMEs in Nairobi.

Of the 14 firms, all were situated in the Nairobi industrial area, between Jogoo and Mombasa roads, except one, which was located at Ruaraka area along Baba Dogo road. These two locations were suitable for the firms for they were out of the Nairobi Central Business District (NCBD), but within five kilometers from the Nairobi city cetre. In the two, there was no congestion, no noise pollution, there was ample space for building plants and parking, and infrastructure and utilities were planned and designed for manufacturing concerns.

4.2.2 Registration.

All the firms were registered businesses, with all of them registered as private limited companies, except one, which was a public limited company. The youngest of the firms was started in 1996 while the oldest was started in 1963. All the firms had the necessary operating licenses both from the Nairobi City Council and the Ministry of Trade and Industry. The fact that only one firm was registered as a public limited company indicates the limited access the sub-sector had to public resources for business development. This is because only public limited companies are allowed to solicit funds from the public through issue of shares, debentures, commercial papers or other means. Most of the SMEEMEs did not, therefore, have that benefit of tapping public resources, unlike in the developed economies.

4.2.3 SMEEMEs product range.

The products manufactured in this sub-sector included:

i) Cables. The cables produced included low and medium voltage electrical cables and aluminium conductor cables. Three firms (21%) were engaged in the production of these cables.

ii) Lead acid batteries, battery grade de-ionized water, battery grade acid, battery chargers, welding sets, welding rods, deep cycle batteries, solar panels, inverter power back-up systems, motive power batteries and standby batteries. There were three (21%) SMEEMEs involved in the production of these products.

iii) Three SMEEMEs were engaged in the manufacture of fluorescent lights, lighting fittings and accessories.

iv) Three of the SMEEMEs were engaged in the production of low voltage (LV) switchboards, motor control centers, cable support systems, automation and engineering systems, battery cabinets and distribution boards.

v) One firm was in the manufacture of electrical security locks and

vi) One was involved with making neon signs and sign writing.

Most of the firms were found to be dealing with many other products that they do not manufacture. They import them from trade partners in other countries.

It is evident from the above that most of the SMEEMEs did not manufacture the modern technology products such as computation, transmission and communication equipment. In fact only two of the SMEEMEs (14.29%) had ventured in this zone, as shown in Figure 1. These two engaged in manufacturing of industrial automation systems. This could be the reason why the tremendous technological and economic growth experienced by countries that have embraced the manufacture of modern technology products, such as USA and S. Korea, has not been experienced in the Kenyan sub-sector.

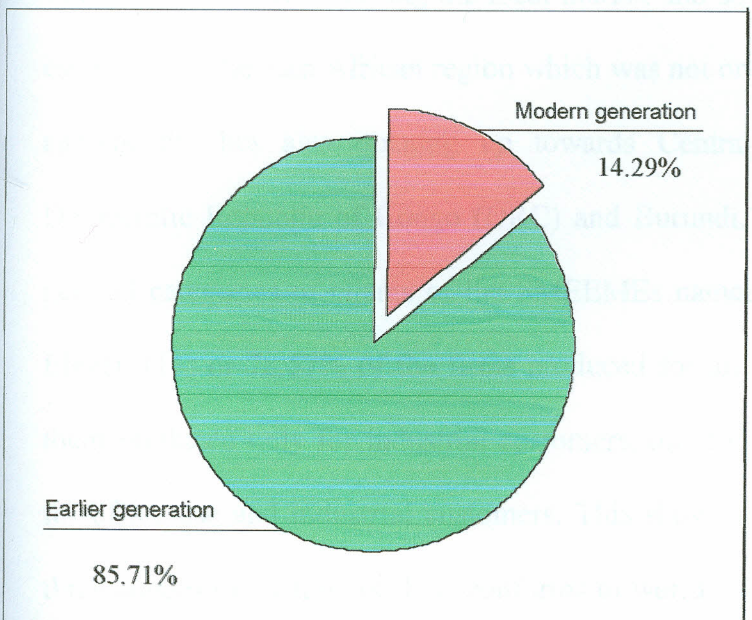


Figure 1. SMEEMEs classification by products manufactured.

4.2.4 Competition.

All SMEEMEs entrepreneurs agreed they face a lot of competition both from their local counterparts in the sub-sector, and from imports. Nine, i.e., 64.29%, of the respondents felt the challenge was very stiff while the other five, i.e., 35.71%, felt it was just stiff. Most of the respondents claimed the competition, especially from imports, was too much and could soon see them out of business, unless the government does something. However, two of them felt that the competition was healthy as it "pushes one to develop ones entrepreneurial skills". These two comments reflect on the tacit requirement for the firms, in the face of competition to develop competences and gain market edges. Failure to do this, one is faced with the threat of exit.

4.2.5 Markets.

The SMEEMEs were serving the local market and some also export some of their products, especially to the East African region which was not only being consolidated by regional trade agreements, but also opening up towards Central Africa, to countries like Rwanda, Democratic Republic of Congo (DRC) and Burundi. In the local market, there were three general categories of clients of the SMEEMEs namely, domestic, office use and industrial. Eleven (11) or 78.57% of the firms produced for all the three categories of clients. One of them produced only for industrial customers, one for both domestic and industrial, and one for office use and industrial customers. This shows that most of the SMEEMEs served the three classes of customers. This conforms to world patterns, as there are growth potentials in consumer electronics, office technology and industrial automation (Commonwealth Secretariat, 1985).

On their target markets, ten (10) of the firms had made efforts and progress in tapping from both the local and export markets. The other four (4) had only accessed the local market alone. It was encouraging that more firms were targeting export markets, a desired and established approach to raise production, productivity and expansion. This had been made easier by integration efforts in the region, such as the rejuvenation of the East African Community, peace reforms in formally war-torn countries (such as Rwanda, DRC and Burundi), which opened up their markets, and general awareness created by various government departments. It is noteworthy that none of the SMEEMEs targeted the developed markets of Africa such as South Africa and Egypt; leave alone the western developed countries or the NICs. It means that though the SMEEMEs were soaking allot of competition from these mentioned quarters, they had not created and were not planning to create competition for their adversaries in their own backyards. The competition punches, therefore, remained a one-way onslaught.

4.2.6 Entrepreneur profiles.

4.2.6.1 Age and gender of SMEEMEs entrepreneurs.

The SMEEMEs' entrepreneurs (business owners) were classified into age groups of five-year intervals. These age groups are shown in table 4.4. It is only in one of the SMEEMEs where the entrepreneur fell in the age group 36 – 40 years. Four of the respondents were in the age group 41 – 45 years, five were in the group 46 – 50 years and the last four were in the group over 50 years. Virtually all the entrepreneurs were above forty years. This indicated the sub-sector was lacking in young entrepreneurs, considering 64.29% of the entrepreneurs were 46 years and above.. This could be due to the fact that one requires time to accumulate experience and capital before embarking on such a serious and demanding venture.

All the respondents were male entrepreneurs. This is true except for the case of the public limited company. This being a public enterprise, with its shares available at the stock exchange, it is possible it could have a mixture of shareholders. However, confirmation of such shareholding was beyond this research. All the same, the sub-sector has exhibited a clear case of male domination of enterprise, which could as earlier mentioned be as a result of the fair sexes' tendency to shun science orientations.

Table 4.4. Entrepreneurs of SMEEMEs Classification by age.

Age group (years)	No. of entrepreneurs
36 – 40	1
41 – 45	4
46 – 50	5
Over 50	4

4.2.6.2 Formal Education of entrepreneurs.

All SMEEMEs' entrepreneurs interviewed had attained post-secondary education in the electrical engineering field. Table 4.5 below details the qualifications of the entrepreneurs.

Table 4.5 SMEEMEs Entrepreneur's educational qualifications in electrical engineering.

	Qualification.			
	Diploma	Hire National Diploma	Bachelor of science	Master of science
No. of entrepreneurs	2	2	8	2
Percentage	14.3	14.3	57.1	14.3

Only four of them had not attained university level of education. Of these four, two had attained diplomas and the other two higher national diplomas in electrical engineering. All the others (71.4%), except these four, had attained university level education. Eight of them (80%) were Bsc. Electrical engineering holders, while the other two (20%) were Msc. Electrical engineering holders. It is noteworthy that the SMEEMEs entrepreneurs were a well-read group, with 71.4% of them having attained university level education. Further to this, all the SMEEMEs entrepreneurs, in their post secondary education, specialized in the area of their current occupations, i.e. related to electrical and electronics engineering.

The entrepreneurs attained their education from three different countries, namely Kenya, USA and India. However, most of them (9 or 64.3%) were educated in India, 3 (21.4%) were educated in Kenya and the other 2 (14.3%) were educated in USA. It therefore seems it was Indian educated entrepreneurs who had made an impact in this sub-sector. The researcher also noted that the two entrepreneurs venturing into the much desired, manufacture of modern technology products, were among those educated in India. They were also both in the over 50 years-age group. Nevertheless, these two are only 25% of the eight of the entrepreneurs who are university trained and may therefore not be enough evidence to relate modern technology adoption tendencies to formal education levels.

4.2.6.3 Training.

The level of entrepreneur development was further investigated in terms of the type of training the entrepreneurs had received outside academic schooling. This is training basically after school, during employment and during business practice. In this aspect there were two broad categories of training, namely business and technical training. In business, the entrepreneurs had mainly received training in the areas of business management, sales &

marketing, Total Quality Management (TQM), change management, and human relations among others. The main institutions cited as the source of training include Kenya Institute of Management (KIM), Kenya Association of Manufacturers (KAM), Kenya Bureau of Standards (KBS), University of Nairobi (UON), Federation of Kenya Employers (FKE), Kenya Polytechnic and various foreign institutions.

All the entrepreneurs reported to have received technical training in electrical and electronics area. In fact all of them specialized in that area in their formal education up to diploma or degree levels, which is in itself very technical. Over and above this, they had undergone further technical training programmes, which varied a lot among the SMEEMEs. The programmes had been delivered in form of in-house seminars/classes, on-the-job training, external training locally (in technology institutions such as universities, polytechnics, etc), and external training abroad. Specific findings on the entrepreneurs training are presented in section 4.3.4.

4.2.7 Workers education and training.

4.2.7.1 Formal education of workers.

All firms, except one, recruited workers who had a minimum of O' level education, regardless of the department the worker was engaged in. The exceptional firm, which was engaged in manufacture of motor vehicle batteries, accepted graduates of NYS programmes. Some of these graduates may not have attained O' level education. Overall the sub-sector engaged workers who had received formal education of at least up to O' level. This implied a requirement of a fairly well literate workforce.

4.2.7.2 Training of workers.

Virtually all workers in technical departments of the SMEEMEs were said to have undergone some training above the formal education. Most had attained some pre-employment qualifications related to electrical/electronics fields. In fact all entrepreneurs, when hiring engineers, technicians and technical assistants required specific electrical/electronics qualifications from the candidates. All SMEEMEs offered some kind of training to their workers. This took place in two broad categories, technological skills training and business management training. Most of the firms (10, or 71.43%) gave preference to training in technological skills when offering training opportunities to workers. The other 28.57% of the SMEEMEs emphasized both training in technological skills and business management. None of the firms preferred business management training alone for its workers. There was therefore, a bias in technological training among the SMEEMEs workers. This was because the bulk of the workers were engaged to do the technical work. Only a few were exposed to management tasks and were therefore the few ones that required some business training. In many cases the business management tasks were in the hands of the entrepreneurs. Nevertheless, technical knowledge of electrical/electronics nature was imperative in the sub-sector, and this was why there were no SMEEMEs emphasizing business management only.

4.2.8 Conclusion.

The SMEEMEs in Nairobi were found to be quite few and mainly located within the industrial area. Most of them were engaged in the manufacture of the earlier generation products and sold their products locally, except a few who accessed export markets within the East and Central African region. Male entrepreneurs and workers dominated the sub-sector and both categories had attained at least 'O' level education and some technical training.

4.3 Modern Technology Adoption Efforts by SMEEMEs in Nairobi.

After getting the general characteristics of the SMEEMEs in Nairobi, an examination was made of the efforts they were making towards acquisition of modern technologies and skills upgrading of both owners and workers. These efforts are discussed in the subsequent sub-sections.

4.3.1 Manufacturing machinery.

All the SMEEMEs were using some kind of manufacturing machinery, which were all electricity powered. The machinery was bought locally or was imported, as new or as used. All the SMEEMEs interviewed had at some time acquired some machinery as new, but five of them had also acquired second-hand machinery. Majority (64.29%) of the SMEEMEs acquired their machinery when new, while 35.71% procured both new and second hand. When it comes to sourcing, six of the firms (42.86%) procured their machinery both locally and from outside. Three (21.43%) sourced their machinery locally while the other five (35.71%) only imported their machinery. This indicated that most of the SMEEMEs (78.57%) imported some or all of their machinery. The SMEEMEs manufacturing machinery was therefore generally foreign sourced.

The entrepreneurs were also asked to give their opinion on the current status of their machinery. They were to classify their machinery as either 'latest-state-of-the-art' or 'yesterday's but coping' or 'rudimentary'. 'Latest-state-of-the-art' referred to the most recent, and best available manufacturing machinery for the sub-sector. 'Yesterday's but coping' referred to those machines that were not as efficient as the latest, usually the model before the latest, but were still good for production. The 'rudimentary' were machines that are very basic and elementary machinery, which have been in use for long and are next to being obsolete. Seven of the respondents (50%) felt their machines were a combination of 'the-latest-state-of-the-art' and 'yesterday's but coping'. Their responses are detailed in table 4.6 below.

Table 4.6 SMEEMEs manufacturing machinery classification by status.

Status	No. of firms	Percentage
Latest-state-of-the-art	1	7.14
Latest-stae-of-the-art / Yesterday's but coping	7	50
Yesterday's but coping	5	35.71
Rudimentary	1	7.14

Only one of the respondents (7.14%) had 'the-latest-state-of-art' machinery. Five (35.71%) said their machines were 'yesterday's but coping' while only one accepted his machinery was rudimentary. Going by these responses it seems most of the entrepreneurs tended to use yesterday's technology. They do not have the latest-state-of-the-art machinery that exhibits the desired modern technology that would leverage their production and market command locally and internationally.

4.3.2 New product development.

An inquiry was made as to whether the SMEEMEs had developed new products in the last three years. The results are shown in Table 4.7 below. Six of SMEEMEs (42.86%) had not developed any new products in that period, while the others (57.14%) had. All the six that had not develop new products in the last three years were engaged in the manufacture of the earlier generation electrical/electronic products such as low voltage transformers, battery chargers, welding sets, neon signs, switch boards, electric cables, car batteries, warmers, fryers, lightings and fittings, etc. Six of those who had developed new products were also in the manufacture of the earlier generation products. The last two were involved in manufacture of both the earlier and modern technology products. This showed little difference between those that developed new products and those that did not. This is especially on those manufacturing the earlier generation products for they are split in the middle. However, it is noteworthy that all those who were in the manufacture of modern technology goods developed new products.

Table 4.7 New product development by SMEEMEs in Nairobi.

Product generation	Developed	Didn't develop	Total
Old	6	6	12
New	2	0	2
Total	8	6	14

The respondents were requested to give an opinion on how their business was doing in this age of globalization, both in coping with customer demands and accessing markets. The range of responses was 'at par with competition', 'coping' or 'struggling'. Their responses were analyzed in consideration of the generation of products they manufacture and whether or not they engaged in new product development. This is detailed in Table 4.8 below. Two of the respondents said they were at par with competition; they had no problem matching the rest of the world. The two had both developed new products in the last three years, but only one of them was in the manufacture of modern technology products. Seven of the SMEEMEs (50%) claimed they were coping. Despite competition from others who they feel had an edge in the market, especially importers, they still were able to get a good share of business to enable them break-even and make some profits. At least they were making ends meet, but most said they were just making it. The other five said they were struggling. They were finding it hard to keep pace with competitors in terms of quality and prices. They were hardly being able to break-even, and they kept on dropping staff and products so as to reduce costs. They were not sure of the future.

Table 4.8 SMEEMEs' performance, entrepreneurs' own assessment.

Product generation	Developed new products			Didn't develop new product			Total
	At par	Coping	Struggling	At par	Coping	Struggling	
Old	1	4	1	0	2	4	12
New & old	1	1	0	0	0	0	2
Total	2	5	1	0	2	4	14

The two firms that claimed to be at par with the competition were both involved in new products development, but one was engaged in the earlier generation products manufacture while the second was engaged in manufacturing both the earlier and new generation products. A producer could, therefore, be able to match world-class competition in this sub-sector regardless of the product generation the manufacturer is engaged in.

Of the seven SMEEMEs that were coping, five (71.43%), had developed new products in the last three years, but two (28.57%) had not. This is a pointer to the importance of new product development in today's global market. Nevertheless, the percentage of the firms that were coping but had not developed new products was significant. This may mean that it is still possible to do well in the sub-sector without developing new products, an implication of existence of unexhausted demand for existing products.

One of the five firms that were coping and had developed new products in the last three years was engaged in the manufacture of both the earlier and modern technology products. It is noteworthy that this firm is not among those that claim to be at par with the best SMEEMEs world producers. Though engaged in manufacture of both the new and old generation products, the firm still is not as comfortable as the two who claim to be at par with the world best. Four (80%) of the five firms, whose entrepreneurs claimed to be struggling, had not developed new products in the last three years. The picture emanating from the above description is that SMEEMEs that developed new products in the last three years, whether in the modern or earlier generation, were doing well or were coping with competition. Only one of the firms that had developed new products (12.5%) was reported to be struggling. However it is good to note that two of the six firms that didn't develop new products in the last three years were coping.

Five (41.67%) of the twelve SMEEMEs that were engaged in the manufacture of the earlier generation products were struggling according to the entrepreneurs. On the other hand none of the firms engaged in production of both the earlier and new generation products was struggling. Firms that were taking up new generation products, which usually involve modern technology, can therefore be said to be doing well or coping with competition better than those that have not. However, the percentage of firms manufacturing the earlier generation products that were doing well or coping with competition was quite high (58.33%). These firms were thriving in this earlier generation products even as the few local and most international firms venture into the new generation products. This implied an existence of a potential in these products that was yet to be fully exploited. This was evident in the case of manufacturing of cables where several cables demanded locally were still not being manufactured locally. As such, there was room in the electric and electronic sub-sector in Nairobi for manufacturing of the earlier generation products and the new generation products, though evidence showed that those involved in manufacture of the new generation products are likely to do better.

4.3.3 Acquisition of New Product Development Technology.

The firms that had developed new products were investigated as to how they got their new product development technology. Five methods of acquiring the new product development technology were cited. These were acquisition of new machines, getting into joint ventures, hire of technical assistance contracts/licenses, research and development and hire of technical experts. As illustrated in Figure 2 all the eight firms that developed new products engaged in research and development and acquired new machines. All the SMEEMEs that developed new products claimed that R&D method of technology acquisition was market driven, since they had to respond to customers' requirements. They therefore, did research to develop products to fit those customer needs. Beyond research and development, only two of the eight SMEEMEs that developed new products (25%) hired technical experts to assist them develop new products. Three of them got into joint ventures with foreign companies to start the new products while four of them got technical cooperation licenses. None of the firms used direct purchase of technical know-how and there wasn't a case of foreign direct investment (FDI).

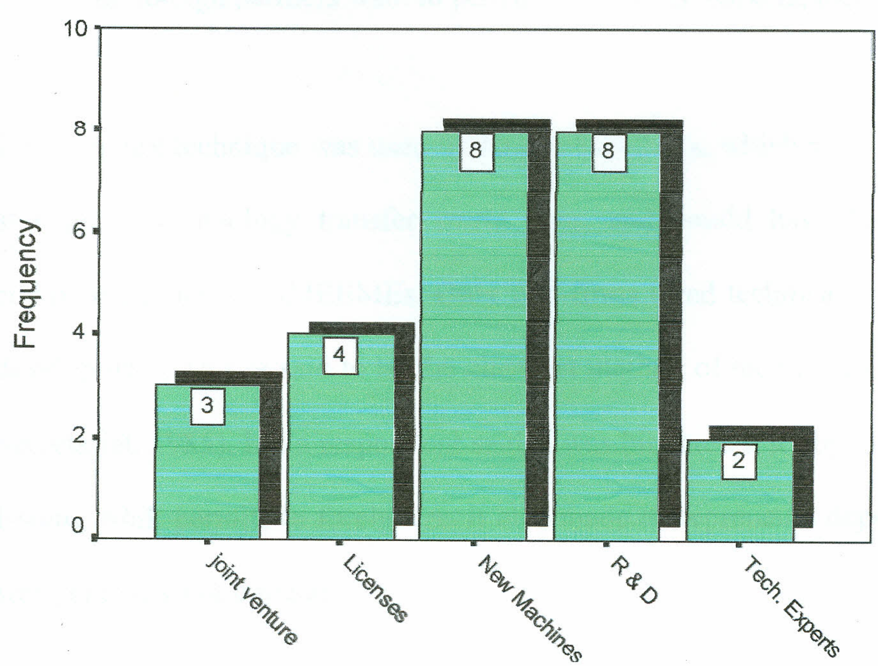


Figure 2. Product technology acquisition methods

The most common methods of developing new ideas and products, therefore, were research and development, and acquisition of new machines. Like most of the respondents said, R&D was very useful as it was used to find out and develop what the customers wanted. It helped to come up with customer tailored solutions giving manufacturers a market edge. It also made it possible for the manufacturers to benefit from tested technologies and still retain independence. However, it might not have been the best in developing new modern technology products, which might be without the local markets. The next most popular method was technical cooperation licenses/contracts. This was whereby locals manufacture foreign developed products with the permission of the principal companies in exchange for payment of royalty or license fees. The principal companies were the innovation owners abroad and the inventions they lease to the locals may involve production technology, brand names or even franchises. This worked well for the SMEEMEs as they did not have to spend much on R&D, but only pay royalties, which mostly were based on production. However, one of the respondents was quick to point out that this method is "economically correct but risky. The foreign partners want to penetrate the local markets, then dump the local partners".

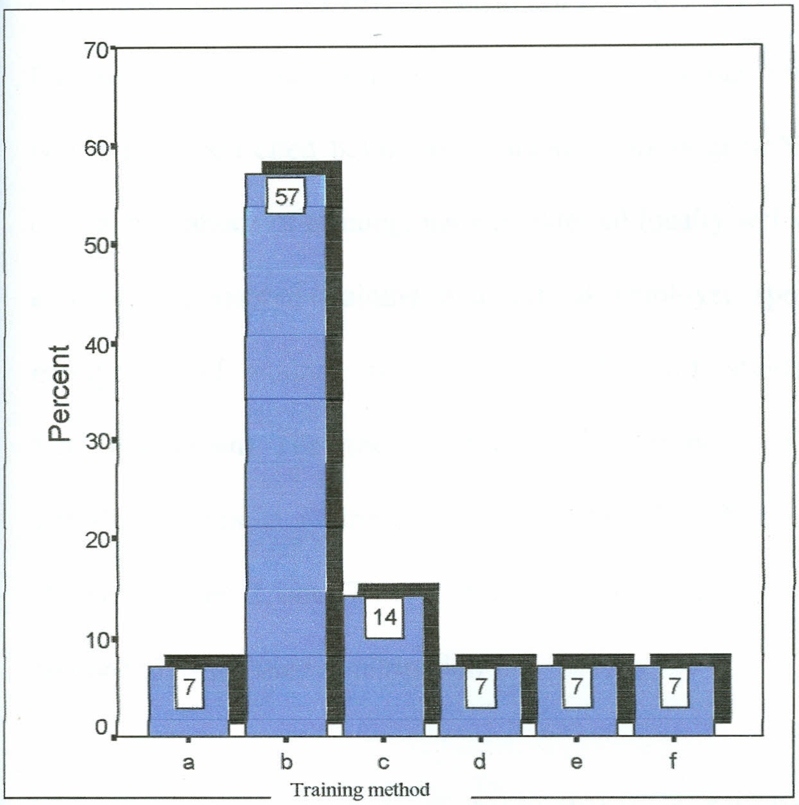
Joint venture technique was used by three SMEEMEs, which were a bit low. This is a major strategy of technology transfer world over, and would have been expected to be more common among the SMEEMEs. Only two firms hired technical experts to assist in product development. This is said to be the cheapest method of technology transfer (Commonwealth Secretariat, 1985), but a respondent said it was hindered a lot by government bureaucracy in issuing work permits to foreigners. It also made entrepreneurs dependent on the experts and was generally not popular.

It is noteworthy that there were no foreign investors in the SMEEMEs sub-sector in Nairobi. All the SMEEMEs owners interviewed were Kenyans. Direct foreign investment is a cheap method of bringing in modern technology into the country, since the foreign firms put in the necessary capital investment. Why had foreigners not invested directly in this sub-sector in Nairobi? The answer to this question is beyond this study but a pointer was a case of a foreign firm, which had invested in the country, but had to relocate to South Africa due to tax matters (Wandera, 2004). Overall, the major methods used in modern technology transfer worldwide (UNCTAD, 2003a), had not taken foothold among SMEEMEs in Nairobi. This was especially so in joint ventures, foreign direct investment, and technical cooperation contracts.

4.3.4 Training and skills upgrading.

The mastery, use and adaptation of new technologies call for more skills, higher levels of skills and different kinds of skills (UNCTAD, 2003a). As mentioned earlier, all of the entrepreneurs had attained post secondary education. They were generally well educated, giving them a good background for technical and business training. The same could be said of the workforce in general. The workforce was of at least O' level standard of education, giving it basic literacy for any further training. The SMEEMEs were therefore generally endowed with trainable personnel.

Both the entrepreneurs and workers of the SMEEMEs were exposed to some training, either technical training or business training or both. For technology acquisition purposes, technical training was the more relevant, and as mentioned in the first part of this chapter, it was emphasized by the SMEEMEs. However, at this juncture it is good to look at how the training was conducted among the SMEEMEs and, therefore, to what extent it facilitates modern technology adoption. Starting with entrepreneurs training, various methods were embraced by the sub-sector in entrepreneur training, which are detailed in figure 3 below.



Key.

a	In-house formal, in-house on the job, external locally employer sponsored and abroad employer sponsored.
b	In-house formal and in-house on the job.
c	In-house formal, in-house on the job and external locally self sponsored.
d	In-house formal, in-house on the job and external locally employer sponsored.
e	In-house formal, in-house on the job, external locally self sponsored and external locally employer sponsored.
f	All five combined

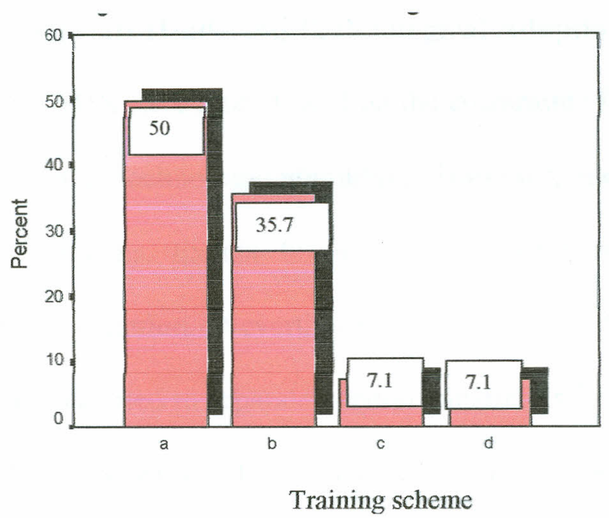
Figure 3. Methods used for entrepreneur/manager training.

All SMEEMEs had commonly used in-house formal means of entrepreneur training. These were usually in form of classes, seminars and demonstrations held within the entrepreneurs' premises, by experts on various processes, machines or products, which might have been new to the SMEEMEs. Possible reasons for this methods' popularity was its convenience, low costs and minimum interruption in day-to-day running of business. Another method applied by all the SMEEMEs was in-house-on-the-job training. This was whereby the entrepreneurs learnt new skills by doing and by working alongside experts. This was almost an inevitable way of learning, as one had to keep up with changes coming up from the environment, though it may not have required deliberate effort. As such all SMEEMEs entrepreneurs were engaged in it.

However, that was as far as their similarity went in training. As shown in Figure 4 above, eight of the SMEEMEs (57.14%) had not tried any other methods of training except in-house formal and in-house on-the-job entrepreneur training. One of the remaining six (7.14%), which had been cited before as an ideal business growth case, had embraced all the other common methods of training, namely external locally self sponsored training, external locally employer sponsored training and abroad employer sponsored training. As a result the enterprise had attained such international qualifications as ISO 9001, ISO 14001 and KAIZEN (Japan). The other five SMEEMEs entrepreneurs used different combinations of the last three methods of training. Two of the SMEEMEs (14.29%) used combination **c**, as shown in figure 2, one (7.14%) used combination **d**, one (7.14%) used combination **e** and the last one (7.14%) used combination **f**.

It is apparent from the above disclosure that most of the SMEEMEs were not making enough efforts in acquisition of skills. Over 57% of them relied only on in-house methods of skills upgrading, which could be very limited especially in acquisition of modern technology. This was due to the fact that providers of such training might not have been ready to come to the firm level or may be from outside the country. It was therefore hard to tap from them through in-house training techniques. This could have contributed to most of the SMEEMEs not engaging in the manufacture of the modern technology products.

Workers training schemes offered by the SMEEMEs include entry-level training (formal combined with on-the-job), apprenticeship, continuous training for existing workers to maintain and upgrade skills, external training locally, and external training abroad. All the SMEEMEs (100%) gave entry-level training as well as continuous training to existing workers. Nine of them (64.29%) gave apprenticeship programmes, only one (7.14%) offered external training locally and two (14.29%), offered external training abroad. Most of the SMEEMEs made use of at least two of these schemes. Figure 4 below shows the common combinations of workforce training schemes.



Key.

a Entry-level, apprenticeship and continuous training.

b Entry-level and continuous training.

c Entry-level, apprenticeship, continuous training and external training abroad.

d Entry-level, apprenticeship, continuous training, external training locally and external training abroad.

Figure 4. Workers training schemes

Seven of the SMEEMEs (50%) combined entry-level, apprenticeship and continuous training. Five of them (35.71%) made use of entry level and continuous training while only one (7.14%) exposed its workforce to all the five training schemes. The other one (7.14%) engaged its workers in all above schemes except external local training. Most of the entrepreneurs were therefore offering in-house training to their workers. Very few (14.3%) were exposed to external training, either locally or abroad. To learn new ideas, they therefore required experts to be availed at the employers' premises, who would impart the necessary knowledge or skills. This would be dependent on, among other things, availability of such experts in the desired technology area, their costs and employer's ability to meet them, availability of necessary technology hardware in-house and availability of suitable training utilities. Were most of these requirements readily available among the SMEEMEs? As it will be seen later on when looking at constraints facing SMEEMEs, they were not. Therefore, the ability of most SMEEMEs to train workers on modern technologies, which were basically externally sourced, and mostly from abroad, was limited.

4.4 Constraints Hindering Technological Adoption by SMEEMEs.

The SMEEMEs were interviewed on the constraints facing their businesses, more so the ones affecting their technology upgrading. However, most of the respondents just gave their general problems. Except for a few, they were not able to give specific problems on technology adoption. Nevertheless there were a few who were quite precise and the researcher has tried to separate general constraints from technology adoption constraints from the SMEEMEs who did not. The constraints forwarded as hindering both technological advancement and general growth were inadequate financial resources, high costs of technology, lack of technology information, lack of skilled workforce and high costs of production. Others were lack of raw materials locally, lack of utilities, inadequate markets, unavailability of some equipment, depressed industries, poor infrastructure, poor security, foreign competition, government bureaucracy, counterfeiting, lack of level playing field in local and regional markets, and lack of support by local technology consumers. The most common of these problems and the number of SMEEMEs that experienced them are illustrated in Figure 5.

All the SMEEMEs (92.86%), except one, complained of lack of adequate financial resources and that many projects they wished to undertake were often frustrated by this problem. Ten of the respondents (71.43%) complained of high costs of modern technology, while only two (14.28%) voiced the lack of technology information. Six of the respondents (42.86%) faced the problem of inadequate skilled manpower and ten of them (71.43%) were affected by high costs of production; resulting from high costs of raw materials, high taxes and high costs of power, among others. Six of the respondents (42.86%) complained of lack of raw materials locally while twelve (85.7%) complained of poor utilities especially electricity supplies. Another six (42.86%) cited lack of adequate market locally to justify investment in manufacture of modern technology goods, especially those of very large-scale and large-scale integration.

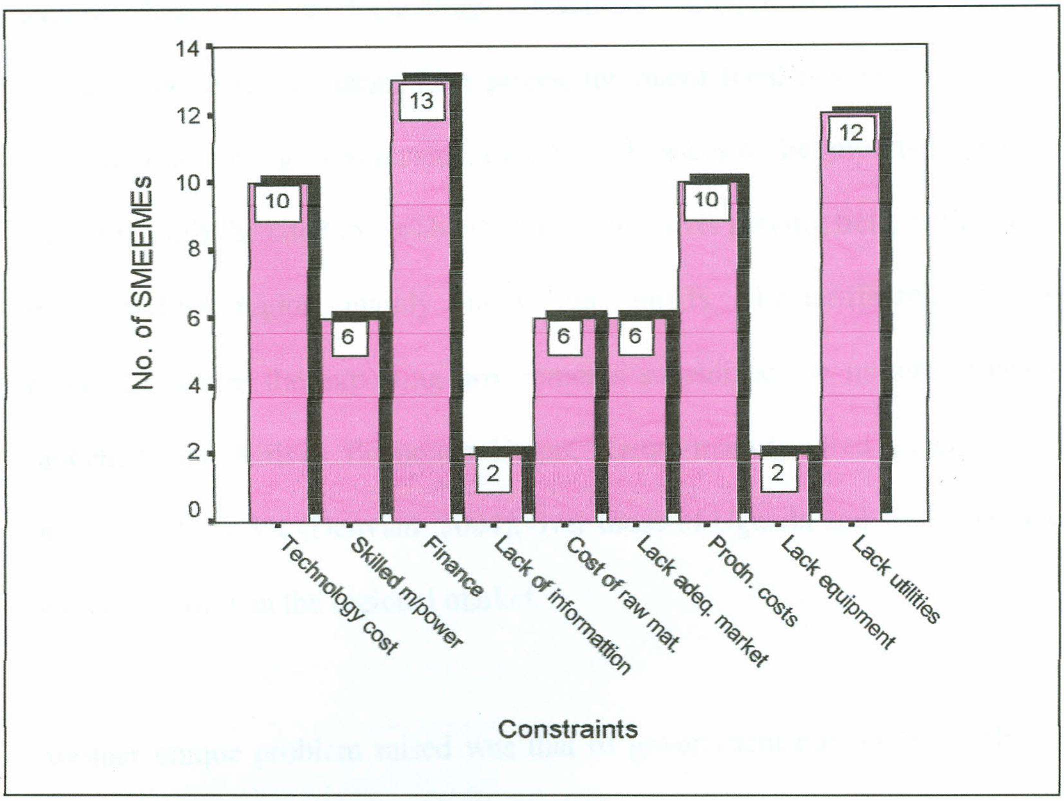


Figure 5. Constraints facing SMEEMEs in Nairobi

These include accounting and computing machinery, television and radio transmitters, apparatus for line telephony and line telegraphy, and mobile phones among others. One of them explained that the optimal volume of production to break even with most of such products was too high, and the local and regional markets could not sustain a demand enough to meet the optimal volumes. Yet, to venture into neighbouring markets, for exports, one must be successful in home market to start with (Naresh, 2004).

There were some constraints that were not very common among the SMEEMEs. Two firms, one in battery cells manufacture and another in cables manufacturing, complained of inadequate or lacking testing equipments/facilities. That, at times, ascertaining products standards and qualities was therefore a problem. Another unique problem was raised by a manufacturer of a wide range of electrical/electronic products, who was in both the earlier and the modern generation of products. He claimed that the "local manufacturers do not get support from the local technology consumers". Despite their production of high quality products and offering competitive prices, the major local buyers hardly bought from them. They kept on buying from outside, even though prices of the imports might have been higher. Related to this, he cited the problem of lack of a level playing field, both in the country and in the COMESA region, mainly due to duty tariffs. The tariffs regime favoured imports, especially where the exporting governments subsidized the imports. Even in the recently launched East African Economic Union, Kenya manufactured goods were subjected to a higher tariff, by 5% (Denvani, 2004), over those of Uganda and Tanzania, making the goods less competitive in the regional market.

Another unique problem raised was that of government bureaucracy. That permission was required from the government to engage in manufacture of some products such as semi conductors and telecommunication equipment. That permission could be very long in coming. Bureaucracy was also cited as a problem in the case of hiring technical experts from outside the country. The experts were required to get work permits, which were not easy to get. All firms in cables manufacturing complained of a depressed construction industry in the country. This had made demand of their products to shrink and they were forced to seek new markets and products. A respondent along Mombasa road brought up the problem of security. He said it had become a major cost, whereby his firm spent to the tune of Kshs. 500, 000/= per month on security alone. Finally, another firm in battery cells manufacturing complained of bad business practices from competitors, such as production of sub-standard goods and counterfeiting.

These were a myriad of constraints facing the SMEEMEs. The SMEEMEs were requested to give the three most severe constraints, ranking them in accordance to their perceived severity. Twelve (85.7%) of all the SMEEMEs gave competition from imports as their most severe problem. The second most severe problem was lack of financial resources, ranked second by twelve (85.7%) of the respondents, while poor utilities and infrastructure was third, ranked so by ten (71.43%) of the respondents. The above order of constraint severity was replicated by those SMEEMEs that did not develop new products in the last three years. However, when considering responses of only the eight manufacturers that developed new products in the last three years, the constraints ranking changed a bit but competition still topped, as shown in Table 4.9.

Table 4.9 Most severe constraints faced by SMEEMEs.

Rank	By all SMEEMEs	By SMEEMEs that did not develop new products.	By SMEEMEs that developed new products.
1.	Competition	Competition	Competition
2.	Inadequate finance	Inadequate finance	Lack of adequate mkt.
3.	Poor utilities & infrastructure	Poor utilities & infrastructure	Poor utilities & infrastructure

The SMEEMEs that developed new products in the last three years ranked competition as the most serious problem, followed by lack of adequate markets and thirdly the problem of poor utilities. A look at the responses of the two firms that manufactured both products of the earlier and modern generations show that they cited two of the constraints in Table 11 and an additional one, lack of trained manpower. One ranked lack of trained manpower as number one problem, followed by lack of markets and then poor utilities. The other one listed lack of markets as the top, then lack of trained manpower, and last poor utilities. This is illustrated in Table 4.10 below.

Table 4.10 Most severe constraints faced by the two SMEEMEs manufacturing both earlier and modern generation products.

Rank	A	B
1	Lack of trained manpower	Lack of adequate market
2	Lack of adequate market	Lack of trained manpower
3	Poor utilities	Poor utilities

It is clear from the above disclosure that the most pressing constraint to the SMEEMEs was competition from imports. We are in the age of globalization, in which business operations transcend country and regional boundaries, into what is termed as the global village. Most trade barriers that used to protect local firms from competition from outside have gone, through liberalization. The local products now face competition from imports, usually from more resourceful and more experienced manufacturers. The main assailants in this sub-sector were products from the Far East. Nevertheless, its good to note that the two firms which were venturing into the modern products manufacturing, shown in Table 11, did not take this to be a major problem, they did not rank it among their first three most severe problems.

Most of the SMEEMEs also lacked adequate financial resources. However this was not one of the top three most severe problems to the two firms mentioned above and to those that are developing new products. Considering that these last two groupings (the SMEEMEs venturing into modern generation products and those that developed new products) were the more serious players in the sub-sector, it may therefore mean that lack of finances was not a big problem in the sub-sector. Other than the issue of competition, there was great similarity in the problems experienced by the SMEEMEs that developed new products and those in the modern technology products manufacture. These were the problems of lack of adequate markets and poor utilities and infrastructure. Further to this, the two firms in manufacture of modern technology goods stressed the problem of lack of trained manpower. It therefore seems that the constraints perceived by the SMEEMEs to be crucial depended on their level of operation. Those in manufacture of the earlier generation products, who showed little or no advancement towards the new technology products, complained of fairly fundamental problems such as lack of financial resources and competition. The SMEEMEs that were more assertive in the sub-sector, those that had tendencies towards modern technology products, complained of constraints of a higher level. They complained of problems like lack of adequate trained manpower and lack of adequate markets for the modern technology products.

4.5 Future outlook.

What plans and strategies did the SMEEMEs have for the future? The respondents were exposed to this question, with a main emphasis on technology upgrading. First the respondents were required to suggest products they would want to develop in future for higher growth. All the respondents except one said they wished to develop new products. The exceptional one said there was no hope in manufacturing locally and he intended to concentrate on trade, installations, repairs and maintenance contracts.

Of the SMEEMEs that planned to develop new products in the future, ten of them (77%) wished to develop products in the earlier generation of electrical/electronic products. They wished to develop new products in their line of production that were improved, products that were more competitive. Most (77%) wanted to develop cheaper products to suit the low-income markets in the country. For example, firms in the manufacture of batteries and solar panels wanted to develop low cost products that the *mwananchi* can afford. They felt that though their products, especially solar panels, had a big untapped market, their costs made them out of reach for most people. In fact, in this area concerning energy, costs were a major market hindrance and the way forward was the development of alternative energy sources that are cost effective. A shot in the right direction was that of a firm which had developed a solar powered refrigerator. A security locks manufacturer expressed similar views. His main customers had been financial institutions and other big organizations. He felt that if he developed cheap security lock systems he would capture a wider market, covering schools, churches and domestic establishments. A neon signs manufacturer repeated this sentiment.

Other SMEEMEs wanted to develop new products that were not available locally. There were several products, though in the earlier generation of electrical/electronic products, that were not produced locally. Cable manufacturers had many examples. One of them claimed that welding cables, though widely used in the country, had to be imported. The firm had developed one and by the time of the study it had been taken to Belgium for trials. High voltage cables were also not produced locally, they were, in Africa, being produced in South Africa and in Egypt only. Trailing cables were not available locally and alluminium-overhead conductors were only manufactured by one firm in Kenya. All these were products most cable manufacturers wished to venture into in the future. Similarly, a firm producing kitchenware wishes to manufacture microwaves. All these examples illustrated the potential of these earlier generation products in the sub-sector and explained why many SMEEMEs involved in their manufacture have been performing quite well.

Three of the SMEEMEs (23%) aspired to develop products both in the earlier and the modern generation. They specifically mentioned transformers, high voltage switchgears, automation systems and communication equipment. By then, all medium and high voltage switchgears and transformers used in Kenya were imported. Local firms only provided technical support, installation assistance and commissioning. Yet these equipments were required by our large utility organizations such as power generators and distributors, and large electricity consumers. It therefore was a desirable thing to manufacture them locally to make them more affordable and to reduce delivery schedules. It was towards this end that one of the SMEEMEs was reported in the local press to have set aside Kshs. 500,000 million to establish a high voltage switchgear manufacturing plant in Nairobi (Devani, 2004). This was a firm moving in the right direction and has severally been referred to in this study as a success case of business-startup-survival-growth-and expansion.

On the manufacture of modern technology products that had become so popular among Kenyan and world consumers (such as computers and mobile phones), most SMEEMEs said they were out of reach. The main reason given for this was the lack of market to justify such investment locally, coupled with poor enabling environment. One of the entrepreneurs said that this was "technology so near, yet too far".

In general the SMEEMEs aspired to develop products in the earlier generation of electric/electronic goods. However, it is good to note that there were many products in this earlier generation, whose demand was not met locally. So, there was kind of 'new products to be developed in the old generation'. In fact all the SMEEMEs were targeting these earlier generation products except the very few that also envisaged manufacture of communication equipments and industrial automation systems.

4.6 Desired training.

Did the SMEEMEs entrepreneurs require further training to help them in their new product developments? Three (21.43%) of the respondents' answer to this question was NO. They said they did not require further training to enable them accomplish their future strategies. The three were in lighting & lighting fittings manufacture, security locks manufacture and neon signs manufacture. One, who had said he had no hope in local manufacturing, wasn't sure whether he needed further training or not. All the other ten expressed a need for further training. Six (42.86%) of them were not specific on the training they required. They just said they might need training in their relevant manufacturing areas. The other four (28.57%) were more specific, mentioning training interest areas of semi-conductor engineering, alternative energy, high integration dynamics, robotics and general industrial automation technology.

In conclusion, it was apparent that most of the entrepreneurs required some training for their future development programmes. However, most of them were not able to point out the specific training they required. This may reflect on their indecisiveness about the future, lack of vision or that the futures they were talking about were a bit far. Two of the few that were able to give specific training areas were those engaged in the modern technology products manufacturing. The other two were in batteries and solar panels manufacturing and both expressed the desire to learn more on alternative energy sources. All these four seemed to have been doing well, and it is therefore possible to conclude that the SMEEMEs that seemed to be doing well, also had more confidence in the future and had concrete plans for future development.

4.7 Affiliation to business associations.

Most of the SMEEMEs belonged to a business association. Only three did not. One of the three said it was not necessary, while the other two did not want to explain. All the others at least belonged to an association. Eight of them were members of Kenya Association of Manufacturers (KAM). Of these KAM members, one was also a member of International Batteries Manufacturers Association (IBMA) and Kenya Renewable Energy Association (KEREA), while another was also a member of Federation of Kenya Employers (FKE). Two of the firms were members of FKE only and one was a member of KEREA only. It seems most of the SMEEMEs associated with other members in their areas. This can be very good as networking can be done in tapping new ideas and methods of production among the sub-sector players. Most of the SMEEMEs belonged to KAM alone. This is a good association whose primary interest is to facilitate an enabling environment for manufacturers in Kenya. But it is a bit too general to ignite specific initiatives in technology adoption in a specialized area like electric/electronics. Though it has a department on electric/electronics, more of the operations are on finance and management of projects, trade promotion, business information services, and social and legal affairs. There is no forum for exchange of technological issues especially emerging ones.

It should further be noted that none of the entrepreneurs interviewed is a member of International Electric and Electronics Engineers (IEEE), the world renown association for electrical/electronic engineers of substance worldwide. This is a good forum for learning the best and the latest that may suit our local industries, which our entrepreneurs seem to have missed.

CHAPTER FIVE CONCLUSIONS AND RECOMMENDATIONS.

5.1 Introduction.

This study consisted of the analysis of the Small and Medium Electrical and Electronic Enterprises (SMEEMEs) in Nairobi. The analysis began by looking at the demographic and operational characteristics of the SMEEMEs. Next was the analysis of their modern technology adoption efforts and lastly the analysis of the constraints they experienced in their technology upgrading efforts. This last chapter will comprise of, first, conclusions, which is a summary of the findings of this study. This will be followed by recommendations on the way forward for technology upgrading for the electrical electronics manufacturing sub-sector and finally will be a small section on recommendations for further research.

5.2 CONCLUSIONS.

5.2.1 Demographic and operational characteristics.

1) Size of and employment by SMEEMEs.

The total number of SMEEMEs in Nairobi was found to be fourteen (14). Though many other firms had been included in authoritative lists as electrical and electronic manufacturers, they were found not to be so. Some do manufacturing but not of the electrical/electronic components of their products or manufacture products that cannot be classified under electrical and electronics. Seven of the 14 SMEEMEs fell under the classification of small enterprises, which employ between 10 and 49 workers. The other seven were medium enterprises, which employ between 50 and 249 workers.

The small-scale class of the SMEEMEs employed a total of 226 workers, while the medium-scale classification employed a total 1,013 workers. Total employment by the sub-sector was therefore 1,239 workers. Male workers overwhelmingly outnumbered female workers, comprising 86.36% and women 13.64% of the total SMEEMEs employment. 1.86% of the workforce were family members of the proprietors' core family. 92.49% of the workers were permanently employed, 1.94% were part-time workers, 2.99% were casual workers and 2.58% were apprentices. When classified according to their job descriptions, 2.26% of the workers were directors, 3.55% were managers, 7.26% were supervisors, 66.83% were technicians, 17.51% were other categories (such as accounts clerks, salesmen, secretaries, etc.) and 2.58% were apprentices. In general the SMEEMEs' workforce was male dominated. It was permanently engaged and most of the workers are technical workers.

2) Registration.

All the SMEEMEs were registered businesses as private limited companies except one, which was registered as a public limited company. This implies that most of the SMEEMEs were private initiatives of a few members who cannot reach out for public resources for their business expansion purposes.

3) Product range.

Most of the SMEEMEs (85.71%) produced the earlier generation products like lightings & fittings, cables, lead-acid batteries, security locks and switchboards among others. They had not taken up the modern technology products such as computation, transmission and communication equipments, which were making big sales the world over.

4) Competition.

Most of the SMEEMEs complained of stiff competition in local and export markets. The competition was partly from fellow sub-sector members but more so from imports, especially from the Far East. Nevertheless, two of the SMEEMEs didn't find competition much of a problem; they said they were competing at par with foreign competitors.

5) Markets.

Locally, the SMEEMEs products served domestic, office use and industrial markets. Eleven of them (78.57%) produced for all these three markets while one produced for industrial customers only. Another one produced for both domestic and industrial markets while the last one produced for both office use and industrial markets. However, in general it can be concluded that the SMEEMEs produced for all the three markets. Over and above the local market, ten of the SMEEMEs had targeted and accessed export markets within East and Central Africa region. Access to these markets had lately been enhanced by the rejuvenation of the East African Community and peace reforms in formally war-torn countries in the region like Somalia, DRC, Sudan, Rwanda and Burundi.

6) Entrepreneurs' profiles.

All SMEEMEs entrepreneurs were male except in the public limited company where the shareholding was not investigated. Most of the entrepreneurs (64.29%) were at least 46 years old. All the entrepreneurs had attained post-secondary level of education with 71.43% having attained university level education. Most of them (64.3%) were educated in India while the rest got their education in Kenya

(21.4%) and USA (14.3%). Over and above formal education, all the entrepreneurs had received technical training in electrical/electronics and business training, mostly through formal in-house training and on-the-job training. In general the entrepreneurs were a well-educated and trained lot in their area of specialization.

7) Workers education and training.

Most of the SMEEMEs (92.86%) employed workers who had attained a minimum of O' level education, which implies the sub-sector had a fairly well literate workforce. Virtually all technical workers had received pre-employment training in electrical/electronics related courses, which was a prerequisite for employment. They had been exposed to further training in their working places with 71.43% of the firms giving preference to workers' technological skills training while the other 28.57% emphasized both technological skills and business management training.

5.2.2 Modern technology adoption efforts by SMEEMEs in Nairobi.

Other than their characteristics, the SMEEMEs were investigated on the extent to which they use various methods of technology adoption.

1) Manufacturing Machinery.

All SMEEMEs had acquired new manufacturing machinery except 35.71% of them who also bought second-hand machinery. Most of the firms imported their machinery. Only one of the entrepreneurs (7.14%) had the latest-state-of-art machinery, while the rest generally had good machinery, which was described as 'yesterday's but coping'.

Only one entrepreneur had rudimental machinery. Overall the SMEEMEs are not using the best manufacturing machinery there is.

2) New product development.

Only 57.14% of the SMEEMEs had been engaged in new product development in the last three years. All those that were not involved in new product development (42.86%) were manufacturing the earlier generation products such as welding sets, battery chargers, neon signs and batteries. Among those that were developing new products, six engaged in production of the earlier generation products while two were engaged in both the earlier and the modern generation products.

On their performance in the market place in this age of globalization, the SMEEMEs responded on whether they were 'at par with competition' or 'just coping' or 'struggling'. Among the SMEEMEs that had developed new products, two (25%) were at par, five (62.5%) were coping and one (12.5%) was struggling. On the other hand, none among those SMEEMEs that didn't develop new products was at par, two (33.33%) were coping and four (66.67%) were struggling. It is apparent that those SMEEMEs that developed new products were doing well.

A further look into the performance in respect to products generation revealed that one of the firms at par was in the earlier generation products while the second was in both the earlier and the modern generation. This implies that a firm could match competition, whether it was producing the modern technology products or not. Six of the firms producing the earlier generation products were coping and five were struggling. Only one firm producing both the earlier generation and modern generation products was coping. No SMEEME is struggling that has endeavoured into the modern technology products. This points out that the firms tending towards modern technology products are performing better in the market place. However, it is note worthy that many of those SMEEMEs in the earlier generation products manufacturing were also doing well, to an extent of being at par with competition. This was an indicator of a lot of potential still existent in this earlier generation products manufacturing.

3) New product development technology acquisition methods.

Five methods were used by the SMEEMEs that developed new products to acquire the product and manufacturing technologies. One was research and development, which was applied by all the firms. Most said they prefer it as it helped them capture market trends and then act on them. Hire of technical experts was used by two (25%) of them while three (37.5%) engaged in joint ventures. Four (50%) of them used technical licenses/contracts and all those that developed new products always bought some new hardware for the new products.

The SMEEMEs were therefore mainly using R&D and acquisition of new machines to get new product technology. Other methods renowned world over to be very effective in technology upgrading were used by a few SMEEMEs while others were not applied at all. Less than 50% of the SMEEMEs were using joint ventures and technical licenses while there was not a single case of foreign direct investment. These three are the commonly used methods of technology transfer in the more successful economies and their limited application in the electric/electronic sub-sector may have made modern technology flows into the sub-sector very limited.

5.2.3 Constraints hindering technological upgrading of SMEEMEs

Many constraints were cited to hinder the development of SMEEMEs. Those that constrained technology adoption by the SMEEMEs were; high cost of technology, inadequate financial resources, lack of technological information and lack of skilled workforce. Others were lack of raw materials locally, lack of utilities, inadequate markets, unavailability of testing equipments, poor infrastructure, government bureaucracy, foreign competition and lack of support by local technology consumers. When asked to rank the constraints in accordance with their severity, the top three ranked problems by all SMEEMEs were competition from imports, lack of financial resources and poor utilities, in that order.

When considering only those firms that developed new products, competition from exports still topped, followed by lack of adequate markets and then poor utilities. However, when it came to the two firms engaged in manufacturing of both the earlier and the modern generation products, the top three problems changed to lack of trained manpower, lack of adequate markets and poor utilities. This shows that the SMEEMEs that were in the manufacture of the earlier generation products, who showed little or no advancement towards the new technology products, emphasized fairly general problems such as lack of financial resources and competition. The others that were embracing new products development and new technology products complained of more technologically based problems like lack of trained manpower and lack of adequate markets for the new technology products. However, lack of utilities was a common constraint to all SMEEMEs.

5.2.4 Future outlook of the SMEEMEs.

About 93% of the SMEEMEs expressed their wish to develop new products, of which 77% wished to develop products in the earlier generation of electric/electronic products. They wished to develop new products in the electric/electronic sub-sector that were improved and cheaper to suit the low-income markets in the country. Others wished to develop new products in this earlier generation that were not locally available. 23% of the SMEEMEs wished to develop products in both the new and earlier generations. They cited products like transformers, high voltage switchgears, automation systems and communication equipment. Most of these products were being sourced abroad and the SMEEMEs wished to manufacture them locally, to make them more affordable and to reduce delivery schedules. In general, most of the SMEEMEs were targeting product developments in the earlier generation products.

5.2.5 Affiliation to business associations.

Most of the SMEEMEs belonged to some business association. Only one did not. Most of them (57.14%) were members of the Kenya Association of Manufacturers (KAM), while a few belonged not only to KAM but also to more sector-specific associations such as International Batteries Manufacturers Association (IBMA) and Kenya Renewable Energy Association (KEREA). Though the SMEEMEs seemed to identify the importance of association and networking, the sector-specific associations that would enhance sharing of new manufacturing ideas were rather few.

5.2.6 Summary.

The small and medium manufacturing enterprises in Nairobi were found to be quite few and their contribution to national output was low in comparison with other industries. This was more so when you compared them with their counterparts in the developed and newly developed countries. Most of the SMEEMEs engaged in and wished to continue in the manufacture of the earlier generation products. Only a few had ventured into or were envisaging entering into manufacturing of modern technology products. Nevertheless, most of the new technology products were found to be out of range for the sub-sector for now. At the same time, it came out clearly that there was a lot of potential in the earlier generation products in this sub-sector. Many firms were engaging in their production and were doing very well, and illustrated there was much more room for production in this products. So, firms were doing well, whether engaging in manufacture of the earlier generation products or also venturing in modern generation products. However the firms that were doing well, that had a competitive edge in the market, are those that were using new technologies to improve their products and develop new ones in accordance to changing market demands.

Initiatives in modern technology by the SMEEMEs were found to be weak, with the most popular methods of technology upgrading being sparingly used. A horde of constraints were cited to afflict the sub-sector in its technology upgrading efforts, with the most common ones being lack of financial resources, competition from exports and poor or lack of utilities. Many of the SMEEMEs were found to belong to various business organizations, with most of them being members of the KAM while a few belonged to more professional associations.

5.3 RECOMMENDATIONS.

The following recommendations are made to enable SMEEMEs match foreign competition both in the local and regional markets:

First, the SMEEMEs must learn to respond to the changing demands in the market place. This, as evidenced in the study, is basically by engaging in new product development. Further, it has been proved that growth potential in the manufacture of the modern generation products is much higher than that of the earlier generation products, and therefore, as much as possible, it is good to embrace manufacture of these high premium products.

That various measures be taken by the government and other stakeholders, to contain the constraints facing the SMEEMEs and attract more investors, especially Foreign Direct Investment, into the sub-sector. These measures should include:

i) Abolishment of restricting legislation. Though most of the limiting legislations for technology transfer in Kenya in the past were abolished in the 1990s, there is need to iron out the situation farther. To attract more investment in this highly potential area, investors should be allowed to bring in experts from outside the country with ease. Issue of work permits to such experts should therefore be expedited. Issue of licenses to operate businesses involving high technology communication equipment and airwaves should be liberalized.

ii) Punitive tax regimes should be addressed especially on equipment and spare parts imports. To encourage more foreign direct investment in this sub-sector and technological growth, these taxes should be reduced and if possible zero-rated. Farther, new investors can be given tax holidays to attract them into the country and sub-sector. The foregone tax revenue for the government will be a small price to pay for future gains.

iii) Energy tariffs were found to be very high and prohibiting in Kenya. These rates should be reviewed to match or even surpass those of neighbouring countries to enhance the competitiveness of the SMEEMEs.

iv) It is desirable to establish a well-developed banking system with appropriate financing mechanisms that will improve the sub-sectors access to financial resources and improve their uptake of technologies. Public funding could also be increased to supplement the private incentives. This could take the form of targeted grants and subsidies, collective funds and insurance arrangements.

v) Provision of utilities. A major constraint among the SMEEMEs was lack of and poor quality electricity. Power outages were too many, which was a reflection of inefficiency of the power producers and distributors. To improve on such services, privatization of such services has long been recommended. This applies to other services for the sub-sector, such as water supply, telephone mainlines, internet hosts, road network and security services. However, given the monopolistic nature of most of these utilities, regulatory functions are important to ensure that public monopolies are not replaced by private monopolies (UNCTAD, 203a).

vi) Another strategy that is being used to promote technological activity among local manufacturers and attract foreign investors in many countries is establishment of science and technology parks. This is more so in the electric and electronic sub-sector and the Kenyan sub-sector has a lot to gain from such an establishment. A technology park is a property based development for the purpose of attracting high-technology business by providing at close proximity a pool of specialized labour, R&D facilities, consultancy services and business management expertise and venture capital (Alhassan, 2003).

Science and technology parks are a means of supporting a knowledge-based economy, and fostering market-oriented technological development. They typically accomplish this by bringing together academic, business and governmental organizations into one physical location, and supporting interrelationships between these groups through incentives established by government policies. In addition to providing space for business and production, the park can house centers for scientific research, and technological innovation and incubation, training and forecasting, as well as facilities for fairs, exhibitions and market development through popularization. This sounds just right for the Kenyan electric and electronics-manufacturing sub-sector, as this kind of arrangement seems to contain remedies to most of interventions required for the sub-sector. Unfortunately, such a programme is not in place. Nevertheless, an Investor in a technology firm in Kenya expressed a wish to establish a Ksh. 40 million-technology park to promote the development of Kenya's vibrant Jua Kali sector (Desai, 2004). This would be a desirable move but he observed that "more enthusiasm from the government is required in matters of industrialization and science".

5.4 Suggestions for further research.

Finally the researcher would like to suggest case studies to be done on firms that ceased their manufacturing initiatives in the sub-sector. Out of an initial target of 45 firms in this sub-sector, the researcher found out that 30 of them had stopped their electrical/electronic manufacturing practices. The circumstances, problems and technological tendencies, which precipitated in their demise of these firms, need an investigation. Why did they have to fold up their manufacturing operations? What can be done to prevent other firms in the sub-sector to go the same way? What lessons can be learned from these cases of failure? These are some of the questions that the suggested studies may endeavour to answer.

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APPENDICES.

APPENDIX I
INTERVIEW GUIDE.

AN EVALUATION OF MODERN TECHNOLOGY ADOPTION EFFORTS BY SMALL ELECTRICAL AND ELECTRONICS MANUFACTURING ENTERPRISES IN NAIROBI.

DATE_____________________ RESPODENT No.__________

PART I PERSONAL AND BUSINESS CHARACTERISTICS.

1. Business location? ____
2. What is the name of your business, postal address and telephone number?

   ____

   ____

3. a) Is the business registered? Yes _______ No ___________

   If yes, what form of business ownership is your business?

   i) Sole proprietorship
   ii) Partnership
   iii) Limited company
   iv) Public limited company
   v) Other (specify)

4. When was the business started? Year ___________
5. What is your age?

   20-25 years
   26-30
   31-35
   36-40
   41-45
   46-50
   over 50

6. a) What products do you manufacture?

   i)______________________________

   ii)______________________________

   iii)______________________________

   iv) ______________________________

   v) ______________________________

   b) Do you manufacture anything on contract or sub-contract? Yes __ No __

   If yes, which products do you manufacture on contract/sub-contract?

   i) ______________________________

   ii) ______________________________

   iii) ______________________________

7. a) Who are the clients for your products?

   i) Domestic consumers

   ii) Office use consumers

   iii) Industrial consumers

   iv) Other (specify)

8. Do you target the local market or export market? Local ___ Export ___

   If export, which are your export destinations and what products do you export?

Country	Product
i) ____________________	____________________
ii) ____________________	____________________
iii) ____________________	____________________

9. a) Do your products face competition? Yes ________ No ________

   If yes, who are your main competitors?

   i) ______________________________

   ii) ______________________________

   b) Are your competitors local or foreign? Local ____ Foreign ___ Both ___

   c) How would you describe the competition?

   i) Stiff __________ ii) Very stiff _______ iii) Weak _______

10. a) How many employees do you have in your business in total? __________

b) How many of the employees are men/women? Men ____ Women ____

c) How many of the employees are:

i) Family members? ___________

ii) Permanently hired? ___________

iii) Part-time employees? ___________

iv) Casuals? _________

v) Apprentices? _________

d) How many of the employees fall under the following classification?

i) Director _________

ii) Manager _________

iii) Supervisor __________

iv) Technician __________

v) Technical assistant ___________

vi) Other(specify) ____

e) How many on-the-job trainees do you have? _______________

PART II EDUCATION AND TRAINING.

11. What is the highest level of formal education you have completed?

Primary _____, Secondary ______, Post secondary _____, None _____

12. a) Have you been trained in technical skills? Yes ____ No _____

b) If yes, where were you trained?

____

c) What qualifications did you attain? ______________________________

____

d) Is your current business in your line of professional training? Yes___ No _

13. a) Have you undergone any training after starting this business/employment?

Yes _________ No __________

If yes, was it:

i) In-house, formal (classroom/seminar)? __________

ii) In-house on-the-job? _________

iii) External locally self sponsored? _________

iv) External locally employer sponsored? _________

v) Abroad employer sponsored? _________

b) What qualifications did you attain?

____

14. a) What type of business training have you received?

Name Courses.

____

____

____

None _______

b) Where did you train in business?

____

15. a) What is the minimum education requirement in your workers recruitment?

____

b) What special training do you require from your employee recruits?

____

b) In which area do you give preference when offering training opportunities to employees?

i) Business management.

ii) Technological skills

iii) Other (specify)

____

____

16. What training schemes do you use in training workers.(tick all applicable)

a) Entry level – formal training combined with on-the-job training. ____

b) Apprenticeship (training by working alongside an experienced person) __

c) Continuous training for existing workers to maintain/upgrade skill. ____

d) External training in local technical schools and colleges. _____

e) External training abroad. ___

f) Other (explain) ____

____

PART III TECHNOLOGY ADOPTION

17. a) Do you use any machinery in your manufacturing process? Yes ___ No __

If yes, did you acquire them as new or second hand?

New ________, Second hand ____________

b) Are the machines locally acquired or imported?

Locally ____________ Imported ______________

c) What is the source of power of your operations?

i) Human powered

ii) Petroleum

iii) Electricity

iv) Solar

v) Other (specify)

____

____

____

c) How would you describe your machinery?

i) Latest state-of-the-art

ii) Yesterday's but coping

iii) Rudimentary (very basic)

iv) Other (specify)

____

____

____

18. Have you developed any new product in your business in the past three years?

Yes _____, No _____ If yes,

a) How did you acquire your new product development technology? (tick all applicable)

i) Direct purchase of technical know how from abroad

ii) Purchase of technical assistance contracts/licenses

iii) Engaging in joint ventures

iv) Hiring of technical experts

v) Research and development

vi) Other (explain)

____

____

____

b) For any in a) that apply to your business, what makes you choose the method and how do you go about it?

____

____

____

____

____

____

____

19. Are you engaged in manufacture of the earlier generation electric/electronic goods such as electric cables, batteries, welding rods, armature rewinding, switch gears, electric bulbs & fittings, etc.? Yes ______ No ____.

If yes, i) How can you describe performance of your business in this age of globalization? _______________________________________

ii) Are you aware of a new generation of electric/electronic products that have greater potential in the new global village? Yes ___ No ___

If yes what efforts have you made or are planning to make so as to engage in manufacture of these new generation products?

____

____

20. Are you engaged in manufacture of the high potential, new generation, electronic goods such as office, accounting & computing machinery, industrial automation systems, communication and transmission apparatus, etc? Yes __ No _

If yes, i) How can you describe the performance of your business in this age of globalization? _______________________________________

ii) How did you learn of and get your technology for these modern products?

- through magazines and journals
- through direct purchase of technology abroad
- through purchase of modern machines
- purchase of technical assistance contracts/licenses
- joint venture
- hiring of technical experts
- research and development
- other (explain)

____

____

____

21. Is your business foreign owned? Yes _______, No ________

If yes, have you been using technology that already existed in this country or you introduced it?

____

____

____

PART IV CONSTRAINTS

22. a) Do you have any constraints that hinder your product development efforts?

If yes, list the major constraints in their order of severity.

i) ______________________________

ii) ______________________________

iii) ______________________________

iv) ______________________________

v) ______________________________

vi) ______________________________

b) How do the listed constraints hinder your business growth?

i) ______________________________

ii) ____

iii) ____

iv) ____

v) ____

vi) ____

c) What would you say limits you in your efforts to manufacture the new generation high potential electronic goods? (tick all applicable)

- lack of financial resources
- high cost of technology
- lack of technology information
- low levels of education and technical skills
- high costs of production
- lack of raw materials locally
- lack of utilities e.g. electricity
- other (explain)
- ____

  ____

  ____

PART V STRATEGIES FOR TECHNOLOGICAL UPGRADING

23. What products in this sub-sector do you aspire to develop for higher growth?

    i) ____

    ii) ____

    iii) ____

    iv) ____

    v) ____

24. Would you require any training in advanced technology for expansion of your business? Yes __________ No ____________

    If Yes, what technology? ____

    ____

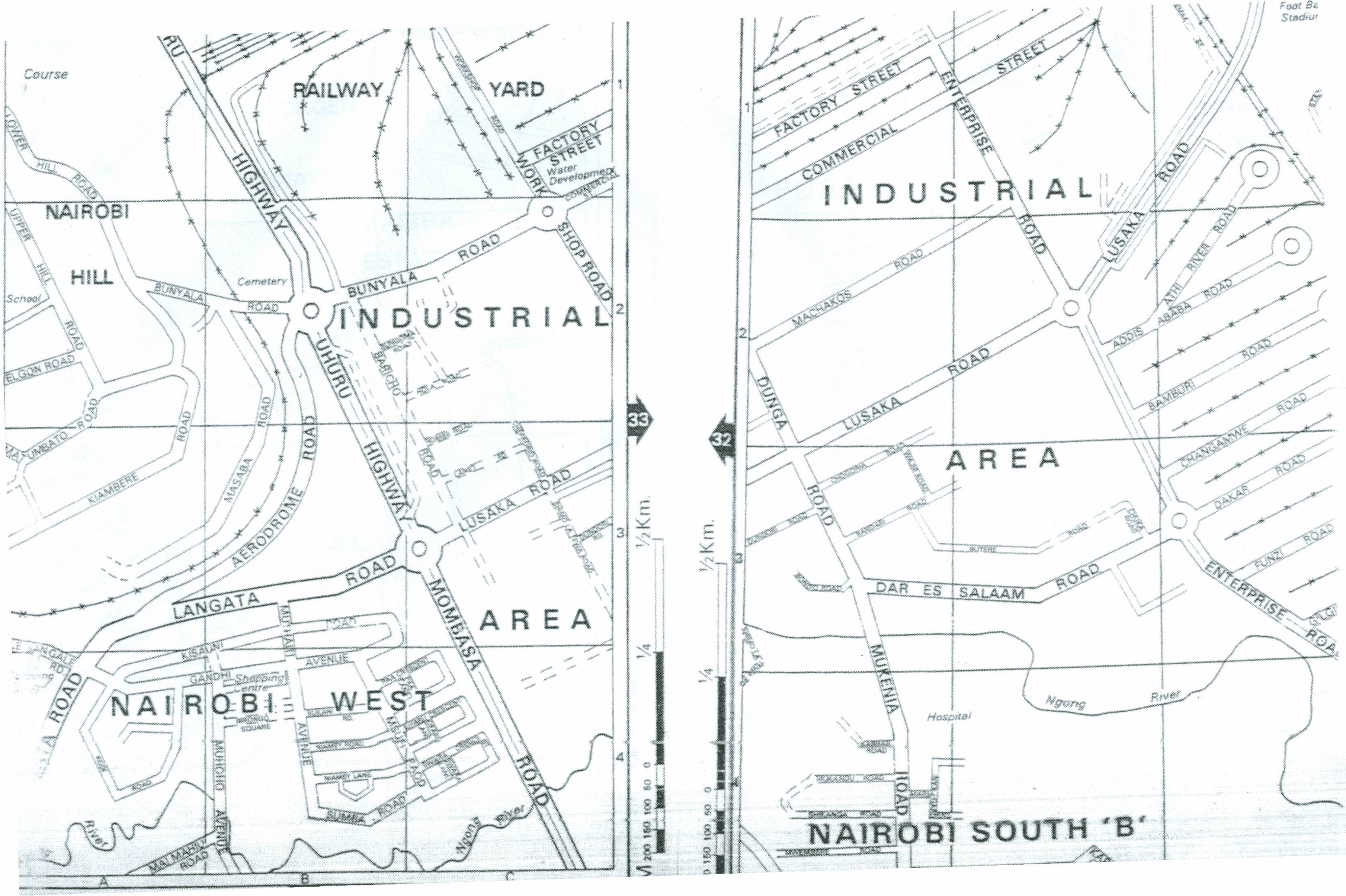
If No, Explain

25. Do you belong to any business association?

Yes, which one?

No, Explain

26. Identify the major strategies that would enhance technological capability not only of your business but also that of the sub-sector at large.


Course
RAILWAY YARD
FACTORY STREET
Water Developmen
COMMERCIAL ST
WORK SHOP ROAD
NAIROBI HILL
LOWER HILL ROAD
UPPER HILL ROAD
School
Cemetery
BUNYALA ROAD
INDUSTRIAL
UHURU HIGHWAY
ELGON ROAD
MASABA ROAD
KIAMBERE ROAD
AERODROME ROAD
LUSAKA ROAD
LANGATA ROAD
MOMBASA ROAD
AREA
KISAUNI
AVENUE
GANDHI
Shopping Centre
NAIROBI WEST
MUHOHO AVENUE
NIAMEY ROAD
NIAMEY LANE
SUMBA ROAD
Ngong River
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COMMERCIAL STREET
ENTERPRISE ROAD
INDUSTRIAL
LUSAKA ROAD
ATHI RIVER ROAD
ADDIS ABABA ROAD
MACHAKOS ROAD
BAMBURI ROAD
CHANGAMWE ROAD
DAKAR ROAD
FUNZI ROAD
DUNGA ROAD
AREA
32
DAR ES SALAAM ROAD
BUTERE
ENTERPRISE ROAD
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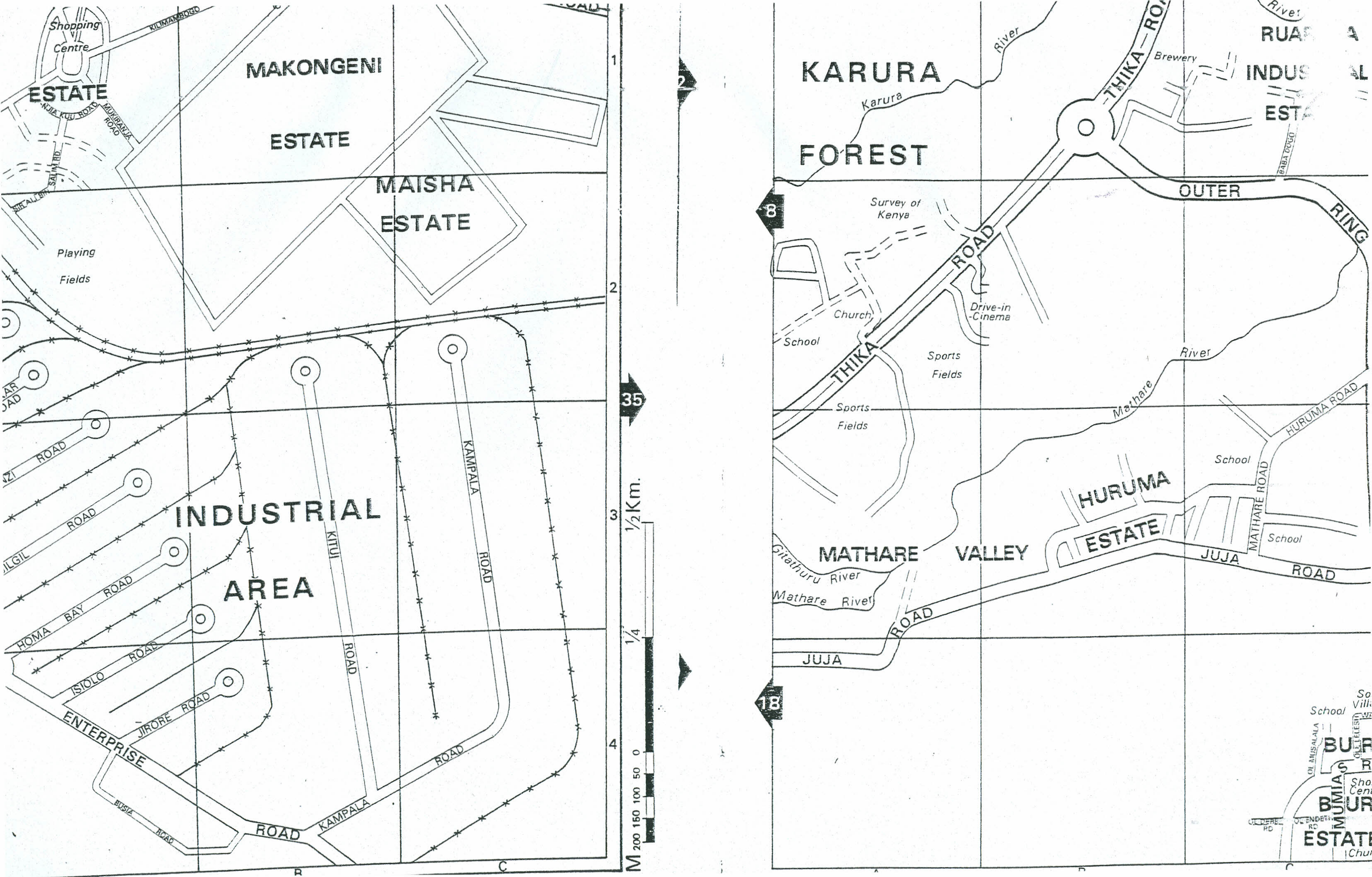
Shopping Centre
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MUKIRANJA ROAD
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Fields
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HOMA BAY ROAD
ISIOLO ROAD
JIRORE ROAD
ENTERPRISE ROAD
BUSIA ROAD
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FOREST
Karura
River
THIKA ROAD
Brewery
RUA
INDUS
EST
BABA DOGO
OUTER
RING
Survey of Kenya
Church
School
Drive-in Cinema
Sports
Fields
Sports
Fields
Mathare River
HURUMA ROAD
School
MATHARE ROAD
HURUMA
ESTATE
School
MATHARE
VALLEY
Gitathuru River
Mathare River
JUJA ROAD
JUJA ROAD
JUJA
School
MUMIAS
ESTATE