Chapter One

BACKGROUND

1.1. INTRODUCTION

The crucial role played by industrialisation in the development process has encouraged developing countries to focus on industrial development as a means to achieving rapid economic growth. But the extent of industrialisation, seen by many as a panacea to underdevelopment, is still low in Third World countries, particularly in Africa. The low level of industrialisation in Africa, particularly sub-Saharan Africa has been attributed to several sets of factors. Lall et al., (1994), Stewart (1991) and Ndam (1991) note that industrial development in sub-Saharan Africa has stagnated or declined because of: (i) external shocks, such as declining terms of trade, rise in interest rates resulting in high debt servicing, droughts and civil wars; (ii) poor macro-economic management and inappropriate or inadequate industrial policies such as inward-looking trade strategies, and financial market segmentation and suppression; (iii) a bias in policy against the small- and medium-scale private sector; and (iv) poor and inadequate institutional infrastructure to support industry.

Mytelka (1989 and 1992) however observes that the situation has arisen mainly because of the industrialisation model that African countries adopted from the start. That model is characterised by import reproduction\(^1\) rather than import substitution or export promotion and concentration on final-stage manufacturing (mainly assembling), which has limited technological learning and created industries that were highly dependent on imported capital and intermediate goods.

Another explanation is that advanced by James (1996) who sees the dismal growth of the industrial sector in terms of the poor performance of the dominant state-owned firms. He argues that since the establishment of state owned firms depends on foreign aid, their choice of technology and operation has been subject to a number of

\(^1\) Import reproduction implies the wholesale mimicking of products and processes from industrialised countries, without understanding the embodied technology and determining the relevance to the local environment and adaptability to local inputs.
conditionalities tied to aid and supplier's credit. Consequently, this has not only led to inappropriate technology choices, but also to dependence on imported inputs and limitations on production in areas that would compete with firms in the donor countries.

While many governments have tried to improve on their industrial policy environment and infrastructure with some level of success (World Bank, 1994), still industrial development in the 1990s has remained elusive. World Bank (1997) data shows that sub-Saharan Africa's average annual industrial growth rate has declined from 0.6 per cent during 1980-90 to 0.2 per cent between 1990-1995. The share of manufacturing value added as a percentage of gross domestic product (GDP) also declined from 36 per cent in 1980 to 30 per cent in 1995. Data from UNIDO (1996) also shows that the share of exports of manufactures and manufacturing value added of sub-Saharan Africa's industrial sector relative to the rest of the world and to other developing countries has been declining rapidly since the 1980s. This means that there are some factors among those given above that have not been adequately addressed to reverse the trends. According to Lall et al (1994) and Lall (1996) the key factor is technology development. He observes that although there is little doubt that external shocks and poor policies have adversely influenced the performance of the manufacturing sector in sub-Saharan Africa, these put together cannot adequately explain the extent of industrial slack and lack of competitiveness in the region. He therefore notes that the main constraints must be those related to technological development. Lall et al (1994:3) argue that it is "... the lack of the skills and knowledge needed to set up and efficiently operate modern industry... that explain[s] why much of African manufacturing remains confined to the lowest end of the technology scale and why it responds poorly to the improved incentives that structural [and policy] reforms have provided".

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2 Lall's argument is based on the observation that despite many other developing regions having endured similar external shocks and policies, the industrial development in those regions was much higher compared to that in the sub-Sahara region.
The lack of industrial technological capability is not a recent phenomenon. Many African governments realised this as far back as the 1970s. And, to circumvent the dearth of technology necessary for industrialisation, African countries decided to rely on imported technologies as a means of filling up the technological gap. Many African countries have since that time therefore invited foreign experts to prepare feasibility studies and design industrial projects and foreign entrepreneurs to invest and manage joint venture industrial projects with the government (Ndam, 1991) as a means to acquiring technology and realising rapid industrialisation. Through these joint ventures, import substitution industries were set up with multinational companies (MNCs) having the controlling shares in equity. While the government guaranteed the investment, MNCs were responsible for the transfer of turn-key technologies and management of the firms. The expectation at the time was that through these joint ventures and import substitution, a local technology base could be built from which indigenous technologies could be developed. This was based on the evidence from other developing countries like Brazil, India and Korea. Evidence from these countries had shown that technology imports can fill in the technology gap and hence lead to faster industrialisation. However, after a decade of heavy reliance on foreign investment and imported technology (Okello and Oluoch-Kosura, 1997) as part of an import substitution industrialisation (ISI) strategy, it was found that very little, was realised. This was because, unlike in Korea (Enos and Park, 1987) and Brazil (Dahlman, 1984) where technology imports were accompanied by the development of an indigenous technological base, in Africa this was not emphasised. For example Brazil ensured that the imported technology was used to develop the local technological capability through human capital formation and technology assimilation and adaptation. Apparently this is the same process that India (Jain, 1991), and Korea (Enos and Park, 1987 and Kim, 1986) went through in the 1960s and 1970s to develop indigenous technological capability and achieve faster industrial development.

However, in sub-Saharan Africa, since the importation of technology in the 1970s was seldom accompanied by efforts to develop indigenous technology, both the
industrial sector and local technological capabilities remained underdeveloped. This is because the government's industrialisation plans were narrow in focus. They primarily laid emphasis on foreign investment for employment generation while overlooking the critical issues of local technology capability and technological capacity building. Thus, the option of 'catching up' with the rest of the world in industrial development by filling the technology gap through importation and use of foreign technologies apparently did not yield the expected results. Besides being due to the fact that the plans were narrowly focused, this was partly because the African countries lacked the institutions and framework for technology adaptation and development. This is because most African countries have been complacent with regard to developing the necessary institutions for the development, innovation and adaptation of technologies that are suitable to their development needs.

These trends have worried many governments and disillusioned the continent's policy-makers, particularly because while their industrial development has continued to stagnate, that of other developing countries have made quite some progress. Questions therefore began to be asked as to why the disparity in performance persists. A retrospective re-assessment of the whole industrialisation plan and programme then showed that the differences in performance arose as a result of the inadequate creation of local technological capabilities (Wad, 1984). The assessment that the development of an indigenous technology base provides a foundation for rapid industrialisation led to the design of strategies to tackle the issue.

Although at a continental level, the first step was taken way back in 1973 it was not until the 1980s that concrete measures started being undertaken. In 1973, an intergovernmental committee of experts was set up with the support of the United Nations Economic Commission for Africa (ECA) to look into and advise on science and technology in Africa. Its main agenda was to find ways of strengthening local technology capability and means to achieving faster technology-led industrialisation. As a result of the committee's advocacy for a Regional Plan of Action towards the application of science and technology in development, two Conferences of Ministers
responsible for Science and Technology (S&T) in Africa (CASTAFRICA) were held in 1974 and 1979. While CASTAFRICA-I did not achieve much, CASTAFRICA-II came up with more concrete resolutions. Among the major resolutions of CASTAFRICA-II, which was held in Monrovia, Liberia, was that all African governments must strive to link their development with S&T, and that each country should have at least one department responsible for formulating S&T policies and related activities. These resolutions and recommendations that were contained in the ‘Monrovia Strategy for Economic Development of Africa’ resulted in a proliferation of S&T institutions in the continent.

CASTAFRICA-II therefore marked the forging of a common front in the search for better industrial strategies. Immediately after CASTAFRICA-II, an extraordinary assembly of the Organisation of African Unity (OAU) Heads of State and Government was convened in Lagos, Nigeria to adopt the Monrovia declaration. The Monrovia Declaration, that is the ‘Monrovia Strategy for Economic Development of Africa’ was then adopted by the OAU leaders as the ‘Lagos Plan of Action’. The ‘Lagos Plan of Action’ which was then presented to the Third United Nations Development Decade was committed to:

- the establishment of a sound industrial base with special emphasis on the development of the requisite national industrial and technological policies, capabilities and institutional infrastructure as well as the intra-African co-operation in order to permit the industrial take-off of Africa.\(^3\)

Further, the declaration was committed *inter alia* to the development of indigenous entrepreneurship, technical manpower and technological capabilities to make Africa’s people to assume greater responsibility in achieving rapid industrialisation.

In the 1980s many African countries started changing their perception on the role of technology in development as a result of the CASTAFRICA recommendations. In Kenya for example it brought about the establishment of a National Council of Science and technology, the establishment of autonomous research and

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development (R&D) institutions and a Ministry of Science, Research and Technology. The aim of the move was to develop local technologies, and assist entrepreneurs in the adaptation of imported technology and in innovation. Also, focus shifted from promoting industrial development per se to technology and industrial development as complementary activities. The aim was to shift from heavy dependence on imported technology to a certain level of technological self-reliance through the development of an indigenous technology base.

In order to develop an indigenous technological base in Kenya, government policies emphasised four areas: (i) generation of local technologies by strengthening the capacity of local technological development institutions, (ii) development of a well-trained work-force and adequate skilled manpower through the expansion of the education system, (iii) development of local entrepreneurship through the promotion of small-scale enterprises (SSEs), and (iv) development of a machinery and engineering services manufacturing sector.

In the 1980s therefore, the government increased its financial allocations to R&D institutions. Hence, these institutions were able to develop and expand their infrastructure facilities, increase their work-force, and invest more on R&D. The education sector was expanded with new institutions being established in the country and student enrolment increased. For example between 1980 and 1989, 24 new technical colleges were built and the number of students enrolled at all levels rose from 4.5 million in 1980 to 6.1 million in 1989. In the area of promotion of SSEs as seed-beds for the development of local entrepreneurship, the Kenya Industrial Estate (KIE) which was responsible for the promotion of SSE was strengthened and several other programmes such as the Nyayo Estates programme started. In the machinery

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4 The name of this Ministry has ever been changing. Presently the R&D institutes are under the Ministry of Research, Technical Training and Technology.

5 The Kenya Industrial Estate was established in 1967. Its main function until 1992 was to provide financial and technical assistance to small scale entrepreneurs in the manufacturing sector. In 1989, the KIE was transformed to a semi-autonomous statutory body so as to improve the delivery of its services to its clients. The Nyayo Estates was a programme that was started by the President in 1985 to assist micro-enterprises with the provision of facilities such as business premises, water, electricity and other physical amenities.
and engineering sector, although not much progress was achieved after 1985, the period between 1979 and 1984 witnessed a rapid increase in the number of metalworking sector (MWS) enterprises. During this period, (1979-84), due to the policies that the government had put in place, the number of metalworking units increased by 7.6 per cent from 556 to 598 units.

As a result of the above measures, studies (Coughlin, 1988; Juma et al., 1993; and King, 1996a) have shown that quite some considerable level of technological capability was achieved in Kenya, especially among the small-scale metalworking enterprises. This has been possible because of the government's effort to focus on the development of the metalworking and SSE sectors that are the linchpins to indigenous technology development in a developing economy. These sectors are known to be the most dynamic in technology adaptation, assimilation, innovation and development as a whole (Acs and Audretsch, 1990; Rothwell, 1986; and Rothwell and Zegveld, 1978). However, the technological dynamism of these sectors is strong if it is supported by the necessary fiscal, monetary and other policies that relate to industrial and technology development. Thus, the role that SSEs and MWS can play in promoting indigenous technology through technology adaptation and innovation is susceptible to the policy environment. Therefore any change in the policy environment leads to either an improvement or deterioration of the sector's capacity and capability to spearhead the development of indigenous technology in developing countries.

Thus, since Kenya in the late 1980s introduced economic reform policies and ultimately liberalised its economy in 1992, the new policy measures are bound to have had some influence, either positive or negative, on the metalworking SSEs' capability to develop the expected indigenous technology. Unless the impact of such policies is known well in advance, the process of attaining some level of self sufficiency in technology and advancing the rapid industrial development that the country had started to realise in the 1980s may be hindered. It is in this background
that a study to evaluate the impact of economic liberalisation on the technology adaptation and innovation process in SSEs is being proposed.

1.2 STATEMENT OF THE PROBLEM

The Study Problem

In the late 1970s, Kenya faced a worsening economic situation and economic growth started declining. There were indications of an economic recession mainly as a result of the burgeoning oil prices and falling agricultural commodity prices in the world market. As a measure to address these problems, the government came up with *Sessional Paper No. 1 of 1986 on Economic Management for Renewed Growth*. The subsequent development plan, the Sixth National Development Plan (1989-1993) was thus geared to implementation of the Sessional Paper. One of the important policies outlined in the Sessional Paper and expounded in the Plan was the provision of an impetus to small-scale firms in spearheading industrial and technological development. The new strategies and programmes spelt out in the Plan to boost the SSEs were: the development of an award scheme to promote innovation and invention; assistance to SSEs in obtaining technological information and knowledge; an examination of the legal machinery governing small-scale firms and the restructuring of supportive public and private sector efforts in training, research and development, business advisory services and counselling.

The SSEs responded positively to these measures. The small-scale MWS for example took the lead to locally produce some machinery and equipment, especially agricultural machinery; spare-parts; and simple machinery and equipment that were previously imported (Juma *et al.*, 1993 and King, 1996a). Technological adaptation capabilities also emerged. Increasingly, SSEs replaced imported raw materials with local substitutes and developed technological capacities and skills. At the time, it was observed (King, 1996a; Briggs *et al.*, 1995; and Coughlin, 1984) that the metalworking workshops and foundries in Kenya were gradually developing technologically to manufacture, for instance, the technology demanded by the country's rapidly growing fast food market. These capabilities related to the local
production of small-scale industrial machinery, spare-parts and other related capital goods. Some achievement in technology adaptation and innovation especially in the small-scale metalworking was being realised. This was however happening within the framework of a controlled economy with trade barriers to protect domestic manufacturers.

In the late 1980s the economic policy scenario changed. Inspired by the World Bank and International Monetary Fund (IMF), Kenya chose to implement drastic economic reforms. In the trade sector this entailed the removal of import and export barriers, domestic price decontrols, foreign exchange deregulation and the opening up of the domestic market to foreign investment. These economic reform measures were ultimately fully embraced in 1992. Since then, SSEs have been exposed to competition of a kind that is seen by some to have unleashed further innovative activity, and by others to have stymied the existing and future accretion of technology capabilities. The impact of liberalisation on indigenous technology development is thus an issue that needs to be empirically examined and analysed. Its effects need to be known because they may be impeding the technology adaptation and innovation activities and thus hindering productivity and economic growth in general. To avoid technology retrogression and to ensure a technology-led industrial and economic development, the existing environment under which SSEs are operating should be comprehensively understood. More so, the impact of economic reforms should be assessed early enough so that its adverse effects can be contained and its positive impact sustained.

Although the issue of the impact of economic reforms on technology development and innovation has enjoyed a prominent position in the research agenda in recent years, most of the work has centred on large scale firms. With the growing body of anecdotal evidence indicating that SSEs are playing an increasing role in technology innovation and adaptation, it becomes imperative that the effects of the recently

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6 See for example Jacobsson and Alam, 1994; University of Gothenburg and University of Nairobi, 1994; and Worgat et al, 1993;
embraced economic reforms in developing countries on SSEs' innovation activities be investigated. After more than five years of reforms, studies on innovation, particularly that in SSEs, should broaden their focus and include the assessment and evaluation of the impact of reforms on technology development. Though, a number of studies have been conducted to assess this, their scope has been limited to industrial development and technology institutions in general. None of them, particularly in the Kenyan case, have looked at the impact of reforms on SSEs and firm level technology innovations. But, since SSEs are key to Kenya's economic development, and are the most vulnerable to such policy changes, there is urgent need for such a study to be conducted in Kenya.

Though there are a few recent studies (Parker and Steel, 1992; Bagachwa, 1991; Dawson, 1991; Steel and Webster, 1991; and Frischtak, 1990;) conducted in other African countries such as Ghana, Senegal, Malawi and Tanzania which try to evaluate the impact of structural adjustment programmes on SSEs, they do not comprehensively deal with the issue of technology. Therefore they do not render themselves as reference points for the understanding of the impact of reforms on technology adaptation and innovation in SSEs in Kenya and the rest of the African continent. Moreover, in the instances where the studies covered the subject of the structural adjustment programme (SAP), technology development and SSEs (such as Kweka et al., 1997; Briggs et al., 1995; and Lall et al., 1994) their scope was limited to analysing the impact of economic reforms on technological capabilities and not technology innovation and adaptation as a whole. Thus, although attempts have already been made to try to understand the effects of economic reforms and liberalisation on industrial development, the growth of SSEs and technological capability, a gap in information and analysis still exists with regard to the impact of SAP policies on technology innovation and adaptation, particularly in Kenya. Therefore, in order for Kenya and other African countries to avoid retrogressing technologically, a comprehensive study is necessary to fill up the gap in the
information that is required for technology development planning purposes. In this object, lies the focus of the study.

**Objectives of the Study**

The overall objective of the study is to assess the extent to which structural adjustment programmes and specifically economic liberalisation has affected technological development in small-scale industries in Kenya. Within this broad framework, the specific objectives of the study are to:

1. analyse the relationship between technology innovation and adaptation and firm specific variables like firm size, age of the firm, age and education level of the entrepreneur, R&D expenditure, technical work-force employed, turnover, etc.
2. evaluate the impact of liberalisation policies on technological adaptation and innovation amongst small-scale metalworking enterprises;
3. find out how liberalisation has affected firm specific variables and identify the exogenous factors that influence and determine the rate and level of technological adaptation and innovation; and
4. propose and recommend practical policy measures that would enhance the positive aspect of liberalisation, and ensure a sustained indigenous technological development in SSEs in a liberalised economy.

**Research Hypotheses**

The main hypothesis of the research is that the introduction of economic liberalisation, especially that related to trade (e.g. import and export liberalisation, price de-control), finance (de-control of interest rates) and investments would have a mixed impact on technological innovation and adaptation in the small-scale MWS. The argument here is that with small-scale MWS enterprises being exposed to more competition under economic liberalisation, some would be more concerned with their survival in the market rather than growth and expansion through improvement of their technology. On the other hand, others would seize the new opportunities in the liberalised market to expand and also undertake technological changes so as to
remain competitive and survive. Some SSEs would be able to capitalise on the positive attributes both internal and external to the firm to introduce new technologies and improve on the existing ones.

One the one side, the expectation is that due to reforms, firms especially those in the small-scale category will cut down on the size of technical staff, experience falling turnover levels and profit margins, reduce expenditure on R&D, and curtail training of staff and participation in trade fairs and exhibitions all of which are core firm specific factors facilitating innovation. It is also expected that reforms would adversely affect the external determinants of the small firms' innovation capacity and capability. These include among others, government's financial support to R&D in public institutions and assistance to innovating firms; protection of the local market against technology and goods dumping; increasing the cost of skilled labour and generating scarcity of certain technical skills; and increasing cost of investment finance. Hence, these conditions that economic liberalisation create in the economy will repress and stifle technological innovation and adaptation activities in the small-scale MWS.

On the other side, the hypothesis is that reforms by bringing about some competition in the market, would lead to higher levels of dynamism and efficiency in firms. Consequently, firms will be able to increase their output, increase the export volumes of their products, recruit more skilled and technical staff, invest more on R&D, etc., and hence increase their ability and capacity to innovate. Similarly, it is possible that all the external factors that influence the firms' capability to innovate would improve and the latter would become more efficient. This side of the argument therefore proposes that the introduction of economic reforms will have a positive impact on the firms' technology innovation and adaptation activities in small-scale MWS firms.

What is being hypothesised here is that the impact of reforms can be like "a double-edged sword; threatening some firms . . . and revitalising some others . . ." (Adeboye et al, 1995:16). It is the nature and relative magnitude of these consequences that determine the effect of the economic reform measures on a firms' technological
innovation. Based on these conceptual projections, this study therefore aims at testing the following hypotheses:

1. That there exists a significant direct relationship between the SSEs' specific variables, such as age of the firms, firm size, number of technical and skilled personnel, the qualification and duration in previous employment of the entrepreneurs, the amount of R&D, and the firms' ability to innovate and adapt technology.

2. That there exists a significant direct relationship between SSEs' technology innovation and adaptation and the liberalisation measures implemented in Kenya.

3. Given these relationships, that the economic reform programme and liberalisation would have both a positive and negative effect on technology innovation and adaptation in the small-scale MWS in Kenya.

**Justification of Study**

If a country is to industrialise, then the development of an indigenous technological base is inescapable. As Kenya is planning to become a Newly Industrialised Economy (NIE) by the year 2020, the development of local technological capacity and capability to at least some level of self reliance is critical. In attaining the required capacity and capability, the hope lies with the SSEs because they are the linchpin to industrial development in developing economies. An analysis of the performance of SSEs under liberalisation, must evaluate whether the technological adaptation and innovation capability already created is not hampered in the wake of reforms. Such an evaluation is important because if under a liberalised economic regime the existing capacity of the SSEs to adapt and innovate is suppressed, then measures should be swiftly taken to avert it. Alternatively, if the liberalisation policies are found to favour innovative activity in the SSEs then these must be enhanced. Anything, short of such a move may not only make the vision of transforming the Kenyan economy to an NIE enunciated in the Government's Sessional Paper No. 1 of 1994 on Economic Recovery and Sustainable Development in Kenya to the year 2020
economy to an NIE status unattainable but also exacerbate dependency on foreign technology. Principally, this is what forms the basis of our study.

Secondly, the justification for the study also lies on the prime role that the MWS plays in technology development. Identified as the engine of technological innovation, the sector lies at the heart of the process of the generation and diffusion of technology. It supplies and increases the capital stock required for production while continuously offering new goods and creating new and greater demand. Presently, Kenya has one of the most developed metalworking industries in the region and especially in the small-scale size category. Its contribution to Kenya's industrialisation and economic development is therefore distinctive. The metalworking sectors' peculiarity arises from the fact that: (i) It provides the base for the establishment of other enterprises and serves a market segment, that in terms of both consumption and capital goods is not well catered for by large scale firms. As a result, low income earners and small-scale investors largely depend on the small-scale MWS for the supply of domestic appliances, equipment and machinery. (ii) It serves as an ancillary producer for other firms. (iii) It has exhibited a high capacity to assimilate and adapt foreign technologies and develop indigenous technological capability. These factors thus warrant a study to look into the sector under the present condition of economic reforms, which apparently are affecting both the firms and its clientele.

In summary, it is therefore hoped that the study will complement the lately emerging literature on the effects of SAP and in it, technocrats would find data based upon which they can formulate future technology development policies. The findings and recommendations would provide the background to the search for ways and means of enhancing the positive aspects and at the same time curtailing the adverse effects of liberalisation and economic reforms in general.
1.3 RESEARCH METHODOLOGY

Scope and Design

The conceptual framework adopted for the study has determined its scope and the research techniques employed. Instead of taking a broad view of the technology production and mastery process as has been the case with other similar studies (Mwamadzingo, 1996a; Oyelaran-Oyeyinka et al.; 1995; Briggs et al., 1995; and Lall et al., 1994), the research focuses on the post-investment stages of technology innovation and adaptation. To capture the actual technology development process in small-scale firms, where most of it is incremental and minor in nature, emphasis was on the post-investment stage because very little if any adaptation and innovation activity goes on at the pre-investment stage.

A multilevel approach where data is obtained from both the firm level and the national level, form the basis of the scope and design of the research. This is because technology capabilities are developed, acquired and accomplished at the firm level and at the national level. At each of these levels, the study investigated what spurred firms to institute changes in the factors, mostly inputs related (e.g. R&D expenditure, technical personnel staffing levels, capital acquisition, etc.), that influenced the technology development process since the 1990s. Since the study postulated that there is a direct relationship between the factors that influence firm level and national level technological development and the specific performance indicators of the firms and institutions, these were also assessed. The study therefore investigated how firm specific variables such as age, size, levels of employment, R&D expenditure, and investment in machinery and equipment affected technology innovation and adaptation in them.

In attempting to capture the impact of liberalisation on the technological activities of the SSEs, the study analysed how price decontrol, exchange rate floatation, import and export liberalisation and interest rate decontrol have affected the firms' performance. At the institutional level, the economic reform issues analysed in terms of their performance and subsequently their ability to support and promote
technology development, are cuts in government expenditure, commercialisation of services, and retrenchment programmes.

In scope, the research is however limited to small-scale MWS enterprises and to those institutions that are involved in the promotion of SSEs technologically. The rationale of the study coverage being confined and narrowed to the SSEs in the MWS is as discussed in the justification of the study.

**Data Collection**

Much of the study is based on quantitative and qualitative data obtained from evidence and opinions sought from selected SSEs in the MWS, public and private institutions and government policy-makers. The study is based on both library research and field investigation. During the desk research, the available literature on the subject was reviewed and information on the Kenyan manufacturing sector and specifically SSEs collated. Likewise, reviews were made of materials and secondary data on economic reform policies and institutions established to promote the growth of SSEs and assist in technology development in the industrial sector.

Published records from government departments like the Central Bureau of Statistics (CBS), Department of Industry, Investment Promotion Centre (IPC) and other relevant institutions like Kenya Industrial Research and Development Institute (KIRDI), Kenya Association of manufacturers (KAM) and Kenya Industrial Estates (KIE) were the main sources of data. Other important sources of data during the library research stage of the study were scholarly and consultancy studies. After the library research work, a survey was undertaken. At this stage, a field survey of selected SSEs, institutions and government officers was executed as detailed below:

**Field Survey**

Due to incompatibility of the data from primary and secondary sources that was gathered through desk research, the study undertook a field survey. This supplemented and complemented what existed and provided a set of coherent data for analysis. The starting point of the field survey was a field cognisance study where
the SSE firms to be studied were identified for purposes of sampling. This initial phase of the survey also identified institutions in the country that support and collaborate with SSEs in their technology development activities. After the field cognisance study, an actual field survey was undertaken as detailed below.

**Survey of Firms**

Initially 150 firms were to be covered in the field survey. The sampling of these firms was based on a stratified random sampling method from a list of all known existing small-scale metalworking enterprises. The list of all known existing small-scale MWS firms was compiled from KIRDI's directory of manufacturing industries in Kenya, KIE's project profiles and SSE databases in the Ministry of Planning and National Development.

Once the list was drawn the firms were then categorised according to their regional location namely Nairobi Area (Nairobi city and its environs), Coastal region (Mombasa town and its environs), Central Region (Thika and Nyeri towns) and Western region (Kisumu and Nakuru towns). For each of these regions, thirty SSEs were randomly selected except for Nairobi where 60 were selected. The proportionate distribution of the firms was based on the weightage of the number of firms in the region. This process ensured that the sample selected is representative of the sector nationally.

During the survey however not all the 150 sampled firms were covered. Due to difficulties in contacting busy entrepreneurs and persuading them to take part in the lengthy interviews in case of visits and non-response for unknown reasons in case of mailed questionnaires, only 118 firms were covered.

For each of the 118 sampled firms covered, a full structured and open ended questionnaire was administered (Appendix M). The questionnaire, which was administered to the firm managers and/or firm owners, solicited specific information on all issues pertaining to the firms' technological innovation and adaptation activities. Information on the type of technological adaptation and innovation carried out during
the pre- and post- liberalisation period was sought. Data was also collected on firm specific variables that influence technology activities such as number of research personnel employed and R&D expenditures, technical staff training, the levels of turnover and profits, existing linkages and collaborations with government and private sector R&D institutions, etc.

Through the questionnaire, information was also sought on how firm specific factors have been affected by liberalisation. Specifically, the variables studied among the firms that were expected to have been influenced by liberalisation were capital investment levels, education and skill levels of the work-force including the management, R&D expenditures, number of persons engaged in R&D, number of collaborations with technology institutions, allocation of funds by the government for R&D, public and private sector institutions support, etc.

The questionnaires from the 118 firms were then prepared for coding. However, during the coding and analysis of the data, 26 questionnaires had to be discarded due to the incompleteness of the data provided. Essentially, therefore, only 80 firms out of the 118 that were covered were included in the study. The regional distribution of the 80 firms that were actually included in the study is as shown below.

<table>
<thead>
<tr>
<th>Region</th>
<th>Number of Firms Covered</th>
<th>Percentage of Total</th>
</tr>
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<tbody>
<tr>
<td>Nairobi Area (Nairobi city and Athi River)</td>
<td>43</td>
<td>53.8</td>
</tr>
<tr>
<td>Coast region (Mombasa)</td>
<td>15</td>
<td>18.8</td>
</tr>
<tr>
<td>Western region (Kisumu, and Nakuru)</td>
<td>14</td>
<td>17.5</td>
</tr>
<tr>
<td>Central region (Thika and Nyeri)</td>
<td>8</td>
<td>10.0</td>
</tr>
<tr>
<td>Total</td>
<td>80</td>
<td>100.1</td>
</tr>
</tbody>
</table>

**SSE and Technology Support Institutions**

The research also involved the carrying out of interviews with identified institutions engaged in promotion, research and development activities in the industrial sector, particularly those that collaborate with SSEs in the MWS. Institutions both in the public (KIRDI, Appropriate Technology Centre (ATC) of Kenyatta University, etc.) and private sector including non-governmental organisations (NGOs) such as the Kisumu Innovation Centre- Kenya (KIC-K) and the Appropriate Technologies for Enterprise
Creation (ApproTEC) were covered. Using a check-list questionnaire form, information on the activities of these organisations was sought through focused interviews with their chief executives or project officers. Emphasis was on obtaining data on their operations since the mid-1980s and getting the officers' opinion on how liberalisation has affected their operations, programmes and projects.

**Government Officers**

Besides interviewing firms and institutions, discussions were conducted with senior government officers, who are policy-makers, and private sector personalities involved in the promotion and development of SSEs. The focus in gathering data from this second category of respondents was to seek the officers' interpretation of the government's industrial and technological policies. Their views and interpretation of the impact of economic reforms on the industrial and technology development programmes targeted at the SSEs were also sought.

The government officers interviewed included those from the Ministry of Commerce and Industry, Ministry of Research, Technical Training and Technology, Ministry of Finance and Ministry of Planning and National Development. In the private sector, those interviewed included officials from KAM, National Chamber of Commerce and Industry (NCCI), Federation of Kenya Employers (FKE) and Small-scale Enterprise Associations.

**Data Analysis**

Data collected from the various phases of the data collection process, as discussed above, was then coded and organised for computer analysis. The organisation of the data collected through the questionnaires involved, among other things, standardisation of various variables to common units of measurement. Also, to ensure consistency and compatibility, data on the firms' output, R&D expenditure and investment that was given in current prices was deflated to constant 1982 prices. A GDP deflator was used in converting the data from current to constant prices because of none availability of alternative indices like whole sale price index,
consumer price index or GNP deflator in series from 1965 to 1996. Even for the GDP deflator, it had to be calculated from current and constant GDP figures for each respective year (see Appendix A).

After the coding and organisation of the data was complete, descriptive and analytical methods were applied to analyse the various data variables. Simple statistics such as means and percentages were used to analyse variables like firms' ownership, age of firms, levels of entrepreneurs' education, firms' output and other related variables. However, for the analytical part of the study where relationship between the firm specific variables and technology innovation capability had to be established, simple correlation analysis was done using Karl Pearson's method. The Karl Pearson's method computes a correlation coefficient given by:

$$r = \frac{\sum X_i Y_i - n \bar{X} \bar{Y}}{\sqrt{\sum X_i^2 - n \bar{X}^2} \sqrt{\sum Y_i^2 - n \bar{Y}^2}}$$

where:
- \(r\) = Karl Pearson's correlation coefficient
- \(X_i\) = \(i\)th value of \(X\) variable
- \(X\) = mean of \(X\)
- \(Y_i\) = \(i\)th value of \(Y\) variable
- \(Y\) = mean of \(Y\)
- \(n\) = number of pairs of observation of \(X\) and \(Y\).

In testing the significance of the relationship the following formula was used:

$$t = \frac{r \sqrt{n-2}}{\sqrt{1 - r^2}}$$

where:
- \(r\) = the coefficient of correlation
- \(n\) = number of sample observation, and
- \((n-2)\) = degrees of freedom (d.f)

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8 According to Sills (1972), the GNP deflator, the wholesale price index or consumer price index are the best indices that can be used for inflation or deflation purposes. Since these indexes were not available and complete set of data was not available to calculate them, the GDP deflator was used.
1.4 ORGANISATION OF THE THESIS

The thesis is organised in eight chapters. In Chapter one, the background, and an introduction to the study is made. The problem being investigated is stated in the second section of the chapter giving details of the objectives, hypothesis and justification of the study. Section three discusses the research methodology employed in designing the research, collection and analysis of data. Further chapter one gives a synopsis of the structure of the thesis.

In Chapter two, definitions of some concepts and terms often used in the thesis are given as part of the conceptual framework. Then, the theoretical approach adopted in understanding and analysing technology innovation and adaptation is addressed. The chapter also reviews the available relevant literature on the subject. It tries to strengthen the justification for and theoretical framework of this study through a review of studies on the impact of liberalisation on SSEs by other scholars.

The background of economic reforms and its impact on the manufacturing sector in Kenya is the subject of discussion in Chapter three. Here, the genesis of economic reforms that led to economic liberalisation is reviewed. Growth trends of the manufacturing sector for one and half decades since 1980 are also analysed. Further, the chapter analyses the impact that economic reforms in general and particular liberalisation measures have had on industrial technology development in the country.

Chapter four of the thesis is generally an offshoot of the previous one. It examines the metalworking and the SSE sectors in Kenya which have been selected as the focus in the study. The historical development of the MWS from the 19th century to date and its economic performance are discussed in the first section. Section two looks at the emergence of SSEs and government policies relating to SSE development.

Chapter five reviews the technology policies of the country and the institutional infrastructure for technology development. The various policies that the government expounded in its 'blue prints' are analysed chronologically and strengths and
weaknesses of such policies explicated. This is then followed by a discussion of the institutional framework for technology development in the country. Lastly the chapter ends with a discussion on the impact of economic reforms on the development of human resources required for technology development.

Based on data collected from the field survey, Chapter six assesses technological development, innovation and adaptation in the small-scale metalworking enterprises. In the first section, the chapter provides the characteristics of the small-scale MWS firms covered in the study. The characteristics analysed include firm ownership, age of the firm, firm size, profiles of the entrepreneurs in terms of age, levels of education and experience, and levels of investment in machinery and sources of the same. Section two discusses the pre- and post-liberalisation performance of the surveyed units. Here, the trends in levels of output, profits, market areas and employment are analysed. The R&D activities of the firms relating to technology innovation and adaptation including R&D linkages and collaborations are presented in the fourth section. The section also attempts to discuss in detail the process, levels and types of technology innovations and adaptations that the firms undertook since their establishment. It then compares the innovations and adaptations undertaken before liberalisation with those during the post-liberalisation period.

The various factors that influence and determine the firms', capacity, capability and ability to innovate are discussed in Chapter seven. An in-depth analysis of the relationship between the various firm variables and innovation and how these have been affected by liberalisation measures is given.

Policy implications and conclusions derived from the study form the last chapter of the thesis, Chapter eight. All the major issues that have policy ramifications for technology development and promotion in the country, and the sustenance of technological innovation and adaptation in SSEs are discussed. From these discussions, some suggestions and recommendations are then provided that are aimed at building up an indigenous technology base by taking advantage of the emerging opportunities and threats arising from the implementation of SAPs and particularly the liberalisation of the Kenyan economy.