Chapter Five

TECHNOLOGICAL DEVELOPMENT: POLICY AND INSTITUTIONAL FRAMEWORK

5.1 INTRODUCTION

This chapter is devoted to the analysis of the institutional framework and the policies adopted for technological development in Kenya. It traces the evolution and development, over time, of these policies and institutions. Although currently Kenya does not have what can be termed a comprehensive industrial technology policy, an effort has been made to survey all government policy statements and pronouncements contained in official government documents to construct a national technology policy.

The evolution of the science and technology (S&T) development effort is traced from the pre-colonial times, but with attention focused on the post independence period, especially after 1974, when the first systematic approaches to S&T promotion were announced in the fourth development plan. The section also appraises the funding for research and development (R&D). What emerges from the appraisal is that this important component in technology development in the country has been adversely affected by economic reforms.

The second section of the chapter is devoted to analysing the existing institutional framework for carrying out technology development in Kenya. Weaknesses of the structure have been identified and the issue of lack of linkages and collaboration between technological institutions themselves and between them and the manufacturing sector have been elaborated.

Human resource development aimed at promoting S&T is discussed in the third section of this chapter. The restructuring of the education system to re-orient it to the

\[52\text{In Kenya no government policy document exists that is entirely dedicated to reflecting its industrial technology policy. Numerous government Sessional papers and departmental blue prints exist that touch on science and technology issues as they pertain to their role in socio-economic development and the development of the Science and Technology sector.}\]
emerging needs of the economy following the introduction of the structural adjustment programme (SAP) is the locus of the discussion. The impact of the SAP on education and training is also briefly evaluated.

Essentially, this chapter tries to bring into perspective the problems and inadequacies reported by the small-scale enterprises (SSE) and technological institutions in the metalworking sector (MWS), based on their innovation effort as presented in the next two chapters. It will be found that the lack of a coherent and comprehensive technology policy, lack of funding and inadequate training programmes have played a major role in limiting local technology innovation and adaptation.

5.2 INDUSTRIAL TECHNOLOGY POLICIES AND STRATEGIES

Industrial Technology Development and Acquisition: A Review of Policies

Recognition of the growing importance of technological advance has led governments everywhere to adapt far more comprehensive and forthright policies with respect to technology development (Kaplan, 1995). Technology policies are designed, at an aggregate level, to achieve three principal objectives viz. "to enhance national capacities for invention and innovation; to ensure access to international technology; and to enhance the diffusion of new and appropriate technologies and technological best practice" (Kaplan, 1995:238). Apparently, Kenya's technology policies have been formulated to address the same universal concerns. The policies aimed at the development, acquisition and promotion of technologies in the industrial sector in Kenya can therefore be categorised into two. On the one hand, are those policies that are aimed at acquiring state of the art technologies from existing sources mostly through foreign investment and importation of machinery and equipment. On the other, are policies that are designed for the development of indigenous technologies through local R&D efforts. This section looks at these policies so as to provide a general insight into the existing technologies in the manufacturing sector in Kenya and how they have been acquired, developed and promoted.
acceleration in the rate of growth of demand for manufactured goods.\textsuperscript{15}

Thus, the MWS is seen as the engine for the attainment of technological independence through the generation of capital goods, diffusion of technology and the development of indigenous technological capability. Fransman, (1984) observes that the machine production sector lies at the heart of the process of technological change, generation and diffusion. This is because technological change, whether involving process or product technology, requires the production of new or modified machinery. White \textit{et al.}, (1988) and Dahlman and Westphal (1981) also argue along the same lines as Fransman. In his discussion, Fransman concludes that local machine producing capability is necessary for both minor forms of technological change such as the modification and adaptation of products and processes and radical changes. White \textit{et al} (1988) recognise that the capital goods industry has a great influence on other industrial sectors: new machines mean higher productivity for those who install them.

The innovative capability of MWS emanates from the symbiotic relationship that exists between the sector as a producer of capital goods and users of its products (Baark, 1991 and Matthews, 1991). Matthews (1991) notes that the sector is a centrifugal force for fostering technological innovation due to its uniqueness of being both a producer and user of capital goods. The incentive to innovate in the sector therefore stems from two reasons. First, the improvement of the efficiency of its own hardware technology (machines and equipment) would increase the efficiency of the process by which its products are made. Second, there is an important nexus between the sector and other end-users. Since "capital goods are the carriers of embodied technology in other sectors of the economy" (Baark, 1991:905), competitive pressures from downstream capital goods markets necessitate continuous improvements in productive efficiency. As these pressures are transmitted to the capital goods sector, they act as catalysts for technological change. Therefore, the interdependence of the MWS with the rest of the industrial sectors as observed


Rosenberg (1976) has also looked at the role of the capital goods sector as a source of capital accumulation and technological change. He stressed that improvement achieved in the sector ensures not only reduction in production cost but also encourages capital saving innovation in the whole economy. The role of the capital goods sector in the process of technological innovation becomes more pronounced once it is realised that all innovations, whether product or process, require the introduction of new capital goods, which only the MWS can produce. This made Rosenberg (1976:150) point out that:

One of the most propelling forces in the growth of currently high income countries has been the technological dynamism of their capital goods industries which has maintained the marginal efficiency of capital at high levels.

The limitation and constraints faced by developing countries in the development of local technological capability also received the attention of Rosenberg. Having stressed the pivotal role the capital goods sector plays in innovation and technological change, he was concerned with the absence of a fully developed capital goods sector in the developing countries. Rosenberg (1976) pointed out that unless they have a developed capital goods industry, they will not be able to develop the capability and capacity for necessary technology development.

It was conceived as way back as the 1960s (Todaro and Pack, 1969) that there is a need for developing countries to increase the effort in producing capital goods. Todaro and Pack (1969) argued that a case exists for underdeveloped economies to undertake measures to encourage the growth of domestic capital goods industries, but, with the caveat that the firms established must be efficient. That is, their unit production cost should not be higher than that in developed countries from which the capital goods to be substituted come from. Indeed, although efforts were made to start up capital goods producing firms, studies by Mwau and Coughlin (1991) and
Coughlin (1988) have revealed that the sector in Kenya has faced the same shortcomings as warned by Todaro and Pack. Studying the die, mould and patterns sub-sector in Kenya, Coughlin (1988) found that due to the small market and reliance on foreign technology the products were costly to produce. This phenomenon is common in other developing countries too. As a consequence of the high per unit production cost, Coughlin (1988) observed that import substitution and penetration of the export market have been impeded. The Mwau and Coughlin (1991) study had similar findings. They found that in the electrical cable manufacturing sector, capacity utilisation is low. It ranges between 21 per cent and 67 per cent. They attributed these low levels of capacity utilisation to low demand, lack of raw materials and spare parts, inadequate supervisory skills, competition from imports and inappropriate policies.

Despite the premonition by Todaro and Pack (1969), developing countries, like Kenya, have gone ahead to start up capital goods units with the hope of providing a base for their future industrial development. Apparently, without due cognisance of the problems to be faced. However, as Matthews (1991) observes, the initial inefficiencies encountered are but only the opportunity cost an economy has to incur in establishing indigenous technological capacity. This is justified by the ‘infant industry protection’ thesis where protection measures are instituted even if they lead to inefficiencies. The argument here is that even with inefficient capital goods units, the developing countries will benefit from learning effects, industrial linkages, and incremental innovation. And ultimately, this will lead to the emergence of dynamic efficiencies that will propel the sector towards international competitiveness and export promotion.

Evidence from India and Korea shows that the initial protectionist policies adopted by the government towards the capital goods sector resulted in the development of the technological base that has propelled India’s and Korean industrial development. Lall et al., (1994) and Jacobsson and Alam (1994) observe that although the high protection of the capital goods sector in India deprived the industrial sector of new technologies and resulted to the production of goods of poor quality and at high cost, it led to the development of indigenous technological capabilities. Wogart et al.,(1993) note that by the time the governments’ protective regulations on the machinery and capital
goods sector were relaxed in the 1980s, firms were able to adjust and reach international competitiveness in the production and export of machinery and other capital goods.

These observations lead to the argument that third world countries' dependence on imported technologies can only be curtailed if the MWS is developed and its innovative capability enhanced. The existence of a strong MWS in countries like Kenya would provide substantial benefits, the most important being the production of capital saving forms of product innovations. Achieving this result will however require the MWS to have the capacity and capability to 'imitate' and reproduce cheaper machinery coupled, in some cases, with modifications that lead to further capital saving and technology development. Discernible from the reviewed literature is that it is almost unequivocal that SSEs play an important role in innovation just like large scale firms. The capability in technology adaptation and innovation is however preponderant in the metalworking sector. However since it has been observed that in developing countries the metal working sector is still in its infant stage, the success they have achieved in 'pushing' industrial development was mainly due to protection through restrictive trade policies. Now that such protection has been diluted by liberalisation, doubts are being raised as to whether the sector will survive and if so how it will continue playing a catalytic role in the innovation process.

**Effects of Economic Liberalisation on SSEs**

Concerns on the impact of the structural adjustment programme on the technology generation capabilities in Africa have been expressed since the 1980s. Policy analysts and technology policy researchers have been pondering this issue, but then the time was not yet ripe to assess the impact of SAPs on the economies' technology development. Among the early researchers to comment on the subject were Juma and Ojwang (1989:11). They observed that:

The adoption of structural adjustment policies, if not coupled with the generation of indigenous technology, could lead to the erosion of the little capability that was built over the years. . . . Africa is thus in a state of technological discontinuity which in fact coincides with major technological adjustments in the industrialised countries. It is a period of ferment; the situation looks dismal but the conditions for new beginnings are ripe.
It is this type of fear, filled with both optimism and scepticism, that led to a number of studies that assessed the impact of economic reforms generally on the African economies. In the 1990s the World Bank sponsored some studies (e.g. Parker et al., 1995; Lall et al., 1994; Steel and Webster, 1991; and Frischtack, 1990) aimed at evaluating and assessing the effects of SAPs on the growth and performance of SSEs, the dominant component of the indigenous industrial sector in African countries. In addition, these studies tried to find the response of SSEs to the new policy environment. In general, the findings in all the studies are almost the same. In their report that incorporate study results from five African countries viz. Ghana, Malawi, Senegal, Mali and Tanzania, Parker et al., (1995:1) summarise the impact as follows:

Policy reforms had both positive and negative effects on the environment for MSE [Micro and Small Enterprise], which have always faced difficult, ever changing economic conditions and which by necessity, must be adaptable. The surveys confirm that MSEs are responsive to their environment and that SAPs altered that environment in ways that reduced constraints on many MSEs but aggravated the pressures of surplus labour and intense competition on others.

The impact of economic reforms on SSEs varies between countries and sectors. The variation among countries is largely attributed to the differences in the implementation of the SAP policy package. The impact varies among sectors due to the peculiar operational characteristics of each of them. In a generalised form however, the effects had close similarities. At an aggregate level, where SAPs were implemented the removal or reduction of import licensing gave the SSEs greater access to imported inputs; devaluation altered the prices of locally available goods relative to imported products, raising costs of firms that depended on imported inputs while protecting those that relied on domestic materials; and reduction of state monopolies and intervention in pricing and distribution gave firms freer rein in obtaining resources and marketing products.

In Ghana, Steel and Webster (1991 and 1992) for example found that due to economic reforms, SSEs employment fell sharply because many of the firms were
squeezed between high cost of imported inputs and greater competition from liberalised imports. The study also found that among the SSEs surveyed, on the one hand, the older firms that had been established before the introduction of economic reform programme (ERP) in 1985 faced a decline in output. On the other hand, the new firms, that is those that were established after the introduction of ERP, increased their output, which they attribute to the initial spurt in growth that normally characterises many SSEs in their first three years of operation as well as their choice of activities with high growth potential. In the area of investment, Steel and Webster observed that new investments were made with new SSEs coming up to supply low cost substitutes mainly from local materials.

Although only one of the World Bank studies (the one by Lall et al., 1994) specifically focused on the effect of liberalisation on technological development, the others also provide some useful insight on SSEs technological innovation and acquisition performance under economic reforms. The findings show that overall, liberalisation had both positive and negative impacts on firms’ technology adaptation and innovation. This is primarily in the area of acquisition of new machinery and equipment, introduction of new products lines or change in product mix, utilisation of local inputs and changes in marketing strategy. For example in Ghana most SSE’s experienced increased activity in these fields. Thus Steel and Webster (1991:ix) conclude in the Ghana study that:

... there is evidence of considerable entrepreneurial initiative in changing product mix and seeking market niches that opened up under the new exchange rate regime. Some SSEs have adapted to changing demand by producing speciality products, custom made items, or low cost substitutes for imported goods.

Liberalisation was in this case found to induce SSEs to introduce new products lines and acquire new machinery and equipment or upgrade the existing ones. In addition, SSEs were found to be involved in formulating new marketing strategies. About 49 per cent of the SSEs surveyed had undertaken these technological changes. The results were almost the same in Senegal and Malawi where 52 per cent and 68 per cent of the firms surveyed had bought new equipment respectively.
The stimulus to these technological developments has been the increased market competition that accompanies liberalisation as observed in Bangladesh by Khundler (1989). This emanates not only as a demand side stimulus, where entrepreneurs change their production mode so as to reduce production cost and cope with market demand, but also a supply side stimulus. Imported products, access to which increase, during liberalisation provide a source of learning for the local enterprises for both product and process innovation. This provides SSEs the opportunity and scope to learn and imitate the new products, processes and equipment being introduced in the market as imports.

A matter of concern in these findings is that these positive effects of liberalisation are limited to progressive and expanding firms. In Senegal, for example it was found that “expanding firms are more likely to have changed their product mix, increased the imported share of raw materials and bought new equipment since 1986 [the year SAP was introduced]” Similarly in Ghana it is the successful SSEs that were able to move to more profitable niches producing specialised, non-traditional items, such as freezers, water coolers and drums, so as to sustain the competition from imports. Some undertook innovative processing such as fuel briquettes from saw dust and knives from used band saw blades and metal packing strips (Steel and Webster, 1992:428).

In addition to the probable suppression of innovation activity in the ‘weak’ SSEs, liberalisation has other negative effects. Parker and Steel found that in Senegal import liberalisation, through removal of restrictive licensing makes imports more available and this limits firms in working towards searching for local alternatives. Although devaluation on the other hand raised the cost of inputs, which discouraged use of imported inputs, “preference for taking advantage of increased access predominated. SSEs shifted more towards imported inputs than domestic ones”. Results from the four other African countries included in the study also show that while SSEs shifting to the use of imported inputs varied between 9 per cent in Ghana to 78 per cent in Tanzania, the switch to domestic inputs was observed in only 9 per
cent and 29 per cent of the firms surveyed in Malawi and Senegal respectively. This clearly indicates that SAPs curtail the utilisation of local inputs and hence the adaptation of process technology to the same.

Studies that specifically evaluated the impact of reforms on technology development in the industrial sector (Lall et al., 1994) and the SSEs sector (Kweka et al., 1997) had almost similar mixed findings. Lall et al., who also studied enterprises in Ghana found that there are significant differences between firms in the effect of liberalisation on technology capability, with economic reforms tending to favour large-scale firms as opposed to SSEs. Overall, due to liberalisation and the general low technology capabilities Ghana faced some de-industrialisation as the liberalisation measures were not accompanied by supply-side measures to develop skills, capabilities and technical support. For example, Lall et al., observe that the trade policies of the SAP, despite having offered some incentives to enterprises to enhance their technological capabilities and to relocate resources to more competitive activities, the response from firms have been weak as relatively few firms improved their technological performance and raised their international competitiveness, while many closed down.

Besides the World Bank sponsored studies, the Economic and Social Research Foundation (ESRF) based in Tanzania also carried out surveys on the industrial sector to assess among other things the impact of reforms on industrial development. Using data from this survey, Kweka et al., (1995) evaluated the effects of import liberalisation on industrial and technological capability development in the garment and light engineering industries in Tanzania. Kweka et al., found that, overall, import liberalisation had more negative impact on the garment sector than the engineering sector. They attributed these differences to the differences in technology requirement and levels of susceptibility to imports between the two sectors. Due to the introduction of import liberalisation in 1988, they found that weaker firms had to either shut down or shift from manufacturing to trading and production of non-tradables i.e. repair and maintenance services. Those that survived, which are few, were either large, export-oriented or foreign linked firms. Among the firms in the engineering sector although
sales grew at 2.2 per cent per year in real terms after liberalisation, compared to a
negative annual growth rate of 9 per cent between 1984-1989, in aggregate however,
60 per cent of the firms faced negative real annual growth rates ranging from 0.06 to
18 per cent. Growth in employment also declined (by negative 11 per cent) and so did
capacity utilisation, which dropped from 57 per cent in 1989 to 42 per cent in 1994.

With respect to technology development, the Kweka et al., study observed that only a
minority of firms were able to upgrade their plant and equipment by investing in fairly
sophisticated machinery such as numerically controlled and computer numerically
controlled machine tools and computer-aided design. But, over 50 per cent of the
firms were technologically stagnant as they undertook insignificant changes in their
production technology in the wake of liberalisation. Although, about 55 per cent of the
engineering firms introduced new products, which they note was as a response to
increased import competition in existing product lines, this amounted only to a "move
down rather than up the technology ladder". Most of these firms moved to simpler
products with localised demand and strong non-tradable characteristics, and 50 per
cent of the firms reacted to the ensuing import competition due to liberalisation by
producing lower quality, cheaper products. Technological capability in the engineering
firms was also found not to have significantly changed in the post liberalisation period.

The intensity of engineering skills remained unchanged, while only 30 per cent of the
firms offered systematic training to their work-force. Subcontracting activities among
firms remained limited and even those that co-operated with foreign firms did not
benefit much in terms of technology transfer.

In conclusion, Kweka et al., (1997:21) observe that:

The extent of technology and skill upgrading in the engineering
industry since liberalisation has been limited. A small proportion of the
firms have adopted fairly advanced technology, more in response to
availability of imported equipment rather than to meet direct import
competition and undertake some skills upgrading. The remainder, the
majority have been largely stagnant in terms of technology and skill
development after liberalisation, with some rebutting to lower levels of
technology.

From the above literature it can therefore be seen that although economic
liberalisation can foster technology development this tends to be limited to firms that are already technologically strong, relatively large, export-oriented and have the necessary technological capabilities in terms of skilled labour, highly trained and experienced entrepreneurs, etc. For developing economies, this is something to worry about as the majority of the firms do not have these characteristics. The situation looks more gloomy for the SSEs in LDCs as besides the lack of the above mentioned characteristics, SSEs are further weakened by lack of investment finance, inadequate government support, etc. Under such a situation and the threat that is posed by the introduction of liberalisation, there is a fear that the indigenous technology development efforts and capacity that had started to develop among SSEs will be stifled.

Although the studies reviewed above provide a general picture as to the repercussions of economic reforms on SSEs, much more exhaustive study is needed to analyse the impact of liberalisation on technology. This is because these studies were not formulated specifically to investigate this aspect but rather the focus was on the general response of small-firms to the policy. Also, the studies did not comprehensively cover the metalworking sector. Although in all the studies reviewed the metalworking industry was included in the sample, its treatment was scanty. Given the pivotal role that the MWS plays in spearheading technology adaptation and innovation, which is the base to economic development, there is need for a study to closely assess the technological performance of the sector under liberalisation.