Industrial Strategy and Local Economic Development: Manufacturing Policy and Technology Capabilities in Ekurhuleni

Thandi Phele, Simon Roberts and Ian Steuart

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Thandi Phele, Simon Roberts, Ian Steuart

Corporate Strategy and Industrial Development research project
School of Economic and Business Sciences
University of the Witwatersrand
Private Bag X3
WITS 2050

Tel: 011 717 8126
Email: csid@sebs.wits.ac.za
www.wits.ac.za/sebs/csid

1. Introduction

A new emphasis has been placed on local economic development in South Africa with all municipalities required to draw up integrated development plans. In addition, many of the actions anticipated under the Department of Trade and Industry's *Integrated Manufacturing Strategy* (DTI, 2002) require implementation at the local or regional level (Machaka and Roberts, 2003). Furthermore, the *Advanced Manufacturing Technology Strategy* (NACI/DST, 2003) envisages a range of measures including the establishment of technology centres and innovation networks which, while national in scope, require concrete actions at a local level.

South Africa is a very interesting case of a late-industrialiser, as relatively advanced capabilities were developed in areas which tied into the apartheid government's strategic priorities and the particular demands of mining. Part of this orientation was a 'science-push' approach to research, through organisations such as the CSIR and Denel.[1] After the first democratic elections in 1994, the very different priorities of the ANC government led to a wholesale rethink of industrial and technology policy. Trade liberalisation led to far-reaching industrial restructuring. Funding for the old research priorities was reduced, and a new technology mission was elucidated in the National Research and Development Strategy (DST, 2002).

Ekurhuleni Metropolitan Municipality is one of six metropolitan municipalities created in major urban concentrations. More importantly, it covers the largest industrial concentration in South Africa and in sub-Saharan Africa. The economy of Ekurhuleni reflects the apartheid legacy of minerals-oriented industrialisation, and the growth of an urban labour pool to supply the mines. Ekurhuleni grew on the back of the main concentration of gold mining in the country. This is reflected in the structure of manufacturing. Ekurhuleni accounted for 37 per cent of South African output of

[1] See also Kaplan (1997) for a discussion of the implications of South Africa's historical model of support for R&D.

machinery and 33 per cent of metal products in 1996, with major markets for each historically being mining.[2] The performance of the Ekurhuleni economy has, however, been very poor in recent years and, with the decline in gold mining, unemployment increased sharply to reach 40 per cent in 2002.[3] Manufacturing in Ekurhuleni recorded an average annual growth of value-added of just 0.4 per cent between 1997 and 2002 (much lower than the national manufacturing annual growth of 2.3 per cent). Regeneration of the industrial base is thus crucial to addressing unemployment and poverty in the region.

This paper examines the impact of national developments and policies on the development of industry in Ekurhuleni. It assesses role of local government in industrial development in light of recent literature addressing agglomeration effects, industrial districts, and the development of local economic competencies and institutions. The analysis draws on recent work on the manufacturing sector in Ekurhuleni and a case study of the foundry industry in particular, focusing on its performance and recent development in terms of firm capabilities, orientation, and the institutional framework[4]

The case study of the foundry industry is set in the context of the increasing international integration of the South African economy and production systems. Increasing international integration means that local capabilities are even more important in attracting and growing industries. The presence of a strong network of manufacturing firms to enable realisation of linkages and spill-overs in value chains and clusters is a key part in making location decisions 'sticky'. This is true in both the major segments served by the South African foundry industry – the auto sector and mining equipment. In the auto sector, production is part of global value chains and a country's ability to benefit from participation in those chains is to do with the location of more sophisticated production activities. In mining equipment, South Africa has developed niche capabilities due to the historical demand from local mining operations. As South African mining companies become increasingly international, they are moving to global sourcing of machinery inputs. The challenges, therefore, are to maintain and grow existing capabilities, as well as to leverage those capabilities.

Manufacturing development and production capabilities

Despite international trends to liberalisation and increased international flows of goods and capital, industrial activity remains highly concentrated in local regions or districts (Helmsing, 2001). Different explanatory frameworks have been developed, with differing implications for the role of local government. The new economic geography associated with Krugman emphasises externalities, such as associated with labour

[2] Calculated from data in the latest available manufacturing census, for 1996.
[3] On the broad definition. This unemployment rate is significantly higher than for Gauteng (35%) and for major urban areas throughout South Africa.
[4] The research involved a short survey of firms, followed by 18 in-depth interviews with suppliers and foundries, and focus groups to cross-check the analysis.

markets and skills development, specialist inputs required by firms, and technology spill-overs (see, for example, Krugman, 1998a and b).

In contrast, a focus on the organisation of production rather than market failures in exchange underpins frameworks explaining the dynamic of local economic development and the collective development of firm competencies at the local level (Best, 2001; Schmitz, 1995). Local economic development can be approached utilising a framework of inter-firm relationships, productive and technological capabilities, and the role of institutions. In this approach, not only are there processes of cumulative causation driving the returns to firms from location decisions, but it is important to understand the position of firms in terms of their vertical and horizontal relationships, and the role of large firms in governing commodity or value chains (Kaplinsky, 2000). This view emphasises that the orientation of firms and their relationships with government are influenced by the historical development of capitalism in a country (Chandler et al., 1997).

Technological capabilities are a central element of firms' overall capabilities. Indeed, a major body of the literature argues that how enterprises manage the process of mastering, adapting and improving upon existing technologies is the single most important determinant of industrial development (as noted by, for example, Lall, 2003). This in turn is an outcome of firms' decisions and wider strategic orientation. It reflects deliberate actions and the evolution of firms in the context of their environment and incentives. A firm's 'strategic dimensions' (Teece and Pisano, 1998) can be identified as its managerial and organisational processes (including patterns of practice and learning), its present position (including its technological and intellectual property, customer base and relations with suppliers), and the paths available to it (the strategic alternatives and opportunities available to the firm).

We start from the premise that there are widespread and intrinsic features related to technological capabilities, which mean it takes time and effort to learn to use technologies, and that private firms will inherently under-invest in the related activities to build technological capabilities (Lall and Teubal, 1998; Lall, 1994). Firms deal with the demands of technological changes by developing organisational and managerial routines. Market failures are pervasive and learning and technical change involve ongoing incremental and path dependent processes. This corresponds with a wide range of studies examining detailed processes of technological change and economic development at the institutional level (for a review see Dosi *et al.*, 1994).

This approach has drawn from contributions in economic history, such as those by Chandler, that have found the types of organisation required to successfully exploit technologies to be a major part of explaining countries different industrial growth performance (Chandler, 1990; Chandler *et al.* 1997). Amsden has particularly highlighted the importance of organisational characteristics in late industrialisers where the main challenge is to do with adopting and adapting technologies from industrialised nations (Amsden, 1997).

The potential gains from shared learning, a wide skills pool, and sharing of appropriate institutions supporting research, training and development are important in explaining why – despite globalisation – production is increasingly concentrated in specific locations. These factors mean that there is a strong path dependency driving agglomeration effects. Locations and countries that were first-movers derive an initial advantage which is compounded over time. For late-industrialisers the clear implication is that co-ordinated and purposive action is very important in the development of more sophisticated industrial activities (Lall, 2003). Analyses of the East Asian experience of industrialisation have highlighted the importance of co-ordination across R&D, investment, training and product development activities within selected sectors (see, for example, Lall, 1994; Lall and Teubal, 1998).

Industrial and technology policy in South Africa

Historically, industrial and technology policies both focused on strategic concerns of the apartheid government such as defence and liquid fuels, and the needs of resource extraction and processing industries. By comparison, recent industrial and technology policy frameworks aim to encourage downstream value-addition and employment creation. The Department of Science and Technology's recent *Advanced Manufacturing Technology Strategy* (AMTS) and the Department of Trade and Industry's *Integrated Manufacturing Strategy* (IMS) complement each other. They emphasise the need to develop production capabilities, for firms and public institutions to work together effectively, and for technologies to be the foundation for growth of output and employment. Many of these areas require action at the local level. Building the local industrial base requires getting groups of companies to work together effectively, local testing and training facilities and linkages with tertiary education institutions.

The *Integrated Manufacturing Strategy* of the Department of Trade and Industry (2002) places increased value addition downstream and the strengthening of vertical and horizontal linkages at its centre. The strategy identifies a range of broad issues to be taken forward through specific policy measures. These issues include the pricing of inputs and improving skills and technological capabilities.

The *Advanced Manufacturing Technology Strategy* of the Department of Science and Technology through the National Council on Innovation (NACI, 2003) also establishes a framework for government action to support industrial development, specifically as it relates to research, technology and productive capacities. This strategy is to be given effect in specific programmes such as a *National Tooling Initiative* launched by the CSIR's National Product Development Centre. This is being driven initially by the auto industry but has now grown to be much broader. The *Advanced Metals Initiative* has also grown out of the AMTS, and is aimed specifically at light metals. A key target area is the application of technologies to aerospace.

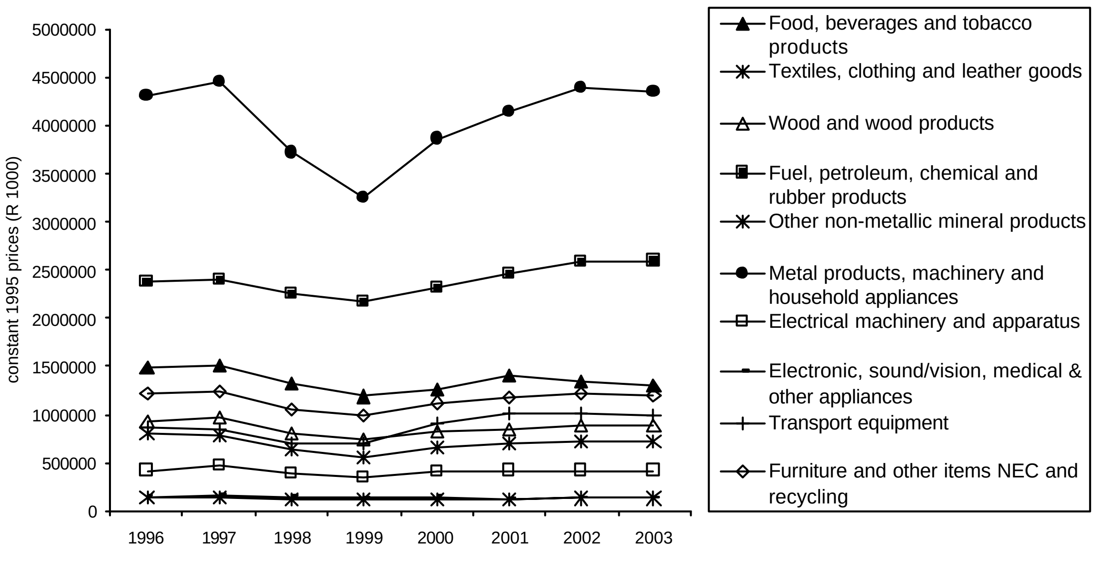
Much of the actual programmes such as technical centres or innovation centres envisaged under the AMTS have concrete locations as part of growth clusters. This is evident in the Automotive Industry Development Centre, which is linked to a supplier park in Rosslyn outside Pretoria and a chair in automotive engineering at the University of Pretoria. In these initiatives champions are needed, from the different stakeholders and particularly government and business.

2. Ekurhuleni – the workshop of sub-Saharan Africa

Industry in Ekurhuleni is concentrated in intermediate products such as machinery and metal products, and consumer goods, including food products and consumer chemicals (such as soaps and paints). It does not have a significant proportion of the very capital-intensive upstream industries such as non-ferrous metals, basic chemicals and basic iron & steel. Although capital-intensive, these sectors have recorded the highest output growth over the past decade (see Machaka and Roberts, 2004a). Instead, firms in Ekurhuleni use the products of these sectors as material inputs for higher value-added and more labour-intensive manufacturing.

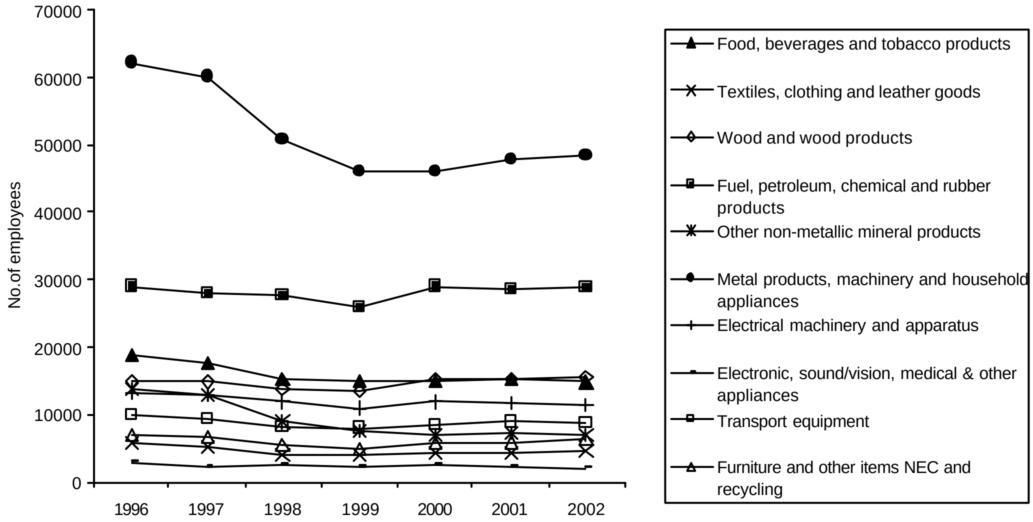
The sectors in which Ekurhuleni tends to be strong have also been among the hardest hit by the restructuring induced by the liberalisation of the South African economy and the tight macroeconomic policies in place since the mid-1990s (albeit now being relaxed). The largest broad industry grouping of metals, machinery & appliances experienced a major contraction in activity in 1998 and 1999 (Figure 1). While there has been a recovery in value-added, there is quite a different picture in terms of employment (Figure 2). After massive job-losses in metals, machinery & appliances and in other non-metallic minerals (which includes cement and brick-making), employment levels have only increased marginally in recent years.

Figure 1. Value-added, of manufacturing sub-groupings in Ekurhuleni



Source: Global Insight

Figure 2. Formal employment, of manufacturing sub-groupings in Ekurhuleni



Source: Global Insight

The performance of the Ekurhuleni economy therefore reflects the overall patterns of development in the South African economy and the very poor performance of more labour-intensive downstream sectors, and of sectors with higher levels of value-added such as machinery and equipment.[5] As the major site of machinery and metal products manufactures in South Africa, the Ekurhuleni economy performs poorly when these sectors do so. Manufacturers in Ekurhuleni also suffer from the pricing practices of the dominant upstream suppliers of basic chemicals and basic metals, which are located elsewhere (see, Dobreva and Madosi, 2004; Masethe and Roberts, 2003). These firms charge prices at import parity levels for products even where South African production greatly exceeds demand and there is a large trade surplus.

Liberalisation and increasing international integration has induced changes in firms' competitive orientation. Despite the relatively low level of direct exports by firms in Ekurhuleni, firm survey results reveal that firms responding to increased competition through quality, design and delivery time are much better performing than those that have a narrow price-based orientation.[6] The emphasis on non-price competitiveness suggests the importance of developing strong local linkages, and institutions. The ability to deliver on factors such as quality and design depends on working together with related firms and firms providing inputs to improve design, to improve delivery times, and reduce rejection rates. Linkages are weak at the present time. The 23 per cent of firms importing the majority of their inputs tended to be slightly better performing than firms sourcing inputs locally.

[5] The auto sector is an exception in that it has performed well in terms of value-added, but there are no major auto assemblers in Ekurhuleni.
[6] Survey of all manufacturing firms in Ekurhuleni in 2003, with 383 responses. See Machaka and Roberts (2004b) for full report of results.

That firms whose strategies are oriented to non-price factors perform better is strongly reinforced by the findings on production costs, investment and training. Across all these areas, firms which have taken the high road of skills development, upgrading machinery and equipment and, as a result, have increased spending on wages and on delivery, have reaped the benefits in terms of higher output growth and employment.

Similarly, the survey results revealed a strong association between investment in new machinery and equipment in the previous two years, and employment and output growth. Rather than investment being labour replacing, firms upgrade capital stock as part of a dynamic growth path. The main motivation for investment was demand expectations, followed by raising efficiency, and the need to improve quality through employing more up-to-date technology. The virtuous link with domestic demand is consistent with the low capacity utilisation reported, and firms generally financing investment through retained earnings. In terms of skills and training, the average level education of the firms' workforce was not associated with performance but firms training activities and use of the skills development levy were each significantly associated with better performance.

The findings from the manufacturing survey all point to the need to understand firms' production capabilities, their adoption of improved technologies and upgrading of skills. These are evidently central to realising the objectives of national industrial and technology policies. And, while the influences on firms' decisions include macroeconomic factors, particularly demand, key considerations include understanding inter-firm linkages and the local institutional framework. In the context of Ekurhuleni, this is directly relevant to understanding the extent to which the orientation of manufacturing industry shifts from one focused on mining and resource-based activities to a broader-based growth path. The case study of the foundry industry enables us to explore these issues in much greater depth.

3. Industrial development and production capabilities: the case of the foundry industry in Ekurhuleni

3.1 Industry overview[7]

Currently, the South African foundry industry consists of over 200 foundries (including ferrous and non-ferrous foundries), generating a combined turnover of R10.3 billion. The number of firms has shrunk significantly from over 400 at the end of the 1980s, although in the last three years new entrants have increased numbers once more. The industry produces 500 000 tons annually and employs over 15 000 people. In terms of market share, the foundry industry is dominated by a small number of large groups and individual companies. Eight companies account for more than 60 percent of tons cast and more than 70 percent of total employment.

[7] This section draws heavily from Viljoen (2003)

The South African foundry industry mainly serves the mining, automotive, and general engineering sectors. Automotive components account for approximately 40 to 50 per cent of the industry's total production followed closely by mining. Of the approximately 500 000 tonnes of metal cast, 80 per cent is ferrous and 20 per cent non-ferrous. With respect to non-ferrous production, however, approximately 85 per cent of all aluminium castings produced in South Africa are supplied to the automotive industry (Viljoen, 2003). The aluminium foundry industry has shown consistent growth since 1992, attributed largely to the Motor Industry Development Plan (MIDP).

Geographically, more than half of all the foundries in South Africa are located in Gauteng. In turn, more than 65 per cent of all foundries operating in Gauteng are situated in Ekurhuleni, due largely to historical demand from a concentration of firms in the mining, metals and machinery, and engineering sectors. The Western Cape, Eastern Cape and KwaZulu-Natal all have significant foundry industries but are small relative to Gauteng.

The South African foundry industry has undergone a significant amount of restructuring and consolidation over the past 10 to 15 years. The gradual liberalisation of the South African manufacturing sector since the early 1990s, global improvements in casting technology and the quality of castings, and the ability of transnational corporations to source castings from anywhere in the world have all heightened competitive pressures in the domestic foundry industry.

The changing patterns of capabilities, with the increased importance of the auto sector and the historical importance of mining, are reflected in the trade performance of the industry. The only two product groupings with consistent trade surpluses since 1995 are 'grindings balls & similar articles' (HS732591) and 'hydraulic turbines, water wheels & regulators parts' (HS8410) associated with mining and with infrastructure respectively. But, by 2003, auto components accounted for the largest share of exports. 'Parts of engines' accounted for 41 per cent of exports followed by 'spark-ignition reciprocating or rotary internal combustion piston engines' at 30 per cent. These product groupings have recorded huge improvements in their net trade performance on the back of large increases in exports. Other product groupings recording improvements in net trade performance are: 'pumps'; 'cast articles of iron or steel not elsewhere specified'; and 'cast pipe-fittings'. Together with the auto components categories, these groupings have recorded improvements through increased exports and, in most cases, reduced imports.

The main production technologies are sand-casting, die-casting and investment-casting. Of these sand-casting is by far the most widely used in South Africa. It is also less technologically advanced. However, within sand-casting there is a wide spectrum of technological sophistication.

Now that the process of liberalisation is broadly complete, the key challenge is create an enabling environment in which to enhance the competitiveness of firms. The importance of linkages and interdependencies cannot be overstated in an industry that supplies critical intermediate inputs to sectors prioritised by the AMTS and IMS on which future growth in manufacturing is largely predicated. It is crucial that initiatives to provide an enabling environment for improved competitiveness of the South African foundry industry are centred in strengthening linkages and improving levels of intra-industry coordination – ultimately ensuring the transition of a sector hamstrung by the economics of Apartheid and characterised by vastly different levels of technological capabilities and innovative capacity to one in which all firms form an integral part of a knowledge-intensive, learning economy.

3.2 Firm performance and competitiveness in Ekurhuleni

This section examines the main factors underlying the performance of the industry, drawing on a survey and interviews of foundries situated in the Ekurhuleni Metropolitan region. The survey focused on technological capabilities and skills development and training in the foundry industry while the interviews tended to concentrate on a qualitative analysis of the institutional arrangements underpinning the industry. 25 firms responded to the survey representing a 34 per cent response rate. Follow-up interviews were held with 15 firms and three suppliers.

Overview

South African foundries are in general locally owned and independent. 76 percent of the firms surveyed are independent and locally owned, while a further eight percent are locally owned and part of a group.

In total, the firms surveyed employed 3 411 employees in 2003. Small firms represent the largest number, at 44 percent of the sample (Table 1), but only account for 9 percent of employment in 2003.

Table 1. Firm size distribution

Firm size (by number of employees)		Number of firms
Micro	(1 – 5)	1
Small	(6 – 49)	11
Medium	(50 – 250)	6
Large	(>250)	7

Firm performance reflects the recovery in the industry in the past two to three years. Of all the firms surveyed, employment has grown at an average annual rate of 3.5 per cent between 2001 and 2003. The majority of firms (68 per cent) reported employment growth, while 24 per cent reported negative growth, and eight per cent reported no change. In addition, in each year from 2001 to 2003 more than half the responding firms recorded high turnover growth (turnover growth in excess of 10 percent). Firms that reported positive employment growth also reported high growth in turnover.

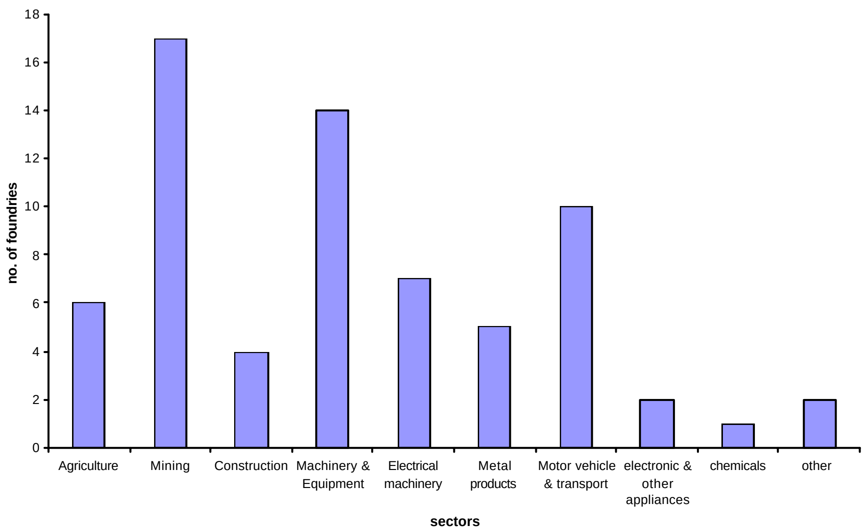
There are a number of reasons for the relatively good performance of firms. First, it suggests the emergence of a dynamic industry grouping after almost a decade of decline in the industry. Second, the timing of the survey meant it captured improved performance following the Rand's depreciation at the end of 2001. Third, it also possibly reflects the greater likelihood of better performing firms responding to the survey.

Firm interviews clearly revealed that competitive pressures have led to the emergence of a two-tiered structure in the domestic foundry industry, in which firms are characterised by very different technological capabilities. The first tier comprises firms that have responded to competitive pressures by improving their technological capabilities and innovative capacity. These firms have focused on their core business activities by outsourcing non-core functions, have modernised their equipment and have acquired new technology. The second tier consists of firms that have focused on narrow cost-minimisation strategies and have not tended to invest in improved machinery or in skills. There are no clear links between performance and the type of technology utilised or with firm size. Rather, the characteristics of dynamic firms cut across categories.

Main Markets

The majority of firms surveyed supply the mining, machinery & equipment, and motor vehicles & transport sectors (Figure 1). The findings reflected in Figure 1 differ somewhat from national data in that mining is relatively more important in Ekurhuleni. 68 percent of foundries in Ekurhuleni supply the mining sector (exclusively or in addition to other sectors). Nevertheless, the automotive sector has become a significant contributor to the overall output growth in castings in Ekurhuleni. This appears to be due to the deepening of input linkages encouraged by the evolution of the Department of Trade and Industry's Motor Industry Development Programme (MIDP).

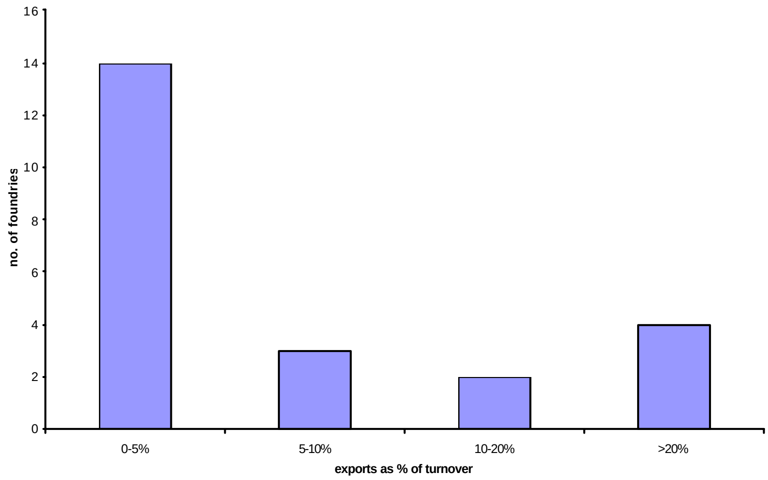
Figure 1. Downstream users of castings



There are clear differences in the demand trends between different markets. While overall capacity utilisation is low, with the great majority of foundries surveyed running only a single shift per day, firms supplying the auto sector have high levels of capacity utilisation (Viljoen, 2003). In addition, firms using the more capital-intensive investment and die casting processes also have higher levels of capacity utilisation. Overall, the very low levels of capacity utilisation reflected in the single shifts suggests a circle of weak demand and an inability of firms to access new markets.

The majority of firms surveyed are negligible exporters or are not involved in export activity at all (Figure 2).[8] Indeed, only four firms export more than 20 percent of sales. Interviews revealed that integration with international markets is, however, very important. Foundries are increasingly indirect exporters as their cast components are embodied in assembled products. But, it is not necessarily so much the quantity of exports as the drawing of firms into international production networks which has impacted on firm behaviour. Local linkages are very important elements of this, most obviously in the auto sector where improved links with international assemblers with operations in South Africa has meant upgrading firm capabilities. Similar dynamics were, however, also present in firms selling into machinery & equipment manufacturers with increased international exposure.

Figure 2. Exports as percentage of turnover



Not only does this suggest that firms are strongly oriented towards domestic markets but also that export growth is part and parcel of a dynamic growth process of building capabilities based on linkages and relationships developed locally. In other words, the more the institutional framework supporting the local foundry industry is strengthened and adapted to meet the industry's needs in an increasingly competitive global environment, the better the industry's export performance will become over time.

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[8] Figure 2 does not imply that all the firms surveyed are exporting. The first column indicates the number of firms exporting between 0 and 5 percent of turnover, which includes firms that do not export at all. Furthermore, the survey did not make the distinction between direct and indirect exports and, hence, the data may be understating the number of firms involved in export activity, even if only indirectly.

Technology and productive capabilities

The majority of firms tend to specialise in a particular casting process (sand, die, or investment casting), with only 16 percent of firms surveyed using a combination of casting techniques (Table 2). These findings were supported by the follow-up interviews, which revealed a clear trend towards increased specialisation, concentration on core activities, and the outsourcing of non-core functions.

Table 2. Type of casting process[9]

Method	Number of firms
Sand	17
Die casting	9
Investment	2

68 per cent of firms surveyed use sand casting techniques (of which 76 per cent specialise in sand casting alone), while only two firms surveyed specialise in investment casting (only six foundries in the whole of South Africa use the investment casting process).

While two-thirds of firms reported making technological improvements since 2000, these were generally of an incremental nature related to ongoing product development. Approximately one third of the improvements were reported as radical (substantial shifts in product lines, the development of entirely new goods, or major changes to the production process). Radical improvements tend to be made to the production process rather than the product itself, which ultimately must to conform ultimately to the specifications of the customer. The firm may suggest changes to the product as part of the process of customer interaction but these changes are usually not radical.

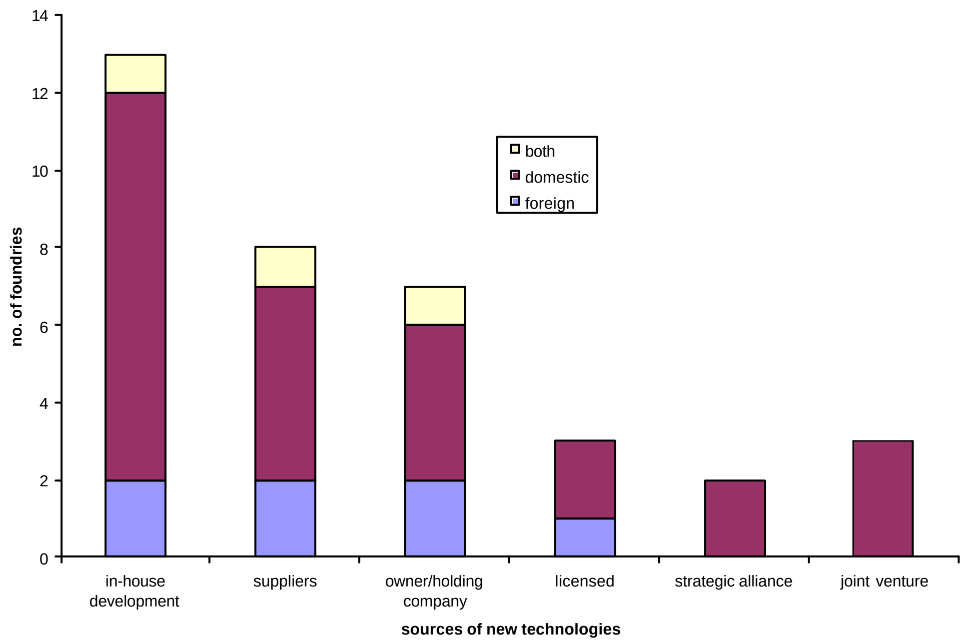
The importance of firm capabilities, and the predominance of incremental product development, is emphasised by the survey responses which indicate that the main source of technological improvements is in-house (Figure 3). Moreover, the majority of improvements to casting products or processes, whether in-house, from suppliers, owners or licenses, were derived from domestic sources. Of the firms that reported in-house development as the primary source of technological improvements, 69 percent indicated that it was performed on an on-going basis and 31 percent indicated that it was performed on an ad-hoc basis.

All the firms surveyed specialising in either die or investment casting processes have introduced technologically improved casting products or made improvements to the casting processes since 2000. In contrast, only 38 percent of all firms using sand casting processes have made improvements to their products and/or processes over the same

[9] The total reflects firms using more than one process.

period. This suggests a very clear link between the type of casting process and the ability of companies to develop their technological capabilities independently.

Figure 3. Sources of technological improvements to products and/or processes



In terms of ownership, the majority of firms with significant foreign ownership specialise either in investment casting or die-casting. These firms tend to be more technologically dynamic and significantly more proactive in acquiring new technology than firms involved in sand casting. Foreign ownership, however, should not be viewed as a necessary condition for technological dynamism since there are very dynamic, locally-owned firms across the range of casting techniques. While ownership *per se* does not differentiate dynamic firms from less dynamic firms, a number of firms that reported making improvements to products and/or processes either have well-established links with foreign organisations (for example, Casting Technology International or the American Foundry Society) or are producing castings or using specific casting processes under licence from companies overseas. In these cases, major research and development (R&D) takes place abroad. The licensee therefore benefits from a significant amount of information-sharing and technical support, allowing it to focus on incremental innovation in products and processes through well-established channels of customer and supplier interaction.

In terms of technological dynamism and the extent to which firms are able to develop their capabilities, the sector to which firms using different processes supply may also be important. Die casting firms supplying the automotive sector have clearly benefited from positive externalities generated by the Motor Industry Development Plan and have developed their capabilities on the back of the programme's success. Nevertheless, differences between the processes themselves do suggest potential differences in the technological capabilities of firms and, all else being equal, the rate at which firms can build upon those capabilities. Investment casting, for example, is a multi-stage process in which sequencing and control assume critical importance. Unlike sand casting, investment casting requires a significant amount of knowledge and skill to perform well. This does not imply, however, that technological dynamism is determined by the production process or that there are no sand casting firms in the first tier of foundries.

Although firms indicated in-house development as the main source of technological improvements, a number of respondents in the interviews indicated that customer interaction was itself a critical component of technological improvements made in-house. Significantly, however, no less than 57 percent of firms surveyed respectively ranked universities/other tertiary institutions, industry associations, and science councils as weak or unimportant sources of information in their innovative efforts. Indeed, 78 percent of firms ranked science councils as a weak or unimportant source of information.

Clearly, relationships between the industry and these organisations are chronically weak and much greater coordination between tertiary institutions, science councils, and other research organisations is needed in developing local capabilities in the casting industry.

72 percent of the respondent firms engaged in formal research and development (R&D), reinforcing the point that local technological capabilities and innovative capacities do exist to be harnessed more effectively. Furthermore, expenditure on R&D does appear to be positively correlated with technological improvements: of the firms that have made improvements to products and/or processes since 2000, over 90 percent recorded positive expenditure on R&D. Given a positive relationship between R&D expenditure and improvements to products and processes, a case can be made for a national casting centre, for example, with government support, to provide matching funding for firms engaged in formal R&D processes.

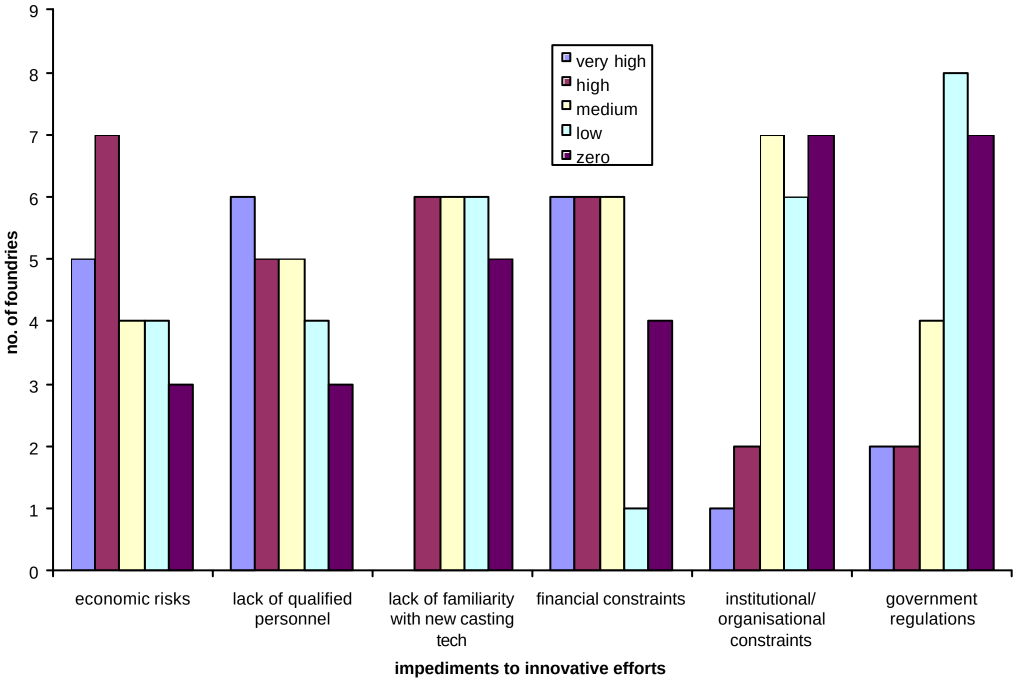
Firms indicated the following factors as key impediments to their innovative activities in casting products and/or processes (Figure 4):

- Financial constraints
- Economic risks
- Lack of qualified personnel
- Lack of familiarity with new casting technology.

84 per cent of the firms sampled did not indicate institutional constraints in the industry as significant impediments to their innovative activities. In the interview sessions, however, institutional constraints came through as a major limitation to increasing innovative capacity within the industry. Respondents variously noted that firms were suffering from "a lack of intra-industry cooperation", that individual firms "were extremely reticent to engage in collective discussion and deliberation", and that "more structured institutional arrangements [are needed] in order to facilitate the exchange of

ideas between smaller foundries”. The small size of the domestic market, which arguably makes it more difficult for institutional arrangements facilitating information sharing and processes of formal deliberation to evolve spontaneously, underscores the need for a national centre to promote information sharing and knowledge transfer, and provide technological support and research and development services to the second tier of (less technologically dynamic) foundries.

Figure 4. Impediments to firms’ innovative efforts in casting



Finally, with respect to testing and certification – an increasingly important component of the casting process – 56 per cent of the respondents indicated that they have some testing facilities on-site although some firms do use laboratories in Ekurhuleni for more sophisticated testing and process certification. Firms without the facilities use the testing facilities of other foundries and/or laboratories in Ekurhuleni.[10]

Investment, training and skills Development

The majority of firms surveyed indicated that the average age of their casting equipment and machinery is relatively old. 63 percent of firms reported an average age of machinery of more than 10 years. 29 percent reported an average age between 5 and 10 years, while only 8 percent of firms reported an average age of less than 5 years.

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[10] The main types of testing and certification firms require were identified as follows: radiography; tensile testing; metal specification; chemical composition; ultrasonic mechanical testing; sand testing and microstructure examination; metrology; pressure testing and heat treatment; IEC and SABS quality certification; and corrosion testing.

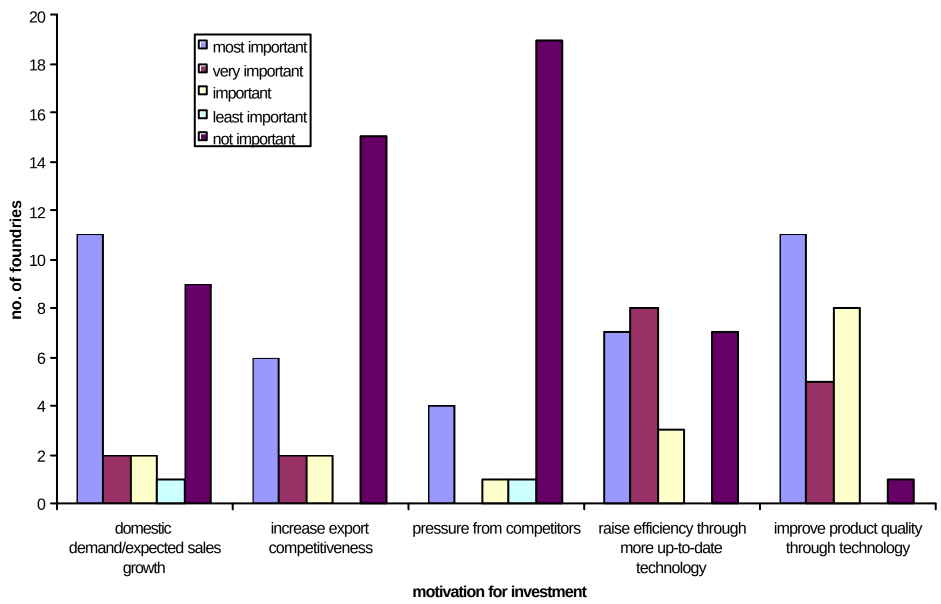
Despite this finding, 56 percent of firms surveyed have made major investments in casting machinery and equipment since 2000. Most of these firms are in the medium- and large-sized firm categories, suggesting that significant barriers to investment exist for smaller firms, which, in light of the independent nature of South African foundries, would not have access to intra-group finance. Importantly, far fewer firms using sand casting processes made major investments in casting machinery and equipment since 2000 than either die casters or investment casters.

Of the firms that have made significant capital investments in casting technology since 2000, 65 percent reported an annual growth in turnover greater than 10 percent in 2003 while over 71 percent reported positive employment growth in the same year. There is thus a clear correlation between upgrading capital stock and higher turnover growth. Furthermore, while first-tier firms across the range of casting processes are embarking upon a process of modernisation, it does not appear to be at the expense of labour. Indeed, upgrading capital stock seems to induce relatively strong dynamic effects with respect to employment growth.

In the vast majority of cases, therefore, improving technological capabilities through investment in new machinery and equipment is a necessary precondition for employment growth and increased competitiveness. Second-tier foundries, however, are generally not embarking upon a process of modernisation and are not building upon their existing technological capabilities. These firms continue to use casting equipment often in excess of twenty years old and are finding it increasingly difficult to produce high quality casting products now demanded by the market. Consequently, foundries in the second tier will struggle to remain in the industry without a range of targeted support measures.

The most important factors motivating firms' investment decisions include the need to improve efficiency and quality, and expected growth in domestic demand (Figure 5). Increased international competitiveness was found to be a relatively insignificant motivational factor, supporting the finding that the vast majority of firms are not export oriented.

Figure 5. Motivation for Investment



Key factors discouraging investment include exchange rate volatility, high interest rates, labour regulations and the exchange rate level. The perceived inflexibility of labour regulations aside, the findings support the conclusion contained in the SAIF report (Viljoen, 2003) that the difficulties of financing local investment against a weak currency and high interests rates present a significant challenge to local firms.

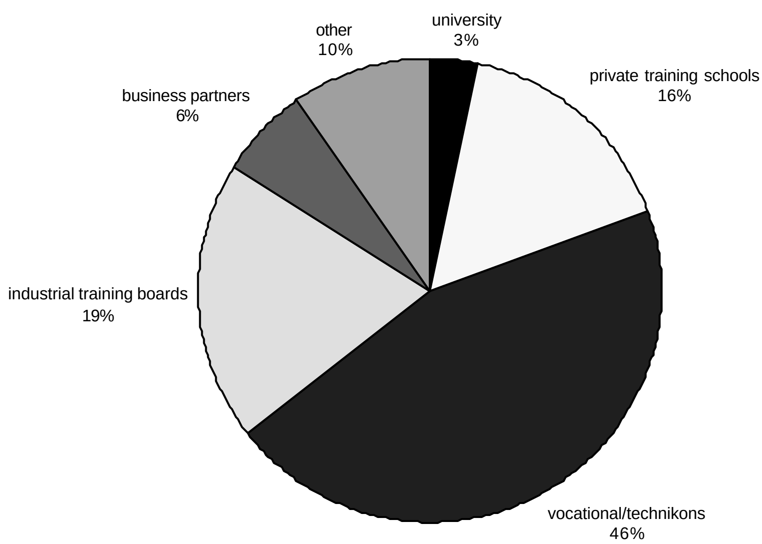
Training and Skills Development

Over 70 percent of firms surveyed reported a level of education below matric as the average level of education of employees on the shop floor. While some shopfloor employees have a level of education above matric there is a significant gap in the level of formal education between them and their colleagues. Only 13 percent of firms indicated that some form of post-matric training was necessary to ensure an adequate grasp of basic foundry skills. In the interview sessions, the majority of respondents indicated that existing levels of education do not impact adversely on productivity but rather present practical challenges in providing on-the-job training. Another major problem facing the South African foundry industry is an increasingly limited pool of skilled of labour from which to draw.

65 percent of firms indicated that the average time to train basic foundry skills is greater than 3 months. This relatively suggests therefore that training and skills development is a major issue for firms rather than levels of education *per se*. While a number of firms have established their own in-house training programmes – in both basic foundry skills and more advanced skills specific to the type of casting process employed – a major problem with these initiatives is that they are not formally accredited.

The importance of an industry-wide, accredited training programme cannot be overstated. Programmes already exist regionally, which could be replicated nationally. Technikon Witwatersrand (TWR) is the main educator on a tertiary level in foundry technology. In addition, the Western Cape Institute of Foundrymen (WCIF) provides accredited training programmes to foundry employees in all aspects of foundry technology. It is very clear that the training programme provided by the WCIF has galvanised local industry and has provided an enabling environment for processes of deliberation, knowledge-sharing, and technology transfer between firms[11]. Presently, technikons and other vocational training institutions are the most preferred source of outside training, followed by private training schools and industrial training boards (see Figure 6).

Figure 6. Preferred source of outside training



Other challenges which need to be addressed, particularly (although not exclusively) for export-oriented firms, include the lack of awareness of the importance of on-time delivery amongst shop-floor employees as well as the need to ensure and maintain quality in the production process.

Finally, 7 firms, representing 30 per cent of firms surveyed, claim back the skills development levy. 5 firms (71 per cent) are large-sized firms and 2 firms (29 per cent)

[11] The WCIF training programme consists of nine modules covering all aspects of foundry technology including quality control, productivity and production planning, and supervisory management. Each module consists of various chapters and is presented by experienced managers from within the industry itself. The WCIF training programme is MERSETA accredited and could provide a useful model for a national skills development and training programme in foundry technology.

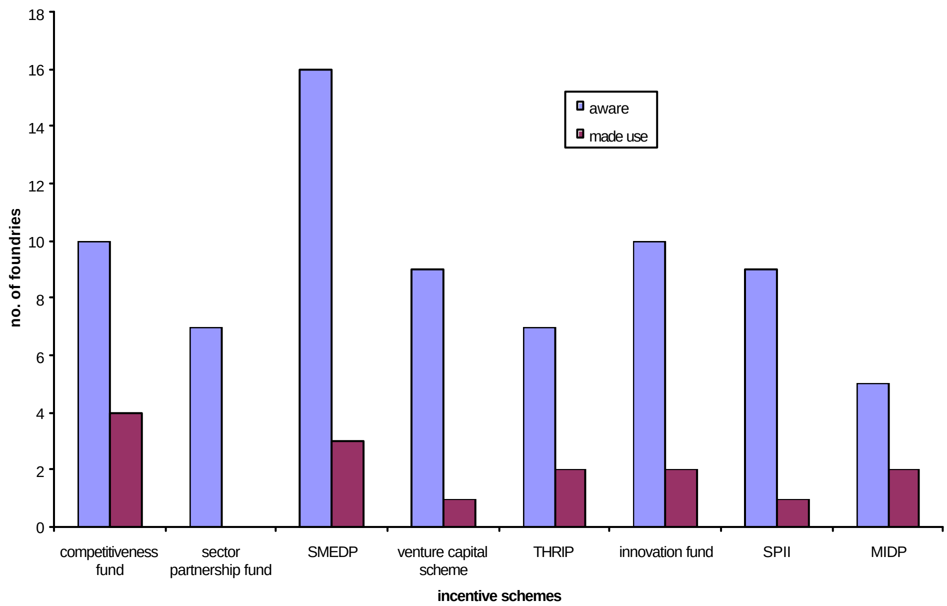
are medium-sized firms. Not only does this support views expressed by respondents in the interviews to the effect that the process of claiming back the skills levy is complicated and laborious but it also implies that small-sized firms do not claim back the skills levy at all. Here firm size appears to be important: there is thus a great potential for accredited training initiatives for small firms as well as for the provision of assistance to small firms in claiming back the skills development levy.

Government incentives

The survey reveals that awareness of the various government incentives available is relatively low and that only a small proportion of firms have used or are making use of the incentive schemes. Only 9 foundries, representing 39 per cent of the sample, have used at least one incentive scheme. Further, there is a greater tendency of large firms to make use of incentives. Of firms that have used at least one incentive, 67 per cent are large and 33 percent are small firms. In other words, no medium-sized firms and very few small-sized firms have made use of an incentive scheme at all.

The most widely used incentive is the Competitiveness Fund followed by the Small & Medium Enterprise Development Programme (SMEDP). The MIDP, the Technology and Human Resources for Industry Programme (THRIP) and the Innovation Fund are used in the same proportion. While only a small number of firms 'use' the MIDP, in the interviews it was evident that the majority of firms supplying castings to the automotive sector have clearly benefited, although indirectly, from the provisions of the MIDP.

Figure 7. Awareness and usage of incentive schemes



4. Conclusions – the role of government, technological capabilities and local economic development

The paper has examined the basis for manufacturing performance and firms' productive and technological capabilities as a key element in this. This forms part of a bigger question as to the reorientation of South Africa's industrial development path from the historical trajectory to one of broad-based manufacturing growth, employment creation and increased value-addition. The Ekurhuleni economy, as the largest industrial concentration in South Africa built on the back of mining, exemplifies these challenges. Together with the case study of the foundry industry, the analysis enables an assessment of local linkages and firm decision-making in a major existing local agglomeration.

The evidence on manufacturing performance in Ekurhuleni reveals major contractions in manufacturing industries as a result of liberalisation, weak demand, and restructuring by firms. Moreover, while better performing firms are those which have focused on non-price competitiveness and upgrading machinery and skills development, local linkages between firms are weak and firms remain subject to the pricing power of upstream suppliers of basic chemicals and metals.

The foundry industry is crucial to overall development of local manufacturing capabilities as it provides intermediate inputs to a wide range of other sectors, including machinery & equipment and the auto sector. The findings from the firm survey and in-depth firm interviews highlight the importance of understanding firm decisions and local linkages in developing their production capabilities. This relates to firms decisions across product development, investment in new machinery, and training and skills development. Domestic markets and domestic demand are a very important factor in this. In particular, the foundry industry demonstrates the gains from the progressive broadening and deepening of local inputs to the auto sector stimulated by the Motor Industry Development Programme. This has provided a foundation for firms to plan investment decisions, upgrade machinery, build technological capabilities and develop skills.

While liberalisation and increasing international integration have been important pressures on firms' restructuring, it is not direct exports in themselves which have been important for firms adopting a dynamic as opposed to a cost-minimisation orientation. Rather, it is the opportunity for firms to link into international production networks, including technologies and institutional links (such as with CTI) which are important. In doing this, firms internal capabilities to engage in ongoing product development and also to draw on local suppliers are essential. Such developments are built on an existing productive base. While local linkages are important for more successful firms, inter-firm linkages in the industry overall are not good.

Given the intrinsic tendency for firms to under-invest in technology related activities (whether narrowly defined R&D or broadly defined product development), appropriate institutions have an important role to play. But, the case study revealed that relationships between industry and tertiary institutions, science councils and other research organisations are chronically weak. There appears to be poor communication and little co-ordination between industry and these organisations. There is also a striking lack of a co-ordinated approach to formal training in basic foundry skills, which the study demonstrates is much more important than the average level of education of workers. Partly the lack of co-ordination between industry and institutions mirrors poor communication between the firms themselves. It does, however, point to a need for a more proactive stance by public institutions, with public funding, in addressing a problem of collective action. The performance of the group of dynamic firms in the industry demonstrates the benefits to be gained from such an approach to support the industry as a whole. In the absence of such an approach it is very doubtful whether the jumps realised by firms supplying the auto industry will be somehow transferred to those supplying machinery and equipment.[12]

An effective strategy for the industry requires information, analysis and co-ordinated action. While policy-makers and government officials may be far-sighted, it is also the case that they respond to clearly articulated positions. It is not coincidence that the auto industry has a sector specific strategy given its size and lobbying power. The danger is that the other industries with similar characteristics are those such as basic chemicals and basic metals which built their strength under far-reaching support from the apartheid state.

The roles of local government therefore include representing the needs of the local economies over which they preside to national and provincial government, and national institutions. The national policy frameworks also place considerable weight on local implementation. This requires capabilities of local government, which appear poorly developed at present. International experience of the development of local agglomerations points to the importance of effective co-ordination and implementation of initiatives at the local level, especially around technology and production capabilities, and skills development. This, together with more effective co-ordination between technology, industrial and skills policies, is a major challenge for the next decade of South Africa's economic development.

[12] Indeed, current research on machinery and equipment has revealed widespread dissatisfaction with the quality and delivery of local foundries.

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