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Trade and Uneven Development: Oppo rtunities and Challenges

The significance of product development to firm competitiveness: A case of plastic product firms in Ekurhuleni

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The significance of product development to firm competitiveness: A case of plastic product firms in Ekurhuleni

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Understanding firm competitiveness and product development is crucial to industrial development. The plastics sector provides a good case in which to explore these issues. The plastics sector has been one of the better performing sectors in recent years in terms of output and employment. Plastic products are increasingly replacing metal products, thus placing the plastics sector at the core of manufacturing. There are constant developments related to the properties of materials such as rigidity, colour and flammability. Hence it is vital for firms to adapt, combine and develop capabilities to establish new products and markets. These factors require downstream firms to align their technological capabilities and dynamics to meet such sector specific and international challenges. The paper assessed different dimensions of firms competitiveness and capabilities, including technological capabilities, investment decisions and skills development. It finds that the firms that are engaging product development and industrial restructuring through upgrading or re-organisation of their production processes tend to be more competitive and were growing. The paper also highlights actions required in order to upgrade and re-organise production processes, including appropriate government policies.

1. Introduction

The accumulation of useful knowledge and the extension of its application are the essence of modern economic growth (Teece, 2000). Growth accounting studies typically find that a very large proportion of growth is due to the 'Solow residual', which includes technological progress (Best, 2001). There is now widespread agreement that technology should be regarded as an important variable in growth models, but it is poorly understood. Moreover, in neoclassical economics, technology is limited to decisions by optimising firms over current and potential production techniques based on relative prices and returns (Roberts, 2001b).

Physical resources can be acquired and combined by any firm to get the desired production level, but it is the intangible resources such as knowledge and capabilities that cannot be easily imitated (Foss 1996). With respect to capabilities it is both empirically and conceptually difficult to fully separate technology, production and organization (Foss 1996). This is confirmed by earlier work that view technology, organization and skills as intertwined and not completely separable (Nelson & Winter 1982; Prahalad & Hamel 1990).

Numerous definitions and explanations are offered in literature in defining capabilities, product development, competitiveness and skills (see Chandler 1992; Lall 2001; Foss 1996; Prahalad & Hamel 1990). Generally, the term "capability" refers to the important role of management in adapting and restructuring the firms' resources in order to influence its overall competitiveness. According to Best (2001), capability refers to the ongoing institutional processes that are core to the strategy and performance of a firm. Firm capabilities are a knowledge-acquisition process that usually involves the commercialisation of a new product for national and or international markets (Chandler 1992).

"Product development" is defined as the process of acquiring knowledge to create a new product to serve the needs and wants of customers who are already buying a company's products. It also refers to improving an existing product. The process of product development generally also requires firms to scale-up their production process. This

usually includes upgrading of machinery and equipment, the acquisition of relevant skills through training of the workforce.

Nelson and Winter (1982) refer to a "skill" as a capability for smooth sequence of coordinated behaviour that is ordinarily effective relative to its objectives, given the context in which it usually occurs. It is tacit knowledge, meaning that the performer of the skills is not fully cognisant of the details of such acts, and finds it difficult to articulate or account for it.

"Competitiveness" is primarily a firm-level concept and refers to the ability of a firm to produce output of superior quality and lower costs than its domestic and international competitors. It is reached by improving product quality and through processes of product development. Competitiveness is also synonymous with a firm's long-run profit performance (Asian Development Outlook 2003).

These definitions above suggest that there are strong interdependencies characterizing product development, technological capabilities and skills of firms. Thus any discussion of product development requires that reference be made to the technological capabilities and skills of a particular firm's competitiveness. The interdependencies of competence and capabilities may yield superior efficiencies (Foss 1996).

Comparisons with countries such as Chile suggest that the plastic sector is one of the engines of growth under industrialisation. Plastic products form intermediate inputs to a very wide range of industries placing it at the heart of manufacturing. The largest concentration of downstream plastic firms is located in Ekurhuleni, an area that is the industrial engine of Sub-Saharan Africa. Therefore understanding the factors that influence the competitiveness of a potential growth sector becomes important. Plastics are also increasingly replacing other materials. The local (South Africa) plastics industry has however not realised its potential – there is a large trade deficit, indicating significant growth can be gained from improving international competitiveness. Therefore it is important to understand the factors that underpin a firm's competitiveness such as product development, technological capability and skills.

For downstream plastic firms in Ekurhuleni, evidence from the firm survey concluded that quality, design and delivery dimensions of competitiveness have become increasingly important to firms, to compensate for the competitive disadvantages in input costs (CSID 2005). The traditional modes of competition that were based on low cost and price are being overshadowed increasingly by competition that is based on quality, flexibility, design and reliability (Lall 2001). The importance of non-price competitiveness highlights the need for ongoing upgrading of production capabilities, including the renewal of machinery, ongoing skills development, and effective local accessibility of technical services. Thus the basis of this paper is to assess the extent to which the firms doing product development and engaged in industrial restructuring through upgrading or re-organisation of their production process are more competitive.

This paper draws on more than 50 interviews with plastics firms in Ekurhuleni and institutions; in addition the results of the 2004 manufacturing firm survey carried out in Ekurhuleni are used to evaluate the importance of technological capabilities for improved competitiveness and growth. Responses were received from 41 plastic product firms from an estimated 200 firms in Ekurhuleni. Associations are explored in the survey data using cross-tabulations. The firm interviews were semi-structured using a topic guide based on the main areas of enquiry and the preliminary survey findings (Kvale, 1996).

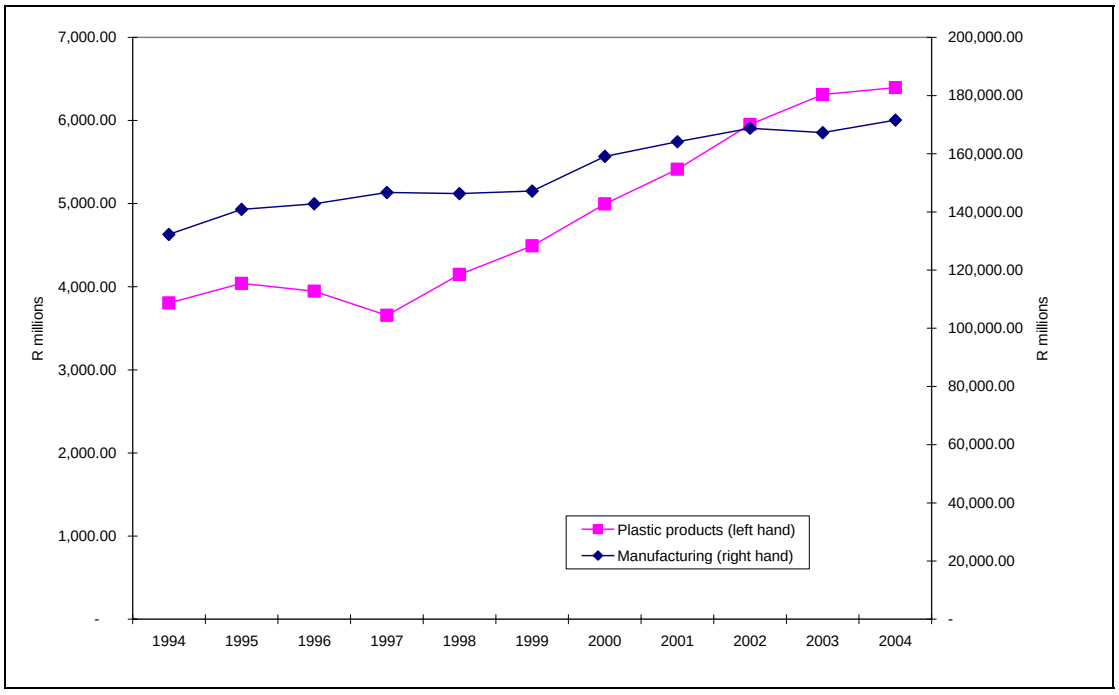
The paper will continue by giving an overview on performance of the industry at a national level in section 2. Section 3 of the paper will discuss the theoretical framework that supports the assertion the product development is a necessary condition for firm-level competitiveness. Section 4 will highlight some of the product development that took place in the plastic sector and will draw on the theoretical framework to illustrate how that relates to competitiveness and the role that upgrading and re-organisation of activities has played. An analysis of the industry dynamics and technological capabilities of the downstream plastic firms in Ekurhuleni based on findings of the manufacturing survey and firm interviews will also be discussed. As part of section 4, an analysis of the institutional and policy framework will also be briefly assessed. Section 5 will conclude with potential action by government.

2. Performance of plastic industry

Overview

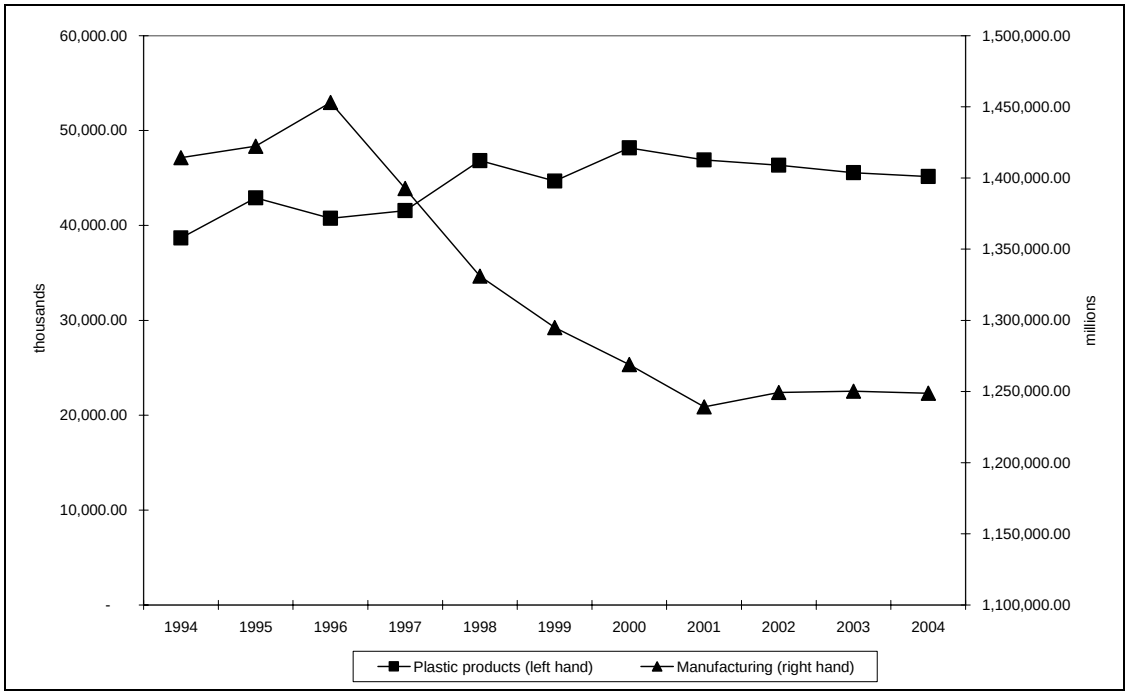
Plastics sector value-added broadly followed GDP, recovering towards the end of the 1990s, recording particularly strong growth in 2003 after the depreciation of the Rand (Figure 1). The employment performance of plastics is also encouraging (Figure 2). The plastic products sector has been one of the best performing in terms of employment, with an average annual growth in employment of 1.72 per cent and value-added of 5.88 per cent for the past 10 years. This is comparable to growth of overall manufacturing value-added of 2.4 per cent and an average annual contraction in manufacturing employment of –1.3 per cent per annum and total economy of 3.35 per cent (value added) and a sluggish employment growth of 0.11 percent during the same period. Growth in employment and in fixed capital stock preceded the strong increase in output in 2001 and 2002.

Figure 1: Value added for plastic products (Rmn, constant 2000 prices)



Source: Quantec

Figure 2: Employment for plastic products and total manufacturing



Source: Quantec

The real capital stock doubled from 1995 to 2000, and continued to grow from 2000 to 2002 (although at lower rates). Investment in machinery & equipment peaked at R494mn in 2001 (in 1995 prices), or 19 per cent per cent of value added. By 2003, however, investment had fallen back once more and GDFI was equal to just 13 per cent of value-added. Although investment levels in recent years appear high, they are in fact only a return to the investment levels recorded in the late 1980s.

This pattern is consistent with survey data and interviews which indicate that investment in upgrading machinery & equipment has been essential for firms' competitiveness, and has been accompanied by increased employment levels as part of a broader growth path.

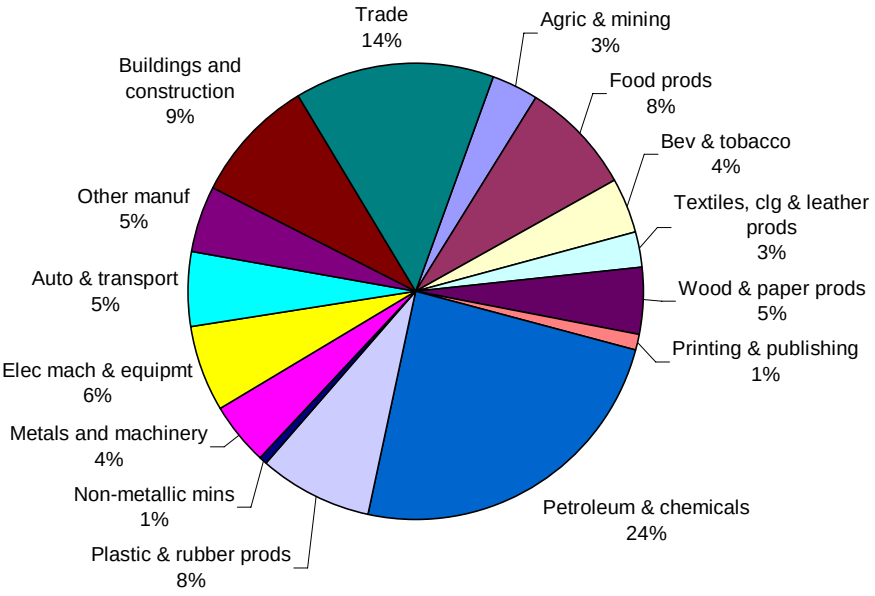
Input-output linkages

The inputs to the manufacture of plastics are dominated by primary forms of plastics (polymers), which account for 51 per cent of total inputs, and 30 per cent of the total output value. The competitiveness of the sector is therefore closely bound up with

pricing of polymer inputs. Services such as transport and communications also account for a significant proportion of input costs (at nine per cent).

Most plastics products form intermediate inputs for other domestic industries (figure 3). Only 6 per cent are sold to households or to government or purchasers in the service sector and eight per cent are sold as exports. As intermediate products, plastics feed into a wide range of sectors, effectively placing the industry at the heart of manufacturing.

Figure 3: Breakdown of industries to which plastics products are sold



Source: Statistics South Africa, Final supply and use tables

Of these, the packaging (which forms part of the demand of the other sectors) is by far the largest market, accounting for more than half of all plastic products by weight. The significance of packaging in plastics in South Africa is also very large (and other groupings are relatively small) by international comparison reflecting the relatively low level of development of plastics in South Africa.

This further reflects the importance of plastics as a material as well as the use of plastics for packaging. The nature of much of plastics output means that it is both a contributing factor to, and reliant on, the performance of manufacturing more broadly.

The industry can be broken down by process (injection moulding, extrusion, blow-moulding, roto-moulding etc.), or by market, as mentioned above. There are also distinct differences between high-tech engineering plastics products, and lower tech commodity type products. For example, in the automotive sector specialised plastic products are replacing some metal components.

Trade performance and competitiveness

South Africa is a major producer of the raw materials required for plastics production and there is a trade surplus in inputs such as polypropylene and PVC. This upstream competitiveness is, however, not being translated into the competitive performance of downstream plastics product manufacturers in export markets or against imports. In addition to comprising a large share of total exports, primary plastics have been among the fastest-growing exports. Polymers of propylene which are used in the production of auto components, appliances, packaging and furniture, have the largest share of total plastics exports. Import-parity pricing for locally made polymers means that there is no cost advantage for local manufacturers from using a locally manufactured input.

If we exclude polymers, there has been a persistent and significant trade deficit in plastic products. Exports have accounted for around eight per cent of output for most of the last decade while imports are equivalent to around 13 per cent of plastics consumption. Exports did, however, improve significantly in 2003.

There is an important difference by level of processing, with South Africa recording a better performance in finished plastic products which recorded only a slight trade deficit. Semi-finished products by comparison, which include tubes & pipes, floor

coverings and plates and sheets of plastics, have a very large trade deficit.[1] Since they require lower levels of processing, the competitiveness of these products depends to a greater extent on input costs.

In addition, one of the most successful export groupings of finished plastic products, that of baths & basins, has more than doubled exports over the period and uses imported raw material. The baths and basins category contributes eight per cent of total plastics exports. Its exports are largely destined for Europe. This again highlights the inherent possibilities for plastics products.

3. Theoretical framework: Technology and production capabilities

The paper is concerned with product development as a sub-set of the broader capabilities of firms. Other factors that influence firm competitiveness are: its strategic orientation (price vs non-price measures); the degree of export orientation; technological capabilities; skills; the market size and structure; a firms' organisational strategy in terms of managerial and administrative ability; and the policy framework. Firms can be understood in terms of their productive resources, capabilities and competencies which explain the differences in their competitiveness. Although not all factors mentioned above will be considered in the paper, given the interdependence of product development to a firm's technological capability, investment and skills it is necessary to consider these aspects.

This paper assesses the extent to which product development as a competence might not be a sufficient condition for competitiveness but certainly a necessary condition. The Schumpeterian growth process that focuses on micro level puts technology, R&D and innovation as the centre of firm competitiveness.

A critical factor in the competitiveness of a manufacturing cluster is its ability to innovate (CSID 2004a). Organisational capabilities contributes not only the growth of the firm, but also to the industries in which they operate and their broader national

[1] Semi-finished products are HS3916-3921, and finished products are HS3922-3926.

economy. Firm capabilities are generated during the knowledge-acquiring process that usually involves commercialisation of a new product for national and or international markets (Chandler 1992). Firms that are more innovative are more likely to sustain a more competitive position (Orford 2004).

The capabilities of firms are not necessarily a result of their organizational arrangements but rather have to do with their strategic choices and orientation (Teece and Pisano, 1998). The approach a firm takes depends to large extent on the strategic control being placed in the hands of those with incentives to allocate resources to innovative activities. An important question that underpins competitiveness is what determines firm capabilities and the decision involved in growing such capabilities. Earlier research emphasized that product development depends on a combination of in-house experience and learning, in combination with drawing on a numerous external sources of information and advice (Teece, 2000).

An indication that firms have a sustainable competitive advantage is provided by whether a firm is able to compete in export markets (Lall 2001). Work done earlier on the relationship between export orientations (measured as a proportion of exports in production) and firm performance in South Africa could not find any evidence supporting a positive relationship (Roberts 2001a). But this was however due to the weak local demand at the time, which explained why the firms that increased exports did not experience improved performance. Exports are treated as a way of maintaining production volumes when local demand is weak, especially when there are economies of scale (Roberts 2001a).

The growth trajectory for small firms in the era of trade liberalisation lies in their ability to learn how to upgrade their production capabilities and access new and complex markets (Tewari and Goebel 2002). Developing countries obtain technologies primarily from the industrialised world and their main technical challenge is to initially master, adapt and improve on the imported knowledge and equipment (Lall 2000). Product development involves utilisation and adaptation of these technologies to improve product design and specifications. Leaders in the global market have been firms that could respond rapidly through product development together with management

capability to effectively coordinate and restructure internal competencies (Teece and Pisano 1998).

Four dimensions can be identified to the processes of technology and industrial development: technological upgrading within industries, entry into more complex activities; increasing local content involving local innovations and design; and the mastering of more complex technological tasks within industries (Lall 1994).

The importance of skills for competitiveness is generally accepted, but is essential to explain the link between skills and competitiveness. The effective use of technologies requires skills (Lall 2001). Product development which at times involves a move from simple to more complex technologies requires new and better skills. The fast rate of improvement in technical progress, dictates that production activities change and also the skills needed to operate them (Lall 2001). For countries to grow in a competitive environment, they have to increase their skills levels, this explanation can easily be transferred to micro level. Even for the non-traded products, threat from imported products and the need therefore to be competitive and grow, impose the need for increased skills (Lall 2001).

Knowledge and skills are mainly developed through learning by trail and error and sourcing feedbacks (Chandler 1992). Such innovative skills and knowledge are usually firm-specific (Best 2001). In all the cases of product development that are alluded to in the paper, the skills or innovative capability are only specific to those particularly firms. American and German firms have managed to outperform their British counterparts through creating, maintaining and expanding on their capabilities (Best 2001).

The role of government policy in developing industrial competitiveness is one that is important to assess**.** The institutional environment which is mainly provided by government is also a key determinant of competitiveness (Asian 2003). Two main approaches can be adopted in dealing with industrial competitiveness namely the neo-liberal approach and the structuralist approach (Lall 2001). The latter is based on a relatively strong theoretical approach argues that markets are efficient and the institutions are usually in place to make markets work effectively. Should there be any divergence from the optimal scenario it cannot be rectified by government intervention.

The structuralist approach on the other hand, puts less emphasis on the efficiency of markets. It acknowledges that markets are powerful but concedes that they are not perfect and believe government intervention is required to improve market outcomes.

The discussion now shifts to exploring the plastic industry in Ekurhuleni and understanding the underlying factors that determines its competitiveness

4. Industry dynamics and evidence of product development: Plastic industry in Ekurhuleni

To understand the relationships between product development and firm competitiveness, information obtained from the 2004 firm survey carried out in Ekurhuleni and interviews conducted with 50 firms and institutions is drawn on. The interviews were able to give a deepen understanding of the factors that influence firm competitiveness.

The analysis is divided in four parts. Firstly, indicators of firm competitiveness in terms of its strategic orientation referring to price and non-price competitiveness and the degree of export orientation will be assessed. Secondly, an assessment of firms' technological capabilities and investment will be examined. Thirdly, the skills and training initiatives will be assessed. Lastly, an analysis of the policy framework since 1994 and the different government incentive schemes will be carried out.

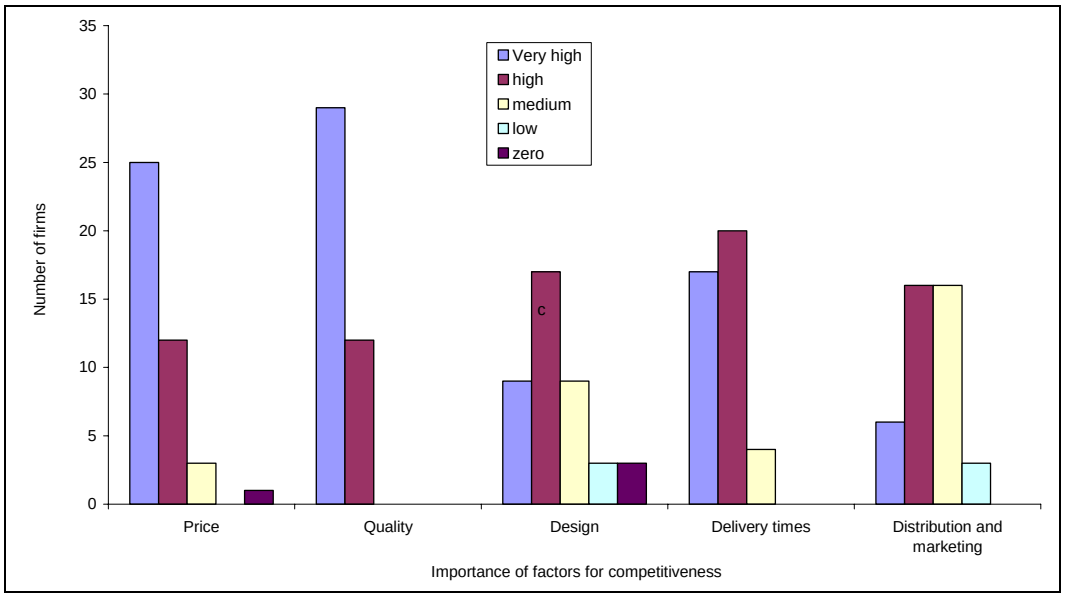
4.1 Strategic orientation and markets

In terms of competitive orientation, quality was ranked as most important for firms, followed by price and then delivery time (Figure 5). There were no straight forward associations in the survey responses between the strategic orientation of firms (in terms of price and non- price competitive aspects) and their performance in terms of turnover or employment. This is a noticeable change from previous survey results (Dobreva and Madosi, 2003). It is also not in line with firm interviews which emphasised the importance of non-price competitiveness for better performance. This could be due to

the strong growth in demand locally that pulled up the performance of those firms who are not focussed on non-price competitiveness.

The importance of quality is consistent with the intermediate nature of many plastics products. Quality can be measured both in terms of reliability, safety and relevance to the consumer. The importance of quality is evident not only in the motor vehicle components but it is also true in other products. Information from an interview carried out with a CD box manufacturer highlighted, there is no acceptance of even minute imperfections in the injection moulding of CD boxes as this would mean the automated packing machines would stall. The importance of quality is even greater for new developed products. The plastic converter that designed brackets to mount geysers against the wall had undertaken several stress tests to ensure their stability and safety of the product. The local test did not seem sufficient because when the product was tested it was found to of inferior strength to hold a geyser. Modifications were done to the product until stress tests that were sourced internationally passed the products. This relates to the accessibility of technical testing facilities that will be discusses below.

Figure 5: Competitive factors

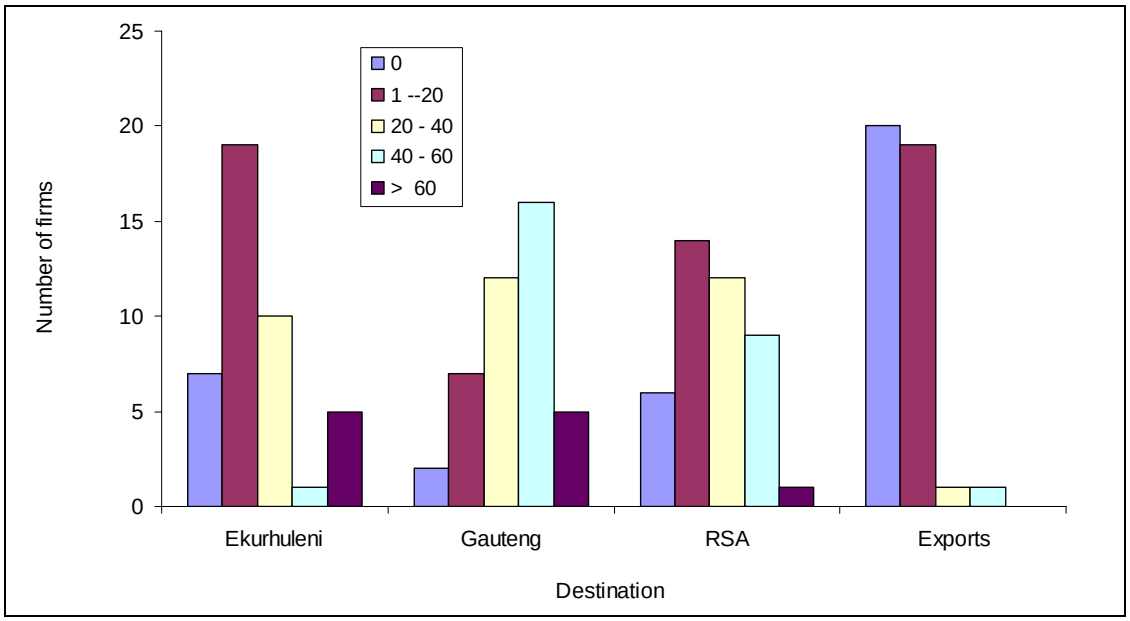


Of the surveyed downstream plastic firms, a very small proportion export more than 20 percent of their output (figure 6). Firms were also asked to rate the growth in demand in the different markets (Ekurhuleni, Gauteng, RSA and export market) over the previous

12 months. Growth in the demand of the export market was relatively weaker compared to local market (Gauteng and the rest of RSA) and this is primarily attributed to the strength of the local currency. Despite the low levels of export, of the firms that do export, 44 percent indicated growth in demand in their international markets. A positive association was also established between those few firms that are exporting; those that are experience growth in their export markets and increased performance in terms of employment.

This was also confirmed by the interview results that found that there was distinction between firms that make internationally traded products and those firms that only produce products for the local market. The firms that manufactured non-traded products experienced rapid growth than those that compete internationally. The low performance of firm making internationally traded products was mainly influence by the strength of the currency. It is important therefore to note that the disassociation that was established from the survey results and interviews between trading internationally and/or locally with firm performance had little to do with whether the firm had an export orientation but everything to do with the strength of the local currency.

Figure 6: Proportion of output sold to different regions



The firms that experienced demand growth for exports are less likely to rate quality as very important for competitiveness.[2] Exporting firms were found to be less likely than non-exporting firms to rate design as being very important.[3] While this may appear surprising, the interviews revealed that the downstream plastic firms generally export to overland Southern African markets, where competition is, in fact, relatively low. This is particularly the case for tubes and pipes and other building materials which are exported predominantly to the region. For the plastic product firms that export bath and basins mainly to Europe, quality is very important.

Given the results from the survey, exporting does not therefore appear linked to upgrading of capabilities but was linked to improved employment performance. And, while the survey could not find any apparent association between exporting and investment, firms with growth in export demand are unsurprisingly more likely to rate foreign competition as a major motivation for investment.[4]

In the interviews however there were examples of firms achieving export success based on their local capabilities, including design and product development. The examples of export success include swimming pool cleaners and fruit crates. Each of these was motivated initially by local demand factors (described below in more detail in section 4.2).

4.2 Technological capability and investment

The manufacturing of plastic products involves both relatively standardized production technologies embodied in machinery and more complex process to make engineering plastics as the case for firms involved in product development. These are plastic products which are replacing metals (such as the development of a plastic chain to drive a food products conveyor).

Besides the skills of the workers, the technology of production in the plastics sector mainly entails the machinery, moulds and computer software. Production processes are

[2] Significant at 5% level.
[3] Significant at 5% level. Exporting firms are also less likely to rate price and quality as being very important for competitiveness, although this is only significant at the 20% level.
[4] Significant at the 20% level.

mostly micro and computer controlled but the industry is said to lag in the use of information technologies (Wesgro, 2000). As mentioned earlier, technologies primarily from the industrialised world, and requires from domestic manufactures to adapt and master these production technologies are generally embodied in imported machinery. This is true for plastic firms that have to master production processes and the different production technologies, to work with the properties of different material inputs, and to be able to ensure the desired characteristics in the outputs. An obstacle in achieving economies of scale and improving firms' competitiveness is the cost and local supply of moulds (Dobreva *et al* 2005).

The four dimensions highlighted earlier in the process of technology and industrial development are not foreign concepts for downstream plastic firms. The interviews revealed that the downstream firms that were engaging product development were all expanding their operation by upgrading their machinery and equipment and acquiring new machinery.

As a material in which there are constant developments related to chemical properties such as rigidity, colour and flammability, the capacity of firms to adapt and adopt technologies as part of ongoing product development and innovation is crucial to the downstream plastic sector. As mentioned earlier, product development depends also on links with external sources for information and advice. Information from key informants highlighted that technological trends and priority areas of development are mainly identified through international visits to trade shows were the latest technology developments are show-cased. In addition, strategic technical alliances with foreign, primarily European, plastic converters were identified as being critical to the firm's technological and innovative capacity.

The development of new products by small plastics convertors depends to a large degree on the owner-engineer typically running such firms. These developments are generally in response to perceived needs of local customers. Best (2001) also postulates that the firms that generate new product development abilities usually compete on short cycle times in the design to manufacturing process. What certainly came out from interviews with plastic firms is their ability to compete on short – runs. The flexibility in the production runs by way of adjusting their production to accommodate customer

demands has given those firms that respond to such short-run requests a competitive advantage. Some examples of product development are:

Pool cleaners: The original design for automatic swimming pool cleaners has spawned an ongoing process of improvement, designed to yield a more effective product, with greater durability. The tooling costs in South Africa meant importation of tooling; this has been reversed recently with the tooling being transferred back to South Africa due to the firms' involvement in product development, and their production capabilities.

Geyser brackets: The search for new products by a medical equipment firm which had already specialised in producing highly specified products led them to examine replacing metal geyser brackets with plastic ones. Problems with the design for wall mounting led to this small firm using a US university's research capacity to test and refine the product.

Fruit crates: South African fruit exports remain in the cold chain (in storage and transport) for considerable lengths of time during which standard corrugated cardboard boxes become wet and soggy. Extruded corrugated polypropylene sheet was developed to replace cardboard, and one firm has specifically focused on developing the corner pieces for the boxes to ensure strength and stacking. This is product development by a small firm in Ekurhuleni

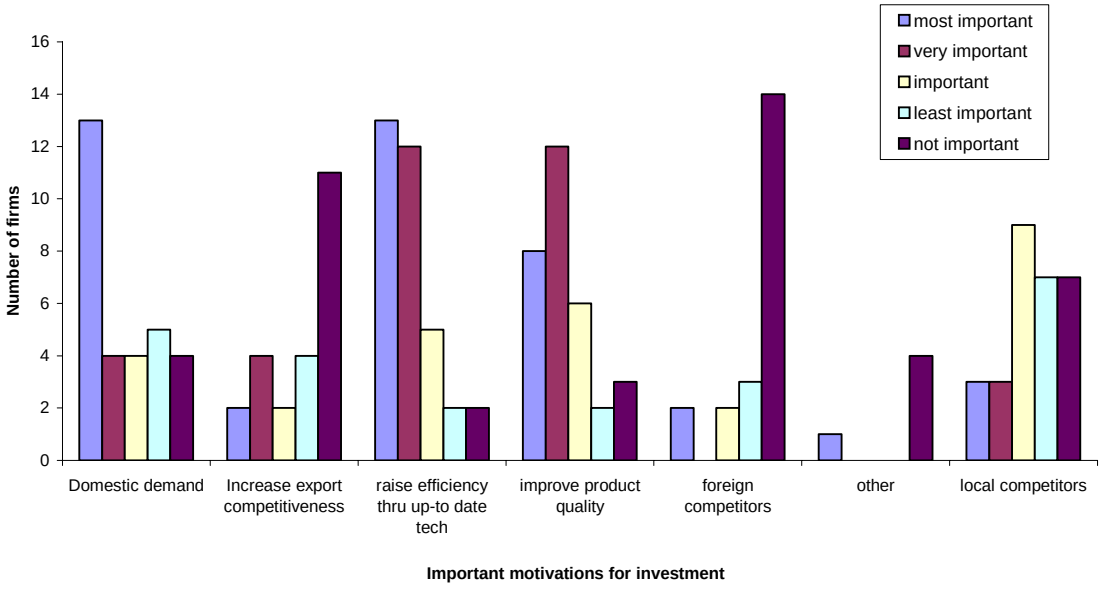
Certification is an important aspect in downstream plastic firms, especially for engineering plastic products. The replacing of metal is an important objective thus customers need to have a guarantee of the specifications and characteristics of products. Certification however has proofed to be a barrier to product development, apart from the pool cleaner manufacturing due to its links with the auto sector, the other two plastic convertors that engaged product development did not have formal ISO accreditation, which is viewed as expensive and cumbersome, but all have developed internal quality control systems and interact on a regular basis with their main customers and international linkages to built a reputation over time.

A second set of issues relate to sourcing machinery and tooling. While there has been a major improvement in investment, the average age of machinery in many firms is still

relatively old with 56 percent of the surveyed firms in Ekurhuleni reporting an average age in excess of 10 years. The costs of replacing machinery and equipment which are mostly imported are high and as result are not replaced as often as the case in the industrialised economies. Investment levels of the surveyed firms declined slightly from 2003 to 2004. Investment in 2004 averaged R1.8mn per firm (R25 864 per employee), down from R1.9mn in 2003 (R26 706 per employee). With only 33 firms making investments in 2004, compared to 35 in 2003.

The most important reasons cited by plastic firms in the 2004 manufacturing survey in Ekurhuleni for investing in machinery and equipment was raising efficiency levels through up-to-date technology, followed by increases in local demand, and improving product quality (Figure 6).

Figure 6: Motivation for investment



Associations between the motivations for investment and firm performance and orientation were also established. Firms for which improving product quality was the most important motivation are more likely to have recorded annual turnover growth above 10 per cent, and are more likely to rate price as very important for

competitiveness,[5] and are likely to rate technology as very important for competitiveness.

These associations suggest upgrading strategies focused on improved quality, efficiency and delivery times. This is reinforced by interviews, in which firms facing intense competition were focusing increasingly on improvements in the consistency of delivery of quality products, and on realising efficiencies in production in order to realise a healthy financial return. The firm interviews also highlighted many cases of firms who were investing to increase production capacity to meet rapidly growing local demand, especially in construction related products. These firms were not apparently under any greater pressure than previously in terms of quality and delivery times.

Information obtained from interviews highlighted that the investment in machinery and equipment and upgrading of technological capabilities that accompanies it was associated with turnover and employment growth. Even in cases where investment increased capital intensity, it was still part of overall improvement in the firm's competitiveness.

4.2.1 Tooling

The relatively old machinery and equipment and low levels of investment in new machinery often affects the quality of moulds. Tooling is an important component of technology and capital equipment. The making of moulds and dies is critical. Good tooling means greater efficiency and product quality, and the design of moulds can greatly reduce the amount of material required for a specific product. These concerns run across plastic products, good examples of relatively basic products where strength and rigidity are very important would be plastic chairs and crates.

The nature of plastic products means new moulds and dies are required for new products or variations on existing ones (Dobreva et al 2005). The ability to design and delivery moulds therefore become crucial to product development.

[5] Significant at 5% level.

Interviews with firms have raised tooling as a serious concern, the orientation of downstream industries towards shorter production runs and the development of customised products requires it be supported by an able and responsive tooling sector. For several of the interviewed firms, a perfect mould in terms of quality and specifications and on-time delivery were more important than the price of the moulds.

Weaknesses in local tooling were raised as a crucial issue in almost all firm interviews. The very late delivery and serious complains with the quality of tooling have both significantly harmed the performance of the plastics industry itself. Examples abound from the interviews, including the following cases:

- A local chair manufacturer worked for more than one and a half years with a local tooling firm to get the correct mould for an upright chair. In the end the firm sourced the tooling from Portugal, with delivery of the mould in six weeks.
- A manufacturer of CD boxes repeatedly failed to get the correct moulds, from the local toolmakers and now imports his moulds from Italy (although more expensive, in this case). It is absolutely essential that the moulds are perfect otherwise the automated machinery for packing the CDs will not handle the boxes.
- Local tooling firms are typically reported to take six months to deliver moulds and dies. On top of the long turnaround times for moulds, the quality of the moulds is also questionable. This partly due to the severe shortage of tool makers in the country accompanied by the strong growth in local demand.
- The many different small components for a swimming pool product led the firm to source moulds from China, with delivery in only four to eight weeks from time of order.
- Local firms have developed links with Asian tooling firms to ensure responsive delivery to South Africa

The importance of tooling sector cannot be over emphasised. For on-going product development to take place, a tooling sector that can deliver on-time and more importantly respond to short production runs of the sector is pertinent in order not to compromise the sectors competitiveness.

4.3 Skills and training

Increasing firm level competitiveness was the second most important reason for increasing employment, after growth in the local market.

Most employment in plastics remains in the unskilled and low skilled category; and the average education level of employees in Ekurhuleni's plastic manufacturers was low, with 85 per cent of firms reporting the average level of education in their workforce as being below matric. Technical, IT, literacy, communication and customer handling skills are reported as most underdevelopment by the survey respondents. Management skills were not rated as weak, but this was contradicted by interviews, this maybe due to the fact, that the survey was completed by managers.

Training expenditure by plastic firms has been relatively low in 2004, with an average training expenditure of R909 per employee. This is significant drop of average training expenditure per employee recorded in 2003.

In interviews with firms, training and skills development were identified as very important across all employee grades. Skills constraints were reported to an important factor for increased employment. A plastic manufacturing firm's performance depends on the abilities of their relatively low-skilled machine operators to ensure the consistent quality of the product and efficient changeovers between different production runs. Another feature of the better performing firms was a low turnover of personnel, which facilitated the accumulation of on-the-job skills.

Interviews have identified at least two distinct strata of workers where skills are reported scarce. At a higher level of formal training, suitably qualified tertiary trained engineers are produced by only a handful of institutions and not in a quantity that is reportedly sufficient for industry. Similarly, at an operations level a scarcity of skilled mould setters and operators was also identified. It is also worth noting that the reported scarcity of higher level formally trained personnel may be only at a level beyond a first degree. Evidence of this comes from the recent closing of the plastics diploma programme at the Cape Technikon, as well as industry observers noting that often times students with diplomas end-up taking jobs as mould setters or operators.

The scarcity of skills at the operations level appears to be a large concern by industry. Larger firms with internal training capacity report that they have been forced into internal staff development to fill these positions and even then, once trained their staff are often poached by other firms free-riding on their training capacity. This situation appears to have placed the industry in a state of under-investment in skills development, in a clear example of market failure.

4.4 Institutional and Policy framework

4.4.1 The policy framework

There have been essentially two legs to industrial policy since 1994. The first is trade liberalisation which has brought far-reaching industry restructuring, and challenges firms to be internationally competitive (Roberts 2001a). The second is a series of incentive measures designed to support firms in various ways. The incentives provided by national government are aimed at improving production capabilities of firms, and through that spillover to other firms in related activities (op cit). However an individual firm who's primary aim is to maximise returns takes into account only its expected return when making a decision to invest.

Thus, consideration that should be kept in mind with incentives that are purely functional in nature is that the firms which are able to access them tend to be firms that have the means in any case, which are your large firms (Roberts 2001a). The supply-side programmes appear to have achieved limited impact in terms of improve production capabilities and competitiveness of firms and industries; this however does not imply that government measures are necessarily unimportant. The supply-side measures largely failed to address considerations of production linkages as well as the complex factors underpinning the development of capabilities and firms positioning. This requires that policies be targeted to carefully selected downstream manufacturing sub-sectors. An alternative, and not necessary mutually exclusive, approach is to identify groupings of activities where there is potential and provide more targeted support to build clusters of activities (Roberts 2001a). This starts from the premise that the performance of individual firms depends on a network of related firms and

institutions that provide a pool of skills, intermediate inputs, ancillary services, and markets for intermediate products (CSID 2004a).

4.4.2 Government incentives schemes

Use and awareness of the national incentive schemes are generally low. Studies carried out on usage and awareness of incentive programmes found that use of government schemes to be relatively low (FRIDGE 2003; Dobreva and Madosi, 2004 and. CSID 2005). Evidence from the 2003 CSID survey indicates that while usage and knowledge of these programmes is low, it is higher than the average for all manufacturing firms in Ekurhuleni (Dobreva and Madosi, 2003). The most widely used incentives schemes according the 2004 Ekurhuleni survey used is SMEDP followed by the EMIS (table 1). The two schemes also standout as being associated with better performance. The firms that received funding from the IDC were also more likely to train, focus on higher quality products and levels of technology.

There are seven primary sources of innovation funds directly relevant to Ekurhuleni plastic manufacturers: 1) the Innovation Fund 2) the Competitiveness Fund 3) the Support Programme for Industrial Innovation 4) the Sector Partnership Fund 5) the National Research Fund and 6) the Technology and Human Resource for Industry Programme 7) Khula Technology Transfer Fund (CSID 2004b) but usage has generally been limited.

Table 1: Government incentives – awareness and usage (no. of firms)

	Aware	Made use
Competitiveness fund	17	2
Sector partnership fund	8	0
SMEDP	23	5
Venture capital scheme	11	1
THRIP	7	2
Innovation funds	10	0
SPII	9	4
Standard leased factory building scheme	6	1
Export finance guarantee scheme	12	2
Export marketing	13	3

4.4.3 Research Institutions

Institutions available to downstream plastic firms for research purposes can be divided into four broad categories: 1) Public Sector Research Institutions 2) Industrial Research Institutions 3) Tertiary Research Institutions and 4) Collaborative/Cooperative Research Institutions.

In the public sector, the majority of research capacity appears to be located within the Council for Scientific and Industrial Research (CSIR) A perception, not totally unfounded, persists that the CSIR is only interested in larger, longer-term and costly projects (CSID 2004b). The commercial focus of the CSIR has also been identified as limiting its scope for R&D initiatives to support plastics converters

It was established from interviews with firms and institutions that many plastic converters have some internal research capacity and that some equipment suppliers have also been identified as offering technical services to plastics converters, however, the nature and scale of these services needs to be further investigated. Both polymer and additive suppliers were also identified as having industrial research capacity for plastics converters

There appears to be a gap between the supply of available research capacity and demand for that research capacity by South African plastic converters. While a spectrum of basic to applied research is being conducted nationally, there does not appear to be a high level of industry involvement directing this research.

5. Conclusions

The assertions above, all relate to the dynamic questions of firms resources, production capabilities and strategic orientation. For the plastic product firms in Ekurhuleni that had a strategic orientation in terms of design and quality, more commonly had the production capabilities such as the required human resources for industrial design and up-to date machinery that made them more competitive than their competitors.

The importance of non-price competitiveness also implies the importance of ongoing upgrading of production capabilities, including renewal of machinery, ongoing skills development, and effective local provision of technical services and logistics to clusters of firms. The local demand has been instrumental in the development of local technological capabilities. The progress in local capabilities has also involved taking international products and reverse engineering. Superior quality and being innovative are increasing becoming important for ongoing competitiveness. Thus product development has become a key determinant to gain competitive advantage and firms that are not engaged in product development will lag behind.

In light of the trade liberalisation, globalisation and the impact of industrial policy to date, firms in Ekurhuleni find it difficult to compete internationally and with imports thus intervention by government is critical to aid firms to gain competitiveness. Local firms are undoubtedly able to engage in innovation. The importance of local demand in developing production capabilities cannot be overlooked as it creates a platform for export. In order to widen technological capabilities, access to international markets is beneficial however obstacles in information gathering, financing exports, and obtaining the necessary certification should be reduced. Ongoing technological development itself requires the ability to test products to determine and improve specifications. In addition improved technological capabilities require skills development and training to take place. The examples of product innovation given above requires of government to build on the following.

Technical services and testing facilities: The ability to adopt and adapt international technologies is very important for firms and suggests gains from technology centres should be available. There are several institutions already in place to which firms can turn for support. These are however, are either tied to polymer suppliers or are part of organisations (often in universities) which have historically received funding due to links with defence and are not geared to commercialisation of innovations. Shared testing facilities with public funding assistance, is important because available testing facilities are generally in-house for large firms but not usually an option for smaller firms.

An important technology initiative of direct relevance is the 2002 National Research and Development Strategy. The National R&D Strategy aims to support South Africa's R&D investment and more generally enhance the performance of its national system of innovation. For it to succeed, however, requires strong links being developed with skills development and industrial policy (CSID 2004b). Technology policies in general and local technology policies in particular need to support existing business organisations' knowledge and encourage the use of appropriate management, distribution, marketing, and design technologies. In this regard, the government's Advanced Manufacturing Technology Strategy (AMTS) is an important development.

A gap also appears to exist between the technology policies intended to direct the sector and their utilisation/application among plastic converter firms. In this regard, the AMTS is significant as it appears to be focused on redressing this imbalance. It will be important to ensure the intentions of the AMTS are translated into actionable realities on the ground. The AMTS of the Department of Science and Technology through the National Council on Innovation establishes a framework for government action to support industrial development, specifically as it relates to research, technology and productive capacities. This strategy is currently being realised in specific programmes. Rather than just focusing on hi-tech niches, it is important that the need to support upgrading of labour-intensive industries such as downstream plastic sector be taken into account. 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.

Tooling initiative: The poor state of the local tooling industry has consistently arisen in research as an obstacle. Product development requires local mould-making capacity, which is weak. While firms appear to be increasingly sourcing tooling overseas from countries such as Italy and Portugal, local tooling capabilities appear an important part of a strong local industry able to move up the value-chain. This suggests that collective development of tooling by plastics and tooling firms is required; something which is more difficult if all tooling is imported. This is reinforced by the decisions of some even relatively small firms in engineering plastics such as in medical equipment to maintain in-house tool-shops. It is also very important where firms focus on customised and

niche products. The national tooling initiative currently underway will come some way in addressing the issue but what is required is short to medium initiatives to address the tooling problem for plastic firms

Ongoing investment in new machinery: Investment in plastics appears to complement employment rather than to be labour replacing, especially if one excludes capital-intensive extrusion. Where new machinery means higher throughput, and therefore higher output per employee, research has shown that this is strongly correlated with overall employment growth as these firms expand their overall operations as a result of being more competitive. Therefore more generous incentive provision should be considered to fast track investment

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