AN OVERVIEW OF RESEARCH AND DEVELOPMENT ACTIVITIES IN THE SOUTH AFRICAN AUTOMOTIVE INDUSTRY

MICHAEL GASTROW

ABSTRACT

Since 1995 South Africa's automotive industry has had to adjust to market liberalisation, rapidly integrate into global supply chains, adapt to World Class levels of competitiveness, and has seen increased ownership by multinationals. The effects of these changes on R&D activities are examined here. Data from the national R&D survey are used to further explore the structure and direction of automotive R&D. It is found that R&D activity is under pressure, and likely to decline. However, there are certain niche areas in which R&D is more resilient and likely to continue.

Key words: automotive, manufacturing, industry, research, development

1. INTRODUCTION

The changes that took place in South Africa in 1994 had a profound impact on South Africa's largest manufacturing sector, the automotive industry. Over the course of a decade (1995-2005), the following key changes took place: market liberalisation, the introduction of the Motor Industry Development Plan (MIDP), increased multinational ownership, and accelerating economic growth in South Africa post 1998, amongst others. While these changes posed great challenges to the industry, it has nonetheless grown over the last decade, and currently makes up approximately 7% of South Africa's GDP and 13.5% of exports (NAAMSA, 2007). This paper aims to shed some light on how the changing dynamics of the manufacturing environment affected the knowledge economy of this key sector of industry, focusing on research and experimental development activities (OECD, 2002).

2. THE AUTOMOTIVE SECTOR PRE-1995

Until the mid-seventies, South Africa had the rudiments of an internationally integrated automotive sector. High tariffs and a growing domestic market prompted several assemblers (Original Equipment Manufacturers or OEMs) to invest in assembly plants. A supply base for these plants was developing, although this was distorted by local content programmes specified in terms of weight rather than value. However, political upheaval in the wake of the 1976 Soweto riots changed this, resulting in the withdrawal of multinational ownership from a large proportion of the industry, economic sanctions, and increased political isolation. Those with the available capital (mining houses, insurance funds) snapped up the remnants.

At this point the competitiveness trajectory of the industry began to fall rapidly behind its international counterparts. The sector missed exposure to the lean manufacturing revolution that began during the late seventies at Toyota, and was moreover cut off from international competition, skills and knowledge.

Isolation also required that a wide variety of models be produced in low volumes, missing out on economies of scale. Thus, while the international industry rapidly advanced, the South African industry remained stagnant, inefficient, and plagued by market distortions.

3. MARKET LIBERALISATION AND THE MIDP

After 1994 the new government perceived that sustained economic growth, and a reduction of the inefficient distortions built up during isolation, would require market liberalisation. It was acknowledged that this would result in difficulties for certain sectors, particularly those where a substantial competitiveness gap had built up between local industry and international competitors.

Thus, in 1995, the automotive industry was under serious threat. However, government also recognised the importance of automotive manufacturing to South Africa's economy. The sector was a large source of value added, and an important area in which exporting capacity could be developed. The industry also has a large multiplier effect, as demand moves up the supply chain, fostering second, third and even fourth tier manufacturing activity. In South Africa's case, where the manufacturing base is comparatively undeveloped in relation to other sectors (e.g. the resources sector), this is particularly important for long term stability and growth. The Department of Trade and Industry therefore developed a plan to support the industry through these changes, with aims of supporting export activity, re-integrating the sector into international value chains, and improving efficiencies.

The Motor Industry Development Plan was introduced in 1995, and has since been extended and amended several times; it is currently due to continue until 2012. Under this scheme import duties for both vehicles and components were gradually reduced: protection for Completely Built Units (CBUs) was phased down from 115% in 1995 to 30% in 2007. An import-export complementation scheme enabled firms to rebate their import duties by exporting. Other elements included further rebates and allowances on imports, a direct investment subsidy, and the abolition of local content requirements.

Despite the generous support that was offered in other areas, market liberalisation was to place huge pressures on the industry, particularly on components suppliers. South African OEMs were no longer forced to purchase components from domestic suppliers, who were now effectively operating in an open market, and the emergence of China as a manufacturing superpower during the nineties exacerbated pricing pressures.

However, the MIDP created incentives for OEMs to invest in production in South Africa, for both local and export markets. Although it made sense for them to work with South African suppliers, these did not need to be domestically owned. Indeed, the MIDP allowed OEMs to retain their global supply networks. This meant that local components suppliers needed to position themselves within these global supply chains or face extinction.

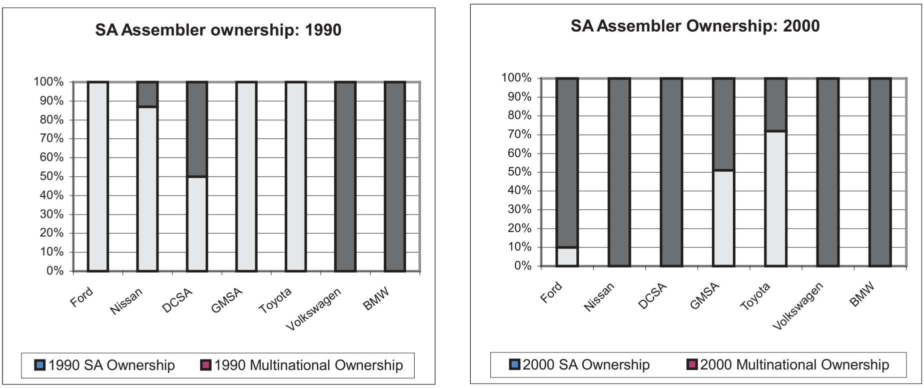
This increased pressure is reflected in turnover and employment losses during the mid and late nineties (Black, 2002). However, this period also saw the onset of major restructuring and competitiveness improvements in the sector. Perhaps incentivised by the offerings of the MIDP, firms used benchmarking and the importation of skills from multinationals to raise their competitiveness in almost all the key operational performance areas (Barnes, 2000). However, the sector continued to lag behind international competitors – highlighting the extent of the competitiveness gap that had evolved during South Africa's isolation (Barnes, 2000). The final outcome was that by the end of the nineties, at the beginning of a period of sustained economic growth, the industry was leaner, more competitive and more globally integrated, and those firms that had survived market integration were more ready for the global economy. In light of the analysis below, this also seems to apply to the R&D activities of the sector: after a difficult period of restructuring and adjustment during the mid and late nineties, automotive R&D activity appears to have stabilised, perhaps assisted by the unprecedented growth over the last five years.

4. INCREASED INTEGRATION INTO GLOBAL VALUE CHAINS

4.1. Changing ownership profiles

Before 1995 most of South Africa's assemblers were South African owned, and operated under licensing agreements with their multinational parent companies. However, after 1995 several changes converged to entice multinationals to return to South Africa: an increasingly stable political climate, a growing local market, reduced trading barriers, and the benefits provided by the MIDP. This resulted in the trans fer of ownership among both assemblers and components manufacturers (source: Barnes, 2000)

Figure 1: Profiles of SA Assembler ownership: 1990 and 2000.



With the exceptions of BMW and Volkswagen, both of which were already 100% MNC-owned, substantial ownership changes occurred at all of South Africa's assemblers, amounting to a transfer of the majority of South African-owned assemblers into multinational hands. This in turn had numerous implications for domestic upstream suppliers. Firstly, these suppliers were now expected to meet more stringent international performance criteria – not only in terms of price, but across all operational performance criteria such as quality, delivery reliability, delivery frequency, conformance to standards, and, importantly, new product development capacity.

4.2. Changing sourcing agreements

There were further challenges for domestic suppliers: international sourcing agreements tied OEMs to component-producing MNCs – global giants such as Bosch, Visteon, Faurecia, and Magna – each with turnovers many times exceeding that of the entire South African industry. This prompted many such MNCs to move into South Africa, either starting up greenfield operations or setting up joint ventures with existing firms. On the whole the effect was to shift the ownership profile of the South Africa supply base towards international ownership and joint ventures: between 1997 and 2003 sourcing from domestic multinational subsidiaries increased from 26% to 37.5% of the supply base, while the use of local firms with local technologies declined from 25.8% to only 10% (Lorentzen & Barnes, 2004).

The result of this was to squeeze out South African technology, and also South African R&D, from the local automotive industry (Lorentzen & Barnes, 2004). There were multiple factors influencing this. Firstly, chronic over-capacity globally had resulted in large-scale M&A activity, consolidating the number of OEMs and first tier suppliers, and concentrating R&D in a small number of major centres, almost entirely in the developed world. Secondly, global sourcing agreements between OEMs and first tier suppliers became more common, particularly for components that required relationship-specific investments. In 'follow-sourcing' agreements the same manufacturer supplied components in multiple locations. This benefited OEMs by reducing monitoring costs while providing homologous and reliable components. OEM assembler investments in developing countries are now closely followed by the establishment of follow-sourcing factories by major multinational components manufacturers.

Follow-sourcing is complemented by follow design, in which multinational components suppliers take on increasing responsibility for design and R&D, supplying 'black box' components to increasingly lean OEMs. As a result, automotive R&D has come to be performed by fewer, larger, multinational firms, protected by considerable barriers to entry. As expressed by Lorentzen and Barnes (2004): 'The structure and organisational configuration of the car industry and the strategic orientation on its key players militate against the involvement of upper-tier manufacturers from developing countries in design and of independent suppliers in global supply chains more generally.'

Follow-sourcing and the increased usage of standardised global platforms resulted in a long term decline in the use of locally adapted technology (Barnes, 2000). This led to a decline in product development activities to support such local adaptations. Notable exceptions are cases where outdated models continue to be produced locally (e.g. the Citi Golf, Toyota Tazz, and Mazda 323 models).

4.3. The effects on R&D

However, the above changes do not reflect a simple case of imported knowledge replacing local knowledge (Lorentzen & Barnes, 2004) - rather they reflect a complex of interactions between the two sets of technologies, skills and capacities. Market liberalisation, value-chain integration, and MNC ownership all resulted in increased interaction between local and foreign knowledge. This can have both positive and negative effects on domestic R&D. In certain cases, inflows of foreign technology may create a more competitive climate, resulting in increased incentives for innovation. The opposite may also be the case, where the need for local innovation is reduced through ‘no need to re-invent the wheel’ situations. These changes will vary on a case-by-case basis. For example, for a technical newcomer, the best way to grow technological competences may be through licensed technology. More mature firms may be able to take on more advanced knowledge through foreign direct investment.

Ownership and market focus also influence the capacity of firms to exploit technological opportunities. Independent firms have fewer resources to dedicate to R&D, but at the same time are not limited by their parent companies, and can therefore take greater risks. Interviews with senior OEM management by Lorentzen and Barnes highlighted that local OEMs and the aftermarket are more permissive in accepting technological solutions that deviate from the norm. Firms with this market focus are therefore more likely to retain their technical competences, including the ability to design and test new solutions.

The question of technological spill-overs is also far from clear-cut. Positive technological spill-overs may develop if local firms manage to copy technology from MNC subsidiaries. Another form of positive spill-over may emanate from local firms interacting with MNC subsidiaries that use advanced technology, resulting in diffusion to local firms and a reduction in the risk from go-it-alone innovation. However, in practice positive technological spill-overs are often elusive, and empirical research has not resulted in strong evidence of such effects (Blomstrom & Kokko, 1998; Gorg & Greenaway, 2002).

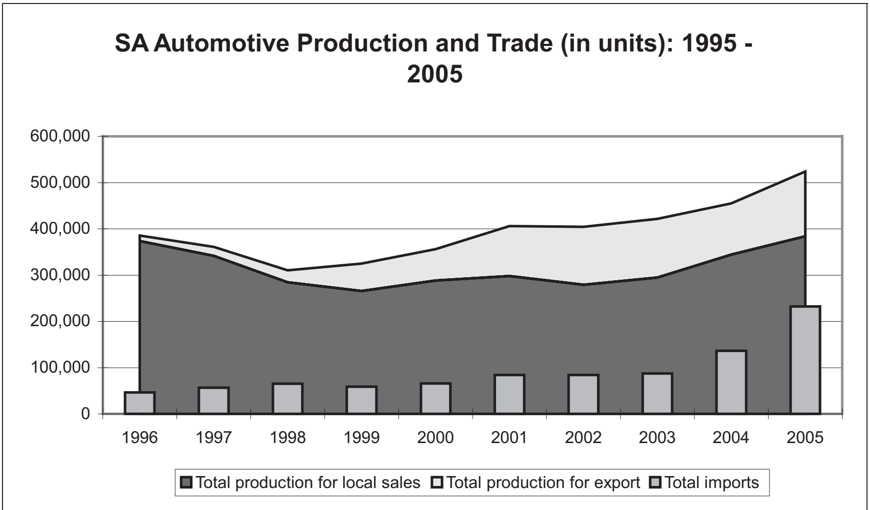
How these influences are played out depends on numerous micro and macro factors (Lall, 1993; Pack & Saggi, 1997). On a firm level key competences include the search for new knowledge, skills development and internal knowledge diffusion. At a macro level key areas are investment in education, information provision and general infrastructure. It is thus clear that innovation in the sector is strongly influenced by the National System of Innovation, and an enhanced understanding of R&D in the sector can only be of benefit here.

On the whole, value chain restructuring has placed automotive R&D in South Africa under significant pressure, and this looks likely to continue. However, recent data indicates that R&D activity continues, and is moreover relatively stable over time. This suggests that there remain niche areas in which local firms have retained or even improved their R&D capacities – a finding supported by a series of OEM interviews to be explored in section 6.

This begs the question of how R&D managed to survive given all the factors described above. The next section investigates growth in trade, production and investment in the decade following 1995 and whether this may have provided a basis for expanded or at least sustained R&D activity.

5. TRADE, PRODUCTION AND INVESTMENT: 1995 – 2005

Figure 2



Source: DTI

5.1. Production and trade

The initial period of structural adjustment and re-integration into the global economy were difficult years for South African automotive manufacturers. Between 1996 and 1998 total domestic production (domestic sales plus export production) dropped by 20% while imports increased by 40%. Production for exports more than doubled, but this was off a very low base, and exports made only a small contribution to an otherwise shrinking production output.

However, the years 1999 to the present day have seen a striking and significant turnaround. Between 1999 and 2005 overall production increased by 69%, breaking through the 500 000 unit barrier for the first time. Recent figures indicate that this trend has continued through 2006 and 2007 (DTI, 2007).

A buoyant domestic economy stimulated production for the domestic market by 30% between 1999 and 2005, despite the high rate and level of import penetration. However, the main driver of production growth was the increase in export production, which by 2005 was at twelve times its 1996 level.

There is an extended literature addressing the causes and dynamics of this improvement (Barnes & Morris, 2000; Black & Bhansi, 2006; Black, 2002; Flatters, 2005), which falls outside the ambit of this paper. However, the key drivers appeared to be: domestic economic growth, the importation of skills from multinationals, improved processes and practices through benchmarking and upgrading towards world class manufacturing, and increased domestic political security.

What effect did this growth have on R&D, if any? The main effect may have been to act as a partial countermeasure to the movement of R&D offshore. This would go some way towards explaining why total R&D activity in South Africa has remained relatively constant over the last few years – or at least has only declined slowly.

5.2. Capital investment

Table 1: SA Assembler capital expenditure (R Millions)

	R&D/Engineering	Total
1997	112	1266
1998	139	1343
1999	115	1511
2000	141	1562
2001	245	2078
2002	262	2726
2003	194	2325
2004	274	2220
2005	259	3576
2006	399	6215
2007 (proj.)	435	5753

Source: NAACAM

The increasing success of the industry, combined with the incentives of the MIDP, amongst other reasons, drew increasingly large investments, particularly by OEMs (NAAMSA, 2007). Between 2001 and 2006 over R19 billion was invested in the automotive assembler industry, of which R2 billion was dedicated to engineering and R&D fixed investment. Capital expenditure on R&D and engineering is projected to reach its highest level ever in 2007, when R435m will be invested in these areas.

This supports the notion that growth in the sector, manifested in increased R&D and engineering investment, has supported niche areas of R&D and allowed them to survive despite adverse value chain dynamics and other challenges. This is further supported by the data and interviews to be explored in the next section.

6. CESTII DATA

6.1. Methodology

The Human Science Research Council's Centre for Scientific, Technological and Innovation Indicators (CeSTII) is responsible for the South Africa's official national annual research and development survey, carried out for the Department of Science and Technology and a number of other users. This survey requires all organisations (including government, education, non-profit and business) performing research or development activities to return a survey containing basic economic and R&D data. CeSTII therefore has access to the most informative available database of South Africa's R&D activity, including that in the automotive sector.

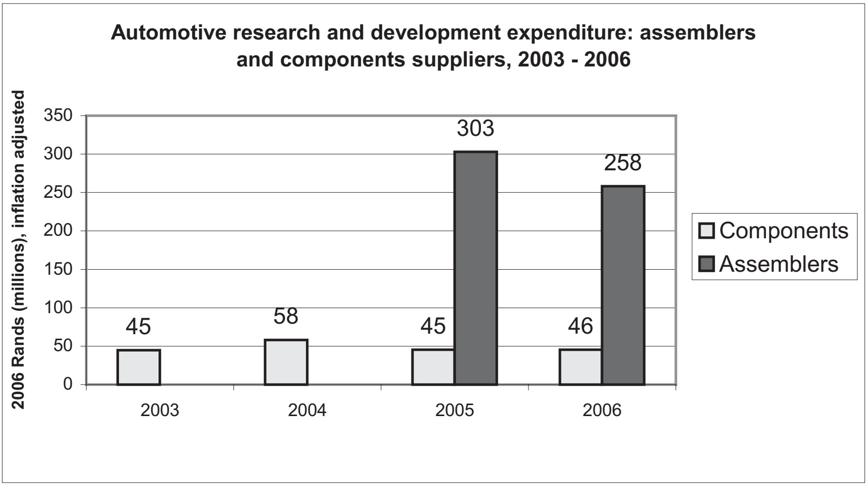
The CeSTII survey faces several logistical difficulties, particularly with regard to R&D undertaken by smaller firms. However, it does represent the large majority of R&D activities in South Africa. In the case of the automotive sector, the benchmarking database of B&M Analysts has been used to supplement CeSTII's database, which is particularly beneficial in that it captures many of the smaller components manufacturers that were not included in the national survey. B&M analysts obtained their data through the national benchmarking programme of the South African Automotive Benchmarking Club (SAABC), which benchmarks each of its approximately seventy member firms on an annual basis – including the R&D activities of these firms. However this data was aggregated to protect the confidentiality of the SAABC members, and as a result is not amenable to detailed statistical analysis, and makes any kind of regression analysis impossible. Data analysis must therefore in this instance refer to the aggregated primary data only.

National R&D surveys carried out according to the Organisation for Economic Co-operation and Development (OECD) Frascati guidelines (OECD, 2002) were carried out in 2002, 2003/4, 2004/5 and 2005/6. Notice must be taken, however, of the survey's purposive methodology, in which the database of South African R&D performers is consistently extended to include greater coverage. Thus earlier surveys have slightly less coverage than later ones, a factor which should be borne in mind when analysing longitudinal trends. This is particularly relevant to data pertaining to the OEMs, where only the 2003/4 and 2005/6 surveys attained sufficient coverage for analytical purposes. This data has been complemented by an intensive follow-up with assemblers in 2006, including a series of interviews with 5 of South Africa's 7 assemblers. This rendered a wealth of contextual information relating to automotive R&D.

6.2. R&D expenditure

One measure of R&D activity is the total expenditure on research and experimental development activities, as represented in the chart below:

Figure 3:



Source: CeSTII

The two years of data available for assemblers reflects a decline from R303m to R258m, a drop of approximately 15%. However, in the absence of more longitudinal data this cannot be described as a trend – particularly when the high variability of R&D expenditure is taken into account, as evidenced in the previous table.

In the components manufacturing sector, total expenditure on R&D has remained consistent, with the exception of a higher figure in 2004. Despite the cards being stacked against R&D in the components sector, it seems fairly resilient. It is conceivable that the major losses of R&D activity already occurred during the mid-nineties, and that the niche areas of R&D that remain are survivors of a Darwinian sort, and therefore not as structurally threatened.

This chart also clearly reflects the structure of R&D activity in the sector. Despite the fact that component manufacturers are far more numerous, their cumulative R&D activity is dwarfed by the handful of assemblers – highlighting the fact that in South Africa assemblers represent the core of product development. In 2006 components R&D amounted to R46m, only 18% of the assemblers' total of R258m.

What this chart also highlights is that despite the significant pressure that has been placed on local automotive R&D, the sector remains a significant player. Combined components and assembler R&D expenditure of R304m represents approximately 3.5% of all the research and product development in the country (including universities, government and business). Moreover, the leveraging effect of R&D through the industry makes it even more significant to the national economy.

It is clear therefore that some areas of automotive R&D have managed to survive. Strategies to achieve this were explored in a series of interviews with assemblers undertaken from November 2005 to January 2006. These included: BMW, Ford, Volkswagen, General Motors, and DaimlerChrysler. In all cases the respondent was a product development manager or a senior executive.

Different assemblers have developed differing roles for R&D within their organisations. At General Motors South Africa (GMSA) R&D plays a significant role. The firm has retained a large proportion of its R&D expertise, and is the design centre for a number of models in the African, Middle Eastern and Latin American markets. These models are designed and developed almost exclusively in South Africa. Further R&D activities include heat and endurance testing, engineering for other GM models, the development of specific components, and capital investment in R&D buildings and equipment. Furthermore, interviews highlighted that based on the new R&D tax incentive[1], GMSA is considering increasing its levels of R&D activity – since R&D would be less of a cost burden and the accelerated write-off of investment in R&D would result in significant savings. However, the interview also found that, despite continued R&D at GMSA, the firm's R&D capacity had gradually eroded over the last few years – high costs and a lack of suitable engineers being cited as the key reasons.

Volkswagen South Africa (VWSA) also emerged as an important R&D performer. Here adaptive engineering takes place for several models. Also, VWSA is the lead product developer for the Citi Golf, hence all product development activities for this model take place locally. This results in a constant demand for product development activities, as it is necessary to constantly offer new versions of the product for marketability purposes. Other areas of development include product adaptation to meet European emissions requirements, local content testing, and engineering innovation towards cost reduction.

DaimlerChrysler South Africa (DCSA) also emerged as a significant R&D performer. The three main areas of R&D were for the C-Class Mercedes, the Mitsubishi Colt bakkie, and software development expenditure. BMW, however, reported a lower level of R&D – due to an organisational structure which vests a higher level of control over R&D in the international development centres.

Finally, Ford SA also reported significant R&D. For several models Ford SA is the global 'lead vehicle engineer', meaning that all design, testing, modification, prototypes and crash tests take place locally. Further specialised research is also undertaken at Ford's R&D centre.

Overall the interviews highlighted which the key areas were in South African automotive R&D: firstly, those manufacturers that have been designated lead engineers for certain models carry out a high level of R&D. Secondly, older models that remain in production provide a consistent demand for development – these include the Citi Golf, the Toyota Tazz, Mazda Midge, and Corsa Lite. Other important areas include hot weather testing, component testing, and adaptation to local conditions. It is important to note that according to the Frascati definition of R&D, incremental product adaptation that does not result in novel functionality is not included as R&D. The R&D discussed above therefore excludes routine engineering activities, design functions, and routine industrial engineering.

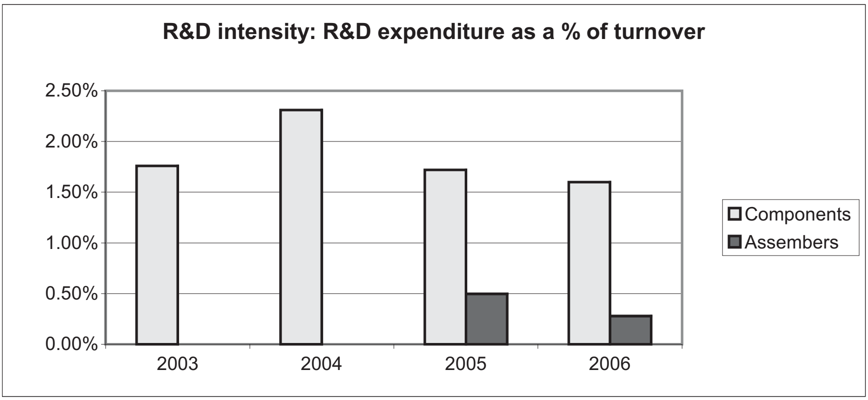
Thus, while supply chain factors appear to be pulling R&D away from the South African industry, the growth of the industry appears to buoy R&D activity, providing impetus for those niches where local R&D need not take place at international centres. The key restraint, emphatically highlighted by each of the respondents, was the availability of skilled engineers and scientists.

6.3. R&D intensity

The R&D intensity of a firm or an economic sector can be measured by its R&D expenditure as a proportion of turnover. In R&D intensive firms, research and development generally play a more important role, consume proportionally more resources, and are generally more critical to the success of the firm. Also, in an effort to promote the development of a knowledge economy (for example, government's target to spend 1% of GDP on R&D), those sectors which are more R&D intensive will create a proportionally larger contribution to the national knowledge economy.

Here CeSTII's data is revealing:

Figure 4



R&D intensity has declined among both components manufacturers and assemblers, most significantly among the latter. This suggests a continuation of the drainage of R&D capacity towards offshore locations. Rising domestic turnover levels are not accompanied by increased domestic R&D, but rather by sustained nominal R&D, which results in an overall decline in this indicator. Thus while absolute levels of R&D are relatively stable, it seems that South Africa's automotive manufacturers are become consistently less R&D intensive.

Although assemblers expend far more on R&D than do component suppliers, the latter are more R&D intensive. In 2006 assemblers spent 0.28% of their turnover of R&D, while components suppliers spent an average of 1.6%, almost six times as much proportionally.

Thus, while assemblers carry out the bulk of R&D in the sector, R&D remains critical to components suppliers. When considered in conjunction with the finding that R&D expenditure in the components sector has also been more resilient over time, it seems that automotive component firms should certainly remain on the map in terms of policy support for R&D.

In a broader context, 2002 data found that the R&D intensity of international component manufacturers is substantially higher than that of South African firms. International firms spent an average of 2.4% of their turnover on R&D – approximately 30% more than South African components firms and more than 8.5 times that of the South African assemblers. This highlights the fact that South Africa's automotive industry is in fact of a low R&D intensity in a global context – bolstering the proposition that is it only niche areas of R&D that have survived the transition years after 1995.

7. POLICY IMPLICATIONS

The overall picture drawn by the CeSTII data and interviews to some extent agrees with the existing discourse related to automotive R&D: the structural environment points towards a long-term decline. Total expenditure on R&D is stable among components manufacturers, but may be declining among assemblers (next year's R&D survey will be interesting in this regard). R&D intensity is declining for both groups, and for both is well below the international average.

However it is also evident that there remains substantial R&D activity in the automotive sector, largely among assemblers, who appear to have identified a set of niche areas in which there remains a demand for domestic R&D. R&D also plays an important role among components manufacturers, who are more R&D intensive than assemblers, and have moreover stabilised their R&D expenditure.

It thus appears that, while the last decade may have seen a considerable reduction in R&D, it by no means signals the end of research and development in the sector. Instead it may be seen as an adjustment towards the industry's true comparative advantages: areas of R&D that are more efficiently performed offshore have largely moved there. Those that are more efficiently performed locally have remained.

The key task for policymakers is therefore to identify the macro and micro factors which may support these critical areas. On a macro level assemblers were unanimous in their identification of a lack of engineering and scientific skills as a key weakness. The regulatory environment (including R&D taxation and support in the MIDP) also plays a role in regard to changes in international sourcing agreements. On a micro level, issues such as firm-level technological maturity, ownership and market focus, technological spill-overs, and skills development, amongst many others, appear to be relevant. A meaningful survey of the macro and micro factors that impinge on the critical remaining areas of South African automotive R&D requires further focused study.

Other areas of potential research interest stem from those elements of CeSTII's R&D data that have not been included in this analysis. While this paper has attempted to trace a broad outline of automotive R&D in South Africa, more detailed data may shed further light on these dynamics. These data include: economic data (turnover, employee numbers), structural data (subsidiary structures, collaboration partners, geographic distribution, SIC codes, RF codes), demographic data (headcounts, FTEs, race, gender, and qualification levels of employees), amongst others.

However, these findings also provide some direction to government and industry with regard to automotive R&D policy. Firstly, there is good reason to bolster policy support for automotive R&D in niche areas (re-design of older models, lead design for certain new models, component and vehicle testing). These niches have a comparative advantage, as demonstrated by their survival despite adverse conditions. The strengthening of these niches is likely to strengthen the knowledge economy of the domestic automotive manufacturing industry as a whole, moving it higher up the knowledge value chain, increasing the level of higher value-adding activities, and making it more attractive as a destination for foreign capital in the sector. Automotive multinationals perceive R&D capabilities as an increased incentive for investment. It is therefore recommended that policy instruments such as the Motor Industry Development Plan (MIDP), the Technology Innovation Agency (TIA), and the Support Programme for Industrial Innovation (SPII), and the various statutory bodies established to provide development capital to industry, take an increasing role in providing support in these niche areas.

It is also clear that a lack of human resources, particularly a lack of highly skilled engineers, is the greatest constraint on the growth of R&D in the automotive sector. This is a common problem in the South African manufacturing sector. Increased government support for the development of human resources directed at automotive R&D would effectively unleash the potential of the area and provide the basis for growth in R&D and the benefits this provides to the industry. This could be applied through increased bursaries, internships, and in a broader sense, science and technology education at a secondary school level.

From an industry point of view, automotive components manufacturers span a diverse set of sub-sectors, and it is therefore difficult to draw common conclusions. However, providing product development services is an essential part of the offering of many of these firms, and certainly essential, albeit to different degrees, at the OEMs. If one considers that the knowledge economy, in the form of R&D and innovation, is considered to be a key driver of growth in the industry, it may be recommended to industry leaders to also bolster support for those R&D functions that have survived the difficult changes over the last decade. Large component firms and OEMs operate on very tight margins – however it would be arguably a positive medium-term investment to provide financial support for the development of human resources, whether internally or externally, to support these firms' development functions.

Industry leaders could also take cognisance of the fact that a re-arrangement of ownership and sourcing agreements may have placed pressure on R&D in South Africa, but it has certainly not spelled the end. The continued negotiation of these terms to retain R&D activities in South Africa would provide a long-term advantage to the domestic industry.

8. REFERENCES

Barnes, J. 2000. **Domestic Market pressures facing the South African Automotive Components Industry**. Research report No. 33, Industrial Restructuring Project, School of Development Studies, University of Natal.

Barnes, J. & Morris, M. 2000. **An analysis of the endogenous and exogenous factors impacting on the success of the Motor Industry Development Programme**, CSDS Working Paper No. 27, School of Development Studies, University of Natal.

Black, A. 2002. **The export success of the motor industry development programme and the implications for trade and industrial policy**. Paper presented at the Trade and Industrial Policy Strategies 2002 Annual Forum.

Black, A. and Bhanisi, S. 2006. **Globalisation, Imports and Local Content in the South African Automotive Industry**. Conference paper: Accelerated and Shared Growth in South Africa: Determinants, Constraints and Opportunities,18 - 20 October 2006.

Blomström, M. & Kokko, A. 1998. **Multinational corporations and spillovers**. Journal of Economic Surveys, Vol 12, No. 2, pp 1-31.

Department of Trade and Industry. 2007. **Trade, macroeconomic and automotive sector statistics**. <http://www.thedti.gov.za>

Flatters, F. 2005. **The economics of the MIDP and the South African Motor Industry**. Paper prepared for TIPS/NEDLAC South Africa Trade and Poverty Programme (SATPP) Policy Dialogue Workshop, 2 November 2005.

Görg, H. & Greeaway, D. 2002. **Much ado about nothing? Do domestic firms really benefit from foreign investment?** London Centre for Economic Policy Research, discussion paper no. 3485.

Lall, S. 1993, **Promoting Technology Development: the role of technology transfer and indigenous effort**. Third World Quarterly, Vol 14, No. 1 pp95-108.

Lorentzen, J. and Barnes, J. 2004. **Learning, upgrading and innovation in the South African Automotive Industry**. The European Journal of Development Research, Vol 16, No 3, Autumn 2004, pp.465-498.

National Association of Automotive Component and Allied Manufacturers. **Key information on the South African Automotive Industry**. http://www.naacam.co.za/.

National Association of Automobile Manufacturers South Africa. 2007. **New Vehicle Manufacturing industry: capital expenditure 2000 – 2007.** www.naamsa.co.za/papers/2007/0220/.

National Treasury and the South African Revenue Service. 2006. **Draft Revenue Laws Amendment Bill (Section 11D).**

Organisation for Economic Co-operation and Development. 2002. **Frascati Manual: proposed standard practice for surveys of research and experimental development**.

Pack, H. & Kamal, S. 1997. **Inflows of foreign technology and indigenous technological development**. Review of Development Economics, Vol 1, No 1, pp 81-98.