ELECTRONICS FIRST PAPER

The Scope of the Electronics Industry in the Western Cape

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EXECUTIVE SUMMARY

The electronics industry in the Western Cape has repeatedly proved itself in terms of world-class innovation and production. The industry is characterized by a handful of generalist companies with strong capabilities in professional electronics, while small to medium companies specialize in security systems and electricity pre-payment meters. Although the Western Cape has design talent, there is a lack of ability to take engineering development into practical manufacturing. This is one of the areas in which local Contact Electronics Manufacturers (CEMs) can effect improvement.

The labour force in the electronics industry is fortunate in having highly skilled engineers of world-class standard. However, the electronics industry in the Western Cape does not have the potential or capacity to create tens of thousands of jobs. The high cost of labour, in relation to Asian labour rates, prevents the sector from competing at the low end of the technology scale i.e. in low-tech, high-volume products. Instead, the sector competes with low-volume, high-tech products.

There is limited investment in the sector owing to the number of regulations surrounding the government incentives. Potential investors find the entire process intimidating and onerous.

Investment opportunities in the South African electronics sector lie in the development of:

- access control systems and security equipment;
- automotive electronic subsystems;
- systems and software development in the banking and financial services sector;
- silicone processing for fibre optics;
- integrated circuits; and
- solar cells.

There are also significant opportunities for the export of hardware, e.g. electronic security devices and associated services, as well as software and peripherals. With the exception of automotive electronic subsystems, these investment opportunities also apply to the Western Cape.

South Africa's first satellite was designed, developed and produced in the Western Cape, proving that there is no lack of innovation in this region's electronics sector. Indeed, this sector has illustrated a high level of innovation, with a variety of customised products and flexible services in the market today.

The high level of innovation in the electronics sector in the Western Cape is found in design, low-volume manufacturing, customisation and problem solving. Its propensity to satisfy customer needs, willingness to facilitate practices outside normal product offerings (in order to accommodate these needs) and flexible service delivery, can also contribute to competitiveness.

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LIST OF INTERVIEWEES

CSIR Defencetek

EBV Electrolink

EDH

Electronic Industries Federation

Elprom

Microtronix

Peralex

Phoenix Contact

Psitek

Savant

South African Electrotechnical Council

Spescom

Tellumat

Tenesa

Trax

University of Stellenbosch

Unistel

Vektronix

Ziton

TABLE OF ACRONYMS AND DEFINITIONS

EIF	Electronic Industries Federation
SIC	Standard Industrial Classification
HS Code	Harmonised and Commodity Description and Coding System
ICT	Information and Communication Technology
MEDS	Micro-Economic Development Strategy
EU	European Union
GDP	Gross Domestic Product
EBG	Electronics Buyers' Guide
CEM	Contract Electronics Manufacturers
DTI	Department of Trade and Industry
ICTE	Information and Communication Technology and Electronics
SITA	South African State Information Technology Agency
SMME	Small, Micro and Medium Enterprises
BEE	Black Economic Empowerment
SAEEC	South African Electrotechnical Export Council
R&D	Research and Development
PAMTS	Provincial Advanced Manufacturing Technology Strategy
ECSA	Engineering Council of South Africa
ISETT SETA	Information Systems, Electronics and Telecommunications

	Technologies Sector Education Training Authority
DST	Department of Science and Technology
SPII	Support Programme for Industrial Innovation
THRIP	The Technology and Human Resources for Industry Programme
SKA	Square Kilometre Array

1 INTRODUCTION

The general conception is that increased knowledge is crucial to economic improvement through efficiency improvement and enhanced competitiveness. In support of this concept, the Department of Trade and Industry (the dti) specifically motivates and encourages technology-rich sectors to promote overall improvement in South African competitiveness. The electronics sector, being a technology and knowledge-intensive economic sector, can thus be seen as one of the key drivers of economic development in South Africa. This is mainly because, around the world, it produces the 'greatest number of productivity-enhancing innovations' and requires a higher rate of research and development than other sectors. The Electronic Industries Federation (EIF) – making the case for the sector – has previously estimated that 'economically successful countries' have shown that between 40% and 90% of their growth can be attributed to advances in technology. The electronics sector is also closely tied to the power generation, telecommunications and information technology industries, giving it a strategic role to play in the Government's social development objectives.

The electronics sector, by definition, is both wide and deep. For the sake of consistency, we use the terminology of the dti:

'The Electronics Industry encompasses an exceptionally broad range of technology. For the purpose of this document, we ring-fence the Electronics industry to include the complete life cycle (design, production, maintenance, etc.) of electronic devices from raw material and components, through to boxes, or subsystems and includes hardware and embedded software. This industry spans all sectors (telecommunications, IT, Aerospace, etc.)'[1]

The electronics-manufacturing sector forms part of the engineering sector. An examination of Standard Industrial Classification (SIC) codes shows that electronics manufacturing is closely related to a number of other sectors. These include:

- Capital equipment (the official SIC definition includes the production of office, accounting and computing machinery as capital equipment)
- Electrical machinery and equipment
- Medical technology
- Optical technology

[1] A Description of the South African Electrotechnical Industry, http://www.savant.co.za/home.asp?pid=1100

- Information technology
- Defence and military technology
- Research and development
- Telecommunications.

Appendix 1 contains the official SIC definitions that cover electronics, as well as its corresponding HS codes. For the purpose of this analysis, HS codes were used because they provide a more detailed level of breakdown per item. The primary series that this study was based on is the range including H8501 to H8548, Electrical and Electronic Components and Assemblies.

The scope of the assignment embraced the South African electronics sector in general, but with specific emphasis on the Western Cape. The study also focused on:

- Companies whose primary focus is the manufacturing of electronic equipment, modules or components
- Companies which undertake, on a contractual basis, to provide manufacturing services
- Companies which only provide design services
- Associations representing the Electronics industry
- Research facilities and tertiary institutions related to the industry.

Excluded from the study were companies that simply distribute electronic products and ICT-related electronics, because these aspects were covered in the previous MEDS ICT Review.

2 OVERVIEW OF THE ELECTRONICS SECTOR

1.1 International Electronics Overview

The world electronics industry went through its worst crisis ever during 2001-2002, when the average growth rate slowed down to approximately 4% after a long-term trend of approximately 10%. Growth has subsequently stabilised to a level between 6% and 7% in 2003. The slowdown was attributable to a combination of persistently slow market and production growth in developed countries such as Europe, the USA, Japan, Korea and strong growth in developing countries and particularly China.

This growth pattern was very similar in all the main electronic product families, with the exception of automotive electronics with a significantly stronger growth rate (owing to the fact that electronic components are increasingly being used in motor cars), and avionics and defence with a significantly slower growth, due to shrinking defence spending and a slowdown in civil aviation.

Electronics.ca specialises in research into the electronics industry. The findings that emerged from a study published by Electronics.ca focusing on the world electronics industry from 2002-2007, determining market trends, growth rates, geographical patterns, new products, etc., are discussed below.

1.1.1 A new geographical pattern

Up until 2003, Europe, the USA, Japan, China and Korea collectively produced 90% of the world's electronic products, with Europe and the USA being the biggest players. However, by 2007, China will start producing at the same level as Europe and the USA. The prediction is that after 2007, China will surpass Europe and the USA to become the biggest electronics producer in the world.

Markets will still remain more concentrated in the richer countries (nearly 70% in Europe, North America and Japan). This means that China and other developing countries will be exporting to the richer areas of the world on an increasing scale. However, 'delocalisation' of production to these exporting areas is largely governed by the size and growth of the local markets. 60% of China's production of electronics is for the local Chinese market, and globally the rest of the world (including Asia) has a production equivalent to its market.

The following items were highlighted in findings from Reed Electronics Research's latest survey[2] on China:

- In 2003 Chinese electronics production amounted to US$147 billion, ranking third behind the USA (US$286 billion) and Japan (US$170 billion).
- The country accounted for 11.1% of global electronics production in 2003. This compares to only 2.3% in 1993. (Chinese electronics production in 1993 amounted to US$17.7 billion. In comparison, the US output was estimated at US$221 billion.)
- In terms of market size China, at US$138 billion, surpassed Japan to become the world's second largest market in 2003. It still trails the US, where the electronics market was valued at US$362 billion. It is projected that the Chinese electronics market will reach US$215 billion by 2007, and account for 16% of the global market.
- The average annual growth rate forecast for the Chinese electronics market in the period up to and including 2007 is 13% per annum, compared to 4% for the US in the same period.

According to a study conducted by In-Stat [3], there are two primary drivers of the high Chinese electronic market growth:

- A burgeoning domestic market and
- An influx of overseas companies establishing low-cost volume manufacturing bases in the country.

1.1.2 New products, new markets

Innovation is not slowing down in the electronics industry. The best indication of this is the significant market share that mobile phones have acquired in just over 10 years – 60% of total telecommunications, and 10% of the total electronics industry. These figures on their own indicate that mobile phone growth must now slow down to some extent, in spite of new features (cameras) or new services (i-mode, UMTS).

[2] http://www.in-stat.com

[3] http://www.in-stat.com

Innovation is continually stimulated by the so-called 'Moore Law', which describes the exponential increase in chip functions combined with their exponential cost reduction. This renders continual new applications for electronics possible, as well as continual price decreases that open up new markets.

Nonetheless, markets are maturing in the richer areas of the world. With the exception of mobile phones, it is increasingly difficult for any single new product to have an impact on a world electronics industry that has grown to an impressive size (US$ 1 220 billion in 2002).

The most dynamic factor governing change will be the growth of new geographical markets. China, in particular, will be the major growth market during the coming period. In other words, if only the richer areas (Europe, the USA, Japan) are taken into account, the electronics industry would seem to be entering a new period of mature and slow market growth at very little more than 4% annually. Production in the richer areas should grow at practically the same rate, which indicates that 'delocalisation' of production basically only means that the richer countries cannot hope to supply developing areas through their exports.

1.1.3 New products and growth leaders

The major growth leader during the coming period will be automotive electronics. This is because increased comfort, engine efficiency and safety entail an increasing electronic content in cars. This value of this electronic content will grow on an average from 1700 euros per car in 2002 to 2450 euros in 2007, i.e. a share approaching 25%. This is a field in which growth will also be strong in the richer countries.

A major change during the coming period will be the replacement of CRT (cathode ray tube displays) by flat screens, first for PC monitors, but progressively also for TVs. This, combined with new consumer products such as DVD writers, sophisticated set-top boxes, digital TVs, home cinema sound packages, digital cameras and game consoles, will revitalise the consumer electronics sector that has long been lagging behind the average growth trend of the electronics industry.

Power electronics will be a third growth domain during the coming period, reflecting progress in power semiconductor technologies, as well as a more comprehensive approach to the signal-power interface and system.

1.2 National Electronics Overview

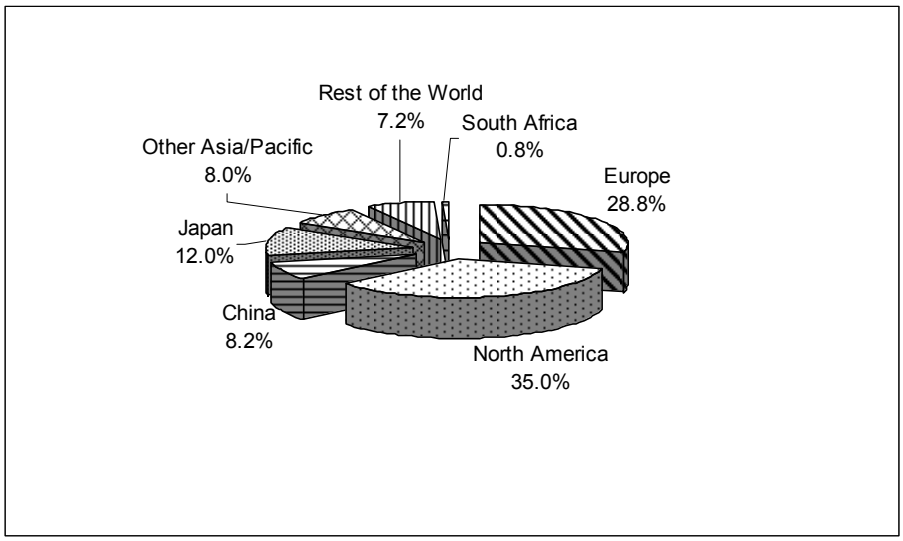
The electronics sector in South Africa originally developed to satisfy a public sector demand. The electronics capacity was required to develop the telecommunications industry, supply military systems (after the United Nations arms embargo of 1976) as well as to help the parastatals drive economic development in the late 1970s. A survey conducted in 1988 indicated that the demand for electronics in the defence industry far outweighed the requirements for power and security systems, with the combined demand for electronics from Armscor, Telkom (and the Post Office) and Eskom accounting for as much as 75% to 85% of the local electronics market. Although 80% of the electronics capability was originally centred in 6 companies, the original requirement for electronic products had stimulated the capacity to innovate and design highly competitive systems.

From the late 1980s into the 1990s, the composition and output of the South African electronics sector changed as a result of the structural and market condition changes that occurred during that period. The following were some of these changes:

- In 1987 structural crisis in the apartheid economy caused the government to begin a process of commercialisation of its massive parastatals. This led to changes in their procurement policies, ending decades of preference being given to local electronics. Parastatal business fell dramatically to just over 20% of the total electronics market
- Defence spending decreased dramatically in the 1990s. Armscor's market declined by an average of 15% between 1990 and 1998, which had a severe knock-on effect on the electronics sector
- The total output value of electronics more than doubled from R25 billion in 1996 to R51 billion in 2000
- The growth in demand for Information Technology systems motivated an investment of approximately R20bn between 1990 and 1995
- New targets set by Eskom to electrify RDP houses increased the demand for Power electronics systems
- An international Telecommunications revolution impacted on South Africa through the arrival of cellular technology.

The electronics industry revenues in South Africa amounted to R57.5 billion in 2002. Key players in industrial, power, defence and telecommunication electronics include Siemens, Alcatel, Ericsson, Altech, Grintek, Tellumat and Marconi. South Africa's contribution to the world output in the electronics sector is insignificant, amounting to no more than 1% (as illustrated in Figure 1.1). The 'rest of the world', referred to in the same figure includes Brazil other South American countries, Russia, Africa (excluding South Africa) and the Middle East.

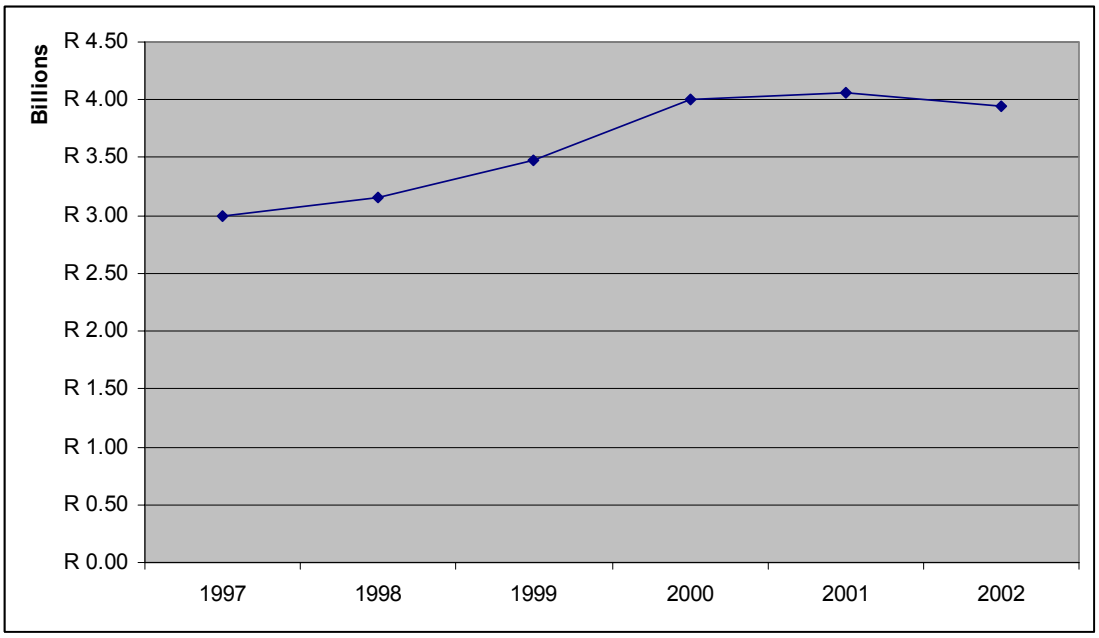
Figure 2-1: 2002 World electronics market by regions



With improved economic and regulatory conditions, and high levels of growth and activity in the African telecommunications market, South African companies are ideally situated to supply the growing demand for fixed and wireless telecommunications equipment to the rest of the continent.

An established, highly competitive consumer electronics market producing high value-added electronic products has also played an important role, with South African exports accounting for approximately R4bn per annum. South African companies have proved themselves by being recognised as world leaders in pre-payment revenue management and fraud prevention systems, and in the manufacture of set-top boxes, all exported successfully to the rest of the world. Other consumer products, such as small appliances, are also increasingly exported to the EU.

Figure 2-2: South African Electronics (H8501 – H8548) Export Performance



Source: SA Customs and Excise

Even though the total electronics industry in South Africa is growing, the overall manufacturing of high volumes of electronics components and products is on the decline. The reason for this is the small size of the domestic market, which does not warrant investment in manufacturing capacity. In 2004, electronics exports accounted for less than ten percent of the Western Cape's total electronics turnover of R13.6 billion. This low export percentage is true for South Africa as a whole. The small domestic market and low level of international market presence has resulted in a reduction in South Africa's manufacturing capacity in this industry.

South Africa's major electronics industries are predominantly centered in Gauteng, the Western Cape and KwaZulu-Natal. Based on export contribution, the Western Cape is the second-largest producer of electronic products in South Africa and contributes approximately 22% of total output.

1.3 Western Cape Electronics Overview

It was determined that in 2004, the electronics sector in the Western Cape contributed approximately R13.6 billion per annum to the total electronics output of approximately R62 billion.

The sector is widely distributed, i.e. there is no obvious cluster or concentration of activity in any of the sub-sectors. There are a few large or well-known companies (e.g. Tellumat, Ziton, Rhomberg) but the sector mostly consists of lesser-known, small and medium enterprises. Many of these companies are smaller niche players. There are approximately 476 electronics companies listed in the Electronics Buyers' Guide (EBG). The EBG is an annual directory that lists electronics companies in South Africa, categorising them according to the products and services they offer. Of the 476 companies, 74 are based in the Western Cape.

The Western Cape Electronics sector includes companies, universities, technikons, research institutes and representative bodies involved in the following sub-sectors:

- Defence Electronics
- Consumer Electronics
- Power Electronics
- Telecommunications
- Security Electronics.

The following table illustrates the Western Cape Electronics sector's broad representation across the various categories of the sector. The list below is not exhaustive but merely represents the main players in each sector.

Table 1: Companies categorised in the Electronics industry sectors

Industry Sector	Companies
Telecommunications	• Tellumat • Psitek • Data Voice • Freeplay
Aerospace	• Sunspace
Defence	• RRS • CCII • Avitronics • Omnipless • Peralex
Instrument and Control	• Rhomberg
Security / Risk	• Ziton

Management	• ET systems • GNS
Automotive	• Control Instruments
Power	• Omnitech, • MLT Drives • Wattronics
Other	• Tedelex (consumer e.g. tv & hi-fi) • Rhomco (assemblers) • Trax (Printed Circuit Boards), • Elprom (CEM) • EDH – Ballistic Projectile Systems • Nicon – CEM

A number of the companies and systems developed in the Western Cape owe their existence to the strong local expertise in the area of high frequency, microwave electronics technology. The products and solutions developed by companies such as EDH, RRS and Omnipless are all derived from this technology base. The Western Cape has a particularly high level of expertise in this field as a result of the extensive research and programmes driven by local institutions such as the University of Stellenbosch.

Apart from the systems already mentioned, the Western Cape's recent successful developments, which are also world firsts, include EDH's Speedgun, Sunspace's commercial satellites, the battery-free radio, electro-magnetic geological exploration systems and Blob-technology systems.

As has been mentioned, as result of cost structures and the state of technology, the sector does not compete well at the lower end of the technology scale, i.e. the low cost, mass production and high volume products, which are dominated by the Chinese.

2 PROFILE OF THE ELECTRONICS SECTOR

2.1 Foreign investment in the Electronics Sector – types of investments, capital intensity and production capacity

There is a limited amount of international investment activity in the South African electronics sector. Some of the success stories in the Western Cape include Ziton, which has been acquired

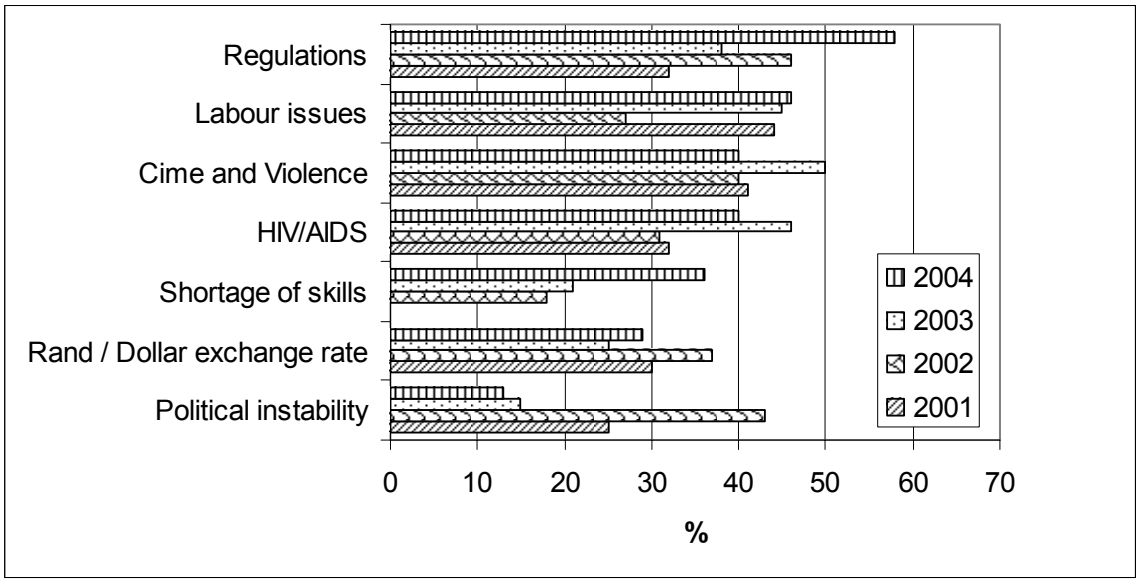
by American-based Edwards Systems Technology, the French initiative Tenesa and Reutech Radar Systems (RRS), of which 33% is owned by the European Defence and Space Company, EADS. Apart from these, the majority of the companies are self-funded, e.g. Tellumat, Tedelex, Psitek, EDH and Romco. Furthermore, of the 9 companies that are listed on the Johannesburg Stock Exchange, only one is based in the Western Cape. Most of the companies in this sector rely on private capital. Other investors include Venfin and the IDC.

Although South African companies and products are starting to make a name for themselves on the international stage, little is known internationally about South Africa's electronics capabilities. Furthermore, the sector is not very attractive to foreign investors. To gain a better understanding of why there has been such limited investment in the electronics sector, a list of the Western Cape's attractive and unattractive investment factors has been tabulated:

Table 2: Attractive and unattractive investment factors in the Western Cape

Attractive Investment factors	Unattractive Investment factors
Attractive lifestyle and environment	Unfavourable position – too far from markets, not only in Gauteng but also Asia, Europe and USA
Good platform to launch into the rest of Africa	Relatively high cost of labour on the manufacturing and production side compared to Asian competitors
Same time zone as Europe	Small local market
Good infrastructure (e.g. international airport, world-class harbour, good communication networks)	Insufficient government support
Climate in Western Cape more conducive than Gauteng, i.e. less static	High property (incl. factory) prices compared to other South African locations
Cost of highly skilled labour	Lack of incentives
The Western Cape has South Africa's highest percentage of people with post-school qualifications and technical skills, and the electronics students are of world-class standards	Crime

Figure 2-1:The top 7 factors that hamper investments in South Africa



Source: Financial Mail 2005.

From the figure above, it is clear that the number one reason why foreign investors will not invest in South Africa is due to its perceived cumbersome regulatory environment. Respondents, interviewed were unanimous that there are too many restrictive regulations in the application process for incentives which discourages many companies from pursuing government incentives and support programmes.

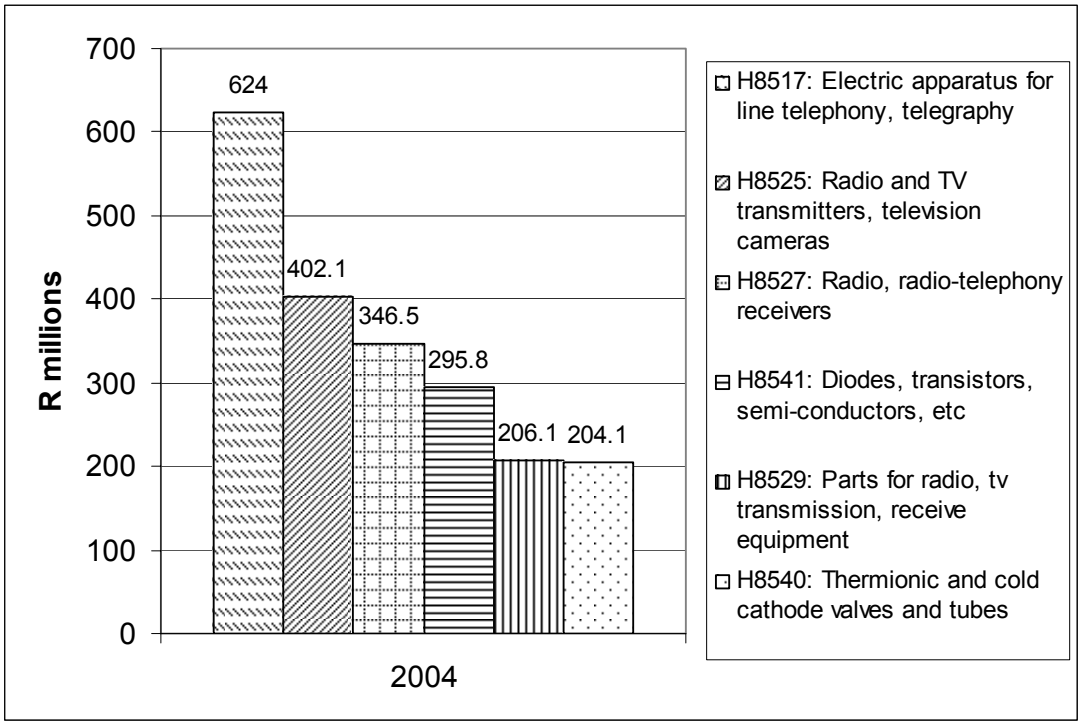
Crime and HIV/AIDS are also cited as negative investment factors – and these scourges are rife in South Africa as a whole. The other factors such as labour issues, shortage of skills, rand/dollar exchange rate and political instability are rated as having less of an impact on the sector.

In an effort to promote foreign investment in the electronics sector, the dti commissioned a study on the South African Electrotechnical industry in 2004. The objective of the study was to formulate a quantitative view of the South African industry. The findings from the study were compiled in the form of an overview brochure of the South African electrotechnical sector, which was forwarded to some 50 overseas economic representatives to provide them with a complete profile of the industry. The aim is that this study will enable these representatives to convey the depth of the industry in South Africa to their principals, which will hopefully result in an influx of capital into the country's electronics industry.

2.2 Export and import values and volumes over the past decade, with key products exported and imported

South Africa is a net importer of electronics, and the total deficit between imports and exports amounted to just over R20bn in 2003. During 2004 the difference between imports and exports was R29.5bn for the Western Cape alone. The top three commodities imported for South Africa were all imported into the Western Cape. Figure 4 shows the six electrical and electronic components imports that contributed the most to electronics imports in the Western Cape.

Figure2-2: Western Cape's 6 largest commodities imports in terms of rand values in 2004



Source: SA Customs and Excise

Germany is one of the primary suppliers of electronic commodities to the Western Cape, with 82% of the electric apparatus for line telephony and telegraphy (H8517) linked to the telecommunications industry, and 74% of Radio and TV transmitters, and television cameras sourced from there. Of the R 295.8 millions worth of diodes, transistors, semi-conductors, etc., imported, 77% come from Germany, which were all used as part of the primary components for assembling the photovoltaic cells manufactured and exported by Tenesa.

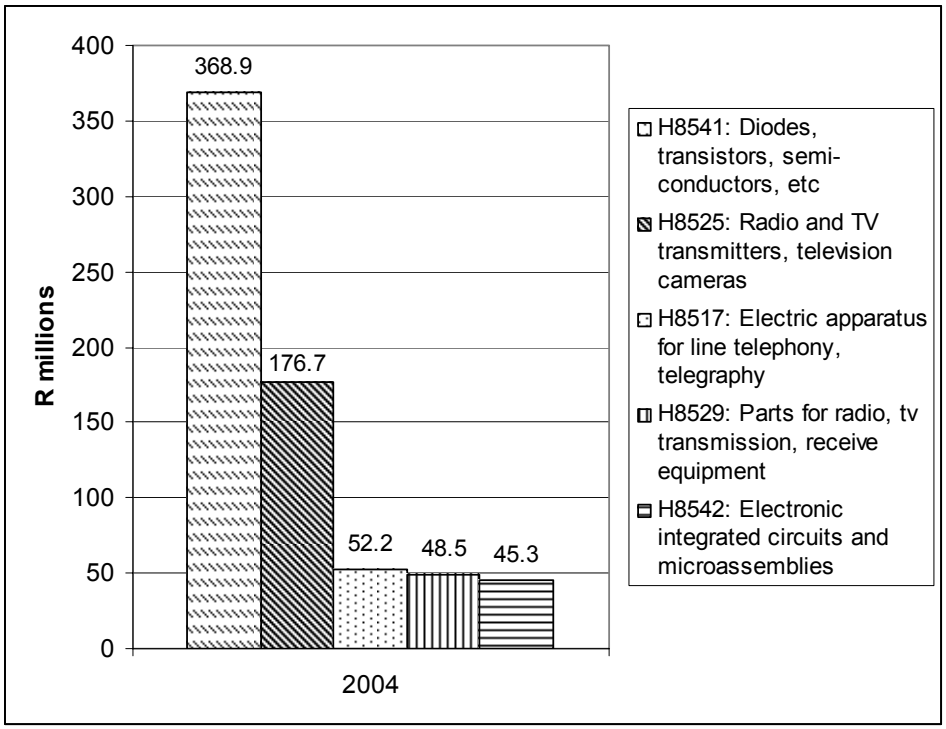
Asian producers are also key suppliers, with 50% of Western Cape Radio's radio-telephony receivers coming from Hong Kong, while 26% comes from China and 15% from Malaysia.

The strong rand has had a negative impact on companies exporting electronic equipment., during the past three years. Component availability is good and will probably remain so until the growth in the developed world increases from the relatively low levels currently being experienced in most major economies. Imported component prices should remain fairly static unless industrial growth increases or major new applications for components are found. Inventories are at normal levels and are likely to remain so this year. The value of South Africa's currency will continue to have a significant effect on the industry in 2005.

The issue of the banning of certain hazardous substances from components (particularly lead) will cause problems for the industry. The equipment-exporting companies are likely to be the hardest hit by these new rules. The legislation is not uniform in the USA, Europe and the East and the component manufacturers do not have a uniform approach in attempting to comply. The component importing companies are doing what they can to clear up the confusion that exists. However, the problems will remain until the manufacturing companies can comply fully. In the meantime, they will have to keep their customers up to date with their progress, which some of them are still not doing successfully. How the various authorities involved in this issue will monitor and enforce compliance is still not clear, but problems are likely to continue to crop up in 2005.

There has been a dramatic decrease in electronic exports from 2002 to 2003. This can be attributed to the appreciation of the rand. Electronics export opportunities are diverse but there is an emphasis on those offerings that support or make use of ICT products. However, with the rand gaining strength, a few companies have halted exports.

Figure 2-3: Western Cape's 5 largest electronic commodities exports in terms of rand value in 2004



Source: SA Customs and Excise

From Figure 2.3, it is clear that diodes, transistors, semiconductors, etc. (H8541) are the Western Cape's biggest electronics export commodities by far. Since 1995, export of these commodities has grown from R0.3 million to R368.9 million in 2004, of which 94% is exported to France. These exports are predominantly photosensitive semi-conductor devices including photovoltaic cells, light-emitting diodes and mounted piezoelectric crystals. These exports are largely produced locally by a French company called Tenesa, which manufactures and assembles such photovoltaic modules. As mentioned previously, most of their parts are imported from Germany. After assembly in South Africa, the components are exported to the mother company, Total Energie in France and these are then dispatched to other countries, of which 60-70% goes back to Germany. There is a huge demand in Germany because the government there has provided incentives for people to produce renewable energy to be used for energy distribution, transmission and generation. The R368.9 million mentioned above accounted for 91% of the total South African export of this commodity, although it only contributed 0.25% of the total international export value in 2003. The export market for this commodity has grown by an annual average of approximately 93% since 1999, due to enhanced pressure for countries to adopt renewable energy sources in the wake of the Kyoto Protocol.

The reason why assembly is done in South Africa and not France or Germany is that the process is labour-intensive and labour in South Africa is cheaper than in Europe. As a result of the relatively low volumes involved (approximately 800 units per day) it is not possible to realize economies of scale through the use of expensive machinery and equipment, and the process therefore becomes very labour-intensive indeed.

There has also been a significant growth in products such radio and TV transmitters and TV cameras (H8525) since 1995 – from nearly R6 million in 1995 to R176.7 million in 2004 (67%). The majority of these products are exported to Europe, specifically Denmark and the UK.

A total of R52,2 million worth of electric apparatus for line telephony and telegraphs (H8517) was exported in 2004. The area of telephony and telecommunications is a field in which South African and Western Cape based companies such as Psitek have proved themselves. The market in Africa specifically, is showing tremendous growth, which the local companies are well positioned to capitalise on.

Local manufacturers of parts for radio, TV transmission and receiver equipment (H8529) have proved themselves internationally, with 47% of these components being exported to Germany and 31% to the US.

The electronics commodities that have shown the most growth internationally since 1999 are parts and accessories for recorders (except for cartridges). However, these commodities constitute a small proportion of the Western Cape export value, making up approximately R535 000 of the nearly R6m export value for South Africa as a whole.

Electronic and integrated circuitry was the highest-value international electronic assembly commodity, which reached an annual export value of US$ 147 billion in 2003. The value of the South African export activity for this commodity was R318 million while the Western Cape only contributed R7.5 million during the same period. This value grew to R45 million during 2004, of which 78% of the exports were destined for Nigeria.

Conclusion on Electronic Imports and Exports

Although the Western Cape electronic export market is active and exports mainly to countries in Europe and Africa, it is still primarily an importer of electronic goods. The items that are exported are not aligned to the primary South African electronic exports of transmission and reception apparatus for radio-telephony, radio-telegraphy, radio-broadcasting or television.

However, two of the top 5 Western Cape export commodities are capitalising, albeit in a relatively small way, on the top 5 international ‘best-sellers’ trends, including parts for radio and TV transmitting and receiving equipment. Apart from these, the Western Cape has chosen

instead to compete in niche markets such as photovoltaic cells. Considering that diodes, transistors, semiconductors, etc. (H8541) make up a third of the Western Cape's electronic exports, attributeable to a single foreign investor.

3 GROWTH PROSPECTS IN THE ELECTRONICS SECTOR

3.1 Growth outlook – medium to long term forecasts

Electronics.ca Publications is a research organisation that specialises research in semiconductor, electronics manufacturing, wireless technology and converging markets. Electronics.ca Publications' latest survey provides a forecast of growth in the global electronics industry as illustrated by Table 3.

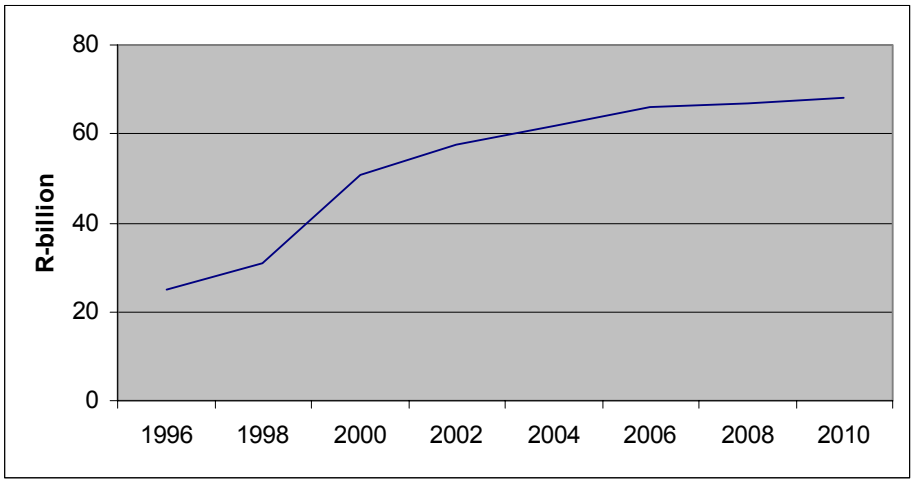
Table 3: Market by regions, 2002-2007

Market	2002 Billion Euros	2007 Billion Euros	2002-2003 % change	2003-2004 % change	2002-2007 % change
Europe	328,7	410,6	2,3%	5,0%	4,5%
North America	399,5	487,7	2,7%	4,6%	4,1%
China	93,5	210,8	17,4%	22,5%	17,7%
Japan	137,4	163,2	1,9%	4,3%	3,5%
Other Asia Pacific	91,3	141,0	9,3%	8,7%	9,1%
Rest of the World	91,1	128,1	4,7%	5,8%	7,1%
Total	1 141,4	1 541,3	4,4%	6,8%	6,2%

Source: Electronics.ca

The growth is driven largely by China and the sector that will experience the most growth is the automotive sector. The South African electronics sector, on the other hand, has an expected growth rate of approximately 4,5%, which is 1,7% lower than the global growth rate of 6,2%.

Figure 3-1:Growth of South African Electronics sector



Note: the above graph has been drawn up from data obtained from the dti, previous research reports as well as from AMI primary research.

Although the electronics sector has experienced a rapid expansion in sales since 1998, there are early indications that the market is starting to mature and 'level out' in terms of its growth. The rate of growth in turnover has started to slow down since 2000 and industry experts expect a further deceleration of growth in the years to come.

Industry experts and key stakeholders have identified the following barriers to growth:

- Lack of venture capital and other finance – most venture capital and finance provided by organisations in the ICTE sector is focused on ICT companies rather than electronics companies.
- Lack of local customers – the South African electronics sector has a small local market with most of the output being exported to other countries with bigger demands. The government can boost the local demand by reviewing the tendering processes, possibly giving greater weight to quality requirements, local content and employment, as well as more efficient operation of SITA with regard to the disbursement of contracts.
- Cost of regulatory compliance – at the end of 2004, a survey undertaken by SBP called Counting the Cost of Red Tape for businesses in South Africa was completed and the findings were that regulatory compliance or 'red tape' will cost South African businesses R79 billion in 2004 (6.5% of gross domestic product). The survey covered all parts of the economy, including manufacturing, mining, construction, trade, agri-business and services. Compliance costs include management time, interacting with

authorities, paperwork and professional services and consultants' fees. At least 10 of the industry-related players interviewed quoted red tape as a major obstacle, especially seen in the light of applying for funding and incentives such as SPII and the Innovation fund.

- Lack of government support and support services. The Government should assist the industry by investing support in the following areas:

    1. Facilitation of development of industry coherence and shared vision
    2. Investment facilitation
    3. Enhanced export support and international marketing and market intelligence
    4. Increased support for all stages of R&D and product development
    5. Expansion and integration of SMEs within the sector
    6. General enhancement of incentives
    7. Targeted skills development
    8. Strengthening of Black Economic Empowerment and Equity
    9. Registration and Protection of Intellectual Property
    10. Meeting international quality and standards requirements
    11. Boosting domestic demand
    12. Cost reduction for satellite usage.

3.2 Trends in the sector growth

Interviewees were of the opinion that the growth in the Electronics industry in South Africa and in the Western Cape has reached a plateau, with very slow growth. This slow growth can be attributed to the turnover generated from systems integration slightly offsetting the loss experienced by manufacturing in the electronics industry. There has been a worldwide trend over the past few years for companies to focus more and more on systems integration. Instead of developing or manufacturing a solution/product from scratch, the South African Electronics industry has been increasingly involved in systems integration, which is the integration of two or more modules (complete products with a specific functionality) to form one, new product with

different functionality to address a different need. Low-level design and manufacturing is therefore not a necessity. As mentioned previously, manufacturing has declined because of the small domestic market. For this reason, the industry has shifted its focus to integrating existing manufactured modules to form new solutions, instead of manufacturing from scratch.

3.3 Market prospects in the product / service segments

Major world market growth areas include the following:

- Automotive electronics – with demands for increased comfort, enhanced features, engine efficiency and safety increasing the electronics content of vehicles.

- Consumer electronics – with the replacement of cathode ray tube displays by flat screens and new consumer products, such as DVD-writers, set-top boxes, digital TVs, home cinema, digital cameras and game consoles revitalising the sector.

- Power electronics – with increasing demands for security and uninterruptability of supply, mobility and the emergence of a widening array of mobile devices, and the development of electric and hybrid vehicles.

The trends in the Western Cape and South Africa are similar to those in the rest of the world. However, the Automotive Electronics trend is more applicable to other provinces than to the Western Cape as this sector is not significant in the Western Cape and these trends will thus not have major implications for the region's electronics sector. South Africa's leading developer and producer of electronic systems for the automotive industry, Control Instruments Shurlok, although it has a head office based in Franschoek and some design facilities in Stellenbosch, has most of its manufacturing capacity based in Natal. In order to cater for the increasing demand for electronics in the automotive industry, it has injected more than R70 million into its Pietermaritzburg-based company, Shurlok International.

Apart from some manufacturing in the consumer electronics environment taking place through Tedelex, most of the manufacturing facilities catering for this market segment are located elsewhere in South Africa, e.g. Set-top boxes in KwaZulu Natal.

In accordance with findings from the PAMTS work team focusing on the electronics sector, the power electronics market opportunity is the most attractive area for the Western Cape to pursue, given the options presented.

3.4 Driving factors in the sector – private and public initiatives

3.4.1 SAVANT

SAVANT is an initiative launched by the dti to market the Information and Communication Technology and Electronics sector (ICTE) locally and internationally. The initiative also aims to strengthen the South African ICTE sector in order to add dimension to its global competitiveness.

- the dti commissioned two studies in 2004 relating to the South African electronics industry, one on contract electronics manufacturing and the other on the electro-technical industry in South Africa. The reports emanating from these studies have been utilised by SAVANT to promote the industry locally and internationally.

- Recently released statistics show that the SAVANT web site received over one million hits between February and October in 2004. The most active countries visiting SAVANT besides visitors from South Africa are from the USA, UK, France, Australia, Germany, Canada, India and China, amongst others.

3.4.2 The South African Electro-technical Export Council

The South African Electro-technical Export Council (SAEEC) is a public/private partnership between South African companies and the Department of Trade and Industry to support and co-ordinate export initiatives for the Electronics, Electrical Engineering, Information Technology and Telecommunications sectors.

The SAEEC promotes and develops the electro-technical industry in South Africa by identifying and creating export opportunities, participating in international exhibitions, establishing new distribution channels, sharing information, contracts and risks, researching the market and providing logistical support, etc.

With 67 members, the SAEEC is able to speak with one voice when lobbying for policies affecting the industry.

3.4.3 Futurex

Futurex is the new, single, unified and definitive showplace for the Information and Communications Technologies and Electronics (ICTE) industries, an exhibition 'where ICTE and business connect'. Futurex provides a forum for leaders in technological thinking and key business buyers to meet to discuss the technologies, equipment, systems, services and

business solutions critical to success in the e-business age. Futurex provides a stage for SMMEs to showcase their products to the market. This event is staged every September in Cape Town.

3.4.4 Technopark

The idea of establishing a science park in Stellenbosch was originally conceived by Professor Christo Viljoen, then Dean of the Department of Engineering at the University of Stellenbosch, in conjunction with the Municipality of Stellenbosch.

Despite a diversity of approaches, in order to be successful, science parks at least need to be seen as offering the tenant either an exceptional package according to the normal real estate criteria (including that of image), or an expectation that valuable relationships with academic and/or other enterprises are likely to result. Clearly, a strong mix of both attractions is desirable, but for many parks one factor or the other appears dominant.

In some parks, which can be termed 'real-estate driven', the relationships are relatively undeveloped or even haphazard, and emphasis is placed on the creation of an attractive, well-landscaped environment, with the accent on the 'park' aspect.

In other parks the property aspects take second place to a park management focus on encouraging a climate of strong relationships, especially between tenants and higher education institutes.

Technopark in Stellenbosch is real-estate driven, but with emphasis also placed on relationships with Stellenbosch University. A number of science parks have failed, whilst others are highly successful. Stellenbosch's Technopark has been a relative success since it has all the macro-ingredients for success, namely:

1. A desirable living environment
2. Nearby availability of a major technological university/universities
3. Presence of major institutional facilities
4. A skilled labour force.

Among all the successful parks, one strong common factor is observable: there is a deeply involved originator or champion: Professor F.Terman at Silicon Valley, Dr Bradford at Cambridge, I.G. Dalton at Edinburgh, Dr S Li at Hsinchu in China and locally, Professor Christo Viljoen at Technopark in Stellenbosch.

Companies in Technopark that are in the electronics industry include Reutech Radar Systems, Elprom, EDH, Sunspace and Nicon Systems.

Reutech Radar Systems (RRS), located in Stellenbosch, is 55% owned by Reunert and 33% by the European Defence and Space Company, EADS (the latter buying into the local company as it had no tracking radar capability of its own). The Black Empowerment Company Kgorong Investment Holdings, holds the remaining 12%. RRS, which has a staff of some 100 people, specialises in ground-based and ship-borne radar systems.

A major recent success was the award to RRS of the contract to develop and manufacture the radar tracking systems for South Africa's new corvettes. Eight RTS 6400 optronics radar-tracking systems will eventually be delivered to the SA Navy and through EADS there will be good opportunities for export. The RTS 6400 was an entirely local development and incorporated on the X-Band radar pedestal are normal wide and narrow TV cameras, as well as two dual field-of-view infrared cameras operating in the 3 to 5 and 8 to 12 micron spectral bands. The first camera was specially developed by Kentron for this specific application. A laser rangefinder with a high repetition rate is also part of the optronic system. The RTS 6400 is capable of detecting and tracking a fighter aircraft at a range in excess of 38 km, while a missile will be detected at a distance of more than 21 km.

The history of RRS goes back to the 1980s and the company's experience in radar originates from its local manufacture under licence of the Alenia ATCR33 radar system for the SAAF. From this small beginning RRS has developed and manufactured a broad range of search and tracking radars to meet the needs of the SANDF.

Other systems in current production include the ESR220 2-D surveillance radar designed to provide early warning for mechanised troops. A number of these systems have already been delivered to the SANDF. The ESR220 is totally autonomous, being fitted to an 8 x 8 transporter, with the capability of being fully operational 10 minutes after arrival at the deployment site. 3D surveillance radar systems developed by RRS include the 150 km ESR360VX and the 200 km ESR360L. The technology incorporated in the latter has also been applied to a newer development, the 400 km extended range ESR380 air surveillance radar.

Although mainly involved in the defence sector, the tracker used by the SALT telescope was also developed by RRS, and they were involved in the design, production and commissioning of the dome and structure drive, and control systems.

Even though Technopark is a successful science park housing 30 companies, it has not yet reached its full holding capacity.

3.4.5 Capricorn Park

Capricorn Park is an industrial/housing complex in Muizenburg in the Western Cape. Interviewees agreed that Capricorn Park was not a success and the reason cited was that there was no focus on technology. The intention was to have facilities ranging from manufacturing to recreation, with the idea of stimulating social as well as technological development, but the technology focus became diluted.

It is noticeable that a large number of parks have been established as a consequence of the initiatives of entrepreneurially minded academics that recognised opportunities to develop particular areas of technology.

Personal involvement makes a major contribution to the development with informal networks of personal relationships. The commitment to a clear identity for the parks, despite a slow start, is crucial for their success. The temptation to water down this identity is order to achieve a faster growth rate, is one that is carefully guarded against by most recently opened parks. It is perhaps this temptation and the loss of a clear identity that has led to Capricorn Park being characterised as less than successful.

4 ELECTRONICS SECTOR VALUE CHAIN

The structure of the electronics industry is increasingly modular. Process technology is being driven in large parts by the vendors of production equipment, and the use of full-service contract manufacturers for circuit board and final product assembly is widespread and increasing. Even the design process is being ‘unbundled’, with repetitive and specialised design tasks being turned over to external suppliers. This industry structure allows ‘virtual’ component design houses to be regularly founded with no intention of ever establishing in-house production.

Figure 4-1: Electronics sector value chain

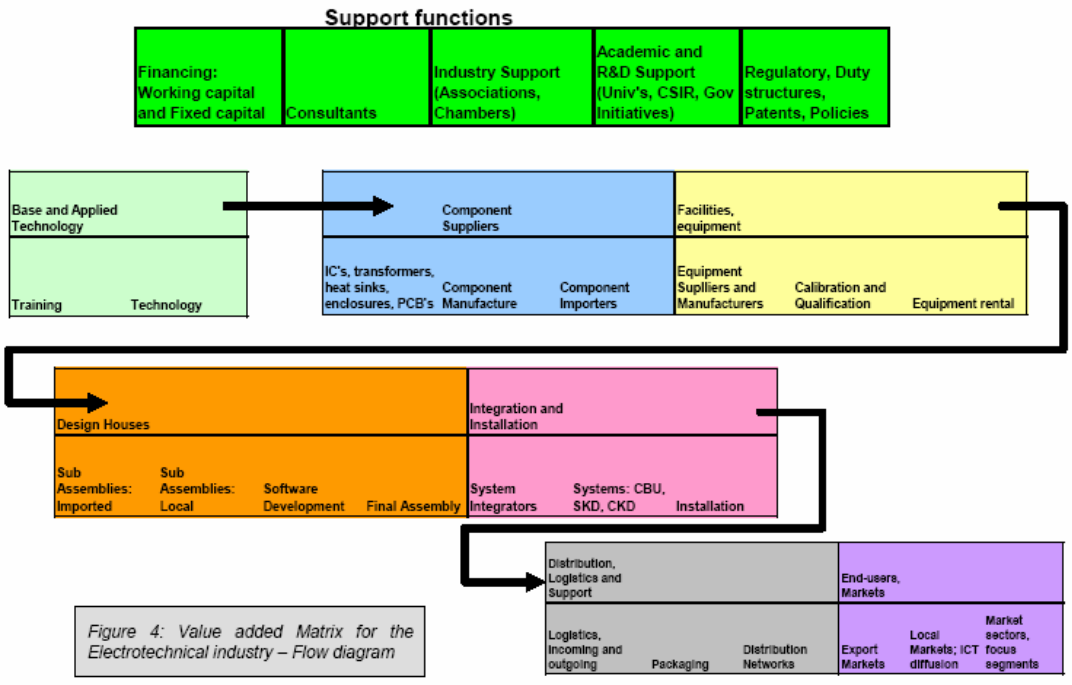


Figure 4: Value added Matrix for the Electrotechnical industry – Flow diagram

In the Western Cape, sales and distribution of electronic devices or components is the part of the electronics value chain in which most of the electronics companies are found, including Phoenix Contact and EBV Electrolink. According to the EBG database, there are approximately 50 electronics manufacturers and assemblers in the Western Cape, including the larger contract electronics manufacturers like Elprom, Rhomco Electronic Assemblers, Trax and Tellumat. There are no more than 15 electronics design and development companies in the Western Cape, the more well-known and successful ones being Psitek, Nicon Systems and OmniPless. These companies own the intellectual property, the design and the manufacturing capability of their product line. There are approximately 17 companies involved in system integration.

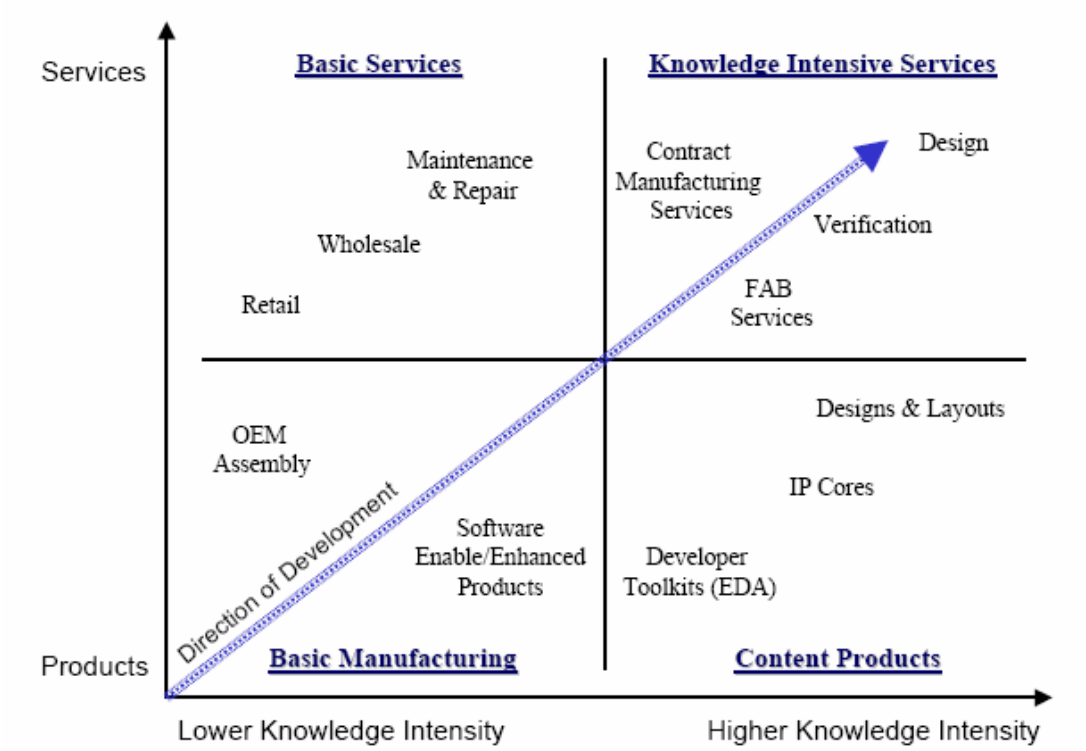
Many companies desire to integrate downstream from their 'core' activities of product development, sales and marketing by developing new capabilities in 'value-added' services such as system integration. These strategies are being pursued even as upstream activities such as manufacturing are shed. The highly competitive pricing of large scale manufacturing of electronics by China has seen a dramatic outsourcing of manufacturing to the Asian countries, while training and product development is still done by the design houses.

Table 4: Examples of companies in the electronics value chain

Component suppliers	Airwave Technologies, Amptron Electronics, TraX Interconnect,
Design	Adequate energy, Nicon Systems, Psitek, EDH
Assembly	Rhomberg, Rhomco
Integration and Installation	MLT Drives
Distribution, Logistics and Support	EBV Electrolink, Phoenix Contact, Peralex

The above table is not exhaustive but merely provides examples of companies in parts of the value chain. The following figure illustrates the move of the sector towards knowledge- intensive services.

Figure 4-2: Dimensions of specialisation and development in Electronics



There has been a fragmentation of the value chain in recent years, with separation of activities and increasing specialisation along a dimension running from basic manufacturing assembly to high-value, knowledge-intensive services (Figure 4.2). Integrated OEM design, verification, manufacturing, assembly, distribution, maintenance and repair are increasingly giving way to the fragmentation of those activities, and to firm and regional specialisation. The move towards a

more knowledge-intensive service can be attributed to the growing number of innovations in the industry, examples of which will be discussed in the next section. This has led to increased specialisation and focus by the design and development companies, and the resultant outsourcing of manufacturing capabilities, which in turn has led to the rise of Contract Electronic Manufacturers (CEMs).

5 TECHNOLOGY BASE OF THE ELECTRONICS SECTOR

A wide range of technologies is in use in the Western Cape electronics sector and many of these are deployed across several focal areas.

5.1 Current and Future technologies

Although the Western Cape has a specific expertise base in the high-frequency microwave electronics field, recent developments have also seen the emergence of capacity in the area of electro-magnetic compatibility (EMC) and Chip on Wire or Blob technology.

Apart from the various applied technologies required in the development of specific solutions or products, it important to also consider the technologies required in the manufacturing of these systems, which is employed by a number of the companies in the Western Cape such as Trax, Tellumat, Alprom and Ziton.

- Design technologies such as CAD, simulation tools, graphic packages and routing software
- Thick-thin technologies such as hybrid micro-electronic circuits
- Board production technologies including screening, chemical treatment and environmental impacts, speed of board production and PCB testing technologies
- Board assemble technologies such as pick & place, solder, oven technologies, Surface Mount Technologies, Through Hole Techniques (TH) and hand soldering
- Electromechanical equipment assembly technologies including chassis production technology and robotic assisted assembly
- Front-end engineering technologies
- Box build and system integration technologies

- Testing & quality control technologies including Automated Optical Inspection (AIO), In-circuit (ICT), final functional (FFT) and burn-in (screening)tests and Electro Magnetic Frequency compliance testing

5.1.1 Current Technologies

Currently there are technologies that are shaping the Western Cape electronics sector causing them to change designs, equipment, processes and methodologies. These technologies are robotics, wireless applications, miniaturisation, nano-technology and bionics.

Robotics

A robot is defined as a re-programmable, multifunctional manipulator designed to move material, parts, tools, or specialised devices through various programmed motions for the performance of a variety of tasks.

Robotics is expected to rival the automobile and computer industries in money and jobs. According to the Robotics Industries Association, a trade association representing companies in the robotics industry, the use of robots in the electronics industry should grow by an average of 35 % a year over the next couple of years.

However, this technology is still new and emerging in the Western Cape and therefore will not experience the same growth that is expected worldwide.

Robotics in the Western Cape will be getting a boost from Government in the near future as a result of the launch of the technology roadmaps in the electronics sector at the end of 2004. One of the anticipated outcomes of the project is that manufacturers will no longer have to spend up to $800 an hour to pay robotics engineers from Europe, since these skills will be available in South Africa.

Wireless Technology

Some of the latest wireless technologies include Bluetooth and Ultra-Wideband. Bluetooth is a standard developed by a group of electronics manufacturers that allows any sort of electronic equipment such as computers, cell phones, keyboards, and headphones to make their own connections without wires. This technology has allowed for cable replacement, access points in homes and offices, and seamless access anywhere.

Ultra-Wideband (UWB) is a radio or wireless system that uses time-domain modulation methods (e.g. pulse-position modulation) for communications applications, or time-domain processing for sensing applications. Even though much of the Ultra-Wideband technology is restricted to

military and government use, there are many practical commercial applications as well, e.g. tags (electronic signs). UWB has the ability to replace all the wired and wireless components we have today with a faster, more efficient method of wireless technology. UWB is the answer to wireless technology for the future. This technology is critical in applications such as RFID, which could potentially have a huge impact on the retail sector.

With the existing knowledge of high frequency microwave electronics technology in the Western Cape, the province is well positioned to excel in this area.

Miniaturisation

Miniaturisation is the current trend in the Electronics industry. Designers and developers are trying to make components smaller, faster and more efficient, causing manufacturers to upgrade their machinery and equipment constantly. Already, Festo has launched a worldwide first in South Africa in the form of the smart cubic (SC), which represents the maximum possible degree of miniaturisation and performance density, such as is demanded by the light-assembly and semiconductor industries.

Highly sophisticated equipment is required in this area, which increases the barriers to entry by elevating the capital requirements. Given the current level of sophisticated equipment and factories of Electronics companies such as Tellumat, Ziton, Nicon, Elprom and Rhomberg in the Western Cape, there is a base potential for the sector to produce a similar product to that of Festo's smart cubic.

Miniaturisation leads on to nanotechnology. Nanotechnology and the integration of biotechnology and electronics are two new, developing technologies.

5.1.2 Emerging / Future Technologies

Nanotechnology

Nanotechnology is the study, manipulation and manufacture of ultra-small structures and machines made up of as little as one molecule. Devices with minimum feature sizes less than 100 nanometres (nm) are considered to be products of nanotechnology. The research spending patterns of Europe (€1.3b over four years), USA (up to $800m in 2003) and Japan (up to $1b in 2003) confirm that nanotechnology is a serious technological development.

A South African nanotechnology strategy has been developed during numerous workshops involving experts in the different industries that may be affected by nanotechnology. According to

Manfred Scriba, Secretary of the CSIR Nanotechnology Forum, the conclusion drawn was that nanotechnology in the electronics sector in South Africa is not feasible.

This emerging technology can be a huge boost to the sector but current realities are, however, that owing to the loss of scientists to other countries in recent years, the fragmented pockets of expertise, lagging behind global technologies and the lack of nanotechnology research funding, it will not be feasible to pursue the implementation of nanotechnology in the electronics sector in South Africa or indeed in the Western Cape. In addition, many of the natural resources that might give us an advantage are exported without full beneficiation thereof. Moreover, the enormous capital required to establish nano-technology facilities is also a stumbling block to the development in this area.

Biotechnology and Electronics

An example of the integration of biotechnology and electronics is bionics. Bionics is defined as the coupling of living organisms and electronics. This includes artificial muscles, nerve-muscle connections, cochlea implants, sight implants, electronic noses, artificial joints, etc. It also includes living cells that are used as sensors and interface with an electronic connection.

South Africa has already proved that it is quite capable of integrating biotechnology and electronics with its innovative APS therapy, which uses electronic devices to alleviate acute and chronic pain. There is potential for the Western Cape to capitalise on this future technology as it already has a biotechnology sector. The consolidation of these two sectors creates the opportunity for the establishment of the Western Cape as a Centre of Excellence for such an initiative. This initiative will, however, require a long-term investment and focus.

Energy

Renewable/ Alternate energy consists of solar technology, wind technology and fuel cells/battery. Given that wind technology involves little in the electronics manufacturing area and fuel cell technology is very immature in the Western Cape, the following discussion will be focused on solar technology.

The term ‘solar power’ refers specifically to the conversion of sunlight into heat or electricity. Solar power is captured, concentrated and stored in solar cells. Solar power in the home or business generally requires electricity back-up to meet all the energy needs required.

The solar technology value chain consists of the following components:

- Research and Development – There is a fair amount of R&D in the Western Cape concerning solar technology, with UCT, UWC and iThemba labs currently involved in photovoltaic research.

- Materials Manufacturing – South Africa is the source of the best raw materials for silicon in the world but these are currently being exported as low-value raw materials rather than being processed to add value. There is an opportunity to set up a facility to produce high-quality metallurgical silicon in bulk, as well as the opportunity to produce wafer-grade poly-silicon for the local and global market. However, although South Africa has the manpower to operate such a facility locally and the technology has low barriers due to the expiry of patents, what is lacking is capital, operating experience and market experience. The motivation of large industry players (e.g. Sharp, Sumitomo, Wacker, Monsanto) to establish a silicon- processing plant in the Western Cape would be most beneficial as regards development in this area.

- Cell Fabrication – this represents another major opportunity in the photovoltaic value chain. There are currently no cell fabrication plants in the Western Cape. Opportunities exist to use locally produced materials, especially cheap substrates, rather than high-quality substrates, which is a major cost factor of the cells, as well as the opportunity to find novel applications for low-cost photovoltaics.

- Panel integration / Assembly – Panel assembly is currently labour-intensive, and done by companies such as Tenesa, Helios and Desolo. The technology for assembly and integration is well established and growth in this area is dependent on demand and local supply of materials.

- System Integration – The companies that are involved in system integration have their services or market driven by demand.

Demand drivers in photovoltaics affect the state of technology and the industry, and these include off-grid power requirements, legislation to either require or enforce a percentage of renewable energy, lower costs for photovoltaics and higher grid energy costs, etc.

The challenges involved in developing novel technologies and products in photovoltaics and nano-crystalline electronics include a lack of capital and limited R&D funding, as well as the absence of a bridging programme between academic R&D and commercialisation. The potential solutions to these challenges include tax breaks, subsidies, technology partnerships/ joint ventures, assistance with the legal issues of IP and creating a community around the issue of bridging the gap.

5.2 Technology development and innovation

The Western Cape has no shortage of innovators and skilled engineers. The following are some of the technological innovations pioneered in the Western Cape:

Speed gun

EDH (Electronics Development House) launched its first ballistic measurement radar based on phased-array technology. This radar measured projectiles in flight up to distances of 25km. All the ballistic characteristics of the projectile were successfully measured, including the speed at any point from launch throughout the flight, the spin rate and position in space. These tests were performed at military test establishments with live firing of ammunition. The latest EDH technology is capable of measuring objects over longer ranges and at projectile speeds exceeding 3000 m/s.

Based on similar technology, and giving equally accurate results as those of its military cousins, EDH developed and launched its sports products for ball tracking. The first on the market was the purpose-built bowling speed system for Cricket under the name EDH Speedster in 1996. In 2001, the EDH Tennis serve speed system was launched under the name EDH RacquetRadar. The EDH golf tracking system was launched under the proprietary name FlightScope in 2003. Other sports have also benefited from EDH technology.

The SUNSAT Satellite

Designed and built almost in its entirety by postgraduate students from the University of Stellenbosch, SUNSAT-1 heralds South Africa's entry into the Space Age.

It was launched in early 2000 and its primary purpose is to take low-cost, high-resolution photographs of South Africa.

Transformerless dip/sag compensation device

The use of a cascaded multilevel inverter for transformerless sag/dip compensation has been investigated. This topology is investigated as a cost-effective means for series sag compensation by eliminating the large injection transformer and output filter components that are used in conventional series injection devices. This prototype inverter is designed for sag compensation of a 250 kVA load. In this design, cost-effectiveness plays a major role in the selection of the energy storage and the switching components. Control schemes are discussed for series sag compensation with this multilevel inverter. New control methods for sag compensation and injection are also introduced. A prototype has been developed and the control schemes of this sag compensator have been successfully verified in the practical results and

show successful compensation for sags for different types of loads. The performance of this compensator makes it promising for future power rating upgrade and industrialisation.

Telephone metering device

Psitek's inception was based upon the development of a unique telephone metering device, which was originally developed for Telkom. This technology was the foundation that helped grow the company to a level where 15 years later, it holds approximately 8 international patents and trademarks, and amongst other products has 130 000 pre-paid telephone systems in operation across Africa.

In 1994, Psitek developed the Sigi for Siemens Telecommunications, for deployment in Vodacom community phone shops around the country. The Sigi Pro can be used in rural communities as a community payphone, such as in Vodacom phone shops or telecentres.

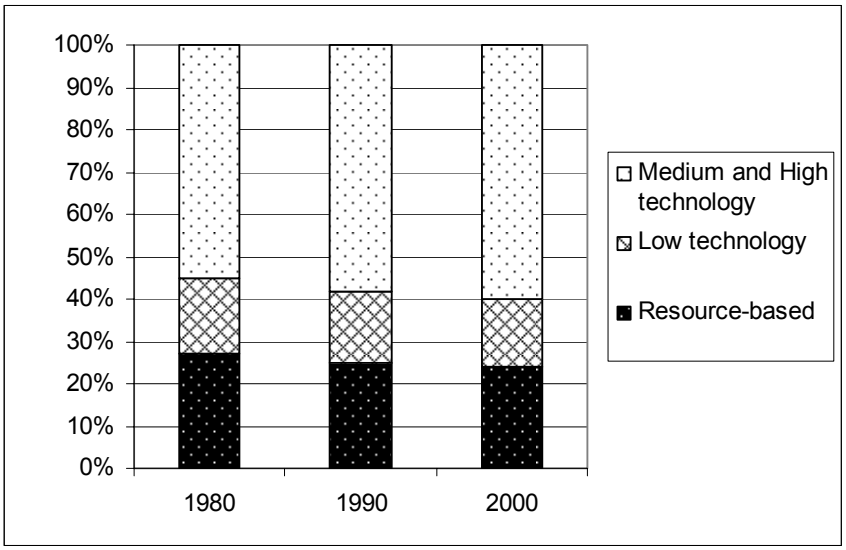
The latest version of the Sigi Pro was introduced in mid-1998. The phone offers the unique integration of voice, data and fax facilities and is equipped with a metering unit for billing purposes. A standard fax machine, as well as a PC, can also be connected to the control unit, allowing access to Internet and e-mail.

These innovations are just a few examples of the technologies and products that have been conceived in the Western Cape. Apart from these innovations, there are also numerous patents held by the various universities in the province.

5.3 Technological Challenges

The Western Cape electronics sector attempts to compete internationally utilising medium-to-high technology, when role-players should really be looking at being able to deliver high-to-very high technology products at the edge of the latest technology, in order to be effective globally. Figure 9 illustrates the global trend of moving away from lower technology and more towards higher technologies.

Figure 3: Structure of Global Manufacturing Value-Added



Source: Asian Development Bank

A recent report by S. Lall defined the various levels of technology as indicated in the graphs above, as follows4:

Resource-based manufactures (RB)

Resource-based manufactures (RB) include processed foods and tobacco, simple wood products, refined petroleum products, dyes, leather (but not leather products), precious stones and organic chemicals. RB products can be simple and labour-intensive (e.g. simple food or leather processing) or capital, scale and skill-intensive (e.g. petroleum refining or modern processed foods).

Low technology manufactures (LT)

Low technology manufactures (LT) include textiles, garments, footwear, other leather products, toys, simple metal and plastic products, furniture and glassware. These products tend to have stable, well-diffused technologies with low R&D expenditures and skill requirements, and low economies of scale. Labour costs tend to be a major element of cost and the products tend to be undifferentiated, at least in the mass-produced (non-fashion) end of the scale. Barriers to entry are relatively low; competitive advantages in products of interest to developing countries come from price rather than quality or brand names.

Medium technology manufactures (MT)

Medium technology manufactures (MT) are 'heavy' products like automobiles, industrial chemicals, machinery, and standard electrical and electronic products. These products tend to have complex but not fast-changing technologies, with moderate levels of R&D expenditure yet advanced engineering and design skills, and large scales of production. In engineering products, there is an emphasis on product design and development capabilities as well as extensive supplier and subcontractor networks. Barriers to entry tend to be high, not only because of capital requirements but also because of strong 'learning' effects in operation, design and, in certain products, product differentiation.

High technology manufactures (HT)

High technology manufactures (HT) are complex electrical and electronic (including telecommunication) products, aerospace, precision instruments, fine chemicals and pharmaceuticals. Products with advanced, fast-changing technologies and complex skill needs have the highest entry barriers. The most innovative ones call for large R&D investment, advanced technology infrastructures and close interactions between firms, universities and research institutions. However, many HT activities, particularly electronics, entail simple technologies for final assembly, where low wages are an important competitive factor.

In order to counter the comparative high minimum wage rates, the Western Cape electronics sector need to differentiate itself through more complex activities implying focusing on higher technology solutions and through high levels of quality. Countries that compete in this high-tech, low-volume arena (e.g. the USA and European countries) have higher labour rates but they use very high-level technology. Compared to these countries, South Africa already has a competitive advantage in terms of the professional standing of its engineers, but in order to compete in the same arena, South Africa needs to use the same level of technology as they do, i.e. high-to-very-high technology.

There are factories producing at good quality levels in the Western Cape, but they tend to be followers in technological advancement, following the latest trends with some delays. In order to be competitive, the Western Cape electronics sector must not only adjust very rapidly to changes in technology, but its practitioners must also be leaders in their area of expertise and avoid operating under obsolete technologies.

[4] Industrial Competitiveness: The Challenge for Pakistan, 2004. Asian Development Bank Institute

5.4 Technology promotion

In 2004, the Provincial Advanced Manufacturing Technology Strategy (PAMTS) was launched in Cape Town. The PAMTS aims to make South Africa less dependent on imported technologies, develop strategies aimed at enhancing the global competitiveness of the South African manufacturing industries, increase local innovation and implement technology that will have a favourable impact on knowledge-intensive, national manufacturing industry initiatives.

Workshops have already been conducted in the Western Cape in an attempt to gain a deeper understanding of the electronics industry so as to promote its growth.

In the same year, the Department of Trade and Industry commissioned a report on technology development trends in South Africa of relevance to various sectors, e.g. ICT, Agriculture, Tourism, etc. This report highlighted four technologies as being critical for the continuous development and growth of the automotive sector. One of these technologies includes sensors, electronics and telematics. As previously mentioned, automotive electronics is a growing trend, but this does not impact greatly on the Western Cape electronics sector as it is not a significant sub-sector in this region.

5.5 Conclusions on the technological positioning of the sector

The Western Cape electronics sector is regarded as a strong innovator. The designs and development of devices are world class, but the use of medium-to-high technology prevents the sector from reaching its full potential. While many countries have been successful at innovation with the use of medium-to-high technology, in order to compete against the high-tech, low-volume electronics leaders in European countries, South Africa should adopt high-to-very-high technologies. Many of the numerous innovations that have been pioneered locally are licensed to overseas companies for the commercialisation phase. The sector does not compete at the lower end of the technology scale, i.e. the low-cost, mass-production and high-volume products as dominated by the Chinese. Given the lack of protection from cheap imports, the relatively high cost structures that result from small production volumes, local labour costs and imported technology, the local sector cannot effectively compete with lower-cost production environments such as China and most likely never will. Other countries in the electronics industry have high cost structures as well, but South Africa's are high when compared to countries playing in the high-volume, low-tech field such as Brazil and China.

As already intimated, a more realistic strategy is to compete at the higher end of the technology scale, producing high-cost, low-volume products. At the moment, this is more or less where the Western Cape is positioned. The current reality is that on average the electronics sector players

in the Western Cape rather find unique new applications of existing technologies without inventing new break through technologies.

In order to become a major player at this high end of the scale, the sector needs to invest more in research and development (R&D). This can be achieved with support from the government, sufficient funding and the appropriate skills. The latter is not such a big problem as industry experts agree that the Western Cape has a pool of highly skilled engineers and innovators.

Therefore, the Western Cape should find a niche at the high end of the technology scale in which it can be competitive. The niche served by the local industry is bounded by the following:

- Sub-sector choice
- Technology intensity
- Product or service set
- Local skills level and availability
- Market penetration or appropriateness
- Mid-to-low manufacturing volume capability
- Supplier chain dynamics
- Packaging and delivery logistics.

6 LABOUR MARKET OVERVIEW OF THE SECTOR

Labour trends, the skills mix in the Western Cape Electronics sector, skills requirements and Electronics SETA support are subjected to scrutiny in this section of the report.

6.1 Labour trends

Employment within the electronics sector in the Western Cape is estimated to have increased by almost 8% in 2001, after declining by about 4% in the preceding two years. However, the employment rate has subsequently slowed down considerably owing to the strength of the rand, which affected the export market negatively. There is a general acceptance that the electronics sector will not continue to experience the high rates of growth in output that they have in recent years. The greatest increase in demand in the sector is expected to be in the categories of physical and engineering technicians, and administration and support.

Table 5: Total Western Cape ICT sector employment

Category	Percentage	Estimated total number
ICT Professionals	50%	13 800
ICT Practitioners	14%	3 864
Electronics & hardware technicians	15%	4 140
Electronics engineers	3%	828
Sales and Administration	18%	4 968
	100%	27 600

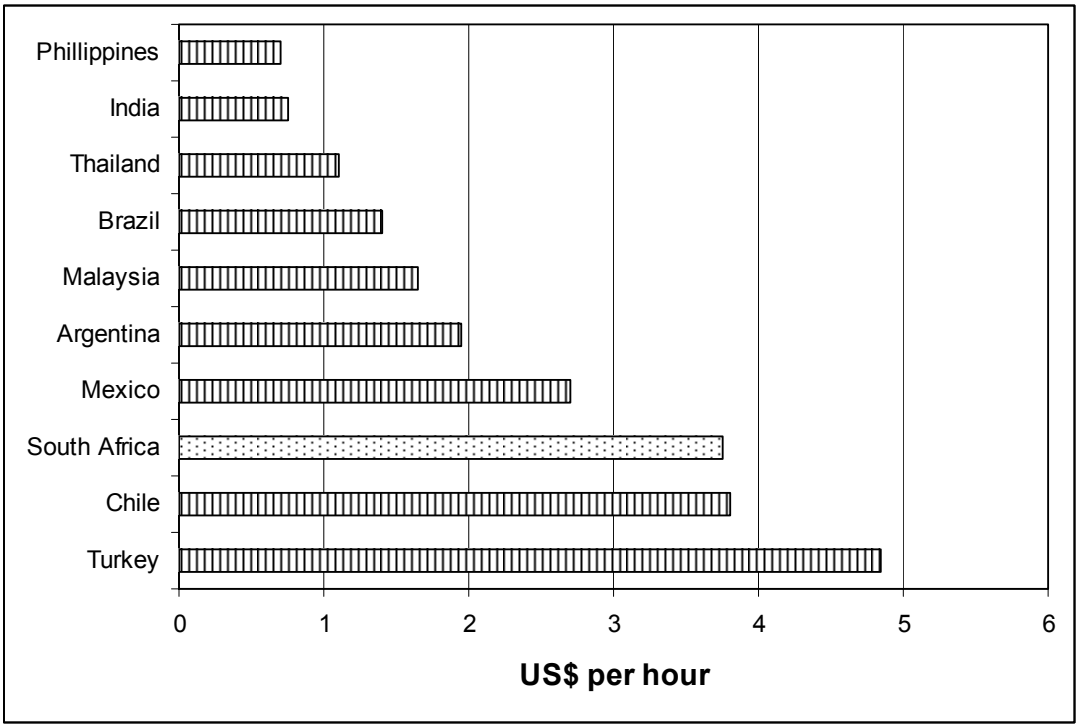
Source: citi

There are approximately 4 140 Electronics and Hardware Technicians in the Western Cape, which include computer technicians, electronics repairers, electronics assemblers and maintenance technicians. It is estimated that about half of these are involved in the electronics sector. There are approximately 828 electronics engineers in the Western Cape, bringing the estimated employment figure for the electronics sector in the Western Cape to 2 898.

According to PayScale, electronics engineers in South Africa earn between US$18 696 and US$42 845 per year, depending on the amount of experience and region. This is significantly less than the UAE where electronics engineers earn up to US$63 889 for 10-19 years of experience, and our North American counterparts who earn up to US$77 800.

South Africa's manufacturing labour costs, on the other hand, are lower than those of its European and American counterparts, but significantly higher than in countries such as India, Brazil, Malaysia and Mexico, as illustrated by Figure 6.1.

Figure 6-1: Manufacturing Labour costs, Estimated Comparative figures 2003



Source: *the dti* South Africa

6.2 Skills mix in the sector

There are numerous tertiary institutions in the Western Cape that offer courses in the electronics field. Technikons include the Cape Technikon and Peninsula Technikon, and universities include the University of Cape Town and the University of Stellenbosch.

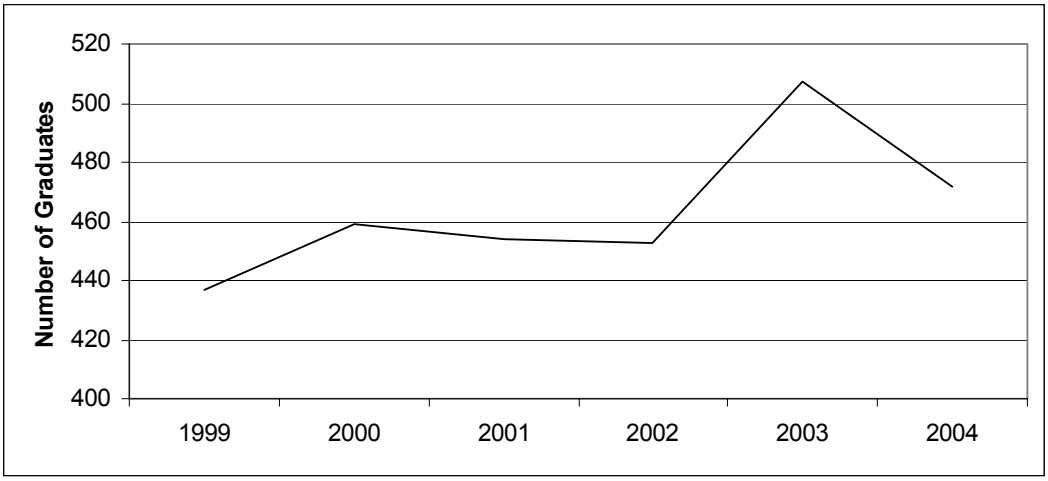
- The University of Cape Town offers relevant degrees with subjects that include Acoustics, Control and Process Control, Data Communications, Digital Systems and Computers, Electrical Machines and Transformers, Electronics and

Telecommunications, Illumination, Instrumentation, Microwave, Radar, Power Electronics and Power Systems.

- The University of Stellenbosch offers degrees with subjects that include electrical power systems, electronics, electromagnetic systems, computer systems, control systems, signal processing and industrial electronics as subjects. Stellenbosch delivers approximately 60 graduates in the field of electronic engineering each year.
- The Cape Technikon offers diplomas that include control systems, digital systems, electronic applications, electronics, power electronics and electronic communication as subjects.
- The Peninsula Technikon offers diplomas that include avionics, digital systems, process instrumentation, digital communication and systems and control systems as subjects.

The following graph illustrates the total number of graduates from the engineering departments of the University of Cape Town, the University of Stellenbosch, Cape Technikon and Peninsula Technikon who have had electronics as a subject.

Figure 6-2: Number of engineering graduates with electronics as a subject from the Western Cape's tertiary institutions



Following the success of SUNSAT, a company was formed for the further development and promotion of the satellite. This company, Sun Space, employs graduates from the University of Stellenbosch as well as from other tertiary institutions in the Western Cape and in the rest of South Africa. The company has grown from approximately 30 employees 2 years ago, to about 50 now. Approximately 75% of the employees are graduates from tertiary institutions in the Western Cape of which 80% are from University of Stellenbosch. The rest are from other parts of South Africa.

The Information Technology and Industrial Training Board (ITITB) provides skills training, apprenticeships and in-house training.

There is no lack of highly skilled labour involved in design and development. The problem lies in the lack of semi-skilled to skilled, low-cost personnel. South Africa cannot compete against the cheap imports from the Far East due to the low labour costs in that region. South Africa has one of the most comprehensive sets of labour laws in the world guaranteeing the protection and rights of employees. Stringent health and safety regulations exist and the many labour unions in the country make sure that these laws and regulations are adhered to. For this reason, the cost of labour is too high to compete with that in countries such as India, Malaysia and China where such strictures protecting employees do not exist. The skills gap exists not at the higher end of the resource scale, but rather in the technical and manufacturing aspects. Many companies resort to in-house training in order to train their manufacturing and technical staff.

One such company is Elprom. The company has struggled to find a local institution able to provide it with the kind of training it needs to train electronics-assembly operators. The training available in the industry has almost no manufacturing content, further aggravating the problem of the lack of electronics manufacturing in South Africa. The industry as a whole needs improvement in this area, and many companies alleviate this problem through in-house training.

Companies such as Elprom require very specialised training, e.g. in process control on wave soldering and robotic soldering. However, there is no formal centre of education to which companies can send staff to receive the relevant training. Learners can receive a technician's diploma from Technikons and yet have no electronic assembly experience.

However, looking at the higher end of the scale of highly skilled engineers, when compared with the USA and European countries, South African engineers are competitively priced, though not inferior to their Northern Hemisphere counterparts. This unfortunately contributes to the outflow of skilled engineers that has plagued the electronics sector. Many South African engineers have moved to the USA, Europe and Canada because of the higher salaries offered there.

The Engineering Council of South Africa (ECSA) is a statutory body established in terms of the Engineering Profession Act, 2000 (Act No. 46 of 2000). ECSA's mission is to ensure, through a co-operative process of quality assurance, that persons wishing to enter the profession are educated and trained according to widely accepted standards. The tertiary institutions in the Western Cape have engineering courses and programmes that are accredited by ECSA, and an ECSA team is sent to these institutions periodically for check-ups and assurance that these courses / programmes still comply with ECSA's minimum standards and requirements.

ECSA is one of the councils that form part of the Washington Accord. The Washington Accord was signed in 1989. It is an agreement between the bodies responsible for accrediting professional engineering degree programmes in each of the signatory countries. It recognises the substantial equivalency of programmes accredited by those bodies, and recommends that graduates of accredited programmes in any of the signatory countries be recognised by the other countries as having met the academic requirements for entry to the practice of engineering. This means that the engineering graduates in South Africa and in the Western Cape meet international standards. The Washington Accord covers professional engineering undergraduate degrees, not engineering technology and postgraduate-level programmes.

The signatories of the Washington Accord are Australia, Canada, Ireland, Hong Kong, New Zealand, South Africa, the United Kingdom and the United States. Countries with provisional membership status include Germany, Malaysia and Singapore.

6.3 Electronics SETA support

The mission of the Information Systems, Electronics and Telecommunications Technologies Sector Education Training Authority (ISETT SETA) is to generate, facilitate and accelerate the processes of skills development for workers at all levels in the ISETT sector by linking future technology trends with new skills development programmes.

The ISETT SETA offers learnership programs composed of both structured learning and structured work experience. They train and educate learners in general electronics theory aspects and attempt to fine-tune these skills by placing them in a real-world working environment. However, interviewees have stated that they need more specific education and training, e.g. in wave soldering. This is an area in which ISETT SETA could potentially support the organisations more specifically, by streamlining their courses to cater for these requirements.

6.4 Conclusions on labour conditions in the sector

The Western Cape electronics sector is in the fortunate position that it has access to highly skilled engineering and design competence, as well as a productive and trainable labour force. Although the relatively high cost of labour in South Africa and the Western Cape affect competitiveness in the higher volume manufacturing categories, the competitive professional fees encourage the move towards a more technology-rich environment.

The Western Cape has skilled engineers of world-class standard fostered by its universities and technikons. Although some interviewees cited the outflow of highly qualified, skilled labour as a problem, this is not so prevalent as to have a drastic effect on the sector. The outflow of highly

skilled engineers to countries such as Canada and the US can be combated through growth strategies such as the more effective use of science parks. Recent trends have also indicated a tendency of many professional staff to return to South Africa, bringing with them not only valuable experience but also international ties to larger corporations.

The problem lies in the lack of training, workmanship standards and abilities in the industry, and some companies resort to undertaking all their own training, using an inductive training method, which is a form of apprenticeship. The sector needs personnel trained not only in technologies but also in production methodologies, and this is where the ISETT SETA may step in to fill the gap, by adjusting their training programmes to meet the needs of the industry more appropriately.

7 KEY INVESTMENT INCENTIVES AND INVESTMENT TREATIES IN ELECTRONICS

There has been very little foreign investment in the electronics sector. One company that has benefited from foreign direct investment (FDI) is Grintek. In 2004, Swedish technology group, Saab AB's invested in Grintek. Valued at over R100 million, this new direct foreign investment is linked to Saab's Industrial Participation obligations stemming from South Africa's purchase of Gripen advanced fighter aircraft. This shows that Government's strategy of leveraging long-term international alliances and global market access for South African companies from the strategic defence procurement programme is working. Saab secured a 21.2% stake in the Centurion-based Grintek Ltd, in a transaction that will boost South African high-technology development, manufacturing and exports.

One of the local investors is Venfin. This is an investment holding company focusing on telecommunication, technology and media businesses, with the potential to produce superior growth. In the electronics industry, Venfin has investments in Psitek and Tracker. Psitek provides products in the fixed-line and cellular communications arenas and Venfin has a 32% stake in this company. Venfin has a 32.1% share in Tracker, whose core business is the sale and installation of vehicle tracking systems, and the tracking and recovery of stolen vehicles by electronic means.

Another local investor is the Industrial Development Corporation (IDC). The IDC is a self-financing, national development finance institution (DFI) established in 1940 by an act of Parliament, the IDC act. It focuses on contributing to economic growth, industrial development and economic empowerment through its financing activities. In the local electronics sector, the IDC has provided companies such as EDH with funding.

An important instrument of government to promote innovation is through the dti's Innovation Fund, which invests in technologically innovative R&D projects.

7.1 Current government support programmes and initiatives

Technology Roadmaps

The Department of Science and Technology (DST) embarked on a technology road mapping exercise in 2002 that embraces three of the areas flowing from the Technology Foresight Process. These are: 1) Electronics 2) Information and Communications Technology and 3) Advanced Materials and Manufacturing.

In September 2004, another Technology Roadmap was launched, targeting the electronics and aerospace industries. The Technology Roadmaps form part of an advanced manufacturing technology laboratory project, which in turn forms part of the national advanced manufacturing technology strategy (AMTS) for South Africa.

The AMTS was approved by Cabinet in 2003 and the implementation phase commenced in 2004. Technology sectors likely to have the most impact on the South African manufacturing sector have been identified for interventions with a strong human resources development component.

These include advanced materials, product technologies, logistics and cleaner production technologies, as well as information and communication technology (ICT) in manufacturing.

The provinces of KwaZulu-Natal, the Eastern and Western Cape and Gauteng were specifically earmarked for this project. These roadmaps, developed by government, industry and academia, will provide a forecast of the skills and technologies that industry will need in the next five to ten years. An outcome of the project should be more exports of manufactured goods. In addition, manufacturing costs will be reduced. For example, manufacturers will no longer have to spend up to $800 an hour on paying robotics engineers from Europe, since these skills will be available in South Africa.

The Technology Roadmaps have not been completed as yet – expectations are that one or two roadmaps will be done by the end of this year. Most of 2004 was spent trying to get industry buy-in. It is a continuous process and the feedback so far has been mixed. The majority industry players involved are SMMEs. The process of developing the roadmaps has so far proven to be challenging but strong linkages are being forged with critical members such as tertiary institutions.

7.2 Investment incentives

A range of incentives is available to qualifying investors. The more commonly used incentives are given below:

Table 6: Incentives offered by the Government

Name of Incentive	Benefit	Main conditions
Strategic Industrial Project (SIP)	50-100% tax allowance	Manufacturing and selected services, minimum investment of R50 million
Small and Medium Enterprise Programme	Cash grant of up to 10% of qualifying assets	Investments < R100m; benefit decreases with size of investment
Skill Support Programme	50% of training costs, subject to a maximum of 30% of wage bill	Training programme must be certifiable
Support Programme for Industrial Innovation (SPII)	50% of the direct costs incurred in development	Development must be a significant technological advance and have commercial advantage over existing products
The Technology and Human Resources for Industry Programme (THRIP)	Matching of industrial partners' financial contribution according to approved ratio.	The project must be a high-quality science, engineering and/or technology research project that must lead to a prototype, product/process to benefit the industrial partner(s).

The better-known incentives are SPII and THRIP.

- Support Programme for Industrial Innovation

  The Department of Trade and Industry (DTI) introduced the Innovation Support for Electronics Scheme (ISE) in October 1989 to promote the local design and manufacture of innovative electronic products. Owing to the need to offer a wider support structure, the Support Programme for Industrial Innovation (SPII) replaced the original programme on 1 April 1993. SPII is designed to promote technology development in manufacturing industries in South Africa through support for innovation in competitive products and/or processes.

  The SPII Programme offers three schemes, namely the Matching Scheme, the Feasibility Scheme and the Partnership Scheme.

  - The Matching Scheme gives a grant of 50% of the actual direct cost incurred in development activity, up to a maximum grant amount of R1.5 million per project. As of 1 January 2005, the Matching Scheme was exclusively available for SMEs.
  - The Partnership Scheme gives a grant of 50% of the actual direct cost incurred in development activity, with no maximum grant amount and with a repayment mechanism

in the form of a levy on sales. The Partnership Fund is intended to fund large-scale R&D.

- The Feasibility Scheme supports the preparation of a feasibility study for potentially innovative projects by means of a grant of 50% of the costs of a consultant. The grant is limited to R30 000 and only SMMEs qualify for support.

- The Technology and Human Resources for Industry Programme (THRIP)

  The Technology and Human Resources for Industry Programme (THRIP) aims to boost South African industry by supporting research and technology development, and by enhancing the quality and quantity of appropriately skilled people.

  The following funding limits currently apply:

  - A maximum of R150 000 per SA student (at 4th year level of study or higher) involved (spending at least 20% of time on project) in the project.
  - Matching of industrial partner's financial contribution according to approved ratio, for all the THRIPable costs of the project, except for intellectual property rights (IPR) funding, which works differently.
  - Matching of contributions in kind (at historically disadvantaged institutions (HDIs) only), according to approved project support ratio, to a maximum of R1 million per project per year.
  - A THRIP contribution to TIPTOP, according to the approved project support ratio, to a maximum annual package of R300 000.
  - A once-off contribution to an SMME or to a project leader based at an HEI, of a maximum of R10 000 towards the cost for legal advice on the development of an agreement on the treatment of IPR. This amount need not be matched by an industrial partner contribution.

Even though the above incentives offer attractive benefits, interviewees indicated that they only assist the investors in the initial start-up phase. Thereafter, they are left to sustain the business with no tax incentives or cash grants, leaving the investors weary of these incentives. These incentives do not attract investors because the entire application process is too cumbersome, involving too much paperwork and too much red tape. Many companies realise that to apply for these incentives, they must employ a consultant to assist them in the application process and this proves too costly for many SMMEs.

7.3 Investment treaties

South Africa imports electronics from, and exports electronics to, countries all around the world. Imports of base electronics, e.g. off-the-shelf chips and boards, come from the Far East from

countries such as Malaysia, Singapore and China, while South Africa exports to the USA and countries in Europe. Power electronics equipment is exported to developing countries and parts of Africa such as Sudan.

The more specialised, highly researched, expensive electronic components are imported from countries such as Germany and USA, while the cheaper, mass-produced components come predominantly from Eastern countries such as China and Taiwan.

In 2004, the United States lifted a ban against South African defence weapons firms Armscor, Fuchs Electronics and Denel that was instituted in 1994 as a result of the companies' sanctions-busting activities in the US during the apartheid era. The decision removes the final impediment to normalised defence trade relations between South Africa and the US. (The ban had been provisionally suspended in 1998 after then Deputy President Thabo Mbeki and former US Vice President Al Gore agreed to a framework establishing export compliance programmes for each company.)

Later on in 2004, there was the signing of a memorandum of understanding (MOU) between the Australian Electrical and Electronic Manufacturers Associations (AEEMA) and the South African Electronic Industries Federation (EIF) and Electro-technical Export Council.

The implications of the agreement for the sectors in both countries are significant and include joint manufacturing, technology exchange, access to new markets, including working together on projects in other markets, with particular initial focus on South East Asia and North Asia, as well as cooperation on standards. Interaction will be managed through the South African Technology Centre located at Monash University in Melbourne.

South Africa currently suffers from dilution and fragmentation because there are over 30 industry bodies in the sector, all with similar mandates and small budgets with which to achieve them. This agreement will stimulate more cooperation and collaboration.

7.4 Investments from donor funding organisations

The IFC, World Bank, Development Bank of Southern Africa, IDC, EU and IMF all have an interest in South Africa. These organisations fund projects that improve living conditions, infrastructure, aid social development and business development, etc. For example, the IFC is increasing its interests in South Africa by $50-150-million a year over the next few years to support small and medium enterprises, believing that South Africa will never achieve its massive job creation goals without making the regulations easier for small businesses. Another example is the European Programme for Reconstruction and Development (EPRD), an initiative by the European Union. An estimated 70% of EPRD funds go to projects such as water supply,

sanitation, health, education and training and local economic development, while a minimum of 25% of EPRD resources is channelled through decentralised co-operation projects (non-governmental organisations, community-based organisations, etc.).

Many of these investments do not have a direct effect on the sector, but rather on the country as a whole. However, they do make investors see South Africa, and hence its industries, in a more positive light.

8 OPPORTUNITIES IN THE ELECTRONICS SECTOR

8.1 Benchmarking and Peer group learning

Much can be learnt from the attempts by other countries in a similar position to develop their electronics sectors. The positive and negative experiences of Ireland, Israel, Mexico and Taiwan will be considered in this section.

8.1.1 Ireland the 'production platform' – success built on FDI

The rapid expansion of consumer electronics, professional electronics (particularly optical and precision equipment) and pharmaceuticals is central to rapid growth in the Irish economy. At the outset, the industry strove to attract foreign capital and removed all protectionist limitations. As a result of foreign direct investment (and reinvestment) by US companies, consumer electronics grew (by 1998, 61% of all consumer electronics companies were US owned, employing 82% of the sector).

Factories were initially used for production only, with design and R&D being located in the USA. More recently, R&D expenditure has increased in Ireland. Most electronics production (91%) is for export and they produce high-value products (computer and office equipment and components)

Graduate employees make up between 12 and 14% of the workforce (suggesting skill levels).?? Ireland initially attracted labour-intensive investment in technologically mature sectors, then later electronics and still later R&D-intensive electronics.

FDI has since slowed down and 'inward investment' and 're-investment' in plant capacity has become more important. There has been a policy shift to integrate science, technology and industrial policy, and to develop the local Irish electronics sector.

8.1.2 Israel the 'development centre' – success built on defence spending

Israel's electronics sector is characterised by the rapid expansion of consumer electronics, professional electronics (particularly optical and precision equipment) and pharmaceuticals.

The electronics sector was built on protectionism and strong state intervention to secure strategic military needs (the initial sector was based on licensed production of French military technology and a French-Israeli technology partnership). Israel's later isolation caused it to go it alone and stimulated 'massive growth' in the defence industry (and hence electronics). In 1974, the defence budget was nearly 50% of the country's gross national product.

In 1998, 84% of electronics companies were domestically owned, employing 75% of the sector. High levels of R&D (military and civilian – up to 47% of sales in some cases) were driven by local demand. By 2001, half of production was for the domestic market, and the rest for exports (telecommunications and medical diagnostic equipment).

The sector employs more highly skilled labour (between 29 and 48% of the workforce are graduate employees) and focuses on R&D-intensive production. Skilled labour is ample in terms of availability and this has been improved through the inflow of skilled labour from the former Soviet Union.

Given the defence background of Israel's electronics sector, there has been a high level of spin-offs from defence technology to civilian technology. Israel's strongest electronics companies still reflect a link with the defence industry.

Generous capital grants and R&D grants were introduced to stimulate the sector, but attempts to attract FDI failed because of global slowdown in the 1980s and a national macro-economic crisis.

8.1.3 Mexico – failure through attracting the wrong type of foreign investment

In 1970, there was a strong consumer electronics sector in Mexico: 16 TV manufacturers, 30 manufacturers of radio and audio equipment and 120 component suppliers – most of which were Mexican-owned. Foreign firms seeking to access consumer markets had to follow joint ownership and local sourcing obligations.

High levels of foreign investment were attracted through import substitution industrialisation policies in the 1950s to 1970s – half were jointly owned with European or US companies and the other half were Mexican-owned. Local content requirements, of up to 98% in some cases,

caused high levels of subcontracting and specialisation in many small local components producers.

In the 1980s, reduced economic performance crowded out a number of companies producing for the Mexican market, which resulted in a shift towards assembly and distribution of Mexican products for export to Asia. However, the growth of the East Asian consumer electronics market further damaged the Mexican electronics industry.

The deterioration of the industry was attributed to rising imports from Asia, unexpected and rapid reduction in trade protection for components and growing domestic financial crisis and recession.

Mexico was unable to adapt to global changes in the way that Taiwan had managed to do, because of the kind of foreign investors it attracted – the kind of investment limited international exposure, technology transfer, business linkages and learning for Mexican companies.

The foreign investment that Mexico attracted was focused on shifting US component supply to low-cost production zones in Mexico in response to increasing competitive pressure from Japanese consumer electronics. US investors had little interest in securing demand from Mexico's consumer markets, preferring instead to export to the US – this limited interaction between Mexican and US companies and reduced opportunities for technology and learning transfer.

The nature of Mexico's Border Industrialisation Programme (1965-1974) attracted US investors to operate from within Mexico (on the Mexico-US border) but without any obligation to contribute to the development of Mexico's consumer electronics sector through partnerships, etc. As such, investors had no intention of penetrating new Mexican markets, but were bent on protecting their own domestic US markets against Japanese imports through operating from cheaper platforms

Typically, the type of investors who ran to Mexico for protection were low-cost, low-quality producers whose domestic US markets were under the greatest threat. Moreover, their initial investments were only in 'passive componentry' requiring little subcontracting from Mexican suppliers.

The nature of US investment in East Asia (see below in the example of Taiwan) put that region in a better competitive position than did US investment in Mexico. Any opportunity for Mexican suppliers to produce for US border-based investors was destroyed in the mid-1970s recession, which few of them survived, and the US investors turned instead to cheap component suppliers from Japan.

Mexico only received investment from declining US parts makers and assemblers. There was little integration between foreign and Mexican companies, and few supply linkages were created, which meant that many Mexican companies did not survive the mid-1970s recession. The drop in trade protection left many Mexican producers poorly placed to position themselves for the international division of labour and to compete against cheap component imports.

Late into the 1980s, Asian investment in the Mexican television industry was of a better nature, assisting to build the industry.

8.1.4 Taiwan – success through global integration with foreign investors

Taiwan's globally competitive consumer electronics industry is attributed to economic success and global integration.

High levels of joint ventures and technology transfer agreements provided local firms with opportunities for borrowing and internalising new processes – the computer and semi-conductor sub-sectors developed on the previously accumulated knowledge and capital base of consumer electronics. Foreign and Taiwanese companies are members of the same trade association, thereby ensuring facilitated learning and cross-firm communication, and maximising opportunities for Taiwanese companies to internalise international strategies and technologies.

The industry is dominated by strong inter-firm alliances between locally owned companies that lobbied the government diligently for targeted support. This ensured that Taiwan was appropriately integrated into the global electronics value chain.

Foreign investors made it possible for local firms to gain access to global production chains and implement new technologies (especially linkages with US and Japanese multinationals).

Japanese investment attracted through Taiwan's growing consumer market, made use of Taiwan for labour-intensive aspects of production (accessing low-cost labour). Taiwan was a low cost production zone with close proximity to Japan. High levels of import protection encouraged greater levels of partnership between Japanese and Taiwanese companies.

Global competitive pressures shifted international investment away from Japan and the USA to Taiwan – in particular, the search for cheaper components caused an increase in investment by foreign firms in Taiwan; this put Taiwan on a firm footing in the international division of labour as a global source of components and parts.

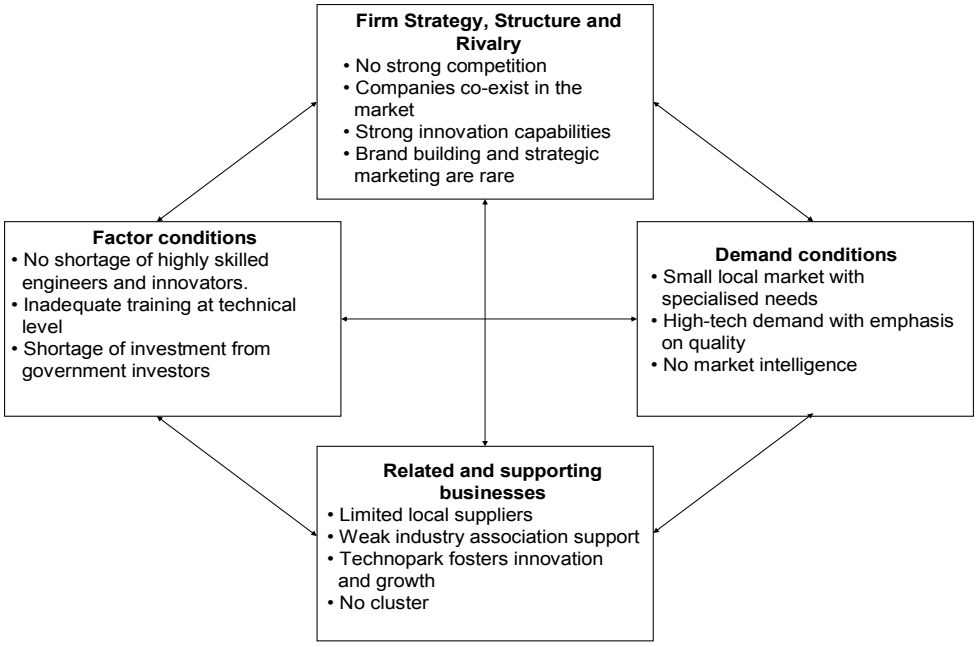
Eventually, export markets were created through the development of the local components industry (greater demand for Taiwanese components also led to an increase in 100% locally owned companies).

US companies invested in high levels of training and technology transfer for Taiwanese managerial staff. The dual regime of US and Japanese foreign investors provided education, improved the quality and efficiency of components production, supplied stable markets and improved international business linkages for local Taiwanese firms.

8.2 Competitive Advantages in the Electronics Sector

According to Porter's 'Diamond Model' for stimulating cluster development, the four elements of the diamond are demand conditions, related and supporting industries, factor conditions and firm strategy, structure and rivalry. There are also the random influences of culture, policy and chance that can influence competitive advantage in the short run.

Figure 8-1: : Porter's diamond model applied to the electronics sector



These factors are also affected by the lack of communication in the Western Cape Electronics sector. The Western Cape electronics sector would benefit from adopting a more collaborative

culture. The creation of a unified electronics sector identity and brand could help to establish the sector more firmly in the international market.

The following competitive advantages arise from an analysis of the above:

- Higher number and quality of engineers in the Western Cape
- Potential for higher level of innovation.

8.3 Major opportunities identified

Enhancing design expertise

The Western Cape has an abundant supply of high quality, competitively priced engineers and designers who, when operating in design houses for global international giants, are capable of attracting a part of the global value chain. However, there is a need for development in this market since there is a great deal of international competition, for instance from the EU and USA, which deliver high-quality engineers, and countries such as India and Ukraine, which deliver engineers of similar quality, but at a lower cost. South Africa should therefore encourage the development of higher-quality engineers with innovation and customisation abilities.

Exploiting African (developing) markets

African (developing) markets present a unique opportunity for the South Africa electronics industry, in that these are not just largely unexploited markets, but also represent an area in which South Africa has a unique set of competitive advantages. As part of the African community, South Africa possesses knowledge and an understanding of the needs, capabilities and unique problems and obstacles facing developing countries and in particular, Africa. This understanding gives the South African electronics industry a definite competitive advantage in identifying, designing, manufacturing, customising and developing low-cost products, suited to developing market needs. This potential market is largely unexplored due to the fact that First World economies do not understand the market needs in developing countries and are largely incapable of identifying these opportunities. South Africa also has a geographical, cultural, political, language, time zone and logistical advantage above traditional global competitors, with regard to the African market.

International Markets

Penetrating the EU, the USA or the AU export markets might seem onerous, as a result of a great deal of competition and many barriers to entry in these markets, but the Western Cape electronics industry does have the basic characteristics necessary for effective participation in

specific sectors of these markets. This sector was identified as high-value, low-volume, customised products. Competing in this sector means that competition from traditionally low-cost centres that deliver mass products will be avoided and the main competition should come from the local EU, USA or AU Electronics industries. The labour and general cost structures of the electronics industries in these markets are high, but the quality standards are also high and service delivery is very efficient. The EU, USA or AU electronics industries also have a few implied advantages, such as geographical location, time zones, language and cultural similarities, logistical and time-to-market efficiency, as well as familiarity and therefore lower perceived levels of risk. The Western Cape electronics industry can, however, be competitive in these markets, if its practitioners are able to deliver the same quality of products and services, by utilising their inherently lower cost structure, and therefore delivering these products at a very competitive price. There are also time zone (in terms of the EU), language and cultural similarities, and the lower cost structure could absorb additional freight and logistical costs, necessary to overcome the aforementioned barriers.

Excess manufacturing capacity

The sector has excess manufacturing capacity available, which when utilised fully, will reduce role-players' cost structure substantially and enhance their return on investment.

Having said that, under-utilisation of capacity is a global phenomenon at the moment, due to a three-year downturn in the electronic goods markets. This opportunity is therefore not unique to the Western Cape, although the Western Cape electronics sector may suffer from under-utilisation of capacity in some cases due to a lack of accurate market research, a need for flexibility, a loss of market share or substandard business practices, rather than a decline in demand.

Full assembly and completion of products

The Western Cape Contract electronics manufacturing industry is capable of manufacturing products through the full assembly line and delivering completed products, by applying expertise at every level of the value chain. Although it is not unusual for a global Contract Manufacturing giant to deliver a few different services throughout the value chain, either by itself or as part of an Industrial/Techno Park, it is not that common for small contract manufacturers that specialise in customisation and flexibility to have the same capabilities.

Low-volume, high-value manufacturing

There is a great deal of competition and many barriers to entry in international markets, but the electronics industry in the Western Cape does have the basic characteristics to be effective in

specific sectors of the international market. As has been stated, this sector was identified as high-value, low-volume, customised products and flexible service delivery. Working in this sector means not having to compete with traditionally low-cost centres, which deliver mass products at very low costs and high technological standards. Our labour and general cost structures are high, when compared with these global giants. The competition is stiff and barriers to entry are high, and the electronics sectors in these markets have high quality and service delivery standards and efficiency.

However, the South African electronics sector can be competitive in these markets, if it is able to deliver similar quality products and services, and simultaneously utilise its customisation and flexibility to add additional value to products. The Western Cape electronics industry also has a few other inherent obstacles to overcome, such as geographical disparity, time zone (excluding the EU), language (excluding English-speaking nations) and cultural differences, logistical barriers and time to market delays, which make competing at international level even more difficult.

Niche markets / products

The Western Cape electronics industry cannot compete directly with low-cost, mass- production global giants, and it is therefore actually compelled to go for niche markets/products. However, competing at this level requires a great deal of investment in research and development in order to exploit new technological developments and identify niche market needs and requirements. This specific sector is difficult to develop, as it requires a lot of entrepreneurial and innovative qualities and these are usually born out of expertise acquired by specific individuals, which cannot easily be copied, in other companies. The South African electronics industry has previously been successful in this market, which illustrates that South Africa does indeed possess the basic infrastructure, knowledge and expertise to make a success of niche markets, even if only on a small scale.

Research and Development Hub

In order to compete in the high-tech, low-volume, niche sector, intense research and development needs to take place. A research and development hub could be established in the Western Cape to render possible not only technological and technical R&D, but also R&D to gather market intelligence. Best practices, benchmarks and relevant trends must be established in order to attain a competitive advantage.

Industry association

The EIF is the main electronics industry representative. Companies in the sector have not been very supportive of their representative, which has resulted in its inability to address the industry's unique and common needs. The EIF currently only has 40 members, which in itself shows a lack of support from the industry. However, the EIF may not be the ideal association for the electronics sector in the Western Cape as it is based in Gauteng and the distance makes interaction very difficult.

A new, unifying electronics body in the Western Cape, operating under the EIF, could consolidate the industry and represent it at exhibitions, seminars or in negotiations with Government institutions or international stakeholders. This association could promote and market the Western Cape electronics sector and research trends that will impact the region specifically.

Square Kilometre Array

In 2003, South Africa submitted its bid to host the world's biggest radio telescope, the Square Kilometre Array (SKA). The South African bid identifies three sites in the Northern Cape as ideal locations for SKA radio telescopes, each with a diameter of 150 km. The sites are in the Kalahari (north of Upington); in the Karoo (north of Carnarvon); and in Namaqualand (east of Springbok).

South Africa's offer to host the SKA was submitted to an international panel of experts who will select the host country based on a comprehensive set of criteria. If South Africa is successful in winning this bid, it will bring a massive injection of expertise and economic activity to the Northern Cape. Local industries that will benefit include the aluminium, computer, communications, steel and electronics sectors, e.g. electronic beam-forming will be necessary for some array configurations, with the software compensating for oblique angles of incidence (the wave-front striking the array elements in sequence), amongst other things.

The SKA is one opportunity that the electronics industry in South Africa, specifically the Western Cape, will be able to exploit. Other opportunities include the Pebble Bed Nuclear Reactor and the Sunspace Aerospace project. However, although these opportunities have great potential, they are individual projects that will only benefit a few companies in the electronics sector.

The above opportunities are all possible in the medium to long term. However, considerable investment and Government support must exist in order for these opportunities to be realised. There are other opportunities such as chip and superconductor development that our overseas counterparts are exploiting, but because the Western Cape lags behind global trends in terms of technology as well as certain specialised skills, it is not feasible to exploit these opportunities in the region in the near future. Basic technologies need to be mastered first, before the more ambitious technologies are pursued.

9 CONCLUSION

Several reasons for a lack of Western Cape competitiveness have been identified, namely:

- The South African electronics sector cannot compete with the low-priced imports from the Eastern countries. For this reason, the manufacturing of electronics has been declining steadily, forcing many companies to seek niche markets. The direct effect is that South Africa imports low volumes of electronic components for assembly in the country, resulting in a higher cost per unit.

- The cost of labour is high compared to other countries such as Malaysia. This cost leads to higher prices, hence lowering competitiveness. Labour rates range from as little as US$0.70/hr in Asia comparing to approximately US$3.75/hr in South Africa.

- Logistical difficulties arise as a result of SA's distance from significant electronics markets.

- A short-term view of research and sector development initiatives. For example, SPII only addresses the embryonic stages of product development, does not meet further direct costs, and the R1.5m ceiling is insufficient for most R&D expenses in the sector.

- The lack of communication between sector stakeholders - A lack of proper formal communication channels and therefore effective communication and cooperation, has been identified as an aspect that inhibits the proper and effective functioning of the sub-sector as a whole. Many opportunities have been lost due to a lack of communication between original design houses, suppliers and contract manufacturers, when products and services were imported for local manufacturing or exported for further processing, rather than looking to local manufacturers, which could deliver the same functions at similar prices and quality standards.

- Industry fragmentation - There is an electronics industry body in the form of the EIF, but because of the lack of communication between sector stakeholders, it has become a case of the left hand not knowing what the right hand is doing. Companies typically do not give much support to the associations as they feel that it is a waste of time and that it does not add value to them as a business. For this reason, the EIF and other similar associations find it difficult to work as one body with one voice.

- Marketing and promotion -The Western Cape electronics sector does not have adequate marketing and promotion. Efforts are largely focused on Gauteng.

- Responsiveness to technological advancement – The local electronics industry is reactive rather than proactive – following rather than leading, as compared with international

market and technological trends. If the South African electronics industry wants to enter the high-value, low-volume, customised, flexible or design- oriented market, it is of the utmost importance that their products should be of high quality and comply with technologically advanced standards.

- Insufficient investment in research and development – Research and development is the cornerstone of any business that thrives on building a concern based on strengths such as design capabilities, customisation and flexibility in product offerings. The Western Cape electronics industry should therefore invest a similar or even larger proportion of its net profits in research and development, than is done internationally.

- The cumbersome application process for incentive programmes hampers investment flows into the Western Cape. Industry experts agree that the process is too time-consuming with too much "red-tape" and the process is daunting for potential applicants.

The following table highlights the strengths, weaknesses, opportunities and threats to which the electronics sector in the Western Cape is subject. This table is based upon findings from secondary research that has been verified by AMI primary research.

Table 7: SWOT analysis of the Electronics sector

Strengths:	**Weaknesses:**
• Engineering and design skills • Labour legislation (flexible enough to allow for flexible manufacturing) • Scale (allows for short lead time and flexibility) • Innovation • Access to African markets • Understanding of African markets • Time zone (reduced delivery time to some areas) • Labour stability • Low cost of electricity • Quality of transport and logistics infrastructure • World class manufacturing processes in many areas • Free trade agreements (AGOA, EU) • Strong at systems integration level • High quality of products • Good academic base • Niche markets	• Lack of communication between sector stakeholders • Capacity utilisation • Inadequate customs procedures • Cost structure in high volume sector • Industry fragmentation • Marketing and promotion • Geographical location (distance to some major markets) • Responsiveness to technological advancement • Insufficient government support • Insufficient investment in research and development • Poor market intelligence • Lack of localisation • Lagging behind global trends

Opportunities:	**Threats:**
• Enhancing design expertise • African market • International market • EU Free Trade Agreement and AGOA • Potential MERCUSOR Free Trade Agreement • Global system integration capabilities • Technology Management opportunities • Natural resource beneficiation • Full assembly and completion of products • Low volume, high value manufacturing • Niche markets • Excess capacity • Square Kilometre Array (SKA)	• International small-volume, high-value manufacturers • Contract manufacturing giants • Competition in engineering design • High technology manufacturers • Outflow of highly qualified, skilled labour • Stagnant global market • Lack of competitiveness of fragmented SA industry • Low levels of Foreign Direct Investment • Foreign un-utilised capacity • Regional growth

Although early indications are that the electronics industry in the Western Cape is stagnating, current general programmes launched by the National government are in place to promote innovations and development. It is however a concern that the majority of the interviewees commented that the cumbersome application processes involved in applying for these incentives act as a deterrent rather than a motivator for entrepreneurs.

Although the government has attempted and is attempting to stimulate this sector by commissioning Technology Roadmaps, the implementation of these roadmaps are time consuming resulting in industry losing focus and enthusiasm to carry it through. Many companies are not reaping the benefits of these reports.

In the current environment, the labour force has proven to be proficient as there are many highly qualified engineers in the electronics field. Although the number of graduates in the electronics field has declined slightly, the tertiary institutions in the Western Cape are still regarded by industry experts as producing some of the best engineers in the country. On the lower end of the skills scale, the sector is challenged by the lack of trained people at the manufacturing and assembly level. The training and education facilities are not adequate to meet the needs of companies requiring such skills.

In general, the sector does not compete in the low-tech, high-volume arena, but rather focuses on the higher-technology, low-volume arena. However, it is not completely competitive in this sector because of its use of medium-to-high technology. The Western Cape is lagging quite a few steps behind the rest of the world in terms of high technology development. The focus should therefore be on following the niche product development route.

The Western Cape can position itself as the affordable centre of high-tech, low-volume products. European countries are constantly on the lookout for affordable places that will not cut back on quality. The labour in the Western Cape electronics industry is cheaper than that of Europe, and its engineers are of world-class standard with no compromise on quality.

The industry is extremely fragmented and without unification, the growth will be in the form of slow incremental increases each year and eventually start declining. With more open communication, an association that can effectively represent the Western Cape Electronics sector, more government support, better training facilities for the lower-end labour skills and the adoption of more relevant high-to-very high technology, the Western Cape electronics sector has the potential to become a competitive electronics producing region over time.

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APPENDIX 1

SIC group code	List of economic activities	HS product code ranges
3710	Manufacture of electronic valves and tubes and other electronic components	85401100 to 85429999
3720	Manufacture of television and radio transmitters and apparatus for line telephony and line telegraphy	85170000 to 85299999
3730	Manufacture of television and radio receivers, sound or video recording or reproducing apparatus and associated goods	85180000 to 85259999
3741	Manufacture of medical and surgical equipment and orthopaedic appliances	84192000 to 94021030
3742	Manufacture of instruments and appliances for measuring, checking, testing, navigating and for other purposes, except industrial process control equipment	90141000 to 90528910
3743	Manufacture of industrial process control equipment	90251100 to 90259999
3750	Manufacture of optical instruments and photographic equipment	90011000 to 90249999
3760	Manufacture of watches and clocks	91011100 to 91149000

HS Code	Definition
H8501	Electric motors and generators, except generating sets
H8502	Electric generating sets and rotary converters
H8503	Parts for electric motors and generators
H8504	Electric transformers, static converters and rectifiers
H8505	Electro and permanent magnets, equipment using magnets
H8506	Primary cells and primary batteries
H8507	Electric accumulators
H8508	Hand tools incorporating electric motors
H8509	Domestic appliances, incorporating electric motors
H8510	Shavers and hair clippers, electric
H8511	Ignition/starter equipment, internal combustion engine

H8512	Electric lighting, signal equipment, car electrics
H8513	Portable battery, magneto electric lamps
H8514	Industrial, laboratory electric furnaces, ovens, etc
H8515	Electric solder, weld, braze, hot metal spray equipment
H8516	Electric equipment with heating element, domestic etc
H8517	Electric apparatus for line telephony, telegraphy
H8518	Audio-electronic equipment, except recording devices
H8519	Electronic sound reproducing equipment, non-recording
H8520	Electronic sound recording equipment
H8521	Video recording and reproducing apparatus
H8522	Parts, accessories of audio, video recording equipment
H8523	Prepared unrecorded sound recording media (non-photo)
H8524	Sound recordings other than photographic equipment
H8525	Radio and TV transmitters, television cameras
H8526	Radar, radio navigation and remote control apparatus
H8527	Radio, radio-telephony receivers
H8528	Television receivers, video monitors, projectors
H8529	Parts for radio, tv transmission, receiving equipment
H8530	Electrical signalling and traffic control equipment
H8531	Electric sound or visual signal equipment
H8532	Electrical capacitors, fixed, variable or adjustable
H8533	Electrical resistors and rheostats except for heating
H8534	Electronic printed circuits
H8535	Electrical apparatus for voltage over 1 kV
H8536	Electrical switches, connectors, etc., for < 1kV
H8537	Electrical power, etc., control and distribution boards
H8538	Parts for electrical switches, protectors, connectors

H8539	Electric filament, discharge lamps
H8540	Thermionic and cold cathode valves and tubes
H8541	Diodes, transistors, semi-conductors, etc.
H8542	Electronic integrated circuits and micro-assemblies
H8543	Electrical machinery and apparatus
H8544	Insulated wire and cable, optical fibre cable
H8545	Carbon electrodes, brushes and electrical items
H8546	Electrical insulators of any material
H8547	Insulating fittings for electrical equipment
H8548	Electrical parts of machinery and apparatus