the dti
Department:
Trade and Industry
REPUBLIC OF SOUTH AFRICA

Study to identify electronic assemblies, sub-assemblies and components that may be manufactured in South Africa

Final Report
15 June 2010

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Study prepared by Kaiser Associates Economic Development Practice

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EXECUTIVE SUMMARY

The **purpose of this project** is to identify electronic components, sub-assemblies and components that can be manufactured in South Africa as well as to recommend interventions to create an enabling environment for manufacturing in South Africa. It covers **10 subsectors**: automotive industry (vetronics), avionics and aerospace, radar, energy-saving technologies, lighting, consumer electronics, telecommunications, Information Technology, and other electronics and sub-assemblies.

Production capacity varies greatly between and within sub-sectors. Unit output ranges from 2 million a year (Altech UEC set-top boxes), to 1.5 per year (SunSpace micro satellites). The table below provides the current production capacity of survey respondents in each sub-sector:

Table 1: Survey responses on production capacity utilisation

Sub-sector	Production capacity (current % use)	Response count
Automotive industry (vetronics)	62%	3
Avionics and aerospace	100%	2
Radar	100%	1
Power electronics	83%	2
Electronics	60%	8
Energy-saving technologies	80%	1
Lighting	80%	1
Consumer electronics	75%	2
Telecommunications	53%	2

Through a process of detailed company and stakeholder interviews combined with analysis of international market and supply trends, manufacturing activities and capabilities in South Africa, the following **opportunities** have been identified across the 10 subsectors:

Table 2: Summary of identified opportunities

Sub-sector	Identified opportunities	Categorisation				Examples of companies with relevant capacity
		Components	Sub-assemblies & assemblies	Finish products	Technical services	
Automotive industry (vetronics)	▸ Vehicle and asset tracking and fleet management		✓	✓	✓	▸ PFK Electronics ▸ Cartrack ▸ Digicore ▸ MixTelematics ▸ TraceTec ▸ Altech Netstart ▸ iTrac Live ▸ Tracker ▸ Trolleyscan
	▸ Engine management systems		✓		✓	▸ Robert Bosch ▸ PI Shurlok ▸ Pasdec
	▸ Vehicle security products ▸ Immobiliser			✓	✓	▸ PI Shurlok ▸ PFK Electronics ▸ Periseo

Sub-sector	Identified opportunities	Categorisation				Examples of companies with relevant capacity
		Components	Sub-assemblies & assemblies	Finish products	Technical services	
	technologies					▸ Control Instruments Automotive
	▸ Harness manufacturing		✓			▸ Pasdec ▸ Periseo ▸ PFK Electronics ▸ Hesto Harness
	▸ Automotive batteries	✓	✓		✓	▸ First National Battery ▸ Willards ▸ Dixon Batteries ▸ Sabat Batteries ▸ Freestart Battery
Avionics and aerospace	▸ Specialised and niche avionics equipment		✓	✓	✓	▸ ATE ▸ Denel (Aviation, Saab Aerostructures, Dynamics) ▸ Fuchs Electronics ▸ Reutech Communications ▸ SAAB Grintek ▸ EADS ▸ Ansys ▸ Peralex ▸ Parsec ▸ Tellumat
	▸ Military avionics		✓		✓	
	▸ Small aircraft avionics systems		✓		✓	▸ MGL Avionics ▸ UAVs: Denel Dynamics, ATE, Tellumat
Radar	▸ Sports radar systems			✓	✓	▸ EDH
	▸ Contract radar design				✓	▸ EDH ▸ Reutech Radar Systems
	▸ Sonar and marine technologies		✓	✓	✓	▸ EDH ▸ Reutech Radar Systems
Power electronics	▸ Renewable energy systems			✓	✓	▸ MLT Drives ▸ Eveready/ Kestrel ▸ Alstrom ▸ Tenesol Manufacturing ▸ Emerson Network Power ▸ Aero Energy ▸ African Windpower ▸ Setsolar ▸ Thin-film Solar Technologies ▸ Solarite ▸ Jupiter Resources ▸ Dirwatt Limited
	▸ Transformers	✓	✓			▸ Powertech Transformers ▸ Desta Power Matla ▸ CM Transformers ▸ Lehman Transformers ▸ ABB
	▸ Switchgear	✓				▸ CBI Electric ▸ Siemens
	▸ Sensors and systems unique to the South African economy	✓	✓		✓	▸ Detek ▸ Conlog ▸ Denel Dynamics ▸ Ansys

Sub-sector	Identified opportunities	Categorisation				Examples of companies with relevant capacity
		Components	Sub-assemblies & assemblies	Finish products	Technical services	
Energy-saving technologies	▸ Smart metering applications ▸ Pre-paid electricity vending		✓	✓	✓	▸ CBI ▸ Conlog ▸ Custom Power Solutions ▸ Hefcom ▸ Landis + Gyr ▸ Powertech
	▸ Solar energy products		✓	✓	✓	▸ Jupiter Resources ▸ Setsolar ▸ Thin-film Solar Technologies ▸ Solarite ▸ Tenesol
	▸ Renewable energy storage		✓	✓	✓	▸ FNB Industrial ▸ Dirwatt Limited ▸ Emerson Network Power
Lighting	▸ Energy-saving LED lighting		✓	✓	✓	▸ LED Lighting ▸ Spero Group ▸ Sunfor Technologies
	▸ Underwater LED lighting products		✓	✓	✓	▸ Multisource
	▸ Intelligent LED streetlights ▸ LED traffic lights		✓	✓	✓	▸ Lee Power Electronics
	▸ Fluorescent lamp production			✓	✓	▸ Eveready
	▸ LED mining headlamps			✓	✓	▸ First National Battery
Consumer electronics	▸ Localised final product assembly		✓	✓	✓	▸ Altech UEC ▸ Amalgamated Appliance Holdings ▸ Mustek ▸ Pinnacle Micro ▸ Nu World Holdings ▸ Defy ▸ Vektronic ▸ Gemini
	▸ Set-Top Boxes and Digital Television		✓	✓	✓	▸ Altech UEC ▸ Vektronic ▸ Parsec ▸ Tellumat ▸ Reunert ▸ Pace Electronics
Telecommunications	▸ Wireless and cell phone backbone and antennas		✓		✓	▸ Tellumat ▸ Reunert Group ▸ Advanced Digital Services ▸ Allpronix ▸ Q-KON SA ▸ Poynting Antennas ▸ SAAB Grintek ▸ RF Design ▸ Radio Data Communications
	▸ Fixed telecommunication infrastructure – backbone, fibre		✓		✓	
Information Technology	▸ Avionics software				✓	▸ Denel Aviation ▸ SAAB Grintek ▸ Peralex

Sub-sector	Identified opportunities	Categorisation				Examples of companies with relevant capacity
		Components	Sub-assemblies & assemblies	Finish products	Technical services	
						▸ Natcom Electronics ▸ Tellumat
	▸ Tracking and security connectivity				✓	▸ PFK Electronics
Other electronics and sub-assemblies	▸ Local support for complex PCB manufacture		✓		✓	▸ WH Circuits ▸ Cirtech ▸ Trax Interconnect ▸ Master Circuits
	▸ IPC-Class 3 compliant manufacturers		✓	✓	✓	▸ Already IPC-Class 3 compliant: – Parsec – Omnigo – Jemstech ▸ Others: – Elprom – RC&C – Robert Bosch – Sabertek – Tellumat
	▸ Specialised medical imaging technologies		✓	✓	✓	▸ Lodox Systems ▸ CapeRay ▸ GeoMed

Based on the research and the wider experience of the project team, the following areas are likely to present more significant growth, employment and innovation prospects for South Africa.

- Renewable energy and energy-efficient technologies
- Automotive electronic systems (including engine management systems)
- Telecommunications backbone infrastructure
- Systems integration and technical services overall

The research and analysis also revealed six main categories of **challenges** faced by the South African electronics sector. These are shown below, together with the associated **recommended areas of support**:

Table 3: Summary of challenges and associated recommendations

Challenges	Description	Recommended areas of support
Competition from imports	▸ Higher cost base and smaller volumes ▸ Illegal imports and duties applied incorrectly ▸ Low import tariffs for finished goods ▸ Insufficient preference given by large buyers (government, SOEs, corporates)	▸ Provide for targeted applications to ITAC for import protection (i.e. on a product by product basis) ▸ Advocate for wider implementation of CSDPs (other SOEs and more widely) ▸ Specify electronics in revised preferential procurement framework ▸ Improve customs inspection and product categorisation for SARS ▸ Ensure that migration to Digital Terrestrial Television supports local IP, enables local manufacturing and access to wider African markets ▸ Include higher technology products

Challenges	Description	Recommended areas of support
		(including electronics) in private supplier development programmes ▸ Negotiate with corporates to consider local electronics suppliers in large contracts ▸ Shift production towards higher value addition ▸ Ensure implementation of ICT Charter commitments
Obstacles to widespread innovation	▸ Weak support for local IP ▸ Insufficient funding for R&D ▸ Lack of focus of R&D on industrial applications ▸ Limited availability of skilled personnel ▸ Limited collaboration with universities ▸ A lag in take-up of technology by SA industry and consumers ▸ Overseas location of multinational's R&D facilities	▸ Include high technology electronics (not just ICT) as one of the focus areas of TIA ▸ Create access to shared prototyping facilities ▸ Encourage innovation-oriented mindset within industry ▸ Package information on available innovation support ▸ Align regulation and buyer awareness with new technologies and growth areas
High cost structure and lack of finance	▸ Relatively high cost of labour ▸ High freight costs for imports and exports (and long lead times) ▸ Gaps in infrastructure and services provision ▸ Fluctuating exchange rates ▸ Tariffs applied to imported components ▸ Ageing and out-of-date equipment ▸ Difficulties accessing funding, including: – Risk sensitivity of banks – Not meeting incentive eligibility requirements – Effect of global recession – Poor awareness of incentives	▸ Create labour intensive manufacturing incentives ▸ Rework current focus of MIP ▸ Provide shared infrastructure ▸ Shift production towards higher value addition ▸ Better marketing of existing funding options ▸ Access to specific funding for purchase and customisation of production software ▸ Improve government and SOE payment cycles ▸ Clarify VAT Export Incentive Scheme
Limited availability and quality of skills (engineers, technicians, artisans)	▸ Inadequate education and training (including little practical experience) and declining quality of graduates ▸ In some cases, weak or no relationships between companies and universities ▸ Competition for skills with international markets, local offices of international companies and management positions ▸ Immigration requirements constrain sourcing skills from overseas	▸ "Careers in electronics" campaign ▸ Align school maths and university electronics curricula in partnership with industry ▸ Prioritise electronics manufacturing in learnership programmes at SETAs ▸ Increased incentives for in-house training ▸ Create mentorship system in private sector ▸ Streamline process to draw in needed skills from abroad
Barriers to international market access	▸ Obtaining the necessary certification and meeting required quality standards ▸ Lack of testing facilities and certification support ▸ Perceptions of a poor quality of SA products ▸ Limited marketing skills, time and resources ▸ High transport costs, time and	▸ Provide financial support for obtaining certification needed in foreign markets ▸ Reduce red tape in EMIA scheme ▸ Increase values for EMIA scheme ▸ Improve SABS services

Challenges	Description	Recommended areas of support
	language differences, exchange rate costs ▸ Limited market information	
Fragmented industry organisation	▸ Insufficient recognition as an industry ▸ Companies see themselves as part of another sector rather than electronics	▸ Establish electronic design and manufacture interest group/ forum

For each of the above recommended areas of support, this report provides a motivation and assessment of risks as well as a description of actions required. Furthermore, in order to **plan for implementation**, the recommendations identified above have been categorised according to the **type of support required**, as follows:

1. Information sharing: gathering and dissemination of information to industry on areas such as available support and market information.
2. Refinement of incentives: adjustment of existing incentives to accommodate industry needs or development of new incentives
3. Prioritisation of electronics within wider strategies and initiatives: this is applicable in cases where initiatives already exist but do not currently include or prioritise electronics manufacturing
4. Improved service delivery: public sector performance of regulatory and other services in areas that are not only relevant to electronics
5. New/specialised programmes: development of new initiatives that are specific to electronics in areas where no existing initiative is in place

This report also takes each of the above categories and sets out the key mechanisms, content and role players ensuring that all the required areas of support are covered in terms of approach to implementation.

LIST OF ACRONYMS AND TERMS

AC – Alternating current

ADC – Analogue-to-digital converter. An electronic device used to convert an analogue voltage to a digital representation. These devices are used to convert signals for use in digital signal processing applications. Typical applications include signal processing, audio processing, control systems and instrumentation systems.

ADEC – Association of Distributors and Manufacturers of Electronic Components

AIS – Automotive Investment Scheme

ANSI – American National Standards Institute

APDP – Automotive Production and Development Programme

ASHRAE - American Society of Heating, Refrigerating and Air-conditioning Engineers

ASIC – Application Specific Integrated Circuit. ASICs are integrated circuits, which are designed and fabricated for a specific application or design. These circuits are proprietary and optimised for the target application, making them exclusive to a specific company or product. These devices are expensive to produce but allow the designers total control over the performance and characteristics of the device. The development of FPGA technologies has had an impact on ASIC development, as the design processes are comparable and FPGA designs can be converted to ASICs when high volume production is required.

BGA – Ball-grid Array. Bal-grid arrays are a component packaging technology in which electrical connections are made through a square matrix of small metal pins on the underside of the component. Unlike many surface mounting technologies, the pins on a BGA package are covered by the package itself and cannot be visually inspected.

BITF – Black IT Forum

BOM – Bill of Materials

CAD – Computer Aided Design. CAD refers to all manner of design software for the modelling, drawing and processing for design tasks. CAD in respect to PCB design refers to the processes and software required to design, layout and route a PCB for manufacturing.

CANBus – A data-exchange protocol and interconnecting bus technology designed specifically for use in automotive electronics.

CCD – Charge-coupled device

CCTV – Closed-circuit television

CDMA – Code division multiple access. CDMA is a networking technology which allows multiple transmitters and receivers to communicate over a single communication spectrum. The term is used to describe both wired and wireless networks.

CDMA 2000 – CDMA 2000 is a mobile phone communication standard which makes use of CDMA technology.

CE Mark – The CE marking on products is required to show that a product has met EU consumer safety, health or environmental requirements. It is required on all electronic products sold in European markets. These requirements arise from the EU directives applying to electronic products and devices must be tested by an approved certification laboratory.

CFD – Compact Fluorescent Devices

CRT – Cathode Ray Tube

CSDP – Competitive Supplier Development Program

CSSA – Computer Society of South Africa

CUASA – The Communications Users Association of South Africa

DAC – Digital-to-Analogue converter. A DAC is an electrical device for creating a relative voltage from a digital signal. These devices are used in signal processing applications which require an analogue signal as an output. Typical uses of DACs include audio generation, process control and digital signal filtering.

DC – Direct current

Die – Silicon wafers are cut into individual pieces known as dies, which contain the circuitry. This is then packaged using a component technology to form an IC.

DNS – Domain name server

DOE – United States Department of Energy

DPI – Dots per inch

DVB-T – Digital Video Broadcasting – Terrestrial (technical standard)

DVB-T2 – Digital Video Broadcasting – Terrestrial Second Generation(technical standard)

EAS – Electronic automotive systems

EEPROM – Electrically Erasable Programmable Read Only Memory

EIA – Electronic Industry Association

EMC – Electromagnetic Compatibility. EMC requirements exist to ensure that devices do not interfere or be susceptible to interference. These standards are required for the certification of products and must be tested by an approved laboratory. EMC Directive 89/336/EEC is the applicable standard required for CE certification

EMI – Electromagnetic Interference

EMIA – Export Marketing and Investment Assistance

ENERGY STAR® – The Energy Star © program is a voluntary organisation between the U.S. Department of Energy, the U.S. Environment Protection Agency and various product manufacturers and retailers. Products qualifying for Energy Star© branding must be more energy efficient than similar products of the same type.

ESD – Electrostatic Discharge

ESD Class 1 – Devices that are susceptible to ESD voltages greater than 0 to 1,999 volts

ESD Class 2 – Devices that are susceptible to ESD voltage greater than 1,999 to 3,999 volts

ESD Class 3 – Devices that are susceptible to ESD voltages greater than 3,999 to 15,999 volts

ESD Class Non-Sensitive – Devices that are susceptible to ESD voltages greater than 15,999 volts

FAA – Federal Aviation Administration

FCB – Flexible Circuit Board

FCC – Federal Communication Commission. The FCC is responsible for regulating all the radio frequency transmissions and broadcasts in the United States and has specific regulations that apply to products that operate in the unlicensed frequency band (Title 47 Part 15). The FCC also specifies many conditions that must be met to prevent interference due to spurious emissions.

FCC Class A – FCC compliance required for equipment for office use. This is specifically defined as non-residential use. This certification is identical to the Canadian RF Emission requirements.

FCC Class B – FCC compliance required for equipment for residential use.

FDA – Food and Drug Administration

FPGA – Field Programmable Gate Array. FPGAs are integrated circuits, which are designed to support dynamic configuration of their internal components. These devices contain logic blocks, analogue devices, digital circuitry and input/output circuitry, which can be dynamically configured via a hardware description language such as VHDL and Verilog. These devices offer many of the advantages of ASICs, such as speed and highly parallelized operation, and add other benefits such as the ability to change the configuration after design-time. FPGAs are used extensively in signal processing and high-speed analogue systems.

FR4 – A Fire-retardant material used as a substrate in PCBs.

GBCSA – Green Building Council of South Africa

GERBER files – Gerber files are a widely used file format for transferring PCB data such as tracks, routing and drilling locations for use by PCB manufacturers. It has become a commonly accepted standard in the electronics industry.

GPS – Global Positioning System

GSM – Global System for Mobile Communication

HB-LED – High-brightness LED

HDI – Historically Disadvantaged Individual

HDTV – High definition television

HVAC – Heating Ventilation and Air Conditioning

IEEE – Institute Electric and Electronic Engineers

Inverter – An inverter is a power electronics device that converts direct current into alternating current – performing the opposite function of a rectifier. These devices are often used to convert electricity from a battery to an alternating form for use by grid-based electrical systems. These devices are finding increased usage in power conversion systems, electrical vehicles and uninterruptible power supplies.

IP – Intellectual Property

IPAP – Industrial Policy Action Plan

IP Cores – FPGA design is based on modular components, which are usually specified in a hardware description language such as VHDL. Entire sub-systems can be built within self-contained modules and simply incorporated into a design, allowing rapid prototyping and development. These pre-built components are often referred to IP cores and are often licensed to companies. This has led to the creation of entire companies that produce only IP-cores, such as ARM.

IPC – The IPC is an international standards organisation which governs the manufacturing and assembly of electronic components. It is an ANSI-accredited body and provides a means of guaranteeing quality in both the finished product and the manufacturing process. Accreditation is voluntary but many industries require a level of compliance, especially within the medical, automotive, avionic and military sectors.

IPC Class 1 – IPC Class 1 devices are classified as general electronics products where the function is the primary requirement of the finished product. These devices are generally consumer electronics products where device failures, latent defects and product life spans are tolerable.

IPC Class 2 – IPC Class 2 products are classified as dedicated service electronic products in which an extended life or continued performance is required. These are devices in which guaranteed continued uninterrupted operation is not required.

IPC Class 3 – IPC Class 3 products are classified as high-performance electronic products in which extended uninterruptible performance and performance-on-demand is required. These devices often include critical safety systems, missile and defence systems in which extended life spans and response times must be guaranteed. These devices must also perform in harsh environments.

IR – Infrared

ISDB-T - Integrated Services Digital Broadcasting – Terrestrial (technical standard)

ISM Band – The Industrial, Scientific and Medical radio frequency band is frequently used as devices can operate within this frequency band without a license. All electronics equipment should be designed to tolerate interference in this frequency band.

ISETT SETA – Information Systems, Electronics and Telecommunications Technologies Sector and Training Authority

ISO – International Standards Organisation

ISPA – The Internet Service Providers Association

ITA – The Information Technology Association of South Africa

ITAC – International Trade Administration Commission of South Africa

LAN – Local Area Network

LCD – Liquid Crystal Display

LED – Light Emitting Diode

Lumens – Lumens are the SI unit for the measurement of the power of light as perceived by the human eye.

NAB – The National Association of Broadcasters of South Africa

NTI – The National Tooling Initiative

MEMs – Micro-electromechanical systems

Microcontroller – A microcontroller is similar to a microprocessor in that it contains a processing logic that is capable of executing sequential programmatic statements. Unlike a microprocessor, microcontrollers often contain all the necessary components to function. These components include permanent and volatile memory, input and output peripherals, analogue to digital conversions, timers, external interface circuitry and even power supplies. These devices therefore require fewer supporting components but provide less overall flexibility than a microprocessor-based solution.

Microprocessor – A microprocessor is a specific component or device that is capable of executing sequential programmatic statements. Unlike microcontrollers, these devices are simply processors and require external devices such as memories and peripheral circuitry. These devices form the core of many embedded systems and are also available as IP Cores for use in FPGA and ASIC development.

MIL – A unit of measurement equal to 1/1000 of an inch. Used commonly in the PCB industry.

MIL-STD – Military Standard. Military standards for electronics typically include increased tolerance for high temperatures and radiation exposures. Many of these standards have been incorporated by other standard bodies, such as ISO and IPC.

MIDP – Motor Industry Development Programme

MPEG – ISO/ IEC Moving Picture Experts Group

MPR II – Swedish electromagnetic safety requirements for VLF and ELF ranges, which is required for all electronic devices sold in Sweden.

NiCAD – Nickle-Cadmium battery

ODM – Original Device Manufacturer

OEM – Original Equipment Manufacturer

OS – Operating System

PCB – Printed Circuit Board. PCBs are a required sub-assembly in almost every electronic device as it provides the interconnections and mounting points for components. PCBs consist of copper tracks fabricated onto a laminate material onto which components are soldered. PCBs have copper tracks on a single-side, both sides or can consist of many individual layers sandwiched together.

PCI – Peripheral Component Interface

RAM – Random Access memory (*i.e.* volatile memory).

Rectifiers – A rectifier is a power electronics device that converts alternating current into direct current. As the majority of electronic equipment makes use of direct current, these devices are commonly used to convert electricity from the power grid into a form usable by electronic devices. Power rectifiers are used in uninterruptible power supplies, battery chargers, electrical vehicles, and for power transmission along DC transmission lines.

RF – Radio Frequency

RFI – Radio Frequency Inteference.

RoHS – Restriction on Hazardous Substance Directive. The RoHS directive is a requirement to limit the usage of certain hazardous substances in electronic products, and is now required by all electrical products for sale in European markets. The standard restricts the usage of six hazardous substances, of which mercury, cadmium and lead are the most widely known. There are a few exceptions in fields such as medical instrumentation and control devices.

ROM – Read-only memory (i.e. non-volatile memory)

SABS – South African Bureau of Standards

SABTI – The South African Business & Technology Incubation Association

SACF – The South African Communications Forum

SACU – Southern Africa Customs Union

SAEEC – The South African Electrotechnical Export Council

SARS – South African Revenue Service

SAVA – The South African Value Added Network Service Providers Association

SETA – Sector Education and Training Authority

SMD components – Surface mount device. SMD component technology is a packaging form factor in which the components are attached directly to the surface of a PCB. Unlike through-hole technology, in which components are inserted through a hole in the PCB, SMD components can be attached to both sides of a PCB and require far less space. As a result, these devices are far more difficult to solder by hand and usually require an automated manufacturing process.

SOE – State Owned Enterprise

Solder reflow ovens – Solder reflow ovens are used in the automated population of PCBs in order to attach surface mount components. In a typical manufacturing process, solder is initially applied to the component pads on a PCB through a special solder mask. Components are then placed onto the PCB using a pick-and-place machine. At this point the components are not physically attached to the PCB. These boards are then passed into a special solder reflow oven which cycles the temperature in order to melt the solder and firmly attach the SMD components to the PCB. The temperatures used in this process vary depending on the nature of the components and PCB materials used. This technique cannot be used for through-hole components.

SPII – Support Programme for Industrial Innovation

TEO – The Enterprise Organisation

THRIP – Technology and Human Resources for Industry Programme

Through-hole components – Through-hole components are an older electronic component packaging technology in which each component has a series of metal protrusions which fit through holes on the PCB. The component will therefore sit on the one side of the board, with its electrical connections on the underside. This technology is easier to solder manually than SMD and newer technologies but requires larger integrated circuits and is difficult to automate.

Through-hole plating – Through-hole plating is a stage in PCB manufacturing in which vias are specially coated with a conductive material to ensure conductivity.

TIA – Technology Innovation Agency

UAV – Unmanned Aerial Vehicle

UHF – Ultra-high frequency

UL – Underwriters Laboratories. The UL is a privately held product safety and certification company in the United States. It is approved by OHSA but does not approve products directly. It evaluates and tests products and devices against the appropriate standards and allows companies to carry the UL mark if they remain complaint with the standards. Technically, it does not carry any legal significance as it is simply a trademark but is widely considered as a requirement for electrical products.

UPS – Uninterruptible Power Supply

USB – Universal Serial Bus

Verilog – A hardware descriptive language for use in FPGA and ASIC design. Refer to VHDL.

Vetronics – Automotive electronics for use in military vehicles

VFD – Variable frequency drives

VHDL – VHSIC Hardware Description Language. VHDL is a specialised syntactical language, which allows physical hardware to be designed in a method comparable to that of software programming. VHDL is not compiled to an executable, but rather synthesized into a set of hardware gates that can be physically deployed to an FPGA. It is similar in nature to Verilog

VHF – Very-high frequency

VHSIC – Very High-Speed Integrated Circuit

Vias – A via is a small hole drilled through a PCB to connect tracks on different sides or layers. Vias must therefore be coated with solder or metal to ensure that there is an electrical connection through the hole. On complicated multi-layer boards, it may become necessary to connect only two inner layers with a via, and this type of connection is referred to as a blind or buried via.

VLSI – Very Large Scale Integration. VLSI is a term used to describe the process in which integrated circuits containing thousands of transistors are fabricated onto a single piece of silicon.

VoIP – Voice-over-IP

WAN – Wide Area Network

Wave soldering and partial wave soldering – Wave soldering machines are used to automatically solder through-hole components to a PCB. These devices consist of a bath of molten solder which pumped or passed across the underside of PCBs containing through-hole circuitry with areas that do not require solder protected with a special coating. Wave soldering techniques can be used to solder surface mount components, although this is less common due to the popularity and benefits of reflow techniques. Partial wave soldering devices allow only a portion of the PCB to be exposed to the solder waves, protecting previously soldered components.

WiFi – A wireless local area network technology. WiFi is actually a band name belonging to the WiFi alliance and is used to denote products complying to a certain class of wireless networks.

WiMAX – Worldwide Interoperability for Microwave Access. WiMAX is a radio transmission technology for transferring high-bandwidth applications such as data, audio and video over long distances. It similar in nature to WIFI but operates at higher data rates and over greater distances.

WTO – World Trade Organisation

PART A: PROJECT BACKGROUND

1 Introduction and purpose

The purpose of this project was to identify electronic components, sub-assemblies and components that can be manufactured in South Africa as well as to recommend interventions to create an enabling environment for manufacturing in South Africa. The project commenced in October 2009 and was completed in June 2010. It was funded and managed by **the dti**.

For the purposes of this study, the following sub-sector categories were used:

1. **Automotive industry (vetronics):** All the electronic and electrical sub-systems used in military, consumer and industrial vehicles
2. **Avionics and aerospace:** Avionics is defined as the development and production of electrical equipment for use in aircraft, spacecraft and satellites and missiles. The aerospace industry can be defined as the industry that researches, designs, manufactures, operates and maintains vehicles moving through air and space
3. **Radar:** Includes all technologies related to the generation, transmission, reception and processing of data for radar applications. Also includes related technologies, such as ultrasound and sonar-based systems as they operate on similar principles
4. **Power electronics:** The applications of solid-state electronics for the control and conversion of electric power, in particular higher than 24V
5. **Energy-saving technologies:** Product, systems, and components which assist in overall energy reduction, through generation, increased efficiency or novel processes, including lighting, heating, power storage and efficiency of operation
6. **Lighting:** Made up of two types of products: light-producing technologies and lighting-controlling technologies, coverage in this report is those items that have an electronic rather than purely electrical aspect e.g. containing a PCB
7. **Consumer electronics:** Includes any device containing an electronic circuit board that is intended for everyday use by individuals
8. **Telecommunications:** Comprises the technologies and systems required to transmit data for the purpose of communication
9. **Information Technology:** The sector overall refers to both the hardware and software that are used to store, retrieve, and manipulate information; within this report which focuses exclusively on electronics, the scope is limited to embedded software
10. **Other electronics and sub-assemblies:** Electronics components and sub-assemblies, as well as the medical devices sub-sector, are covered within this section

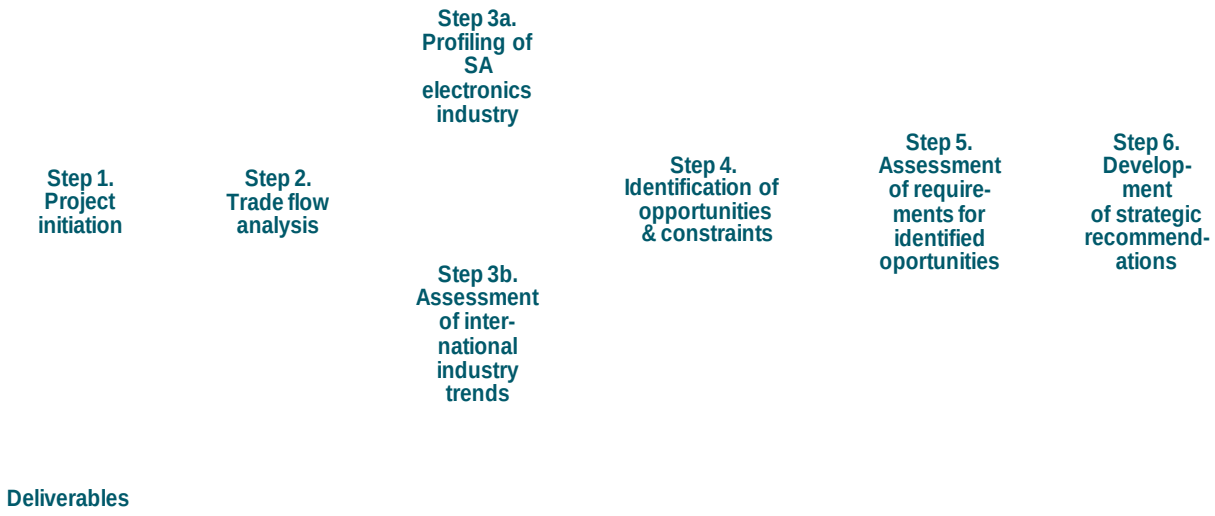
Each of the above sub-sectors was analysed in detail through company and wider stakeholder interviews as well as review of research reports, company websites and other secondary sources. A description of the methodology used to complete the project can be found in Section 2 together with a description of the key project activities that were conducted.

The output of this study will be used by **the dti** and other stakeholders to provide more effective support to existing and new players within the electronics manufacturing sector. Furthermore, the detailed company profiles and brief company descriptions will also provide an additional base of knowledge for **the dti** on companies operating in the sector in South Africa.

2 Project approach

The diagram below sets out the overall approach to delivering this project, as well as some of the key activities that were conducted:

Figure 1: Overall project approach



Key activities undertaken as part of the research and analytical process included:

- In-depth interviews with over 60 companies in the electronics sector, including the main players in each sub-sector
- Accessing information from key databases (e.g. Pulse) to provide core information for additional South African electronics companies
- Review of local and international research reports, company websites and other secondary sources
- Wider stakeholder interviews with industry associations government departments
- Detailed analysis of the 10 subsectors covering: sub-sector definition, international market and supply trends, manufacturing activities and capabilities in South Africa
- Assessment of opportunities within each sub-sector drawing on company interviews and sub-sectoral analysis
- Consolidation of challenges faced by the industry and their stated support needs
- Identification of potential support areas and an assessment of relevant planned and existing support
- Development of recommendations for specific actions required to address challenges and grow the electronics sector
- Categorisation of support required to provide a basis for a suggested approach to implementation by role players

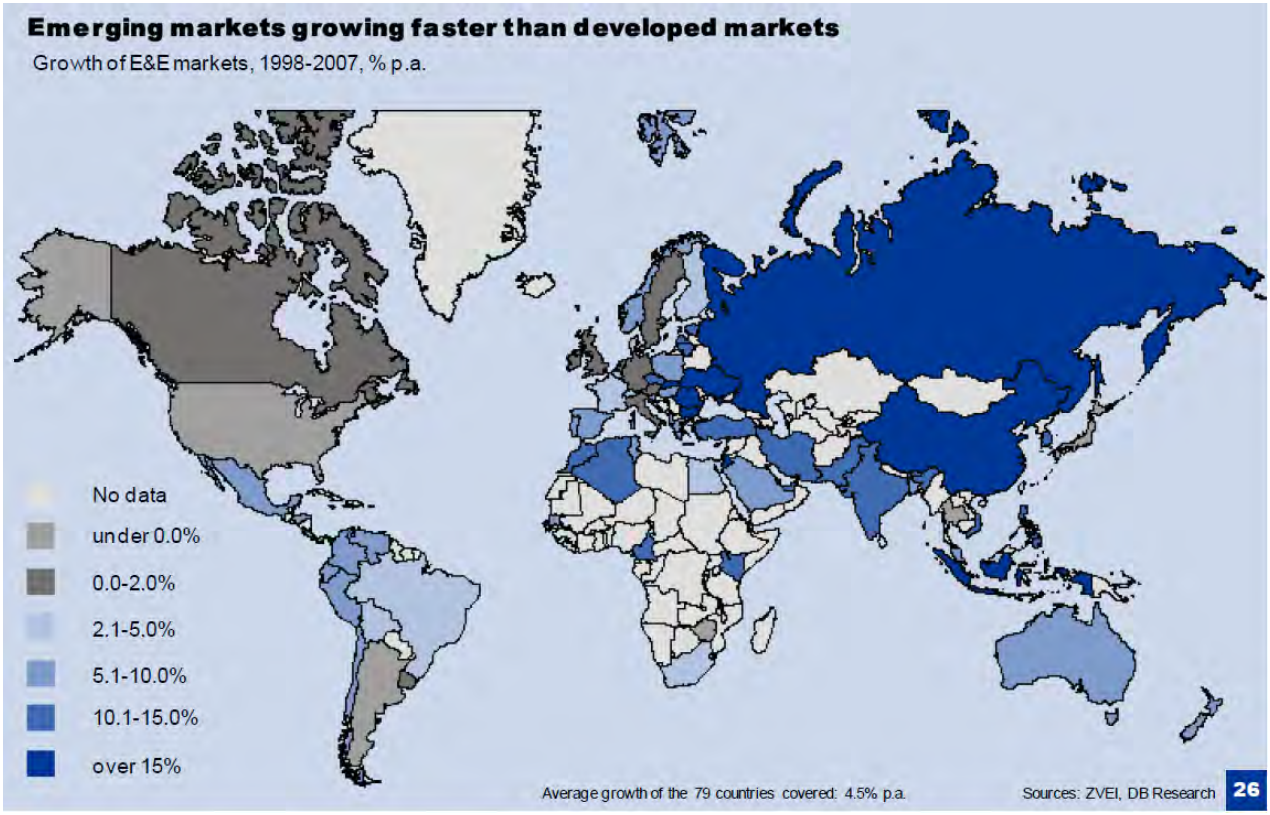
3 Overview of the South African electronics sector

3.1 International industry overview

The world electronics market was worth close to US$2 trillion in 2007, and is forecast to increase to over US$3 trillion by 2012.[1] Industrial products account for 39.6% of total electronics sales, while computer sales account for 20%. Semiconductors have a share of 13.5%; consumer electronics makes up 13.4%; communications account for 9.9% and automotive electronics industry accounts for 2.6%.[2]

Asia currently dominates the demand for electrical and electronic products, with a market share of 47% in 2007. The Americas have the second greatest demand, followed by Europe which accounts for a quarter of the global demand.[3] However, per capita demand for electrical and electronic products in Europe and the Americas is about two-and-a-half times as high as in Asia. The figure below shows the growth rate of the electric and electronic market by country. Asia not only dominates demand, but is also the region which has the fastest growth of electric and electronic markets.

Figure 2: Growth of electricity and electronics markets, 1998 - 2007[4]



On the supply side, Asia is also dominant, in particular China – which accounted for half of Asia's electronics production and almost one-third of world production in 2007. Japan was the second largest Asian producer, with 13% of global electronics output. Europe is the second largest

[1] BBC Report. (2008). Global Electronics: High Growth Products and New Markets
[2] *ibid*
[3] CBI. (2009). The electronic components market in the EU
[4] Deutche Bank. (2009). German E&E report

production region, followed by the Americas. The Americas have lost significant market share to Asia (15% from 1998 to 2007). [5]

The (ongoing) migration in production from West to East can partly be attributed to the faster economic growth in Asia. The growing affluence has increased the demand for consumer goods, while economic growth bolstered the demand for capital goods in the industrial sectors. In addition, many Asian economies deliberately use incentives to attract the settlement of a strong electrical and electronic industry. The migration has also come about due to companies making use of a global value chain. Production is therefore shifted to low cost countries in the East, whilst much of the design still takes place in the West.

3.2 Local industry structure and key role players

3.2.1 Industry structure

The South African electronics sector comprises manufacturers in a variety of segments, with the automotive, military/defence, mining, medical and security electronics sectors being the most dominant in terms of manufacturing activity. There is also activity in power electronics, consumer electronics (e.g. decoders, remote controls), battery manufacturing, avionics and telematics (e.g. pre-paid meters).

Large enterprises or conglomerates with a significant market presence and influence in the sector include the Altron Group, the Reunert Group, and Denel. These companies have diverse interests, often spanning multiple sectors and industries, and leverage this for vertical integration and to generate internal demand. A typical example would be RC&C manufacturing, a contract manufacturer within the Reunert Group, which produces components for many other companies within the group e.g. consumer goods for Nashua Mobile and missile fuse components for Fuchs Electronics.

The major contract manufacturers include Tellumat, Elprom, RC&C, Bosch and Pi Shurlok. Many of the large contract manufacturing companies in South Africa specialised in serving particular industries such as the automotive or telecommunications sectors. Recently, these companies have begun diversifying their customer base in the face of diminishing demands from those sectors.

According to **the dti**'s Electrotechnical CSP, there are thousands of electrotechnical manufacturers, the majority of them SMMEs (SMMEs account for 60% of enterprises in the sector). Electronics manufacturing in the SMME range is characterised by small established firms, predominantly owned and/or managed by people fitting a particular demographic profile (white males approaching retirement age). Based on interviews conducted for this project, it would appear that many of these SMMEs have either stabilised in terms of growth and expansion, or are slowly shrinking their manufacturing operations as there is no clear successor or purchaser for the business due to the country-wide shortage of qualified, experienced technical personnel (e.g. engineers) in South Africa.

A notable feature of the electronics sector in South Africa is that a number of very small companies are innovative and have strong reputations in niche customer sectors. Examples include SURE Engineering, which has a worldwide reputation for electronic safety products; MGL Avionics, which is the market leader in avionics for non-certified aircraft; and Trolleyscan, which has built a worldwide reputation for RFID innovation. All these are SMMEs, yet they are highly competitive in global markets with very sophisticated technology.

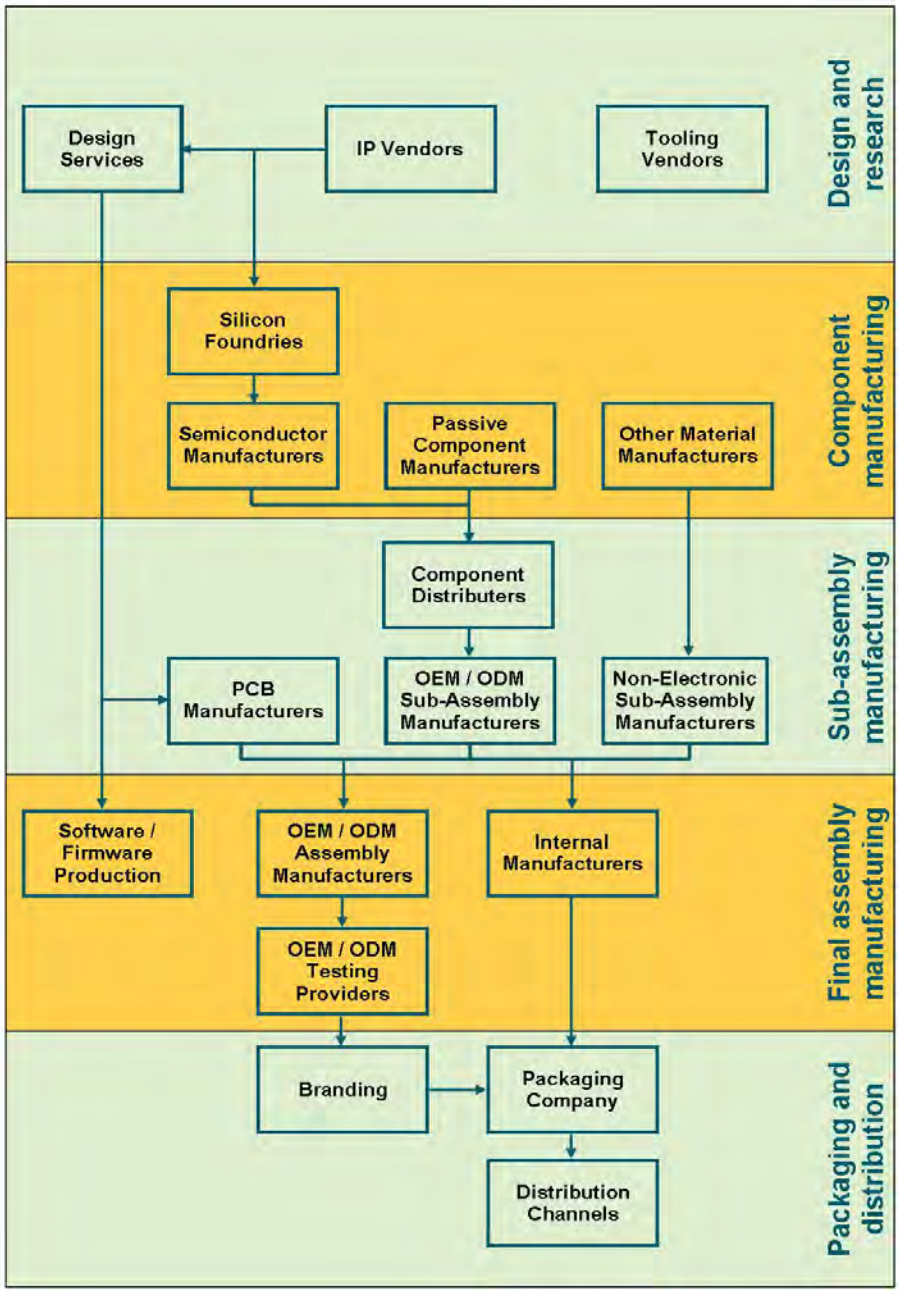
[5] Deutche Bank. (2009). German E&E report

Electronics manufacturing performs poorly in terms of BEE transformation however. According to available data, there are currently approximately 850 BEE companies are registered on **the dti**'s BEE database for the sector.[6] The majority of these BEE companies are licensed distributors of foreign products, suggesting that there is an under-representation of BEE electronics manufacturers as well as BEE distributors of locally manufactured products.

Nature of manufacturing activity in South Africa

The typical value chain for electronics manufacturing can be represented as follows[7]:

Figure 3: Value chain for electronics manufacturing



Source: Kaiser Associates, 2010

[6] **the dti**, 2005, Electrotechnical Customised Sector Programme'

[7] It should also be noted that each segment of the electronics sector has its own value chain, involving different activities and role players – please refer to Appendix B for an example of the value chain for the automotive sector. .

Companies involved in the manufacture of electronic devices and components can generally be categorised as either internal manufacturers or contract manufacturers. Internal manufacturers, as the name suggests, perform the majority of the manufacturing tasks within their corporate structure. As a general rule, despite being vertically integrated, the majority of companies still outsource the manufacture of certain sub-assemblies such as PCB boards and mechanical products such as enclosures.

Many small manufacturers in South Africa fall into the category of internal manufacturers, with certain sectors such as battery manufacture exhibiting very high levels of vertical integration. First National Battery, for example, manufacture nearly every sub-assembly of their product internally and have a plastic-injection facility, lead smelter and two separate manufacturing sites. Other companies such as Martin-Electronics, who produce remote control devices for the consumer market, perform the final assembly within their factory but outsource the manufacture of PCBs.

Overall, the South African electronics manufacturing sector is fairly well represented by industry players at each stage of the value chain. An assessment of the overall strengths, weaknesses, opportunities and threats for the sector are provided below:

Table 4: Overall SWOT assessment

Strengths	Weaknesses
▸ **Systems engineering**: a legacy of South Africa's previous isolation is that there is a very well-developed skills set in designing and integrating large and complex systems, which can be applied in niche products requiring integration of many technologically diverse components. ▸ **Innovative industrial design**: this segment of the value chain is very active locally, and company examples include UEC and Tellumat, which produce world-class consumer products that are locally designed. ▸ **Embedded systems:** Owing to an educational focus on integration of systems rather than component design, South Africa has a workforce with good skills in embedded systems, which require a blend of hardware and software competence. ▸ Manufacture of PCBs: local companies are able to produce up to 10-layer PCBs with track and space widths of 8 milli-inches; these are suitable for all but the most demanding applications, and these facilities are a significant enabler for the R&D functions in many local companies.	▸ **Component manufacturing** – There is limited local manufacture of components such as integrated circuits, discrete semiconductors, and passive components such as resistors, capacitors and inductors. However, a few exceptions where there is some local capacity include small transistors and transformers (e.g. Lehman Transformers, CM Transformers). Some companies used to manufacture components, but have changed to distribution instead (e.g. African Capacitors, ABB). ▸ Market demand for these is met by imports despite international evidence showing that niche manufacturing of these components can be successful in a high-labour-cost economy (as is the case in France). ▸ **Lack of skills in fabless design**. – The failure of all local educational institutions to train VLSI (Very Large Scale Integration) designers has left South Africa with no competence in fabless chip design, which is a significant part of the sector in other similar economies.[8] ▸ **Tooling and specialised manufacture** – there is little specialised manufacturing catering to the requirements of the consumer industry, and much of the tooling for the non-electrical components is imported.

[8] Fabless chip design companies focus on the design and development of their product and outsource the silicon wafer production. Note that South Africa has a FabLab programme that provides design and fabrication workshops which gives designers (across all sectors) the capability to turn their ideas and concepts into reality, but they do not necessarily provide the specialised facilities for electronics design and development.

Opportunities	Threats
▸ Vehicle and asset tracking and fleet management (particularly exports) ▸ Vehicle security products (particularly exports) ▸ Immobiliser technologies ▸ Harness manufacturing ▸ Engine management systems ▸ Automotive batteries ▸ Specialised avionics: military, commercial, small aircraft ▸ Sports radar systems ▸ Radar design ▸ Sonar and marine technologies ▸ Renewable energy systems ▸ Transformer manufacturing ▸ Sensors and systems unique to the large South African economy, e.g. mining and minerals beneficiation ▸ Smart and pre-paid metering applications ▸ Solar energy products ▸ Energy-saving LED lighting ▸ Underwater LED lighting products ▸ Intelligent LED streetlights ▸ Fluorescent lamp production ▸ LED mining headlamps ▸ Set-Top Boxes and Digital Television ▸ Localised final consumer electronics product assembly ▸ Wireless technology and wireless antennas ▸ Fixed telecommunication infrastructure, ▸ Avionics software ▸ Tracking and security connectivity ▸ Local support for complex PCB manufacture ▸ IPC-Class 3 compliant manufacturers ▸ Specialised medical imaging technologies	▸ Sustained low demand during the recovery from the recession ▸ International competition ▸ Decrease in demand from public sector and limited local preference ▸ In some markets, long contracting periods makes the companies in the sub-sector vulnerable and prone to cycles ▸ Poor quality and service delivery to consumers of solar energy products is hurting the industry

3.2.2 Geographical patterns in manufacturing

Based on secondary research and interviews, electronics manufacturing activity appears to be concentrated in Gauteng, the Western Cape, the Eastern Cape and KwaZulu-Natal. Support services and functions also appear to be concentrated in these regions e.g. a company may have manufacturing operations in the Eastern Cape and a repair facility in Gauteng. In terms of regional variations, the Western Cape appears to have a relatively high proportion of large, telecommunication manufacturing firms, Gauteng offers a relatively high proportion of industrial hardware, armaments and infrastructural manufacturers, whilst the Eastern Cape and KwaZulu-Natal are dominant in automotive electronics manufacturing. In addition, the Mpumalanga Industrial Development Zone has prioritised electronics manufacturing and support services (e.g. bulk buying of electronics for SMMEs) as a service offering[9].

[9] TradeInvest South Africa, 17 November 2009, 'MIDZ seeks investment in electronics manufacturing' Available online (http://www.tradeinvestsa.co.za/investment_opportunities/337380.htm)

3.2.3 IP ownership and role of partnerships for R&D

South Africa is identified to be producing 0.5% of the world's research literature and less than 0.01% of the world's patents.[10] This is partly due to much of the science base existing in South Africa not being orientated to support industrial interests – universities emphasise animal, plant and environmental disciplines; and the CSIR receives only 10% of its resources from the private sector.[11]

Mixed views were expressed in interviews regarding the importance and success of relationships with research institutions and other industry players for R&D purposes.

In certain electronics segments, R&D is not regarded as important due to the use of standardised technology, and the reliance on imports of more technologically advanced products when required. For other companies, local IP is the basis of their competitiveness. Their relationships with local research partners (in industry as well as academia) have been instrumental in product development. These are companies in sectors such as consumer, power and automotive electronics. A number of successful local companies specialising in high-technology applications, such as digital signal processing and power inverters, have active internship programs and regularly hire graduates from local universities. University-local industry linkages (as manifest in the industry funding for academic research e.g. through THRIP) are among the highest in the world. However the character of the THRIP program is pre-competitive in nature - the expected outputs are prototypes and/or demonstrators and the researchers are expected to make their findings known in the academic literature. The main key performance indicators of the program are explicitly recognised to be number of publications in refereed journals and qualified personnel (e.g. number of PhDs awarded).[12]

Other companies however, view local research institutions (e.g. universities) as offering little value because they are disconnected from the process, product conditions and trends experienced by manufacturers. Often these companies cannot justify the time investment required to produce results from collaborations with local research institutions. They prefer either to conduct their R&D entirely in-house, or to partner with international institutions.

There is significant intellectual property generated within South Africa, some of which is lost to due to the practice of off-shoring IP. This is due in part to the relative ease with which start-up capital can be obtained in countries with developed venture capital ecosystems. There are also concerns over the ownership of intellectual property when companies collaborate with academic institutions. The practice of off-shoring IPs relates to the concept of the "innovation chasm."

The argument is that useful knowledge is produced in the science base (universities and contract research organisations) in the country and because of the innovation chasm it fails to be transfer to the local industry and benefit the country. Instead local knowledge is "lost" (transferred abroad), where it is developed further and it is exported back to South Africa.[13] However a recent study found that although there are some cases of "lost technology" (e.g. the multi-media satellite antenna system and the aeronautical satphone system of Omnipless (Pty) Ltd; the production of cheap photovoltaics by Photovoltaic Technology Intellectual Property (Pty) Ltd), the overall effect of the innovation chasm is not profound.[14]

[10] Pouris. (2008). Science-industry relations and the SA innovation chasm: Searching for lost technologies
[11] *ibid*
[12] *ibid*
[13] *ibid*
[14] *ibid*

3.3 Industry manufacturing capacity assessment

In terms of types of technology and volume of production, the electronic manufacturing sector in South Africa is primarily clustered around two categories. In the first category are small manufacturers producing low volume products for specialised or niche industries, and in the second category are manufacturers who are large by South African standards (e.g. up to 2 million units p.a., but medium sized at best by global standards) producing high-end quality products for the automotive, mining, defence and telematics industries.[15]

Many small electronics producers utilise hand assembly for the bulk of their manufacturing operations. Some firms assemble entirely by hand, whereas others may utilise some automation equipment, such as a small pick-and-place machine (augmented with hand assembly for through-hole components and connectors). These companies tend to be established firms manufacturing mature products, producing low-volumes for niche or specialised industries. Manual assembly is very labour intensive, and is limited in both the feasible production volumes and the variable quality due to human error. Larger companies can have close to full automated assembly and automated optical inspection.

According to feedback received from industry, as a whole the electronics sector is currently experiencing a great deal of instability due to the current economic recession (which has had a negative impact on demand and sales), and fierce competition from Chinese imports (which tend to be cheaper and of equal or better quality than locally manufactured products). This has resulted in numerous company closures at the SMME level, particularly amongst companies without a diversified customer base. Some segments such as defence have been less affected by the current recession due to the longer contract cycle. Other firms have shifted their emphasis to niche applications to reduce competition with Asian firms.

Production capacity varies greatly between and within sub-sectors. Companies manufacturing complex PCB boards may only complete a couple of units a month, whilst highly automated manufactures may be able to place 100,000 components an hour. Examples of unit output are 2 million set-top boxes a year (Altech UEC), 7,000 batteries per day (First National Battery) to 1.5 satellites per year (SunSpace). None of these are very large by global standards – e.g. Flextronics will reach a notebook production capacity in China of 20 million notebooks in 2010[16].

Many companies interviewed reported having excess manufacturing capacity relative to their full production capabilities. The table below provides the current production capacity of the stakeholders consulted by sub-sector:

Table 5: Survey responses on production capacity utilisation

Sub-sector	Production capacity (current % use)	Response count
Automotive industry (vetronics)	62%	3
Avionics and aerospace	100%	2
Radar	100%	1
Power electronics	83%	2
Electronics	60%	8
Energy-saving technologies	80%	1
Lighting	80%	1
Consumer electronics	75%	2
Telecommunications	53%	2

[15] Much of the high-volume contract manufacturing capacity in South Africa was created through demand during periods were South Africa was isolated due to sanctions, driven primarily by demand from the military and telecommunication sectors. Automotive subsidies also led to the creation of a large automotive electronics industry, which is currently facing increasingly aggressive competition. South Africa therefore has some established capacity in large-volume manufacture.
[16] Shanghai Daily, 23 April 2010

Only 22 of the companies interviewed were able to provide a percentage indication of capacity usage. Capacity usage varies greatly between and within the subsectors, with several companies running at full capacity and some indicating future plans to expand capacity.

However, many of the larger firms are still recovering from the global recession (e.g. Bosch Group: Robert Bosch Solutions, CZ Electronics, PI Shurlok, RC&C Manufacturing, SAAB Grintek all reported capacity usage below 50%). Excess capacity was attributed to:

- Decline in sales/consumer demand by volume and value
- Mismatch between capabilities of machinery and equipment owned, and the stage of development of a business
  - Some companies possess machinery and equipment that is capable of high volume output, but the business is not large enough to handle orders of that scale. This is due in part to the fixed range of capacities provided by equipment such as pick-and-place machines, requiring companies to install far greater capacity than may be required.
  - Many companies have spare capacity in terms of process and equipment capacity but lack the staff and finances to operate at full utilisation.
  - A number of firms have also invested in high-volume; low flexibility systems and now find themselves in need of machines which are more capable of flexible manufacturing.

Two of the worst affected manufacturing industries have been the automotive and PCB industries. Large contract manufacturers are operating well below their maximum levels, especially in the automotive sector, which has been hit particularly hard by the economic recession. A number of these manufacturers are looking to enter the mainstream contract-manufacturing arena to better utilise their equipment. Certain larger corporate manufacturers also have spare capacity but are unable to utilise the spare capacity due to internal company policies preventing contract manufacturing.

To cope with the instability in the electronics sector, companies have reported resorting to cutting down the number and duration of work shifts, reducing the number of permanent employees on the payroll (retrenchments as well as changing the classification of employees to temporary or part-time labour), and scaling back on the volumes and variety of products manufactured (i.e. more streamlined and smaller-scale manufacturing). 'More small jobs' in particular has been a crucial survival strategy for even large contract manufacturers. Another survival strategy has been for manufacturers to become import agents on behalf of clients, and act as distributors for products they would normally have produced themselves but which are now cheaper to import[17]. These companies are also showing an increased willingness and capacity to take on prototyping and testing functions from their clients, thereby offering an increased variety of outsourcing capability for those clients.

The increase in excess capacity in the electronics sector is broadly in line with trends noted by Statistics South Africa in 2009 for the utilisation of production capacity by large manufacturing enterprises with a turnover of more than R100 million per annum. Available figures for manufacturing sectors most closely related to electronics are given below:[18]

[17] This approach is also used in instances where volumes required by clients are too large to be fulfilled by the contracted manufacturer

[18] Statistics South Africa, 2010

Table 6: Stats SA data on production capacity underutilisation in relevant sectors (2009)

Manufacturing sub-segment	Production capacity under-utilised in the year 2009 (%)	Major reasons for capacity under-utilisation (%)		
		Insufficient demand	Shortage of raw materials	Shortage of skilled labour
Electrical machinery	17.3	13.4	1.9	1.1
Radio, television and communication apparatus and professional equipment	16.2	11.5	1.9	1.4
Motor vehicles, parts and accessories	29.9	25.5	1.2	0.8

Interventions related to factors of production (people, equipment) tended to be flexible, allowing for increased manufacturing at short notice (e.g. ready availability of part-time/temporary employees), whereas those related to outputs tended to be more permanent (e.g. some companies moved out of manufacturing entire product categories).

PART B: ANALYSIS OF ELECTRONICS SUB-SECTORS

4 Automotive industry (vetronics)[19]

4.1 Sub-sector definition and overview

The automotive electronics sector comprises all the electronic and electrical sub-systems used in military, consumer and industrial vehicles. Strict standards and quality control procedures apply to automotive electronic products, increasing the cost and complexity of production. Automotive electronics are either supplied as components to automotive manufacturers by OEM suppliers or sold to customers through aftermarket sales.

Electronic products for use in military vehicles are substantially different from those required in consumer and industrial vehicles and are often referred to as vetronics.

Automotive OEM products can be divided into four major categories as follows:

- **Power train and safety systems:** The electronics involved in providing the core driving functionality and providing safety features in a vehicle are critical systems. Failures in these systems due to latent defects, design flaws or software problems can result in significant damage to the vehicle or loss of life. As a result, these systems place the greatest demands on both the design and manufacturing processes, especially as car manufacturers are increasingly relying on such electronics to perform engine, braking and steering functions.

  Examples of such systems include: engine management systems, ABS braking technologies, air bags, active or electronic suspension systems, drive-by-wire and power steering systems, fuel injection management systems and transmission systems.

- **Controls, comfort and convenience systems:** Modern vehicles usually include a substantial number of electronic sub-systems dedicated to providing functionality for the direct benefit of the driver and passengers. These systems often relay critical information, such as dashboard displays, or perform a necessary function as in the windscreen wiper control systems. The failure of such a system is, however, not as severe as in the case of devices controlling power train functionality or safety systems. However, the majority of automobile manufacturers strive to achieve the highest level of quality in such system to ensure customer satisfaction, as there is constant innovation and improvement in this particular class of product.

  Examples of these systems include: climate control systems, central locking systems, dashboard and instrument clusters, interior lighting systems, heads-up displays, headlight management systems and safety warning systems. The lighting products (e.g. interior lighting systems and headlight management systems) are dealt with in 9.3.

- **Driver assistance systems:** In recent years, the adoption of specific electronic systems to assist the driver has gained increasing popularity. These features first began appearing in high-end luxury vehicles and have begun trickling down into other models. These systems provide assistance to the driver in the form of additional information, visual assistance, audible warning and even the automation of certain driving tasks (through features such as adaptive cruise

[19] Sources for this section include: Altera (unknown date) 'Automotive Industry Trends' – www.altera.com ; Deloitte (unknown date). 'Global industry trends in the automotive industry and the effects on South Africa : where to from here?' – www.deloitte.com ; HaHansen's top ten automotive electronic trends (http://www.hansenreport.com/); Trends in the Automotive Industry: Implications on Supply Chain Management (pdf) Cisco White paper (February 2008) Michael Schwarz; Trends in Automotive Communication Systems; The Absorptive Capacities of South African Automotive manufacturers, Jo Lorentzen, Human Sciences Research Council, Cape Town, South Africa, University of KwaZulu-Natal, Durban, South Africa

control and radar-guided braking). These systems pose additional challenges to designers and manufacturers as their operation is not critical to the functioning of their car but malfunctions or unexpected behaviour can lead to serious accidents and injury. These devices therefore need to exhibit a degree of accuracy and reliability equal to that of critical power train systems and often need to include redundancy and intuitive driver override functionality.

Examples of these systems include: parking sensors, white-line monitoring systems, night vision systems, adaptive headlight control, collision detection systems, tyre-pressure monitoring systems and engine diagnostics and warning systems.

- **Information, communication and entertainment systems:** The majority of vehicles manufactured include at least one dedicated system to provide entertainment, information or communication facilities, with high-end luxury vehicles often including a vast array of tightly integrated systems. These systems exist in the slight overlap between the consumer and automotive electronics sector and provide non-critical features to the driver and passengers. Failure in these systems does not directly affect the performance of the vehicle and poses very little security risk. There are additional design considerations as such systems are required not to distract the driver. Due to the lesser restrictions and the need to continually support consumer technologies, this category of product is continually being upgraded and improved.

  Examples of these systems include: navigation systems, passenger and rear seat entertainment systems, audio systems, hand-free mobile phone systems, telematics services and radio/satellite receivers.

South African companies are involved in the manufacturing in many of these categories (see 4.3 below).

Aftermarket electronic products

Aftermarket electronics components are generally not required for the operation of a vehicle but rather provide additional or enhanced functionality. Such components may also be offered as a lower cost or alternative replacement for core components, although this is less prevalent in automotive electronics industry. Aftermarket components are often used to provide features that are directly integrated into newer vehicles, such as security and communication products.

Aftermarket electronics products are rarely found for power train and safety systems but are regularly available in the other three categories. Examples of such products are given below:

- **Controls, comfort, security and convenience systems:** car alarm systems, immobilisers, remote and wireless entry systems, tracking devices, vehicle “black box” systems, remote cut-out devices and central locking systems.

- **Driver assistance systems:** parking sensors, collision avoidance systems, heads-up displays, vehicle tracking systems and fleet management system.

- **Information, communication and entertainment systems:** navigation systems, entertainment and multimedia systems, hand-free kits, radio and stereo equipment and additional vehicle lighting.

It is important to note that the above definition of aftermarket electronic products refers primarily to electronic systems, and not necessarily electronic sub-assemblies and components. Electric products, such as spark-plugs and electric motors, are widely available from aftermarket suppliers but are not included in this definition. An exception is made for automotive batteries due to their importance and prevalence in both the South African manufacturing industry and the future of the electronics market.

Military vehicle electronics (vetronics)

Although many of the electronics systems in military vehicles bear resemblance to those in consumer vehicles, there are substantial differences due to the increased requirements placed on military equipment and systems. These include longer product lifespan, increased resistance to temperature and shock and often "ruggedized" form factor. Military vehicles are also equipped with other systems requiring electronics. These include radar systems, weapon systems, radio communication equipment, transponders and satellite communication equipment. These devices are usually highly specialised and produced exclusively for a single application.

There is some local production capacity for in this category (see 4.3 below).

4.2 International market and supply trends

4.2.1 Market trends

The number of vehicles in the world is rapidly approach 1 billion. There were approximately 900 million vehicles in use around the world in 2009, with 250 million in the United States alone. Worldwide sales have averaged in the realm of 65 million per year over the past four years, with the current estimates for 2010 being as low as 55 million units.

The automotive market has been greatly affected by the financial recession, with sharp decreases in car sales throughout many of its major markets. Frugal consumers, difficultly in accessing finance, rising input costs and an unstable oil price have all contributed to major losses for most automotive manufacturers. This has caused an oversupply of vehicles, resulting in both permanent and temporary plant shutdowns.

New car sales in the United States reached their lowest figures since 1982 having dropped by 24% from 12.3 million in 2008 to 9.3 million in 2009. This has caused companies such as GM to radically decrease their worldwide workforce (to 235,000 people), despite receiving USD$80.7bn in financial aid.

China has surpassed the United States as the largest automotive market with vehicle sales having increased dramatically by over 44%, with 7.3 million units sold in 2009. Strong sales have continued into 2010, with luxury car sales increasing 66% in the first three months of the year and analysts at Scotiabank, expecting total vehicle sales to China to increase by 20% to 9 million units in 2010. The analysts also predict that the China, India and Brazil will lead vehicle sales in the next two years, with the United States trailing but still experiencing growth rates up to 10%.

It is estimated that car manufacturers will sell approximately 11.5 million vehicles in the United States during 2010. Of the cars sold, 3.2% would be hybrid vehicles, 2.2% would be diesel and less than 1% would comprise electric vehicles. Analysts have predicted that, despite the increasing demand in automotive markets, the United States and European automotive industries will not recover to previous level of demand for four or five years.

Experts believe that the last five years have proved to be a turning point for the international automotive industry as fuel efficiency and emission reduction has overtaken safety as the primary concerns of both consumers and manufacturers. Consumers are also turning towards cheaper vehicles and are exhibiting preferences for small compact vehicles.

Many industry experts believe that the trend towards smaller, more compact and ultimately more fuel-efficient vehicles will continue into the financial recovery. During previous slumps in the automotive market, such as the one caused by the oil crisis in the 1970's, consumer demand for luxury vehicles returned to previous levels after a few years. Due to the increasing costs of

automobile ownership and mandates from governments to produce cleaner and more efficient vehicles, many analysts believe that the consumer preference has been fundamentally changed.

COMPARISON WITH SOUTH AFRICAN MARKET

South African domestic new vehicle sales in 2009 were estimated at around 400,000 units - including cars, light commercial, medium and heavy trucks and buses (roughly 0.6% of global sales).[20] The South African market in particular experienced strong growth before the economic recession, with growth rates averaging above 10% annually. For example the light trucks market generated total revenues of $3.9 billion in 2008, representing a compound annual growth rate (CAGR) of 12.7% for the period spanning 2004-2008. Medium and heavy trucks market generated total revenues of $637.2 million in 2008, representing a compound annual growth rate (CAGR) of 5.7% for the same period.[21]

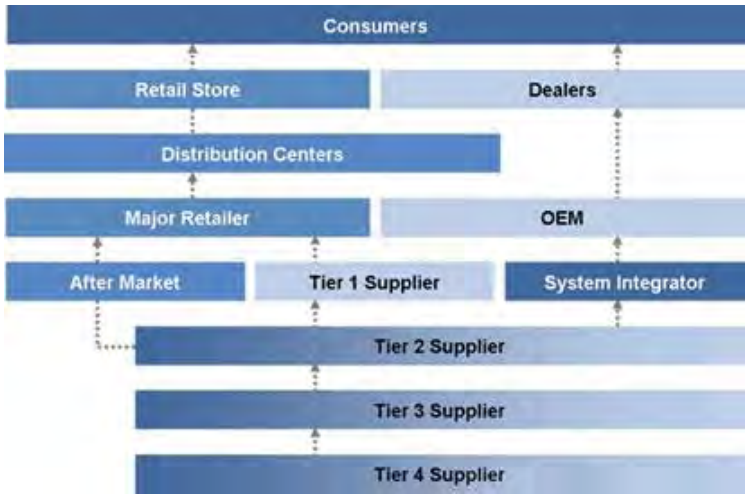
Car manufacturers had invested heavily in brand-building exercises building up to 2008/2009, but it did not fully prepare them for the economic downturn. The auto sector was one of the hardest hit by a recession in 2008 and 2009. However, the sector is set for a strong recovery in 2010.[22]

Exports are also projected to recover recovering sharply, helping to lift total domestic production by nearly 20% (with a pull-through effect to component and sub-assembly demand). Total domestic production of motor vehicles during 2010 is expected to rise from 374,000 vehicles in 2009 to close to 450,000 units in 2010.[23]

4.2.2 Supply trends

The automotive industry supply chain is highly structured and has sophisticated supply chain management practices. The diagram below illustrates a typical structure of an automotive supply chain.

Figure 4: Illustrative automotive supply chain[24]



OEM suppliers typically produce sophisticated and highly modular electronic assemblies for direct integration into vehicles. Often these systems provide critical functionality or are tightly integrated into the design of the vehicle, but may be specific to a certain model or range of vehicles. OEM

[20] NAAMSA statistics
[21] Datamonitor. 2010. Automotive: South Africa Industry Guide
[22] Africa reports. 2010. S.African car makers upgrade 2010 sales rise forecast.
[23] *ibid*
[24] Maxima (2010) 'Automotive supply chain'

manufacturing contracts typically involve large volumes of products over a long duration, often lasting in excess of five years. The contracts generally specify stringent defect rate limitations due to the high costs involved in product recalls.

Automotive electronics systems are often designed in a modular fashion as a variety of interconnection standards have been developed to allow vehicle-wide communication between devices. Example of such interconnection protocols includes both application independent standards such as RS-232 and RS-485, and industry specific standards such as CAN Bus. As a result, vehicle electrical systems are not produced as single monolithic assemblies, but individual sub-systems are developed and manufactured by separate organisations.

Automotive electronics are tightly coupled to the trends of the automotive industry, although the quantity of electronics required in each vehicle has been steadily increasing over the past twenty years. As a result, the demands placed on the automotive electronics industry are usually higher than other automotive component industries. Automotive design cycles have also shortened over the past five years to between 24 and 36 months, down from previous industry standard cycles lasting 60 months.

Currently, automotive electronics assemblies constitute 22% of the cost of a vehicle. Industry experts disagree on whether this value will continue to increase, or whether it will remain constant but the experts agree that the complexity and semiconductor content of such systems will maintain steady growth rates. One reason cited for the levelling of cost associated with electrical systems is the gaining importance and popularity of economical vehicles, such as the Tata Motor's Nano, which contain far fewer electronic systems.

The exception is hybrid vehicles, in which the percentage of the costs devoted to electronics often exceeds 50% as the power train is electrically-driven and therefore requires a far more complicated electrical distribution system. These vehicles are manufactured primarily by Eastern automobile manufacturers and therefore may not source components from Western sources.

Eastern OEM suppliers are beginning to expand their operations beyond simply manufacturing and have begun developing research and product engineering departments. The centre of innovation in the automobile industry is also shifting away from Detroit and towards Germany, as German automobile manufacturers currently lead the industry in this capacity.

Automotive electronics manufacturing operations are currently primarily performed in the Eastern Cape with the three largest automotive manufactures operating from the region.

Industry experts feel that car manufacturers will increase the number of outsourced components involved in their manufacturing process but will demand more customisation from their OEM suppliers. This stems from the increasing customisation options offers to customers and will require increased tracking and traceability on behalf of OEM suppliers. These companies will also continue to outsource such work to low-cost manufacturing countries but will be more sensitive to the actual total cost of manufacture, taking into account logistics costs, quality assurances and overall risk profile.

OEMs have become more sensitive to the risks involved in distributing manufacturing operations globally. This is primarily due to the increased adoption of just-in-time and just-in-sequence manufacturing methodologies which require reliable and timely delivery from suppliers. Interruptions to such supply chains, whether caused by man-made or natural interruptions, can delay or even halt production and therefore need to be carefully mitigated.

4.3 Manufacturing activities and capability in South Africa

The automotive manufacturing industry is both an important and well-established sector in the South African economy. The support provided to date by the Motor Industry Development Programme is considered by many stakeholders to have been key to shaping the industry into its current form. Automotive component manufacturing is well established within the country (and electronics components within this). For example, the National Association of Component Manufacturers (NAACAM) has around 190 national member companies with 230 regional manufacturing sites, in addition to 12 associate members who provide mainly logistics, IT and financial services to members. The NAACAM manufacturing members comprise almost 50% Tier 1 suppliers, with the balance Tier 2 and 3 manufacturers, and 141 members being suppliers of OE components to vehicle assembly plants and/or manufacturers and suppliers of OE as well as P&A and aftermarket/replacement components.

A number of large automotive electronic manufacturing companies are present that supply both local and international automotive manufacturers and are globally competitive. These companies usually supply OEM products for direct inclusion in new vehicles, either directly to automotive manufacturers or through global automotive distributors.

Dedicated automotive electronic contract manufacturers and OEM providers in South Africa include:

Table 7: Examples of South African automotive electronic contract manufacturers and OEM providers

Company	Nature of business	Category of automotive (vetronics)	Description
Robert Bosch South Africa	▸ Contract manufacturer	▸ Power train and safety systems ▸ Driver assistance systems	Produces starters, alternators, engine control and management systems, small motor control systems and braking systems
PI Shurlok	▸ Contract manufacturer	▸ Power train and safety systems ▸ Controls, comfort and convenience systems ▸ Aftermarket products	Produces automotive electronic control units (ECUs), instrument clusters, body and comfort automotive electronics, power train electronics, vehicle security electronics and telematics modules
Pasdec	▸ Contract manufacturer	▸ Power train and safety systems	Produces wiring harnesses for the automotive industry
Periseo	▸ OEM supplier	▸ Power train and safety systems	Produces harnesses and specialised vehicle passenger systems
Rhemkor Technologies	▸ Contract manufacturer	▸ Power train and safety systems	Produces enclosures, frames and metal products for the automotive industry
PFK Electronics	▸ OEM supplier	▸ Aftermarket products	Produces security products and wiring harnesses for the automotive industry
Control Instruments Automotive	▸ OEM supplier	▸ Power train and safety systems ▸ Aftermarket products	Produces electrical components, industrial products, ignition components, switches and lighting, steering & suspension products, emergency lighting equipment, security systems, Bluetooth accessories
Hesto Harness	▸ OEM supplier	▸ Power train and safety systems	Produces automotive wiring harnesses

Company	Nature of business	Category of automotive (vetronics)	Description
Lumotech	▸ OEM supplier	▸ Controls, comfort and convenience systems	Produces automotive lighting: headlights, taillights, reflectors, sundry and signal lights, glass lens spotlights
RG Brose Automotive components	▸ OEM supplier	▸ Controls, comfort and convenience systems	Manufacturers of window regulators, door systems, closure systems, seat systems.

South Africa has a strong track record for producing high-quality automotive electronic components. Automotive manufacturers prioritise quality and require extremely low defect rates. Large South African contract manufacturers, such as Robert Bosch and PI Shurlok consistently exceed the quality required.

South Africa also has a large aftermarket electronics industry. As aftermarket electronic components are rarely used to substitute OEM equipment, the majority of companies focus on providing additional services or comforts through aftermarket equipment. Companies involved in aftermarket electronic manufacture and distributing include:

Table 8: Examples of automotive electronic aftermarket providers in South Africa

Company	Nature of business	Primary function
PFK Electronics	▸ Manufacturer	▸ Automotive security ▸ Vehicle tracking ▸ Fleet management
Cartrack	▸ Manufacturer ▸ Distributor	▸ Vehicle tracking
Digicore	▸ Manufacturer ▸ Service provider	▸ Vehicle tracking ▸ Fleet management
MixTelematics	▸ Manufacturer	▸ Vehicle tracking
TraceTec	▸ Manufacturer	▸ Vehicle tracking
Altech Netstart	▸ Service provider ▸ Distributor	▸ Vehicle tracking
iTrac Live	▸ Manufacturer	▸ Vehicle tracking
Nu World	▸ Importer	▸ Automotive audio products
Tracker	▸ Distributor	▸ Vehicle tracking ▸ Fleet management

South Africa also has a large number of automotive battery manufacturers, which produce products for both the local market and international customers. These companies include:

- First National Battery
- Willards
- Dixon Batteries
- Sabat Batteries
- Freestart Battery

There are also a number of companies in South Africa that produce specialised automotive vehicles for military and industrial use. These vehicles usually require customised and application-specific electronic systems, which are produced in low volumes. These companies include:

Table 9: Examples of specialist military or industrial automotive manufacturers in South Africa

Company	Nature of business	Description
BAE Land Systems	▸ Manufacturer	Global manufacturer of ground combat vehicles.
Denel Group: Denel Land Systems	▸ Manufacturer	Development, production, maintenance and upgrades of infantry systems, artillery gun

Company	Nature of business	Description
		systems (like the G5 and G6 systems) and combat turrets, as well as small arms.
TFM Industries	▸ Manufacturer	Manufacture multipurpose armoured vehicles
Bird Machines	▸ Manufacturer	Manufacturer of trackless underground mining machinery
Sandvik	▸ Manufacturer	Manufacturer of trackless underground mining machinery
Rham Equipment	▸ Manufacturer	Manufacturer of trackless underground mining machinery
Bell	▸ Manufacturer	Manufacturer of trackless underground mining machinery
Fermel	▸ Manufacturer	Manufacturer of trackless underground mining machinery
GHH	▸ Manufacturer	Manufacturer of trackless underground mining machinery
Atlas Copco	▸ Manufacturer	Manufacturer of trackless underground mining machinery
Dezzi	▸ Manufacturer	Manufacturer of trackless underground mining machinery
Aard Mining Equipment	▸ Manufacturer	Manufacturer of trackless underground mining machinery

4.4 Sub-sector assessment

Table 10: Automotive electronics SWOT assessment

Automotive industry (vetronics)	
STRENGTHS ▸ Existing expertise and capabilities in many aftermarket products, e.g.: – GSM-based vehicle tracking solutions – Vehicle security products – Immobilisers ▸ Strong military expertise	**WEAKNESSES** ▸ Dependence on imported electronic components ▸ Cyclical demand and long-term contracts may mean long waiting periods to enter the market (or to recover from missed opportunity) ▸ Distance from export market
OPPORTUNITIES ▸ Vehicle tracking and fleet management (particularly exports) ▸ Vehicle security products (particularly exports) ▸ Immobiliser technologies ▸ Asset tracking ▸ Harness manufacturing ▸ Automotive batteries	**THREATS** ▸ Sustained low demand during the recovery from the recession ▸ Direct competition from international firms ▸ A decrease in government support (e.g. MIDP) or market forces may shift OEMs production

5 Avionics and aerospace

5.1 Sub-sector definition and overview

Avionics can be defined as the development and production of electrical equipment for use in aircraft, spacecraft and satellites, and missiles, whilst the aerospace industry can be defined as the industry that researches, designs, manufactures, operates, and maintains vehicles moving through air and space.

Within this sub-sector, applications can fall into the following segments:

- Defence
- Public
- Commercial and industrial
- Civilian/private use

Excluding radar (dealt with separately), electronics can be included in many systems within aerospace products, including areas such as:

- Navigation and guidance (including unmanned systems)
- Detection
- Power management and storage
- Missile systems
- Communication
- Imaging, night vision and recording
- Information management and processing
- Temperature management
- Safety systems
- Training simulations
- Load management
- Seat configuration
- Entertainment systems (in the case of commercial aerospace)

The sub-sector is an area with high investment in research and development, and technologies emerging from this sub-sector often go on to have wider applications in other sectors.

5.2 International market and supply trends[25]

The aerospace industry is a significant global market. Estimates are that the aerospace and defence market size in 2008 was US$674.6bn, with a compound annual growth rate of 5.4% from 2004 to 2008. The top 10 companies accounted for US$544.4bn or 80% of this demand. These companies are:

- General Electric Company
- European Aeronautic Defense and Space Company (EADS)
- The Boeing Company
- United Technologies Corporation
- Lockheed Martin Corporation
- Northrop Grumman Corporation
- BAE Systems plc
- General Dynamics Corporation
- Raytheon Company
- Thales SA

[25] Datamonitor (2009) 'Global Top 10 Aerospace and Defense Companies'

A slightly wider market category of arm shows a similar pattern, as indicated in the graphic below.

Figure 5: Top arms sales companies[26]

Company (country)	2008 arms sales (US$ m.)	2007 arms sales (US$ m.)
BAE Systems	32 420	29 860
Lockheed Martin	29 880	29 400
Boeing	29 200	30 480
Northrop Grumman	26 090	24 600
General Dynamics	22 780	21 520
Raytheon	21 030	19 540
EADS	17 900	13 100
Finmeccanica	13 020	9 850
L-3 Communications	12 160	11 240
Thales	10 760	9 350
United Technologies	9 980	8 760
SAIC	7 350	6 250
KBR	5 730	5 000
Computer Sciences Corp.	5 710	5 420
Honeywell	5 310	5 020
ITT Corporation	5 170	3 850
Rolls Royce	4 720	4 580
Almaz-Antei	4 340	2 780

Many of these major players have a presence in South Africa, e.g. BAE Systems, SAAB and EADS (see section 5.3).

American aerospace and defence markets are currently the most significant, making up 51.9% of the market.

Forecasts are that aerospace and defence demand will grow to US$910bn by 2013. In terms of both defence and commercial market segments, because of the long contract cycles, demand can be counter-cyclical (as in the current recession), but can also fluctuate significantly based on whether orders are secured or not.

UAVs (unmanned aircraft) are expected to be a significant growth area in the sector – Boeing estimated that the market will be valued at US$160bn over the next ten years.

Some of the same companies operate in both the military and commercial segments (e.g. Boeing) whilst others specialise in commercial or civil applications.

It is a highly internationalised industry with strong global companies, which in some cases have vertically integrated groups that supply some components and subassemblies internally. As with the automotive industry, very high quality standards and reliability are required, and supplier selection is carefully managed.

[26] www.sipri.org

COMPARISON WITH SOUTH AFRICAN MARKET

The total South African defence related industry contributed 0.56% of GDP in 2004/2005, amounting to R10bn in turnover (and 15,000 direct jobs) – this would compare to roughly 2% of the global market.

South African Airways has concluded a $1bn deal with French aircraft manufacturer Airbus, for the supply of 6 new wide-body, twin engine aircrafts in 2011.[27] Prior to this SAA spent $1.5bn on upgrading its long-haul fleet in 2002 and $680m in 2000 on 21 Boeing aircrafts.

5.3 Manufacturing activities and capability in South Africa

Thanks to strong historical investments in defence, South Africa is considered to have strong aerospace capabilities in both the public and private sectors. More recently, government attention to initiatives such as micro-satellite development have helped bolster the capacity of the sub-sector, and the area of Unmanned Air Systems and Vehicles (UASs and UAVs) is being explored.

Examples of relevant development, manufacturing and contract production companies include the following:

Table 11: Examples of aerospace and avionics companies in South Africa

Company	Nature of Business	Description
ATE	▸ Design, development and manufacturer	Develops and supplies mission computers for systems integration in helicopters, fixed wing military aircrafts. Imports components and assembles the products in-house. Also designs and develops UAVs. Currently working at 100% of manufacturing capacity, focusing on low volume, high quality products.
Denel Group: Denel Aviation	▸ Maintenance, repair and overhaul	Denel Aviation primarily focuses on MRO, but manufactures ground support and test equipment, constant current regulators for airport runway lights and bird repeller units.
Denel Group: Saab Aerostructures	▸ Design and manufacture	Leading designer and manufacturer of complex metallic and composite aerostructures for the military and commercial aviation sector.
Denel Dynamics	▸ Design and manufactures	Denel Dynamics produces a range of missiles, unmanned aerial vehicles (UAVs) for use in both military and civilian operations, ground-based air defence systems for terrestrial and naval us. Detek (a wholly-owned subsidiary of Denel Dynamics) produces integrated optics, vacuum packaging technologies, MEMS sensors and infrared detectors (both single element linear detectors and XY arrays)
Denel Centre for Learning and Development	▸ Training and skills development	Training through Apprenticeship Department (Aviation and Engineering Industry), Youth Foundation Programme, Advanced and Type Training (Aviation Industry).
Reutech Group: Fuchs Electronics	▸ R&D ▸ Manufacturer	Fuchs Electronics develops and manufactures electronic fuses used in aircraft weapons applications.

[27] Davenport. 2010. SAA to take delivery of six new Airbus A330-200s in 2011. *Engineering news*

Company	Nature of Business	Description
Reutech Group: Reutech Communications	▸ R&D ▸ Manufacturer	Manufactures technologically advanced tactical airborne VHF/UHF radios.
Sunspace	▸ Design ▸ Manufacturer	Primarily subcontracts out manufacturing, but retains small in-house facility for low volume, high quality requirements for satellite systems.
SAAB Grintek Group: SAAB Grintek Defence	▸ Design ▸ Manufacturer ▸ Maintenance	Develops, manufactures, and maintains fighter and commercial aircraft focusing on military and commercial sectors. Also offers maintenance and component services and develops unmanned aerial vehicles.
SAAB Grintek Group: SAAB Grintek Technologies	▸ Design ▸ Manufacturer ▸ Maintenance	Designs and manufactures antennas, aviation systems, enterprise and power technologies
SAAB Grintek Group: Grintek Ewation (joint venture, 55% Grintek/ 45% EADS)	▸ Design ▸ Manufacturer ▸ Maintenance	Electronics warfare manufacturer
EADS	▸ Customise ▸ Distribute ▸ Maintenance	Distribution and customisation of Eurocopter products and services along with fleet support
Ansys	▸ Manufacturer	Ansys manufactures on-board interfacing and control systems, used in the Rooivalk helicopter. Ansys focuses on the niche market and delivers small batches (typically 5-10 units over a long period) of manufactured products.
Peralex	▸ Contract manufacturer	Design and manufactures signal processing products and systems for use in electronic defence products and direction-finding devices. Grintek is its largest customer. Operating at full capacity – which is often a constraint.
Parsec	▸ Contract manufacturer	Performs assemblies and sub-assemblies which are integrated into larger systems. Parsec is the preferred supplier for Denel and is routinely involved in design activities.
Aerosud	▸ Prototype design and development ▸ Manufacturing	Focuses on aviation-specific niches including aircraft structural fabrications, composites, plastics and airline interiors systems

Over and above the above, relevant capacity is vested in public research institutions, such as the CSIR's Defence, Peace, Safety and Security unit, which has a strong base of engineers and is involved in research in areas such as optronic sensor systems, aeronautic systems, electronic warfare systems, command control and information warfare.

5.4 Sub-sector assessment

Table 12: Avionics and aerospace SWOT assessment

Avionics and aerospace	
STRENGTHS ▸ Historical investments in defence resulted in strong aerospace capabilities in both the public and private sectors ▸ South Africa has skilled engineers in sectors directly applicable to avionic technology	**WEAKNESSES** ▸ Producers are becoming tier 2 suppliers and are therefore becoming dependent on large OEMs such as Eurocopter ▸ Politics has an impact on the market, sales are not determined by market forces alone
OPPORTUNITIES ▸ Specialised and niche avionics equipment ▸ Small aircraft avionics systems	**THREATS** ▸ Decrease in demand from public sector as governments are forced to tighten fiscal policy after the global recession ▸ Manufacture and development is beginning to shift overseas due to manufacturing and support concerns

6 Radar

6.1 Sub-sector definition and overview

Radar is an acronym for Radio Detection and Ranging. It is a method to identify the range, altitude, direction or speed of both moving and fixed objects such as aircraft, ships, motor vehicles, weather formations, and terrain by using a narrow beam of extremely high-frequency radio pulses or electromagnetic waves that get reflected back by the object to the transmitter. The signal is then displayed on a radarscope. The direction of the reflected beam and the time between transmission and reception of a pulse determine the position of the object.[28]

The radar sub-sector includes all technologies related to the generation, transmission, reception and processing of data for radar applications. The sector is also expanded to include related technologies, such as ultrasound and sonar-based systems as they operate on similar principles.

The radar sector includes both military and civilian applications. Radar is still primarily used in defence systems and is becoming tightly integrated into battlefield management systems. Military uses of radar technology include:

- Detection systems for aircraft and missiles
- Marine radar and sonar technologies
- Missile-guiding technologies
- Electronic evasion systems
- Synthetic aperture imaging systems for surveillance
- Radar jamming systems

Radar technology is also used extensively in non-military applications. The **most prevalent of such systems are civilian airport landing and control tower systems**, which rely primarily on both short-range and long-range radar technologies. Meteorological systems also utilise weather radar technology to assist in weather predictions. Other non-military uses of radar and related technology include:

- Automotive radar systems
- Ground penetrating radar for mining and prospecting
- Sonar-based fish detection systems
- Commercial marine radar systems
- Radar guns for measuring speed, including in sport applications
- Radar level sensing (for level-sensing applications)

6.2 International market and supply trends

6.2.1 Market trends

Despite generating healthy revenues of US$1.84bn in 2009, the defence radar market is declining. The overall market shrank by 9.4% in the past year. This drop is due in part to lower military spending and experts predict that the decline will continue over the next ten years.

However, the radar market is still considered to be lucrative, with predictions placing the overall market value at US$54bn over next decade, with over 15,000 individual units being produced.

The largest demand for military radar equipment is expected to come from military aerospace companies, for use in military fighter aircraft. Avionics equipment typically accounts for over 30% of the costs involved in the manufacturing of a typical fighter jet, with a significant portion of those costs going to radar systems.

[28] Engineering Dictionary - http://www.interfacebus.com/Electronic_Dictionary_Radar_Terms_R.html,

Industry analysts predict that the integration of radar into military systems will continue and will in part drive radar sales around the world. These technologies are often referred to as "network-centric tactics" and are predicted to be a significant growth area in the future.

A further driver for military radar systems is the widespread adoption of Unmanned Air Vehicles (UAV) technologies and Unmanned Air Systems (UAS). These systems can easily be fitted with radar-based surveillance equipment, such as synthetic-aperture radar systems or traditional radar detection systems. These systems will further boost radar sales over the next ten years.

One particular trend in the radar market is the growing interest in multi-use radar systems, in which multiple radar platforms are combined into a single unit. These are particularly prevalent in the wide uptake of Active Electronically Scanned Array (AESA) radar systems, which make use of a digital signal processing technique known as beamforming over the traditional mechanically scanned radar systems.

Non-military applications of radar technologies also show strong signs of growth, especially in the field of sport radar tracking, airport radar systems and weather radar. The South African government has recently earmarked R240m for the purchase of new Doppler radar stations to improve weather predictions across South Africa. These investments are long-term and therefore generate cyclical demand patterns.

COMPARISON WITH SOUTH AFRICAN MARKET

Consolidated information on the size of the South African radar market is not readily available. Purchases tend to be dependent on upgrades or expansion by a small number of entities (such as the SANDF, ATNS and SA Weather Service). Some examples of the scale of investments are provided below.

- Air Traffic Navigation Services[29]:
  ATNS has an installed radar capital investment of around R380m; recent investments of over R34m have been made. Assets are depreciated over 7 to 15 years. Estimates are that an approach radar sensor currently costs R65m and a display unit R11m.

- The South African Weather Service:
  SAWS recently unveiled a new R240-million weather radar network investment programme, which would be funded by South Africa's Department of Environmental Affairs (DEA) over a three-year period. This investment is to upgrade and replace the country's 30-year old radar systems, thus improving the country's weather-observation capacity[30].

6.3 Supply trends

Military and surveillance radars are dominated by Raytheon and Northrop Grumman, although the European companies, Thomson-CSF and Marconi Electronic systems are gaining traction. Other consortia, such as AGS Industries and MEADS are also gaining influence in the radar market. Other major suppliers include:

- Accipiter Radar Technologies, Inc
- Delphi Engineering Group, Inc
- DeTect, Inc
- DRS Training & Control Systems, Inc
- Easat

[29] ATNS 2009 Annual Report; Response by the Minister of Transport to parliamentary question Number 848, April 2010
[30] Engineering News, 29 March 2010, R240m weather-radar network viewed as key climate-adaptation tool

- EWR Weather Radar
- GPR Professional Services, Inc
- ISEE
- Linktronic
- Lockheed Martin
- Malibu Research
- Micromet
- Penetradar Corp
- Radio-Research Instrument Co., Inc
- Raytheon Canada
- Saab Microwave Systems
- SELEX-Gematronik
- Sivers IMA AB
- SKY Computers Inc.
- Southern Radar Imaging
- Syracuse Research Corporation

The weather radar market is dominated by two major suppliers: Honeywell and Rockwell Collins. Honeywell recently acquired the AlliedSignal range of airborne weather products, which removed the third major competitor.

6.4 Manufacturing activities and capability in South Africa

South Africa has a number of companies that actively develop military radar technologies. These companies produce equipment and products primarily for the export market. There are also a number of companies that produce the signal processing and data analysis components of the radar system. Companies manufacturing radar and related products in South Africa include:

Table 13: Examples of military radar manufacturers in South Africa

Company	Nature of business	Description
Reutech Radar	▸ Manufacturer ▸ Integrated system provider	Manufacturer of a wide range of radar products, including: 3D and 2D surveillance systems, tracking systems, movement and surveying (used in mining)
EDH	▸ Manufacturer	Manufacturers of military radar equipment and sports radar products.
Parsec	▸ Sub-assembly contract manufacturer	IPC Class 3 manufacturer supplying radar sub-assemblies and processing equipment.
Peralex	▸ Sub-assembly designer ▸ Sub-assembly manufacturer	Designs and manufactures high-speed signal processing and analysis hardware sub-assemblies.
Tellumat	▸ Integrated systems provider ▸ Manufacturer	Manufacturer of military and civilian radar applications and systems.
Denel Dynamics	▸ Manufacturer	Manufactures radar tracking systems for missiles and UAVs.

There are also a number of companies producing radar products for non-military usage. These companies are listed below:

Table 14: Examples of companies producing non-military radar products in South Africa

Company	Nature of business	Description
EDH	▸ Manufacturer	Sports radar and tracking products
SIA Solutions	▸ Manufacturer ▸ System provider	Airport approach and landing systems

EDH manufactures a range of sport tracking systems based on 3D radar technology. The company is a market leader in this technology, and face very little international competition. SIA Solutions is partially owned by Tellumat and provides airport approach and landing systems based on radar technology.

Radar technology requires a number of special components and sub-assemblies. Tolerances in radar systems are very tight, and therefore a close relationship with suppliers is critical. A list of the key suppliers of components and sub-assemblies is given below:

Table 15: Key suppliers of radar components and sub-assemblies in South Africa

Company	Nature of business	Description
RF Design	▸ Distributor	Specialises in radar, microwave and high frequency components.
Poynting Group	▸ Manufacturer ▸ Distributor	Supplies high-quality and custom antenna for use in high-frequency applications.
RS Components	▸ Distributor	General distributor with large product range, including many specific radar components.
ECS	▸ Distributor	Supply various components
Avent Kopp	▸ Distributor	Supplies a wide range of RF, analogue and processing components.
Arrow Altech	▸ Distributor	Supplies a wide range of RF, analogue and processing components.

6.5 Sub-sector assessment

Table 16: Radar SWOT assessment

Radar	
STRENGTHS ▸ South Africa has expert designers and manufacturers of high-quality military radar equipment, many of which have ample spare capacity ▸ Pioneers in the field (e.g. sports radar technology) ▸ There is existing skills and potential to manufacture non-military based products	**WEAKNESSES** ▸ Exchange rate fluctuations increases the minimum volume required to remain sustainable ▸ Majority of electronic components are imported ▸ Local industry dependent on defence expenditure
OPPORTUNITIES ▸ Sports radar systems ▸ Contract radar design ▸ Sonar and marine technologies	**THREATS** ▸ Squeeze on defence budgets due to fiscal tightening ▸ Large contracts and long contracting periods makes the companies in the sub-sector vulnerable (e.g. lack of cash flow)

7 Power electronics

7.1 Sub-sector definition and overview

Power electronics is the applications of solid-state electronics for the control and conversion of electric power. Typically, this is classified as any electronic components that use more than 24 V as power electronics.

Key devices that are part of power electronics include –rectifiers, power inverters, transformers, UPS and motor control units.

Rectifiers are electrical devices that convert alternating current (AC) to direct current (DC), which is known as rectification. Rectifiers have many uses including as components of power supplies and as detectors of radio signals. Rectifiers can be classified as uncontrolled and controlled, and the controlled rectifiers can be further divided into semi-controlled and fully-controlled rectifiers. Uncontrolled rectifier circuits are built with diodes, and fully-controlled rectifier circuits are built with silicon controlled rectifiers. Three-phase bridge rectifiers are used for delivering higher power output, up to 500 kW at 500 V dc or even more.[31]

An **inverter** is an electrical device that converts direct current (DC) to alternating current (AC); the converted AC can be at any required voltage and frequency with the use of appropriate transformers, switching, and control circuits. Inverters are commonly used to supply AC power from DC. With HVDC power transmission, AC power is rectified and high voltage DC power is transmitted to another location. At the receiving location, an inverter in a static inverter plant converts the power back to AC. Invertors include semiconductor transistors and semiconductor switches. The most commonly used switching components are MOSFETs and IGBTs. Resonant filters are applied if the invertor is designed to provide power at a fixed frequency.

A **transformer** is a device that transfers electrical energy from one circuit to another through inductively coupled conductors—the transformer's coils. A varying current in the first or primary winding creates a varying magnetic flux in the transformer's core, and thus a varying magnetic field through the secondary winding. This varying magnetic field induces a varying electromotive force (EMF) or "voltage" in the secondary winding. This effect is called mutual induction. Larger power transformers operating at high voltages may be wound with copper rectangular strip conductors insulated by oil-impregnated paper and blocks of pressboard.

Uninterruptible power supplies are electrical products that provide emergency power to a finished product when the input power source (often the utility mains) fails. A UPS differs from an emergency power system or standby generator in that it will provide instantaneous or protection from input power interruptions by means of diesel generators and flywheels for high power users. Additional features available on high-voltage supplies can include the ability to reverse the output polarity along with the use of circuit breakers and special connectors intended to minimise arcing and accidental contact with human hands. Some supplies provide analog inputs (i.e. 0-10V) that can be used to control the output voltage.

A **variable-frequency drive (VFD)** is a system for controlling the rotational speed of an alternating current (AC) electric motor by controlling the frequency of the electrical power supplying the motor. A variable frequency drive system generally consists of an AC motor, a controller and an operator interface. Motors are usually three-phase induction motors. Variable frequency drive controllers are solid state electronic power conversion devices which include rectifier and inverter circuits. The rectifier is usually a three-phase, full-wave-diodebridge which coverts AC power into DC power. The inverter circuit then changes the DC power into three channels of AC that can be used

[31] Interactive Power Electronics Online Text (1999). “Chapter 3: Rectifiers” - http://services.eng.uts.edu.au/~venkat/pe_html/contents.htm

by the AC motor. Medium voltage VFD controllers are designed to operate at 2,400/4,162 V (60 Hz), 3,000 V (50 Hz) or up to 10 Kv.

Prepayment metering is a system developed to provide customers with electricity. The standard business model of electricity retailing involves the electricity company billing the customer for the amount of energy used in the previous month or quarter. Prepayment meters require customers to make advance payments before electricity can be used. If the available credit is exhausted then the supply of electricity is cut off by a relay. In South Africa, prepaid meters are recharged by purchasing credit and re-charging the meter by entering a unique, encoded twenty digit number into the meter keypad.

More broadly in the power electronic sub-sector, there are control systems used for buildings, mines and other industry, such as 'HVAC' control systems, building management systems, fire detection and management systems and automation systems.

HVAC control systems are computerised system to control climate and temperature. HVAC stands for heating, ventilation, air-conditioning. Often, these systems integrate fire, security, and lighting controls into one system. Central controllers and most terminal unit controllers are programmable, meaning the direct digital control program code may be customised for the intended use.

7.2 International market and supply trends

7.2.1 Market trends

The global market for power electronics was worth US$9.8bn in 2007. This was expected to reach $10.2bn by the end of 2008 and $17.7bn in 2013, for a compound annual growth rate (CAGR) of 11.7%. The U.S. market generated $2.1bn in 2007 and was expected to generate $2.2bn in 2008. This should reach $3.9bn in 2013, a CAGR of 12.1%.[32]

The power electronics market is expanding, especially power devices for application markets above 1.7kV, such as wind power converters and electricity transportation and distribution. The total expected market size for such devices is $405m (including power devices and power modules) much smaller than lower voltage markets. Electricity T&D will benefit from the strongest CAGR between 2010 and 2015: 11.1%. Wind turbine converters have not suffered so much from the 2009 crisis, and their growth is expected to be the second strongest, with 2010 – 2015 CAGR of more than 9%.[33]

The world UPS market contracted by a projected $400m in 2009 due to the financial downturn, but long-term growth forecasts show recovery to nearly double-digit growth by 2011.[34]

Variable frequency power converters used in wind turbines are expected to account for $1.21bn in global sales this year and it will grow at an annual growth rate of 14.5%. Capacitor and ultracapacitor manufacturers are among the suppliers benefiting from the spread of wind turbines as it is ultracapacitors that control the pitch of the blades.[35]

[32] BCC Research (2008). ' Power Electronics: Technologies and Global Markets'
[33] Bharat Book Bureau (2010) 'High Voltage Power Electronics Market and Technology Trends' – www.bharatbook.com
[34] Power Electronics Technology (2009). 'Global UPS Market to Dip by more than 5% in 2009. – www.powerelectronics.com
[35] Power Electronics Technology (2006). 'Wind Will Power Component Development Too' – www.powerelectronics.com

COMPARISON WITH SOUTH AFRICAN AND AFRICAN MARKET

"Control's and instrumentation" is one of the five focus areas of Eskom's Commercial Supplier Development Programme (CSDP)[36]. Eskom plans to spend R4bn on controls and instrumentation by 2013, R1bn of which is aimed at local companies. Furthermore R21bn will be spent on plant and equipment, R15bn of which will be local content. For example, General Electric has recently announced that 75% of the value of a R500-million switchgear contract with Eskom will be produced in South Africa[37].

7.2.2 Supply trends

The major international power electronics companies include:

- Mistubishi Electric
- Vestas
- Ciemat
- Infineon
- GHE Group
- IREC
- Areva
- Alstom
- Altran
- Siemens

Many of these companies are present in the South African market, although some offer distribution services rather than local production.

7.3 Manufacturing activities and capability in South Africa

Powertech Transformers are the only African company capable of manufacturing large scale power transformers. There are three South African companies producing power transformers locally who have a combined turnover of around R600m. In 2004, there was little excess capacity[38]. Alstom is also an important manufacturer of transformers, with production facilities in Gauteng.

In South Africa, the manufacturing capability includes the following:

- **Powertech Transformers**: Powertech is focused on delivering advanced technologies for the creation, management, distribution, storage and use of electricity across industries. Power and distribution transformers for the African continent are manufactured by Powertech Transformers at its operations in Pretoria West, Cape Town and Johannesburg. The range of transformers manufactured by Powertech Transformers cover three-phase and single-phase units, auto-transformers, shunt reactors, rectifier transformers including many others which are tailor-made to meet customers' exact requirements
- **Desta Power Matla (DPM):** The Company manufactures and designs polo mounted, ground mounted and power transformers as well as miniature substations
- **Ellies**: The Company manufactures and distributes electronic products related to television reception, including satellite and terrestrial aerial ranges. The group is also a market leader in domestic electrical and industrial audio products, and a major importer of associated products.
- **MLT Drives**: is a small Cape-based company with a staff of some 25 employees. It was established during 1986 with its focus on the design, manufacturing and marketing of advanced power electronic products, these including inverters, battery chargers and alternative energy solutions (e.g. wind and solar)

[36] http://www.eskom.co.za/
[37] Engineering News, 19 May 2010, GE commits to localisation as it wins R500m Eskom order
[38] dti (2004) 'Research Study into the Power sub-sector of the Electrotechnical Industry in South Africa'

- **GE Security**: GE Security covers the full spectrum of security and detection systems solutions, including high-tech video monitoring, web-based surveillance systems, access control, fire alarm and life safety, commercial and residential intrusion detection, and explosives and narcotics detection
- **ABB**: The Company offers a range of power and automation technologies solutions. Solutions for utilities include: electrical power infrastructure for transmission and distribution networks and associated products and systems, such as substations, reactive power compensation, utilities automation (including protection, control and Scada), water EPC contracts and power plant automation. In South Africa, the group has a strong local manufacturing capability with seven manufacturing sites around the country
- **Alstrom**: innovators and manufacturers in heat transfer equipment and design. Products include: heat exchangers for general applications, fuel oil preheaters, heat exchangers for special applications, heat recovery heat exchangers, packaged heat transfer systems |liquid-vapour separators/boiler room accessories, storage tanks and plate and frame heat exchangers
- **Sperosens:** manufacturers and suppliers of telemetry systems and fixed systems, LED illumination products, continuous miner monitoring systems, fire suppression systems, gas detection and emission monitoring and process measurement instruments
- **CM Transformers**: Designers and manufacturers of all types of small transformers for the telecommunications, instrument, audio and appliance industries. Designer and manufacturer of all types of transformers for original equipment manufacturers
- **Lehman Transformers**: Manufacturers in the electronic transformer winding industry. They are suppliers to other electronic manufacturing companies and work in conjunction with OEM companies to develop transformer and /or wound products. They have also worked with overseas companies in cutting edge technology and have been instrumental in assisting in transformer development and the supply of large quantities of transformers

South Africa is considered to have capacity in the following areas:
- Power transformers, inverters and rectifiers
- Fire detection systems (e.g. GE Security)
- Power metering (e.g. Conlog)

There are a number of companies in South Africa which currently produce power transformers, inverters and rectifiers. These include:

Table 17: Examples of power electronics manufacturers in South Africa

Company	Nature of business	Description
MLT Drives	▸ Manufacturer ▸ Distributor and Maintenance	Manufactures converters and invertors for use in energy conversion solutions. Transformers are imported, as part of 70% of components used in final manufacturing.
Powertech Transformers	▸ Manufacturer	Only African manufacturer of large high voltage transformers. Produces around 120 units with rating from 20 to 800MVA and voltages up to 500kV each year. Powertech Transformers also produces distribution transformers.
ABB	▸ Manufacturer	Produces medium and high voltage transformers, and transformer components. It has 8 manufacturing sites across South Africa.
African Capacitors	▸ Distributor	Produces power capacitors for UPS applications. These are sourced from India, for cost-effectiveness and reliability.
Parsec	▸ Component manufacturer	Performs assemblies and sub-assemblies which are integrated into larger systems. Parsec is the preferred supplier for Denel and is routinely involved in design activities.

There are a number of companies in South Africa which currently produce fire-detection systems, as set out in the table below.

Table 18: Examples of fire detection manufacturers in South Africa

Company	Nature of business	Description
GE Security	▸ Manufacturer ▸ Distributor	The Ziton range of fire detection systems are all manufactured in South Africa and distributed internationally. The range also includes fire alert sirens, door sensors, laser-based fire detection sensors. Board population and final assembly takes place in Cape Town factory, currently utilising 75% of their production facilities.
Sperosens	▸ R&D ▸ Manufacturer ▸ Distributor	Distributes sensors, monitoring systems, process measurement instruments and fire suppression systems for a range of clients – including domestic (IS Oldham) and international (Weber Captor GmbH) companies. Also develops, manufactures and maintains the Toxalarm – a cap mounted carbon monoxide warning device.

There are also a number of companies in South Africa which currently produce energy meter equipment (see also the section on energy-saving technologies for information on suppliers of smart metering solutions). These include:

Table 19: Examples of energy metering manufacturers in South Africa

Company	Nature of business	Description
Vektronix	▸ Contract manufacturer	Contract manufacturer of pre-paid utility meters for a host of national and international companies. Imports 90% of components and sub-assemblies. Focus on high volume assemblies – facilities not configured to support volumes lower than 500 units.
Conlog	▸ Manufacturer	Provides pre-paid meters – including meter hardware and revenue management systems. Imports PCBs, but sources sub-assemblies from local manufacturers. Capable of producing 800,000 units per year.
Strike Technologies	▸ Manufacturer	Developer, manufacturer and distributor of medium to high voltage protection relays, surge protection equipment, industrial earth leakage relays, energy and demand metering and protection test equipment.
Landis + Gyr	▸ Manufacturer	Landis+Gyr offers metering solutions, from credit and prepayment metering to meter test equipment. The company's prepayment metering solutions comprise a range of meters and sophisticated vending software marketed under the brand name Cashpower. Its' credit metering solutions from grid to residential applications are sold throughout Africa. The company also has sole distribution rights for MTE meter test equipment, which it markets and sells in selected African countries.
Actaris	▸ Manufacturer	Provider of metering, data collection and utility software solutions, with nearly 8,000 utilities worldwide relying on technology to optimise the delivery and use of energy and water. Their products include electricity, gas, water and heat meters, data collection and communication systems, including automated meter reading (AMR) and advanced metering infrastructure (AMI); meter data management and related software applications.
CBI: Low Voltage	▸ Manufacturer	Manufacturer of electrical distribution and protection components for low voltage electrical distribution systems. Located in Elandsfontein, Gauteng.

7.4 Sub-sector assessment

Table 20: Power electronics SWOT assessment

Power electronics	
STRENGTHS ▸ Local manufacturers are producing more robust wind turbine systems ▸ Strong local demand which is likely to grow because of the renewable-energy feed-in tariff (Refit) and the energy crises ▸ Relatively low labour costs give transformer manufacturers an advantage as the process is hard to automate ▸ Extensive mining and mineral benefaction industry provides local demand for sensors and systems	**WEAKNESSES** ▸ Import electronic components ▸ Difficulty in obtaining capital ▸ Lack of skilled engineers, technicians and artisans ▸ Lack of funding for securing new markets
OPPORTUNITIES ▸ Renewable energy systems ▸ Transformer manufacturing ▸ Sensors and systems unique to the large South African economy, e.g. mining and minerals beneficiation	**THREATS** ▸ Strong international competition ▸ Increased use of nuclear power ▸ Procurement policies which are not locally focussed could lead to loss of domestic manufacturing capabilities

8 Energy-saving technologies

8.1 Sub-sector definition and overview

Energy-saving technologies consist of a wide range of product, systems, and components which assist in overall energy reduction, through generation, increased efficiency or novel processes. Products which assist with the reduction of emissions, the conservation of water and the promotion of natural alternatives (such as natural light or free-cooling) are also included in this sector.

The energy-savings technology sector is primarily driven by the commercial and residential sectors, with the majority of technologies applying to these users. There are a number of generation technologies, such as systems to improve the efficiency of terrestrial power distribution, which is typically either implemented or controlled through government policy.

Energy-efficient technologies are used throughout the renewable energies discipline, as innovative systems are required to implement alternative energy sources onto national grids. These systems also require storage and power regulation systems, which have unique requirements not found in current commercial applications. Wind power generation is a good example of such an industry where energy-efficient power conversion technologies are required in order to maximise the realisable benefits. These products include sophisticated power inverters, rectifiers and storage techniques.

Commercial applications of energy-saving technologies are primarily centred on improving the energy efficiency of a residential dwelling. In the majority of countries, heating systems consume the majority of energy in a typical household as this is required for heating, cooking and the production of hot water. There are many systems to intelligently manage such systems internally, such as smart appliances, household energy monitors, intelligent metering solutions and timing controls for devices such as electric hot water geysers.

Demand-side management is another technique used to assist in energy saving by allowing utility companies to selectively control demand by disconnecting selected electrical appliances, such as electric hot water geysers, within households during peak periods. This requires an additional communication link between households and the power utility, but is proving to be a viable means of controlling energy consumption.

Household lighting is also a field in which many energy-saving technologies exist (see also the section on lighting). High-efficiency lighting, using compact fluorescent or LED technologies, are gaining popularity and provide simple means of lowering electricity bills. Lighting control systems are also becoming popular, especially in the form of movement-sensitive lighting and intelligent day/night lighting products.

The commercial sector is one of the largest consumers of electricity, primarily due to air conditioning and lighting requirements. Although Building Management Systems (BMS) were originally implemented to allow centralised building monitoring and control, these systems have become increasingly used to assist in reducing energy consumption. This is primarily due to the interconnectivity and large number of sensing inputs implemented by such systems. More sophisticated systems are referred to as Energy Management Systems (EMS), and can implement advanced energy-saving techniques like demand-modelling.

Smart metering technologies, both in a residential and commercial setting, are also classified as energy-saving technologies as they increase the efficiency and accuracy with which electricity usage is measured. These systems can also supply additional energy utilisation information, such as energy usage profiling, peak demand monitoring and supply instability or interruption detection.

The development of electronic vehicles and plug-in hybrids also considered to be an energy-saving technology.

8.2 International market and supply trends

8.2.1 Market trends

Energy-efficient electronics are not consistently considered as a market segment, and therefore an indication of scale of the market needs to be determined from related market segments. For example, estimates put the value of green building construction at US$10bn in 2005, rising to between US$36bn and US$49bn in 2008. Industry analysts expect that this value could increase threefold to reach up to US$140bn in 2013[39]. This growth can largely be attributed to growing public awareness of green technologies and an increasing government regulations regarding energy efficiency in new building. There are also lower operating costs associated with green buildings, and savings of up to 13.6% on average were reported in 2009 (up from 8% in 2005). Green technologies have also been shown to improve building value by up to 10.9% (up from 7.5% in 2005).

Labelling and rating tools for homes and offices are beginning to emerge which provide a means to quantify and compare building energy efficiencies. These technologies are also beginning to find support among large institutions and standards bodies. These systems will allow easier comparison between buildings, offices and household and should encourage adoption of energy efficient systems. Public listing services for such scores could also drive building owners to invest in energy technology improvements.

Chief among these technology improvements is smart grid technology, which is expected to grow rapidly from 2010 onwards. Pike Research suggest that more than 250 million smart metering solutions will be in operation worldwide by 2015, representing a significant growth from the 46 million units installed and in use during 2008. The research suggests that this would make up 18% of the total installed electric meter base in 2015. Estimates put the value of the smart-grid market at US$20bn over the next five years. The research also suggest that 49% of the smart meters sold during the next five years will include home networking connectivity functions, allowing it to control and communicate with household equipment and appliances. By 2013, estimates put the penetration of such meters in the United States at over 81%.[40]

Currently, Europe is the fastest growing market for smart meters due to quick adoption of the technology by local government and utility companies but analysts predict that North America will become the leading market in 2010, and increasing to 55% of the installed smart metering base by 2015. The cleantech market intelligence firm forecasts that total U.S. smart meter shipments will reach 39.5 million units by 2015.

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Government's target is to increase its **renewable energy** capacity to 10,000 GWh by 2012, however capacity is currently still low. For example, the country only has around 10MV of renewable wind energy.[41] The renewable energy market is expected to grow exponentially in the coming years, from $28.4m in 2008 to $262.3m by 2015.[42] This is largely based on the renewable-energy feed-in tariff (Refit) by the National Energy Regulator of South Africa (Nersa). Under Refit 725 MW is to be procured, comprising 400 MW of wind energy, 200 MW of solar energy, 75 MW

[39] McGraw-Hill Construction (2008). '2009 Green Outlook: Trends Driving Change'
[40] Penrith, S (2010). 'Top Ten Green Building Trends to Watch in 2010' – www.earthadvantage.org
[41] Prinsloo (2010). SA should take advantage of multibillion rand green economy potential. *Engineering news*
[42] REEEP. (2008). Amid outgages, South Africa moves slowly on renewables

of landfill gas and 50 MW of small hydro. This translates into a renewable-energy market opportunity of R25bn to R30bn over the next four to five years.[43]

As part of its renewable energy expansion, Eskom is planning to build a 100-MW wind farm in the near future, pending the approvals and licensing processes.[44] South Africa currently has a single operating wind farm, the 5-MW Darling plant. Eskom also reported that it is looking into the feasibility of a 100-MW concentrating solar plant in the North Cape, which the utility noted enabled storage of renewable energy for use during evening peak demand.

There are also increasing opportunities in the private sector. For example, private hospital group Netcare has made its third and largest investment in renewable energy at the Union Hospital in Gauteng, where a R1.6m, 18 500-l solar water heating system was commissioned early in 2009.[45]

In terms of **energy efficiency,** and example of the market size is the retrofitting of publicly owned buildings for energy efficiency. Approximately 4,000 buildings have already been retrofitted, and over 14,000 nationally owned buildings still require retrofitting. An initial budget of R250m has been allocated.[46]

8.2.2 Supply trends

Energy efficient products are supplied by a mix of diversified power and electronics companies (including lighting, power storage and metering, building materials) and specialist producers and systems/solutions providers.

Estimates are that technologies supporting demand response functionality will become increasingly important from 2013 onwards with the Cleantech Market Intelligence firm estimating that the market for such technologies with reach US$1.4bn in 2010 and US$8.2bn by 2020[47].

Metering solutions typically changed very slowly, with electricity meters generally having a 15 to 20 year lifespan. Increased interest in smart metering technologies and the associated savings have begun to alter this replacement cycle, and the sophisticated nature of the products suggest that future lifecycles will become far shorter.

The technologies used in networked smart metering applications are based primarily on the short-range wireless ZigBee protocol, which will allow communication between appliances. Estimates put the adoption of ZigBee in smart metering systems as high as 87%, which should bolster the adoption of ZigBee technologies in other consumer products.

Other important technologies for use in smart metering include Power Line Communication (PLC) technologies, which use the existing power distribution network to communicate with utility companies. This may find higher levels of adoption in Europe, Africa and the Middle East where other transmission technologies are less prevalent. GSM-based systems are also beginning to emerge, and have the benefit of not requiring the same level of infrastructure required by technologies such as PLC.

[43] Clarke. (2010). Bright prospects for a cleaner-energy era. *Engineering News*
[44] *ibid*
[45] van der Merwe. (2009). Netcare invests R1,6m in solar water heating for Gauteng hospital. *Engineering News*
[46] Engineering News (24 July 2009) R250m earmarked for energy efficiency retrofitting of State buildings
[47] Ibid

8.3 Manufacturing activities and capability in South Africa

There are many South African companies manufacturing and designing energy-saving technologies in South Africa. Much of the development and interest has been driven by strong international demand for renewable and energy efficient sources and locally by the recent energy shortfalls experienced over the past five years. Future demand may also be stimulated by regulatory changes, commitments (e.g. energy efficiency audits of public buildings and refitting) and certification (as through the South African Green Building Council[48]) and the development of dedicated funds to support energy efficiency and renewable energy (e.g. the joint effort between explored by the Agence Française de Développement (AFD), the French Development Agency, together with KfW, Germany's development finance institution, and the IDC).

South Africa has both the expertise and facilities to develop and manufacture smart-grid technologies in South Africa. There exists ample manufacturing capacity and technological support for such industries, although many manufacturers have taken to installing internal manufacturing capacity. The following companies are producing and distributing smart metering systems in South Africa:

Table 21: Examples of smart metering manufacturers in South Africa

Company	Nature of business	Description
Circuit Breaker Industries	▸ Manufacturer	Manufacturer of simple (primarily mechanical) electricity meters. Low voltage's main manufacturing centre is based at Elandsfontein near Johannesburg, South Africa. Three assembly plants are operated in the Free State Province
Conlog	▸ Manufacturer	Manufactures prepaid energy systems for local and international customers
Custom Power Solutions	▸ Designer	SPII-funded initiative to develop GSM-based power metering
Hefcom	▸ Manufacturer ▸ Distributor	Specialises in wireless energy metering and utility monitoring systems
Landers & Gyer	▸ Distributor	International manufacturer of energy metering systems
Powertech	▸ Manufacturer ▸ System integrator	Provides custom power metering solutions

South Africa also has a number of companies that produce products for use in renewable energy systems. These companies include the following:

Table 22: Examples of renewable energy systems manufacturers in South Africa

Company	Nature of business	Description
Dirwatt Limited	▸ Manufacturer	Manufacturer of Solar water pumping systems, battery charge controllers, photovoltaic module mounting systems
Jupiter Resources	▸ Manufacturer	Manufacturer of Photovoltaic cells, wind turbines (large), solar charge controllers
Kestrel Wind Turbines (Eveready subsidiary)	▸ Manufacturer	Manufacturer of wind turbines: (600W to 3kW), controllers and wind pumping systems
Southern Cross Industries	▸ Manufacturer	Manufacturer of water-pumping windmills
Set Solar	▸ Manufacturer	Manufacturer of solar panels
Thin-film Solar Technologies	▸ Manufacturer	Manufacturer of solar panels from micro-thin

[48] 'Green Business Council of South Africa' - www.gbcsa.org.za

Company	Nature of business	Description
		metallic film
FNB Industrial	▸ Manufacturer	Manufacturer of lead-acid based storage solutions for solar projects
MLT Drives	▸ Manufacturer	Manufacturer of electronic components for use in renewable energy systems
Solarite / Liselo Solar	▸ Manufacturer	Manufacturer of solar PV modules, regulators and related accessories
Tenesol Manufacturing	▸ Manufacturer	Manufacturer of solar PV modules, solar water pumping systems, hybrid power systems, data logging systems, telecommunications power systems

There are also a few companies that supply or manufacture equipment required in the majority of energy efficient systems, these companies include the following:

Table 23: Examples of manufacturers of equipment required for energy efficient systems in South Africa

Company	Nature of business	Description
Emerson Network Power	▸ Distributor	Power supplies, standby power systems, climate control systems, energy management systems, and shelter and cabinet solutions for the Datacom and Telecommunication industry
Aero Energy	▸ Manufacturer	Manufacturer of rotor blades for wind turbines
African Windpower	▸ Manufacturer	Manufacturer of Off-grid small wind turbines and towers

8.4 Sub-sector assessment

Table 24: Energy-saving technologies SWOT assessment

Energy-saving technologies	
STRENGTHS ▸ Strong local and international growth market ▸ Possible policy intervention to boost market ▸ South Africa already has a well established pre-paid electricity metering industry ▸ Therefore there is existing skill and infrastructure to develop smart meters ▸ Sub-sector marked by new innovations and South Africa offers some of the most innovative products	**WEAKNESSES** ▸ Lack of consumer knowledge about the benefits of the energy saving products ▸ No definitive standards for LED-based illumination ▸ Required to import components ▸ Lack of skilled engineers, technicians and artisans ▸ Lack of clarity on feeding solar electricity into the Eskom grid
OPPORTUNITIES ▸ Smart metering applications ▸ Pre-paid electricity vending ▸ Solar energy products ▸ Renewable energy storage	**THREATS** ▸ Poor quality and service delivery to consumers of solar energy products is hurting the industry ▸ Procurement policies which are not locally focussed could lead to loss of domestic manufacturing capabilities ▸ Strong competition from China in solar energy products such as solar heaters

9 Lighting

9.1 Sub-sector definition and overview

The lighting sub-sector is made up of two types of products: **light-producing** technologies and **lighting-control** technologies.

Light-producing technologies include fluorescent lamps and solid-state lighting products (primarily LED-based technologies). Elementary lighting components, such as filament light bulbs, have not been included.

The majority of light is still produced using filament-based incandescent lighting, but a range of alternative technologies are gaining widespread adoption. These alternatives offer improvements in energy efficiency, lifespan and operational limitations. Traditional filament bulbs offer very low efficiencies and manufacturing requires large quantities of tungsten. There are two competing technologies that are poised to replace incandescent lighting; compact fluorescent bulbs and solid-state lighting technologies.

Compact fluorescent bulbs consist of a gas-filled tube and ballast. The tube is filled with mercury vapour and lined with a phosphorous coating. The ballast, usually now an electrical device, forces a current to flow through the gas-filled tube. This causes the mercury vapour to emit ultraviolet light, which excites the phosphorous coating and produces visible light. The spectrum of light produced by a compact fluorescent light is fundamentally different from that produced by incandescent lighting, and has been traditionally used in commercial lighting environments. Improvements in the coating and ballast technologies have resulted in fluorescent lamps that produce warmer light suitable for residential applications.

Fluorescent lamp are either sold as tubes requiring a special fitting to house the control and ballast circuitry, or as an integrated product in the form of a compact fluorescent bulb with an Edison or bayonet fitting for use in conventional incandescent light sockets. As the fluorescent tubes contain mercury (approximately 5mg of mercury per energy-saving bulb), careful handling and disposal of the lights is required. Fluorescent lamps are also not readily compatible with the majority of dimmer switches used in residential applications. Variable brightness solutions are available for fluorescent lamps but are costly and require special installation.

Despite these problems, there is widespread adoption of fluorescent lamps over traditional filament bulbs, due in part to the acceptance of the technology and the compatible form-factor offered by bulb-replacement lamps. There are also many government incentive programs worldwide to encourage the usage of compact fluorescent bulbs.

Solid-state lighting technologies use clusters of high-intensity light emitting diodes (LEDs) to produce light. LEDs are very energy efficient and recent technological advances in the power, intensity and spectrum of LEDs over the last five years have made the technology suitable for use in the lighting sub-sector. LED illumination products are still in their infancy, with the primary driving force coming from their use as a backlighting technology in televisions and monitors.

An individual LED is relatively small and only produces a small amount of highly-directional light and LED lighting products usually consist of a cluster of individual LEDs. The individual LEDs can be bought as standard components, many of which are common across the industry. LEDs are a semiconductor technology and can be manufactured using a similar process to the standard semiconductor manufacturing processes used throughout the electronics sector. This greatly simplifies production and allows LEDs to be mass-produced with relative ease.

LED lighting offers the advantage of versatile and component-based assembly – making it particularly applicable in a wide range of specialised lighting applications. LEDs are easier to

control and regulate than fluorescent lamps and produce less electromagnetic interference, allowing for greater control over the lighting output. LED lighting is also affected less by temperatures, and operate far more effectively than other technologies in cold conditions. LED lighting technology has not reached the point where it provides a comprehensive solution to all lighting requirements but it is the subject of active research worldwide.

LED lighting technology is also finding widespread adoption in consumer electronic products (particularly for backlighting purposes) and this is contributing to the investment in both research and manufacturing capability of LED technologies. Furthermore, the United States Department of Energy has earmarked the field of solid-state lighting as a critical technology for improving energy efficiency, and is actively supporting and funding research in the sector.

Lighting applications also include **mobile products such as headlamps and mining caplamps, torches and automotive headlamps**. These may make use of a range of technologies, but the use of LED is rising.

Lighting-control technologies are devices and products intended to adjust, manage, regulate and optimise lighting in a given environment. Passive devices, such as light switches, are not included in this definition due to the simplicity of their operation.

Lighting efficiency can be greatly improved through the improvement of lighting control mechanisms. Applicable primarily to the commercial building sector, intelligent building controls are capable of maximising lighting efficiency by turning off lights in vacant rooms and adjusting the brightness according to outside light conditions. These technologies are becoming increasingly important in the design of new buildings, especially in light of the design guidelines proposed by the Green Building Council and the Energy Star program.

9.2 International market and supply trends

9.2.1 Market trends

The global lighting industry produces approximately 20 billion units per year. Predictions in 2007 placed the total value of the global lighting industry in excess of US$94bn by 2010. Philips, a leading producer in the lighting sector, estimates the value of the industry to be US$75bn at the end of 2009, with the United States accounting for approximately US$19bn (20%). One of the primary reasons for the rapid slowdown in actual growth was the sharp decrease in construction and industrial development as a result of the financial crisis.

It is predicted that China will exhibit the highest growth in demand for lighting products, with European and American demand falling below the global average as these markets focus on improving energy efficiency.

Lighting is one of the most important sub-sectors of the electronics industry, on both a domestic and global scale. The Department of Energy in the United States estimates that lighting accounts for up to 8% of the total energy consumption of the country. In commercial buildings, lighting alone accounts for 18% of the energy consumed.[49] Lighting indirectly increases energy consumption further as inefficiencies in lighting products emit a significant portion of the energy consumed as heat – placing additional load on the HVAC systems.

The United States Department of Energy (DOE) predicts that recent technological innovations such as solid state lighting could save 1 488 terawatt-hours of energy between 2010 and 2030. At

[49] US Department of Energy (2009). 'Solid State Lighting – Using Light-Emitting Diodes' – www.energy.gov

current energy prices, the U.S. DOE estimates that this would save the equivalent of US$120bn.[50] Primarily, the DOE expects this saving to arise from the widespread adoption of solid-state lighting in the commercial sector – which currently already utilises the more efficient halogen and fluorescent lighting technologies.

Traditional lighting with incandescent bulbs is declining, with the revenue share of global lighting sales decreasing to 59.2% in 2008 (from 69% in 2004). Companies such as Toshiba, which began producing incandescent bulbs 120 years ago, have ceased production of incandescent bulbs, and instead shifted their focus to LED-based solid-state lighting technologies.[51]

Since its commercial introduction in 1932, the Low Pressure Sodium lamp has consistently maintained its position as the most efficient light source available. Present-style LPS lamps are known as the SOX type, and the entire global supply of approximately four million pieces per year is made exclusively in the UK by Philips at Hamilton, and by GE at Leicester . Despite increasing competition from High Pressure Sodium and Metal Halide lamps, the market for this light source remains quite stable and it continues to be specified for new installations. SOX lamps are generally employed in streetlighting applications, primarily because they are the most efficient light sources available This means that they deliver more lumens of light for each watt of power than any other type of lamp SOX installations therefore have the lowest energy consumption costs which is of crucial importance when thousands of miles of roads must be lit and the electricity bills must be kept as low as possible.

Many countries are attempting to phase out incandescent bulbs in the next few years, with Russia planning to ban 100W bulbs by 2011, and 70W bulbs by 2013. The European Union is also attempting to phase out incandescent bulbs by 2012.

Energy efficient lighting constitutes approximately 28% of the global lighting market. Interestingly, it is the Asian countries which lead the world in the adoption of energy efficient lighting technologies, primarily due to the rapid growth in developing countries and improvements in the median lifestyles in countries such as China. As an illustration, the average American household has 52 light sockets, the average Netherlands household has 40 and the number of light sockets in the average Shanghai household has increased from 5 in 2004 to 18 in 2009.[52] It is this demand, both for lighting products and energy, which has led to the wider adoption of energy efficient technologies in Asia over Europe and the United States.

Consumers are also embracing energy-efficient lighting technology with 87% of consumers prepared to try an energy-saving lighting product with the cost-saving being cited as the primary factor.[53] Consumers are also willing to pay more for energy efficient bulbs, such as compact fluorescents and LED-based technologies, due to the increased lifespan and potential energy savings.

COMPARISON WITH SOUTH AFRICAN MARKET

The lighting industry in South Africa is estimated at R5bn a year[54] (less than 1% of the global market). Eskom's demand side management drive is targeting 18 million light bulbs over 15 years for low income homes.[55] Major construction projects can have a significant lighting aspect to them, e.g. the Cape Town stadium development construction value of lighting and electrical installations was close to R40-million, including approximately 3700 light fittings, some of which are LEDs.

[50] US Department of Energy (2010) 'Energy Savings Potential of Solid-State Lighting in General Illumination Applications 2010 to 2030' – www.energy.gov
[51] LEDs Magazine (2010) 'Toshiba ends production of general-use incandescent lamps '
[52] Kaj de Daas, chairman of Philips Lighting North America speaking to the Wall Street Journal
[53] Study conducted by Arrow (http://www.lighting.com/content.cfm?id=3211&page=/)
[54] Engineering News (February 2009) Lighting industry boom despite constraints
[55] UNIDO (date unknown) Module 14: Demand side management

9.2.2 Supply trends

The varied nature of the products comprising the lighting sub-sector makes an overall assessment of supply trends difficult. Almost all the companies producing lighting products for the global market began by producing incandescent bulbs, and have moved into the energy efficient lighting market.

Toshiba, for example, began producing the first bulb-styled compact fluorescent bulbs in 1980s, and has recently stopped production of incandescent bulbs after producing a total of 4.07bn bulbs over 120 years. Toshiba will now focus on producing solid-state and compact fluorescent technologies.

The major lighting companies include:
- Acuity Brands
- Advanced Lighting Technologies
- Catalina Lighting
- Cooper Lighting
- GE Lighting Systems
- Genlyte Group
- JJI Lighting Group
- Grote Industrie
- Hubbell Lighting
- Columbia Lighting
- Juno Lighting
- Koito Manufacturing Company
- OSRAM GmbH
- Philips Lighting
- Universal Lighting Technologies
- Zumtobel AG

The most of the above companies are billed as integrated lighting producers and either produce energy-efficient lighting products or are actively developing them. Solid-state lighting poses some additional problems to the above companies as the lifespan of an LED can be as great as 50,000 hours, fundamentally shifting the product away from a disposable product. As a result many LED lighting producers are attempting to manufacture entire light fittings, as opposed to bulb replacements.

The solid-state lighting technology market is often described as being the future of the illumination, and is primarily based on LED and organic LED (OLED) technologies. Both LEDs and OLEDs are semiconductors and are manufactured in a similar manner to many other electronic components, and benefit from the usual economies of scale present in the semiconductor market.

The primary driver behind the widespread adoption of illumination LEDs is their usage in backlights for televisions and monitors. This application is not fundamentally different from the requirements of LEDs for use in lighting products and the components and manufacturing processes are the same. Estimates put the market penetration of LED-backlit televisions at 50% by 2013, and this has spurned dramatic investment in LED production facilities. This strong demand will further drive the production of the same components required for LED illumination and estimates put the value of the high-brightness illumination LEDs market at US$8.2bn for 2010, rising up to US$20.2bn by 2014.

Manufacture of LEDs is spread out globally, with fabrication plants operating in the United States, Germany, Malaysia, China and India. A typical LED fabrication plant requires an investment of approximately US$350m and can take up to five years before becoming fully operational. The current costs of LED chips range from US$1 to US$3.50 per unit. The price per unit would need to

fall to approximately US$0.05 per unit by 2013 for the technology to become viable across all sectors.

Leading component manufacturing companies supplying LEDs include the following:
- SemiLEDs
- TSMC
- De Core Nanosemiconductor

9.3 Manufacturing activities and capability in South Africa

South Africa has the skills, equipment and manufacturing capacity to manufacture products in both the solid-state lighting sub-sector and the fluorescent lamp sub-sector. There is moderately strong local demand for lighting products, and especially energy-efficient lighting technologies. South Africa is also equipped with the design skills and manufacturing capabilities to develop products for lighting control technologies but local demand for such technologies is relatively small.

Solid-state lighting solutions

Due to the similarities between the manufacture of solid-state lighting products and conventional electronics contract manufacturing, there is greater scope and lower barriers to entry in producing solid-state lighting products. There are a number of companies in South Africa that produce solid-state lighting products for the domestic and export market. These companies generally design innovative or specialised products and purchase the LED components from global suppliers.

Application-specific PCBs are produced and must be populated, with the LEDs being treated as any other electrical component. Some form of enclosure must also be produced, and a final assembly process is required. These stages can be distributed and outsourced to either local or international firms.

South Africa has sufficient skills and capacity to produce the PCBs required for the majority of lighting applications and any other electrical sub-assembly such as power supplies and converters. The non-electrical sub-assemblies required include enclosures, connectors, sockets and cables. The majority of these can be manufactured in South Africa and can become cost-effective on a global scale due to the lower logistics costs involved in producing locally.

South Africa is currently not in a position to manufacture the high-intensity LED components required for solid-state lighting applications. There is no semiconductor manufacturing industry within the country and therefore none of the required supporting infrastructure or services. The markets have already dominated by large manufacturers capable of exploiting the economies of scale available due to the increasing global demand.

There are a number of companies in South Africa which currently produce solid-state lighting products. These include:

Table 25: Examples of solid state lighting manufacturers in South Africa

Company	Nature of Business	Description
LED Lighting	▸ Product design ▸ Manufacture	Produces LED lighting products such as signs and lights. Purchases PCBs from local and international markets, populates the boards internally (with the majority of components being imported from China) and performs the final assembly in-house.
Spero Group	▸ Product design	Designs custom LED illumination solutions, primarily using imported finished products.
Multisource	▸ Product design	Producers of specialised LED products such as pool

Company	Nature of Business	Description
	▸ Manufacture	and spa lighting. Manufactures LED lighting sub-assemblies overseas and performs final assembly in South Africa. Smaller product lines are manufactured entirely in South Africa.
CR2 Lighting	▸ Importer ▸ Distributor	Importer and value-add distributor of energy efficient LED lighting for the in- and outdoors in the commercial, industrial and residential markets.
Sunfor Technologies	▸ Manufacturer ▸ Importer	Provider of photo luminescent, LED and solar LED lighting products

Fluorescent lamps

South Africa has the capacity to produce fluorescent lamps and is active in the manufacturing sector. Due to the specific nature of the process, it is limited to companies with existing infrastructure and is best performed in a vertically integrated manufacturing process. This creates a barrier to entry for smaller firms. There are also a number of companies that produce and distribute fluorescent bulb technologies in South Africa. These include the following:

Table 26: Examples of fluorescent bulb manufacturers and distributors in South Africa

Company	Nature of Business	Description
Eveready	▸ Manufacturer	Manufacturer of fluorescent lamps for the South African market. Vertically-integrated plant produces the majority of the components locally. PCBs are outsourced to the most cost-effective company.
Philips SA	▸ Distributor and importer	Distributor of compact fluorescent bulbs. Previously manufactured lighting products in South Africa, but currently acting only as an importer and distributor.
ADA Lighting	▸ Distributor	General lighting distributor.
African Capacitors	▸ Importer	Importer of lighting ballasts for fluorescent lighting applications
Lee Power Electronics	▸ Research and development	Manufacturer of energy efficient street lights. Product is manufactured locally under licence from the IP-holders, in Germany.
OSRAM	▸ Importer	Importer of a wide range of fluorescent lamps and plug-in bulb replacements
Eurolux	▸ Distributor ▸ Importer	Importer of lighting products

Philips Lighting investment in Maseru[56]

Philips Lighting, in a joint venture with the Central Energy Fund and Karebo systems, has invested in a manufacturing plant in Maseru aimed at producing energy saving fluorescent lamps for the Southern African market, including recycling. The planned capacity of the facility is 15 million bulbs a year. The first 1 million bulbs have been delivered to Eskom's demand side management programme.

The project will create 500 jobs, and will be one of the first Foreign Direct Investments helping the Lesotho economy to diversify its industrial structure away from the footloose textile industry.

[56] http://saaea.blogspot.com/; http://www.newscenter.philips.com/

Lighting control products

There are also a number of companies in the South African market which specialise in products relating to the lighting control sub-sector. These include companies that manufacture and import products.

Lighting control technologies are primarily used in residential and commercial applications. A number of companies in South Africa produce lighting control products for the residential market such as timers and dimmer switches. These products are usually designed for use with incandescent bulbs.

There is very little demand for commercial lighting control technologies. These primarily take the form of sophisticated building management systems which regulate lighting throughout an entire building. These technologies are prohibitively expensive and are not widely used in the South African building industry.

An example of some of these companies manufacturing, importing and distributing lighting control products is presented below:

Table 27: Examples of manufacturers, importers and distributors of lighting control products in South Africa

Company	Nature of Business	Description
R & D Electronics	Manufacturer	Manufacturer of residential dimmers and motor controls. Utilises both imported and locally-made components and performs the majority of the manufacturing process internally.
Protea Automation	Value-add distributor	Provides customised automation solutions using imported hardware solutions. Does not manufacture hardware but writes specific firmware for the target application.
Siemens South Africa	Distributor	Supplies a wide range of building control systems to the South African market. Siemens also has a training centre in South Africa.
Crabtree	Manufacturer	Manufacturer of a range of switches and sockets, circuit breakers (MCB & MCCB), commercial and industrial lighting products, energy efficient home and light commercial automation, battery and generator back-up power products, supplied into the building and construction, mining and general industrial sectors.
Philips	Distributor	Products include programmable lighting management systems such as the Lightmaster.modular system

9.4 Sub-sector assessment

Table 28: Lighting SWOT assessment

Lighting	
STRENGTHS ▸ Growing international demand in LED lighting products ▸ Existing underwater LED expertise ▸ International government subsidies on the consumer side	**WEAKNESSES** ▸ Lack of consumer knowledge about the benefits of the energy saving products ▸ No definitive standards for LED-based illumination ▸ Local certification standards (e.g. SABS) are not recognised internationally ▸ Lack of expertise at SABS
OPPORTUNITIES ▸ Energy-saving LED lighting ▸ Underwater LED lighting products ▸ Intelligent LED streetlights ▸ LED Traffic lights ▸ Fluorescent lamp production (large export opportunity into Africa) ▸ LED mining headlamps	**THREATS** ▸ Procurement policies which are not locally focussed could lead to loss of domestic manufacturing capabilities ▸ Strong international competition ▸ Loss of manufacturing opportunities to neighbouring countries (e.g. Philips Lighting Maseru Project)

10 Consumer electronics

10.1 Sub-sector definition and overview

The consumer electronic subsector is wide ranging and generally includes **any device containing an electronic circuit board that is intended for everyday use by individuals**. It can be broadly separated into 4 categories, namely:

- Entertainment, e.g.:
  - Televisions
  - DVD players
  - Audio – tuners, amplifiers, CD, MP3,IPod
  - Home theatre systems
  - Video games
  - Digital cameras
  - Camcorders
- Communication, e.g.:
  - Mobile phones
  - Cordless telephones
  - PDAs
- Office productivity e.g.:
  - Desktop and notebook computers
- Other electrical/electronic household appliances) e.g.:[57]
  - Refrigerators and freezers (household and commercial)
  - Dishwashing machines
  - Microwaves
  - Stoves
  - Kettles
  - Toasters
  - Vacuum cleaners
  - Blenders, mixers, juicers

This sub-sector is characterised by rapid innovation. This is highlighted by **changing television technology** which has shifted from flat-screen to LCD and plasma, to high definition and now 3D televisions. Product development cycles are shortening, and the ability to reach the market first can be a key factor in success.

The market is highly dynamic, with swift transitions from one technology to another. For example DVD players were introduced in 1997 in the U.S. and had captured almost all video cassette recorders market share by 2000. DVDs, in turn, are being replaced by Blu-ray players (an optical disc storage medium designed to supersede the standard DVD format), which experienced unit growth was 112% in 2009.[58] Consumer electronics producers are also faced with significant time-to-time market pressures and experience rapid rates of market penetration.

Due to the rapid innovation and gains in manufacturing efficiency the consumer electronics sector is faced with ever declining prices. Based on Moore's law - the number of transistors that can be placed inexpensively on an integrated circuit doubles approximately every two years – every 2 years MP3 players have double the memory capacity and notebooks have twice the processing speed at the same or lower cost. Thus from a product's initial price offering it will experience a steady decrease in price as newer and improved products are released.

[57] Note that many of the white good items such as refrigerators and dishwashing machines would have been regarded electric rather than electronic a few years ago. However, since many of these items now contain electronic control components they are increasingly becoming electronic.
[58] DuBravac. 2009. 'Future Technologies and the Direction of the CE Industry'

The sector is also characterised by the convergence of technologies and products. The merging of hitherto separated markets of digital-based audio, video, information technology and telecommunications has resulted in a greater demand for consumer devices. [59] This includes the emergence of mobile telecommunications technology, incorporating both visual and MP3 capabilities. This convergence also means that it is becoming increasingly difficult to pigeonhole specific products – and companies for that matter – into traditional categories such as telecommunications, radar or consumer electronics. Cellular phones, for example, encompass all 3 of these categories – enabling users to access the internet, take pictures, use GPS technology and make phone calls.

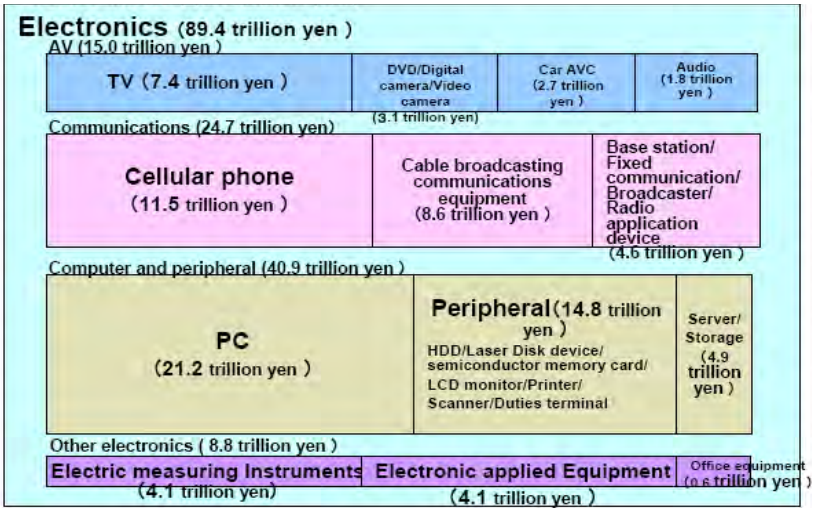
10.2 International market and supply trends

10.2.1 Market trends

The global consumer electronics market was worth approximately US$680bn (R5,079bn[60]) in 2009. The Asia Pacific region accounted for the largest share of global sales with 34% (US$234) followed by North America (20%, US$134bn) and Western Europe (19%, US$131bn). In contrast Africa only accounted for 2% of total sales (US$15bn).[61]

The diagram below gives an indication of the relative share of technological consumer electronics products within this market.

Figure 6: Dominant products within global consumer electronics



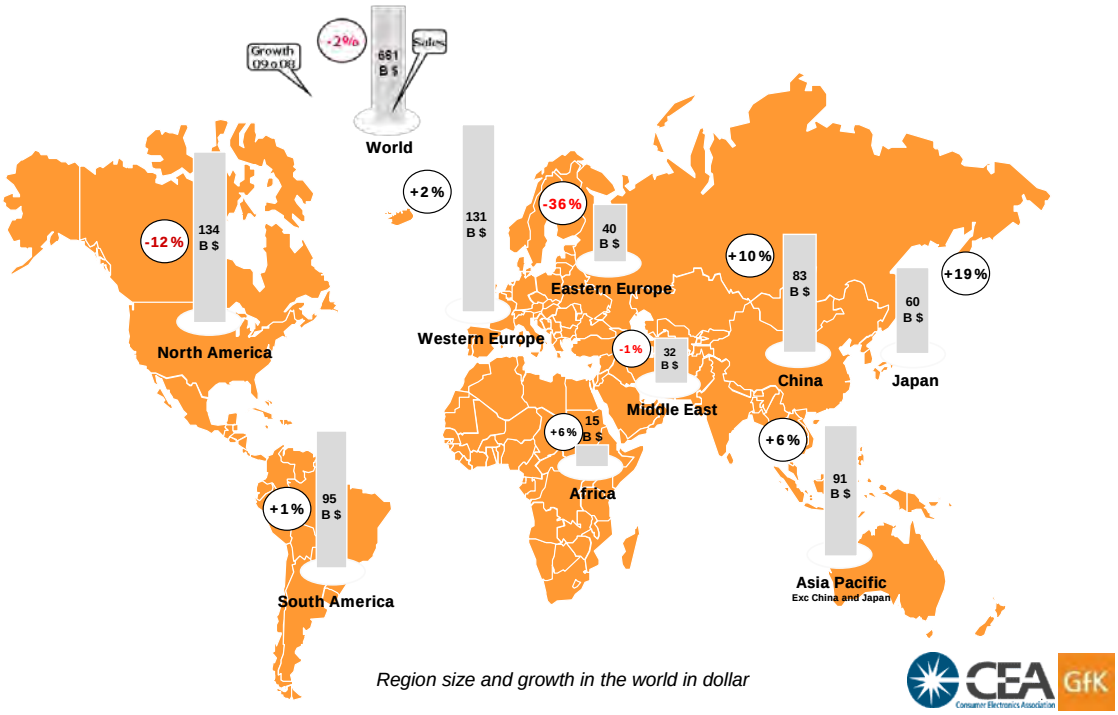
The consumer electronics market has grown substantially in recent years, from US$454bn to US$680bn. The global household appliance market size was estimated at US$131.1bn or 678.7 million units in 2007[62].

In 2008 home appliances alone formed 6% of world electronics production. Consumer electronics accounted for 11% of U.S. residential electricity use and 4% of total U.S. electricity.[63] This has partly been driven by the large increase in consumer electronics products in the household – which has nearly doubled from an U.S. household average of 13.5 units in 1995 to 25 units in 2005.[64]

[59] RNCOS. 2006. 'Worldwide Consumer Electronics Market'
[60] Converted using May 2010 exchange rates, www.xe.com. Rates1 USD = 7.47 ZAR
[61] DuBravac. 2009. 'Future Technologies and the Direction of the CE Industry'
[62] Datamonitor
[63] *ibid*
[64] Johnson. 2007. 'Key Drivers for Energy Efficiency in the Digital Home'

Due to the global economic recession many regions had negative sales growth in 2009. Household appliances were particularly hard hit by the recession with its associated pressure on home purchases and bonds. North America's sales dropped by 12%, whilst sales in Eastern Europe decreased by 36%. However, the countries such as China and Japan still showed strong growth (10% and 19% respectively). The map below gives an indication of growth trends prior to the recession (2008 – 2009).

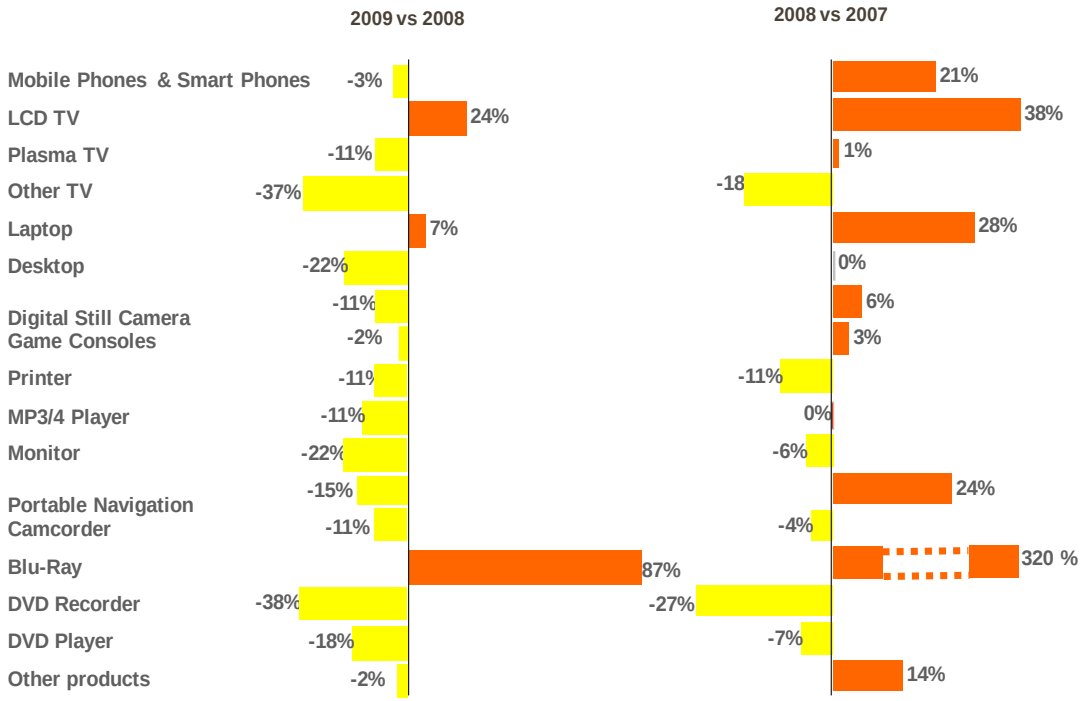
Figure 7: Consumer electronics regional sales trends[65]



The regional product varies somewhat. At a product level, there were only 3 goods driving growth in 2009, namely LCD TVs, laptops and Blu-Ray. The complete year on year sales growth by product is provided in the figure below:

[65] DuBravac. 2009. 'Future Technologies and the Direction of the CE Industry'

Figure 8: Year on year sales growth by product[66]



The figure above highlights the impact of the recession, as only 3 products showed positive year on year growth in dollar sales in 2009, whereas most products showed positive growth in 2008. Products experiencing negative growth in 2008 and 2009 were DVD recorders and players, printers and monitors, indicating possible declining industries.

More general market trends include the ever increasing list of new products, the miniaturisation of devices and the cross breeding with other industries (e.g. wireless LANs, smart phones, GPS technology).

COMPARISON WITH SOUTH AFRICAN MARKET

South Africa's consumer electronics devices market is projected at US$6.8bn (R50.79bn[67]) in 2010. This expected to increase to US$9.9bn (R73.9bn) by 2014, driven by demographics, product innovation, rising incomes, and rising computer penetration.[68] Computer hardware accounted for approximately 61% of South African consumer electronic spending in 2009. Mobile handset sales accounted for approximately 21% of consumer spending.[69]

Overall the household appliances market generated total sales of R20bn, representing a CAGR of 13% between 2003 and 2008. The market for household appliances declined by 2% in terms of volume sales, but declined by 8% in terms of value sales in 2008.[70] Large appliances did particularly poorly, declining 9% in volume and 10% in value terms. This indicates that due to a lack of disposable income consumers cut back on not only the number of goods bought, but also bought cheaper goods.[71] It is estimated that between 2009 and 2013 household appliances will grow 3% in volumes, but decline by less than 1% in terms of value.[72]

[66] *ibid*
[67] Converted using May 2010 exchange rates, www.xe.com. Rates1 USD = 7.47 ZAR
[68] Business Monitor International. 2009. 'South Africa Consumer Electronics Report Q1 2010'
[69] *ibid*
[70] the dti. 2009. White goods industry sub-sector customised sector programme working document
[71] *ibid*
[72] *ibid*

10.2.2 Supply trends

Despite the rapid growth of the electronic sector profits for manufacturers have often remained low.[73] This is partly due to large retailers, e.g. Wal-Mart, which are squeezing the profits of electronics companies by setting the price that the supplier has to meet.[74] Furthermore, the high level of competition means companies are forced to compete on price and invest heavily in branding and advertising. Since consumers have little switching costs they have considerable buying power. This too forces the margins down, as suppliers are forced to compete on price, despite the product differentiation that is available in the market. There is also increasing pressure on suppliers to deliver more energy efficient products.

The supply chain of consumer electronics goods relies heavily on outsourcing and often uses just-in-time distribution methods – which requires fewer inventories, but is reliant on good forecasting and rapid response rates. The supply chain is highly internationalised, with development and design tending to happen in developed countries with high technology capabilities, but the manufacturing and assembly often occurring in developing countries with cheaper labour costs. In terms of production, outsourcing has allowed many OEMs to re-allocate resources away from manufacturing toward product design and marketing. It has also reduced costs, which drive volume in the price elastic consumer market.[75] For example, Sony procures (for all operations) more than 30,000 different parts from nearly 800 affiliated parts suppliers to support manufacturing at more than 50 plants worldwide.[76] Much of the component production occurs in East Asian countries such as China, Thailand and Malaysia and other low cost countries including Mexico and some Eastern European countries. China is one of the largest producers of consumer electronics. Low labour costs along with a fast-growing domestic market has lead China's consumer electronic manufacturing industry to grow from US$71.5bn to US$167bn in 2010.[77] About two-thirds of this comes solely from foreign funded or Sino-foreign joint ventures. The world's top electronic manufacturers have all invested in China, considering it to be a key region in their global manufacturing facility layout.[78] Much of this advantage is based on China's skilled – yet low costing - labour force, mature supply chain and strong logistics capabilities.

The scale of investment required in new facilities or the upgrading of facilities is large. For example, LG Electronics Inc. developed a $450 million multi-product manufacturing facility in Indonesia in the mid 1990.[79] In order to upgrade its facilities in Mexico which produces TVs, refrigerators and electric ovens, LG Electronics Inc. planned to invest an additional US$100 million over three years (starting in 2008).[80]

Producers of consumer electronics are driven by convergence of technology. The best example of this is the Apple iPod, which by combining several elements such as design, PC interface (iTunes) and touch screen technology – none of which was new – was able to design a hugely successful product.

The main companies involved in consumer electronics include:

- AB Electrolux
- Apple Inc.
- Eastman Kodak Co.
- General Electric
- Haier

[73] IBM Electronics Podcast. 2005. 'The Consumer Electronics Industry: Markets, Models, and Meta-Value' Available [on-line]: https://www-935.ibm.com/services/us/imc/pdf/xs-markets-models-meta-value.pdf
[74] *ibid*
[75] www.connectorsupplier.com
[76] Sterling Commerce Case Study. 2008. 'Sterling Commerce helps link business processes across supply chain'
[77] In-stat. 2006. 'Electronics manufacturing in China'
[78] *ibid*
[79] PR Newswire. 1995. 'LG Electronics announces plans to open manufacturing facility in Indonesia'
[80] PR Newswire. 2008. 'LG Electronics Reorganizes Manufacturing Facilities, Increases Investment in Mexico'

- Hoover Limited
- LG Electronics Inc
- Matsushita Electric Industrial Co. Ltd.
- Maytag Corp.
- Microsoft Corp.
- Nintendo Co., Ltd.
- Pioneer Corp.
- Royal Philips Electronics N.V
- Samsung Electronics Co. Ltd
- SANYO Electric Co. Ltd.
- Sharp Corporation
- Siemens AG
- Sony Corporation
- Speed Queen
- Thomson
- Toshiba Corporation
- Whirlpool
- Yamaha Corp.

Many of these companies are not involved solely in consumer electronics. For example Siemens AG focuses on electronics and electrical engineering, operating in the industry, energy, consumer electronic and healthcare sectors. The digital convergence has brought new companies into the market and has changed the dynamics of the market, with companies from different sectors now competing more directly, e.g. cellular phones are now competing with digital cameras and MP3 players as they offer similar functions.

10.3 Manufacturing activities and capability in South Africa

There is currently limited manufacturing of consumer electronics occurring in South Africa, with a few exceptions such as set-top boxes and aerials. There are a few examples of locally manufactured components e.g. Nu World and Satchwell (a division of Actom that makes elements and controls)

The market is dominated by large multinationals that - despite having significant presence in South Africa - tend to import their products and only do assembly locally. These multinationals tend to outsource their production to low-cost areas such as China and India. An example of this is Defy, which does not manufacture any of its electronic components locally, importing all electronic sub-assemblies and components from overseas.

The consumer market for electronics is highly competitive and experiences downward price pressures. This has forced many South African manufacturers into more niche areas, characterised by lower volumes. The current manufacturing capability in South Africa for consumer electronics is therefore relatively low. An exception to this is the production of set-top boxes, which is designed and manufactured locally and then distributed to the domestic and international market.

Examples of local companies which operate in the consumer electronics sector include:

Table 29: Examples of consumer electronics companies operating in South Africa

Company	Nature of business	Description
Altech UEC	▸ Product design ▸ Manufacture	Manufacturer of television, set top boxes and data transmission equipment
Amalgated Appliance Holdings	▸ Assembly ▸ Manufacture	Produces a range of television technologies, utilising a fully automated circuit board plant with focused production. Also does assembly of PCs for primarily the South African consumer market
Mustek	▸ Assembly	Mustek is one of South Africa's leading branded assembler and distributor of PCs, notebooks and related products. The Group's PC and notebook division, Mecer, is one of South Africa's top-selling PC brands
Pinnacle Micro	▸ Manufacture ▸ Distribution	Distributor of advanced ITC equipment. Manufactures products such as the Proline range of servers, PCs and notebooks
Qeo Wireless/XYZ Ltd	▸ Design	Developed a cellphone prototype in 2003: the mobile smart phone offers extended features and functionality over and above basic voice and messaging facilities Did not successfully launch to market due to lack of local capacity in areas such as tooling for production of plastic housings and spraypainting of handsets
Nu World Holdings	▸ Assembly ▸ Manufacture ▸ Distribution	Nu World technologies assembles a range of household appliances and electronic equipment (e.g. kettles, toasters, assembly of kit-form flat-display screens). Also the local agent for JVC, Telefunken and CASIO. Nu World is also South Africa's largest manufacturer of small electrical appliances
Microsound	▸ Product design ▸ Manufacture	Microsound produces custom made-to-order intercom solutions for schools. The company also manufactures apartment intercom systems, office and conference intercom systems, fire and security intercom systems and access control solutions
Martin Electronics	▸ Manufacture	The company manufactures remote control devices for domestic uses such as garage doors and alarm systems and has begun venturing into other security-related products such as infrared sensors and access control systems.
Defy	▸ Assembly	Defy assembles and distributes white goods such as stoves, microwave ovens, refrigeration, laundry, air-conditioning
Vektronic	▸ Contract manufacture	Currently produce televisions and set top boxes
Gemini	▸ Design ▸ Manufacture	Specialists in gate automation and produce a range of electronic gate and garage door operators. Based in Gauteng but distributed throughout South Africa and other parts of Africa incl. Nigeria, Botswana and Angola
IC Security Products	▸ Manufacture ▸ Distribution	Security products include: safes, bulletproof vests, cash carrying and cases and detection equipment
Sonor Audio	▸ Design ▸ Manufacture	Loudspeaker, stereo and home theatre production
Audio Geometry	▸ Manufacture	Product range includes: electronic crossovers, ambience noise controllers,100v line mixer-amps and line amplifier, light controllers and dimmer packs, preamps
Satchwell (Alstrom Group)	▸ Manufacture	Manufacturer of standard products, which include electric heating elements, thermostats, spiral and solid hotplates, special elements, energy regulators and various other controls and components
Vivid Audio	▸ Design ▸ Manufacture	Manufacturer of speakers

Most of the companies that do manufacture their products locally tend to operate in small, niche areas. One such example is Microsound - which produces custom made-to-order intercom solutions. Using a small in-house team Microsound produces the majority of its products using hand-assembly techniques. In contrast Nu World imports the majority of electronic products and sub-assemblies from overseas, with the bulk of products being supplied in kit-form directly from suppliers.

Examples of international companies which operate in the South African market include:

Table 30: Examples of major international consumer electronics companies with a presence in South Africa

Company	Nature of business	Description
Sinoprima Investments & manufacturing SA Pty Ltd	▸ Manufacture ▸ Distribution	Manufacturer and distributor of LCD TVs, plasma TVs and cathode-ray tube TV
LG Electronics	▸ Distribution	Distributes TVs and DVD players, digital cameras, white goods, MP3 players
Samsung Electronics Co. Ltd	▸ Distribution	Distributes TVs and DVD players, digital cameras, white goods, MP3 players
Sony Corporation	▸ Distribution	Distributes TVs and DVD players, digital cameras, white goods, MP3 players
Royal Philips Electronics N.V	▸ Distribution	Distributes TVs and DVD players, digital cameras, white goods, MP3 players
Panasonic	▸ Distribution	Distributes home appliances, car navigation systems, notebooks, security systems, office products, professional AV and healthcare products
Hoover	▸ Distribution	Distributes vacuum cleaners
Apple	▸ Distribution	Distributes audio devices, notebooks, cellphones (the iPhone)

10.4 Sub-sector assessment

Table 31: Consumer electronics SWOT assessment

Consumer electronics	
STRENGTHS ▸ South Africa is already a world-leader in set-top box technology ▸ Set-top boxes have the biggest potential applications is in the realm of digital television ▸ Competitive in final assembly of goods	**WEAKNESSES** ▸ Market dominated by large multinational firms ▸ No competitive advantage in the production of high volume consumer goods manufacturing ▸ Import duties on components not locally manufactured ▸ High price of inputs such as metal and pulp paper
OPPORTUNITIES ▸ Set-Top Boxes and Digital Television ▸ Localised final product assembly	**THREATS** ▸ Loss of market share in set-top boxes due to ▸ Shift in consumer behaviour: buyers want to touch and feel the new product before they buy it; this introduces new costs

11 Telecommunications[81]

11.1 Sub-sector definition and overview

The telecommunications sector comprises the technologies and systems required to transmit data for the purpose of communication. Telecommunications is a vital infrastructure component which spans both traditional wired and wireless mediums and is subject to stringent regulation and control.

The telecommunication sector encompasses the following applications:

- **Fixed-line telephony solutions:** The telecommunication sector was founded upon the transmission of telegraphs and human voice over physical wires. This application is still a core feature of telecommunication infrastructure and requires huge investments in equipment and support services. This includes telephone exchanges, public access payphones, PABX systems, digitalisation equipment, interconnection systems, value-added services and consumer telephonic products.

  Fixed-line telephonic systems were originally analogue point-to-point systems, but have since been upgraded to utilise a digital backbone, with analogue signals encoded and decoded on each end. This has allowed voice data to co-exist alongside internet and data traffic, allowing international connectivity and higher quality calls over long distances.

- **Mobile telephone and data networks:** Mobile phone networks offer wireless access to telephony and data services over technologies such as GSM and CDMA. These technologies are international standards, which provide both voice and data transmission over short-link radio transmitters. Mobile phone networks rely on traditional backhaul technologies and localised radio transmission equipment.

  Mobile telephone solutions include a vast array of consumer handsets, interconnection modules and broadcasting equipment.

- **Internet and broadband connectivity:** Internet connectivity requires a number of different technologies in order to provide connectivity. These include fibre-optic and satellite links to other countries, local network backbone and routing services, and the "last-mile" connectivity to users. Routers and switches are used to intelligently route network traffic, dedicated servers are required to provide internet services such as DNS, access control and domain name registration.

  The "last-mile" service between users and their service providers are often supplied alongside traditional fixed-line telephony services, as in ADSL or even fixed data lines. Other options include wireless "last-mile" technologies over proprietary radio frequencies, CDMA technology and GSM networks.

- **VOIP telephony solutions:** Voice-over IP telephony technology is a service where the traditional telephone services are provided over internet-based packet technology. This has the advantages of providing similar levels of service at a much reduced cost (as packet-switching technology is less infrastructure-intensive than the circuit-switched technologies traditionally used in fixed-line telephone networks).

[81] Sources for this section include: Information Society Statistical Profiles 2009 Africa, International Telecommunication Union; http://www.gartner.com/teleconferences/asset_135627_75.jsp; 2010 ICT Market Review & Forecast http://www.tiaonline.org/market_intelligence/mrf/index.cfm; Plunkett Research Statistics, http://www.plunkettresearch.com/Industries/Telecommunications/TelecommunicationsStatistics/tabid/96/Default.aspx

VOIP services are often packaged as products and solutions, which are then sold to businesses as either a stand-alone product or a hosted service.

- **Backhaul telecommunication equipment:** Backhaul telecommunication equipment is used to transmit large amounts of data over large physical distances, and is usually provided as a service to other telecommunication providers. An example would be cellular networks, which may use microwave backhaul services to connect remote areas of their network. Offering backhaul connectivity as a service allows multiple telecommunication systems to share a single link, thereby lowering the costs to each company and preventing duplicate equipment.

  Backhaul equipment traditionally includes fibre-optic links, satellite links and microwave transmission technologies.

- **Radio and television broadcasting technologies:** Radio and television broadcasts typically consist of a few high powered transmitters which transmit to a large number of low-powered receivers. The majority of television and radio broadcasts are analogue signals, which are relatively easy to decode but can be prone to interference and noise depending on the frequency modulation. Both radio and television are closely regulated internationally and require licenses to operate.

  There is growing adoption internationally of digital television technologies, which offer many benefits over traditional analogue broadcasts. In addition, satellite television broadcasting has become a popular alternative to terrestrial broadcast television.

- **Local and wireless networking technologies:** Consumer telecommunication equipment includes many interconnection devices for home and office use. There are two major categories of local networking technologies; local area networks and local wireless networks. Both technologies provide interconnecting functionality between devices.

  Local networking products include network hubs, switches, network routers, wireless access points, repeaters, print servers and broadband routers.

- **Antennas:** antennas are transducers designed to transmit or receive electromagnetic waves. Antennas convert electromagnetic radiation into electrical current, or vice versa. Antennas generally deal in the transmission and reception of radio waves, and are a necessary part of all radio equipment. Antennas are used in systems such as radio and television broadcasting, point-to-point radio communication, wireless LAN, cell phones, radar, and spacecraft communication.

  Physically, an antenna is an arrangement of one or more conductors. In transmission, an alternating current is created in the elements by applying a voltage at the antenna terminals, causing the elements to radiate an electromagnetic field. In reception, the inverse occurs: an electromagnetic field from another source induces an alternating current in the elements and a corresponding voltage at the antenna's terminals.

- **Satellite communication:** A communications satellite (sometimes abbreviated to COMSAT) is an artificial satellite stationed in space for the purpose of telecommunications.

  For fixed (point-to-point) services, communications satellites provide a microwave radio relay technology complementary to that of submarine communication cables. They are also used for mobile applications such as communications to ships, vehicles, planes and hand-held terminals, and for TV and radio broadcasting, for which application of other technologies, such as cable, is impractical or impossible.

11.2 International market and supply trends

11.2.1 Market trends

Estimates put the total revenue of the global telecommunications industry at US$3.7 trillion in 2009, with US$1.2 trillion in the United States alone. Africa has also seen strong growth in the telecommunications sector over the past ten years, exhibiting growth rates double that international average and resulting in over 246 million mobile subscribers in 2008 (up from 11 million in 2000) and over 32 million internet users (up from just 3 million in 2000).

Companies around the globe are positioning themselves for growth as the economic recovery takes hold.

- **Fixed-line telephony solutions**
  The total number of landlines installed in the world is estimated at 1.27 billion as of the end of 2008. This has increased by 2.5% from 1.13 billion in 2003. Landline growth rates have been declining steadily due to customers shifting from traditional wired services, to wireless and VOIP offerings.

  Fixed-line telephone penetration in Africa is well below the average values for developing countries around the world. Between 1998 and 2008, the continent added only 2.4 million new fixed lines, which accounts for less than one percentage of the total number of fixed lines installed globally during that period.

- **Mobile telephone and data networks**
  Mobile technology still appears to the fastest expanding segment of the telecommunication industry with the global growth rate in the number of mobile subscribers reaching 23.2% in 2009. The International Telecommunication Union estimates the total number of global mobile subscribers was 4.01 billion at the end of 2008 – representing approximately 60% of the world's population. It is expected that the global number of mobile subscribers will reach 5.5 billion by 2012.

  Africa constitutes only 6% of the total number of mobile subscribers internationally, with the distribution of mobile phones spreading out across the continent. In 2000, 74% of mobile phones were situated in South Africa, but this value has declined to less than 19% in 2008.

  Estimates also put the global adoption of mobile broadband technology at 600 million people.

- **Internet and broadband connectivity**
  The number of internet users in the world reached 1.5 billion subscribers in 2008, with global broadband access to the internet showing steady growth. International internet penetration rates average about 23% whereas this value is less than 5% for the majority of African countries. The lack of fixed-line infrastructure directly affects access to the internet throughout Africa, although mobile broadband technology is poised to offer the greatest opportunity to bring widespread internet access to the continent.

  Internet access levels in South Africa are higher than the continental average, with approximately 5.3 million unique users in 2009. This represents a 15% growth over the 2008 value of 4.59 million users. Recent price cuts and increased competition from other service providers will help maintain these high levels of internet uptake.

- **VOIP telephony solutions**
  Industry analysts predict that mobile voice calls made using VoIP technology will become a mainstream service, based on the increasing availability of mobile broadband technology. These

services will create the opportunity for new telephonic services that were impossible to achieve with standard mobile technology such as one-to-many calling and direct VoIP calls.

- **Backhaul telecommunication equipment**
  Backhaul services naturally grow along with telecommunication infrastructure, but the nature of these systems is beginning to change from traditional fixed-link links to rapidly deployable backhaul technologies using high-frequency gigabit wireless links. These technologies are capable of providing the data rates and throughput required to support the fourth generation wireless and mobile networks..

- **Radio and television broadcasting technologies**
  (Please also see the consumer electronics section for inputs on set-top boxes)

  The international trend towards digital television broadcast has created strong demand for digital television receivers ranging from simple decoders to high-definition PVR devices. Currently, premium set-top box offerings constitute only one quarter of the volumes of set-top boxes sold annually and half of the revenues. This is expected to increase to 50% of the volumes and nearly 80% of the revenues by 2013.

  Industry experts believe that the global market for set-top boxes will reach annual shipments of 127 million units by 2012, with the market starting to decrease in 2013 whilst the market for IPTV technologies will fail to gain momentum with consumers. This lack of uptake will be caused by the proprietary "walled-garden" approach taken by IPTV providers. However, the market for hybrid television receivers with IPTV functionality will be far greater and offer the best opportunities. The United States is not as significant a market in this segment as in most other electronics segments because of the high reliance on fibre.

COMPARISON WITH SOUTH AFRICAN AND AFRICAN MARKET

The telecommunications industry in South Africa is thriving, contributing more than 7% to South Africa's gross domestic product (GDP). With approximately 5.5 million installed fixed-line telephones, South Africa is ranked 23rd in telecommunications development in the world and represents more than 30% of the total lines installed in Southern Africa.

There are also continual investments in telecommunications infrastructure. For example, Telkom is a key player in a US$630 million optical fibre undersea cable project that will cater for Africa's growing telecommunications needs for the next 25 years.

In 2005 telecommunication services amounted to sales of R353bn, whilst infrastructure expenditure was R79bn. Total telecommunication related sales grew 10% from 2004 – 2005.[82]

11.2.2 Supply trends

The telecommunications market is historically important to the electronics industry as it lead to the creation of the current contract manufacturing mindset present in the industry today. During the internet boom of the 1990's, the vast demands placed on equipment manufacturers such as Cisco, caused them to begin outsourcing the manufacture of their networking equipment. This move led to the concept of hardware design companies with no internal manufacturing capabilities, and the start of the modern multi-national electronics contract manufacturing industry.

[82] http://www.thedti.gov.za/publications/electronics.htm

The telecommunication market is affected by both "demand pull" and "supply push" forces. The increasing reliance on telecommunication by other industries has created a growing demand for telecommunication products and sub-assemblies, whilst the rapid and continuous technological innovations and development in the field further propel the telecommunication sector. This traditionally makes it difficult for telecommunication equipment providers to utilise their own manufacturing facilities. As a result, the telecommunication industry is one of the most outsourced and globally-distributed manufacturing sectors.

Telecommunication products are heavily based on components to convert between analogue and digital signals, signal processing technologies and high-speed data processing. These tasks require specific components such as high-speed transceivers, analogue to digital converters, modulation systems and sophisticated filtering technologies. Major suppliers of these components include:

- Altera
- Analog Devices
- Freescale Semiconductors
- Maxim / Dallas Semiconductors
- National Semiconductor
- ST Microelectronics

Many telecommunication products also make use of proprietary silicon hardware, which is costly to design but lowers the production cost of each unit. These systems also need to support a growing number of industry standards, such as audio and video standards, data storage standards and transmission protocol standards. Often these features are provided by dedicated hardware modules, which can be used among a wide range of different products.

11.3 Manufacturing activities and capability in South Africa

South Africa has a large and active telecommunication industry, with many companies researching and producing new products. The industry is growing, fuelled by the strong growth of mobile service providers and the introduction of the second fixed-line network operator. Telecommunication infrastructure also received significant investment ahead of the FIFA 2010 World Cup, further bolstering the industry.

South Africa currently has two major fixed-line network operators. These are Telkom, which has a large and established fixed-line network and Neotel, a convergent telecommunications company which received the second network operator license.

Suppliers include the following:

Table 32: Examples of telecommunications suppliers in South Africa

Company	Nature of business	Description
Onecell Holdings	▸ Manufacturer	Manufacturer and distributor of GSM-based payphones.
Psitek	▸ Manufacturer	Producer of supervised public payphones, point of sales systems and electronic voucher distribution systems.
Saicom	▸ Service provider	Distributor and supplier of GSM payphone solutions throughout Africa
Tellumat	▸ Manufacturer ▸ Importer / distributor	Tellumat manufacture and produce a large number of telephone products for Telkom and consumers
Reutech	▸ Design ▸ Development ▸ Manufacturer	Reutech Communications specialises in technologically advanced secure V/UHF Communication Systems for use on Airborne, Naval and Land based platforms
Omnipless	▸ Design ▸ Manufacturer ▸ Distributor	The company designs, manufactures, and supplies L-band mobile satellite communication systems and Inmarsat Satcom products. The company offers antennas and

Company	Nature of business	Description
		systems, including flat panel and maritime tracking antennas, SwiftBroadband solutions, and switched circuit connectivity that are suitable for air transport, business aviation, and military communication applications, as well as e-mail access, web browsing, real-time video and data transmissions, and voice communication. It serves aeronautical satellite communications market.
Grintek Telecoms	▸ Design ▸ Development	Grintek is one of South Africa's leading empowerment IT and telecommunications solutions and integration companies. Grintek Telecom provides tailored and innovative IT solutions from initial project and business requirement consulting, through to implementation, integration and ongoing support.

Marpless used to have the contract to manufacture payphones for the South African market but the contract has since come to an end and the new contract is currently out to tender. There is a trend towards providing payphone services through mobile networks via GSM payphones. This application has proved to be very successful and may cause a decline in the distribution of payphones in the future.

There are currently three mobile network operators in South Africa and one virtual network operator (which do not own a licensed range of frequencies). These companies are currently expanding their infrastructure to support more subscribers and higher mobile data rates.

South African companies have also attempted to enter into the mobile handset market. QEO Wireless designed and prototyped a smartphone intended to be a low-cost, locally-assembled mobile phone offering an industry-competitive set of features.

The company encountered major challenges in prototyping the handset and sourcing local manufacturing partners and as a result of the above, the handset never went into mass production.

South Africa has an established industry in the manufacture and distribution of telecommunication backhaul equipment. These technologies form the basis of mobile networks, voice and data transmission services, and terrestrial broadcast services. The following companies manufacture related products:

Table 33: Examples of telecommunications backhaul-related manufacturers in South Africa

Company	Nature of business	Description
Tellumat	▸ Manufacturer ▸ Consulting	Offers a wide range of turn-key telecommunication solutions and services for both wired and wireless applications.
Parsec	▸ Manufacturer	High speed data processing systems.
Red Line Telecommunication	▸ Manufacturer	Manufacturer of carrier class free space optical (FSO) transceiver systems
Advanced Digital Devices	▸ Manufacturer	Manufacturer of fibre optic interface equipment
Allpronix	▸ Manufacturer	Manufacturer of network switches, routers and media converters
Q-KON SA	▸ Manufacturer ▸ Distributor	Supplier of microwave and satellite backhaul communication solutions
Radio Data Communications	▸ Manufacturer	Manufacturer of long-range radio data linking equipment
Spescom	▸ System integrator	Provides video and voice communication platforms.
Reunert	▸ Manufacturer	Groups structure includes Nashua, Reutech and

Company	Nature of business	Description
	▸ Supplier ▸ Distributor	CBI electric.CBI electric manufactures telecom, energy and low voltage equipment. Nashua supplies mobile, communications, electronics equipment. Reutech Communications specialises in technologically advanced tactical VHF/UHF communication systems for the defence environment.

South Africa does not manufacture any consumer networking equipment in South Africa. These markets are dominated by large multinational contract manufacturing companies. The barriers to entry in these markets are extremely high due to the economies of scale. There are also difficulties in the worldwide export of telecommunication equipment due to the differing international standards and requirements.

11.4 Sub-sector assessment

Table 34: Telecommunications SWOT assessment

Telecommunications	
STRENGTHS ▸ Strong fixed telecommunications infrastructure ▸ Existing telecommunications presence throughout large parts of Africa ▸ Dramatic growth in wireless technology market with the cost, size and power requirements of wireless functions falling rapidly	**WEAKNESSES** ▸ Lack of available skills in terms of engineers and technicians ▸ Majority of electronic components are imported ▸ Local manufactures are do not have the capacity to compete on the same scale as international firms
OPPORTUNITIES ▸ Wireless technology and wireless antennas ▸ Fixed telecommunication infrastructure, especially infrastructure rollout and replacement in Sub-Saharan Africa	**THREATS** ▸ Strong international competition from large telecommunications companies with high R&D spend ▸ Procurement policies which are not locally focussed could lead to loss of domestic manufacturing capabilities

12 Information Technology

12.1 Sub-sector definition and overview

The Information Technology sector as a whole refers to both the hardware and software that are used to store, retrieve, and manipulate information[83]. For the purposes of this study, embedded software, firmware, silicon designs and other related electronic systems within information technology will be considered. This report does not cover other software (such as eCommerce applications, multimedia applications, other business applications, web and other development tools, systems integration, security software) and IT services (such as consulting, internet, web hosting/domain administration, content aggregators, maintenance and repair). IT consumer hardware is addressed under consumer electronics).

An embedded system is any electronic system that uses a dedicated sequential processor, but that is not a general-purpose workstation, desktop or laptop computer. Such systems use microcontrollers (MCUs) or microprocessors (MPUs), or they may use custom-designed chips. Embedded systems are employed in automobiles, planes, trains, space vehicles, machine tools, cameras, consumer electronics, office appliances, network appliances, video games, cellphones, PDAs, GPS navigation as well as robots and toys[84].

In embedded systems, the software typically resides in firmware, such as a flash memory or read-only memory (ROM) chip, in contrast to a general-purpose computer that loads its programs into random access memory (RAM) each time. Embedded systems generally consist of a processing core, volatile memory, input and output interfaces and some form of non-volatile storage to hold firmware. Firmware differs from software in that it forms a critical functional component of the device. All embedded systems implement some version of firmware, either through sequential instructions stored in memory, or through synthesised logic gates in the case of ASICs and FPGA processors.

Embedded software is a configuration of instructions that permanently reside in a ROM or flash memory chip. Embedded software is instruction code which plays an integral role in the electronics it is supplied with. It's written for machines that are not multi-purpose computers. Embedded software is 'built in' to the electronics in cars, telephones, audio equipment, robots, appliances, toys, security systems, pacemakers, televisions and digital watches, for example. This software can become very sophisticated in applications like airplanes, missiles and process control systems.

Embedded systems are responsible for the majority of product defects and malfunctions, primarily as the production of embedded software resides in the overlap between hardware and software development. In most development processes, these tasks are performed by different people and rarely occur simultaneously (as the software developers generally wait for the hardware to be prototyped before finalising the software development).

Silicon design services are also becoming a major industry, with the advent of power hardware description languages such as VHDL and Verilog. These allow companies to develop hardware systems using traditional programming techniques. Such systems can be deployed to Field Gate Programmable Arrays (FPGAs) or be adapted for development directly into silicon as an ASIC. These systems take a strong modular approach, and provide “blocks” of functionality through IP cores which allow developers to rapidly implement complicated and sophisticated product prototypes.

[83]Mario Alexandrou (2010) IT definitions http://www.mariosalexandrou.com/definition/information-technology.asp
[84] PC Mag (2010) Embedded systems
www.pcmag.com/encyclopedia_term/0,2542,t=embedded+system&i=42554,00.asp

12.2 International market and supply trends

12.2.1 Market trends

Embedded systems operate in the following key markets and industries: automotive, transportation, consumer electronics, industrial automation, medical, military and aerospace, mobile phones, telecom and datacom and retail automation.[85]

VDC[86], an international research group, estimates that the embedded software and tools market size in 2010 is approximately $2.4bn (CAGR - 5%).

Although sub-sector growth of 8% is projected for 2010, the worldwide recession has negatively impacted the sub-sector since 2006. Embedded system manufacturers have been most affected and the recession has accelerated changes on the supply-side competitive landscape. The following verticals were also negatively impacted: automotive, consumer electronics and retail. Medical devices however, are expected to show a low single digit increase.[87]

Embedded system outsourcing is also a key market characteristic. Primary geographic sub-regions to which engineering tasks are being outsourced[88]:

- Operating system development/testing: North America, India, Pakistan and Western Continental Europe (including France, Italy, Portugal, Germany but excluding Scandinavia)
- Firmware development/testing: India, Pakistan, North America and Western Continental Europe
- Software application and middleware development/testing: India, Pakistan, Bangladesh, North America, East Asia (excluding Japan, South Korea, Oceania)

Large users of embedded systems include: automotive manufacturers (almost all embedded systems), mobile phones (embedded operating systems), set-top boxes, airline entertainment systems, automation and control equipment, avionics and flight systems, GPS and GSM equipment.

COMPARISON WITH SOUTH AFRICAN MARKET

Specific embedded software market information is not readily available. However, more widely, the South African IT industry growth outstrips the world average. The size of the South African IT security industry was estimated at around R1bn in 2005, but with an expected growth rate of up to 20% until 2008. About 30% of revenue is earned from the delivery of 'pure' services, whilst 50% comes from security software and 20% from security hardware sales.[89]

Africa is currently one of the fastest growing markets for IT in the world, with an annual growth rate of more than 14%.

[85] VDC research (2010) Embedded systems market statistics
[86] Founded in 1971, VDC specialises in providing technology executives with the market intelligence they need to make critical business decisions with confidence. Our core products and services consist of a large portfolio of syndicated research reports, custom research and consulting engagements, and tactical marketing support services. They are based in Natwickk, MA in America
[87] VDC research (2010) Embedded industry consolidation
[88] Statistics drawn from VDC's research report, 'Embedded Software and Tools: 2010 Market Intelligence'. Research based on primary research (over 75 calls to embedded software suppliers, and over 500 email surveys with global engineers. Further information on research design: contact Stephen Balacco at sbalacco@vdcresearch.com (Embedded Software Practice Department at VDC)
[89] **the dti**. 2005. South African network, system and internet security industry

12.2.2 Supply trends

Embedded software is showing strong trends towards embedded operating systems such as micro-Linux (µlinux), Windows CE and even Android (to a certain degree). Note that Apple's Operating system for the iPhone, iTouch and iPad is considered an embedded operating system.

There is also a strong demand for real-time operating systems for embedded devices. RT OS is one such example. These are required in time-critical applications such as safety equipment, flight controls and automotive electronics.

Suppliers include microcontroller suppliers such as Microchip, Freescale, Motorola, Intel and perhaps most importantly ARM. ARM-based systems are the most widely deployed micro-processing solution but the company does not currently manufacture. They simply licence their technology.

The major international embedded software developers include:
- Intel AND AMD
- Linux
- EPAM Systems
- Mindteck

12.3 Manufacturing activities and capability in South Africa

South Africa has competitive advantages in the area of embedded software design and development of custom turnkey solutions by providing an embedded design service for original equipment manufacturers (OEM's) and customers who have their own design and development capability. South African software engineers are considered both cost and time competitive.[90]

The rise in CMMI (Capability Maturity Model Integration) rating in South Africa (in particular through initiatives supported by **the dti** and the Johannesburg Centre for Software Engineering) is helping to raise the competitiveness of companies in the sub-sector.

Gartner, the international research group, rates South Africa as one of its top 30 software development outsourcing destinations, with 2007 research putting it on par with Israel in the Europe, Middle East and Africa region, and next to Australia and India globally.

South Africa's experience in demanding industries such as the defence sector has created embedded software business opportunities for South Africa in North America and Europe. Also, the diversity of South Africa's electronics market and products, the presence of highly skilled IT professionals and the country's first world know-how in business, make South Africa an effective test lab for new innovations. Testing and piloting systems and applications are growing businesses in South Africa. Currently South Africa is pioneering pre-payment systems, vehicle tracking systems, air traffic control systems, and m-commerce systems.

Embedded software design and development and support

South Africa has the capacity and skills to design and develop embedded software as well as provide domestic and international clients with outsourcing and consulting services. Companies operating in South Africa include:

[90] African Business Review (2010) South African Electrotechnical Export Council: Competitive advantage

Table 35: Examples of embedded software developers in South Africa

Company	Description
Parsec	Parsec (Pty) Ltd specialises in board design, FPGA development, Digital Signal Processing application, embedded Software development, Data Acquisition systems And Contract Manufacturing. Parsec provides engineering solutions worldwide to research institutes, OEMs sub-system integrators and engineering service providers
NamITech	Provides secure end-to-end business solutions and the development and implementation of value-added applications stemming from the intelligent use of smart cards, biometrics and public Key Infrastructure (PKI)
Grintek	A contractor and supplier of electronics-related products and services to the telecommunications, mining, avionics, defence, air traffic control, security and power utilities markets in the RSA and selected export markets
Protea Automation	Protea Automation industries include: cement, chemical/ petrochemical, combustion plants, food beverages (sugar mills), paper/ pulp, platinum/, steel/ aluminium, power plants, waste incinerators and wastewater plant
Peralex	Peralex provides a range of design and development support, from product conceptualisation through to manufacturing, which includes technology investigations, software and hardware development, FPGA design, as well as CAD
Natcom Electronics	The company is a custom electronics and software design house for outsourced projects in the military, security, industrial and communication markets. Natcom provides solutions ranging from concept definitions to system design, installation and production engineering.
Direchtech	Leader in turnkey Industrial Automation Systems covering the electrical, electronic and mechanical disciplines with recent success in China
Adroit Technologies	The company has developed leading edge software products for Automation, SCADA, MIS and MES solutions.
Crunchyard	Crunchyard has broken new ground in offering a software simulation service over the internet on a pay per use basis
THUSA	South African open source software innovator and technology services and solutions company
Tellumat	Coding for products manufacturing within the company
UEC	Embedding of keys for conditional access

12.4 Sub-sector assessment

Table 36: Embedded software SWOT assessment

Embedded software	
STRENGTHS ▸ Strong domestic growth ▸ South Africa ranks 22nd on total worldwide IT spend ▸ Existing tracking and security knowledge can be used in IT related tracking and security products	**WEAKNESSES** ▸ Difficulties in securing funding ▸ High operating costs (e.g. banking costs, logistics) ▸ Lack of skilled personnel
OPPORTUNITIES ▸ Avionics software ▸ Tracking and security connectivity	**THREATS** ▸ Strong competition from international market

13 Other electronics and sub-assemblies

This section deals with electronics that do not fall exclusively within one sub-sector, as well as the medical devices sub-sector.

13.1 Electronics serving multiple sub-sectors

13.1.1 Definition and overview

There are a number of assemblies, sub-assemblies, components and services that are common to the majority of electronic products and therefore do not fit into a specific sub-sector. These companies often produce application-specific products and therefore work closely with clients in a range of sub-sectors to develop their offering.

These companies generally provide products or services that are crucial for the majority of electronic applications and therefore constitute a vital component of the infrastructure required to support a local electronics industry. Such services include the following categories:

- PCB manufacturers
- Other component suppliers
- Contract manufacturers
- Test and measurement equipment manufacturers

Each of these areas is dealt with in further detail below.

PCB manufacturers

These companies design, test and manufacture printed circuit boards for the electronics industry. These boards are critical components in every electronic product and comprise a large portion of the development activities. These boards provide the base on which components are assembled, and therefore require special integration into the manufacturing process.

PCBs are unique to their application, and therefore vary in size and complexity. PCBs provide the electrical connections between components required in a device, and often are used to provide additional services such as micro-strip antennas and RF chokes, which are fabricated directly onto the PCB surface.

PCBs are available in three main types; single-sided, double-sided and multi-layer boards. Single-sided PCBs consist of copper track on one side of a substrate material on which components are attached. This is the simplest type of PCB and only applicable in very simple or specialised applications.

Double-layered PCBs have such routing on both sides of the material, allowing a far greater flexibility in the connections possible on the board. As an added complication, it becomes necessary to connect copper tracks on the top and bottom of the board together, and this is done via specially drilled holes which are then plated with a conductive material through a technique called through-hole plating. Double-sided PCBs are far more common than single-sided PCBs as they more easily support a combination of surface mount technologies and through-hole technologies.

Multi-layer boards consist of multiple layers of copper tracks sandwiched together. This allows devices to reach unparalleled levels of complexity in a very small form factor but greatly increases the manufacturing complexity and costs. The number of layers of routing can vary between 4 and 30 layers, and often additional complications, such as connections between different layers,

require specialised technology or hardware to correctly manufacture. These boards are becoming increasingly important to the industry as new products generally require at least 4 layer boards.

The substrate material used in PCBs can also vary based on the requirements of the application and recent innovations such as flexible PCBs are now available for use in certain harsh environments.

Lead-free and RoHS (Restriction of Hazardous Substances) boards are also available but require a slightly different manufacturing process due to the differing thermal properties of the lead substitute material. PCBs also require special coatings to protect the board during both operation and soldering.

PCBs also require testing using either automated optical inspection, or a flying-probe test. These systems are often automated and are important in guaranteeing the quality of the manufactured board.

Other component and sub-assembly suppliers

There is a massive range of electronic componentry and sub-assemblies available. For example, RS Components (one of the world's largest component suppliers) supplies around a 450,000 different components from 2,500 different suppliers. Examples of component categories are set out in the table below:

Electronics components, power and connectors	Electrical, automation and cables	Mechanical products and tools	IT, test and safety equipment
▶ Batteries ▶ Connectors ▶ Embedded & Wireless ▶ Optoelectronics and displays ▶ PCB prototyping and ESD handling ▶ Passives ▶ Power supplies ▶ Semiconductors ▶ Transformers	▶ Cables ▶ Control gear ▶ Electrical installation ▶ Enclosures and fans ▶ HVAC and security ▶ Process control ▶ Relays, switches and indicators	▶ Hardware ▶ Mechanical Components ▶ Plumbing and hosing ▶ Pneumatics and hydraulics ▶ Tools and tool storage ▶ Workshop consumables ▶ Workshop and site equipment	▶ Audio and visual equipment ▶ Books ▶ Information Technology ▶ Office supplies ▶ Personal protection equipment ▶ Site safety ▶ Software ▶ Test and measurement

Contract manufacturers

Electronic products primarily consist of PCBs and specific components which need to be attached to the PCB in a very specific manner. There is an enormous variety of components available, each with different form factors and electrical connections. The process of attaching such components to a PCB is referred to as board population and is the primary task of electronic contract manufacturers.

Component suppliers offer a wide range of components, each with slightly differing form factors and electrical connections. There exist a number of standards and technologies for such components, which specify the electrical connections layout and tolerances, but these are continually changing to support the increasing density required by the electronics industry.

Contract manufacturers who perform board population are required to support both modern and mature component placement technologies, which often prevents the manufacturing process from being entirely automated. Currently, there exist two main types of components; through-hole components and surface-mount components.

Through-hole components attach to the PCB through wire legs which fit into holes drilled in the board. These wire legs are then soldered directly to the underside of the board, where they connect to copper tracks on the PCB. This technology is still widely used in established products and for components which require a strong physical connection to the underlying PCB. Assembly for through-hole components is notoriously difficult to automate and component insertion is often performed by hand. Soldering is accomplished with a special device known as a wave solderer, which is both faster and more reliable than hand-soldering such components.

Surface mount components are soldered directly to copper pads on the PCB and are generally far smaller than the equivalent through-hole components. These devices may also have far more individual electrical connection, with the pitch between copper pads becoming increasing smaller. Surface mount technologies can be assembled by hand with difficult, and is best done by an automated pick-and-place machine.

These devices apply solder paste directly to the PCB and then automatically place components onto the pads in their correct locations and orientations. Surface-mount components are generally packaged specifically for use in pick-and-place machines, which often imposes a minimum order quantity on such components. The populated boards are then exposed to heating and cooling cycles in a solder reflow oven in order to melt the solder paste and attach the components to the PCB.

Many surface mount technologies utilise small metals pins on the exterior of the component for electrical connectivity. These connections are visible and therefore quality of the connection on these devices is relatively easy to inspect. Newer surface mount technology, such as ball-grid arrays, arrange their connections underneath the surface of the component to allow for a far greater number of connections. This makes the assembly process more difficult as the solder is covered by the component and not visible for inspection. Special x-ray inspection is required to ensure a good connection for such packages.

Component manufacturers also provide other services, such as mechanical assembly and product testing. These services are usually integrated into the assembly process whenever possible. It is also worth mentioning that in complicated electronic assembles, where faults are detected, manufacturers may rather discard the faulty piece/unit than place additions strain by removing and resoldering a replacement part.

Test and measurement equipment manufacturers

There exist a number of companies that specialise in the design and manufacture of electronic testing and measurement systems. Functional testing for products requires special equipment or jigs in order to simulate the real-world application of a product or device. A number of companies assist in the development and manufacture of such equipment.

13.1.2 International market and supply trends

The electronics industry relies heavily on outsourced manufacturing throughout the manufacturing process. Due to the complex nature of all the involved components, sub-assemblies and assemblies, it is not possible for most companies to become vertically integrated manufacturers. Continuous improvements in technologies, standards and tolerances make it necessary for companies to outsource tasks such as component manufacture, PCB manufacture, assembly and testing to specialised organisations.

At the global level, Original Equipment Manufacturers (OEMs) have continued to outsource manufacturing activities which they regarded as non-core, so that they can focus on their core competencies of innovation and design. In the 1980s and 1990s, many OEMs sold off their

production units to ECMs, resulting in the growth of large ECMs with significant economies of scale which enable them to produce electronic products and components at a much lower cost than the OEMs. The growth of electronic contract manufacturing as a manufacturing sub-sector has resulted in a shift in market power from OEMs to ECMs. The contract manufacturing sector has consolidated over the past five years, with the top 5 companies representing 54% of the total market[91].

The major ECMs are as follows:
- Flextronics International
- Soledron Corporation
- Sanmina-SCI Corp
- Celestica Inc
- Jabil Circuit Inc
- Foxconn

These ECMs are mainly headquartered in North America and Taiwan.

Contract manufacturers are slowly evolving into other spheres of the value chain, primarily due to the competitive nature and low profit margins associated with high-volume manufacturing. These services include the sourcing of components, product design, final assembly, testing and even packaging and distribution. Even aspects of the design phase can be outsourced, due to the availability of application-specific integrated circuits (ASICs) and other system-on-a-chip technologies. Companies that perform these additional services are increasing being referred to as "electronic manufacturing services".[92]

The rise in adoption of contract manufacturing in the electronics market has dramatically altered the manner in which companies operate and structure themselves. Firms have the ability to rapidly vary their production volumes, and reduce their logistics costs by performing manufacturing operations near to the source of components and input materials. Certain companies can also choose to perform the final assembly geographically close to their destination markets to allow for localisation – this process is sometimes referred to as near-shoring.[93]

The emergence of contract manufacturing has lead to the creation of firms that have no internal manufacturing capacity at all. These firms can still compete in high-volume consumer markets through close relationships with the contract manufacturing industry. This has lead to a situation where contract manufacturers act like venture capitalists, choosing to collaborate with start-up ventures and aid in the design and development of the product.[94]

Global production networks are increasingly becoming the *modus operandi* of the sector. Where components are concerned, the trend towards globalisation and diversification of supply has resulted in the division of the global supply chain into several stages:
1. System design and engineering
2. Component manufacturing
3. Component subassembly and final assembly

System design and engineering has for the most part remained in locations that can deliver specific technological and engineering expertise. Component manufacturing tends to split – in the majority of cases the manufacture of standardised components is shifting to low labour cost markets. Components differentiated on the basis of quality or technology however tend to remain in the EU, Japan, and US, or in markets that have developed specific niche expertise (like South Africa). Component subassembly and final assembly is rapidly shifting to markets with the right

[91] **the dti**, 2004, 'The Contract Manufacturing Sub-sector of the Electrotechnical Industry in South Africa'
[92] http://www.ventureoutsource.com/print/node/19
[93] http://www.ittoday.info/Articles/nearshoring.htm
[94] Sturgeon, J., 2003,'Exploring the risks of value chain modularity'

combination of low labour costs and market access (potential for manufacturing scale and effective transport). China is increasingly the most important manufacturing location in the sector (e.g. 7.5% of total global electronics assembly is currently done in China and that this could increase to 35 percent in 2095). However, a number of other markets such as Brazil, Mexico, India, and Hungary are also becoming key locations for electronic component manufacturing and assembly.

The electronics contract manufacturing industry suffered sharp downturns in 2009 due to the economic recession and experienced a 13.4% decline in worldwide revenues. The outlook for 2010 is cautiously optimistic, with worldwide revenue expected to climb 7.8% from US$260.5bn in 2009 up to US$280bn in 2010[96].

Revenues from companies performing purely contract manufacturing services are expected to rise slower than those from original device manufacturers, with ODM revenue expected to increase by 10.8% and contract manufacturing services to grow by only 5.2%.

Industry analysts also predict that worldwide component shortfalls will also negatively affect the growth of contract manufacturing companies, due to unavoidable delays resulting from longer component lead times.

The silicon foundry industry will therefore see large increases in revenue due to increased consumer demand. iSupply estimates that revenues for foundries will increase by 39.5% in 2010, increasing to US$24.8bn (up from US$17.8bn in 2009), experiencing a compound annual growth rate of 12.5%. Worldwide semiconductor revenues are expected to reach a record US$300.3bn in 2010, showing an increase of 30% from US$229.9bn in 2009. The high growth rate is however primarily due to the sharp decline experienced during 2009.

Some examples of component suppliers include the following:

- Amphenol
- AVX
- Bulgin
- Bussmann
- Crouzet
- Finder
- Hellermann Tyton
- Honeywell
- International Rectifiers
- Matsushita
- Moeller
- Murata
- Omron
- Phillips
- Siemens
- Traco Power
- Tyco Electronics
- Weidmuller

[95] Manufacturing and Technology News, 2003, 'Trends in international electronics manufacturing have National Electronics Manufacturing Initiative in a state of flux.'

[96] http://www.isuppli.com/Teardowns-Manufacturing-and-Pricing/News/Pages/Electronic-Contract-Manufacturing-Returns-to-Growth-but-Uncertainties-Remain.aspx

13.1.3 Manufacturing activities and capability in South Africa

There are a number of South African companies manufacturing and producing PCBs for the local electronics industry. Almost all of these companies have little or no export operations and many have been serving the same client base for many years. As PCBs are required in almost every electronic application, the capabilities of local PCB manufacturing operations directly impacts the abilities for companies to do rapid prototyping and development. The following is a short summary of the PCB manufacturers operating in South Africa, including a brief summary of their capabilities:

	Laminate thickness	Minimum conductor widths	Minimum drilled hole diameter	Maximum panel size	Number of layers
WH Circuits	▸ 1.0 - 1.6 mm	▸ 0.2 mm	▸ 0.4mm	▸ 480x300mm	▸ 6 layers
Cirtech	▸ 0.4 - 3.2mm	▸ 0.064mm	▸ 0.2mm	▸ 530x610mm	▸ 12 layers
Master Circuits	▸ 0.8 - 3.2 mm	▸ 0.2 mm	▸ 0.4 mm	▸ 400x400mm	▸ 4 layers
Bosco Printed Circuits	▸ 0.8 - 3.2 mm	▸ 0.18 mm	▸ 1.6 mm	▸ 450x520mm	▸ 2 layers
Trax Interconnect	▸ 1.0 - 3.2mm	▸ 0.125 mm	▸ 0.125 mm	▸ 508x406mm	▸ 12 layers

Cirtech Electronics has recently installed local manufacturing capacity to support the latest PCB manufacturing technology, with the express intent on providing the local industry with small volume and prototyping support. The company used to export such work to overseas PCB manufacturers, and is using its existing clients as an initial customer base.

Although many of the above companies are IPC members, none currently are capable of adhering to IPC Class 3 standards and therefore cannot be used by customers requiring high reliability electronic sub-assemblies. This includes military, avionics and medical applications. Trax Interconnect is currently the only South African manufacturer to be UL Certified and is currently pursuing IPC Class 3 accreditation with the assistance of Denel Dynamics.

There are also a number of core technologies that are not current well supported in the South African PCB manufacturing industry. These technologies include:

- Multi-layer boards beyond 12 layers
- Flex and rigid-flex multi-layer boards
- Support for buried and blind vias on multi-layer boards
- Verified impedance-controlled PCB manufacture

Compared to global levels, there is limited local component manufacture capacity. Most companies primarily make use of imported components that are highly cost competitive, although they may use local supplier during product prototyping in some cases. South Africa is served by a range of component distributors and agents, such as RS Components and Mantech Electronics.

In addition, some manufacturers offer component importing or procurement services to their clients in order to provide a more complete solution and retain their relationships. The South African electronics industry also support a number of contract manufacturing companies, providing both assembly and other value-added services such as testing and procurement. These companies often manufacture for a specific industry, such as the automotive electronics market, but many offer their services to the entire industry. Electronics contract manufacturers in South Africa include:

Table 37: Examples of electronic contract manufacturers in South Africa

Company	Nature of business	Description
Elprom	▸ Contract manufacturer	General contract manufacturer based in the Western Cape
Jemstech	▸ Contract manufacturer	Contract manufacturing company specialising in small volumes and prototype work.
Microtronix Manufacturer	▸ Contract manufacturer	General contract manufacturer
Montaar Manufacturing	▸ Contract manufacturer	Small hand-assembly contract manufacturing company, specialising in prototype development.
Omnigo	▸ Contract manufacturer	IPC Class 3 contract manufacturer
Pace Electronics	▸ Contract manufacturer	Contract manufacturer specialising in the production and repair of set top boxes
Parsec	▸ Contract manufacturer	Small volume contract manufacturer specifically for military electronic products
PI Shurlok	▸ Contract manufacturer	Contract manufacturer for the automotive and telecommunications industry
RC&C Manufacturing	▸ Contract manufacturer	Contract manufacturer and electronic manufacturing arm of the Reunert Group.
Robert Bosch SA	▸ Contract manufacturer	Contract manufacturer for the automotive industry
Sabertek	▸ PCB manufacturer ▸ Contract manufacturer	Vertically integrated contract manufacturer for electronic components
Tellumat	▸ Electronics contract manufacturer ▸ Mechanical contract manufacturer	Provides both precision mechanical and electronic contract manufacturing services
Universal Pulse Manufacturing	▸ Contract manufacturer	Low volume, high quality electronic contract manufacturing company, focusing on Wimax solutions.
Vetronix	▸ Contract manufacturer	Contract manufacturer offering both manufacturing, repair and reworking services

Volumes present difficulties for contract manufacturers, as many companies are geared for high volume manufacturing operations. The set up and tooling costs, both in terms of capital and labour, can be prohibitively high for small production runs and prototyping operations. There are a number of smaller contract manufacturing operations which provide prototyping solutions, although many of these companies struggle to meet production deadlines on smaller jobs.

The majority of the above contract manufacturers are ISO 9001 approved and many companies are IPC Members. Three of the above companies are IPC Class 3 compliant (see list of acronyms and terms for an explanation of the different IPC classes, IPC Class 3 products demand continued high performance, or performance-on-demand is critical, and equipment downtime cannot be tolerated, the end user environment may be uncommonly harsh, and the equipment must function when required, such as life support or other critical systems). These producers are therefore capable of doing contract assembly work for military industries. These companies are:

- Parsec
- Omnigo
- Jemstech

The automotive contract manufacturers are wary of directly entering the contract manufacturing market, despite having sufficient spare capacity to support production. These companies cite difficulties in operating a dual mentality when it comes to product quality and testing procedures. These companies therefore want to specialise in the manufacture of products that require similar levels of quality and reliability to that required by automotive electronics.

13.2 Sub-sector assessment

Table 38: SWOT assessment for electronics serving multiple sub-sectors

Other electronics and sub-assemblies: Electronics serving multiple sub-sectors	
STRENGTHS ▸ Strong local demand for complex PCBs	**WEAKNESSES** ▸ Problems with testing and certification ▸ Lack of skilled labour ▸ Very few local companies capable of producing complex PCBs ▸ Few companies are IPC Class 3 complaint
OPPORTUNITIES ▸ Local support for complex PCB manufacture ▸ IPC-Class 3 compliant manufacturers	**THREATS** ▸ Lack of demand due to global recession ▸ Opportunity is medical imaging is fast diminishing due to international entrants

13.3 Medical devices

13.3.1 Definition and overview

A medical device is a product which is used for diagnosis, therapy or surgery. Many of these devices include some electronic aspects. Examples of medical devices that include electronics include the following:

- Anaesthesia units and ventilators
- Apnea monitors
- Aspirators
- Auto transfusion units
- Electroencephalogram (EEG)
- Electrocardiographs
- Electronic stethoscope
- Electronic thermometer
- Electronically enabled beds
- Electrosurgical units
- Endoscopes
- External pacemaker
- Foetal monitors
- Heart Lung Machine
- Incubators
- Infusion pump
- Invasive blood pressure units
- Laparoscopic insufflators
- Lensometer
- Phonocardiographs
- Phototherapy units
- Pulse oximeters
- Radiant warmers
- Sphygmomanometers
- Stent
- Stereotatic pointers
- Surgical drill and saws
- Surgical lights
- Surgical table
- Surgical microscope
- Temperature monitor
- Treadmills
- Ultrasonic nebulisers
- Ultrasound sensors
- X-ray diagnostic equipment and scanners

Wider non-electronic medical devices are not considered here, e.g. mechanically-based tools, prosthetics and consumables.

13.3.2 International market and supply trends

The worldwide medical device market is estimated to be worth US$140bn, with the U.S. market generating revenues of US$57.6bn and experiencing an annual 8% growth rate. The United States currently consumes approximately 40% of the total worldwide output of medical devices, and produces over 50% of them.

Healthcare products are also a growing international market, with worldwide healthcare spending per capita growing significantly. In the United States, this has increased from US$4,400 in 1999 to over US$7,500 in 2008. Industry analysts therefore feel that a medical product needs to be successful in the United States in order to make inroads into the international medical market.[97]

The following are considered the top global medical device companies[98]:

- Johnson and Johnson
- GE Healthcare
- Baxter International
- Medtronic
- Tyco Healthcare
- Siemens Medical Solutions
- Philips Medical Systems
- Boston Scientific
- Stryker
- B. Braun
- Guidant Corp.
- Zimmer Holdings
- Becton, Dickinson & Co.
- Kodak Health Imaging
- Hospira
- Smith & Nephew
- St. Jude Medical
- Fresenius
- 3M Healthcare
- Cardinal Health
- Alcon
- Synthes
- Bausch & Lomb
- C. R. Bard
- Dentsply International
- Terumo
- Biomet
- Dräger Medical
- Invacare
- Gambro

The industry is highly regulated because of patient safety and product durability requirements.

COMPARISON WITH SOUTH AFRICAN MARKET

The diverse South African Medical Equipment and Devices (MED) market, ranges from disposable medical devices to major capital items. The ratio between disposables and capital equipment is about 40:60 respectively.

[97] http://www.altera.com/end-markets/medical/overview/med-overview.html
[98] http://www.mpo-mag.com/

Market revenues in the medical device industry in South Africa were $800m in 2006. The expected growth over the 2008 and 2009 as visualised by market players is 8%, which compares favourably with the projected inflation of less than 7%.

The best prospects for medical equipment with advanced technology remain in the private sector. Companies supplying primary healthcare products and services may find opportunities within the clinic building/upgrading programmes. With the growing number of hospitals and laboratories, the demand for the latest medical instruments has increased tremendously in the last few years. Medical equipment analysts have estimated a 7.3 % per annum increase in healthcare expenditure over the next three years. Medical/surgical instruments and appliances, medical needles and catheters, electro-diagnostic apparatus, ultra scanning apparatus and imaging equipment constituted the bulk (70.9%) of the total import figure for the last two years.[99]

13.3.3 Manufacturing activities and capability in South Africa

There are a number of South African companies operating in the manufacture and development of medical equipment. This industry, although small, is supported by a consortium known as Medical Devices to Market (MD2M) which is actively trying to assist the local medical manufacturing industry. The following companies are actively producing electronic medical products in South Africa:

Table 39: Examples of electronic medical equipment companies operating in South Africa

Company	Nature of business	Description
Lodox Systems	▸ Manufacturer	Lodox Systems produces a low-dosage full-body x-ray system specifically for use in trauma centres
GeoAxon	▸ Manufacturer	THRIP-funded producer of biomedical electronic equipment.
Brittan Healthcare Group	▸ Manufacturer ▸ Distributor	Manufacturer of electronic medical products
Geo ICT Health	▸ Manufacturer	SPII-funded project to develop electronic medication usage monitoring units
Cape Ray	▸ Manufacturer	Manufacturer of new digital mammography equipment
Gabler Medical	▸ Manufacturer	Produces suction pumps and small electronic components for use in surgical application
GeoMed	▸ Manufacturer	Produces a range of medical products including paediatric heart murmur detectors
MD2M	▸ Consortium	Organisation to bolster and support the South African medical device community

Although the majority of medical equipment is imported into South Africa, the above companies are often developing and manufacturing innovative products for niche specialisations. These

[99] Proven Trade contracts. (2009). Overview of the Medical Device Market in South Africa. Available: http://www.webptc.com/april09/medical-market-reports.html

companies do not compete directly with worldwide industry players, but are either specialising into untapped export markets or focusing on providing unique localised solutions.

13.4 Sub-sector assessment

Table 40: Electronic medical devices SWOT assessment

Other electronics and sub-assemblies: Medical devices	
STRENGTHS ▸ Existing skills and IP in low-dosage x-ray imaging technologies **OPPORTUNITIES** ▸ Specialised medical imaging technologies	**WEAKNESSES** ▸ Problems with testing and certification ▸ Lack of skilled labour **THREATS** ▸ Lack of demand due to global recession ▸ Opportunity is medical imaging is fast diminishing due to international entrants

PART C: OPPORTUNITIES, CHALLENGES AND RECOMMENDATIONS

14 Assessment of opportunities

The tables below outline potential opportunities identified through the research.

14.1 Opportunities by sub-sector

14.1.1 Automotive industry (vetronics)

Table 41: Identified opportunities in automotive electronics

Opportunity	Motivation	Market segment
Vehicle tracking and fleet management	▸ South Africa is already a leader in the design and manufacture of GSM-based vehicle tracking solutions and should look to increasing the amount exported	▸ Automotive
Asset tracking	▸ The logical extension of vehicle tracking technologies to other sectors offers many opportunities to capitalise on already established technologies. ▸ Examples of such systems include equipment tracking, livestock tracking and cold-chain management systems	▸ Automotive ▸ Industrial ▸ Commercial
Vehicle security products	▸ South Africa produces a wide variety of security products, some of which are specifically for the aftermarket automotive industry. Many of these products are produced for the local industry but offer enormous export potential	▸ Automotive
Engine management systems	▸ South Africa has established capacity in this highly advanced area	▸ Automotive
Immobiliser technologies	▸ South African electronics manufacturers are currently producing innovative immobiliser solutions, such as breathalyser-based systems and remote cut-out devices. ▸ There is strong international demand for these products and this represents a significant opportunity for local industries	▸ Automotive
Harness manufacturing	▸ South African producers are already very active in the manufacture of vehicle wiring harnesses, and find that these can be manufactured locally at competitive prices	▸ Automotive ▸ Military
Automotive batteries	▸ South Africa has a number of automotive battery manufacturers ▸ As automotive battery demand is seasonal, increased export operations will improve overall utilisation of existing equipment	▸ Automotive ▸ Industrial

14.1.2 Avionics and aerospace

Table 42: Identified opportunities in avionics and aerospace

Opportunity	Motivation	Market segment
Specialised and niche avionics equipment	▸ South Africa has a wealth of skilled engineers in sectors directly applicable to avionic technology ▸ A number of South African companies already produce for international aeronautics companies ▸ Opportunities exist due to the focus on quality and performance over costs	▸ Military ▸ Commercial
Small aircraft avionics systems	▸ South African companies already produce high-quality avionics equipment for use in small aircraft ▸ Manufacture and development is beginning to shift overseas due to manufacturing and support concerns	▸ Avionics

14.1.3 Radar

Table 43: Identified opportunities in radar

Opportunity	Motivation	Market segment
Sports radar systems	▸ South African companies have developed a sports radar technology which has applications across a wide range of sports ▸ Local companies are currently unable to keep pace with demand	▸ Consumer electronics
Contract radar design	▸ There are many South African expert designers and manufacturers of high-quality military radar equipment, many of which have ample spare capacity ▸ These companies currently could benefit from political and government assistance in securing contracts	▸ Military
Sonar and marine technologies	▸ South Africa has the skills and potential to manufacture non-military based marine sonar technologies, especially for use in fish detection	▸ Industrial

14.1.4 Power electronics

Table 44: Identified opportunities in power electronics

Opportunity	Motivation	Market segment
Renewable energy systems	▸ South African companies are actively pursuing renewable energy technologies ▸ Local manufacturers are producing wind turbine systems. These companies feel that their systems are more rugged and robust than those on offer, and often target smaller and localised products ▸ Due to international demand for renewable energy technologies, this represents a significant opportunity for the South African industry	▸ Industrial ▸ Power generation ▸ Energy
Transformer manufacturing	▸ Although the demand for power transformers remains relatively constant, the industry requires a high degree of customisation on a device level. These units are also physically large, thereby increasing logistics and transport costs, making	▸ Power ▸ Energy ▸ Power generation

Opportunity	Motivation	Market segment
	local production more viable ▸ Manufacturing process is hard to automate	
Switchgear	▸ Areas of established capacity and competitiveness ▸ Strong demand through Eskom investment and Competitive Supplier Development Programme	▸ Power
Sensors and systems unique to the large South African economy, e.g. mining and minerals beneficiation.	▸ South Africa's extensive mining and mineral benefaction industry provides local demand for such equipment ▸ Potentially small export market and generally low volumes	▸ Industrial ▸ Instrumentation and control

14.1.5 Energy-saving technologies

Table 45: Identified opportunities in energy-saving technologies

Opportunity	Motivation	Market segment
Smart metering applications	▸ Smart metering systems are an inherently localised sector ▸ There exists strong local and international demand for such products ▸ South Africa already has an established pre-paid electricity metering industry, and therefore many of the skills and infrastructure required to support the development of smart metering systems	▸ Energy
Pre-paid electricity vending	▸ South Africa already supplies many international customers with pre-paid electricity vending solutions ▸ This is also a worldwide growth industry and South Africa offers some of the most innovative products	▸ Energy ▸ Power generation
Solar energy products	▸ There is a lot of scope for new developments in the field of solar technology – from both an electronic and manufacturing perspective ▸ This is particularly relevant in light of the South African energy crisis, which creates local demand for the product	▸ Energy
Renewable energy storage	▸ The efficient and effective storage of electricity generated by renewable energy products will benefit the entire renewable energy industry	▸ Energy ▸ Batteries

14.1.6 Lighting

Table 46: Identified opportunities in lighting

Opportunity	Motivation	Market
Energy-saving LED lighting	▸ Growing international demand ▸ International government subsidies on the consumer-side ▸ Offers good alternatives to fluorescent lamps in terms of disposal and environmental impact ▸ Compatible with established contract manufacturing processes	▸ Residential ▸ Retail ▸ Industrial
Underwater LED lighting products	▸ Local demand ▸ Specialised industry with significant skills already present in the country	▸ Residential ▸ Commercial

Opportunity	Motivation	Market
	▸ Long lifespan of LEDs offer clear advantages over filament or fluorescent technologies	
Intelligent LED streetlights	▸ Significant local demand ▸ Potential for large energy savings ▸ Wireless communication technologies offer potential for coordinated “smart” streetlights ▸ Can leverage the ability of LED lamps to adjust brightness	▸ Transportation
LED Traffic lights	▸ Local and international demand ▸ Drop-in replacement ▸ Reliability and safety benefits ▸ Leverages lifespan of LED technology	▸ Transportation ▸ Infrastructure
Fluorescent lamp production	▸ Existing infrastructure and skills ▸ Large export market in Africa ▸ Local subsidies and incentives ▸ Local production reduces logistics costs for manufacture and disposal	▸ Residential ▸ Commercial ▸ Industrial
LED mining headlamps	▸ Large domestic market ▸ LED technology suitable for battery operation	▸ Mining sector

14.1.7 Consumer electronics

Table 47: Identified opportunities in consumer electronics

Opportunity	Motivation	Market
Localised final product assembly	▸ South Africa cannot compete in high volume manufacture but can compete in final assembly ▸ Importing of complete kits, with final assembly is a viable opportunity for South Africa ▸ Allows double-checking of products, thereby increasing overall quality ▸ Localised assembly is a global trend for global manufacturers	▸ Consumer electronics
Set-Top Boxes and Digital Television	▸ South Africa is already a world-leader in set-top box technology but should make efforts to ensure to maintain this position ▸ Biggest potential applications is in the realm of digital television ▸ Quantity of set-top boxes required by countries throughout Africa may represent one of the most viable manufacturing opportunities in South Africa.	▸ Consumer electronics ▸ Telecommunication

14.1.8 Telecommunications

Table 48: Identified opportunities in telecommunications

Opportunity	Motivation	Market
Wireless technology backbone and antennae	▸ Dramatic growth industry with the cost, size and power requirements of wireless functions falling rapidly ▸ Success of mobile phones is fuelling the rise of wireless communications ▸ WiMAX networks will become more mainstream in the near future as the corporate market adopts them as wireless LANs on their premises	▸ Telecommunication ▸ Consumer electronics
Fixed telecommunication	▸ Telecoms infrastructure rollout and replacement in	▸ Telecommunication

Opportunity	Motivation	Market
infrastructure - fibres	Sub-Saharan Africa ▶ South Africa has strong infrastructure (network) electronics capabilities	▶ Consumer electronics

14.1.9 Information Technology

Table 49: Identified opportunities in embedded software

Opportunity	Motivation	Market
Avionics software	▶ Opportunities seem to be increasingly in software rather than hardware	▶ Avionics and aeronautics
Tracking and security connectivity	▶ Leader in tracking and security ▶ Possible spin-off by developing systems to allow remote servicing and communication embedded tracking and monitoring capabilities	▶ Automotive

14.1.10 Other electronics and sub-assemblies

Table 50: Identified opportunities in other electronics

Opportunity	Motivation	Market
Local support for complex PCB manufacture	▶ South Africa has very few local companies capable of producing complex PCBs ▶ Strong local demand for complex PCBs ▶ Many of these boards are exported to overseas manufacturers ▶ Price is often a secondary concern for complex PCBs	▶ Electronics
IPC-Class 3 compliant manufacturers	▶ Although many companies are IPC members, very few are IPC Class 3 complaint ▶ High-value military projects often require IPC Class 3 complaint manufacturers ▶ Companies like Denel prefer to source locally whenever possible but are forced to look abroad when locally compliant companies are not found	▶ Electronics ▶ Military
Specialised medical imaging technologies	▶ South Africa has developed unique low-dosage x-ray imaging technologies ▶ Could also be adapted for security sector ▶ Constitutes a specialised niche in which large x-ray imaging producers do not compete ▶ Opportunities exist presently but are fast diminishing	▶ Medical ▶ Security

14.2 Opportunity summary, categorisation and assessment

The table below categorised the above opportunities in terms of whether they are components, sub-assemblies or assemblies, finished products or wider technical services (such as design, embedded software or systems integration). In some cases the opportunity may fall into more than one category. The table also provides examples of key companies with relevant capacity.

Sub-sector	Identified opportunities	Categorisation				Examples of companies with relevant capacity
		Components	Sub-assemblies & assemblies	Finish products	Technical services	
Automotive industry (vetronics)	▸ Vehicle and asset tracking and fleet management		✓	✓	✓	▸ PFK Electronics ▸ Cartrack ▸ Digicore ▸ MixTelematics ▸ TraceTec ▸ Altech Netstart ▸ iTrac Live ▸ Tracker ▸ Trolleyscan
	▸ Engine management systems		✓		✓	▸ Robert Bosch ▸ PI Shurlok ▸ Pasdec
	▸ Vehicle security products ▸ Immobiliser technologies			✓	✓	▸ PI Shurlok ▸ PFK Electronics ▸ Periseo ▸ Control Instruments Automotive
	▸ Harness manufacturing		✓			▸ Pasdec ▸ Periseo ▸ PFK Electronics ▸ Hesto Harness
	▸ Automotive batteries	✓	✓		✓	▸ First National Battery ▸ Willards ▸ Dixon Batteries ▸ Sabat Batteries ▸ Freestart Battery
Avionics and aerospace	▸ Specialised and niche avionics equipment		✓	✓	✓	▸ ATE ▸ Denel (Aviation, Saab Aerostructures, Dynamics) ▸ Fuchs Electronics ▸ Reutech Communications ▸ SAAB Grintek ▸ EADS ▸ Ansys ▸ Peralex ▸ Parsec ▸ Tellumat
	▸ Military avionics		✓		✓	
	▸ Small aircraft avionics systems		✓		✓	▸ MGL Avionics ▸ UAVs: Denel Dynamics, ATE, Tellumat
Radar	▸ Sports radar systems			✓	✓	▸ EDH
	▸ Contract radar design				✓	▸ EDH ▸ Reutech Radar Systems
	▸ Sonar and marine technologies		✓	✓	✓	▸ EDH ▸ Reutech Radar Systems

Sub-sector	Identified opportunities	Categorisation				Examples of companies with relevant capacity
		Components	Sub-assemblies & assemblies	Finish products	Technical services	
Power electronics	▸ Renewable energy systems			✓	✓	▸ MLT Drives ▸ Eveready/ Kestrel ▸ Alstrom ▸ Tenesol Manufacturing ▸ Emerson Network Power ▸ Aero Energy ▸ African Windpower ▸ Setsolar ▸ Thin-film Solar Technologies ▸ Solarite ▸ Jupiter Resources ▸ Dirwatt Limited
	▸ Transformers	✓	✓			▸ Powertech Transformers ▸ Desta Power Matla ▸ CM Transformers ▸ Lehman Transformers ▸ ABB
	▸ Switchgear	✓				▸ CBI Electric ▸ Siemens
	▸ Sensors and systems unique to the South African economy	✓	✓		✓	▸ Detek ▸ Conlog ▸ Denel Dynamics ▸ Ansys
Energy-saving technologies	▸ Smart metering applications ▸ Pre-paid electricity vending		✓	✓	✓	▸ CBI ▸ Conlog ▸ Custom Power Solutions ▸ Hefcom ▸ Landis + Gyr ▸ Powertech
	▸ Solar energy products		✓	✓	✓	▸ Jupiter Resources ▸ Setsolar ▸ Thin-film Solar Technologies ▸ Solarite ▸ Tenesol
	▸ Renewable energy storage		✓	✓	✓	▸ FNB Industrial ▸ Dirwatt Limited ▸ Emerson Network Power
Lighting	▸ Energy-saving LED lighting		✓	✓	✓	▸ LED Lighting ▸ Spero Group ▸ Sunfor Technologies
	▸ Underwater LED lighting products		✓	✓	✓	▸ Multisource
	▸ Intelligent LED street & traffic lights		✓	✓	✓	▸ Lee Power Electronics
	▸ Fluorescent lamp production			✓	✓	▸ Eveready
	▸ LED mining headlamps			✓	✓	▸ First National Battery
Consumer electronics	▸ Localised final product assembly		✓	✓	✓	▸ Altech UEC ▸ Amalgamated Appliance Holdings ▸ Mustek ▸ Pinnacle Micro

Sub-sector	Identified opportunities	Categorisation				Examples of companies with relevant capacity
		Components	Sub-assemblies & assemblies	Finish products	Technical services	
						▸ Nu World Holdings ▸ Defy ▸ Vektronic ▸ Gemini
	▸ Set-Top Boxes and Digital Television		✓	✓	✓	▸ Altech UEC ▸ Vektronic ▸ Parsec ▸ Tellumat ▸ Reunert ▸ Pace Electronics
Telecommunications	▸ Wireless and cell phone backbone and antennas		✓		✓	▸ Tellumat ▸ Reunert Group ▸ Advanced Digital Services ▸ Allpronix ▸ Q-KON SA ▸ Poynting Antennas ▸ SAAB Grintek ▸ RF Design ▸ Radio Data Communications
	▸ Fixed telecommunication infrastructure – backbone, fibre		✓		✓	
Information Technology	▸ Avionics software				✓	▸ Denel Aviation ▸ SAAB Grintek ▸ Peralex ▸ Natcom Electronics ▸ Tellumat
	▸ Tracking and security connectivity				✓	▸ PFK Electronics
Other electronics and sub-assemblies	▸ Local support for complex PCB manufacture		✓		✓	▸ WH Circuits ▸ Cirtech ▸ Trax Interconnect ▸ Master Circuits
	▸ IPC-Class 3 compliant manufacturers		✓	✓	✓	▸ Already IPC-Class 3 compliant: – Parsec – Omnigo – Jemstech ▸ Others: – Elprom – RC&C – Robert Bosch – Sabertek – Tellumat
	▸ Specialised medical imaging technologies		✓	✓	✓	▸ Lodox Systems ▸ CapeRay ▸ GeoMed

All of the above represent some opportunity for South African. As the table demonstrates, few of these opportunities relate to component production. However, based on the research and the wider experience of the project team, the following areas are likely to present more significant growth, employment and innovation prospects for South Africa.

- Renewable energy and energy-efficient technologies
- Automotive electronic systems (including engine management systems)
- Telecommunications backbone infrastructure
- Systems integration and technical services overall

15 Challenges facing the electronics industry in South Africa

This section discusses the industry-wide challenges as **highlighted by companies interviewed** within the electronics manufacturing sector. These can be summarised as follows:

1. Competition from imports
2. Obstacles to widespread innovation
3. High cost structure and lack of finance
4. Limited availability and quality of skills (engineers, technicians, artisans)
5. Barriers to international market access
6. Fragmented industry organisation

Each of these challenges is discussed in more detail below.

15.1 Competition from imports

Companies find it difficult to compete in the local market with **cheaper imported components and finished goods**. Examples include the consumer remote control industry, the PCB and electronic touch membrane industries, and intercom/PA systems markets. This is often due to competitors producing at a much larger scale than South African companies and with lower cost structures. Companies interviewed also suspect that some products are imported illegally or without paying the appropriate taxes, and therefore compete unfairly with locally manufactured products. These grey market imports are sometimes due to inventory overruns by large contract manufacturers. Companies also feel that institutions such as SARS and SABS do not adequately monitor imports:

- SARS in terms of inspection of imports and enforcement of compliance with tariffs
- SABS in terms of compliance of imported products with national safety standards

In addition, some product categories attract zero import duties (e.g. inverters), making it difficult for local manufacturers to compete with the cheaper imports (in particular where some components attract duties, and the associated finished products do not).

In addition, companies feel that South African customers are not fully aware of the implications of quality differences between locally produced goods and lower quality imports, and may also perceive South African goods to be of a lower quality.

Companies also feel that **large contractors** such as government departments, state-owned enterprises, Telkom, Cell C and MTN **do not give sufficient preference to local suppliers**, particularly where end-to-end systems are procured from international suppliers, who also do not procure inputs from the local industry. According to some electronics companies, limited or no preference is given to local suppliers. Further challenges related to supplying to SOEs are delays in tender adjudication and under-spending of budgets.

Examples:

African Capacitors lost 60% of its business in the lighting market when Eskom began subsidising an imported product in 2005 as part of its demand side management programme, which almost caused the company to close down.

Ansys has observed that delays in tender adjudication processes of SOEs cause the biggest bottlenecks in operations.

Bosco Printed Circuits feels that the wide availability of agencies for overseas Chinese PCB manufacturers has created an environment in which local manufacturing is uncompetitive. The

company estimates that the landed cost of a PCB from a Chinese manufacturer is 40% of its cost price.

CZ Electronics feels that large contractors such as Telkom, Cell C and MTN are looking to the international market rather than the local market, which results in a large loss of potential income for local contract manufacturers.

Tellumat indicates that large network operators often utilise overseas firms to provide end-to-end solutions. These companies therefore specify the use of imported products, often over similar local offerings.

15.2 Obstacles to widespread innovation

Companies have indicated that there is insufficient support for innovation in the electronics industry, particularly for an industry which undergoes rapid technology changes.

Particular issues that have been raised include the **weak support for local IP development** and weak protection of IP in overseas countries where manufacturing could be outsourced e.g. China's compliance with intellectual property protection is considered insufficient. Local patents are not considered transparent or meaningful, and international patents are very expensive (despite availability of some support mechanisms). The new Intellectual Property Rights from Publicly Financed Research and Development Act of 2009 and its regulations do not appear to set clear guidelines on proportionality in determining universities' share of IP, or set conditions for minimum financial investment required before universities can claim rights to IP. The Act is seen by some is seen by some companies as a constraint to collaboration with universities due to concerns about the share of royalties that may accrue to the university, and thus limit the commercial viability for entrepreneurs.

Lack of financial support for R&D is also cited as another obstacle to innovation. In recent years, some centres within the CSIR have increasingly taken a "cost centre" approach and focused on revenue-generation opportunities rather than necessarily research in the long-term national interest; in some cases, the CSIR is competing with private companies for research contracts.

Funding for R&D may be difficult to obtain, particularly for smaller firms which do not have the stability to be able to plan for long term research programmes. **There is a gap in financing for technology-based and other start-ups in South Africa**, particularly for those at the idea stage (with or without working prototype), proof of concept and early operational stages.

SMMEs are often relatively isolated from universities. Universities tend to focus on developing relationships with corporates who have greater funds available, and some are hesitant to approach universities **believing their problems to be too simple to merit attention from universities.**

Institutional bureaucracy within universities has also been cited as a constraint to collaboration. Where the collaboration is formalised and contracts have been agreed to, researchers experience delays in the finalisation of paperwork by university administrators which can prevent collaboration from taking place at all, or hamstring collaboration once research has reached a certain stage.

There is a **shortage of local prototyping facilities** and a lack of suitable shared infrastructure for prototyping that can be used by smaller companies that cannot afford to invest in their own infrastructure, or cannot afford to hire replacement equipment when their equipment is being repaired. However, a number of companies do offer prototyping services, as their facilities are suited to low volume design and production work.

A chasm exists between **blue sky research**, and the development of technology with **industrial applications**. University R&D is not usually focused on identifying and realising the commercial value of outputs, limiting the potential for commercialisation.

In some cases, the perceived lack of support may be related to **incomplete knowledge of the support available** (for example, many companies are not aware of the SPII, THRIP, the R&D tax incentive and the Innovation Fund).

Further obstacles to research and development include limited availability of appropriately skilled personnel in South Africa, and global companies locating R&D activities in centralised facilities overseas.

A number of companies have close ties with universities (often where they have originated as spin-offs), but some find that **collaboration is limited** by the following:

- Universities' longer R&D cycles
- Universities tend to focus on relationships with larger businesses (rather than SMMEs) – in the opinion of interviewees, this pattern relates to historical reasons and the potential for better financial returns
- Limited availability of required equipment
- Distrust in abilities and competencies of a partner. Some industry members see most of academia as out of touch with current trends, and focusing on areas that are either irrelevant or too theoretical to have real-world application
- Distrust of intentions: Where legal agreements have been entered into, there are often concerns that IP will be stolen. Some role players view this more as a perception, and a matter of unclear expectations, than widespread abuse. Others point to actual cases where IP rights have been abused by partners, including both business and government partners

There is also, in many cases, **limited awareness of the potential value and benefits of collaboration** by both academia and industry - there is a tendency to use the time and effort required to initiate and manage collaborations as an excuse not to engage with others. A related issue is lack of information and common understanding about innovation and what it means at the sector or firm level.

Furthermore, companies have indicated that South African uptake of technologies tends to lag technology development, resulting in reduced demand for innovative products.

Examples:

ATE needs more R&D funding to design the next generation of mission computers.

GeoAxon limits its collaborations with universities as it feels that universities take too long to provide feedback and results.

LED Lighting has attempted to utilise university resources to assist with testing of LED products but has found that universities lack the required equipment.

Martin Electronics does not conduct any research with tertiary education facilities as it feels that universities do not take into account market and economic factors in their design and approach to new ventures.

Parsec used to maintain stronger relationships to universities but currently cannot justify the time investment involved. Also, Parsec designs and manufactures numerous products for the defence industry, where factors such as security and intellectual property rights make it difficult to forge close ties to tertiary education facilities.

PCB Pool does little research and development in South Africa. R&D mostly occurs elsewhere through Beta Layout. PCB Pool has no R&D departments and no current links with any universities.

Trolleyscan feels that technology incentives are geared towards long term research and development projects – which require pre-planning, stability and predictability. These are not always easy for a small company to achieve.

15.3 High cost structure and lack of finance

Manufacturing costs in South Africa are not competitive compared to high volume producing countries such as China. According to one manufacturer, the landed cost of bare single-sided and double-sided PCB's imported from China is 40% of local manufacturer's production cost. Contributing factors accounting for South Africa's lack of competitiveness include: the relatively high cost of unskilled and semi-skilled labour (wage rates as well as the costs of hiring and firing), the shortage of skilled personnel, and the high freight costs for imports and exports (due to South Africa's distance from major markets and component suppliers).This also causes long lead times – and these have lengthened where producers have cut down production scale due to the recession. Manufacturers use an allocation system based on geography and market size to cater to worldwide demand – South Africa is not considered big enough or of sufficient strategic importance to be prioritised by international manufacturers.

Gaps in infrastructure and services, particularly increases in electricity tariffs, unreliable supply of electricity, and gaps in transport infrastructure also contribute to higher costs. Increasing electricity costs in South Africa are a factor as the manufacturing value chain incorporates many energy intensive processes, such as solder ovens and plastic-injection mouldings. Interruptions in power have also contributed negatively to manufacturing operations. Power cuts in the manufacturing sector can result in losses and delays, as well as affecting certification standards due to reliability concerns (e.g. entire batches of products may have to be discarded due to a power interruption).

Fluctuating exchange rates are also a concern for manufacturers. Many manufacturers quote prices in foreign currencies (usually in the currency of the most significant input cost) to compensate for fluctuations in the exchange rate which affect both imports and exports.

In addition, tariffs may be applied to components which are not currently available locally. Also, classifications of the various components, sub-assemblies and assemblies are not always applied consistently and correctly, resulting in delays and inconsistent application of tariffs.

Companies are struggling to cope with paying for production facilities and equipment, exacerbated by insufficient demand to fully utilise production capacity. Furthermore, companies find it expensive to replace equipment in order to keep up with changing technologies.

Many electronics companies across sub-sectors and sizes of organisation cited access to finance as one of their greatest challenges, in particular for capital equipment, new product development and accessing new markets. Commercial banks are regarded by manufacturing companies as being overly sensitive to risk and too conservative in their lending approach. Finance for intangible assets such as software was also raised as a specific challenge – many companies indicated that they have been unable to arrange capital for these kinds of purchases. Costs for software can be extremely high (R100,000 or more in some cases), but banks are unwilling to lend as these items are seen as having limited value as collateral. The global recession has further constrained access to finance.

Examples:

Altech UEC designs the PCBs and manufactures prototypes using these South African suppliers, but the large scale manufacturing of PCBs – approximately 2m units per year – is done in China as local suppliers do not have the volume capacity, cost and quality competitiveness. Altech UEC believes that factory worker wages are 4 times more expensive in South Africa than in China.

ATE struggles to access R&D funding to design the next generation of mission computers, as well as capital funding to replace its equipment (e.g. pick-and-place machines).

Bell imports many components which cannot be manufactured cost-effectively in South Africa, resulting in a high reliance on imports in the majority of product categories. This can increase costs and decrease manufacturing flexibility.

Elprom is finding it difficult to source the capital to maintain the latest production equipment, and the company is concerned about the rising costs of infrastructure, especially concerning the cost and reliability of electricity in the near future.

Eveready has difficulty in accessing capital when needed. The company describes the banking sector as too conservative.

GE South Africa imports the majority of components used in the manufacturing process from overseas suppliers in Europe and China, it finds the pricing and service from local companies to be unreliable.

ISS International relies heavily on local infrastructure in order to perform its monitoring services. The company requires reliable internet access and a constant electrical supply. The company has installed a generator to cater for blackouts but this is costly and reduces overall productivity. The company has also installed a number of internet lines in order to obtain better reliability but still feels that there is room for improvement. Another major challenge facing the company is the volatile exchange rate, which has been both beneficial and harmful to the profitability of the company.

Master Circuits feels that South African labour laws are both costly and rigid. Due to the economic recession and a sharp decrease in demand, the company was forced to retrench staff and was therefore required to pay approximately R170,000 in severance packages. This served only to worsen the effects of the recession and downturn in business.

MLT Drives imports aluminium frames and bulk copper from China as local prices are 30% higher. PCBs are mostly sourced from local manufacturers (e.g. Elprom, Plessey, Tellumat). However, Chinese products are generally cheaper and the response time is quicker. There are also large quality variations in South African PCBs. There is also not much quality control and non-genuine parts are a problem.

Nu World finds that the costs of freight (both locally and internationally) are too high.

Parsec finds that exporting is hampered by the fluctuating exchange rate. This is partially due to the long-term nature of military contracts.

RC&C finds it difficult to find appropriately skilled artisans and therefore has to offer higher salaries in order to secure labour.

15.4 Limited availability and quality of skills (engineers, technicians, artisans)

A high proportion of companies indicated that they experience a shortage of skilled personnel for operating production lines and other key manufacturing activities. South Africa has a reasonably supportive national system for innovation and education, which makes well-trained personnel available, that allow high technology firms to develop and engage effectively in global markets. At the same time, there is a pronounced scarcity of skilled personnel, which restrains development of existing firms and the entry of new firms.

Companies have observed that education and training programmes do not provide adequate and relevant training, and little or no practical experience. Some companies have invested significant time and effort in providing in-house training, e.g. PCB manufacturing. Furthermore, companies indicate that the quality of engineering graduates and technicians produced by local universities and universities of technology appears to be declining, and there are concerns about the quality of students being attracted to universities. Companies have also reported that universities are not proactive in pursuing and maintaining relationships with industry, resulting in weak relationships that provide little benefit.

Shortages are further exacerbated by local companies having to compete for skills with international markets, with highly skilled South African emigrating to obtain perceived better work opportunities. Within South Africa, companies are also concerned that local offices of international companies are able to attract highly skilled graduates from local companies. Also, firms may struggle to retain skilled personnel in engineering positions, where management positions may offer higher compensation and people may not have a passion to remain in technical roles.

Companies have also highlighted that the skills shortage is exacerbated by the difficulty in importing skilled personnel due to immigration restrictions, although they did not make mention of whether they had made use of exceptional skills work permits scarce and critical skills quotas– please see **Error! Reference source not found.** for further detail on these mechanisms).

Examples:

ATE experiences skills shortage as experience engineers in its particular sector of electronics are becoming scarce.

CCII highlights finding and retaining capable staff as a major challenge.

Detek currently lacks adequately qualified and skilled personnel and is looking to potentially triple the number of staff in the next two years. It finds that graduates from local tertiary facilities do not have the appropriate skills required for manufacturing, and therefore the company has to perform in-house training.

Denel Aviation noted that many people in artisanal roles no longer have the passion and long-term commitment to a career as an artisan that was previously evident; often artisans are now hoping to move on into other roles, including management.

GE Security has difficulty sourcing skilled labour, especially appropriately skilled technicians. The company finds that standards in education are dropping in South Africa.

Parsec is concerned that international corporations are opening small offices or subsidiaries in South Africa and poaching skilled staff from local companies.

Protea Technology is concerned over the quality of graduating engineers and finds that graduates are not skilled in practical issues and require significant training before being able to fully contribute to the company. Protea has had to send staff overseas for training due to the lack

of sufficiently skilled local institutions, and has resorted to sourcing skilled employees from other countries. Protea does not have any active ties to universities or tertiary education facilities. In addition, Protea feels that many of its newly recruited engineers and technicians start with the intent to switch to management positions, hurting productivity and causing low morale among employees. The company is of the opinion that the current high pay differential between managers and engineers is the cause of the problem.

Sabertek trains staff internally due to difficulty sourcing technical staff to assemble boards on the production line. The company has not been able to find an appropriate external training facility.

Softcon recently employed two software developers from overseas due to limited local skilled personnel, particularly in engineering and software development.

15.5 Barriers to international market access

Certification and quality standards represent a significant challenge for firms aiming to access international markets. For example, to export to the EU it is compulsory to have a "CE marking" for almost all electronic assemblies[100]. This necessitates a local testing environment and certification process. In addition, ISO and other relevant quality standards[101] are market-driven requirements which must be met by firms operating in international markets. Examples of the international certification standards that apply to the different electronics segments, and are necessary to gain access to export markets, are provided below:

Table 51: Examples of relevant certification standards

Sector	Certification	
	Region	Name of certification
General manufacturing	International	International Standards Organisation (ISO)
	South Africa	South African Bureau of Standards (SABS)
	EU	Restriction of Hazardous Substances (RoHS)
	Germany	Deutches Instiut fur Normung e.V. (DIN)
	TUV	TUV Rheinland
	Holland	TNO Certification
	Belgium	NMI Certification
Automotive	USA	Society of Automotive Engineers (SAE)
	EU	Certified Equipment (CE)
	International	International Standards Organisation (ISO)
	Canada	Vehicle Information Centre of Canada Certification (VICC)
	South Africa	Motor Vehicle Security Association of South Africa (VESA)
Medical devices	USA	Food and Drug Administration (FDA) Federal Communication Commission (FCC)
	EU	Certified Equipment (CE)
	International	International Standards Organisation (ISO), International Electrotechnical Commission (IEC)
Avionics and military	USA	Military Specifications (MIL)
		Radio Technical Commission for Aeronautics (RTCA)
Information technology	International	Capability Maturity Model Integration (CMMI)
	International	Underwriters Laboratories Certification (ULC)
Telecommunications	Europe	European Telecommunications Standards (ETS)
	USA	Federal Communication Commission (FCC)
	Australia	C-Tick

[100] Source: CBI (2005), EU Market Survey 2004 – Electronic Components
[101] e.g. Enec in passive components or QS9000 in automotive (Source: CBI as above)

Furthermore, while South Africa has excellent technological capacity in certain market segments (e.g. mining, defence), South African products are not always perceived to be of a high quality by buyers in export markets.

In addition, firms may lack the **marketing skills, time and resources** required to market their products effectively in international markets. Firms have also had mixed experiences when attending trade shows with support through EMIA. In addition, in-market presence may be required by customers.

South African exporters also face **high transport and logistics costs**, while having to compete with companies located nearer to international markets (and closer to component suppliers). Time differences are also a barrier to providing services to international markets, and language abilities may also be a barrier.

The **global economic recession** has limited many international market opportunities as demand has shrunk, and in some cases orders have been dropped or decreased.

In addition, **exchange rate fluctuations** and perceived high value of the Rand further increase costs to access international markets.

There is a limited availability of **market information** on international opportunities and trends. Some concerns have also been raised that market information that is provided by enterprise support institutions such as **the dti** it is not tailored to SMMEs.

Examples:

Altech UEC is constrained by a lack of mutual recognition of SABS standards, and that international certification standards are generally much higher than SABS. Additional certification places a large cost burden on Altech UEC.

ATE experiences challenges meeting the quality standards of European OEMs.

Bosch notes that automotive markets were greatly affected by the recent financial recession and many car manufacturers have scaled down production accordingly. It expects this to result in a decline in electronic orders.

Bell Equipment's performance was negatively impacted by the global recession in 2009. In Europe, total machinery sales were down 50%, in South Africa down 47% and in Australasia, the market shrunk 50%.

Conlog feels that trade missions are currently not effective in securing access to new markets.

Elprom has tried to encourage foreign business with Germany, and has attended trade shows, but found quoting to overseas clients to be difficult due to the language barrier and the reluctance by foreign companies to commit to orders.

GeoAxon produces primarily for the South African market as it does not have CE certification for its products and therefore cannot sell outside of South Africa.

Lodox's single largest challenge is certification and compliance testing, as the local testing and verification authorities are not capable of providing the testing services required for international certification. The company is therefore forced to ship devices overseas to the Underwriters Laboratories (UL) in the United States for testing – a process which is both slow and very expensive. The company feels that this is due to local testing facilities lagging the constantly improving standards.

Master Circuits feels that the market information made available to the public is neither tailored nor suited to SMMEs.

MLT Drives operates both domestically and internationally, but exporting to foreign markets is complicated by the various country specific standards with which MLT Drives need to comply. These include UL (Underwriters Laboratories) in the US, TÜV Rheinland in Germany and C-Tick Mark in Australia.

Periseo hopes to expand into the export market, but requires international certification.

15.6 Fragmented industry organisation

Collaboration between enterprises on training and product development does not appear to be limited; however overall there is weak industry organisation. Companies feel that the electronics industry is not given sufficient recognition as a standalone industry, or, may not see themselves as part of an electronics industry, but rather as, for example, electrical or defence companies. Companies feel that increased industry collaboration could support international market access and R&D.

Examples:

CZ feels that commitment to support the sector should be greater, as for example, it is for the automotive sector.

Defy believes that the industry needs a more organised lobby to secure greater levels of support.

16 Support assessment and recommendations

This section provides recommendations on ways to address the specific challenges highlighted by the companies interviewed (these are covered in detail in the previous section). Firstly a brief overview of each challenge is presented as well as any support measures that were suggested by the companies interviewed (see also Appendix C for a table which shows support needs identified by each company). This is followed by an overview of existing and planned support programmes that are relevant to addressing each challenge, together with an analysis of potential gaps in this support. This then leads to a series of recommendations on specific actions that are still required to address the challenge as well as to ultimately grow the electronics sector. As the majority of the challenges cut across all of the electronics sub-sectors researched, the support required applies across the sector.

Support recommendations will be implemented within the context of the revised Industrial Policy Action Plan. A summary of IPAP2 is therefore provided in the box below.

HIGHLIGHTS OF IPAP 2:[102]

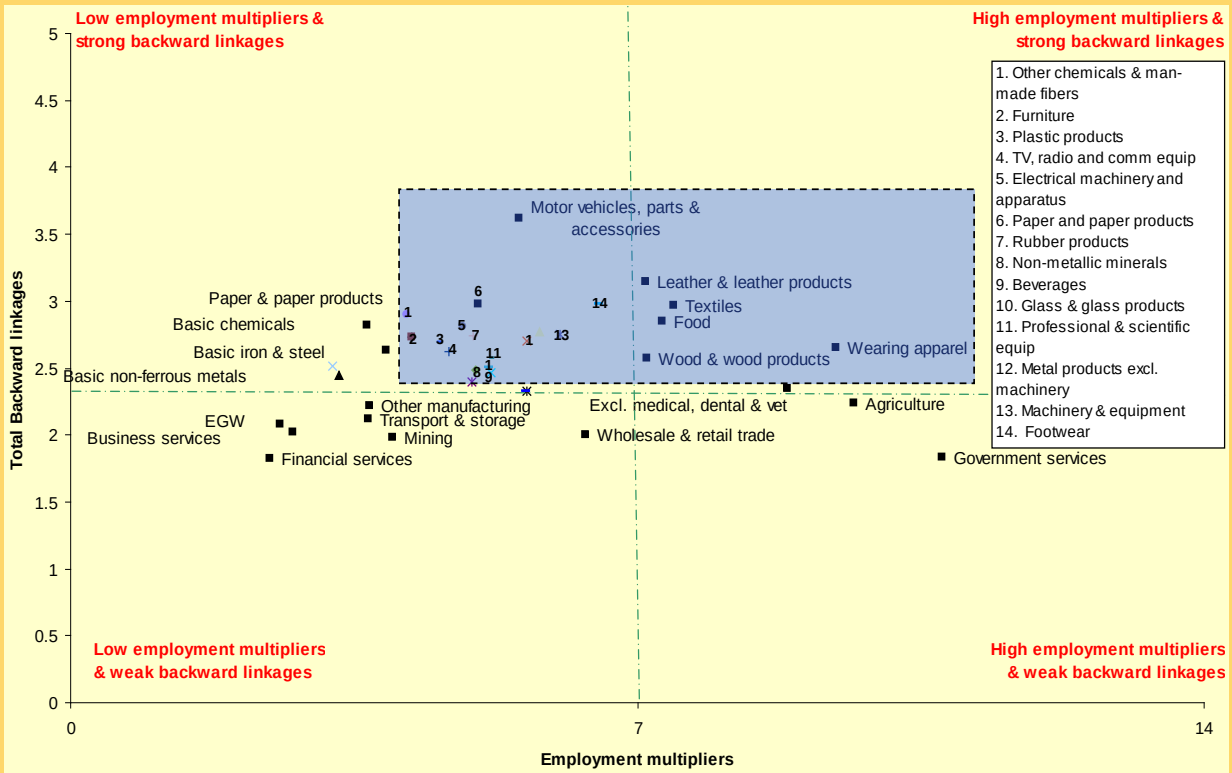
The IPAP is the engine of a new growth path which seeks structural diversification of the economy to more employment-intensive and value-adding activities. It focuses particularly on manufacturing and other value-adding sectors which have strong employment and growth multipliers. Opportunities to grow these sectors and associated constraints are set out in detailed cross-cutting and sectoral Key Action Plans.

Prioritised sectors:

- **Cluster 1: Qualitatively new areas of focus:**
  - **Metals fabrication, capital and transport equipment sectors:** leverage Capex programme, rebuild and position as future exporters
  - **Green and energy saving industries:** solar water heating, concentrated solar power, wind power, energy efficiency
  - **Agro-processing** linked to food security and food pricing imperatives
- **Cluster 2: Scale up / broaden interventions in existing IPAP sectors:**
  - **Automotives, components, medium and heavy commercial vehicles:** raise economies of scale and localisation of components
  - **Downstream mineral beneficiation:** based on establishing minimum beneficiation levels
  - **Plastics, pharmaceuticals and chemicals:** focused on plastics and value-adding pharmaceuticals
  - **Clothing, textiles, footwear, leather:** recapture domestic market share through competitiveness upgrading and tackling illegal imports
  - **Biofuels:** establish regulatory framework and support agricultural and refining investment
  - **Forestry, paper & pulp, furniture:** unblock water licences and promote further processing
  - Strengthening linkages between **cultural industries** and **tourism**
  - **Business Process Outsourcing:** broaden and deepen SA's product offerings
- **Cluster 3: Sectors to develop long-term advanced capabilities:**
  - **Nuclear:** leveraging local production and technology transfer
  - **Advanced materials:** feeding into new growth industries such as aerospace, solar/ nuclear
  - **Aerospace:** strengthening integration into supply chains

[102] Government of South Africa, February 2010, 2010/11 – 2012/13 Industrial Policy Action Plan, and presentation to Portfolio Committee (2010) Industrial Policy Action Plan (IPAP) 2010/11 – 2012/13: economic sectors and employment cluster

Figure: Sector focus of IPAP 2010/11- 2012/13



Key tools identified in the IPAP2 include the following:

- Industrial financing
- Leveraging procurement
- Developmental trade policies
- Competition policy
- Sector development strategies

16.1 Competition from imports

16.1.1 Overview of challenge

Companies find it difficult to compete in the local market with cheaper imported components and finished goods. In addition, companies suspect that some products are imported illegally or without import duties applied correctly, which is exacerbated by a lack of awareness regarding quality differences between locally produced goods and lower quality imports. Companies also feel that it is difficult to compete where finished products attract zero import duties, or lower duties than the associated components. Companies also feel that preference is given to local suppliers by government, SOEs, and large buyers.

To improve competitiveness and access to the local market, companies have suggested that support be provided, or existing support improved, in the following areas:

- Improved enforcing of import duties by customs officials and SABS
- Improved public procurement processes
- Improve the procurement processes of SOEs (including spending budgets, timings for tender awards and payments)

- Incentives to include local industries and products in supply chains
- Local content requirements to encourage contractors to use domestic manufacturers

16.1.2 Existing and planned support

Local production, procurement and supplier development

General government and public entities support for local businesses is through the Preferential Procurement Policy Framework Act (No. 5 of 2000), which allows for a premium to be paid where procurement supports historically-disadvantaged individuals (HDIs), or the goals of the Reconstruction and Development Programme (including support to local companies). This is achieved through the application of the Preferential Procurement Regulations which incorporate the 80/20 (generally between R30,000 and R500,000) and 90/10 systems (over R500,000). In this system 80 (90) points are awarded on price basis whilst 20 (10) points are allocated on the basis of HDI and RDP goals. The private sector is encouraged to procure locally through the B-BBEE scorecard and codes of good practice, through the preferential procurement and enterprise development elements.

According to IPAP2, government is set to place further emphasis on local procurement legislation, regulations and practices. In particular, it will enable the designation of large, strategic and repeat ('fleet') procurements in a range of sectors. This will aim to sequentially increase local procurement and supplier development opportunities; minimising leakages from the domestic economy. Draft revised procurement regulations have been issued for public comment and includes some scope for local content preference.

The Competitive Supplier Development Programme (CSDP) developed by the Department of Public Enterprises and implemented by SOEs, including Eskom, Telkom and PBMR, focuses on localisation of supply chains, through identifying products with potential to be supplied locally, encouraging OEMs to source these locally, benchmarking South African suppliers products relative to international standards, and setting up supplier hubs to improve information sharing. Transnet aims to spend R23bn between 2008 and 2012 on strategic CSDP initiatives.[103] Eskom will spend R131bn on the 5 identified industry groups over a period of 5 years.[104] Denel also has a programme in place to support local suppliers.

The Proudly South African initiative is a campaign to buy locally produced products by raising the awareness of the benefits of supporting local industries. A Proudly South African mark is given to qualifying products (based on 50% local content, quality, fair labour practises and environmental standards). The goal is for end users to recognise the mark and therefore support the product.

The Automotive Investment Scheme (AIS) has recently been approved as part of the Automotive Production and Development Programme (APDP) which replaces the MIDP in 2012.[105] The objective is to increase plant production volumes, sustain employment and strengthen the automotive value chain. This is in line with the shift in focus from the export-orientated MIDP to the production-orientated APDP and will lead to greater localisation of the automotive supply chain. The AIS will provide qualifying firms with a taxable cash grant of 20 percent of the value of qualifying investment in productive assets, with criteria for component manufacturers including proof that a contract has been awarded to supply into the light motor vehicle manufacturing supply chain, and that the investment will achieve at least 25 percent of total entity turnover from the light motor vehicle manufacturing supply chain. An additional taxable cash grant of 5 or 10% grant is available to projects that, amongst others, can demonstrate that investment will:

[103] Transnet (2008) Transnet Supplier Development Plan
[104] Eskom (2008) Eskom Competitive Supplier Development Programme (CSDP) 2008 – 2013
[105] **the dti**,(2 June 2010) Minister Davies approves Automotive Investment Scheme (AIS) guidelines, available at www.info.gov.za

- Maintain employment levels throughout the incentive period and/or result in the creation of new jobs
- Substantially support for the local tooling industry
- Generate significant R&D in South Africa related to the project
- Strengthen supply chain backward and forward linkages
- Substantially increase local value addition
- Increase turnover for component manufacturers

It remains to be seen how competitive the component manufacturers will be under the APDP, as it is estimated that it may only provide around 45% to 55% of 2009 MIDP support levels.[106]

There are also numerous private sector led efforts to localise supply chains. One example is the Anglo Zimele programme which aims to identify opportunities for Black Economic Empowerment SMMEs to supply non-core goods or services to Anglo Group companies, focusing on suppliers located near Anglo activities. These companies are provided with finance, technical assistance, business planning services and the transfer of skills. However, the focus is of these programmes are often on enterprise development, thus non-technical and non-core goods (in the case of Anglo Zimele) are included, rather than production of more technical products.

Tariffs and customs issues

The Industrial Policy Action Plan (IPAP2) indicates a willingness of government to use trade policy instruments such as tariffs "on a strategic basis underpinned by the imperatives of our sector strategies."[107] It also places emphasis on improved policing against practices such as customs fraud, under-invoicing, smuggling and illegal imports – all of which undermine local manufacturers.

Successful applications have been made to ITAC for increased protection of certain products. One such example - which may actually have a negative effect on South African producers - is Philips South Africa (Pty) Ltd request for a 15% ad valorem tax on certain fluorescent lamps. Philips argued that the import tariff was necessary to make its planned manufacturing plant in Lesotho viable in the infant stages. Philips was successful in their application. South African fluorescent lamp manufacturers therefore benefit from receiving greater import protection, but will now face greater competition from within SACU.

The state, through SARS, has also launched a clampdown on customs fraud and counterfeit smuggling. Already there have been some successes as criminal charges were laid against more than a dozen companies.[108] Economic Development Minister Ebrahim Patel said that "The South African Revenue Service has now reported significant progress in respect of investigations and the confiscation of goods."[109] In the clothing and textiles industry alone 4 companies were being investigated for smuggling, 15 for round-tripping and 14 for export incentive abuse. A further 5 companies were being probed for under-declaration of the value of goods and would be criminally charged.[110]

Gaps in support

Preferential procurement provides some benefits for local companies, however the number of points allocated are generally small (measured against price points) and may be ineffectual on large contracts.

Private sector supplier development programmes have shown some success, but often focus on

[106] Venter. 2009. SA autocat industry lost orders worth R8bn over past year. Engineering News
[107] Davies. 2010. National Assembly Statement on IPAP2 by Dr Rob Davies, Minister of Trade and Industry
[108] SA moves on crisis response. www.southafrica.info/news/business/14616.htm
[109] Govt acting to mitigate recession — Patel. www.polity.org.za
[110] Business Day. 2009. Patel warns of blitz against fraud, rigging by business

'easy to produce' goods with little value addition and have scale limitations. Many of the larger private sector contracts are still not benefiting local manufacturers.

In terms of import protection, ITAC appears to provide adequate support, providing tariff protection if it is justified, indicating that there may be poor awareness of the role of ITAC.

Efforts to improve customs administration have had some impact, however this remains a concern.

16.1.3 Recommendations

Table 52: Recommendations to address competition from imports

Recommendation	Motivation and risks	Description
Provide for targeted applications to ITAC for import protection (i.e. on a product by product basis)	**Motivation**: ▸ Rather than the alternative approach of industry-wide protection, a case-by-case approach offers: – Greater efficiency – Quicker implementation – Less market distortion – Easier to justify individual cases of protection to trading partners and WTO **Risks**: ▸ Risk of protecting inefficient industry – which places burden on consumers ▸ Risk of raising costs for other industries	**Options:** ▸ Raise awareness of the role of ITAC through industry associations or directly with companies ▸ Encourage industry associations to coordinate of applications ▸ Provide for easy application by individual companies
Advocate for wider implementation of CSDPs (other SOEs and more widely)	**Motivation**: ▸ Framework already exists, CSDP is intended for more SOEs ▸ Requires commitment to supplier development by SOE	▸ Include electronics manufacturing as one of the target areas for SOEs – E.g. Avionics for SAA – Telecommunications for Broadband Infraco ▸ Advocate for wider CSDP rollout
Specify electronics in revised preferential procurement framework	**Motivation**: ▸ Pending regulations make provision for inclusion of particular product groups ▸ Overall procurement regulation will not be changed for one sector **Risks**: ▸ May increase corrupt and uncompetitive practices	▸ Apply to Treasury for designation ▸ May require consolidation into integrated list ▸ Investigate allowing strategic, repeat procurements
Improve customs inspection and product categorisation for SARS	▸ Fraud and false invoicing appear to have a major influence on the economy ▸ Currently high on government priority list and programmes already initiated – Momentum for improved policing efficiency	▸ Obtain input from electronics manufacturers on which products or importers are suspected of 'under-invoicing' or customs fraud ▸ Clear up HS codes – Consensus on which products fall under which HS code
Ensure that migration to Digital Terrestrial Television supports local IP, enables local	**Motivation**: ▸ Upcoming opportunity to further development set top box industry ▸ Some local producers are already	▸ Ensure technical standards are suitable for local production and aligned with international trends, in

Recommendation	Motivation and risks	Description
manufacturing and access to wider African markets	competitive ▸ DTT contracts will allow companies the volumes required to scale up (and better exploit economies of scale), in particular if they can access wider African markets **Risks**: ▸ High expectations from industry which may not be realised given limited scale of project	particular those in other African markets – This will require resolving the current debate with respect to to digital broadcasting standards and systems DVB-T and DVB-T2 vs. ISDB-T and MPEG-2 or MPEG-4[111]
Include higher technology products (including electronics) in private supplier development programmes	**Motivation**: ▸ Large benefit from private sector supplier development ▸ Current focus on low technology production **Risks**: ▸ Higher technology production is more expensive and has greater quality requirements ▸ Thus greater risk attached to including high technology into supplier development programmes	▸ Advocate for inclusion of electronics, based on research on capacity of local industry
Negotiate with corporates to consider local electronics suppliers in large contracts	**Motivation**: ▸ Major source of demand ▸ Limited effort required for potentially large benefit ▸ BEE framework already allows for local enterprise procurement **Risks**: ▸ Limited influence on companies' final decision ▸ Local premium may raise end-consumer costs	▸ Advocate for consideration of local supply
Shift production towards higher value addition	**Motivation**: ▸ Level of competition can be alleviated by creating greater value addition, e.g. moving into higher technology electronics and niche products **Risks**: ▸ Low cost countries are increasingly moving into higher technology areas	▸ Raising awareness of opportunities in higher value added products ▸ Align programmes to support higher technology activities (see skills, innovation, quality control) – Include design and development (without manufacturing) as eligible for support
Ensure implementation of ICT Charter commitments	▸ ICT BEE Charter commits to a certain level of local procurement	▸ Advocate for adoption and implementation of charter

[111] Relevant documents are available at www.info.gov.za, www.sadiba.co.za and www.pmg.org.za

16.2 Widespread innovation

16.2.1 Overview of challenge

Companies noted that the main obstacles to widespread innovation are weak support for local IP development and protection, insufficient funding for R&D, a lack of focus of R&D on industrial applications, and limited availability of appropriately skilled personnel. Further challenges are constraints to collaboration with universities, and a lag in take-up of technology by South African industry and consumers. In addition, multinational companies tend to locate R&D facilities overseas.

Companies suggested the following support to address these obstacles and simulate innovation:

- Support for collaboration on R&D
- Support to develop local IP
- Creation of more testing and prototyping facilities
- Investment funding assistance

16.2.2 Existing and planned support

The **Support Programme for Industrial Innovation** (SPII) is designed to promote and assist technology development in South African industry. It is an innovation support programme supported by **the dti** and administered by the IDC. The programme consists of 3 schemes:

1. The Product Process Development Scheme provides financial assistance – between 50% to 85% (depending on extent of BEE ownership) of the total qualifying costs incurred in pre-competitive development activity – for small, very small and micro firms during the technical development stage (with a maximum grant of R1m per project)
2. The Matching Scheme is also targeted at SMMEs (medium firms are not included in the Product Process Development Scheme). Financial assistance consists of a 50% to 75% grant with no payback, for innovative development of new products and processes (maximum grant of R3m).
3. The Partnership Scheme (PII) is open to all companies. Funds are provided in the form of a conditionally repayable grant of 50% (minimum grant of R3m) of the qualifying cost incurred during development activity – repayable on successful commercialisation of the project.

Examples of relevant recent SPII projects include the following in 2008/2009:

- Approv Accounting, Blackboard
- Custom Power Solutions CC, GSM Electricity Metre
- Virtual Remotes, remote controls
- Barrows Design and Manufacturing, Smart Location Tracking System
- Blue Waters Interactive, Differential Data Verification (DDV)

the dti also offers the **Technology and Human Resources for Industry Programme** (THRIP) which is managed by the National Research Foundation. It focuses on projects that promote scientific research, technology development and technology diffusion. **the dti** takes on third of the cost of the project (i.e. 2:1 cost sharing). There is also scope to double the support if certain conditions are met. Electronic-related funded programmes in 2008/2009 included:

- Distributed power electronic systems (Phoenix Contact)
- Portable friction stir welding machine (Eskom Holdings, Yenza Manufacturing)
- Optical fibre technology (Hezeki Contracting, Ingoma Communication Services, MCT Telecommunications, Telkom)
- New solar technologies for the telecoms industry (Telkom, TFMC)
- Concentrator photovoltaics (Eskom Holdings)
- PBMR technology development (M -Tech Industrial)
- HTBO satellite modem (HM Wagener and Associates)

- Wireless electronics (Poynting Antennas)
- Thermal design of electronic systems (Anchor Devices)
- Energy efficiency and renewable energy research Eskom (Eskom Holdings, Kingdom Energy, Segal Technology cc)
- Low dose x-rays for medical imaging (Lodox Systems)
- Advanced material science for energy and ICT (Carbo Consult and Engineering, Eskom Holdings, Eskom TESP)
- Optimising power quality and energy efficiency (Bayete New Dimension)
- Fourth generation wireless systems (Alcatel SA, Exotic Systems cc, Natcom Electronics, Telkom)
- Electro-optics in power engineering Eskom Holdings (TLC Software cc)

Another initiative sponsored by **the dti** is the Centurion Aerospace Village. It is located on the boundary of the Waterkloof Air Force Base. The initiative aims to support the implementation of the Aerospace Industry Support Initiative, in particular by promoting Broad-based BEE, supporting human resource and skills development, encouraging development of small and medium enterprises, and overall enabling a higher value-add position for South Africa within the aerospace global value chain.[112]

There are currently 5 FabLabs (fabrication laboratories) in South Africa, located in Bloemfontein, Cape Town, Kimberley, Potchefstroom and Soshanguve. FabLabs are small-scale workshops which are able to produce prototypes of various different sizes and materials, and are based on a model developed by the Massachusetts Institute of Technology (MIT). The Fablabs enable designers and manufacturers to produce tailored products or test their ideas before moving into more serious prototyping. Examples of use of FabLabs include development of LED lighting products.

Another DST initiative is the Centres of Excellence initiative. Centre of Excellence have been created in South Africa, to stimulate the sustained distinction in research whilst generating highly qualified human resource capacity in order to impact national and global knowledge and innovation generation. There are currently 7 centres in South Africa including: The Centre of Excellence in Biomedical TB Research, The Centre of Excellence in Invasion Biology, The Centre of Excellence in Strong Materials, The Centre of Excellence in Birds as Keys to Biodiversity Conservation at the Percy FitzPatrick Institute, The Centre of Excellence in Catalysis, The Centre of Excellence in Tree Health Biotechnology at FABI and The Centre of Excellence in Epidemiological Modelling and Analysis.

The Research Chair initiative, developed by DST and NRF, aims to attract and retain the best and the brightest to South African higher education institutions. Currently, 82 Research Chairs have been appointed in research and knowledge areas that are important for South African needs and priorities.

Through the Tshumisano Partnership, there are several Technology Centres across the country that offers assistance (training, product development, innovation and competitiveness support) to a wide spectrum of SMME sectors. Many of these technology stations are located on university grounds. The technology station in Electronics is located at the Tshwane University of Technology. The technology station in Electronics supports SMMEs and trains and develops their ability to compete globally. The station operates in the electronic, electrical and information and communication technology industries.

The Innovation Fund (a DST initiative managed by the NRF) is mandated to promote technological innovation through investing in late - stage research and development, Intellectual Property protection and commercialisation of novel and inventive South African technologies. The fund also provides critical support to a variety of start up companies. A sample of 2009 start up company

[112] See www.cav.org.za for further information

recipients include: Electric Genetics, Optimal Energy, Jirhersa Medical, Vision Biotech, Vibol Systems, Edgitech, Blue Cube Systems, Johnson Sensor Technology, Sunspace Information Systems, Nulane Investments.

The National Research Foundation also provides critical funding for the promotion and support of national research and innovation. It also conducts research and provides access to National Research Facilities. The NRF provides services to the research community especially at Higher Education Institutions (HEIs) and Science Councils with a view to promote high-level human capital development.

The NRF have also developed a rating system to recognise the achievements of South Africa scientists and leading thinkers/innovators. The awards provide a platform to honour researchers for career contributions to knowledge creation and dissemination as well as capacity development and transformation in the national research system.

The Research and Development (R&D) Tax Incentives Programme, administered by DST in conjunction with SARS and the National Treasury, encourages the private sector to invest in research and development activities. The R&D Tax Incentives are an indirect approach to increasing national R&D expenditure in the science and technology fields.

DST has spent around R147m on 25 projects since its inception in 2003 of the Advanced Manufacturing Technology Strategy (AMTS) programme to support the aerospace industry.[113] This includes the development of expertise in a range of areas, including airframe manufacture, engine components and systems development. The aim is to allow South African companies to become part of the global supply chain of major first and second-tier aerospace companies. However, the three flagship programmes – advanced light weight materials, advanced production technologies and advanced electronics – could also benefit the wider electronic manufacturing industry. These projects are undertaken by consortia comprising large industry, small and medium enterprises, tertiary institutions and science councils. The projects are also in line with DST's initiative to support the development of a competitive titanium downstream capability and a fibre-reinforced composites industry.[114] The AMTS also funds the establishment of advanced manufacturing technology laboratories that for design, development and prototyping of new products, as well as the development and transfer of relevant skills to support industry. There are currently 3 laboratories:[115]

- Aerosud – production technologies, materials development and testing for the aviation industry
- Cape Peninsula University of Technology – adaptronics
- Nelson Mandela Metropolitan University – automotive robotics

The Technology Innovation Agency (TIA) is a new public entity which will attempt to address the lack of home-grown technology (and commercialisation thereof – called the 'innovation chasm') available to South African firms. It was created by the TIA Act (Number 26 of 2008) and falls under the management of DST. According to the Act the objective of the TIA is to support the State in stimulating and intensifying technological innovation. This includes leveraging capital inflows for technology transfers, supporting new products and services and growing the number of technology-based SMMEs[116]. It aims to achieve this through financial (e.g. seed funding, venture capital) and non-financial means (e.g. centres of competence, expert services, technology nurseries and in-bound technology transfers). Highlighted sectors include biotechnology, energy, minerals processing, manufacturing and ICT[117]. Existing entities that will be incorporated into the

[113] Defenseweb. 2009. Pandor re-commits the DST to SA aviation industry
[114] *ibid*
[115] *ibid*
[116] Dr Nhlanhla Msomi. 2010. Strategic Corporate Business Plan Presentation
[117] *ibid*

TIA are the Biotechnology Regional Innovation Centres (BRICs), the Innovation Fund, AMTS and the Tshumisano Trust.

Many of the support programmes mentioned above involve the creation of IP. Although the South African patent regime is ranked highly by many[118], there are some considerable drawbacks (see gaps below).

Gaps in support

Programmes aimed at increasing the technological base (such as SPII and THRIP) have had some success stories. However, concerns have been raised that these programmes have not resulted in high levels of successful commercialisation, and may be too focused on supporting SOEs rather than the private sector (for example, Telkom and Eskom have been recipients of THRIP funds).

It is too soon to tell the success of the TIA, but it is hoped that the entity will be able to narrow the innovation chasm.

CIPRO is a non-examining registration office and there is no complete electronic system available at CIPRO. The substantive novelty and the inventive merit of the application are not subjected to verification. Thus possession of a patent granted in South Africa is not of any substantive value to a South African innovator wishing to commercialise the product. This is a major obstacle to programmes supporting local innovation.

[118] A recent study ranked South Africa 22nd out of 115 countries in strength of patent, copyright and trademark protection. For this example and others see: Kaplan. 2009. Intellectual Property Rights and Innovation in South Africa: A Framework

16.2.3 Recommendations

Table 53: Recommendations to support widespread innovation

Recommendation	Motivation and risks	Description
Include high technology electronics (not just ICT) as one of the focus areas of TIA	**Motivation**: ▸ Currently TIA does not explicitly prioritise electronics - the most relevant priority sectors are energy and ICT (others include biotechnology, minerals processing and general manufacturing) ▸ TIA is the future umbrella organisation for innovation support in South Africa **Risk:** ▸ Competing for resources with other priority areas	▸ Narrow or split 'manufacturing' category in line with level of specificity (e.g. biotechnology, minerals processing, ICT) ▸ Use funding from 'manufacturing' to support new 'electronics manufacturing' focus area ▸ Alternatively broaden ICT category to include electronics
Create access to shared prototyping facilities	**Motivation**: ▸ Cost for individual companies is prohibitive ▸ Potential for local competitive advantage **Risks:** ▸ Danger of underutilised capacity ▸ High costs ▸ Varied and rapidly changing requirements ▸ Availability and lead time may not suit needs of companies	**Options**: ▸ Integrate into existing programme (e.g. FabLabs, advanced manufacturing technology labs) ▸ Advocate for large companies and SOEs to enable access to facilities by smaller companies ▸ Develop a specialised initiative to provide shared electronics prototyping infrastructure ▸ Explore cost and time efficient approaches to outsourcing prototyping ▸ Support CAD and rapid prototyping facilities at universities (including enabling private sector access)
Encourage innovation-oriented mindset within industry	**Motivation**: ▸ Innovation is likely to be a key driver of the sustainability, competitiveness and growth of South African electronics industry ▸ Shift in thinking is a necessary condition to expand innovation levels – Could improve uptake and effectiveness of technology support programmes	▸ Publicise local innovation success stories in sector ▸ Provide benchmark information to demonstrate the risks of not innovating
Package information on available innovation support	**Motivation**: ▸ There is confusion and lack of knowledge by companies relating to existing programmes e.g. some companies do not know about the Innovation Fund, SPII or THRIP, and many do not know which government entity is responsible for which support programme ▸ Lack of clarity on how new and existing programmes will relate to one another	***Precondition:*** Agreement on future scope of innovation support, including nature of incentives, coverage, eligibility, funding mechanism, contact points **Options:** ▸ One-on-one interaction with companies ▸ Communicate support information through industry associations and export councils ▸ Compile packaged brochure ▸ Create information portal

Recommendation	Motivation and risks	Description
Align regulation and buyer awareness with new technologies and growth areas	**Motivation**: ▸ Slow uptake in domestic market acts inhibits innovation ▸ Slow review of regulation, standards and technical specifications act also inhibits innovation – E.g. Confusion on regulation for feeding electricity back into the grid	▸ Identify priority list of new technology growth areas – E.g. Renewable energies, energy efficiency, LED lighting technologies, solar and marine radar technologies ▸ Support information sharing on benefits of new technologies ▸ Partnerships with related organisations – E.g. Eskom, Telkom, Green building council, Sustainable Energy Society of Southern Africa

16.3 Cost structure and finance

16.3.1 Overview of challenge

Manufacturing costs in South Africa are not competitive compared to high volume producing countries such as China. Factors contributing to high costs include: relatively high cost of unskilled and semi-skilled labour, high freight costs for imports and exports (and long lead times) and gaps in infrastructure and services provision. Fluctuating exchange rates and tariffs applied to imported components also contribute to costs. Companies also indicate that they are struggling to fund production facilities and equipment. Many electronics companies experience challenges in accessing finance, citing risk sensitivity of commercial banks, and company profiles not meeting incentive eligibility requirements. The global recession has further constrained access to finance.

Companies suggested the following support to address high costs and access to finance:

- Reduction of import tariffs on components not manufactured in South Africa
- Labour-intensive manufacturing incentives
- Wage subsidies
- Technology “free zones”
- Reliable and cost efficient telecommunications and power
- Reduced red tape
- Support to reduce freight/logistics costs and lead times
- Funding for the upgrading of equipment
- VAT concession or fund for exporters
- Information sharing on existing support

16.3.2 Existing and planned support

Support for tariff reductions or rebates

The International Trade Administration Commission of South Africa (ITAC) was established through the International Trade Administration (Act 71 of 2002). The core functions of ITAC are customs tariff investigations, trade remedies and import and export control. ITAC evaluates applications to increase and lower customs duties, provides rebates and investigates allegations of dumping.

Electronics manufacturers have had some success in obtaining rebates from ITAC on components not manufactured in South Africa. For example, Tedelex Trading (Pty) Ltd applied in 2008 for the creation of a rebate provision for the duty-free importation of liquid crystal digital display panels for the manufacturing of video monitors incorporating an automatic data processing machine. Tedelex argued that there is no domestic company with the capability to manufacture this product. At this time a general tariff of 20% (9.5% for EU and 15% for EFTA) was levied on the product – which fell under HS 8529.90.80 (other parts for reception apparatus for television). ITAC found that the product was not produced domestically and that the rebate would enhance the competitive position of Tedelex – which submitted plans for an assembly plant. Similarly, Altech UEC has recently made an application to ITAC.

Labour support

The creation of a wage subsidy to hire young people without work experience was mentioned in President Zuma's 2010 State of the Nation address as well as the 2010 Budget Speech. Under consideration is a cash reimbursement to employers for a two-year period, operating through the SARS payroll tax platform, and subject to minimum labour standards[119]. Preliminary estimates by the National Treasury were that about 800,000 youths will qualify and that the aim would be to raise employment of school-leavers by a further 500,000 by 2013. However, the proposal has since been challenged by Congress of South African Trade Unions (Cosatu), who argued that the wage subsidy would create a two-tier labour market and threaten job security and the wage rates of workers. National Treasury was supposed to table a discussion document setting out further details of the youth wage subsidy proposals by the end of March 2010, but this deadline was not met. Furthermore President Zuma has recently said that the scheme was "up for debate."[120]

Support for components and equipment

With the exception of the Automotive Production and Development Programme (APDP) (discussed in15.115.1) for some automotive electronic component manufacturers might qualify, there is limited direct support for electronic component access.

Support for components and equipment

With the exception of the Automotive Production and Development Programme (APDP) (discussed in15.115.1) for some automotive electronic component manufacturers might qualify, there is limited direct support for electronic component access.

However, there is some support for access to equipment. For example:

- The Manufacturing Investment Programme of **the dti** can contribute to the costs of a new production facility or an expansion (machinery, equipment, land, buildings and commercial vehicles).

[119] Gordhan. 2010. Budget Speech 2010
[120] Ensor. 2010. DA Urges Zuma to Act On Youth Wage Subsidy. Business Day.

- Innovation and R&D incentives may also contribute to equipment costs e.g. tax incentive on R&D capital expenditure.

Infrastructure and services

Telecommunication costs are likely to decrease in the future as the government continues its 'managed liberalisation' of the telecommunication sector. Neotel, the second operator, launched its first services in 2006. Increased internet capabilities have meant that South Africa has moved from one fixed line operator and three mobile operators less than five years ago to 250 – 300 competitors (many in the form of value added network services). This increased competition will potentially result in lower costs; monthly Internet-service rates in South Africa decreased from about US$60 in 2006 to less than US$30 in 2007.[121]

Unreliable electricity provision and high electricity costs increase the input costs of companies. Electricity costs are set to continue to increase as the National Energy Regulator of South Africa (Nersa) has approved an Eskom power tariff increase of 24.8% as from April 2010 and subsequent increase of 25.8% and 25.9% for 2011/12 and 2012/13.[122] Eskom's expansion and upgrading programs will however allow for more reliable power supply in the medium to long term. Furthermore the increase use (and support for) renewable energies could see energy prices decrease.

Transport and logistics costs are highlighted by the Ease of Doing Business Report as a particular area of concern (South Africa is ranked 148th). The cost to export a container (including costs for documents, administrative fees for customs clearance and technical control, customs broker fees, terminal handling charges and inland transport) is on average 40% more than OECD countries (US$1,531 versus US$1,089) and the time to export is approximately 3 times longer. Programmes are currently in place to reduce transport and logistics cost in South Africa with the framework provided by the National Freight Logistics Strategy (2005), which shifted the strategy to demand-driven delivery of freight logistics, rather than a supply approach. Recent infrastructure projects are also likely to improve transport costs; these include Dube TradePort, airport upgrades and the large road upgrading projects. This seems to be successful as logistics costs relative to GDP in 2009 was at its lowest level since 2004 – R339bn or 14.7% of GDP, a drop of 1.2% from the previous year[123]. However, this is still large when compared with logistics costs of other countries, for example logistics cost from 9.4% of the US GDP. Transport cost increases are also at their lowest since 2004 as transport costs only increased by 2.4% - but still account for 50.4% of total logistics costs.

Companies have also raised concerns about the quality and availability of municipal services and infrastructure, including waste water and solid waste management. The quality of these services is a particular issue for companies with international parent companies that have strict requirements around waste management. Support and funding from the Development Bank of Southern Africa (such as DBSA loans and investments, Development Fund and Siyenza Manje capacity building support) and National Treasury (conditional grants such as the Municipal Infrastructure Grant) can go some way to addressing municipal infrastructure backlogs and service quality

Outside of South Africa, electronics companies make extensive use of postal services and couriers to move components which are often very lightweight (it is the standard method of shipping integrated circuits for example). The unreliability of the SA postal system and the slowness of customs clearing have exacerbated the problem of lead times and supply chain management for local manufacturers. However, private postal service providers help alleviate this issue to some degree.

[121] Sverdlik. 2009. South Africa wired
[122] Creamer. 2010. SA regulator grants Eskom 24,8% tariff increase for 2010/11. Engineering news
[123] CSIR. 2009. 6th Annual State of Logistics Survey for South Africa

The tables below compare costs facing South Africa against various other countries:[124]

Table 54: Comparison of ease of trade rankings[125]

Economy	Rank	Time to export (days)	Cost to export (US$ per container)
Hong Kong, China	2	6	625
Korea, Rep.	8	17	1,060
Germany	14	7	872
Japan	17	10	989
Taiwan, China	33	13	720
Malaysia	35	18	450
China	44	21	500
Czech Republic	53	17	1,060
Hungary	70	18	1,225
Mexico	74	14	1,472
Brazil	100	12	1,540
South Africa	148	30	1,531

Table 55: Comparison of ICT price basket and sub-baskets, 2009 and 2008[126]

Economy	Rank	ICT Price Basket		Fixed telephone sub-basket as a % of GNI per capita		Mobile cellular sub-basket as a % of GNI per capita		Fixed broadband sub-basket as a % of GNI per capita		GNI per capita, US$, 2008 (or latest available year)
	2009	2009	2008	2009	2008	2009	2008	2009	2008	
Hong Kong, China	2	0.26	0.50	0.27	0.43	0.03	0.10	0.49	0.96	31,420
Korea, Rep.	19	0.79	0.84	0.29	0.39	0.68	0.89	1.41	1.24	21,530
Germany	20	0.81	0.79	0.92	0.89	0.27	0.31	1.23	1.18	42,440
Japan	35	1.09	0.87	0.72	0.58	1.39	1.03	1.18	1.01	38,210
Malaysia	46	1.65	1.93	0.82	0.94	0.85	1.09	3.27	3.75	6,970
Mexico	48	1.69	3.56	2.08	3.21	1.04	2.15	1.95	5.32	9,980
Hungary	58	2.18	2.46	2.25	3.13	1.44	1.67	2.84	2.58	12,810
Czech Republic	59	2.18	2.17	2.12	2.57	1.28	1.54	3.13	2.40	16,600
China	75	3.21	4.37	0.92	1.88	1.51	1.83	7.19	9.41	2,940
Brazil	87	4.14	7.68	2.19	5.91	5.66	7.51	4.58	9.61	7,350
South Africa	89	4.20	4.24	4.45	4.67	2.60	2.57	5.54	5.48	5,820
Taiwan, China	-	-	-	-	-	-	-	-	-	-

[124] World Bank. 2010. Doing business report 2010. http://www.doingbusiness.org
[125] The rankings are from the *Doing Business 2010* report, covering the period June 2008 through May 2009.
[126] International Telecommunication Union (2010) Measuring the Information Society

Industrial Development Zones (IDZ) also attempt to lower costs for companies that relocate to the zone – in order to boost investment, develop manufacturing capabilities, improve export competitiveness and create employment. Each zone has well developed infrastructure and offers direct links to an international port or airport – thus reducing logistics costs. Furthermore companies in the IDZ import production-related raw materials and inputs duty free; receive a zero rate of VAT on supplies produced from South African sources; and have reduced taxation and exemption for some activities/products.[127] Since inception the IDZ have seen some success (e.g. approximately R200m has been invested in the East London IDZ and there has already been just under R1bn in return[128]), however **the dti** has indicated that the current policies governing IDZs do not offer sufficient direct legislative support. The need for a tighter policy framework has prompted a review of the IDZs, this is also seen as an opportunity to adapt the IDZs to the export processing zone (EPZ) model used in other parts of the world.[129]

Exchange rate

An often-cited reason for the high cost structure is the strong (and often volatile) rand. A stronger rand means that inputs which are imported (such as electronic components and oil) become more expensive. The volatility of the rand complicates planning and hampers the investment in production capacity for exporters. Many institutions – the main voices being Cosatu and the "manufacturing circle" which met recently with Minister Pravin Gordhan[130] – have called for interventions to ensure an appropriately valued, competitive and stable currency.[131] National Treasury and the South African Reserve Bank have responded that the current floating exchange rate is the "most reliable and most correct approach."[132]

Financial support and impact of economic recession

There are several financial support measures to improve the local manufacturing base – which has a knock-on effect to reduce input cost higher up the value chain. For example **the dti**'s Enterprise Incentive Programme (EIP) which focuses on the manufacturing (using the sub-programme Manufacturing Investment Programme (MIP)) and tourism sectors. MIP is designed to stimulate investment into the manufacturing industry. The programme aims to encourage investment into the industry by providing a grant of up to 30% (below R200m) for qualifying investment costs such as the addition/upgrading of machinery, equipment and land and buildings. The key focus sectors are metal fabrication, capital and transport equipment, automotive and components, chemicals and pharmaceuticals and furniture sectors.

The global recession has had a significant impact on global manufacturing, and may continue to do so as possible additional financial crises hit the global markets.[133] Based on the "Framework for South Africa's Response to the International Economic Crisis" the government has put in place several support measures as a response to the economic crisis. These are orientated around seven broad areas, including investment in public infrastructure, employment, industrial and trade policy measures and social measures. The IDC has made R6bn available for 2009/2010 and 2010/2011 to respond directly to the economic crises. The IDC had already received 49 funding applications, 23 of which (worth R1.2bn) were from existing IDC clients while the remaining 26 (worth about R2.1bn) were from new or potential IDC clients.[134] It had already approved 11 financing applications from distressed companies totalling R743m.

[127] www.idzconsult.co.za
[128] Berry. 2010. SA seeks to align development zones with sector thrust, mulls additional incentives. Engineering news
[129] Berry. 2010. SA seeks to align development zones with sector thrust, mulls additional incentives. Engineering news
[130] Engineering New, 9 June 2010, Finance Minister's meeting with the manufacturing circle
[131] Mail & Guardian. 2010. Rand is too strong, says Vavi
[132] Fixing the exchange rate will be hard – Kganyago. 2010. www.polity.org.za
[133] Xinhua, 10 June 2010, Second round financial crisis possible despite recovery
[134] Business Day, 2009. Patel warns of blitz against fraud, rigging by business

The layoff training scheme aims to retrain vulnerable workers for periods of up to three months to help them secure jobs. It was allocated R2.4bn by the National Skills Fund and the Unemployment Insurance Fund and was supposed to be operational by August 2009. The government also responded by facilitating support for certain key sectors, including the automobile sector and the clothing and textiles industry. In return for support automobile companies were to place a moratorium on retrenchment for the whole period in which they received help.

To aid SMMEs government recommitted itself to paying for contracts within 30 days. The SMME payment assistance hotline was launched by **the dti** and SEDA in September 2009[135] as a mechanism to ensure prompt payment if payment has not yet been received and 30 days had already passed.

There are already several programmes and institutions which provide financial aid for qualifying firms. The Industrial Development Corporation (IDC) provides funding for several sectors, including 'technology sectors' which consists of information technology, telecommunications, electronics and electrical serves. The minimum requirements include a minimum loan of R1m at a prime interest rate. The minimum equity amount is R5m at 8% real after tax internal rate of return and 30% of the upside portion.

General funding for qualifying small businesses are available through Khula Funding Enterprise and Black Business Suppliers Development Programme (BBSDP).

Gaps in support

Although a youth wage subsidy will improve employment levels for youths with no work experience it is unlikely to have an impact on the overall labour costs of companies (with very small and micro firms being a possible exception).

High transport costs remain a problem despite several initiatives. The impact of current infrastructure projects on transport costs is still unclear.

There are already several funding programmes in place, many of which have been successfully used by the some of the companies consulted. Even though firms often cite access to finance as a limitation, in some cases it can be used to validate under-performance. Therefore it is difficult to distinguish between the 'actual' and 'perceived' need for finance. Various funds are currently in place; the key challenge may rather be in communicating the existing funding programmes and improving current funding programmes.

In terms of procurement-related cash flow, **the dti** and seda's SMME payment assistance hotline has been largely ineffective as 70% of the calls logged with the hotline has remained open and have not been addressed.[136] SOEs also have a record of slow payment. These problems also affect larger companies.

[135] Engineering News, 21 September 2009, Govt sets up hot line to speed up SMMEs late payments
[136] Own calculations based on SEDA summary reports

16.3.3 Recommendations

Table 56: Recommendations to address high cost structure

Recommendation	Motivation and risks	Description
Create labour intensive manufacturing incentives	▸ Incentives offer relief from high labour input cost ▸ Encourages increased employment ▸ Can be combined with existing programme	▸ Incentive can take the form of tax break or can add to the BEE scorecard
Rework current focus of MIP	▸ Current focus is not always applicable to electronic companies	▸ Explicitly include electronics manufacturers as part of the target group
Provide shared infrastructure	▸ Sharing infrastructure could decrease some costs such as warehousing, IT infrastructure, office space and equipment ▸ Difficult to coordinate and requires companies with roughly the same products – These companies are in direct competition	▸ Consult companies to identify opportunities (specific nature of infrastructure, locations), interest level and affordability thresholds, e.g. – A centralised certification facility that could perform assessment such as CE, UL, FDA, FCC, IPC ▸ If viable, provide funding for programmes – E.g. Form Joint Action Group to qualify for the Sector specific assistance scheme
Shift production towards higher value addition	▸ Problem of high cost structure can be alleviated by creating greater value addition – e.g. moving into higher technology electronics and niche products	▸ See recommendation in section 16.1.3
Better marketing of existing funding options	▸ Confusion and lack of knowledge by companies relating to existing programmes ▸ Lack of clarity on how new and existing programmes will relate to one another	**Options:** ▸ One-on-one interaction with companies ▸ Communicate support information through industry associations and export councils ▸ Compile packaged brochure ▸ Create information portal
Access to specific funding for purchase and customisation of production software	▸ Difficulties securing funding from public and private sources ▸ Production software is a key input and driver of competitiveness	**Options:** ▸ Specialist production software fund (e.g. matching scheme) ▸ Incorporate into existing funding scheme (e.g. MIP)
Improve government and SOE payment cycles	▸ SMME hotline is currently not effective as 70% of all calls remain unaddressed ▸ Slow payments puts pressure on SMMEs (and larger companies) cash flow	▸ Revise structure of hotline and associated systems – Improved accountability – Integration into performance appraisals of individuals and entities ▸ Create ‘SMME champions’ within government departments and municipalities which drives early payment internally ▸ Explore extending early

Recommendation	Motivation and risks	Description
		payment cycles to larger companies
Clarify VAT Export Incentive Scheme	▸ Due to high value nature of electronics exports VAT payments can be large and generate cash flow issues ▸ Unlikely that VAT structure will be altered for a single sector, therefore work within existing programmes ▸ Indirect imports through intermediaries may create challenges in tracing export paperwork and sharing benefits of exemptions or rebates ▸ There is currently a risk that companies apply the zero VAT tariff rate without proper documentation which results in a fine	**Options**: ▸ One-on-one interaction with companies ▸ Communicate support information through industry associations and export councils

16.4 Availability and quality of skills (engineers, technicians, artisans)

16.4.1 Overview of challenge

A high proportion of companies face shortages of skilled personnel, in particular engineers, technicians and artisans. Companies feel that this is due to inadequate education and training (and little or no practical experience), declining quality of engineering graduates and technicians, and universities failing to attract the best quality candidates. In some cases, companies have no or weak relationships with universities. In addition, South African companies must compete for engineering skills with international markets, local offices of international companies and demand for management personnel. Companies have also experienced difficulties in importing skills due to immigration requirements.

Suggestions to improve this included:
- Support for staff and artisan training
- Support to HEIs for innovation facilities, e.g. CAD software
- Better support for artisan training centres

16.4.2 Existing and planned support

There are various support initiatives currently underway or planned, although the success rates of these programmes vary greatly. Many of these programmes are aimed at alleviating the problem for the whole economy, rather than just the electronics sector.

Schooling and tertiary education

As the skills challenges identified by industry range from fundamental maths and science skills through to the quality of engineering graduates, it is necessary to consider all levels of education in South Africa. Formal education in South Africa is categorised according to 3 levels:
- General Education and Training (GET)
- Further Education and Training (FET)[137]
- Higher Education and Training (HET):

Government's prioritisation of education is evident in the budget allocation of 19.9% of the total national budget to education and training. R1.9bn is allocated to the National Student Financial Aid Scheme (NSFAS) which provides loans and bursaries to students in need of financial aid.

School-level education

Mathematics and science were highlighted as key subjects, the National Strategy for Mathematics, Science and Technology Education (NSMSTE) aims to double the number of South African learners passing mathematics. The strategy identified eight key aims to facilitate sustainable delivery of mathematics and science qualifications. Mathematics has also been made a compulsory subject in the general and further education and training bands[138]. The Dinaledi schools initiative was launched in 2001 as part of the NSMSTE strategy to fast-track maths and science skills. It aims to increase access to maths, science and technology, and to promote and improve results for these subjects in under-privileged communities. In 2009 there were 500 Dinaledi schools in the country (up from 400 in 2006). Dinaledi schools made up 8% of the total number of high schools that registered for the matric exams, and they accounted for 24% (15 500) of learners who achieved 50% and higher for mathematics.[139] Overall there were 298,621

[137] See www.fetcolleges.co.za
[138] Cameron. 2009. Dinaledi Schools initiative boosts maths, science pass rates
[139] Cameron. 2009. Dinaledi Schools initiative boosts maths, science pass rates

candidates who wrote mathematics in the 2008 NSC examinations of which 136,503 passed the examination.

Initiatives such as the MTN Sciencentre in Cape Town and Sci-bono in Johannesburg aim to increase learners' interest in science and technology. By making science and technology interactive and fun these science centres hope to increase the number of learners studying science and technology.

SETAs

The two most relevant Sector Education and Training Authorities (SETA) to the electronics industry are Information Systems, Electronics and Telecommunications Technologies SETA (ISSET SETA) and Manufacturing, Engineering and Related services SETA (MERSETA). The SETAs do not train individuals directly, instead it facilitates the process for training by paying for grants and reimbursing training costs (only if the trainer is registered with the South African Qualifications Authority).

Each SETA has compiled a Sector Skills Plan which contains estimates of scarce skills, shown below are the relevant scarce skills estimates (number of people) for ISSET SETA and MERSETA respectively:

Table 57: ISSET SETA scarce skills list (electronics related occupations)[140]

Occupation and SIC code	Immediate	1st April 2008 to 31st March 2009	1st April 2009 to 31st March 2010	1st April 2010 to 31st March 2011	Total
233301 Electrical Engineer	2	3	3	5	13
233401 Electronics Engineer	45	62	67	56	230
233402 Electronics and Telecommunications Engineering Technologist	2	1	1	15	19
233501 Industrial Engineer	3	5	4	5	17
233502 Mechanical Engineer	17	21	22	21	81
233601 Mining Engineer (excluding Petroleum)	2	3	4	5	14
233603 Mining Engineering Technologist	1	2	2	1	6
233901 Aeronautical Engineer	0	0	0	10	10
261303 Software Engineer	50	60	62	43	215
261304 Software Developer	79	140	73	116	408
263101 Computer Network and Systems Engineer	105	112	119	128	464
263202 ICT Support Engineer	64	105	68	97	334
263203 ICT Systems Test Engineer	11	19	8	20	58
263301 Telecommunications Engineer	11	16	16	10	53
263302 Telecommunications Network Engineer	3	1	1	7	12

[140] ISSET SETA. 2008. Sector skills plan

Occupation and SIC code	Immediate	1st April 2008 to 31st March 2009	1st April 2009 to 31st March 2010	1st April 2010 to 31st March 2011	Total
312302 Electrical Engineering Technician	17	13	11	24	65
312401 Electronic Engineering Draftsperson	2	1	0	1	4
312402 Electronic Engineering Technician	24	36	15	14	89
312501 Mechanical Engineering Draftsperson	4	6	6	4	20
312502 Mechanical Engineering Technician	4	5	6	5	20
313101 Hardware Technician	16	16	16	16	64
313104 Computer Systems Technician	80	59	20	100	259
313105 Telecommunications Computer Systems Technician	4	4	5	1	14
313201 Radio Communications Technician	0	0	0	2	2
313202 Telecommunications Field Engineer	13	18	16	11	58
313204 Telecommunications Technical Officer or Technologist	5	0	0	2	7
323304 Precision Instrument Maker and Repairer	9	1	0	3	13
323402 Toolmaker	6	8	8	5	27
323502 Mechatronics Technician	0	2	2	2	6
341101 Electrician (General)	1	1	1	7	10
341102 Electrician (Special Class)	2	3	3	2	10
342401 Cabler (Data and Telecommunications)	4	2	5	5	16
342404 Telecommunications Technician	8	7	7	9	31
Total	594	732	571	752	2649

Table 58: MERSETA Scarce Skills Matrix for 2008/2009[141]

Occupations or occupation related programmes	Totals learnerships, skills programmes and apprenticeships
Electronic Engineering Technician	24
Boiler Maker	280
Auto Electrician	158
Motor Mechanic	2,711

[141] MERSETA. 2009. Sector skills plan

Occupations or occupation related programmes	Totals learnerships, skills programmes and apprenticeships
Earthmoving Equipment (Diesel Mechanic)	590
Motorcycle Mechanic	30
Welders	100
Fitter	284
Fitter and Turner	200
Metal Machinist (First Class)	100
Turner	100
Instrument Mechanics	70
Tool; Jig and Die Makers	132
Vehicle Body Builder	20
Electrician	344
Instrument Technicians	5
Component Manufacturing	580
Mechanical Engineer	0
Mechanical Engineering Technicians	30
National Certificate in Autotronics	16
National Certificate in Logistics	22
National Certificate in Mechatronics	122
National Certificate in Engineering Fabrication: NQF Level 2 (Boilermaker)	437
National Certificate In Welding (Downhand Welding: Plates): NQF Level 2	269
National Certificate in Mechanical Engineering (Fitting): NQF Level 2 (Fitter)	174
National Certificate in Mechanical Engineering (Fitting and Machining): NQF Level 2 (Fitter & Turner)	116
National Certificate in Mechanical Engineering (Machining): NQF Level 2 (Turner)	70
National Certificate in Mechanical Engineering (Machining): NQF Level 2 (Tool, Jig & Die Maker)	59
National Certificate: Electro-Mechanics	0
National Certificate: Electrical Engineering	0
National Certificate: Automotive Repair and Maintenance	0
National Certificate in Metal and Engineering Manufacturing Processes: NQF Level 2	236
N.C. in Air-conditioning, Refrigeration and Ventilation Level 2 (Reviewed)	140
National Certificate in Engineering Fabrication: NQF Level 2 (Sheet metal Worker)	139
National Certificate in Iron and Steel Manufacturing: NQF Level 2	55

Occupations or occupation related programmes	Totals learnerships, skills programmes and apprenticeships
National Certificate in Aircon Refrigeration Ventilation: NQF Level 2	32
National Certificate in Mechanical Engineering (Machining): NQF Level 2 (Roll Turner)	4

The SETAs have been reasonably successful. Under the learnership programme of MERSETA 43% of those who were unemployed at registration were employed after completion or termination of their learnerships. Of these individuals 83% indicated that the employment was related to the learnership programme they had completed.[142] ISSET SETA was also involved in building capacity at Further Education and Training (FET) institutions by training 66 lecturers to deliver network programmes in these colleges.

Artisan development remains a focus for government to support their interventions in the scarce and critical priority areas that include artisans. In order to qualify for this money the SETAs provide artisan training targets and demonstrate how they have reprioritised their skills development funds towards scarce and critical skills including artisan trade[143]. The Skills Development Amendment Bill (B 49D-2008) makes provision for the appointment of a National Artisan Moderating body to monitor the performance of accredited centres and record artisan achievements.

Part of SETAs funding is through the skills levies of 1% of the total payroll for businesses with payrolls greater than R500,000 per year. In order to claim skills levies back company are required to register a skills development facilitator with SETA, prepare a workplace skills plan and submit an annual report on the training done for the previous year. This encourages businesses to do in-house training. However, certain requirements have to be met – including a 70% placement guarantee (i.e. at least 70% of the trainees need to be employed after training).

FETs

FETs provide training related to National Certificate (Vocational) for Levels 2, 3 and 4 of the National Qualifications Framework (NQF) and can also cover Grades 10 to 12 education. They are intended to provide theoretical and practical skills linked to specific industry requirements. There are 50 multi-site FETs are located across the country.

Relevant training programmes include:

- Electrical infrastructure construction, which includes electronic control and digital electronics
- Engineering and related design, which includes engineering technology and computer aided design
- Information technology and computer science, which includes electronics

The artisan qualification system also requires successful completion of trade tests, most such as the electrician trade test. These trade tests need to be completed at an accredited trade test centre such as INDLELA in Olifantsfontein, Protech Training, Umbilo. Certain companies are also accredited to conduct trade tests, for example Denel and Bell Equipment.

HETs

There are 24 HET institutions in the country, including Universities and Universities of Technology. HETs with electronics departments include Cape Town, Stellenbosch, Rhodes, Durban, Pretoria,

[142] MERSETA. 2008. Impact assessment of Learnerships and Apprenticeships
[143] Minister says Artisan, Apprentice development central to Asgisa success. Available: http://www.skillsportal.co.za/skills_guide/871107.htm

KwaZulu-Natal and Tshwane. They provide both theoretical and practical skills for high skilled employment.

Other skills initiatives

In response to skills shortage many companies have taken it onto themselves to provide in-house training. For example Denel Aviation provides on-site training through the Aviation training Academy with courses certified by the South African Civil Aviation Authority.

The Seda Technology Programme (STP) is a programme of **the dti** which is housed within the Small Enterprise Development Agency (seda) that aims to provide incubation, technology transfer, and quality and standards services. It was created in 2006 as part of a wider consolidation of support to small enterprises, and merged initiatives that were previously administered under the Godisa Trust, the National Technology Transfer Centre (NTTC) and Technology Advisory Centre (TAC) and several incubators[144].

THRIP also encourages the development of research personnel and students. To facilitate technology and skills transfer the THRIP programme encourages the transfer of people through a placement mechanism among the organisations involved in the projects (HEIs; SETIs; and industrial laboratories). The Technology Innovation Agency also aims to develop human capital through partnerships with the NRF and HETs. For more detail on the THRIP programme see section 16.2.2.

the dti has also invested in specific areas which they have found South African skills to be lacking. One such area is the Capability Maturity Model Integration (CMMI) programme, being run by the Johannesburg Centre for Software Engineering (JCSE), at Wits University. In 2007 **the dti** invest almost R1.5m into the programme to help make the South African software development community more competitive on a global scale. The funding will go towards the training costs of JCSE staff to present CMMI training, consulting and assessment services locally.[145]

The Maxum Business Incubator, which is based at and funded through The Innovation Hub in Pretoria (working closely with the publicly-funded Gauteng Enterprise Propeller), provides an enabling environment where start-ups from the knowledge-intensive sectors, including information and communications technology (ICT), biosciences, electronics, and advanced manufacturing and materials, are fast tracked to compete in the global village. The incubation process improves the survival rate of start-up companies by helping them become financially viable, usually within two to three years.[146]

Homecoming Revolution is a non-profit organisation aimed at reversing the South African skills shortage. The Homecoming Revolution website, launched in January 2003, aims to advise and assist potential 'homecomers' to return to South Africa. This includes moving, finding a job, starting a business along with procedural help on entry, residence and financial paperwork.

Immigration regulation has been changed in recent years in order to try to ease access to scarce, critical and exceptional skills. Applications can be made through the temporary residence permit process. Scarce and critical skills quotas can be issued each year in terms of section 19(1) of the Immigration Act, 2002 (Act No. 13 of 2002), The May 2009 schedule[147], for example, includes a range of categories that could be relevant to electronics, including the following:

- Aeronautical engineers (quota of 500)
- Avionics engineers (quota of 250)

[144] The dti, 2009, "Innovation and Technology Programme" brochure
[145] R1.5m boost for software industry. http://ww2.itweb.co.za
[146] Incubator Network Africa. Available: http://www.infodev.org/en/project.22.html
[147] Government Notice No. 605, Government Gazette 25 May 2009 Specific Professional Categories and Specific Occupational Classes

- Electrical and electronic engineers (quota of 500)
- Industrial engineers (quota of 100)
- Electrical engineering draftspersons and technicians (quota of 500)
- Electronics technicians (quota of 250)
- Industrial/product development technologists and testers (quota of 1,000)
- Aircraft and avionics technicians (1,000)
- Manufacturing technologists and technicians (150)
- Electricians (150)

In order to make use of the quota, specific proof of suitability is required, which may include proof of qualifications, registrations with professional body, board or council, and years of experience.

An exceptional skills work permit can be issued to an individual (not linked to a particular employer) if they can demonstrate, along with the other standard temporary residence requirements, that their skills and experience are exceptional and recognised by respected authorities in their field (through submission of a CV, testimonial, letter of motivation, any other supporting proof). The application can also include input from a prospective employer.[148]

Gaps in support

There are several programmes which aim to provide long term solutions to the nationwide skill shortage. It is unclear what the success of these programmes will be. These programmes are general programmes which aim to benefit the whole economy. However, there is also a grave need for more short-term skills solutions geared towards the electronics sector.

Private sector training initiatives have generally been successful. However, these are still on a small scale – both in terms of number of individuals trained and number of companies providing training. The current incentives structure only allows companies to recover some of their SETA training levy, incentivising firms to do the minimum training allowable to regain the levy.

The current public sector focus of mentorship is mainly on supporting start-up companies; however there is a need for mentorship in a wider framework. Concerns have also been raised about the level of experience of some publicly funded mentors. There is currently not enough knowledge transfer both within and between companies and subsectors, creating a risk that much of the current knowledge in the system will be lost. Mentoring within companies is likely to be a privately-driven response as it improves the sustainability of the company. Thus the main gap in support lies in cross-company and inter-industry mentorships.

The new mathematics curriculum has been detrimental to engineering education as key subjects have been excluded (e.g. trigonometry is now an optional exam paper and almost all schools have dropped it). The failure rate for first year under-graduates in all SA engineering faculties has increased to 50-60% in 2009/2010 from 30% in the previous year. Most engineering faculties are now considering stretching engineering degrees by an extra year to accommodate extra maths tuition to compensate for this.

16.4.3 Recommendations

Table 59: Recommendations to address quality and availability of skills

Recommendation	Assessment	Description
"Careers in electronics" campaign	▸ The general drive for maths and science does not guarantee the growth in number of individuals studying electronics related subjects ▸ Need to increase intake of learners	▸ **Options:** ▸ Formation of 'electronics clubs' in high schools – Equipment sponsored by company ▸ Introduce electronics into the curriculum

[148] Department of Home Affairs, Application for Temporary Residence Permit, BI-1738, available at http://www.home-affairs.gov.za/documents/bi1738.pdf

Recommendation	Assessment	Description
	studying electronics into HETs and FETs	(currently only offer information technology) ▸ Expose learners to engaging electronics displays/devices through science fairs, parks, expos and competitions ▸ Share information on available careers in electronics with career guidance councillors ▸ Increase bursaries for electronics studies at tertiary level
Align school maths and university electronics curricula in partnership with industry	▸ Gaps in current curricula relative to industry needs ▸ Rapidly changing sector that requires constant updating in content of training – E.g. fabless design	▸ Create or improve forum for communication between schools, universities and companies
Prioritise electronics manufacturing in learnership programmes at SETAs	▸ Current MERSETA focus seems to be on automotive programmes ▸ ISSET SETA focus is on testing and design rather than manufacturing	▸ Increase number of apprenticeships, learnerships and skill training programmes offered for electronic manufacturing
Increased incentives for in-house training	▸ Require 'positive' incentives as well as the current skills levy ▸ Cannot use tax incentives as the current system is based on tax	▸ Greater points allocation in BEE scorecard for on-site training ▸ Simplify SETA training accreditation
Create mentorship system in private sector	▸ Enables knowledge transfer ▸ Short term solution ▸ Require full buy-in of the current incumbents in the industry – Often felt that the industry is dominated by aging white males who are unwilling to share their knowledge (see for example the Commission Report on the ICT BEE Charter[149])	▸ Identify a respected industry champion within the industry ▸ Call for participation/pledges ▸ Greater points allocation in BEE scorecard for on-site training ▸ Recognition of successful mentors and mentees through industry structures and government
Streamline process to draw in needed skills from abroad	▸ Short term solution ▸ These individuals can also then be used as mentors	▸ Ensure industry is familiar with both scarce and critical skills quotas and exceptional skills work permit processes ▸ Advocate for increased quotas relevant to electronics manufacturing through intergovernmental processes if needed ▸ Reduce immigration paperwork and processing time ▸ Advertise opportunities in South Africa internationally including attracting South Africans and other Africans living abroad

[149] Available: http://www.ictcharter.org.za/content/ICT%20BEE%20Charter%20Commission%20reports.pdf

16.5 International market access

16.5.1 Overview of challenge

Challenges to accessing export markets highlighted by companies include obtaining the necessary certification and meeting required quality standards, which may be difficult to meet due to lack of testing facilities and certification support**,** and perceptions that South African products are not always perceived to be of a high quality by buyers in export markets. In addition, firms may lack the marketing skills, time and resources required to market their products effectively in international markets. High transport costs, time differences language differences and exchange rate fluctuations are also seen as detracting from South Africa's competitiveness. In addition, companies feel that there is limited market information on international opportunities and trends.

Companies suggested the following support to address these barriers:

- Certification support
- Testing infrastructure
- Support on clearing import regulations into foreign markets
- Support to reduce freight/logistics costs and lead times
- VAT concession/fund for exporters
- Assistance to create joint ventures to access African markets
- Support to establish shared facilities in export markets (e.g. sales offices, warehouses)

16.5.2 Existing and planned support

Trade agreements

South Africa has been able to obtain preferential access into many key markets. Examples include the Trade, Development and Co-operation Agreement (TDCA) with the EU and South Africa's inclusion in the African Growth and Opportunity Act (AGOA) which grants preferential access to the US.

Export orientated programmes such as the MIDP and the IDZs (discussed above) provide assistance on clearing customs and have infrastructure in place to reduce freight and logistics costs.

Marketing support

The Export Marketing and Investment Assistance (EMIA) scheme provides funding to exporters to take part in trade shows. Applications must be completed 2 months prior to departure and the funding covers travel, subsistence, partial coverage of the transport of samples and product registration.

South African Vanguard of Technology (SAVANT) is a marketing and awareness programme for the ICT and electronics sectors launched by **the dti** in 2004. SAVANT aims to be a 'one-stop shop' for all ICT and Electronics information in South Africa. It also provides potential investors with current data and information on business climate, investment environment and opportunities in South Africa. It also hosts an information portal, various networking activities and coordinates business to business matchmaking.

Financial and cash flow support

Exporters are also assisted through the VAT Export Incentive Scheme which permits the exporter to zero-rate VAT on exports regarded as a direct export. However, there are certain pitfalls to this scheme.

Technical barriers to trade

SABS is a statutory body that aims to promote and maintain standardisation and quality of commodities and services. SABS focuses on 7 industry sectors, including electrotechnical. This includes the testing and certification of products, developing technical regulations, and also provides training on aspects of certification. SABS offers the Siyakhula certificate – a support mechanism to SMMEs in obtaining ISO9001:2002 accreditation. The Siyakhula Certificate – in combination with ISO9000 – provides for a systematic approach to compliance with ISO9001:2000 through a three-phase approach. Each of the 3 phases takes approximately 6 months to complete with phases building on each other.

The South African National Accreditation System (SANAS) is the single National Accreditation Body that gives recognition to laboratories, certification bodies and inspection bodies.

The SPII programme does include certification costs is a qualifying cost item, but only as part of a wider support package.

Industry organisation

Several export councils have been established to promote exports of selected industry sectors. The South African Electrotechnical Export Council is a public-private partnership with **the dti** focusing on support and growth of exports of the following sectors: electronics, electrical engineering, information technology and telecommunications. The Automotive Industry Export Council was established in 1999. Its main activities are to promote the automotive manufacturing capability, assist trade missions of South African companies to potential export markets and conduct research into new markets and opportunities. Products addressed include passenger cars, trucks and busses, original equipment components, accessories and aftermarket parts.

The export councils such as the South African Electrotechnical Export Councils also aim to provide information specifically tailored to facilitate access to **the dti**'s support initiatives.

Market information

the dti holds regular meetings and briefings with specific companies where concerns are discussed, but also providing information on market opportunities and **the dti**'s programmes.

Provincial trade and investment programmes promote trade by assisting local companies to identify markets and export opportunities. Trade & Investment KwaZulu-Natal (TIKZN) provides relevant reliable information to investors and traders as well as assisting companies to operational funding. Other trade and investment programmes include Trade and Investment Limpopo (TIL) and the Western Cape Investment and Trade Promotion Agency (WESGRO).

Foreign exchange support

There has been some relief in terms of foreign exchange controls. In 2009 it was announced that the then limit of R50m on companies for outward investment would be increased to R500m.[150] Furthermore the 180 day rule was also scrapped. This rule required exporters to convert their foreign exchange within 180 days of receiving it. This allows exporters much more flexibility.

[150] Gordhan. 2009. MTEF Budget Speech

Initiatives such as PayPal may go some way towards simplifying Forex transactions for smaller exporters but can be costly.

Gaps in support

Certification support does not seem to be meeting the needs of industry. This may be a combination of lack of awareness of existing programmes as well as the applicability, administration and funding of the programmes.

The EMIA scheme has had some success in getting international exposure for domestic companies; however several firms have found that the requirements and paper work required are more expensive than the actual support. Tradeshows therefore remain difficult to access.

There is a concern that electronic products are often not considered in offensive positions within trade negotiations.

Companies experience difficulties demonstrating eligibility for VAT exemption where they export goods through agents.

16.5.3 Recommendations

Table 60: Recommendations to address international market access

Recommendation	Assessment	Description
Provide financial support for obtaining certification needed in foreign markets	**Motivation**: ▸ Creating local testing capacity (infrastructure and human capital) will provide support to exporting companies – Only achievable in the medium to long run ▸ A more immediate solution is to provide some funding for this testing **Risks**: ▸ Investing in creating local capacity is also risky since standards change and are upgraded continuously and vary for different sectors – Also require shorter term solution	▸ Create fund for obtaining certification – Require proof that certification is needed to enter the market – Provide proof of readiness for certification ▸ Provide cost sharing (e.g. 80:20) with companies for testing
Reduce red tape in EMIA scheme	▸ Extensive requirement of paperwork and red tape in order to recover costs ▸ Red tape places disproportional burden on smaller companies	▸ Simplify requirements ▸ Improve payout times
Increase values for EMIA scheme (already planned)	▸ Current incentives are not always large enough to make taking part economically viable ▸ Also disproportionally affects smaller business which may not have the funds to cover other expenses	▸ Review current support values and current costs associated with tradeshows – Change thresholds accordingly
Improve SABS services	▸ Ensuring that SABS is operating effectively is important for manufacturers – Also important for local consumers ▸ SABS, similar to manufacturers, also suffers from the lack of skilled labour ▸ SABS certification is not seen as useful to operate domestically or internationally	▸ Improve relationships with companies – Rapid response to questions/ emails/ phone calls ▸ Institute customer satisfaction scorecards ▸ Externally evaluate current capacity of SABS to provide certification

16.6 Industry organisation

16.6.1 Overview of challenge

Companies feel that the electronics industry suffers from weak organisation, and believe that the electronics industry is not given sufficient recognition as a standalone industry. Some companies see themselves as part of another sector rather than electronics, such as electrical or defence.

Support suggested by companies includes creating a stronger lobby to represent the sector.

16.6.2 Existing and planned support

There are numerous industry associations regarding electronics manufacturing. These associations aim to support, develop and grow their respective markets through information sharing, increased coordination amongst companies and lobbying to government. Examples of related industry associations include:

Table 61: Examples of relevant industry associations and structures

Name	Sector	Function
The South African Electrotechnical Export Council (SAEEC)	▸ Power ▸ Electronics ▸ Information Technology	▸ SAEEC is a not-for-gain organisation in a Public-Private-Partnership with **the dti**. It focuses on facilitation, support, development and growth of exports in the electrotechnical sector.
The Association of Distributors of Electronic Components (ADEC)	▸ Electronics	▸ ADEC's objective is to contribute to the growth of the electronic manufacturing industry, at both component and system level
Black IT Forum (BITF)	▸ Information Technology	▸ The BITF is an association of black individuals formed specifically to address the poor representation of blacks in the information and communications technology industry. It currently has a membership base of approximately 1500 IT professionals.
The Information Technology Association of South Africa (ITA)	▸ Information technology	▸ Functions include lobbying and negotiating at government level on behalf of its members on IT related issues. ITA promotes the maintenance of high standards of IT industry technical skills in accordance with international trends.
Information Industry Association South Africa (IISA)	▸ Information technology ▸ Telecommunications	▸ Umbrella association representing ICT Sector participants
The Internet Service Providers Association (ISPA)	▸ Telecommunication	▸ ISPA membership includes large, medium and small Internet service and access providers in South Africa. It aims to facilitate exchange between the different independent Internet service providers, the Department of Communications, ICASA, operators and other service providers in South Africa.

Name	Sector	Function
Computer Society of South Africa (CSSA)	▸ Information Technology	▸ Focuses on: – ICT Policy - representing industry practitioners at Government level. – Education and training – Community development that enhances the standards and levels of ICT – Transformation in ICT
The National Association of Broadcasters of South Africa (NAB)	▸ Telecommunications	▸ Represents the interests of South African broadcasters and we work to promote a favourable climate for broadcasters to operate within.
The South African Communications Forum (SACF)	▸ Telecommunications ▸ Information technology ▸ Electronics	▸ The Forum represents stakeholders in the telecommunication, information technology, electronics and broadcasting industries.
The National Association of Automotive Component and Allied Manufacturers (NAACAM)	▸ Automotive ▸ Electronics ▸ Information Technology	▸ The National Association of Automotive Component and Allied Manufacturers was established 29 years ago to represent the interests of the automotive component manufacturers. There are some 190 national member companies with 230 regional manufacturing sites, in addition to 12 associate members who provide mainly logistics, IT and financial services to members. Outside of NAACAM there are some foreign and smaller local companies who are either not members of any association or are affiliated to tyres, plastics, stainless steel, aluminium and similar bodies.
Illumination Engineering Society of South Africa (IESSA)	▸ Lighting	▸ The lighting industry of South Africa is represented by the Illumination Engineering Society of South Africa (IESSA)
Aerospace, Maritime and Defence Industries Association (AMD)	▸ Defence ▸ Electronics ▸ Automotive ▸ Aerospace	▸ The Aerospace, Maritime and Defence Industries Association of South Africa, AMD, is widely acknowledged as South Africa's Defence Related Industries trade association and is mandated by its members to promote the collective interests of the South African defence-related industry (SADRI)
Sustainable Energy Society of Southern Africa (SESSA)	▸ Energy	▸ Represents the renewable industry in South Africa and promotes the use of renewable energy and energy efficiency including all solar-based energies such as photovoltaics, thermal heating and cooling, wind, biomass and hydro etc.

The number of associations operating within the electronics sector indicates how heterogeneous the sector is, but also highlights the fragmentation of the industry. The number of associations means that information is dispersed and will not always be easily transmitted to all companies in the sector.

Gaps in support

The representation of the sector through multiple organisations means that industry loses bargaining power and lacks clear communication – both within industry and to government. The integration of electronics into related sectors (e.g. vetronics, aerospace, medical devices) also creates difficulties in defining the boundaries of the electronics sector.

Within associations there may exist divergent interests due membership of designers, distributors, manufactures, companies supplying domestic versus foreign markets. This creates challenges to reaching consensus on the needs of the industry.

16.6.3 Recommendations

Table 62: Recommendation to address industry organisation

Recommendation	Assessment	Description
Establish electronic design and manufacture interest group/ forum	▸ It appears that there is no clear voice for manufacturers among existing associations – As evidenced by the vast number of industry associations ▸ Creation of a formal umbrella association may be hampered by dynamics and vested interests from existing associations	**Options for selection of participants**: ▸ Call for nominations ▸ Invite individual participation ▸ Pilot with selected group of key players **Other activities**: ▸ Agree scope of mandate e.g. advocacy, training, information sharing, domestic versus export, strategic focus ▸ Determine funding model or approach to use resources of existing structures

17 Suggested approach to implementation

In order to plan for implementation, the recommendations identified above have been categorised according to the type of support required, as similar types of actions could be grouped together to allow for more effective planning and use of resources. The identified recommendations fit into the following categories:

1. Information sharing: gathering and dissemination of information to industry on areas such as available support and market information.
2. Refinement of incentives: adjustment of existing incentives to accommodate industry needs or development of new incentives
3. Prioritisation of electronics within wider strategies and initiatives: this is applicable in cases where initiatives already exist but do not currently include or prioritise electronics manufacturing
4. Improved service delivery: public sector performance of regulatory and other services in areas that are not only relevant to electronics
5. New/specialised programmes: development of new initiatives that are specific to electronics in areas where no existing initiative is in place

The table below brings together the proposed recommendations within each of the above five areas, and furthermore proposes potential lead and support role players.

Table 63: Summary of support types, mechanisms, content and role players

Type of support	Mechanisms	Content coverage	Suggested lead and support role players
Information sharing	▸ One-on-one interaction with companies (meetings, emails, telephonic) ▸ Workshops ▸ Electronic and hard copy brochures ▸ Online information portals ▸ Supply of information to industry associations and export councils	▸ ITAC application processes for tariff rebates or changes ▸ Benefits of innovation for competitiveness and sustainability of electronics companies and the industry as a whole ▸ Scarce and exceptional skills immigration ▸ Packaged information on available support programmes, incentives and funding sources: – Areas of support could include innovation, equipment, export market entry, investment facilitation, VAT, bridging finance), – Including information on their respective focus areas, eligibility requirements, application processes and contact details	▸ Lead: **the dti** (Electrotechnical and Innovation & Technology) ▸ Support: ITAC, SAEEC
Refinement of incentives	▸ Amendment of existing incentives ▸ Development of new incentives where required ▸ Advocacy ▸ Budget allocations ▸ Amendments of application procedures and eligibility criteria	**Potential areas of support:** ▸ Certification ▸ Production software purchase and customisation ▸ Trade show support ▸ Equipment purchases ▸ Shared infrastructure ▸ Labour intensive manufacturing ▸ Wages/youth employment ▸ In-house training ▸ Development of local IP	▸ Lead: **the dti** (in particular TEO) ▸ Support: DST, TIA, Treasury, DPE, SABS, IDC

Type of support	Mechanisms	Content coverage	Suggested lead and support role players
	▸ Improved administration	▸ Prototyping and commercialisation ▸ VAT on exports **Potentially relevant existing incentives/programmes:** ▸ EMIA ▸ MIP ▸ Siyakhula ▸ SPII ▸ THRIP ▸ Innovation Fund ▸ NRF-rated researchers ▸ NRD President's Awards, Lifetime Achiever Awards ▸ Industrial Development Zones ▸ Regional Industrial Development Fund (pending) ▸ Competitive Supplier Development Programme ▸ VAT Export Incentive Scheme	
Prioritisation of electronics within wider strategies and initiatives	▸ Advocacy ▸ Partnerships ▸ Formal written submissions	▸ TIA priority sectors ▸ CSDPs ▸ Procurement local preference specification ▸ Private supplier development programmes ▸ Corporate large contract procurement ▸ Public sector and SOE technical specifications in new areas, including areas such as digital television set-top boxes, renewable energies, energy efficiency, lighting, power, telecommunications ▸ University and FET curricula ▸ SETA funding and learnerships ▸ Exceptional skills work permits/scarce skills lists	▸ Lead: **the dti** (external relations and policy coordination) ▸ Support: DPE, industry associations, SAEEC, Treasury, ISETT SETA, MERSETA, universities, Eskom, Telkom, Home Affairs, major corporate such as mining houses, telecommunications companies
Improved service delivery	▸ Capacity building ▸ Advocacy ▸ Aligned performance assessment	▸ SABS standards support ▸ SARS customs enforcement ▸ ICT charter implementation ▸ Government and SOE payment cycles	▸ Lead: M&E presidency, Economic Cluster or DPSA ▸ Support: **the dti**, SABS, SARS, Nedlac, SOE procurement forum
New/specialised programmes and initiatives	▸ Partnerships ▸ Budget and resource allocations	▸ Electronic design and manufacture interest group/ forum ▸ Mentorship system in private sector ▸ "Careers in electronics" campaign ▸ Shared prototyping facilities	▸ Lead: Industry association or individual electronics company/leader champion (to be determined) ▸ Support: **the dti**, ISETT SETA, TIA, Fablabs, Departments of Basic and Higher Education

Note that the following areas have not been included in the recommendations, as it is considered that they will need to be addressed at an economy-wide level rather than specifically for the electronics sector:

- Exchange control
- Rand valuation and volatility
- Freight and logistics costs
- Red tape and ease of doing business
- Telecommunications and power cost and reliability
- Access to credit, including sureties (e.g. 80:20) and easing private sector finance following the economic recession

Appendix A: Companies consulted

Companies consulted to date:

1. …XYZ, Roelf Mulder
2. African Capacitors, Alan Gardner
3. Altech/UEC, Anton Lan
4. AMD, Simphiwe Hamilton
5. BAE Land Systems, Natasha Pheiffer
6. Ansys, Ian Esterhuizen
7. ATE, Willem van Bljon
8. Avnet Kopp, Hannes Taute
9. Bell Equipment, Guy Harris
10. Bosco Printed Circuits, Peter Verhuel
11. CBI-Electronic, Chris Oliver
12. CCII, Richard Young
13. Cirtech-Electronics, Stephen Sher
14. Conlog, Vikki Vink
15. CZ Electronics, Rob Bruggeman
16. DannTech, Mike Dann
17. Defy, Hector McDuling
18. Denel: Detek, Christo Schutte
19. Denel Dynamics, Kobus Engelbrecht and Viv Cardinal
20. Denel Aviation/Manpower Group, Garth Tolmie, Jaco Erasmus,
21. Diagnostics Online, David Karpul
22. EDH, Thomas Johnson
23. Elprom, Robert Hutton-Squire
24. Eveready, Avijit Das
25. First National Battery, Tom Cross
26. GE Security, Rodney McKechnie
27. GeoAxon, Dirk Koekemoer
28. Iono.FM, Ryan Dingley
29. ISS International, Errol de Kock
30. LED Lighting, Pierre van Houghten
31. Lodox System, Pieter de Beer
32. Martin Electronics, Stephen Martin

33. Master Circuits, Peter Frankish
34. MD2M , Brian Goemans
35. MGL Avionics, Rainer Lamers
36. Microsound, John Charls
37. MLT Drives, Michael Malengret
38. Montar Manufacturing, Riette Hauptfleisch
39. Mtech Industrial, Dr Pieter Rousseau
40. Mustek, David Kan
41. Nu-World Technologies, Jeffrey Goldberg
42. Parsec, Petrus Pelser
43. PCB-Pool Beta Layout, Ian Fennell
44. Peralex, Alex Bassios
45. Periseo, Dawie Janse van Vuuren
46. PFK Electronics, Colin Synman
47. PI Shurlok, Sean Rogers
48. Protea Technology Group, Gary Johnston
49. RC&C Manufacturing, Bertus Bresler
50. Reutech Group, James Verster
51. Robert Bosch, Paul Krabbendam
52. SAAB Grintek, Pat Ramokgaba, Mark Minnies
53. Sabtertek, Christo Olivier
54. Siemens, Lionel Olivier
55. Softcon Software Solutions, Dene Alkema
56. SunHot Solar, Fazli Okkers
57. Tellumat, Shaun Hendricks (awaiting additional input from Brian Ferguson)
58. TraxInterconnect, Andy Chisholm
59. Trolleyscan, Mike Marsh
60. Vektronix, Kobe Pienaar
61. Vivid Audio, Philip Guttentag
62. WH Circuit, Jean Mearns

Wider stakeholders consulted to date:

1. Association of Distributors and Manufacturers of Electronic Components (ADEC) , Hannes Taute
2. Department of Science and Technology, Marjorie Pyoos
3. South African Electrotechnical Export Council, Eileen Leopold
4. Industrial Development Corporation Techno-Industries SBU, Arno van der Walt

5. SPII Programme, Ntokozo Mthembu
6. ITAC, Nomonde Somdaka
7. ISSET SETA, Neville Nicholas -

Appendix B: Interview guide for companies

1. Interview details:

1.1. Interviewee name:

1.2. Organisation:

1.3. Unit/sub-division:

1.4. Date of interview:

1.5. Interview conducted by:

1.6. Location of interview:

1.7. Confirm/updated contact details (email, phone, address - cross-ref with contact sheet):

1.8. Any comments:

2. Nature of company and products

2.1 What is the primary nature of your business?

2.2 What are the products produced and/or imported by your company?

2.3 Do you manufacture products in South Africa? If not, where is your manufacturing located?

2.4 Describe your company structure and/or holding company structure?

2.5 Are you part of a global supply chain? If so, describe your role.

3. Manufacturing operations

3.1. What is your current manufacturing capacity e.g.:

a. How many employees do you have?

b. What is your maximum production run/output?

c. How flexible is your manufacturing capacity e.g. do you support small runs / prototypes, ability to adapt to seasonal changes in demand?

d. Do you have any quality certification or accreditation e.g. ISO 9000 etc?

3.2. How much of your capacity is used? What are the bottlenecks?

3.3. Do you have excess capacity that can be used to manufacture similar/related products?

3.4. Would you consider manufacturing other product lines Why or why not? What kind of incentives would encourage you to diversify?

3.5. What are your future plans to expand/reduce capacity? What are the reasons for this?

3.6. Which goods and services do you source locally? And your major imports?

3.7. What are the key drivers of competitiveness in your industry?

3.8. Who are your major competitors (local vs. international)?

3.9. How are strong are your R&D/technology links with universities or other industry players? What impact does this have on your competitiveness?

3.10. What are the major challenges you face?

3.11. What kind of support are you as an electronics manufacturer most in need of (top 3 interventions)?

3.12. If you had extra money to invest into your business, how would you spend it?

4. Client profile

4.1. What are the major demand drivers for your industry?

4.2. What are your major types of clients:

a. Sector

b. Local vs. international (exports)

c. Size (large companies, SMMEs)

4.3. How do you see this changing in the next 3 – 5 years?

4.4. Which clients are doing the most technically complex and state-of-the-art work? [IF APPLICABLE]

4.5. Which of your clients are most likely to be capable of flexible manufacturing? [IF APPLICABLE]

4.6. Which would be interested in import replacement? [IF APPLICABLE]

4.7. Which of your clients are successful at the moment and why?

a. Which ones have been the least affected by the recession? And the worst affected?

4.8. What are your clients' biggest growth constraints?

5. Opportunities:

5.1. Generally, what assemblies, sub-assemblies and components do you think have the best potential for local manufacture in South Africa?

a. OR do you believe that the real opportunities lie elsewhere in the electronics sector

5.2. How do these fit in with your current areas of specialisation (e.g. complementary or similar products)? Would you consider producing them yourself? Why or why not?

5.3. Do you think the South African electronics industry has sufficient capacity to produce these goods? Any thoughts on realistic value/volumes? Timeframes to produce at anticipated levels?

5.4. What do you see as some of the major constraints to the local manufacture of the identified opportunity products?

5.5. What measures need to be put in place to promote and support local production?

6. Perceptions of the dti:

6.1 What contact (if any) have you had with **the dti**?

6.2 Which of **the dti**'s programmes or services are you aware of?

6.3 What is the relevance and quality of these?

6.4 What do you think they do well?

5.5 What are the potential areas for improvement?

Appendix C: Required support raised by companies interviewed

The table below summarises the support needs identified by companies that are relevant to the role of government.

Table 64: Support needs identified by individual companies

Company	Support needs identified																			
	Info sharing on existing support	Equipment upgrade funding/ pooling	Investment, financing & cash flow support	Labour-intensive manufacturing incentives/ wage subsidies	Certification support/ incentive & testing infrastructure	Preference / support for local manufacture	Tariff reform, customs & excise support/ efficiencies	VAT concession/fund for exporters	Support to develop local IP, testing & prototyping facilities	Industry supply-chain incentive	Reduced forex controls & admin	Staff and artisan training	Export access and branding/ promotion	Support to reduce freight/logistics costs and lead times	Reliable and cost efficient telecoms & power	Reduced red tape	Technology "free zones"	Support to HEIs for innovation facilities, e.g. CAD software	Improved industry organisation	Improved public procurement framework	Regulatory changes to allow small electricity producers feed-in to grid
African Capacitors	-																				
Altech Group: Altech UEC	x					x	x	x	x	x			x								
Ansys			x						x										x	x	
ATE Group: Advanced Technologies & Engineering Company Pty Ltd (ATE)							x		x												
Bell Equipment							x					x								x	
Bosch Group: Robert Bosch South Africa		x	x			x			x												
Bosco Printed Circuits	-																				
Cirtech Electronics	-																				
Conlog			x			x						x									
CZ Electronics						x															

Company	Support needs identified																			
	Info sharing on existing support	Equipment upgrade funding/ pooling	Investment, financing & cash flow support	Labour-intensive manufacturing incentives/ wage subsidies	Certification support/ incentive & testing infrastructure	Preference / support for local manufacture	Tariff reform, customs & excise support/ efficiencies	VAT concession/fund for exporters	Support to develop local IP, testing & prototyping facilities	Industry supply-chain incentive	Reduced forex controls & admin	Staff and artisan training	Export access and branding/ promotion	Support to reduce freight/logistics costs and lead times	Reliable and cost efficient telecoms & power	Reduced red tape	Technology "free zones"	Support to HEIs for innovation facilities, e.g. CAD software	Improved industry organisation	Improved public procurement framework	Regulatory changes to allow small electricity producers feed-in to grid
Manufacturing (Pty) Ltd																				
Defy																			x	
Denel (Pty) Ltd: Denel Aviation												x								
Denel: Detek (A division of Denel Dynamics)		x																		
Diagnostics Online					x															
EDH														x						
Elprom		x	x																	
Eveready						x							x							
First National Battery												x	x							
GE Security							x													
ISS International															x					
LED Lighting South Africa						x			x				x							
Lodox					x															
Martin Electronics						x	x													
Master Circuits				x									x							
Microsound	-																			
MLT Drives													x						x	x

Company	Support needs identified																			
	Info sharing on existing support	Equipment upgrade funding/ pooling	Investment, financing & cash flow support	Labour-intensive manufacturing incentives/ wage subsidies	Certification support/ incentive & testing infrastructure	Preference / support for local manufacture	Tariff reform, customs & excise support/ efficiencies	VAT concession/fund for exporters	Support to develop local IP, testing & prototyping facilities	Industry supply-chain incentive	Reduced forex controls & admin	Staff and artisan training	Export access and branding/ promotion	Support to reduce freight/logistics costs and lead times	Reliable and cost efficient telecoms & power	Reduced red tape	Technology "free zones"	Support to HEIs for innovation facilities, e.g. CAD software	Improved industry organisation	Improved public procurement framework	Regulatory changes to allow small electricity producers feed-in to grid
Mustek											x					x					
Nu World				x																	
Parsec						x							x								
Peralex		x														x					
Periseo									x												
PFK Electronic					x																
PI Shurlok						x				x		x									
Protea Technology Group												x					x				
Reunert Limited							x		x												
Reunert Group: RC&C Manufacturing							x			x											
Saab Grintek Group			x									x	x		x	x					
Siemens Energy	x		x									x		x							
SunHot Ssolar						x															
Tellumat									x												
Vektronix											x	x									
Vivid Audio														x							
WH Circuits	x	x																x			