AISI

Aerospace Industry Support Initiative

an initiative of the dtic

IMPACT REPORT

2019/20

the dtic

Department:
Trade, Industry and Competition
REPUBLIC OF SOUTH AFRICA

CSIR

Touching lives through innovation

An Initiative of the Department of Trade, Industry and Competition, managed and hosted by the CSIR

AISI Mission

To enhance the global competitiveness of the South African aerospace and defence industry by:

- Developing relevant industry focused capabilities and facilitating associated transfer of technology to industry
- Providing a platform for facilitating partnerships and collaboration among government, industry and academia, locally and internationally
- Identifying, developing, supporting and promoting the interests and capabilities of the South African aerospace and defence industry
- Accelerating the achievement of government strategic objectives including growth, employment and equity

AISI Vision

To position South African aerospace and defence-related industry as a global leader, in niche areas, whilst ensuring effective interdepartmental participation and collaboration.

Contents

1 Executive summary

The Aerospace Industry Support Initiative (AISI) is an intervention of the Department of Trade, Industry and Competition (**the dtic**). **The dtic** was established by the incorporation of the Department of Economic Development into the Department of Trade and Industry (**the dti**).

The AISI was created by **the dtic's** Advanced Manufacturing Chief Directorate to foster industrial development and competitiveness in the aeronautics, space, defence, and more recently, maritime sectors in South Africa. In presenting this Impact Report for 2019/20, the AISI management extends its gratitude to **the dtic**, the local aerospace, defence and marine manufacturing industries, the AISI team, and its host organisation, the Council for Scientific and Industrial Research (CSIR).

> Impact achieved

During the 2019/20 financial year, the AISI supported 13 projects in the surveillance and sensor systems, avionics, propulsion, information systems and aerostructures technology streams. Each of these projects serves one or multiple product markets. The 2019/20 Impact Report is structured according to these technology streams, as illustrated in the graphic on the left.

Significant progress was made in 2019/20 with respect to development of local capabilities, advancement of technology solutions, and exports. The AISI support extended to 41 SMMEs, directly and indirectly, and enabled the creation of 25 new highly skilled jobs.

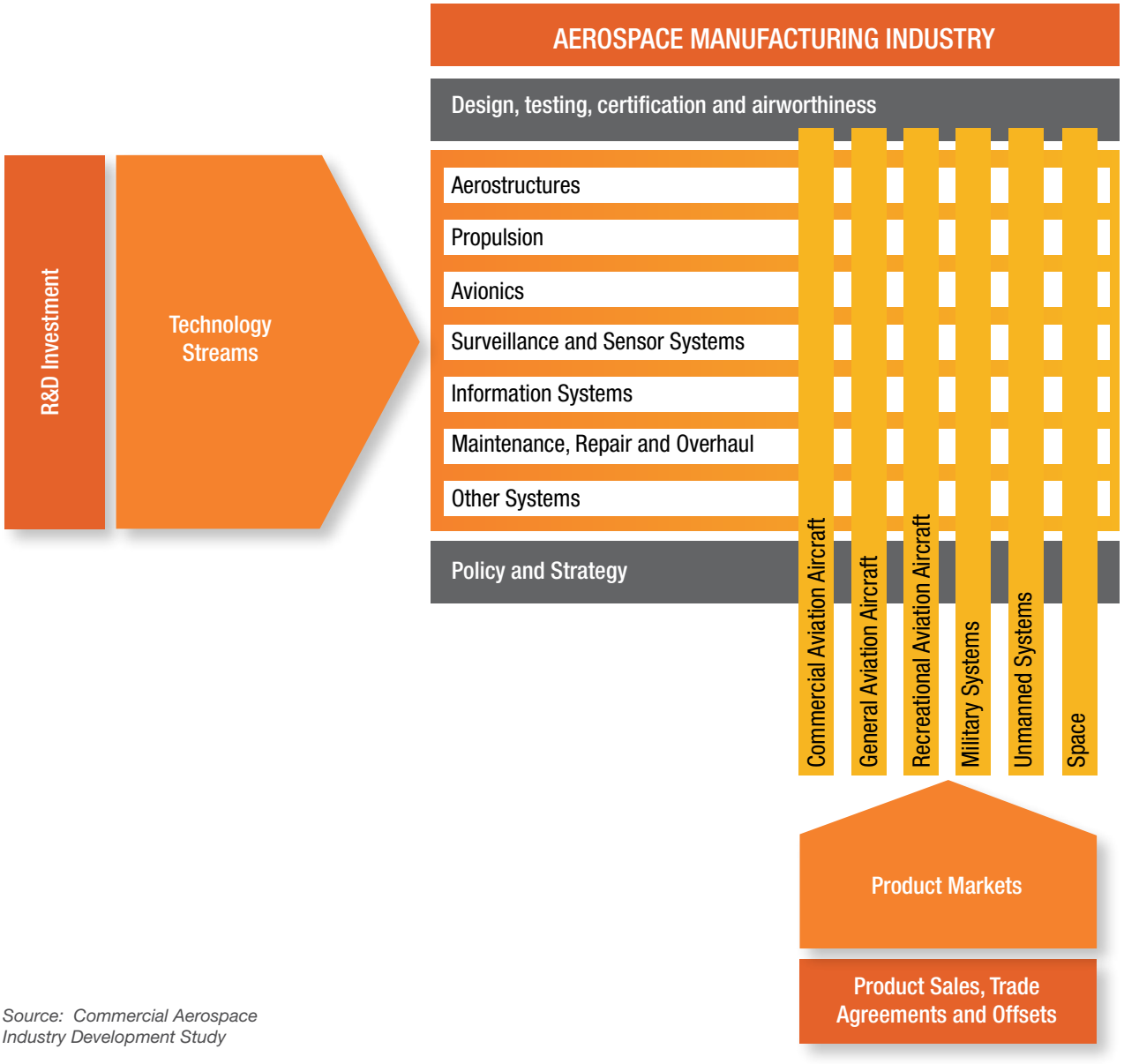
The Marine Manufacturing and Repairs Supplier Development Programme launched in 2019, promotes the maximisation of local content in manufacturing and supports South African maritime companies to acquire relevant standards and accreditation for integration into local and global supply chains.

This report provides a narrative account of projects based on interviews with beneficiaries, and is intended to demonstrate the progress made by beneficiaries in the year, increase awareness of South Africa's innovative aerospace, defence and maritime sectors and showcase the impact achieved by the AISI through its various support interventions.

> AISI programmes

With support since 2006, the AISI enables **the dtic** to achieve the following sectoral development goals:

- Supplier and small, medium and micro enterprise (SMME) development
- Job creation and retention
- Technology development
- Industrialisation of technology
- Localisation and import substitution
- Exports promotion, and
- Fostering transformation in the industry with a focus on women and youth empowerment.



Source: Commercial Aerospace Industry Development Study

These goals are achieved through the implementation of programme-level interventions within specific technology streams and product markets. The AISI utilises relevant tools such as technology roadmapping to facilitate the development of technology strategies for respective AISI beneficiaries. This assists the AISI to identify specific interventions within its mandate to assist in improving the competitiveness of the local industry.

The AISI programmes are designed to assist industry in overcoming challenges, building local capabilities and technological solutions, and enhancing global competitiveness. These five programmes which support the implementation of the AISI mandate are:

Technology-Based Supplier Development

The AISI's Technology-Based Supplier Development intervention provides enabling mechanisms to assist industry to improve productivity, implement quality management systems, optimise operations and integration into global supply chains. These interventions are implemented with a specific aim of broadening the industrial base by encouraging original equipment manufacturer (OEMs), integrators and sub-systems suppliers to work with SMMEs and lower-tier suppliers in technology programmes.

Industry Development and Technology Support

This programme focuses on advancing production innovation such as the use of advanced manufacturing and other fourth industrial revolution technologies to build more durable, compact and efficient products. Access to new and existing processes, products and methods is also facilitated to ensure that beneficiaries develop products and services, which enable them to exploit multiple market opportunities. Integrators and sub-system suppliers are encouraged to include SMMEs and lower-tier suppliers in their supply chains, to enable the continuous transfer of knowledge, expertise, capabilities and technologies, and in doing so, broadening the industrial base.

Marine Manufacturing and Repairs Supplier Development Programme

This programme assists suppliers in ship and boat-building, maintenance and repair, and the associated services industry to enhance their visibility within local and global supply chains and increase their competitiveness. The programme is divided into two interventions, namely support for marine standards and accreditation, and support for technology enhancement. The marine standards and accreditation intervention was created to address the need for local companies to supply approved and certified products and services to designated public procurement in the ship- and boat-building industry. The technology enhancement intervention aims to assist suppliers to enter new markets or enhance existing market positions in the marine and related industries.

Sector Strategic Support Initiatives

The AISI implements, oversees and contributes projects of national interest through this programme. This includes the development of the Commercial Aviation Industry Development Strategy, the hosting of the Joint Aerospace Steering Committee and contributing to the development of the Aerospace and Defence Masterplan, both at operational and strategic levels.

Coordination, Promotion and Awareness

The AISI plays a pivotal role in coordinating activities in and promoting awareness of the aerospace sector in South Africa. A flagship event is the annual Aeronautical Society of South Africa Conference that brings together local industry players to showcase projects and associated impact achieved in the year.

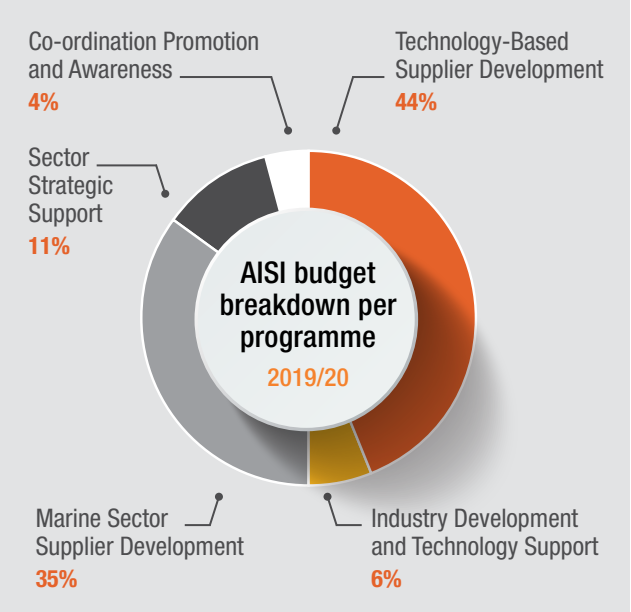


Figure 1 indicates the percentage invested by the AISI in these programmes in 2019/20.

2 Impact and Benefits 2019/20

Aerospace and Defence Impact 2019/20

- New technology development or advancement: 13
- New process development or advancement: 11
- Total number of highly skilled jobs created due to the AISI intervention/support: 25
- Total number of highly skilled jobs retained due to the AISI intervention/support: 212
- Export capability achieved: 6
- Import substitution/ localisation achieved: 5
- Number of SMMEs involved in projects (direct and indirect): 35
- Total number of personnel or students trained as a result of the AISI intervention/support: 63
- SMMEs (AS9100): 4
- Standards and accreditation support
- Facilitated access to national infrastructure – number of academic institutions and science councils involved: 10

Marine Impact 2019/20

- New technology development or advancement: 1
- Number of SMMEs involved in projects (direct and indirect): 7
- Standards and accreditation support: 6

NB: Statistics have been sourced from project beneficiaries

3 Improving the competitiveness of the marine sector through advanced manufacturing

The Department of Trade, Industry and Competition (**the dtic**) is committed to the implementation of advanced manufacturing as a technology in various sectors to enhance South Africa's competitiveness, and promote supply chain improvements and localisation of technology. **The dtic** has tasked the AISI with a new pilot programme, the Marine Manufacturing and Repairs Supplier Development Programme to promote and implement advanced manufacturing within the marine sector.

> Marine Manufacturing and Repairs Supplier Development Programme

The Marine Manufacturing and Repairs Supplier Development Programme was initiated in 2019 on behalf of **the dtic** primarily to assist SMMEs to achieve compliance with marine standards and accreditation. Efforts in the first year focused on establishing systems and processes, and putting measures in place to guide the further implementation of the programme.

The marine manufacturing industry was designated for local procurement and public working vessel procurement to have at least 60% of local content to support component manufacturers. This requires local component manufacturers to produce components that comply with the specifications of marine-accredited components.

However, the fact is that these local component manufacturers do not always have the required marine accreditations, which is a stumbling block in realising the benefits of this designation. Local manufacturers are thus unable to supply components and services in designated public procurement of working vessels. Instead, the process of exemption requests is used by these manufacturers to obtain authorisation to source components and services, in compliance with specifications of marine-accredited components, from suppliers abroad. The local benefits of participation in these procurement opportunities is not fully realised, and competitiveness lags. Zukiswa Kimani, Chief Director Industrial Policy, **the dtic**, elaborates on the programme: "This AISI-led programme plans to leverage the potential of the marine manufacturing industry and associated services to enhance its demand and competitiveness, while developing capacity in the value chain."

Manufacturing and repair of ships and working vessels in South Africa have strong and extended backward linkages that support growth and employment generation in the rest of the economy. The programme therefore also supports technology enhancement interventions, thereby making it possible for SMMEs to develop specific technologies to support marine activities.

> Interventions for improved industry competitiveness

The programme has targeted two interventions in partnership with marine component manufacturers and services to improve industry competitiveness through supply chain improvements and localisation, thereby obviating the need for exemption requests. In each intervention there has been progress.

The first intervention is support offered towards standards and accreditation. The AISI has identified a number of manufacturers that could benefit from services related to marine certification. Bianca Mokuena, Deputy Director: Industrial Policy of **the dtic** says, "Our aim is to help these manufacturers to reach compliance with marine industry standards and accreditation. Marine accreditation is conducted through classification society certifications with one or more of the marine affiliate bodies. In some cases, engineering support or accredited component testing was identified as necessary for the certification process."

A list of targeted components that have been given preference for support, can be found in the sidebar (right).

Six companies have benefited since the commencement of the intervention. These beneficiaries are:

- Paltechnologies
- 6Sigma Shipyards Group
- Bantek Engineering
- Bayside Marine
- Macc Marine and Engineering
- Zero° Industries.

A short discussion from interviews with three beneficiaries whose targeted support is well advanced at this stage, is included on the pages that follow.

> TARGETED COMPONENTS

1. Marine grade steel and aluminium materials
2. Pumps
3. Valves
4. Refrigeration and HVAC systems
5. Fire and smoke dampers
6. Fire monitors
7. Cranes and davits
8. Ventilators and fans, and cabin units
9. Application processes for paints and coatings
10. Insulation materials
11. Hydraulic equipment
12. Radio and radar equipment
13. Seals and gaskets (especially stern seals)
14. Replenishment at sea systems
15. Fixed pitch propellers
16. Incinerators
17. Storage tanks
18. Desalination plant
19. Marine windows and watertight doors
20. Lights
21. Anchors and chains
22. Electrical components and fittings

Paltechnologies first valve manufacturer to be marine certified

Beneficiary name: Paltechnologies

Up to this point, South Africa did not have a certified valve manufacturer to supply to the marine industry. With the help of the AISI, Paltechnologies is now able to supply valves to the marine industry, as the company has recently acquired the necessary certification. Paltechnologies is a 100% black-owned SMME based in Gauteng and is a well-established local manufacturing company. The AISI assisted the company to obtain Bureau Veritas and Lloyd's Register certification of Paltech 80mm, 100mm, 150mm, 200mm and 250mm single eccentric butterfly valves.

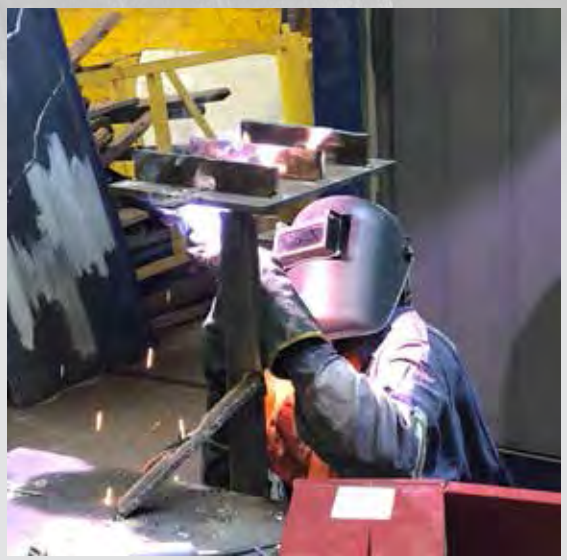
Larise Godwin, Group Quality Manager at Paltechnologies, explains, "Paltechnologies has prior certification for ISO 9001 (the baseline for certification), as well as ISO 14001 and ISO 45001; PED 2014/68/EU (European law), SIL Level 3 IEC61508; Joint Acceptance Scheme for Water Services Installation Components approval; and SABS 1849. However, marine certification has really stringent requirements regarding design, materials and validation. Each step in the production process of the valves must be proven in terms of process and quality against rules as stated by Bureau Veritas and Lloyds." The auditors check the process as it unfolds; non-compliance to any aspect requires a repeat and implies a costly re-inspection. "This route, once complete, ensures that we follow a process that is in line with international standards," confirms Godwin.

Now certification has been finalised, Paltechnologies can proudly state that they are the first South African manufacturer to take their valves onto a ship; both for local and international clients, on merchant ships and naval vessels; as well as for offshore work on oilrigs and other installations.

The Paltech valves in question can be used for a number of applications, for example, shipside valves, bilge and ballast, and sea water and freshwater cooling, among others. Godwin says, "We've finalised the required internal training as our process has been redefined in line with certification requirements and will, of course, continue to do continuous retraining. Our staff complement is increasing through the appointment of mechanical inspectors and artisans to meet the anticipated demand."

Eccentric butterfly valve

6Sigma expands list of marine welding procedures for coding of welders



4G Weldguru

Beneficiary name: 6Sigma Shipyards Group

6Sigma Shipyards Group is a privately owned ship repair and ship conversion company, providing services in and around the ports of Cape Town, Saldanha Bay and Walvis Bay (Namibia). The company is certified for ISO 9001:2015, ISO 14001:2015 and ISO 45001:2018 to provide turnkey engineering, procurement and construction for ship repair, ship conversion, ship refit and steel fabrication and manufacturing.

With the support of the AISI, 6Sigma has engaged with an Approved Inspection Authority company to obtain welding procedure specifications for pipes and plates of different materials with a few of the major classification companies. Jako Laubscher, Group Director, explains, “Welding is critical to any marine repair work and accreditation to marine standards is essential for us to work locally and internationally.”

The accreditation process for welding is singular in that each individual welder must be coded according to a welding procedure that companies own. The 6Sigma team of coded welders also forms part of the ISO certification as an accredited ship building and ship repair company. In addition, stringent requirements for this scarce skill require each welder to make continuous use of relevant qualifications; each welder must take an annual re-coding test or suitable alternative defined by the classification societies.

“Putting welding procedures in place is an expensive investment,” Laubscher confirms. “We are grateful for the support by the AISI to have expanded our list of welding procedures to which we will have our welders coded.” Two welders, three support personnel and two production managers have been employed as result of the AISI’s intervention.

Now that the initial capital layout has been made, 6Sigma will have the necessary accreditation to take on projects to build ships or sections of ships. The company’s workshop in Cape Town has been built in anticipation of bigger projects.

Interestingly, all coded welders will be able to be moved around to any location around the world to exercise their trade under the company they are coded to. In this case, 6Sigma sees potential in both the local and international marine industry. “We’ll keep an eye out for sizable jobs on offer from Transnet National Ports Authority and consider opportunities to bring more international work to our ports for ship conversions, ship refits and ship repair.”

Bantek Engineering's accreditation enables participation in marine industry

Beneficiary name: Bantek Engineering

A steel fabricator based in Port Elizabeth, Bantek Engineering offers in-house fabrication, sand blasting and marine-grade coating to customer requirement. Managing Director Bandla Tikayo is enthusiastic about expanding the operations of this 100% black-owned SMME in the Eastern Cape and the rest of South Africa. He says, "We accommodate orders from our clients and deliver orders according to their specifications. We have always had our in-house welding checked externally to ensure that it is up to standard."

Tikayo has set his sights on the marine sector and notes, "A good understanding of the needs of and designs in this sector is important. I believe we could assist with steel doors fabrication and refurbishment in dry docks, particularly with sand blasting and painting."

To position the company to participate fully in the marine industry, the AISI supported the process to acquire ISO 9001 certifications. Bantek Engineering completed ISO 9001 certifications for general engineering and manufacturing (welding and blasting) services on 4 June 2020, thereby taking first place on the podium in the programme's standards and accreditation intervention. TÜV Rheinland was appointed to assist Bantek Engineering with the necessary systems and the final certification, and in-house training.

This accreditation has multiple benefits for Bantek Engineering, as the company now offers more professional services. It has access to the marine industry, which represents a new revenue stream for the company and will therefore diversify its income sources. This may also be true of the automotive sector where Bantek Engineering's skillset and accreditation would be in its favour.

Tikayo hopes to localise even more skills and technologies at Bantek Engineering and would like to localise them at a later stage in other African countries.

Rescue cage fabricated by Bantek Engineering

> Technology Enhancement project

The second intervention is support towards technology enhancement. This intervention assists suppliers to enter new markets or bolster existing market positions in the marine industry. This, in turn, improves competitiveness as technology validation or technology transfer enables manufacturers to grow.

One beneficiary is currently being supported by the intervention namely Cybicom Atlas Defence. The beneficiary will develop a ship ballast water treatment system. This system is designed to remove and destroy/inactivate biological organisms from ship ballast water. As a result of a change in marine regulations there are more than 57 000 maritime vessels worldwide that will require an investment to install a ballast water treatment system. This provides a window of opportunity over the next few years for proven solutions to meet this demand. Cybicom Atlas Defence aims to address this demand.

> In conclusion

The Marine Manufacturing and Repairs Supplier Development Programme intends to identify new beneficiaries on a regular basis and support them through the standards and accreditation and technology enhancement interventions. Companies involved in the marine manufacturing industry are therefore encouraged to visit the AISI website or contact the AISI team for more information.

> HIGHLIGHTS

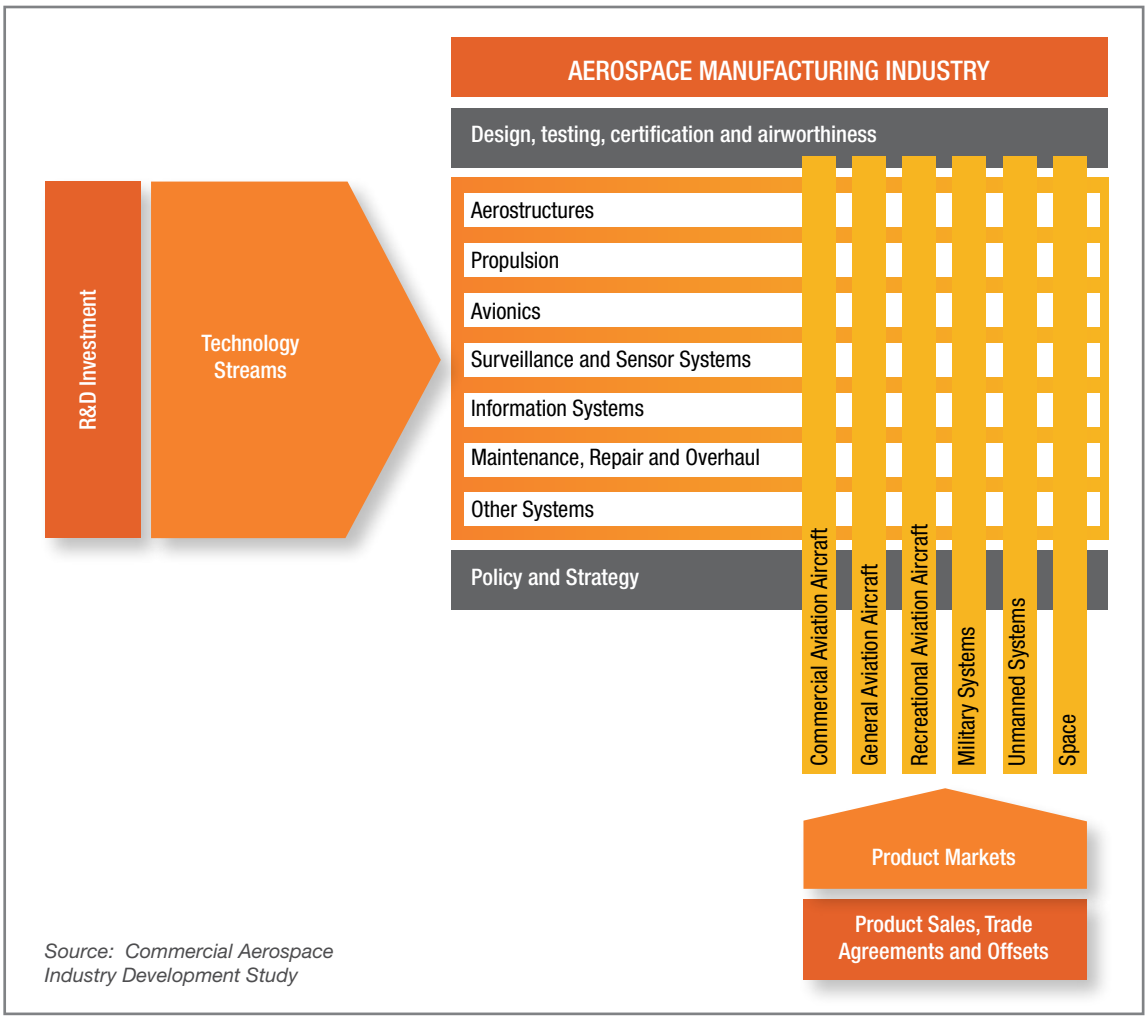
- Positive impact achieved from pilot implementation
- Beneficiaries supported across four provinces
- Potential to benefit other sectors

4 Introduction to projects supported through Technology-Based Supplier Development and Industry Development and Technology Support

Projects that have been supported through two of the AISI's programmes – Technology-Based Supplier Development, and Industry Development and Technology Support – are discussed in the pages that follow.

These projects have been grouped according to the technology streams listed in the graphic below, which depicts various market-related aspects of the aerospace and defence manufacturing industries. The relevant technology streams in the AISI Impact Report 2019/20 are surveillance and sensor systems, avionics, propulsion, information systems, and aerostructures.

A definition of each technology stream (as taken from the Commercial Aeronautical Industry Development Study) is included at the start of each section. Individual projects have been assigned relevant product market designations.



Source: Commercial Aerospace Industry Development Study

Surveillance and sensors

Surveillance and sensor systems typically consist of electronic equipment and optical equipment for ground-based and aircraft applications, which are produced by local manufacturers of electronic equipment. The technologies used include video cameras and closed-circuit television systems; audio receivers and recorders; radar traffic enforcement devices; motion detectors; heartbeat detectors; 'radar flashlights' to detect breathing and other vital signs; devices to 'see' through walls and into enclosed spaces to locate and track concealed persons; and night vision and thermal imaging devices that detect infrared radiation or heat. Seven local companies, with an estimated 1 231 employees, account for 20% of the total turnover of the aerospace industry.

The following five projects supported by the AISI during the 2019/20 period are included in this section:

- Finalisation of a locally developed sensor simulation product for the export market
- Additive manufacturing for satellite communication systems gains momentum
- Novel actuator technology incorporates functionality for thermal management and de-orbiting
- Finalised SmartCAM solution attracts market interest
- Testing phase awaits next generation electrical power system with nano power control unit.

The impact achieved under this stream in 2019/20 is illustrated below.

IMPACT INDICATORS PER TECHNOLOGY STREAM

NB: Statistics have been sourced from project beneficiaries

4

SURVEILLANCE AND SENSORS

PRODUCT MARKET:
Military systems, para-military systems, security companies, vehicle tracking companies

PROGRAMME 1:
Technology-Based Supplier Development

ARGOS-II training simulator with laptop and mission grip

PROJECT AT A GLANCE

Beneficiary name: Cybicom Atlas Defence

Completed project: Development of an ARGOS-II Training Simulator

The development of the ARGOS-II training simulator for the export market has been successfully concluded. This one-year project was the outcome of an AISI-initiated technology roadmap developed in the 2018/19 financial year. The training simulator has been established as a bespoke product to be licensed to Hensoldt.

Cybicom Atlas Defence's experience and skills in this domain provided a technological advantage, as the company had developed the ARGOS-II interface emulator. The training simulator reuses the existing framework of the ARGOS-II emulator for the serial, ethernet and mission grip interfaces while expanding the functionality to include specific ARGOS-II operator training requirements.

The primary benefit of this project to the South African aerospace sector is the introduction of a new manufacturer of locally developed sensor simulation products.

Finalisation of a locally developed sensor simulation product for the export market

Cybicom Atlas Defence has successfully finalised the development of the ARGOS-II training simulator for the export market. Hensoldt, a multinational corporation that focuses on sensor technologies for protection and surveillance missions in the defence, security and aerospace sectors, will commercialise the simulator.

The role of Cybicom as technology partner for the Hensoldt ARGOS Emulator, combined with its experience with the Presagis modelling and simulation tools, provided a unique skill base for the development of the ARGOS-II training simulator. Malcolm Behrens, CEO Cybicom (Africa) Technologies, says, "The ARGOS-II training simulator has been established as a bespoke product to be licensed to Hensoldt, in line with Cybicom's objective to become a preferred simulation technology partner.

"Our experience and skills in this domain provided a technological advantage. This included our work on the ARGOS-II interface emulator. This is an interface test and emulation tool designed for laboratory use in early stage integration of the ARGOS-II system into aircraft platforms by system integrators."

The ARGOS-II Airborne Observation System is a system for installation on helicopters, fixed wing aircraft and unmanned aerial vehicles to provide intelligence, surveillance, target acquisition, and reconnaissance capabilities for military, border and maritime patrol and law enforcement missions.

The ARGOS-II training simulator aims to give operators a hands-on experience in an environment that is as close as possible to the real thing they may encounter. The training simulator reuses the existing framework of the

4 new jobs created

10 jobs retained

New technology development or advancement

ARGOS_II device (Hensoldt product)

ARGOS-II emulator for the serial, ethernet and mission grip interfaces while expanding the functionality to include specific ARGOS-II operator training requirements. Behrens confirms, “The training simulator comprises the mission grip and a laptop.”

The mission grip interface is built into the ARGOS-II EOS Emulator software. The mission grip processes input from the operator-in-training and simulates the behaviour of the ARGOS-II.

Various functional software modules were used for visual simulation of the environment in which the ARGOS-II operator works. The symbology engine gives an exact, one-to-one software generation of symbols used to display ARGOS-II behaviour. The scenario management sends pre-recorded scenarios to the image generator of the simulator, thereby simulating everything in the environment, including the aircraft to which the ARGOS-II is attached. It is possible to choose from two general purpose missions based around the Camp Pendleton airport in California where the operator is operating the ARGOS from a slow-moving helicopter. A more realistic mission scenario is also available which involves tracking a car during a high-speed chase down a freeway. This approach allows an operator to train without the need for more complex simulators or scenario generation applications.

Behrens continues, “We then added television and infrared sensor graphical effects. These visual effects are critical to give the operator the full experience of using the ARGOS-II, and are of great value in certain mission conditions.”

Various operational modes of the ARGOS-II were simulated, such as fixed forward, manual, GeoPointing and AutoTracking (to detect objects within the tracking box). A stand-alone GeoPointing (geographic point coordinates and attributes) function has been designed and implemented and incorporated into the training simulator. Autotracking functionality has been enhanced.

It was also possible to add the Presagis Ondulus IR physics-based model to the training simulator. Behrens explains, “Ondulus IR gives simulations and training scenarios a critical component: physics-based infrared sensors. By adding real-time, high-quality materials-based infrared sensors and sensor views to this simulation environment, we were able to achieve the immersion and realism needed for mission training. Ondulus IR satisfies the criteria for a software package to realistically simulate the thermal imaging sensor on the ARGOS-II.”

Two training simulators were developed during the project – one for future development and one for user training by Hensoldt. Hensoldt has ordered five upgrade kits to existing ARGOS-II Emulators to bring these tools in line with the ARGOS-II training simulator functionality, and a strong marketing drive is underway in the local and international market. Behrens concludes, “The primary benefit of this project to the South African aerospace sector is the introduction of a new manufacturer of locally developed sensor simulation products. The long-term development plan for the training system we are working on, will also include the development of an unmanned aerial vehicle-based flight simulator and a generic control console, and development of a pilot and sensor operator team trainer.”

CONTACT
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> HIGHLIGHTS

- Buy-in for low-cost training solution by Hensoldt
- Export market for the training simulator developed
- New in-house image generation and content creation department

> TECHNICAL TERMINOLOGY

- Emulator: hardware or software that enables one computer system to behave like another computer system
- Simulator: program or machine that simulates a real-life situation as a virtual version for the purpose of instruction

> PARTNERS & COLLABORATORS

- CSIR
- Hensoldt

4

SURVEILLANCE AND SENSORS

PRODUCT MARKET:
Space

PROGRAMME 1:
Technology-Based
Supplier Development

Printed components

PROJECT AT A GLANCE

Beneficiary name: LambdaG

Project in progress: 3D-printed Microwave Sub-Assemblies – Phase I

Three-dimensional (or 3D) printing of microwave sub-assemblies is demonstrating the advantages of additive manufacturing as a technology for satellite communication systems limited by weight and cost requirements.

The first phase of this three-year project (as a result of an AISI-initiated technology roadmapping exercise) has been completed. The aim is to produce a monolithic (single unit) 3D-printed microwave sub-assembly as an antenna feed-chain (with multiple components) operating at K-band (18 GHz–26 GHz) to within the Ka-band (26 GHz–40 GHz). Metal Heart has produced prototypes of these individual components.

An analytical investigation in partnership with Stellenbosch University was needed to qualify the post-processing, and thereby qualify the product. All components were integrated and assembled as an important step prior to the monolithic printing of the sub-assembly in the next phase.

Additive manufacturing for satellite communication systems gains momentum

An innovative project, the three-dimensional (or 3D) printing of microwave sub-assemblies, is demonstrating the advantages of additive manufacturing as a technology for satellite communication systems limited by weight and cost requirements. Dr Vernon Davids, Co-founder & CEO, LambdaG, confirms, “LambdaG is currently pursuing the development of waveguide-based horn antenna systems for satellite telemetry and telecommand, as well as payloads. Our research and development are relevant locally and internationally, particularly as constellations of small satellites increase.”

The primary goal of the project is the production of a monolithic (single unit) 3D-printed microwave sub-assembly. This is an antenna feed-chain (with multiple components) operating at K-band (18 GHz–26 GHz) to within the Ka-band (26 GHz–40 GHz). Individual components make up this wideband sub-assembly, which can be customised to specification.

A highlight to date is that Metal Heart, LambdaG’s industrial partner, has produced prototypes of these individual components, based on optimised designs and specifications. Selective laser melting of an aluminium alloy was used for the prototypes of the choke, conical, square and standard gain horn antennas, 1% and 5% bandpass filters, and stepped septum as an ortho-mode transducer. These components underwent several types of surface finishes and were then electroplated. To evaluate the electrical performance of the manufacturing process, a 5% bandpass filter was machined in aluminium using conventional computer numerical controlled machining.

2 new jobs created

Export capability achieved

1 job retained

Melissa Boonzaaier Davids (Project Coordinator), Vernon Davids (CEO) and Riddhi Maharaj (Project Manager)

Davids confirms, "While we were pleased with the outcome of the 3D-printing, we realised that some designs require careful consideration to ensure a successful additive manufactured part."

The next step was to explore the efficacy of post-processing to reduce the surface roughness of the 3D-printed components. Several methods were tried, notably mechanical (vibratory) polishing and chemical polishing, barrel tumbling or polishing, electropolishing and mechanical polishing. Davids notes that, "In light of the most viable post-processing option, we may consider changes to the materials we have selected for the parts."

Novel plating of the 3D-printed components is part of the next phase of the three-year project. Stellenbosch University's Materials Engineering group has been identified as the collaboration partner to analyse and test the printed parts and plating technique.

Analytical investigation was needed to qualify the post-processing, and thereby qualify the product. The Materials Engineering group assisted with testing of mechanical and material properties through scanning electron microscopy and energy dispersive spectroscopy analyses on several 3D-printed components that had undergone different post-processing methods. The analysis highlighted the challenges with plating and adhesion, to be addressed in the next phase of the project.

Furthermore, the Materials Engineering group conducted surface roughness measurements on two of the 3D-printed parts (the septum and 5% filter), using a surface profilometer. This allows for a quantitative analysis of the roughness reduction across the various post-processing options.

In addition, radio frequency testing – conducted at Stellenbosch University's high frequency laboratory – was used to compare the electrical performance of each post-processing method. These results were required to validate the antenna gain of the different horns with that published for test antennas. In fact, the measured gain of the computer aided design components compared exceptionally well to conical and square horns.

LambdaG also plans to conduct non-destructive testing on some of the 3D-printed components' internal features and geometries (shapes). Davids is pleased that all components were integrated and assembled as an important step prior to the monolithic printing of the sub-assembly in the next phase. This phase will not only produce hardware of increased complexity but will also focus on the qualification of the hardware and manufacturing processes for spaceflight.

To date, this project has demonstrated very positive results of additive manufacturing to produce radio frequency components up to 26.5 GHz with reduced cost, lead-times and weight. Davids confirms, "Although there is lots of work ahead of us before we finalise this project, the impact of the AISI support is already evident through the establishment of a local supply chain for the development of an additive manufacturing post-process."

3D-printed microwave sub-assembly: rendering

CONTACT
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> HIGHLIGHTS

- 3-D printing of prototypes of components
- Investigation of post-processing options
- Local supply chain for additive manufacturing post-processing

> TECHNICAL TERMINOLOGY

- Antenna gain: this indicates how well the antenna converts input power into radio waves headed in a specified direction
- Telemetry and telecommand: collection of data at remote points and their automatic transmission to receiving equipment; command sent to control a remote system or systems

> PARTNERS & COLLABORATORS

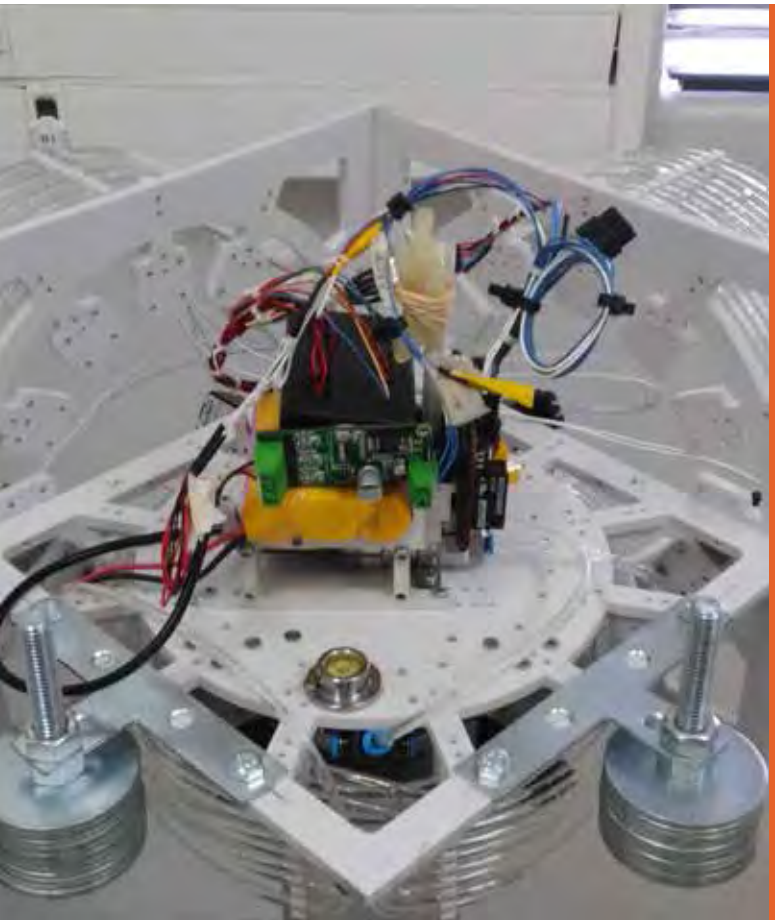
- Metal Heart
- NewSpace Systems
- Stellenbosch University

4

SURVEILLANCE AND SENSORS

PRODUCT MARKET:
Space

PROGRAMME 1:
Technology-Based
Supplier Development



Three-axis control being validated on air bearing table

PROJECT AT A GLANCE

Beneficiary name: NewSpace Systems

Project in progress: Fluid Loop Inertial Actuator – Phase I and II

Development on the fluid loop inertial actuator (FLIA) technology for satellite attitude control has focused on delivering a device with additional functionality for thermal management and de-orbiting.

The demonstrator of the three-dimensional fluid inertial actuator was successfully built and tested on an air bearing table. A thermal demonstration FLIA unit was built to illustrate the heat transfer via forced convection through the fluid. The team also worked on the design of a propulsion model to predict the de-orbiting potential using the FLIA loop.

Material selection for the FLIA was dependent on identifying the requisite properties to meet the three-axis, thermal and propulsion requirements. The completion of Phase 2 marks a milestone in this three-year project which was the outcome of an AISI-initiated technology roadmapping exercise.

Novel actuator technology incorporates functionality for thermal management and de-orbiting

The development of the fluid loop inertial actuator (FLIA) technology for satellite attitude control has made significant progress towards the penultimate goal of the manufacture of a flight-ready device. The development has worked to deliver a device with additional functionality for thermal management and de-orbiting. This has involved theoretical and experimental work.

James Barrington-Brown, Chief Executive Officer at NewSpace Systems, explains how this came about. “We have been able to obtain a provisional patent on the FLIA design. The novelty lies in the 3D orientation by which flowrate and flow changes are possible in three directions in the single fluid loop. With our systems engineering hat on, we took a step back to consider how our clients could benefit from the possibilities inherent in the design of the FLIA. We then realised we still had work to do!”

The NewSpace Systems team of Rudi Glatthaar and Riddhi Maharaj worked tirelessly towards the goal of developing a three-dimensional fluid loop requiring a single pump with a single closed-loop configuration. The angular momentum magnitude range of the FLIA can be adjusted by changing the constant pump flowrate. As determined by the specification for the three-axis FLIA, the pump flowrate can be kept at a constant with changes in the relative flows in each axis resulting in full control of the platform.

The demonstrator of the three-dimensional fluid inertial actuator was successfully built and tested on an air bearing table. The FLIA’s natural frequency of oscillation in the

2 jobs retained

Skills development

New technology development or advancement

horizontal plane was measured to be able to counter this motion and fully demonstrate the FLIA's actuation capability. Barrington-Brown points out, "It was important to address all these aspects as we move towards the development and manufacture of a flight-ready FLIA."

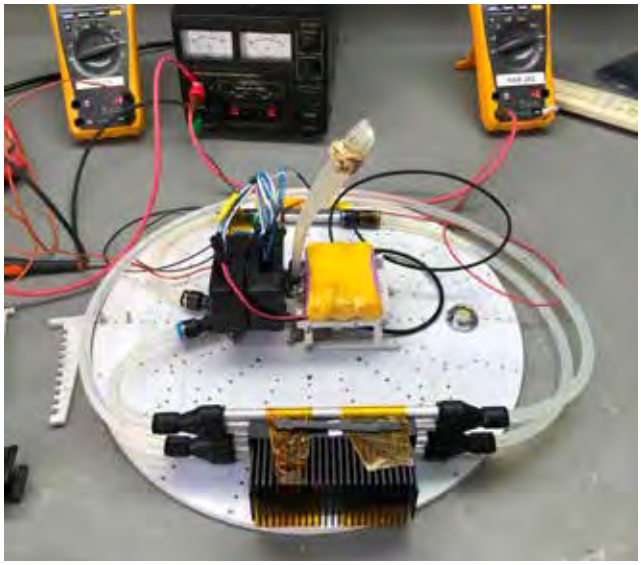
The team also considered the multipurpose use of the pumped fluid, by integrating the fluid inertial actuator with a thermal management system. Barrington-Brown notes, "The altitude of the orbit of a satellite and where it is in its orbital path will impact the thermal environment of the satellite. The FLIA loop offers the distinct advantage of using the pumped liquid as a passive thermal control system by effectively distributing the heat generated within the satellite and from the external environment." A thermal demonstration FLIA unit was built to illustrate the heat transfer via forced convection through the fluid.

Finally, the team worked on the design of a propulsion model to predict the de-orbiting potential using the FLIA loop. Barrington-Brown confirms, "We propose using the FLIA loop as a propellant storage and delivery system, to replace the highly pressurised propellant storage and pumping systems that add to more than 15% of the cost for small satellites. The FLIA loop would then be interfaced with an appropriate thruster."

Material selection for the FLIA was dependent on identifying the requisite properties to meet the three-axis, thermal and propulsion requirements; it was therefore considered once these requirements had been determined. In short, the fluid in the loop should meet the requirements dictated by the attitude control system, the temperature control system, and the propulsion propellant needs.

Barrington-Brown concludes, "When it comes to the choice of material, trade-offs between the three requirements have to be balanced, with three-axis requirements taking priority. Galinstan is the most suitable for use, as it has a low enough boiling point and easily maintains its liquid metal form.

"Our ultimate goal in this project is to have the FLIA on a satellite in space. This is essential to give it the necessary space heritage – official recognition of its use and efficacy in space."



Heat flow experiment: from heat generator to heatsink using forced convection

CONTACT
James Barrington-Brown – jbb@newspacesytems.com

> HIGHLIGHTS

- Provisional design patent
- Demonstrators for three-dimensional fluid inertial actuator and thermal management
- Materials selection for FLIA

> TECHNICAL TERMINOLOGY

- **Forced convection:** heat transfer via a fluid that is made to flow past a solid surface by, for example, a pump
- **Galinstan:** a metal alloy which is liquid at room temperature
- **Orbit:** regular, repeating path that the satellite in space takes around the earth
- **Oscillation:** movement back and forth in a regular rhythm

> PARTNERS & COLLABORATORS

- Kline Engineering
- TraX Interconnect
- University of Cape Town
- University of Stellenbosch

4

SURVEILLANCE AND SENSORS

PRODUCT MARKET:
Commercial aviation aircraft

PROGRAMME 1:
Technology-Based
Supplier Development

PROJECT AT A GLANCE

Beneficiary name: Kutleng Dynamic Electronics Systems

Completed project: SmartCAM

The design of the camera housing and the electronic components have been completed for SmartCAM, an intelligent camera system. The SmartCAM platform provides a platform with onboard signal processing of the images.

The camera lens and standard camera embedded software form part of the SmartCAM solution. The generic design of the SmartCAM allows it to be customised for various spectra. SmartCAM's international launch took place in December 2019 at the Amazon re:Invent event in Las Vegas, USA.

Jenasi SmartCAM enclosure with external Field Programmable Gate Array, System on Module

Finalised SmartCAM solution attracts market interest

Kutleng Dynamic Electronics Systems has completed the design of the camera housing as well as the electronic components for SmartCAM, a unique camera sensor with aerospace, defence, industrial, research, security, and medical applications. The AISI support helped Kutleng accelerate the design and manufacture of both camera housing and electronic components of this compact intelligent camera. A standalone close-in surveillance system technology demonstrator using the SmartCAM is to be installed for evaluation and feedback by a branch of the South African Defence Force.

The successful outcome of a two-year project, the SmartCAM now has a working prototype through the development of an image sensor and processor board. A novel compact electronic design for the processor board contributes to miniaturisation without compromising functionality.

The SmartCAM platform is unique in that it provides a platform with onboard signal processing of the images. This is a significant advantage for machine vision applications, such as visual inspection or guiding of handling equipment tasks, or for machine learning requirements (computer algorithms that improve automatically through experience). The options of auto-extraction and analysis of a video feed, as a further example, confirm the value of onboard signal processing. Benjamin Hlophe, Director of Technical Operations, notes, "The SmartCAM system eliminates over-reliance on the human element and delivers superior perception and detection."

3 new jobs created

2 jobs retained

Export capability achieved

Import substitution achieved

The camera lens and standard camera embedded software form part of the SmartCAM solution. Hlophe explains, “The lens system, sensor system, interface and the computing hardware are integrated. This integration therefore consists of the optics and mechanical interface with an image processing and system interface.”

The generic design of the SmartCAM allows Kutleng to customise it for various spectra. Of particular interest to Kutleng are short wave infrared (SWIR) cameras (for long range surveillance, inspection and industrial applications) and medium wave infrared (MWIR) cameras (all-weather surveillance in protected environments such as a border or an airport).

Hlophe confirms, “Kutleng is exploiting the opportunity to reuse the SmartCAM design for low-cost ultra-high definition visual-range cameras as new sensors come onto the market.”

Kutleng’s existing local clients are pleased with the finalised Smart-CAM design. A highlight was the SmartCAM international launch when the company was invited to demonstrate the product in December 2019 at the Amazon re:Invent event in Las Vegas, USA. Hlophe says, “The SmartCAM attracted attention and we are planning to convert this market interest into orders. We are currently investigating the requirements for us to sell abroad and license the design for manufacturing in the USA.”

The Kutleng team is satisfied with the progress to date and will continue to refine and improve the SmartCAM solution in response to market drivers.

> HIGHLIGHTS

- Compact intelligent camera
- Reusable design
- Successful demonstration in the USA

> PARTNERS & COLLABORATORS

- AVNET
- Kinetic Design
- MTT

CONTACT
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Jenasi SmartCAM multiple spectrum independent camera heads

4

SURVEILLANCE AND SENSORS

PRODUCT MARKET:
Space

PROGRAMME 2:
Industry Development
and Technology Support

The Nano PCU in its mechanical enclosure

PROJECT AT A GLANCE

Beneficiary name: Space Advisory Company

Project in progress: Cervus Electrical Power System Nano PCU

Research and development on a next generation electrical power system, utilising a nano power control unit and 'next generation' major components, has progressed to the critical design stage. This follows finalisation of the schematics, and the printed circuit boards and mechanical designs, which were all reviewed and accepted during the preliminary design review process.

During the critical design stage, the hardware will be manufactured, assembled and then tested to ensure that it meets the required specification. Once manufacturing and assembly are completed, functional testing will be finalised, as well as environmental and qualification testing.

Testing phase awaits next generation electrical power system with nano power control unit

Research and development by Space Advisory Company on a next generation electrical power system, utilising a nano power control unit and 'next generation' major components, has progressed to the critical design stage. With the support of the AISI, the team has been conducting the required thorough research and implementation using 'next generation' electric and electronic components.

This innovative project is in response to the move to smaller and more power-intensive operational satellites which require higher performing electrical power systems that were previously not available. Smuts Louw, New Programmes and Contracts Manager, summarises the situation as follows: "Current components-off-the-shelf electrical power systems available in the market do not readily provide, on a single platform, the flexibility to serve the nanosatellite and micro/mini satellite market space within a single, scalable platform. Selecting correct components for this project has therefore been crucial and will differentiate the Cervus PCU (EPS-Nano) product from what is currently available in the market." Additional project time was allocated to researching suitable components; additional calculations and modelling using the newly selected components were also needed for a workable, reliable solution.

Progress on the detail design phase included the finalisation of the schematics, and the printed circuit boards and mechanical designs. Hardware design called for the creation of product lifecycle plans as per the European Space Agency standards. These designs were all reviewed and accepted during the preliminary design review process. The manufacturing was initiated, and test planning was started.

1 job retained

New technology development or advancement

A prototype enclosure for the power control unit

Louw confirms, “The project is now in the critical design stage. The hardware will be manufactured, assembled and then tested to ensure that it meets the required specification.” He notes that the mechanics, the printed circuit boards and all the components have been ordered. Because of the complexity of the boards, particularly the extensive use of ball grid array integrated circuits, the boards have had to be assembled by an external manufacturer, Barracuda Holding, using highly specialised equipment. The single printed circuit board solution became a three printed circuit board solution to satisfy the compact shapes and sizes compatible with the cubesat standard. Louw notes, “Extensive research was needed to arrive at so-called next generation compactness.”

Once manufacturing and assembly are completed, functional testing will be finalised, as well as environmental and qualification testing. Radiation tests to measure degradation will be done at the Agricultural Research Council’s Infruitec. Thermal environment testing is expected to be done at Spaceteq’s Houwteq facility.

Louw concludes, “Locally, the Technology and Human Resources for Industry Programme’s technology development initiatives strategically synergise the production of various building blocks that are compatible and can be used together for the overarching technology area. We are therefore part of the broader national effort to develop power system technology for space.” He confirms that Space Advisory Company will also target the overseas market, where there is interest and potential use.

> TECHNICAL TERMINOLOGY

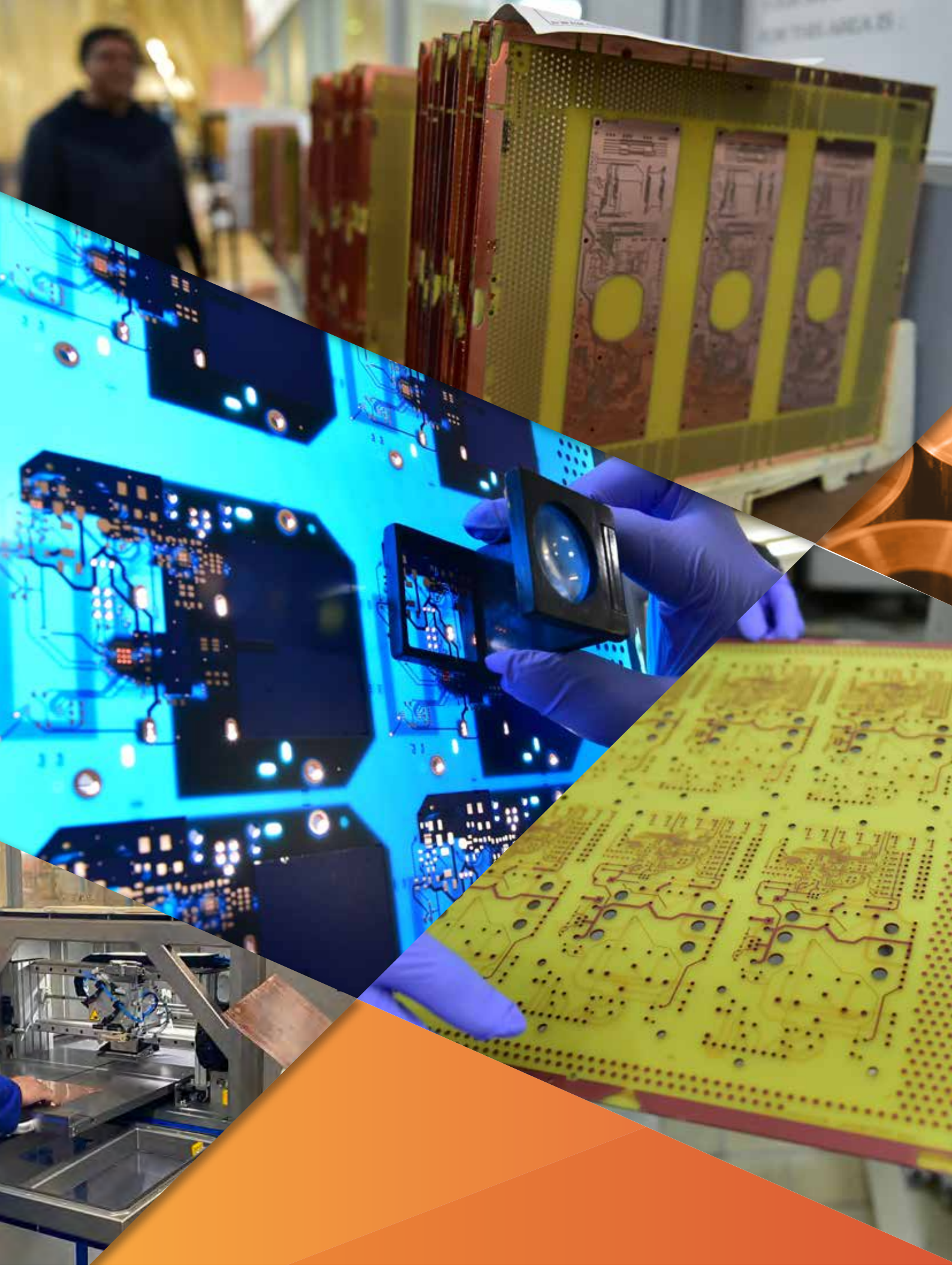
- Emulator: Small satellites:
  Minisatellite: 100 – 500 kg
  Microsatellite: 10 – 100 kg
  Nanosatellite: 1 – 10 kg
- Power control unit: an interface between one or more sources of electrical power

> PARTNERS & COLLABORATORS

- Barracuda Holdings
- Spaceteq
- Agricultural Research Council Infruitec-Nietvoorbij
- National Research Foundation

CONTACT
Smuts Louw – smuts@spaceadvisory.com

Nano-satellite space imager with the enclosure for the power control unit



Avionics

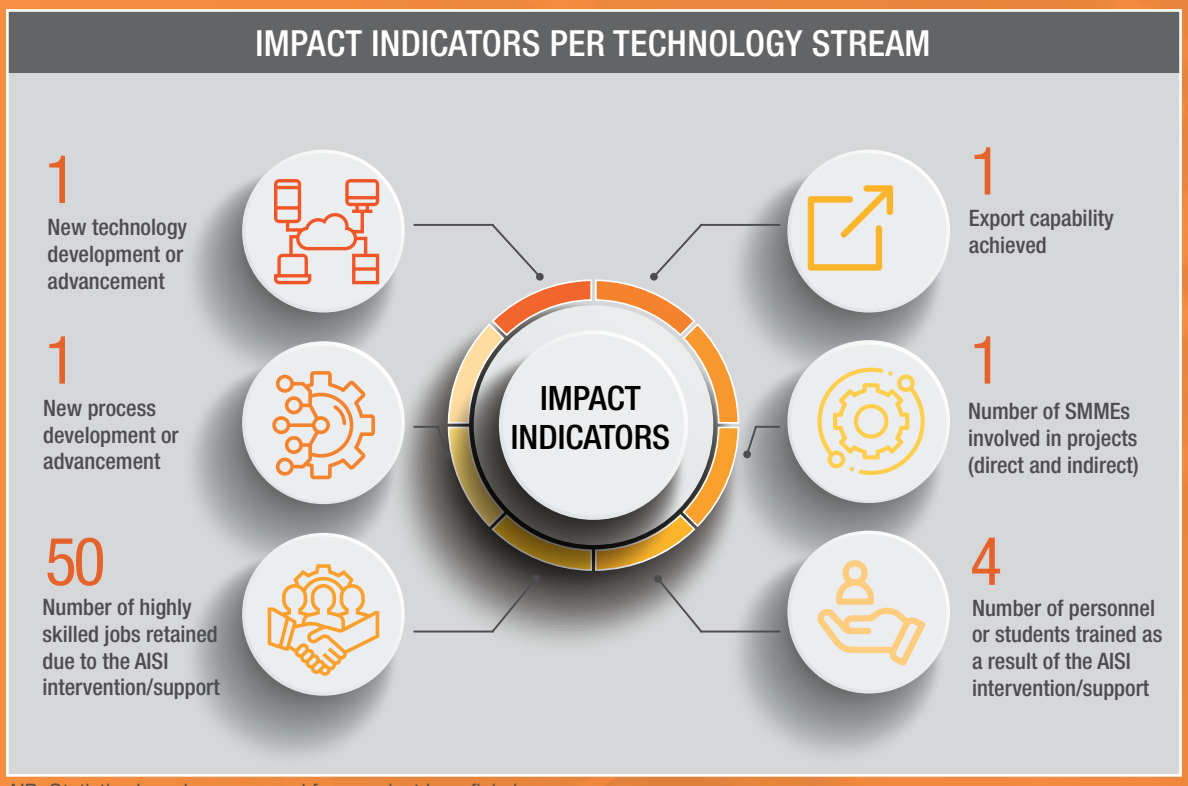
> Introduction

Avionics are the electronic systems used on aerospace vehicles such as aircraft, satellites, and spacecraft. The systems include navigation, communications, display and management of multiple systems, and hundreds of other systems fitted to aerospace vehicles for the performance of different functions. The avionics market locally accounts for 15% of the total turnover of the aerospace industry; 13 active companies employ 1 123 people.

> The following project supported by the AISI during the 2019/20 period is included in this section:

- South African capability in place for manufacturing multilayer printed circuit boards

The impact achieved under this stream in 2019/20 is illustrated below.



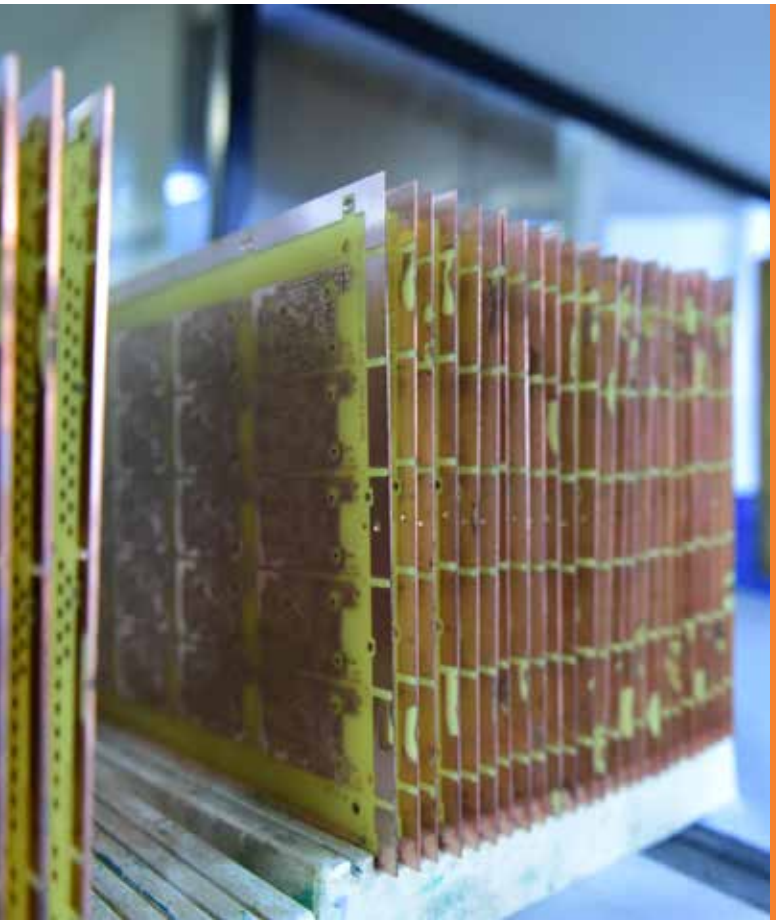
NB: Statistics have been sourced from project beneficiaries

4

AVIONICS

PRODUCT MARKET:
All

PROGRAMME 1:
Technology-Based
Supplier Development



Printed circuit boards

PROJECT AT A GLANCE

Beneficiary name: TraX Interconnect

Completed project: Resin-filled via

South African industry stands to benefit from the investment in a machine for resin-filling of buried vias, through-hole plated vias and via-in-pad in printed circuit boards (PCBs). This makes possible the local manufacture of multilayer PCBs which are required by South African companies to service local as well as export markets.

The machine has been successfully commissioned, and staff have been upskilled. Resin-filling is a process that ensures integrity and quality in PCBs. The one-year project was the outcome of an AISI-initiated technology roadmapping exercise in the 2019/20 financial year.

South African capability in place for manufacturing multilayer printed circuit boards

TraX Interconnect significantly enhanced its offerings as a printed circuit board (PCB) manufacturer in 2019 by adding to its capabilities the ability to resin-fill buried vias and through-hole plated vias as well as resin-fill and cap blind vias (via-in-pad). The company is also able to manufacture thermal vias (to conduct heat). This has been possible through the import and commissioning of the appropriate machine, the MASS VHF300 V, identified and acquired through the support of the AISI; the purchase of state-of-the-art raw materials; and ongoing on-the-job learning and training on how to achieve best results.

The importance of resin-filling vias

The electronics industry is characterised by the ever-shrinking electronic component packages on the market. Electronic engineers in turn design PCBs that are reduced in size and much denser as the number of inner layers increase. Daniel Dock, Managing Director of TraX Interconnect explains, “The real estate for component placement on the outside layers of the board has meant it has become increasingly difficult to route tracks between component pads, leaving very little space for connecting vias.” He singles out via-in-pad technology as a game-changer, “It is now possible to drill directly into the footprint ball grid array pads of components to place vias.” However, to ensure that solder connections are not compromised by solder wicking, resin-filling and capping of via-in-pad are essential.

Dock confirms, “Resin-filling after plating connection carries with it an assurance of integrity and quality.” The

50 jobs retained

Export capability achieved

Quality control of printed circuit boards

Multilayer staff Alexander Hendricks and Moegamat Ajam at the MASS VHF300 V machine

same method is used for filling different types of vias. Thermal vias have thermally conductive pastes for thermal transfer and management.

As late adopters of existing technology, TraX Interconnect has had the advantage of acquiring a machine and materials, which have been refined over several years. Dock explains, "We benefited from collective learning over the years and this gave us confidence to proceed with the integration of this process in our PCB manufacturing." Multilayer staff have been upskilled and various manufacturing processes and procedures have been optimised to local conditions.

Dock is pleased with current and future outcomes. "TraX Interconnect has responded to market needs of our existing clients in the aerospace and electronics industries and has been able (by July 2020) to fulfil orders by seven existing clients to their satisfaction. Many of their products are exported. TraX Interconnect has also been able to export to an overseas customer.

"We are confident that this investment in advanced technology ahead of the demand curve will have positive results."

This transfer of technology to industry is an enabler to increase the global competitiveness of the South African aerospace and electronics industry. Companies are now able to have their PCBs manufactured locally to specifications, as TraX Interconnect accommodates the range of vias that require resin-filling.

CONTACT
Daniel Dock – daniel@trax.co.za

> HIGHLIGHTS

- Ability to do via-in-pad technology
- High reliability of printed circuit board through resin-filling
- Export opportunities for printed circuit boards with resin-filled vias

> MEDIA

- TraX Blog https://www.trax.co.za/blog-1/

> PARTNERS & COLLABORATORS

- CSIR
- Stellenbosch University
- University of Cape Town

Propulsion

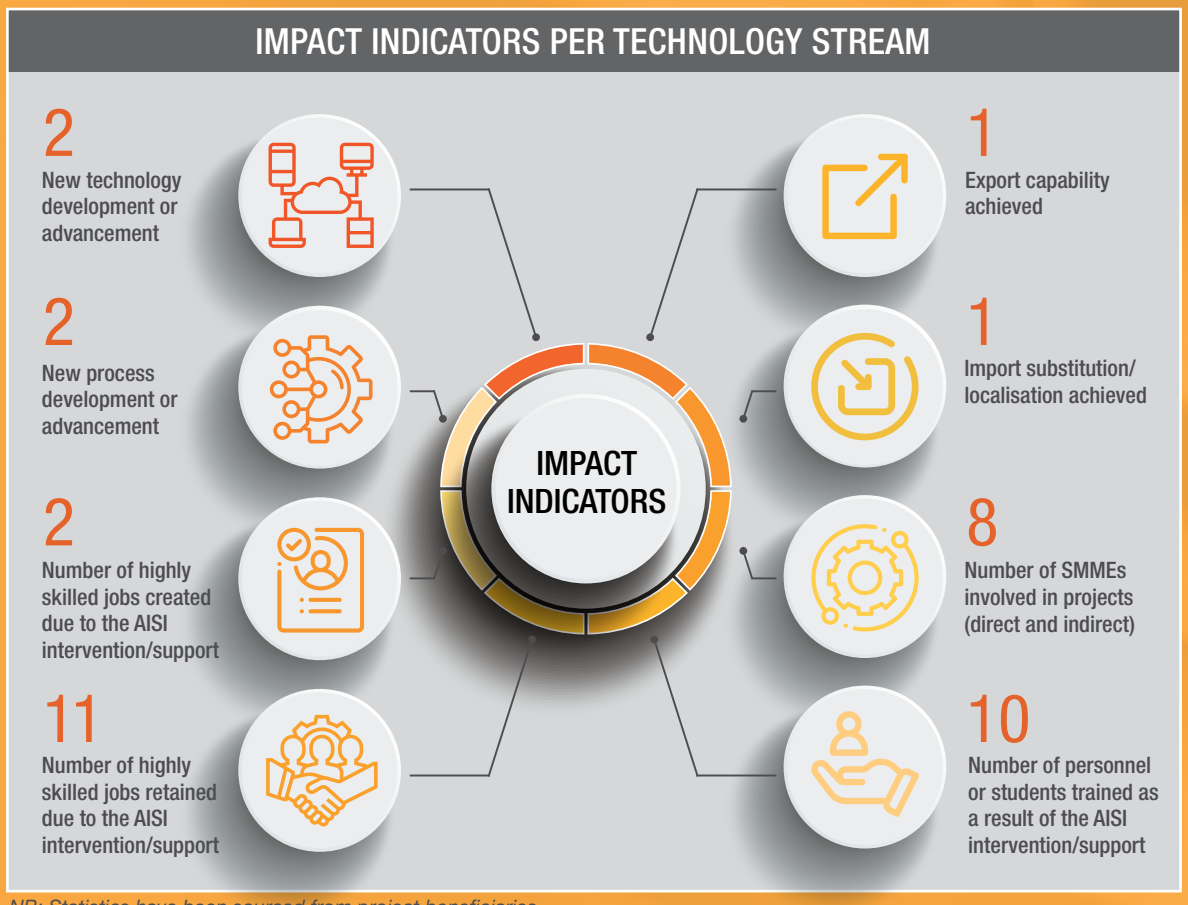
> Introduction

A propulsion system (engine) for an aircraft is a machine that generates thrust to push or transmit a forward motion in the object. The main function of the propulsion system is to produce thrust to lift the object for a prolonged period of time by consuming different fuels. Propulsion systems for aircraft can include internal combustion engines (using petrol), jet or turbine engines (using various types of kerosene) and electrical motors (battery powered). The propulsion market size in South Africa is fairly small, comprising three companies with an estimated turnover of R50 million and 56 employees.

> The following two projects supported by the AISI during the 2019/20 period are included in this section:

- Design stage of 400 N micro gas turbine engine completed
- Multi-partner collaboration enables aircraft engine casting success.

The impact achieved under this stream in 2019/20 is illustrated below.



NB: Statistics have been sourced from project beneficiaries

4

PROPULSION

PRODUCT MARKET:
Recreational aviation aircraft and unmanned systems

PROGRAMME 1:
Technology-Based Supplier Development

400 N Compressor stage comprising an impeller and diffuser

PROJECT AT A GLANCE

Beneficiary name: Cape Aerospace Technologies

Project in progress: 400 N Gas Turbine Industrialisation – Phase I

A three-year project to develop a 400 N micro gas turbine engine in response to growing local market demands from the defence and recreational aviation sectors, has commenced. The first stage of the project, specifically the engineering development of the 400 N micro gas turbine, has been completed.

The in-house design methodology using software systems for the design of new engines was used. Design of individual components was optimised through computer aided design, computational fluid dynamics and other software options. The engine was then assembled in computer aided design to determine the engine envelope.

The 400 N project has been planned in six stages and is currently ahead of schedule. Phase 1 of this three-year project has been completed; it is the outcome of an AISI-initiated roadmapping exercise.

Design stage of 400 N micro gas turbine engine completed

Cape Aerospace Technologies has embarked on a three-year project to develop a 400 N micro gas turbine engine in response to growing local market demands from the defence and recreational aviation sectors. The first stage of the project, specifically the engineering development of the 400 N micro gas turbine, has been completed and work has already commenced on the second stage of the project.

David Krige, Managing Director & Head of Propulsion Systems, explains that in response to market-driven requirements, specifications were defined for the 400 N micro gas turbine. “The CAT 400 turbine is being designed for a thrust of 400 N. It will be as light as possible (less than 4 kg) and operate at allowable component temperatures,” he says.

Krige confirms, “The knowledge we gained during development and subsequent industrialisation of the 250 N micro gas turbine will help us on this 400 N micro gas turbine project.” The 400 N project has been planned in six stages over the three-year period and is currently ahead of schedule.

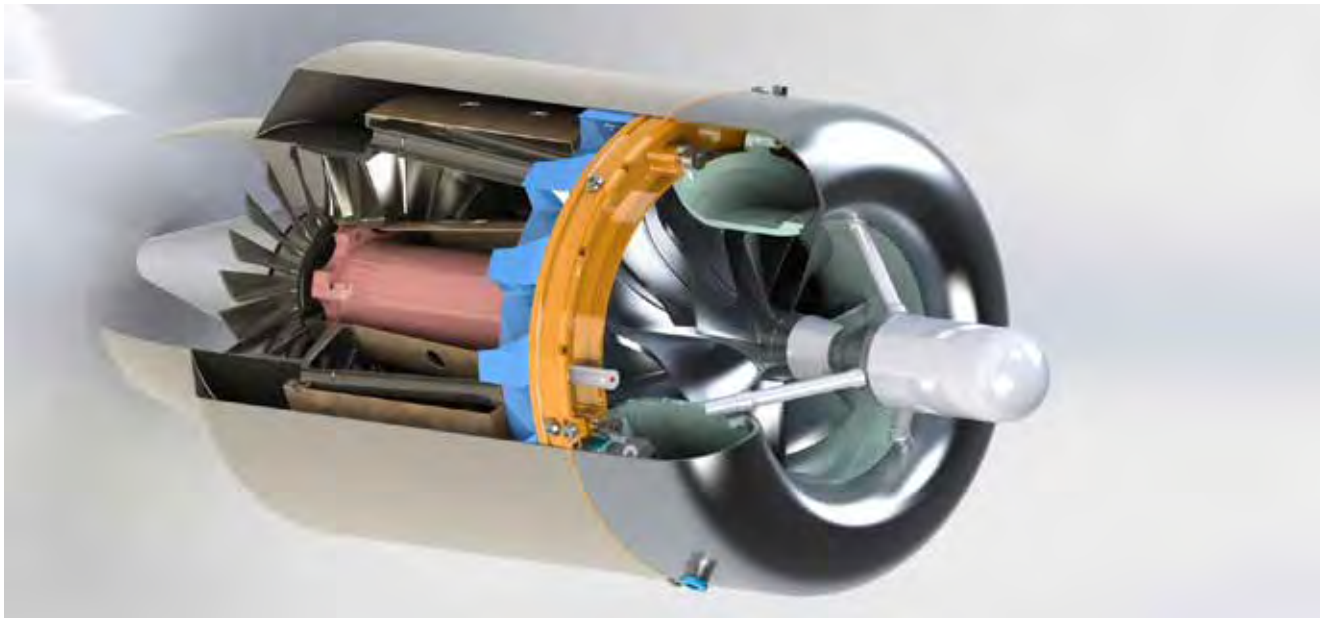
The in-house design methodology using software systems for the design of new engines was used for stage 1 of the 400 N project. This involved one-dimensional and three-dimensional designs, which went through several iterations. Once the best iteration that closely matched client requirements had been identified, the design of individual components was optimised through computer aided design, computational fluid dynamics and other software options.

Krige emphasises the importance of this part of the design process, “The critical and major components for engine operation are the impeller, the diffuser, the combustion

6 jobs retained

New technology development or advancement

New process development or advancement



CAT 400 turbine assembly, indicating the major turbine components. These components include the compressor, diffuser, combustion chamber, nozzle guide vanes, turbine rotor and turbine casing.

chamber, and the turbine stator and rotor. These are the internal components making all things possible for the engine. Therefore, they must be designed to match one another." The preliminary engine performance calculations have indicated how well the components could be expected to work together.

The engine was then assembled in computer aided design to determine the engine envelope. This refers to the fact that the engine in use will be mounted on an airframe in a limited space; it must therefore be designed to fit into this space. The engine envelope of the 400 N has been set at an engine diameter of 147 mm, and an engine length of 380 mm. The engine casing will also need to be as small as possible without compromising the operation of the engine. Krige confirms, "This is a manufacturing constraint that we must constantly bear in mind."

Stage 2 to determine the overall turbine performance and feasibility of the components is currently underway.

Krige confirms that Cape Aerospace Technologies will localise up to 80% of the 400 N content. In addition, the 400 N will use the company's novel plasma ignition system for micro gas turbines. He envisages that the company will also export the 400 N, given international demand for this type of engine. "Our team is growing in response to our market, and we train continuously to ensure that team members can contribute to this project as well as others," he says.

Cape Aerospace Technologies continues to assist undergraduate and postgraduate engineering students at Stellenbosch University whose academic focus is research on gas turbines.

Cape Aerospace Technologies ascribes its success to its meticulous in-house design-to-manufacture process, including engine and subsystem assembly and testing. With the 400 N micro gas turbine soon to be part of the current market range of micro gas turbines comprising the 120 N, and the 250 N for the defence and recreational aviation sectors, all eyes are on Cape Aerospace Technologies' plans for the future.

CONTACT
David Krige – david@capeaerospace.tech

> HIGHLIGHTS

- Market demand for the 400 N micro gas turbine
- Solid local capability leads to good progress
- High percentage of localisation

> PARTNERS & COLLABORATORS

- Stellenbosch University

4

PROPULSION

PRODUCT MARKET:
General and recreational aircraft

PROGRAMME 2:
Industry Development and Technology Support

Block pouring

PROJECT AT A GLANCE

Beneficiary name: ADEPT Manufacturing

Completed project: ADEPT Advanced Casting

A repeatable advanced aluminium casting process for ADEPT's aircraft engines has been established. ADEPT pursued active collaboration with various partners in industry and the National System of Innovation over the past two years to achieve this outcome.

Technology developed and proven in small batch quantities at the University of Johannesburg's Metal Casting Technology Station was migrated to the optimised production environment at the CSIR.

Optimisation was achieved through simulation of the casting process. Machining of castings is done on ADEPT's new four-axis computer numerical control milling machine at Aerosud.

Multi-partner collaboration enables aircraft engine casting success

ADEPT Manufacturing has established a repeatable advanced aluminium casting process for its aircraft engines. This is the successful outcome of ADEPT's active collaboration with various partners in industry and the National System of Innovation over the past two years.

Raymond Bakker, Technical Director of ADEPT, explains, "The University of Johannesburg's Metal Casting Technology Station was our partner for the early stage development in a laboratory environment of the castings for the aluminium cylinder heads and crankcases used in the engine manufacturing process. This pilot plant was an important first step.

"As the next step, non-destructive testing of these development castings by Stellenbosch University's computed tomography (CT) scanner facility, provided us with a benchmark against which to proceed with the next stage of the project."

The CSIR casting facility with existing skills and experience proved to be the best partner for the next step in the industrialisation process. Bakker confirms, "This facility, which offers improved metallurgical processes, has the right balance between a laboratory environment and the capacity to scale up to the requisite volumes."

The technology developed and proven in small batch quantities at the University of Johannesburg's Metal Casting Technology Station was migrated to the optimised production environment at the CSIR. To ensure that manufacturing processes, quality standards, repeatability, and traceability

2 new jobs created

5 jobs retained

Export capability achieved

Import substitution achieved

are in line with aviation industry requirements, process improvements were implemented to address quality and specification deficiencies.

Simulation by industry partner Ametex of the initial casting process provided valuable input during this phase of process optimisation. Bakker points out, "Simulations were done based on datasets collected during the pilot casting process at the University of Johannesburg Metal Casting Technology Station. We found a close correlation in terms of porosity results between these simulations and the results of the CT scans. This gave us confidence to proceed with refinements and changes to the casting process."

These changes comprised slight geometric changes to the component; revision of the feeding system; and design changes to the filling system to allow a broader range of operating procedures for high repeatability of quality outputs. A simulation was conducted to establish the effectiveness of the changes. "Simulation proved its value as it has subsequently been possible to simulate the effectiveness of adjustments to bring porosity to acceptable levels."

In another move aimed at supply chain improvement, ADEPT Manufacturing is machining these castings on its new four-axis computer numerical control milling machine now in operation in its allocated machine shop area at Aerosud in Centurion. This facility is conveniently geographically located relative to both the CSIR and Vestcast, the company which supplies smaller investment castings for machining. This has ensured an optimal supply chain.

Machined castings are transported to Durban and final assembly (together with all other components) is done at ADEPT Manufacturing in Durban before final testing, crating and shipping.

Head machining

Themba September, Executive Chairman, ADEPT Manufacturing, is proud of these outcomes, "We are proud of this example of local manufacturing. Engine 10 on our current production line will include the CSIR-produced castings.

"We are thankful for the support and guidance of the AISI and for the engagement and valuable input of our collaboration partners."

CONTACT
Raymond Bakker – raymond@adeptairmotive.com

> HIGHLIGHTS

- Quality and repeatability of the process
- Compliance with aerospace quality standards

> PARTNERS & COLLABORATORS

- Aerosud Holdings
- Airmotive Technology
- Ametex
- African NDT Centre
- Central University of Technology
- CSIR
- Stellenbosch University
- University of Johannesburg


Functional Tested
TEXAS INSTRUMENTS
J5
J6
J7
J8
LANTERN
AD-FMCOMMS4

Information systems

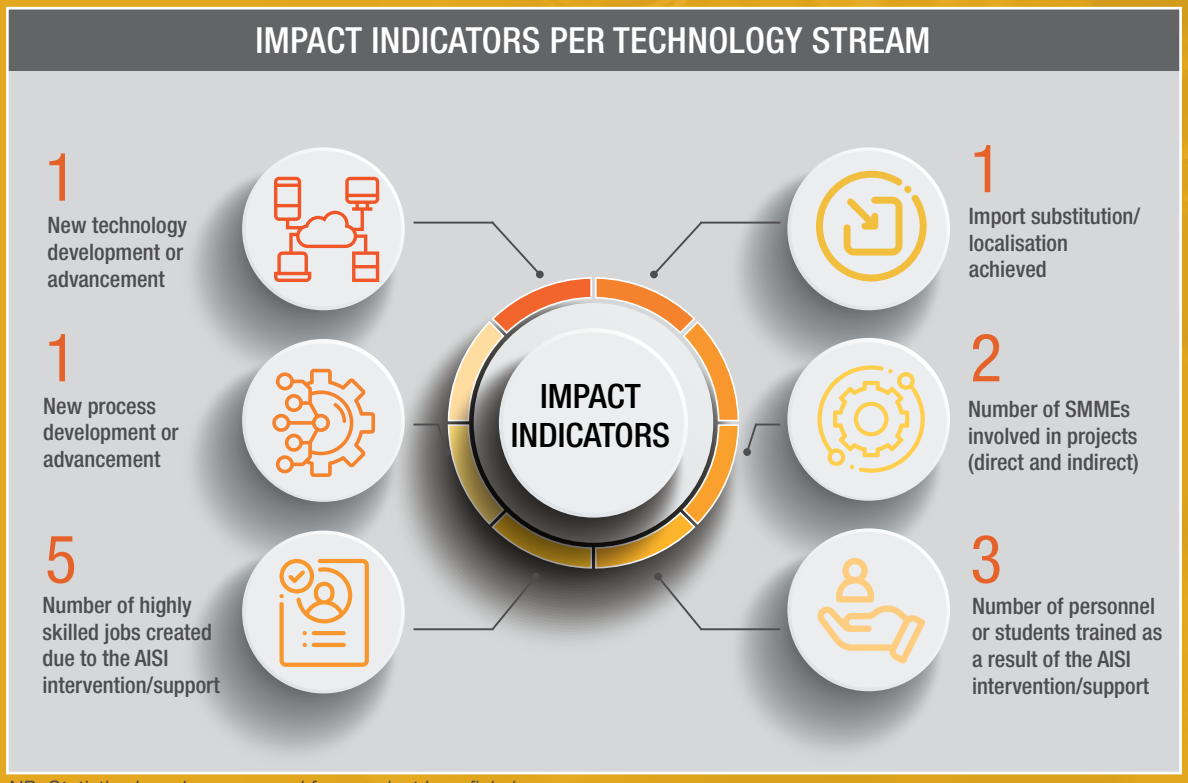
> Introduction

Information systems use data acquired by sensors, which are converted via software to information that can be easily interpreted by humans. These systems are available in the advanced avionics cockpit. The systems support flight progress, and identify terrain, traffic, and weather hazards to be avoided on route.

> The following project supported by the AISI during the 2019/20 period is included in this section:

- New communications requirements for unmanned aerial systems guide product development.

The impact achieved under this stream in 2019/20 is illustrated below.



NB: Statistics have been sourced from project beneficiaries

4

INFORMATION SYSTEMS

PRODUCT MARKET:
Military Systems

PROGRAMME 1:
Technology-Based
Supplier Development

PROJECT AT A GLANCE

Beneficiary name: Lantern Engineering

Project in progress: Lantern Technology Localisation

Development, design and testing of Lantern Engineering's data-only communications radio for an unmanned aerial system (such as a drone) in response to needs expressed by local customers, are in the final stages. Customised hardware, mechanical components, the software and the radio have been integrated into a working radio product, which is ready for field tests.

The radio product addresses new and emerging communications requirements for unmanned aerial systems. The next step is the pre-production cycle and the Independent Communications Authority of South Africa-certification activity. This completes the successful localisation of Lantern's software-defined radio technology capability.

ICASA Frequency Compliant, Beyond Line of Sight Drone Data Radio

New communications requirements for unmanned aerial systems guide product development

Lantern Engineering has reached the final stages of a one-year project, based on an AISI-initiated technology roadmapping exercise, notably the development design and testing of a data-only, radio product for an unmanned aerial system. This development was initiated in response to needs expressed by local customers and the project will be followed by a pre-production cycle and the Independent Communications Authority of South Africa (ICASA)-certification activity. The radio is software defined which means that some or all of the physical layer functions are software defined with advantages of flexibility and the ability to accommodate a wide variety of changing radio protocols in real time.

Mr Chris Williams, Head of Technology and Products, confirms, "The customised hardware, mechanical components, the software and the radio have been integrated into a working radio product. We are pleased that we are now in the product implementation and testing phase. We have gone from design to implementation and testing, and the integrated product is now ready for field tests." A ground station has been built for interaction with the unmanned aerial system.

Lantern was guided in the project by new and emerging communications requirements identified for unmanned aerial systems. "The Lantern data-only unmanned aerial system radio product addresses the gap identified by these requirements," explains Shareef Hoosain, in charge of Programs.

Lantern's strategy for this product development proved successful. The first element was the establishment of the

5 new jobs created

Import substitution achieved

New technology development or advancement

internal design team ("the right people with appropriate capabilities and skills"), which focused on digital signal processing, firmware and software. The success achieved by this team was essential for the finalisation of the product and for the ability of the team to generate associated core intellectual property in the future.

The second element was the product development environment, which enabled Lantern to expedite the design of the hardware internally. The design now caters for features that the market has identified as near-term requirements and addresses the mandatory frequency compliances for radios gazetted by the Independent Communications Authority of South Africa for beyond visual line of sight operations of small, light-weight unmanned aerial vehicles. "Our design capability has put us ahead of the curve – for now!" confirms Hoosain.

A draft mechanical design of the radio was prototyped and manufactured and has been used extensively for marketing and selling purposes. The prototype was used at Defence and Security Equipment International, one of the world's leading defence and security events, held in London during September 2019, where Lantern exhibited the mechanical model with specifications of the radio product. "We market our offering as the printed circuit board and the mechanical design," explains Ghaazim Rylands, who heads up Business Development and Sales. "Acquiring them as separate items gives systems integrators the option to follow preferences regarding integration and assembly."

With support received from the AISI, it was possible for Lantern to demonstrate the successful development of a data-only unmanned aerial system radio product in the South African industry. The product requires comprehensive environmental qualification, which is outside the scope of this project but essential for commercialisation of the product.

This project to localise Lantern's software-defined radio technology capability has been successful. It will lead to the implementation of its communications roadmap, internal resources for software and firmware applications, radio digital signal processor waveforms and algorithms, and new products variants for current and emerging market sectors.

Lantern's success has attracted the attention of a company with interests in unmanned aerial systems. "We believe that our investment in local capability will make it possible for us to develop a new portfolio comprising systems integration, a navigation system, automation and controls, communications and radio frequency systems," concludes Rylands.

CONTACT
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> HIGHLIGHTS

- Integrated working radio product
- Planned field tests
- Independent Communications Authority of South Africa-certification activity pending

> TECHNICAL TERMINOLOGY

- Firmware: Software which is semi-permanently placed in hardware
- Software: Programs and other operating information used by a computer

> PARTNERS & COLLABORATORS

- PdP Systems
- TME Close Corporation
- TraX Interconnect
- University of Cape Town

Aerostructures

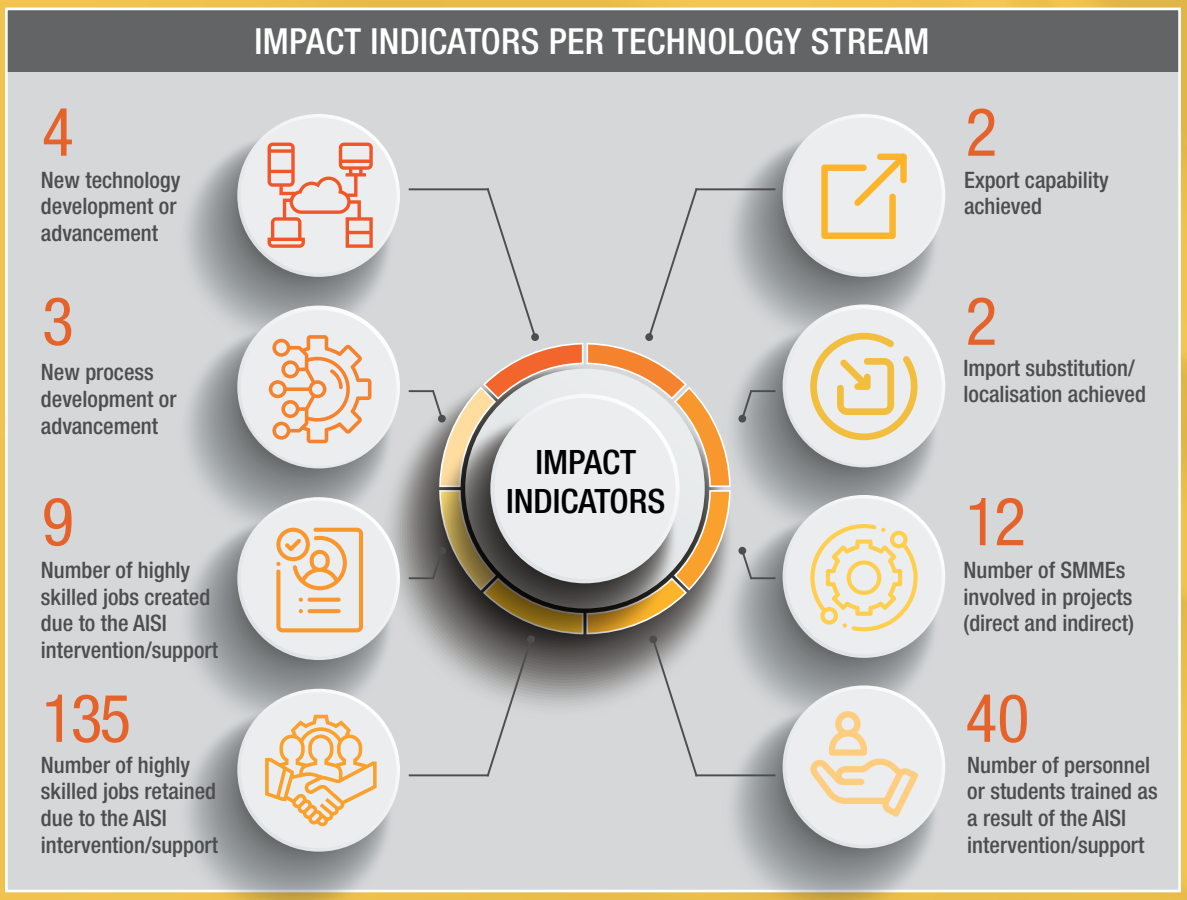
> Introduction

An aerostructure is a combination of all the mechanical parts required to build an aircraft such as flight control surfaces, fuselage, wings, nose, nacelle and pylon, empennage, and others. It is an essential part of the aircraft. Locally, aerostructure manufacturers supply to the larger international commercial aerospace industry and their sub-supplier network. Locally based aerostructure companies include Aerosud, Daliff and Ti-TaMED. There are 45 aerostructure companies in South Africa, with an estimated turnover of R1.26 billion and 1 850 employees.

> The following four projects supported by the AISI during the 2019/20 period are included in this section:

- Jonker Sailplanes' JS2-24 sailplane set to meet competition head-on
- Local aerospace industry benefits from design for additive manufacturing methodology
- Manufacturing execution system enables delivery to multinational clients
- Locally developed UAV nears completion.

The impact achieved under this stream in 2019/20 is illustrated below.



NB: Statistics have been sourced from project beneficiaries

4

AEROSTRUCTURES

PRODUCT MARKET:
Recreational aviation aircraft

PROGRAMME 1:
Technology-Based Supplier Development

PROJECT AT A GLANCE

Beneficiary name: Jonker Sailplanes

Project in progress: 24m Wingspan Open Class JS – Phase I

Jonker Sailplanes has made good progress during the first phase of a three-year project based on an AISI-initiated roadmapping exercise, for the design and industrialisation of a new model, the JS2-24 with a 24.5m wingspan.

Jonker Sailplanes is the only significant manufacturer of sailplanes outside Europe and has successfully exported the JS1C Revelation and the JS3 Rapture. The team worked with the North-West University on aerodynamic research and engineering for the new product to outclass any competition.

Five design iterations were needed for convergence of the conflicting structural and aerodynamic requirements. The overall structural design involved a load mathematical model, load design documents, structural component calculations, and a finite element analysis software package to perform complex structural design analysis.

Computer aided design of the extended 24.5m wingspan

Jonker Sailplanes' JS2-24 sailplane set to meet competition head-on

Local company Jonker Sailplanes has made good progress during the first phase of a three-year project supported by the AISI for the design and industrialisation of a new model, the JS2-24 (with a 24.5m wingspan) in its product portfolio. Uys Jonker, Managing Director, "This development is in response to international market demand, and the fact that competition in the Open Class in recent years from the EB29R sailplane has meant that we need to innovate to meet our competition head-on."

Jonker Sailplanes is the only significant manufacturer of sailplanes outside Europe. It is regarded as a product leader and Jonker confirms that the brand is visible and well supported internationally. "It is, however, imperative that we finalise this new model as marketing in Germany and elsewhere is complex. Ideally, we would like to use the JS2-24 to regain our podium position in the Open Class competitions," he says.

The team at Jonker Sailplanes worked with the North-West University on the relevant aerodynamic research and engineering for this product to outclass any competition. Basic aerodynamic research was conducted to develop better profiles, reduced drag of all interfacing surfaces and to optimise plan forms. The 24.5m wing design presented design challenges stemming from the aerodynamic requirement for a long, slender and thin wing, while the structural design required a wing with a larger cross section. Jonker confirms, "It required five design iterations to enable the convergence of the conflicting structural and aerodynamic requirements."

4 new jobs created

Export capability achieved

New technology development or advancement

Jonker Sailplanes' production facility

Complementary to this was the overall structural design, which involved a load mathematical model, load design documents, structural component calculations, and a finite element analysis software package to perform complex structural design analysis.

Several design challenges were addressed, some of which were fully resolved while others will be addressed during the next phase. These included the design of the structure at the wing root area, which requires further design verification; driving of the flaperons (control surfaces that help to stabilise the sailplane during low-speed flying) at four stations to reduce twist deformation which impacts performance; design of the wingtip lockpin to fit under the flaperon driver tube; and a new airbrake design with an extra lift arm in the middle to pull down the airbrake cap.

Jonker says, "We are pleased with our progress as we also completed the wing control system design using three-dimensional or 3D computer aided design models."

He points out that phases of the project overlap; phase 2 will therefore include mould and tooling design and composite tooling manufacturing, as well as production flap moulds and prototype jigs.

With good progress in hand, the team at Jonker Sailplanes is well positioned to move into the next phases of the JS2-24 project.

CONTACT
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> HIGHLIGHTS

- Convergence of conflicting structural and aerodynamic requirements
- Design challenges resolved

> MEDIA

- *Segelfliegen* (German-language glider magazine)
- *Sailplane & Gliding* (United Kingdom)

> PARTNERS & COLLABORATORS

- Advanced Composite Solutions
- CSIR
- Lektratek
- OnTrack Technologies
- North-West University

4

AEROSTRUCTURES

PRODUCT MARKET:
Commercial aviation

PROGRAMME 2:
Industry Development and Technology Support

Measurement of a static test specimen

PROJECT AT A GLANCE

Beneficiary name: Denel Aeronautics

Completed project: Design, Optimisation and Characterisation of Aluminium Aerospace Parts Produced by Additive Manufacturing

An aluminium aerospace-quality component was locally designed and manufactured using additive manufacturing. The bracket for the bearing block two of an existing indigenous helicopter was identified for redesign and optimisation.

The team developed a multi-step design for additive manufacturing methodology and addressed the gap in the knowledge base for aluminium as a material suited to additive manufacturing. AlSi10Mg aluminium alloy test pieces were manufactured by selective laser melting on an SLM 280 machine at Metal Heart.

Prior to 3D-printing, a build simulation of the bearing block two bracket was done. The bearing block two bracket was successfully manufactured on Metal Heart's SLM 280 machine.

Local aerospace industry benefits from design for additive manufacturing methodology

Results from a project concluded by Denel Aeronautics have shown that an aluminium aerospace-quality component could be locally designed and manufactured using additive manufacturing. Four engineers, Niël Agenbag, Andrew Wood, Stefan Rassmann and Andrew Allcock, were involved in the project.

Additive manufacturing of metals is an emerging field in high technology aerospace manufacturing. Rapid manufacture of complex structures in low volumes can shorten the turnaround times of research and development projects. Rassmann comments, "With this in mind, the team developed a multi-step design for additive manufacturing methodology and addressed the gap in the knowledge base for the investigation of aluminium. The project also included a comprehensive testing programme to characterise the material's static and fatigue properties to generate the exhaustive materials database required for aerospace safety standards." This meticulous process followed in the project is outlined briefly below.

AlSi10Mg aluminium alloy test pieces were manufactured by selective laser melting on an SLM 280 machine at Metal Heart. The test pieces were sent to the Nuclear Energy Corporation of South Africa for the evaluation of their internal quality and the residual stresses induced by the manufacturing process. Fatigue testing and static testing were then conducted on the test pieces. Surface finish on the fatigue specimens was also evaluated. Acceptable results proved that aluminium additive manufacturing using

10 jobs retained

New technology development or advancement

Additive-manufactured bearing block two bracket

selective laser melting is possible in South Africa with resultant material properties comparable to international results.

The project goal of developing optimisation skills was met by identifying three parts from an existing indigenous helicopter for optimisation: a linkage support bracket, a bearing block bracket, and a global positioning system (GPS) antenna bracket. The components were put through an optimisation process using different design goals to gain experience. "While we were interested in the optimisation results of all three parts, we finally narrowed our focus on the bearing block bracket," explains Rassmann.

A computer aided design package was used to recreate three-dimensional or 3D geometry of the optimised bearing block bracket using the output from the finite element analysis optimisation process.

Once the geometry of the optimised structure had been created, it required the use of finite element analysis once more to verify that the redesigned structure met the structural requirements of the original part.

When similarity or even better performance was shown between the existing design and the redesign, no further design refinements were done on the redesigned bearing block bracket.

Before the part could be printed, the next step was a build simulation using Simufact Additive. Simufact Additive allowed the examination of the part at every stage of the build process and highlighted possible failures of the part during manufacture. Rassmann confirms, "The build simulation is a vital step in the design for an additive manufacturing process with important benefits: it allows for the design of the support structures for the part; it minimises distortions and residual stresses induced by printing and can also be used to minimise material usage and total build time."

The bearing block bracket was manufactured on Metal Heart's SLM 280 machine. The final component was inspected and found to conform well to the computer aided design model. The bearing block bracket is subjected to mechanical vibration in service and a bonk test was therefore conducted to check that the natural frequency of the part is higher than the frequency of the vibrations to which it would be subjected when in use. The results of the bonk test showed that the natural frequency of the optimised part is indeed higher than the frequency it would experience when in use.

Prior to this AISI project, Denel Aeronautics had little analysis experience in metallic additive manufacturing. Now the additive manufacturing environment has opened up and a design for additive manufacturing capability has been established at the company. The success of the project has made a significant contribution to the understanding and utilisation of additive manufacturing in the South African aerospace sector.

CONTACT
Andrew Allcock – andrew.allcock@denel.co.za

Static test of test piece produced by additive manufacturing

> HIGHLIGHTS

- Development of optimisation skills
- Aluminium aerospace-quality component locally designed and manufactured using additive manufacturing
- Enhanced understanding of additive manufacturing in the South African aerospace sector

> PARTNERS & COLLABORATORS

- CSIR
- Metal Heart
- The South African Nuclear Energy Corporation

4

AEROSTRUCTURES

PRODUCT MARKET:
Commercial aviation aircraft

PROGRAMME 1:
Technology-Based
Supplier Development

Production of first components

PROJECT AT A GLANCE

Beneficiary name: Aerosud Aviation

Project in progress: Strategic Supplier Development: Rotational Moulding – Phase I

Creation and installation of the manufacturing execution system connecting the manufacturing facility at Pioneer Plastics and Aerosud, have been successful. This follows installation of the Leonardo SMART rotational moulding machine at Pioneer Plastics.

The manufacturing execution system was tested and is now in use for the process development activities. Processes are robustly and reliably developed and industrialised to support production. The production of the first Aerosud aerospace components appears to be imminent.

Phase 1 and part of phase 2 have been completed in this project that was the outcome of an AISI-initiated technology roadmapping exercise.

Manufacturing execution system enables delivery to multinational clients

Aerosud Aviation has achieved a major milestone in the AISI-supported rotational moulding project. The creation and installation of the critically important manufacturing execution system which connects the manufacturing facility at Pioneer Plastics and Aerosud, have been successful, with all communication live. In parallel, the Leonardo SMART rotational moulding machine, identified by Aerosud as the best for purpose, was installed at Pioneer Plastics.

Aerosud Aviation has several production contracts with Boeing and Airbus, and their tier one suppliers, Spirit Aerosystems and Labinal. Aerosud hopes to extend its production footprint with deliverables in this global aerospace market with complex fibre reinforced aerospace components, based on its patented novel cellular core technology for which the new manufacturing facility will support.

Jeff Esterhuizen, Operations Systems Manager at Aerosud, confirms, “We have created a manufacturing execution system-enabled platform for the production of cellular core technology moulded cores. The system was tested and is now in use for the process development activities.

“The new user manufacturing execution system computer at Pioneer Plastics is connected to the existing manufacturing execution system server and data server at Aerosud. It is also connected to the new moulder computer at Pioneer Plastics, using a point-to-point type connection. The top-level manufacturing execution system interfaces with other systems and solutions such

1 new job created

5 jobs retained

Export capability achieved

Import substitution achieved

as product lifecycle management and enterprise resource planning."

Esterhuizen notes, "The manufacturing execution system is a highly customised and complex integrated solution. It is defined by the mission for which it is intended. The context in which it operates, determines the elements used and their interrelationship. Thus, as the manufacturing execution system is customer and product specific, software must be adapted to the end use. The hardware required for the Internet of Things platform was also adapted to this end goal. And connectivity was adapted as the different elements did not necessarily speak the same language."

It was equally important to ensure the correct infrastructure and equipment at Pioneer Plastics. Joanne Zambelli, Senior Engineer at Aerosud, confirms, "Our choice of the Leonardo SMART machine is based on the fact that it is the first rotational moulding machine with a fully controlled and automated cycle. It is a compact production chamber, where all operations – heating, cooling, loading and unloading – take place. It now takes pride of place as the first of its kind in the southern hemisphere." All auxiliary equipment required for the material preparation, manufacturing and inspection processes have also been installed. The production of the first Aerosud aerospace components appears to be imminent.

There is a further requirement for Aerosud: all processes must be robustly and reliably developed and industrialised to support production. Wouter Gerber, Research and Development Manager at Aerosud, explains, "For us to be part of the global aerospace supply chain, it is mandatory that we adhere to EN9100 rev D, by which we document and prove our efficiency, quality and performance throughout the aerospace supply chain."

The success to date of this localisation project secured the Aerosud Aviation and Pioneer Plastics team a prize at the African Advanced Manufacturing and Composites Show in November 2019. External recognition of the nature of this innovative advanced manufacturing solution bodes well for both Aerosud Aviation and Pioneer Plastics in their joint undertaking.

CONTACT
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African Advanced Manufacturing and Composites Show: Gold Award to Pioneer Plastics and Aerosud Aviation

> AWARDS

- African Advanced Manufacturing and Composites Show in November 2019
- Gold to Pioneer Plastics and Aerosud Aviation: Important replacement in Advanced Manufacturing – success in localising a product or process in Advanced Manufacturing

> HIGHLIGHTS

- Rotational moulding machine with fully controlled and automated cycle
- Manufacturing execution system-enabled platform
- Processes robustly and reliably developed and industrialised

> MEDIA

- SA POLYMER TECHNOLOGY Published on Dec 5, 2019 p.42-43 https://issuu.com/tohara/docs/sapt_dec_2019

> PARTNERS & COLLABORATORS

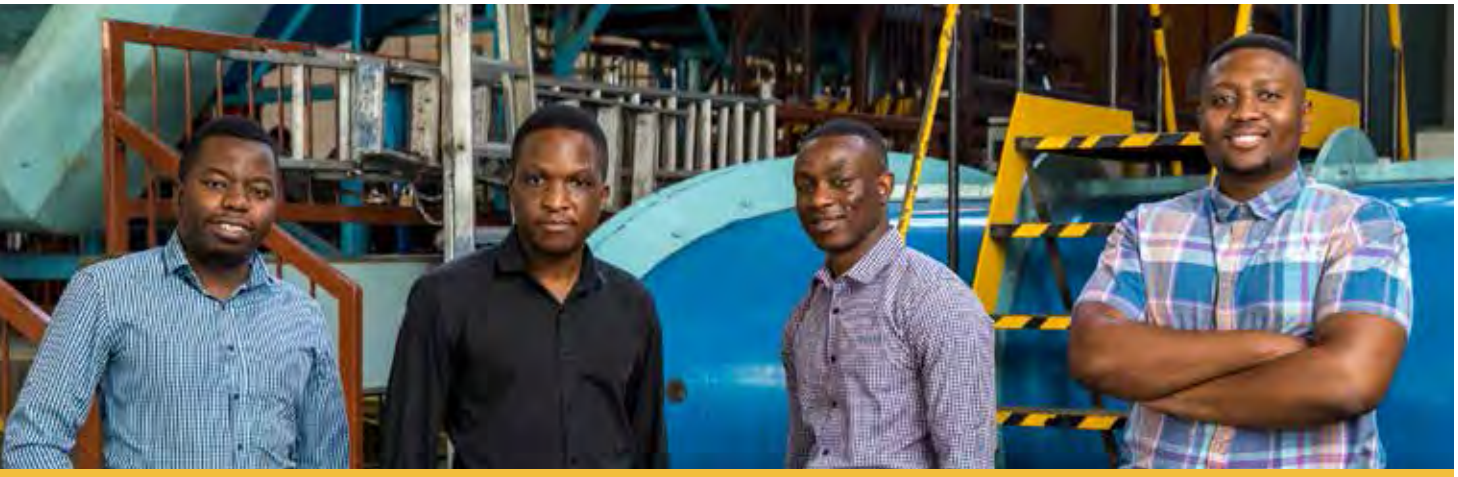
- Persico
- Pioneer Plastics
- University of Pretoria

4

AEROSTRUCTURES

PRODUCT MARKET:
Unmanned systems

PROGRAMME 1:
Technology-Based
Supplier Development



Dalumuzi Dube, Nigel Nkundhlande, Ischmael Chiremba and Edmond Moyo

PROJECT AT A GLANCE

Beneficiary name: Proceptworks

Project in progress: Sentian UAV

Proceptworks has completed a series of experiments using two test beds to obtain results for vertical takeoff and landing (VTOL), hovering, stability and horizontal flight of its locally developed unmanned aerial vehicle (UAV). The two systems (VTOL and horizontal flight) were successfully integrated.

Identified problems encountered have been addressed and the Sentian UAV model has undergone flight tests to identify further challenges, which have also been addressed. The innovative nature of this work was recognised through awards by both Air Traffic Navigation Services and South African Civil Aviation Authority.

The team is confident that the airborne platform will be completed at the end of 2020.

Locally developed UAV nears completion

Significant progress on the development of a uniquely South African modular unmanned aerial vehicle (UAV), dubbed Sentian, will see the airborne platform completed by the end of November 2020. Conceptualised as a 'drone for good' in the service of humanity, this UAV has the potential to support and help all forms of sustainable life. Examples include the use of its payload to deliver critical medical supplies or to provide surveillance of crops.

Dalumuzi Dube, Edmond Moyo, Ishmael Chiremba and Nigel Nkundhlande of Proceptworks are satisfied with the outcomes achieved over the past year. The team built a quadcopter (a type of helicopter with four rotors) as an experimental test bed to ascertain flight dynamics for performance and stability as well as takeoff and landing capabilities. The quadcopter outperformed expectations for flight (including manoeuvres to stretch limits), vertical takeoff, landing and hovering, as well as stability. "We were particularly pleased with the behaviour of the brushless direct current motors which are essential for takeoff and hovering," says Chiremba. These results were then used to configure the systems required for control and flight, notably the flight controller (for which Pixhawk, a sophisticated autopilot system, was utilised) and the ground control system.

The team also tested horizontal flight using a custom-built horizontal flight model as a second test bed. With characteristic ingenuity, the team devised a unique manufacturing process for the model. Dube explains, "Once we had designed the model, we divided it into different pieces for the creation of the mould. These pieces

4 new jobs created

Import substitution achieved

New process development or advancement

were printed like a puzzle by 3D printers and put together to form the negative cavity of the UAV. We then added composites onto the mould. Once the composites were cured, we could take out the shell of the model." The same process will be used to produce the full-sized Sentian UAV.

Electric ducted fans installed on the model converted electricity to thrust, to allow the model to soar into the sky. Minor problems with landing gear and stability were solved, and the team could move onto the integration of horizontal flight and vertical takeoff and landing systems. Nkundhlande says, "The task at hand was to synergise the two systems without losing their independent pre-eminent qualities. There's a short transition between vertical and horizontal flight, which we needed to address."

The team faced several unforeseen challenges on this Sentian UAV scale model during flight tests, the most significant being weight which affected generation of lift (together with thrust, this is essential for take-off). The weight problem was solved through substituting some components with a lighter comparable option. Successful flight tests were conducted at James and Ethel Gray Park, Johannesburg, a model plane flying venue.

Recognition for the team's work in the form of two awards by the Air Traffic Navigation Services provided both an additional financial injection for the project and invaluable training support. The South African Civil Aviation Authority also recognised the Sentian UAV project for its award for aviation innovation.

Emboldened by this recognition and support, the team is working towards the finalisation of the project, based on the good project results achieved. "We are confident of meeting our own deadline," confirms Dube.

CONTACT
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Carbon fibre wing skin layup after curing and before trimming

Carbon fibre wing skin with internal structure/ribs temporarily placed in position

Carbon fibre wing skin after trimming

> AWARDS

- ATNS Avi Awards 2019
  Overall Winner / SMME Winner
- SACAA Civil Aviation Industry Awards 2019
  Runner-up: Aviation Innovation

> HIGHLIGHTS

- Excellent flight performance of quadcopter test bed
- Custom-built horizontal flight model
- Successful flight tests

> PARTNERS & COLLABORATORS

- Air Traffic Navigation Services
- Triwave Technologies
- University of the Witwatersrand

Aerospace and Defence Standards and Accreditation

The AISI continues to offer standards and accreditation support to SMMEs as part of the Technology-Based Supplier Development Programme. In the aeronautics, space, and defence industry, quality management is critical for ensuring product safety as well as delivery to clients. Through this intervention, the AISI supports SMMEs with implementation and maintenance of relevant standards and accreditation for aerospace and defence SMMEs. It is critical for local SMMEs to have accreditation for global quality management systems such as AS9100 and ISO 9000 in order for them to integrate into the global supply chains. The AISI supports SMMEs with implementation of the following standards:

- AS/EN9100: Aerospace Quality Management System
- ISO 9001:2015: Quality Management System
- ISO 14001: Environmental Management System

Table 1: List of Companies supported for Standards and Accreditation

COMPANY NAME	TYPE OF SUPPORT	STATUS
Ti-TaMED	AS/EN9100 Surveillance audit	Completed
Daliff Precision Engineering	AS/EN9100 Surveillance audit	Completed
Production Logix	AS/EN9100 Gap analysis and implementation	On-going
B Engineering	AS/EN9100 Surveillance audit	On-going

> Supply Chain Optimisation

This intervention is part of the Technology-Based Supplier Development Programme of the AISI. Process optimisation projects are undertaken to ensure optimal performance of manufacturing processes within the SMMEs involved. Optimisation of processes leads to efficiency and productivity improvements thereby generating better revenues for the SMMEs. Some of the main areas under supply chain interventions include but are not limited to:

- Productivity improvement, for example, advanced machining techniques
- Internet of Things and real-time machine monitoring
- Theory of Constraints
- Facility layout and planning
- Lean manufacturing.

5 Sector Strategic Support Initiatives

Sector Strategic Support Initiatives creates a platform for industry to facilitate interactions which under normal circumstances would not be possible, allowing industry, academia and government to engage with potential clients, partners and thought leaders. The AISI utilises existing outlets to enhance the presence of the South African aerospace and defence industry, which enables both local and international role players to gain an understanding of the value proposition and competence offered in the country.

> Commercial Aerospace Industry Development Study

As part of its offerings under Sector Strategic Support Initiatives, the AISI commissioned the Commercial Aeronautical Industry Development Study. The study found that the aerospace industry is a small but significant element of the South African manufacturing sector, comprising at least 104 companies. In total the industry size was determined to be in the order of R9.5 billion and it employs nearly 10 000 individuals or just 0.5% of total production in the South African economy (2019).

While its overall value may be small, its highly skilled workforce represents one of the highest earning segments (nearly six times the average of the manufacturing sector in South Africa) and generates a large export income value for the economy in comparison to its size. This is estimated to be >55% of direct turnover as compared to 34% of turnover for the automotive industry in 2017. In addition, it has a large tertiary or induced economic value to the economy as a result of its highly skilled and well-paid workforce who generate an estimated R570 million in tax revenues for the state. This amount far exceeds the value of current support mechanisms deployed to support the sector.

> Aerospace and Defence Masterplan

The South African aerospace and defence economy has been identified by the Industrial Policy Action Plan 2018-2020 and the Reimagined Industrial Strategy as one of the 150 priority South African economic sectors for support and development. The AISI is actively participating in the masterplan development and provides both technical and secretarial support to **the dtic.**

> Joint Aerospace Steering Committee (JASC)

The AISI is continually providing support to the Joint Aerospace Steering Committee (JASC) through provision of technical expertise and secretariat functions. The JASC was established to provide strategic guidance and positioning to the local aerospace and defence industry.

6 Promotion, Coordination and Awareness

2019 AESSA ANNUAL CONFERENCE – African Aerospace: Innovation & Passion

2019 AeSSA Annual Conference delegates

The Aeronautical Society of South Africa (AeSSA), a division of the Royal Aeronautical Society, formed in 1911, plays an important role in the aeronautical and space sector in South Africa. One of its key activities is an annual conference; AISI hosted the 2019 conference. The event, themed 'African Aerospace: Innovation & Passion', took place from 16-18 October 2019 at the CSIR International Convention Centre in Pretoria and was attended by 130 local and international delegates, representing academia, government, industry, the media and science councils.

The formal programme included two international speakers: Billie Flynn, F35 Lightning II Test Pilot, Lockheed Martin; and Ricardo Traven, Chief Test Pilot for Boeing Charleston, 787 Dreamliner Program. Some 25 local and international delegates participated in eight technical sessions, covering a range of topics: aerodynamics and control, satellite technology, aircraft performance and design, aerospace manufacturing, aerospace propulsion, rocket propulsion and other topics. AISI-supported projects were among these presentations. Additional highlights were the Women in Aerospace Breakfast, with Guests of Honour Linda Weiland of Embry-Riddle Aeronautical University and Major Nandi Zama, South African National Defence Force, as well as invited guest, Tshepang Ralehoko, an aspiring pilot. A group of pilots took part in a panel discussion on the second day. A tour to The Airplane Factory in Johannesburg concluded the conference.

Two conference pre-events contributed to the overall success and impact of the 2019 AeSSA annual conference. The first was a lecture and visit to Cape Town on 14 October 2019 by the two international speakers for the benefit of members of the AeSSA Cape Chapter; the second was the participation by the international speakers in the Young Professionals Networking Workshop at Lanseria Airport through a partnership with Sakhikamva Foundation's STREAM Laboratory. The input and participation by AISI staff in their capacity as members of AeSSA were crucial to the success of the 2019 AeSSA Annual Conference.

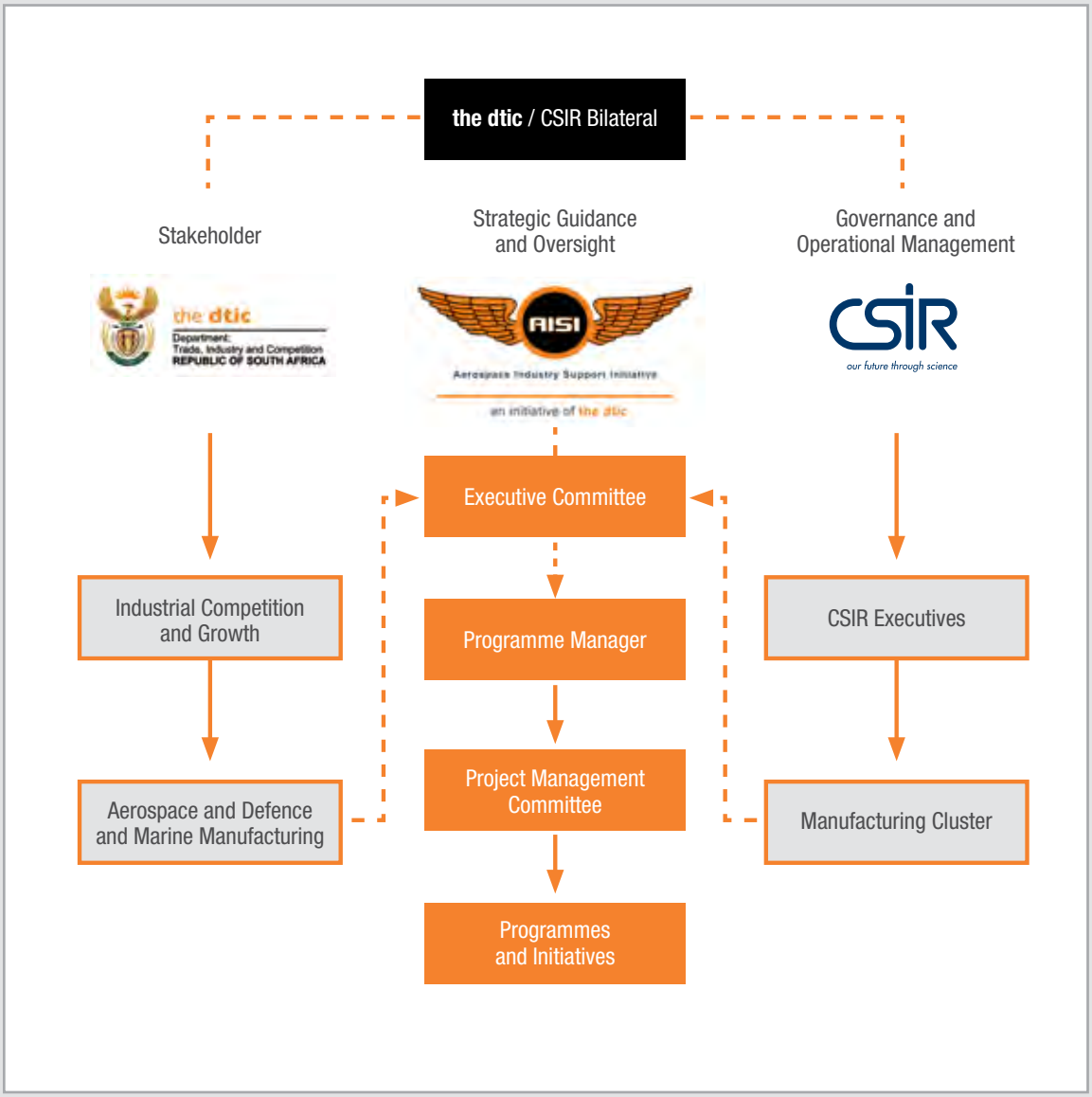
Young Professionals Networking Workshop at Lanseria Airport

CAREER AWARENESS

The Young Professionals are working with the Sakhikamva Foundation by volunteering their time and resources whenever required. A tour of the CSIR was arranged for the Sakhikamva cadet students (grade 12 learners) where they were provided with career guidance, shown the various offerings and capabilities of the CSIR, and encouraged to apply for bursaries and internships in various fields.

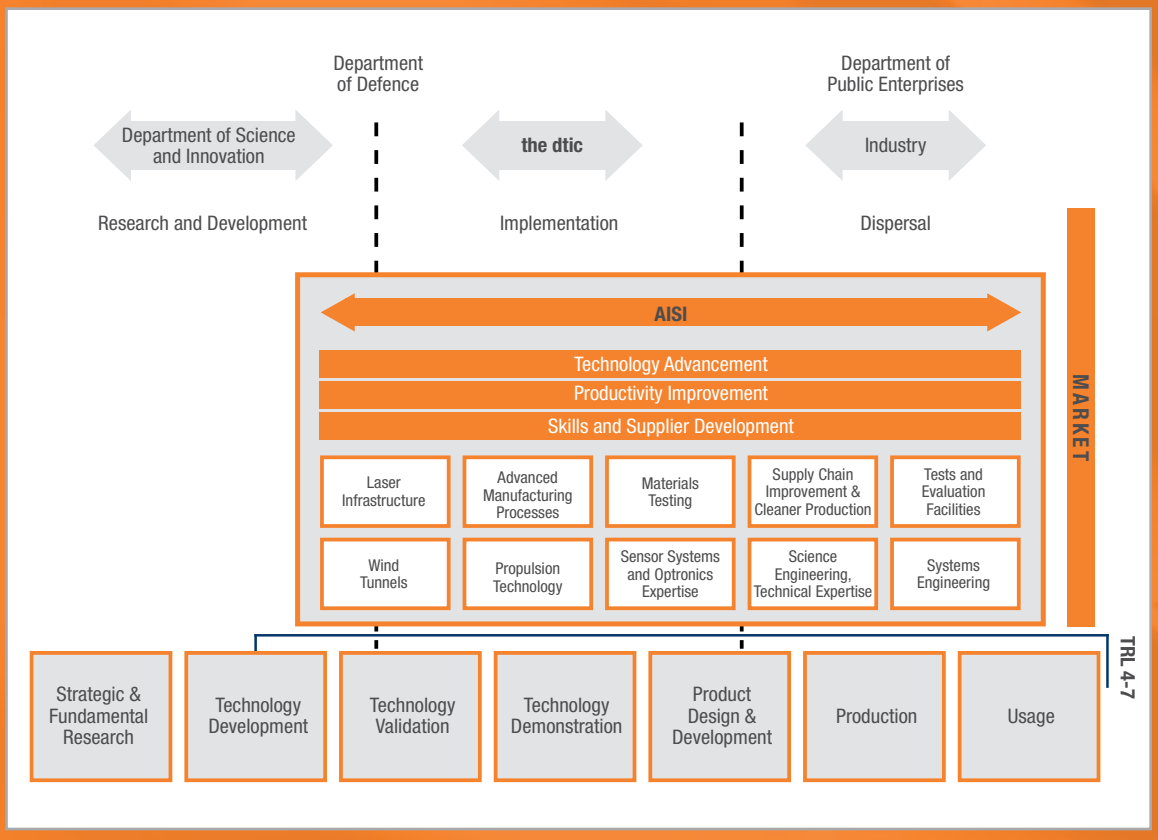
7 AISI governance

The AISI is a fully government-funded industry support initiative of **the dtic**, hosted and managed at the CSIR. The AISI fully complies with the Public Finance Management Act and operates within the procedural framework of the CSIR. On a quarterly basis, the AISI reports to the AISI Executive Committee on progress made against its approved business plan.



8 AISI value proposition

The Aerospace Industry Support Initiative (AISI) assists the aerospace and defence-related industry with technology-based supplier development and the industrialisation of relevant technologies and products. Through this, the AISI will assist industry to verify that technologies and products are technically feasible and thus commercially viable. The value proposition of the AISI in relation to additional players in the aerospace sector is illustrated below.



9 Summary of beneficiary organisations

BENEFICIARY NAME	INDUSTRY PARTNERS AND COLLABORATORS	ORGANISATION TYPE	
6Sigma Shipyards Group	• Wescape Inspection and Quality Services	SMME	
ADEPT Manufacturing	• Aerosud Holdings • Airmotive Technology • Ametex • African NDT Centre • Central University of Technology • CSIR • Stellenbosch University • University of Johannesburg	SMME	
Aerosud Aviation	• Persico • Pioneer Plastics • University of Pretoria	OEM	
B Engineering	• N/A	SMME	
Bantek Engineering	• KTTS Vukani Projects and Construction • TÜV Rheinland Inspection Services	SMME	
Cape Aerospace Technologies	• Stellenbosch University	SMME	
Cybicom Atlas Defence	• CSIR • Hensoldt	SMME	
Daliff Precision Engineering	• Novo Star Management Systems Solutions India	SMME	

	B-BBEE LEVEL	EXISTING CERTIFICATION 2019/2020	INTERVENTION/PROJECT
	3	• ISO 9001:2015 • ISO 14001:2015 • ISO 45001:2018	Authorised Inspection Agency welding certification services: Lloyd's Register, Bureau Veritas, ABS and DNV-GL approved and certified Welding Procedure Specification and Welding Procedure Qualification Record to IACS (EN ISO) and ASME Section IX requirements for various weld types
	2	None	ADEPT Advanced Casting project
	4	• AS/EN 9100 • European Union Aviation Safety Agency POA (Part 21G)	Strategic Supplier Development: Rotational Moulding project
	1	• ISO 9001:2015	Development and implementation of an AS/EN 9100 Aerospace Quality Management System
	1	None	ISO 9001 Quality Management System
	2	None	400 N Gas Turbine Industrialisation project
	1	• J-STD certification from the Institute for Printed Circuits (now Institute for Interconnecting and Packaging Electronic Circuits)	Development of an ARGOS-II Training Simulator project
	2	• AS/EN 9100 • ISO 9001:2015 • Airbus Certification	AS/EN 9100 Aerospace Quality Management System Surveillance Audits

9 Summary of beneficiary organisations

BENEFICIARY NAME	INDUSTRY PARTNERS AND COLLABORATORS	ORGANISATION TYPE	
Denel Aeronautics	• CSIR • Metal Heart • The South African Nuclear Energy Corporation	OEM	
Jonker Sailplanes	• Advanced Composite Solutions • CSIR • Lektratek • OnTrack Technologies • North-West University	SMME	
Kutleng Dynamic Electronic Systems	• AVNET • Kinetic Design • MTT	SMME	
LambdaG	• Metal Heart • NewSpace Systems • Stellenbosch University	SMME	
Lantern Engineering	• PdP Systems • TME Close Corporation • TraX Interconnect • University of Cape Town	EME	
NewSpace Systems	• Kline Engineering • TraX Interconnect • University of Cape Town • Stellenbosch University	SMME	
Paltechnologies	• Bureau Veritas Testing and Inspections South Africa • Lloyd's Register	SMME	

	B-BBEE LEVEL	EXISTING CERTIFICATION 2019/2020	INTERVENTION/PROJECT
	6	• BS EN ISO 9001:2015 • EN 9100:2018 (Technically equivalent to AS9100D) • OHSAS 18001:2007	Design, Optimisation and Characterisation of Aluminium Aerospace Parts Produced by Additive Manufacturing project
	7	• South African Civil Aviation Authority Type certificate for JS1 “Revelation” all variants. • European Union Aviation Safety Agency Type certification for JS-MD Variants	24m Wingspan Open Class JS project
	2	None	SmartCAM project
	2	None	3D-printed Microwave Sub-Assemblies project
	4	None	Lantern Technology Localisation project
	4	• ISO 9001:2015 • ISO 14644-1 • European Space Agency Accredited Technicians	Fluid Loop Inertial Actuator Commercialisation project
	1	• ISO 9001:2015 • PED 2014/68/EU • ISO 14001:2015 • ISO 45001:2018 • SIL L3 61508 & Jaswic	Bureau Veritas and Lloyd’s Register certification of Paltech 80mm, 100mm, 150mm, 200mm and 250mm single eccentric butterfly valves

9 Summary of beneficiary organisations

BENEFICIARY NAME	INDUSTRY PARTNERS AND COLLABORATORS	ORGANISATION TYPE	
Proceptworks	• Air Traffic Navigation Services • Triwave Technologies • University of the Witwatersrand	SMME	
Production Logix	• Aeronet of Things	SMME	
Space Advisory Company	• Barracuda Holdings • Agricultural Research Council Infruitec-Nietvoorbij • National Research Foundation • Spaceteq	SMME	
Ti-TaMED	• Novo Star Management Systems Solutions India	SMME	
TraX Interconnect	• CSIR • Stellenbosch University • University of Cape Town	SMME	

	B-BBEE LEVEL	EXISTING CERTIFICATION 2019/2020	INTERVENTION/PROJECT
	2	None	Sentian UAV project
		• IS0 9001:2015	Development and implementation of an AS/EN 9100 Aerospace Quality Management System
	Non-compliant	None	Cervus Electrical Power System Nano PCU project
	4	• AS/EN 9100 • ISO 9001:2015 • ISO 13485	AS/EN 9100 Aerospace Quality Management System Surveillance Audits
	2	• ISO 9001:2015	Resin-filled via project

10 Abbreviations

AeSSA	Aeronautical Society of South Africa
AISI	Aerospace Industry Support Initiative
CSIR	Council for Scientific and Industrial Research
CT	Computed tomography
EPS	Electrical power system
FLIA	Fluid loop inertial actuator
GPS	Global positioning system
ICASA	Independent Communications Authority of South Africa
JASC	Joint Aerospace Steering Committee
OEM	Original equipment manufacturer
SMME	Small, medium and micro enterprise
the dti	Department of Trade and Industry
the dtic	Department of Trade, Industry and Competition

AISI

Aerospace Industry Support Initiative

an initiative of the dtic

www.aisi.co.za

the dtic

Department:
Trade, Industry and Competition
REPUBLIC OF SOUTH AFRICA

CSIR

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An Initiative of the Department of Trade, Industry and Competition, managed and hosted by the CSIR