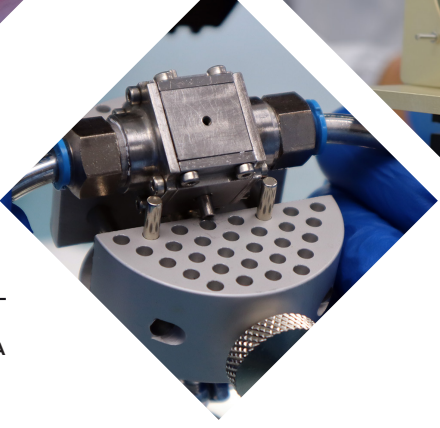
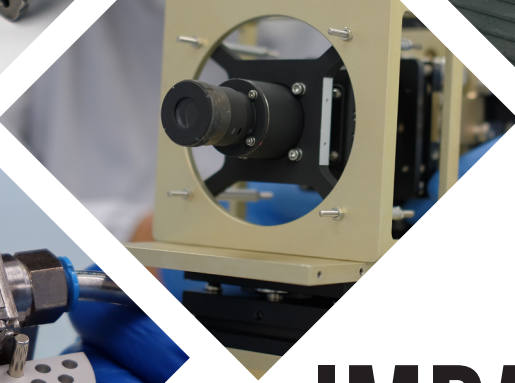




Aerospace Industry Support Initiative

an initiative of **the dtic**



the dtic

Department:
Trade, Industry and Competition
REPUBLIC OF SOUTH AFRICA



CSIR
Touching lives through Innovation

IMPACT REPORT

2020/2021

AISI VISION

To position the South African aerospace-, defence- and marine-related manufacturing industry as a global leader, in niche areas.

AISI MISSION

To enhance the global competitiveness of the South African aerospace-, defence- and marine manufacturing industry by:

- Developing relevant industry-focused capability and facilitate associated transfer of technology to industry;
- Identifying, developing, supporting and promoting the interests and capabilities of the South African aerospace-, defence and marine manufacturing industry;
- Implementing industrial policies in support of government strategic objectives including growth, employment, transformation and equity.

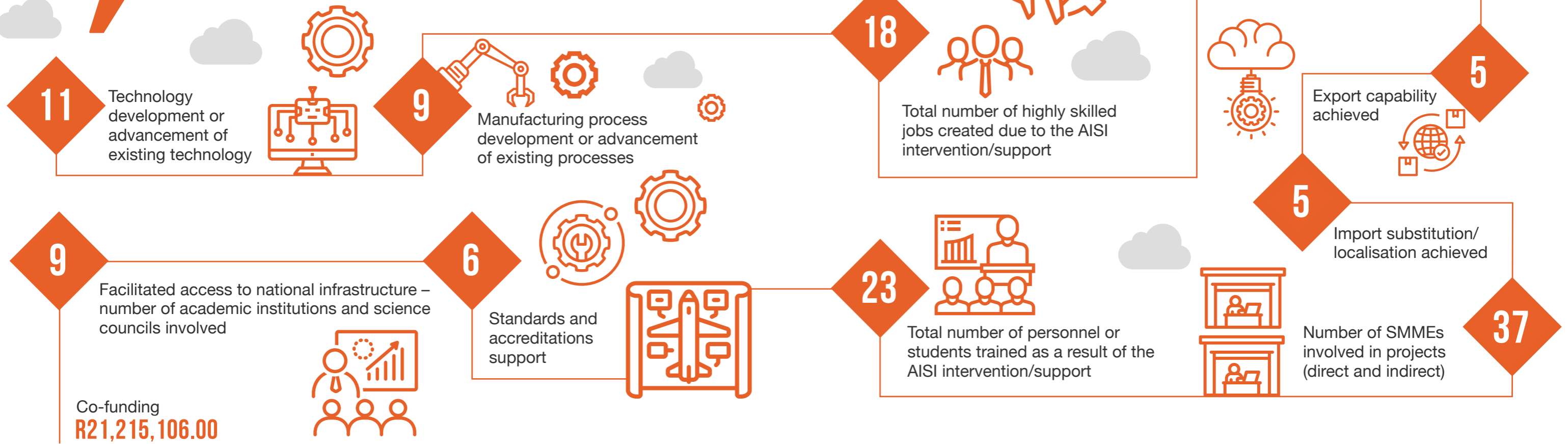
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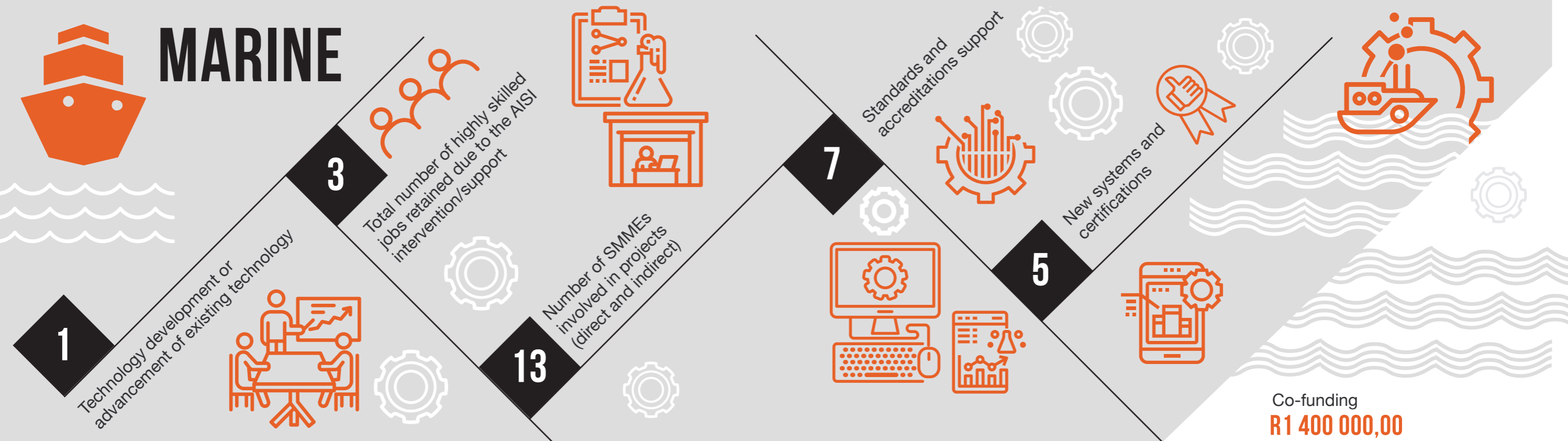
AISI IMPACT AND BENEFITS 2020/2021



AEROSPACE & DEFENCE



MARINE



TECHNOLOGY-BASED SUPPLIER DEVELOPMENT

INTRODUCTION

The Technology-Based Supplier Development is the main programme through which the AISI supports the aeronautics, defence and space industries in South Africa. The programme provides enabling mechanisms to assist industry to improve its competitiveness, productivity and quality management systems. Through this assistance, industry optimises its operations and procedures to ensure that the South African aerospace industry is easily integrated into global supply chains. The strategic focus remains on small, medium and micro enterprises (SMMEs) with the objective of industry transformation, and the broadening of the economic base participating in the industry.

Economic benefits derived through supplier development projects include enhanced competitiveness, increased productivity, integration into supply chains, improved lead times and quality, cost savings, compliance to environmental standards, better delivery performance, higher customer satisfaction, and job creation and retention.

The programme was implemented with increased urgency in 2020/21 to expedite the provision of support to SMMEs that were impacted by the Covid-19 lockdowns and restrictions.

TECHNOLOGY ENHANCEMENT SUPPORT

The companies listed in the following table received AISI support under the technology enhancement intervention in the 2020/21 financial period.

Table 1: AISI technology enhancement beneficiaries during 2020/21

Beneficiary name	Project Title
LambdaG	3D-printed Microwave Sub-Assemblies Project - Phase I and II (Completed Project)
Cape Aerospace Technologies	400N Gas Turbine Industrialisation Project - Phase I (Phase II in Progress)
Aerosud Aviation	Strategic Supplier Development: Rotational Moulding Project - Phase I, II and III (Completed Project)
Jonker Sailplanes	JS Flutter Testing Project (Completed Project)
Proceptworks	Sentian UAV Project (Completed Project)
Lantern Engineering	Lantern Technology Localisation Project (Completed Project)
Jonker Sailplanes	24m Wingspan Open Class JS Project - Phase I (Phase II in Progress)
NewSpace Systems	Fluid Inertial Actuator Commercialisation Project - Phase I and II (Phase III in Progress)

TECHNOLOGY ROADMAPPING FOR TECHNOLOGY ENHANCEMENT

Technology roadmapping continued to be a critical tool used by the AISI to identify technology enhancement projects, and to provide strategic technology management support interventions for SMMEs during the 2020/21 financial period. The tool also helps to verify that projects supported by the AISI, fit into the strategies and technology plans of the benefitting company.

A list of companies that benefitted from the technology roadmapping exercise in 2020/21 follows.

Table 2: AISI technology roadmapping beneficiaries during 2020/21

BENEFICIARY NAME	TYPE OF ORGANISATION	TECHNOLOGY STREAM	TYPE OF TECHNOLOGY ROADMAP
Kutleng Dynamic Electronic Systems	SMME	Avionics, Surveillance and Sensors	Update of existing roadmap
Daliff Precision Engineering	SMME	Aerostructures	Update of existing roadmap
Ti-TaMed	SMME	Aerostructures	New roadmap
LEA Group	SMME	Avionics, Surveillance and Sensors	New roadmap
BM Global	SMME	Avionics, Surveillance and Sensors	New roadmap



Additive manufacturing of microwave sub-assemblies for smaller satellites proves successful and ready for launch



TECHNOLOGY STREAM
Surveillance and sensors



PRODUCT MARKET
Space

BENEFICIARY

LambdaG

PROJECT TITLE

3D-printed Microwave Sub-Assemblies Project - Phase I and II (Completed Project)

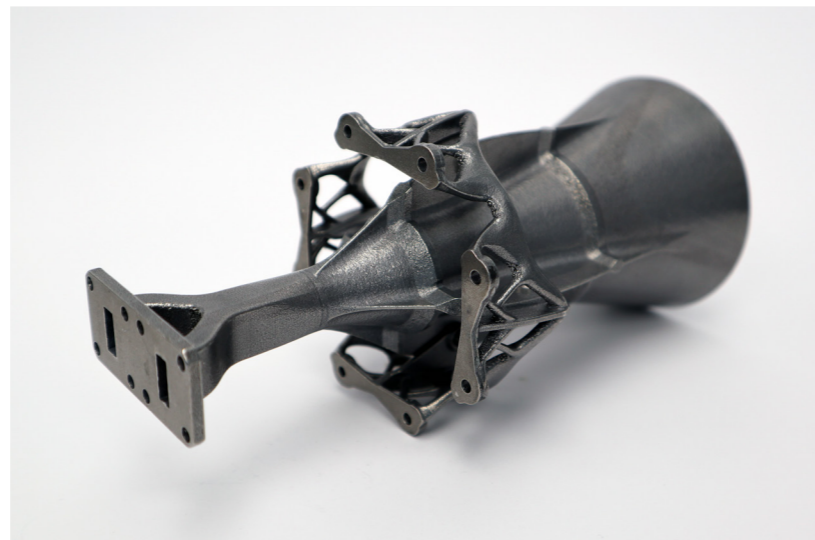
INDUSTRY PARTNERS AND COLLABORATORS

- Metal Heart
- NewSpace Systems
- Stellenbosch University

CONTACT

Vernon Davids - vernon.davids@lambdag.com

LambdaG, a technology company specialising in the design and manufacturing of advanced radio frequency and microwave components, made a decision to develop microwave sub-assemblies using additive manufacturing which has paid off. Using metal 3D printing, the integration of the smooth-walled profiled horn antenna, the stepped septum and waveguide filter into a single microwave sub-assembly, by LambdaG, was successful. LambdaG matured the more complex antenna assembly, optimised for both telemetry and data downlink, up to Ka-band. The additive manufacturing method used was selective laser melting, enabling the fabrication of radio frequency components with complex geometries with reduced size and weight, as available space and weight are at a premium on a small satellite. At Ka-band, a tailored vibratory polishing technique proved to be the best surface finishing method as opposed to complex and costly plating techniques. The surface finish is important to reduce losses in the quality of the signals. During the incubation period the quality of the waveguide components has developed to such an extent that they can now also be offered to the defence and unmanned aerial vehicle (UAV) industry. Although the product is now flight ready, attaining space heritage is vital for market acceptance. The next step is to demonstrate the product in space.



3D-printed microwave subassembly

LambdaG's decision to take a leap of faith in year two of the three-year project to develop microwave sub-assemblies using additive manufacturing has paid off. The sub-assembly is a dual transmit and receive antenna feed system operating at K/Ka-band frequencies and this technology is a key enabling technology in satellite systems.

The LambdaG product ticks numerous boxes in terms of requirements for smaller satellites, notably lightweight, high reliability and high performance. Dr Vernon Davids, CEO of LambdaG, explains how the company outperformed in terms of its own goals. "Following on from the design completed for individual components in the first year of the project, we integrated the horn antenna, the stepped septum (a type of ortho-mode transducer) and the waveguide filter into a single sub-assembly called the transmit and receive integrated assembly. The transmit and receive frequencies are at 26 gigahertz and 23 gigahertz, respectively.

"We took on considerable risks during this part of the project by choosing to mature the more complex antenna which was optimised for the specific frequency band and print components monolithically, in other words, as a single unit. The additive manufacturing method used was selective laser melting. Vibratory polishing proved to be the best finishing method for this sub-assembly as it was compared with several different international plating service providers."

Davids confirms that the design and the manufacturing process have been qualified and the assembly and mounting hardware (brackets) have undergone environmental testing and have passed the strenuous tests. To ensure that the assembly and the brackets can withstand the harsh conditions in space, they were put through thermal cycling (from extremely low to extremely high temperatures) and vibration testing, which simulates launch conditions and conditions in space.

Another significant outcome of the project was the establishment of a local supplier base. In this regard, Davids says that LambdaG has been highly successful:



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

"We have managed to localise the entire supply chain, with the mutual goal among the partners and collaborators to mature this technology, and post-process (clean and finish) these radio frequency components." The project has proved that lightweight, high-performance radio frequency components can be locally manufactured for spaceflight at low cost using additive manufacturing.

TAKING ON INTERNATIONAL COMPETITION

Davids points out that the outcome of the project has put LambdaG in the same class as European manufacturers. "Our assembly is as good as those produced in Europe and conforms to the same verification standards. We are also able to adapt our design and manufacturing process for specific missions as specified by our clients." Fine-tuning of the manufacturing process and know-how remains an ongoing priority.

LambdaG works with academia and other private partners both nationally and internationally, such as the Materials Engineering Group at Stellenbosch University. Davids highlights one significant link as an application for a collaborative R&D project titled 'Precision Additive Manufacturing of Novel Devices and Antennas for Space Applications' between LambdaG, the University of Pretoria, Multipick (Germany) and the Fraunhofer FHR Institute (Germany). The application, although unsuccessful during the final stages of assessment, proved to be an ambitious and exciting opportunity for applied research and product innovation.

This additive manufacturing technology has been showcased at several exhibitions and conferences locally and internationally and continues to garner interest from customers such as satellite system integrators. Locally, conversations have also focused on the possibility of applying the technology to UAVs. Similar to satellites, size and weight are important parameters for any equipment onboard a UAV. The design and manufacturing of the LambdaG waveguides makes diversification into the defence or UAV sectors very feasible, which is actively being investigated.

The next step for LambdaG's assembly is commercialisation and to demonstrate this technology in space on either a paid-for flight opportunity or a technology demonstration mission. Davids confirms, "The South African National Space Agency is planning a heritage space mission, and we'll explore this opportunity with them."

Davids and the team, which includes Riddhi Maharaj and Dr Melissa Boonzaaier-Davids, sum up the highlight of the project to date: "After year two we have a flight-ready product with mounting accessories in hand. The supply chain is completely localised thereby enhancing South Africa's technological competitiveness globally."

WAVEGUIDE

A waveguide is a hollow metal tube used for the transmission of electromagnetic waves. The waveguide can incorporate a filtering function that only allows signals at some frequencies to pass, while others are rejected.

K/KA-BAND FREQUENCIES

The Ka-band in the microwave part of the electromagnetic spectrum covers frequencies from 18 to 27 gigahertz.

The Ka-band is a portion of the microwave part of the electromagnetic spectrum defined as frequencies from 26 to 40 gigahertz.

GIGAHERTZ

A measure of frequency equivalent to one thousand million (10⁹) cycles per second.

IMPORT
SUBSTITUTION/
LOCALISATION
ACHIEVED

2 SMMES
INVOLVED IN
THE PROJECT



Development of local micro gas turbine engine enters penultimate stages



TECHNOLOGY STREAM
Propulsion



PRODUCT MARKET
Recreational aviation aircraft and unmanned systems

BENEFICIARY

Cape Aerospace Technologies

PROJECT TITLE

400 N Gas Turbine Industrialisation Project – Phase I (Phase II in Progress)

INDUSTRY PARTNERS AND COLLABORATORS

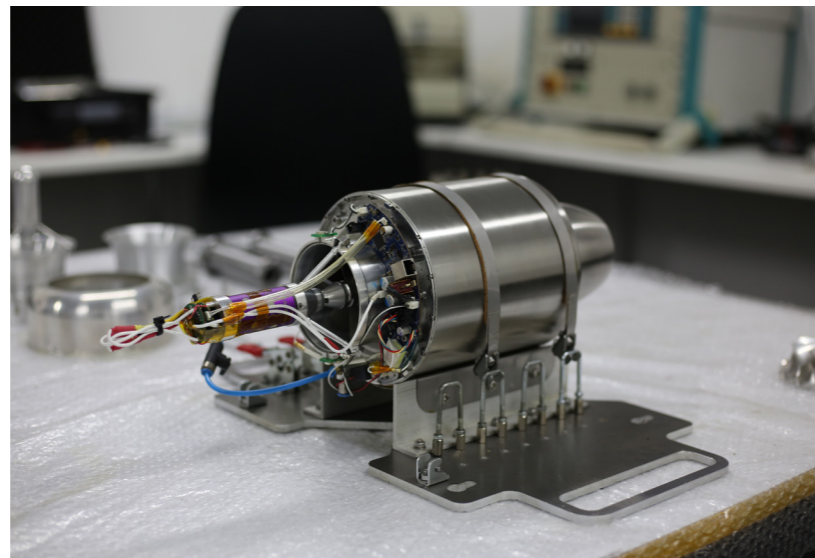
Stellenbosch University

CONTACT

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The ongoing relationship between Cape Aerospace Technologies (a 51% black-owned SMME) and the AISI is yet again delivering a product that will contribute to the South African aerospace market. The recent focus of Cape Aerospace Technologies’s micro gas turbine project has been on component manufacture of design systems, sub-system assembly and testing. Major strides were achieved, though planning of the manufacturing process as software has been developed to enable digital manufacturing with built-in quality control checks to eliminate rejects. The 400 N micro gas turbine is a localisation opportunity for a real market need. This development project is close to fruition and the gas turbine will soon be available for integration within the local and global aerospace markets for uptake in civilian (e.g. sailplanes) and defence applications.

Cape Aerospace Technologies has made good progress on the development of its micro gas turbine or turbojet engine with a proposed static thrust of 400 N. Leading the project is David Krige, Managing Director and Head of Turbomachinery and Propulsion Systems, who reveals that the team is currently working on component



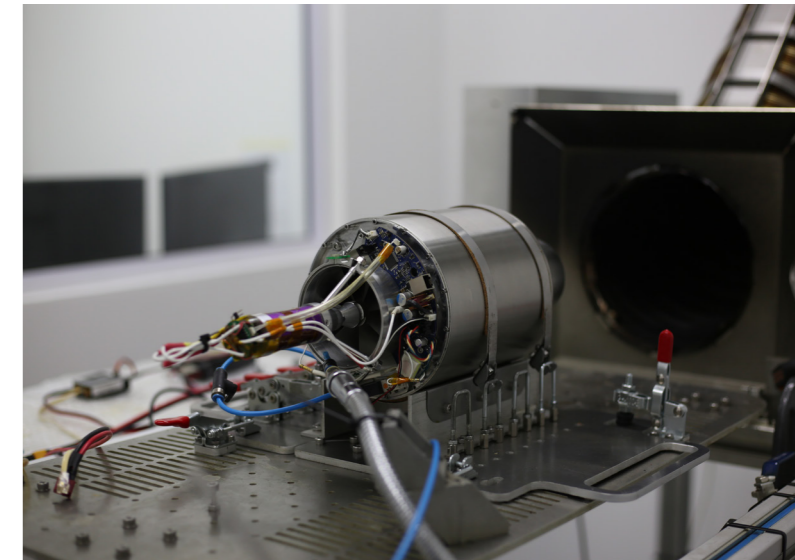
CAT400 Turbojet Prototype on testbed platter

manufacture of design systems, sub-system assembly and testing. This is the next step after the successful completion of the design of the engine with specifications as follows: maximum thrust at 100 000 revolutions per minute; 400 N static thrust; an exhaust gas temperature not exceeding 800°C; ground and in-flight relight capability; and a mass that does not exceed 4 kg with all ancillaries.

The company’s extensive experience in the design of turbine engines plays to its advantage. One example of a successful engine manufactured by Cape Aerospace Technologies is the 250 N gas engine currently used by hobbyists. The 250 N project was an AISI-supported project with skills and knowledge transferred from Stellenbosch University as well as the CSIR to Cape Aerospace Technologies. The know-how gained from past successes has enabled the smooth implementation of the 400 N gas turbine engine project.

The planning that went into the manufacturing of the turbine components was meticulous, and the project purposely used mainly local materials supplemented by imported material as needed. The planning allowed for more time to be committed to the manufacturing of complex components, while easier-to-manufacture components were completed with relative ease with no interruption to other processes. The use of software to enable digital manufacturing, is essential. Krige explains, “Our digital manufacturing process has built-in quality control to separate approved parts from the rejects.” The impressive list of components required can run to over 350 parts in total; each part is there for a reason. The team also uses components off-the-shelf as needed. Once all the components are ready, assembly is done in different laboratories that serve as controlled environments.

Optimisation of the combustion chamber (an essential part of the engine together with the compressor and the turbine) is an iterative and time-consuming experimental process, proving the point that there are no shortcuts in product development processes. Krige makes the point that while software is used for design of the combustion chamber, the accuracy of software results must always be



CAT400 Turbojet engine on Testbed in Turbine Test Lab

verified and this is done by conducting post-machining checks. “Verifying the analytical results is essential,” Krige says.

Krige confirms that most manufacturing has been completed and assembly of all approved sub-systems as part of the prototype is underway. Sub-system experimental testing is needed to finalise and optimise the turbine. Cape Aerospace Technologies’s testing rooms with the necessary equipment contribute to efficiency in this regard to avoid as far as possible potential ‘bugs’ during final engine testing.

Another key element is to ensure that the turbine is capable of an extremely fast start-up time, a requirement that was articulated by clients and a highlight of the project. Start-up in this case is the time required from

0 revolutions per minute to the idling speed of 32 000 revolutions per minute. Cape Aerospace Technologies is a global leader in technology for fast and reliable turbine starts that also have the added ability to relight at high altitude. This expertise was harnessed for the 400 N micro gas turbine project, and the team is anticipating another major advantage of the turbine exceeding thrust requirements.

Cape Aerospace Technologies is well ahead of its timelines on this project and is looking forward to the outcome of the prototype testing which will lead into production. Krige confirms, "Once we move into preproduction and production, more standards and tests are required to ensure the quality of our product."

There is strong interest locally and internationally in this micro gas turbine for both civilian and defence applications. Krige envisages that the product will sell locally and will also be exported. "This lies in the future, and we are looking forward to recouping the investment made into the research and development of this project. Our most valuable assets right now are the know-how and documented processes generated for this project. This intellectual property belongs to the company, and we intend building on and improving it as we go along."

Prospects for Cape Aerospace Technologies's newest kid on the block are indeed positive.

N (NEWTON) IS A UNIT OF FORCE REQUIRED TO MAKE A MASS OF ONE KILOGRAM ACCELERATE AT A RATE OF ONE METRE PER SECOND SQUARED.

Localised micro gas turbine specifications: maximum thrust at 100 000 revolutions per minute; 400 N static thrust; an exhaust gas temperature not exceeding 800°C; ground and in-flight relight capability; and a mass that does not exceed 4 kg with all ancillaries.

THRUST

THRUST IS A MECHANICAL FORCE GENERATED BY AN ENGINE THROUGH A PROPULSION SYSTEM.

EXPORT
CAPABILITY
ACHIEVED

1
FEMALE JOB
RETAINED

3
YOUTH JOBS
RETAINED

2
BLACK JOBS
RETAINED

Successful system and manufacturing process audit concludes with certified aerospace supplier for Aerosud



TECHNOLOGY STREAM
Aerostructures



PRODUCT MARKET
Commercial aviation aircraft

BENEFICIARY

Aerosud Aviation

PROJECT TITLE

Strategic Supplier Development: Rotational Moulding Project – Phase I, II and III (Completed Project)

INDUSTRY PARTNERS AND COLLABORATORS

- Persico
- Pioneer Plastics
- University of Pretoria

CONTACT

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Persico Leonardo SMART machine for rotational moulding

Aerosud Aviation successfully concluded a project to assist Pioneer Plastics (Pty) Ltd to develop its competency as a rotational moulding aerospace supplier. An important part of the project was to develop certified processes to manufacture the subcomponents needed. This included defining the new processes, compiling of process documentation, and the process development itself. The full system and manufacturing process were audited successfully. Pioneer Plastics has been certified as an approved Aerosud supplier for the manufacture of Aerosud’s cellular cores for their composite components. This enabled Pioneer Plastics to supply to the aerospace sector for the first time, opening up new markets for the SMME. This project showcases the successful implementation of a project where an original equipment manufacturer integrates an SMME into its supply chain, with each focusing on complementary critical capabilities for increased localisation.

Aerosud Aviation has successfully partnered for three years with Pioneer Plastics (Pty) Ltd, a local SMME, to develop its competency as a rotational moulding supplier, opening a new market for the company. Access to this technical competency is essential for the patented cellular core technology used by Aerosud Aviation to produce complex integral structures from carbon fibre ‘prepreg’ material (a common term for fabric reinforcement that has been pre-impregnated with a resin system).



Precision control of processing parameters such as internal temperature, internal pressure, external cooling with direct heating technology

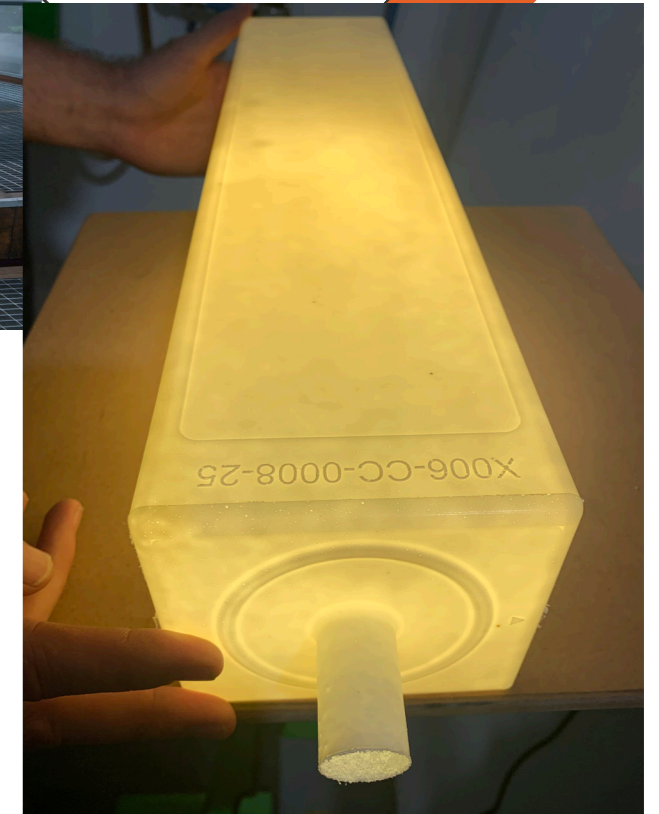
Wouter Gerber, Senior Manager; Research and Development at Aerosud Aviation, is delighted with the outcome of the project, “In partnership with Pioneer Plastics, we have met all the objectives of the project on which we worked concurrently. It has been a pleasure to work with this company and we are grateful for the support received from the AISI for three years.

“The first objective was to create an integrated manufacturing execution system-enabled platform for moulded cores. All communications are now live between the manufacturing facility at Pioneer Plastics and Aerosud. The system was tested and is now in use for the process development activities.

“The second objective was to establish the correct infrastructure and equipment at Pioneer Plastics. The new facility with the Leonardo SMART rotational moulding system acquired from Persico of Italy has been fully outfitted to support the required level needed to supply cellular core components to Aerosud.” Pioneer Plastics is the first company in South Africa and the Southern Hemisphere with this state-of-the-art rotational moulding facility.

QUALITY MATTERS

The third objective was to develop certified processes to manufacture the subcomponents needed. This included defining the new processes, compiling of process documentation, and the process development itself. Gerber confirms, “This is the golden thread in development and production. It ensures common terminology and a narrative of how and why things fit together.”



Rotationally moulded engineering thermoplastic part

The definition of the new processes covered several important activities. It focused on developing the new manufacturing process flow for certified components (including initial processing trials and lessons learnt). Pioneer Plastics is now an approved supplier of Aerosud Aviation following a business agreement between the two companies. Pioneer Plastics is required to deliver parts with a Certificate of Conformance, and stock codes as an identification process for batch production by Pioneer Plastics is now a standard practice.

Quality is always top of mind in manufacturing; therefore, process and acceptance documentation were required to certify the rotational moulding process. This includes a process manual with so-called ‘frozen recipes’ (which are stable, robust and repeatable) for the rotational moulding of various cellular core part numbers by Pioneer Plastics. A process manual of acceptance criteria of rotational-moulded cellular cores is, Gerber explains, vital: “Items are inspected individually and criteria for acceptance or

rejection must be absolutely clear to the person doing the inspection, so as to ensure the success of the next part of the manufacturing process.” An Aerospace level 2 inspection (against either an Aerosud Technical Sheet or an Aerosud Quality Inspection Method) is part of the quality conformance checks for each item, which must be either passed or failed.

Qualifying the process for certification is the final step. It includes a technical audit process once a year to ensure that equipment is within calibration and has been serviced regularly. A surveillance audit process lines up the requirements of the process against stipulated supply chain policies and procedures. The rotational moulding process of the cellular cores is audited by the Aerosud Quality Assurance and Process Engineer. Discrepancies defined as findings are documented for Pioneer Plastics to rectify. The signing off of the rotational moulding process concludes the auditing and qualifies Pioneer Plastics to manufacture Aerosud’s cellular cores in accordance with the stipulated processes against the defined acceptance criteria.

Gerber concludes, “The project has concluded perfectly. All the required machines, systems and amenities for the new facility, which were identified, procured and installed earlier in the project, have been effectively demonstrated. There has been successful integration of the equipment and systems by both Aerosud and Pioneer Plastics. The rotational moulding machine is commissioned, and the full system and manufacturing process audited successfully. Pioneer Plastics has been certified as an Approved Aerosud Supplier for the manufacture of Aerosud’s cellular cores. The process is now robustly and reliably developed and industrialised to support production.

1
**YOUTH JOB
CREATED**

5
**JOBS
RETAINED**

2
**SMMES
INVOLVED**

**STRONG SKILLS
DEVELOPMENT**

Flutter analysis results take Jonker Sailplanes's JS3 RES closer to international certification



TECHNOLOGY STREAM
Aerostructures



PRODUCT MARKET
Recreational aviation aircraft

BENEFICIARY

Jonker Sailplanes

PROJECT TITLE

JS3 RES Flutter Testing Project
(Completed Project)

INDUSTRY PARTNERS AND COLLABORATORS

CSIR

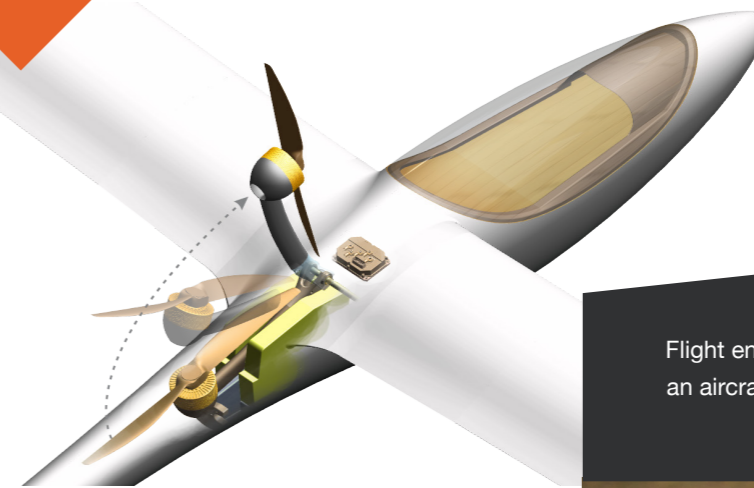
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Jonker Sailplanes's JS3 RES self-launching glider has undergone flutter analysis at the CSIR to determine the flutter speed of the aircraft for the configurations in which the glider will be used. Due to the similarity of the JS3 RES aircraft compared to the JS3 model, only analytical changes for the JS3 RES were made to the existing flutter analysis model of the JS3. These changes were based on the changed structural data supplied by Jonker Sailplanes and in line with the flight envelope of the aircraft. The aircraft met the requirement for CS-22 certification; it also underwent flutter flight testing. Europe is an important market for Jonker Sailplanes products, and certification of the JS3 RES under European Union Aviation Safety Agency (EASA) regulations will open up export opportunities, as was the case for other Jonker Sailplanes's aircraft models.

Jonker Sailplanes's products include the JS3 RES model, which has the option of a retractable electrical propulsion (RES) as a sustainer and a self-launcher up to maximum weight. The JS3 RES model, as it is known, has undergone flutter analysis to determine the flutter speed of predominant configurations (with water ballast and without water ballast) in which the glider will be used. Demonstrating that an aircraft is free from flutter is an important aspect to prove airworthiness and safety for civil aircraft. The flutter analysis is part of the compliance process required by the EASA for CS-22 certification for sailplanes and powered sailplanes. The flutter analysis was conducted by the CSIR's Dr Louw van Zyl.

Flutter denotes the vibration of an aircraft as it draws energy from the airflow and depends on its operating speed. When the aircraft flies above its flutter speed, the vibrations increase and change from stable to unstable which can destroy the aircraft. Jonker Sailplanes's AP Kotze explains the necessity for flutter analysis of the JS3 RES, "We modified the characteristics of the JS3 airframe, specifically the stiffness in the rear of the fuselage, and added extra weight in the form of a larger tailplane. The CSIR had done flutter analysis of the previous model of the JS3. Deviations on this model meant that we did not



Flight envelope refers to the capabilities of an aircraft design in terms of airspeed and altitude for aircraft.

have to start from scratch on the flutter analysis of the JS3 RES. By providing Dr van Zyl with the new characteristics of the airframe, a mathematical model could be created from the existing one."

Van Zyl says, "Analytical changes for JS3 RES were made to the existing flutter analysis model, based on the data supplied by Jonker Sailplanes and in line with the flight envelope of the aircraft. The flutter analysis to identify potentially dangerous flutter phenomena for the various configurations took six weeks. I'm happy to report that the aircraft met the requirement for certification."

The choice of the CSIR as a partner for the flutter analysis has been advantageous in many respects. A good relationship has been built over many years with Van Zyl, who works at the CSIR's site in Pretoria, located reasonably close to Jonker Sailplanes. "We value the opportunity to use a local expert whom we know and respect, and who understands our work. As Jonker Sailplanes, we look forward to future engagement with Dr Van Zyl," says Kotze. Van Zyl performs flutter analyses and flutter flight testing for European companies that require compliance to EASA flutter certification standards.

In addition to the flutter analysis for the JS3 RES, Jonker Sailplanes is legally required to do a flutter flight test of the JS3 RES for CS-22 certification. Kotze notes, "Although flutter analysis is not a perfect science, results from the analysis have given us some peace of mind and lowered the risk factors before we did the flutter flight test." The flutter flight test is conducted to verify the results of the flutter analysis through actual measurements and proving the flutter-free flight envelope.

SEAL OF CERTIFICATION

Documentation required for the JS3 RES's CS-22 certification is in the final stages of revision, and full certification is expected during the last quarter of 2021. Sailplanes are built to order by local and international customers; the majority of Jonker Sailplanes customers are based in Europe. Kotze is confident that demand for



JS1 Jet Sustainer System

the JS3 RES will boost the order book and translate into sales. "Our hope is that this will ensure a steady flow of foreign currency into South Africa which will make it possible for us to keep paying salaries to our staff here in Potchefstroom," he points out.

Kotze concludes, "A highlight to date on this project has been the successful flutter flight testing with the engine system, as well as other configurations, which was done by Uys Jonker of Jonker Sailplanes. The ultimate win will be the approval of certification from the European Union Aviation Safety Agency."

Quality and reliability to enhance flying experience: these are hallmarks of Jonker Sailplanes's JS3 RES.

**130
JOBS
RETAINED**

**LUCRATIVE
EXPORT
OPPORTUNITIES
FOR SOUTH
AFRICA**

Prototype of unmanned aerial vehicle successfully takes flight despite challenges



TECHNOLOGY STREAM

Aerostructures and surveillance and sensor systems



PRODUCT MARKET

Unmanned systems

BENEFICIARY

Sentian Aerospace (previously Proceptworks)

PROJECT TITLE

Sentian UAV Project (Completed Project)

INDUSTRY PARTNERS AND COLLABORATORS

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

CONTACT

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The development work on the Sentian unmanned aerial vehicle (UAV), a long-range, multi-role UAV, has culminated in a prototype. The Sentian Aerospace (previously Proceptworks) team faced and overcame several challenges in the process. The prototype has successfully demonstrated vertical take-off, thereby allowing the team to take on further work required for certification of the product. Another notable achievement by Proceptworks is the integration with industry as two existing aerospace companies provided support and guidance towards the project. Unique innovations characterise the Sentian UAV, which set it apart from other products currently on the market. Promising applications for the Sentian UAV include conservation and border control surveillance as well as sea search and rescue.

Sentian Aerospace (previously Proceptworks) is a black-owned start-up that has made tremendous progress within a short space of time. A team of four enthusiastic young engineers initiated the UAV project in a garage in 2019 and in 2020/21 celebrated its completion. The success demonstrated by the company has not gone unnoticed, as the company won two awards in 2019, namely The Avi-Afrique award hosted by Air Traffic and Navigation Services (ATNS) and the innovation award from the Commercial Aviation Association of Southern Africa (CAASA).



Sentian Drone 1.0 prototype

The long-range, multi-role UAV developed by the team is called 'Sentian'. This success is the outcome of the determination and commitment of the team to devise solutions to the challenges encountered during the project. Dalumuzi Dube shares the team's vision, "Our main objective of the project was to develop a full-scale model or prototype of the aircraft using advanced materials and processes. We also wanted to establish the requirements for the development of this aircraft and learn the requirements associated with project management at this large scale."

Funding and equipment posed significant challenges as the original decision to use a computer numerical control machine to produce the moulds for the parts was too expensive. 3D printing (a type of advanced manufacturing) proved to be an affordable alternative although it was a slower process.

Once the parts had been successfully produced, the team found themselves in a tight spot as the assembly of the prototype required a bigger space. Paramount Group offered the team the use of a workshop, materials and machine assembly equipment to complete this final stage. This incubation by the Paramount Group provided an excellent opportunity for Sentian Aerospace to interact directly with an original equipment manufacturer and allowed them to move to an environment better suited to the company's needs. In addition, ATNS supported Sentian Aerospace by supplying it with material.

UNIQUE MARKET POSITIONING

A requirement of the Sentian UAV is that the aircraft must be flown by a pilot. The Sentian UAV has a vertical take-off and landing system, and incorporates a propeller driven by a small fuel-efficient piston petrol engine at the rear of the aircraft. This generates enough thrust to remain airborne. Dube explains, "The UAV can circle an object of interest." The UAV is programmed by the pilot for flight, including altitude and speed, and has a transponder that is constantly being pinged, helping air traffic controllers on the ground determine its speed, altitude and direction.

The UAV enjoys several market advantages vis-à-vis other products available locally. Four tiers of innovation penetration have been identified. These are lower operating costs per hour; its ability to integrate a variety of payloads;



Nigel Nkundhlande (CTO), Muzi Dube (CEO), Mama Africa, Ishmael Chiremba (COO) and Edmund Moyo (CFO)

its long-range and full-day performance ability (flying from Johannesburg to Bloemfontein and back is possible) and it will be able to reach speeds of up to 300 km per hour. Last but not least is the ability to automate systems that are part of the payload, such as heat-seeking sensors and aerial data collection cameras.

Dube is enthusiastic about the prospects for this unique product, "It has caught the attention of conservation agencies responsible for vast tracts of land covered with vegetation where patrolling by vehicle or on foot is time-consuming. Border patrol is also possible using this UAV. Search and rescue at sea with lower cost is another application."

Completion of the prototype paves the way forward for the team to continue further development work and certification by the local aviation certification authority. Dube projects that once in production, the team will roll out 12 aircraft every year (one per month).

For now, nothing can match the jubilation of the Sentian Aerospace team when the prototype took flight. This was clear confirmation of their dream come true.

4
YOUTH JOBS
CREATED

4
STRONG SKILLS
DEVELOPMENT

Successful localisation of data radio technology strengthens company's competitive edge



TECHNOLOGY STREAM
Information systems



PRODUCT MARKET
Military systems

BENEFICIARY

Lantern Engineering

PROJECT TITLE

Lantern Technology Localisation Project
(Completed Project)

INDUSTRY PARTNERS AND COLLABORATORS

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

CONTACT

Chris Williams – cwilliams@lanterneng.com

The localisation of a software-defined radio for use in unmanned aerial vehicles (UAV) by Lantern Engineering has been successful. The product has been range-tested over a distance of more than 22 km and will be expanded in operational range and features in 2021/22. In the meantime, the product has attracted market attention and Lantern Engineering has used the opportunity to establish distinct yet interrelated areas of expertise, notably long-range high bandwidth radios, automation/control systems as well as payload processing systems. Its ongoing commitment to innovation and localisation, coupled with its demonstrated mastery of the relevant technology, puts it in a strong competitive position.

Lantern Engineering (Pty) Ltd has completed the project to localise its software-defined radio technology capability. This milestone marks not only the achievement of its clearly articulated project objectives, but also the establishment of the range of its capabilities as a competitive South African company.

Chris Williams, Chief Executive Officer of Lantern Engineering, points out, "In pursuing our objectives, we set out to appoint and train engineers and a technician, establish and acquire the requisite tools, complete the software and firmware application development, and conduct the functional product qualification testing. Through the successful development of the product, we have demonstrated convincingly that we need no longer rely on offshore service partners."



High Bandwidth, Long Range Radio with Video Processing for use in Unmanned(UAV)/Drone applications

A range test of the Lantern data radio was conducted in the Overberg region of the Western Cape, where its efficacy without data loss at over 22 km was demonstrated. Williams says, "We intend to expand the operational range and product feature-set considerably in 2021/22. At present, the demonstration and test have proved that we have a functional product that requires only formal environmental qualification and electromagnetic compatibility/safety certification in order to be sold in the market."

THE WAY FORWARD

Williams confirms that the successful development of this product to date has piqued the interest of several local unmanned vehicle systems integrators. This has led to strong market engagement and contracts with companies that export technology, products and systems from South Africa.

A further promising outcome of this project for Lantern Engineering is its establishment of three distinct yet interrelated areas of expertise, notably long-range high bandwidth radios, automation/control systems as well as payload processing systems. Williams points out, "Our intellectual property is built up in these three areas and our capability spans the complete product development and production lifecycle. Our plan is to innovate using these building blocks with ongoing localisation in all three areas. In this way, our position will be strengthened in the highly competitive high-technology market where unmanned vehicle systems integrators look for innovative products." He is confident that the pending launch of Lantern Engineering's capabilities will herald in the next stage of growth for the company with offerings relevant to communications, video processing, computing, automation and control systems and encryption.

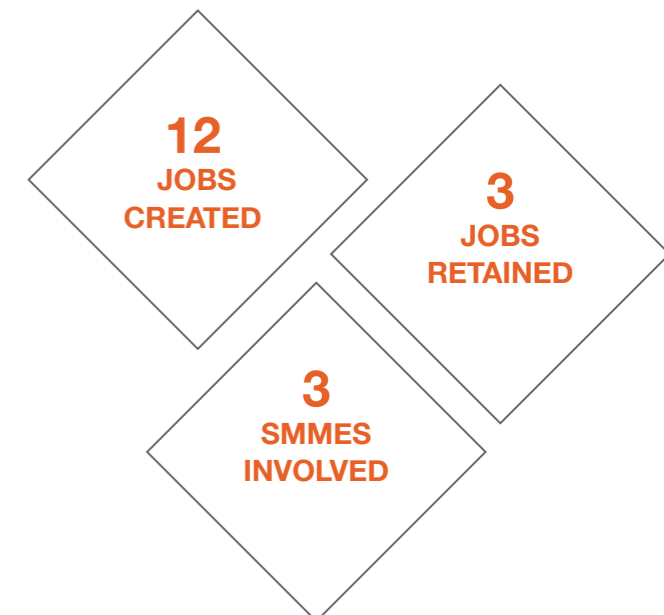
The commitment to finding and training the right people holds future benefits for Lantern Engineering. As a 100% black-owned company, it is dedicated to transformation and the training of young people by giving them a 'home' for their skills and thereby growing the next generation of engineers to serve the local market. The innovative ability of its teams vests in the combination of experience and guidance by more mature staff with



Development and Test environment for a Radio/Video processor to enable Long Range Unmanned(UAV)/Drone operations

the enthusiasm and willingness of younger members to learn through online or even formal training and apply new technologies in their work. "This gives us our competitive edge," says Williams.

He regards Lantern Engineering's demonstrated ability to localise the core technology needed for the Lantern software-defined radio as a highlight of the project. He says, "We have not only succeeded in delivering on the project but have demonstrated our mastery of the technology used in this domain. Our ability to provide a product for long-range, high-capacity and secure datalinks as part of an integrated UAV system puts us in a unique position."



Development of revolutionary new glider to outperform competition in the global market



TECHNOLOGY STREAM
Aerostructures



PRODUCT MARKET
Recreational aviation aircraft

BENEFICIARY

Jonker Sailplanes

PROJECT TITLE

24m Wingspan Open Class JS Project – Phase I
(Phase II in Progress)

INDUSTRY PARTNERS AND COLLABORATORS

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

CONTACT

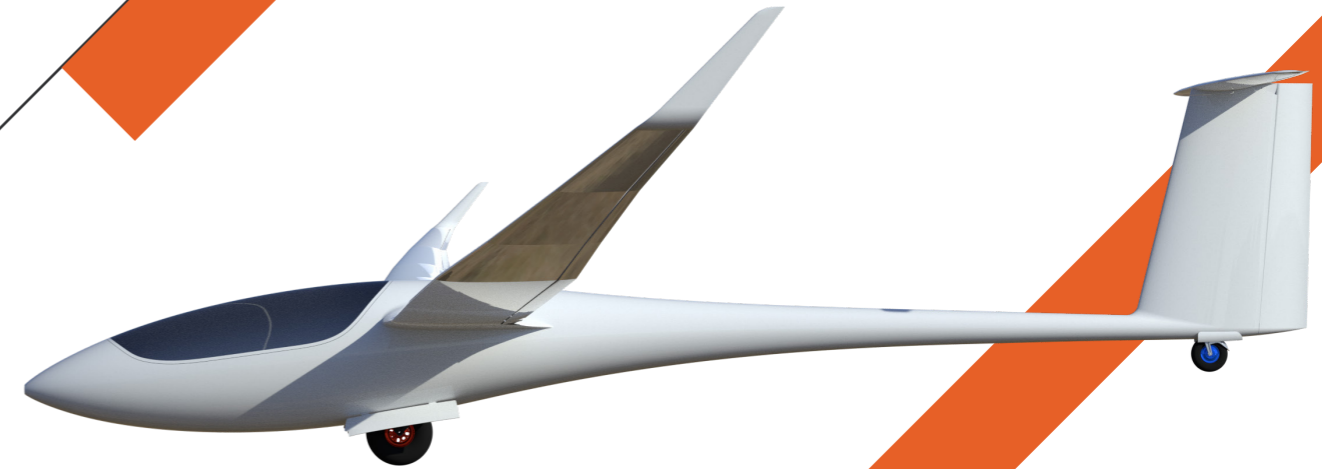
AP Kotze – ap.kotze@js1.co.za

The development of a new glider with a 24m wingspan by Jonker Sailplanes will re-establish the company as a leader in the global marketplace. Following completion of the structural design, the team worked on certification compliance documentation. A separate development facility was upgraded and development work on the moulds for production of the 24m wing was completed. Finite element analysis was done on the full model of the wing to remedy structure and layout to combat deformation of the 24m wing. Once completed, this project will make a major contribution to South Africa's export objectives, particularly in the European and Australian markets. In addition, Jonker Sailplanes's global position as a manufacturer and exporter of advanced, competitive and highly sought-after sailplanes will be cemented.

The determination of Jonker Sailplanes to deliver a JS glider to outperform the current Open Class competition leader EB29R of Binder Flugzeugbau has seen the development of a revolutionary new glider with a 24m wingspan. Jonker Sailplanes's aerodynamic team did preliminary performance calculations to demonstrate that the EB29R (with its 28m wingspan) could be beaten with new technology applied on the 24m wingspan. This will put Jonker Sailplanes in the leading position of the global market for gliders.

This ambitious project which commenced in 2018 has achieved several milestones to date. AP Kotze, Project Leader at Jonker Sailplanes, says, "One of the main aims of the project has been to develop a new 24m wing. This will enable us to replace the JS1 product that has now become outdated and manufacture a glider with an improved 24m wingspan for the Open Class competition." Glider pilots in Europe expressed an interest in a new JS product with enhanced capabilities.

The critical structural design of the new glider was completed during the first year of the project and in 2020 during the national Covid-19 lockdown, the engineering team worked on the main certification compliance documentation.



COMPLEX PRODUCTION REQUIREMENTS

Several decisions were made to ensure that the project maintained momentum despite changes to the project plan, necessitated by the effects of the lockdown. Kotze points out, "We found that the detailed design work took significant longer than expected, as this is the most complex project that Jonker Sailplanes has undertaken to date."

One of these decisions was to upgrade a separate facility in which to do development work. Kotze notes, "We took this decision to safeguard the production of our other products." This entailed new lighting, upgraded electricity to accommodate a diesel generator for power during loadshedding, and levelling tables to manufacture the backing structure for the moulds.

Moulds are used to manufacture the 24m wing according to design specifications. The team refined and documented the process for the production of the 24m wing mould, thereby facilitating necessary follow-up tests.

One of the challenges for the team was the static deformation or bending of the longer wing, as a result of ballast water in the wing required to keep the glider stable during flight. Finite element analysis was undertaken to ascertain possible deformation of the wing on take-off. Interestingly, this became one of the highlights of the project at Jonker Sailplanes as it was the first time finite element analysis was done on the full model of the wing. Kotze confirms, "This work is ongoing now, as numerical methods allow us to continue with refining the geometric design, while additional strength analysis helps us to confirm changes to layout and structure."



S5 Wing Mould Backing Structure

Although several other design aspects still require investigation, work on this development is progressing well. Kotze warns, "We must avoid slips in quality at all costs. We have skilled resources working on this project and look forward to the prototyping of this new glider once all design and manufacturing aspects have been addressed. Our aim is to launch this product into the market and see it soar in the sky!"

**3
SMMES
INVOLVED**

**EXPORT
CAPABILITY
AND IMPORT
SUBSTITUTION/
LOCALISATION
ACHIEVED**

Novel technology for attitude control of satellites enters final development phase



TECHNOLOGY STREAM
Surveillance and sensor systems



PRODUCT MARKET
Space

BENEFICIARY

NewSpace Systems

PROJECT TITLE

Fluid Inertial Actuator Commercialisation Project – Phase I and II (Phase III in Progress)

INDUSTRY PARTNERS AND COLLABORATORS

- StarkCNC
- Carbo3
- RS Components (SA)
- Aerontec
- Clear Design Display

CONTACT

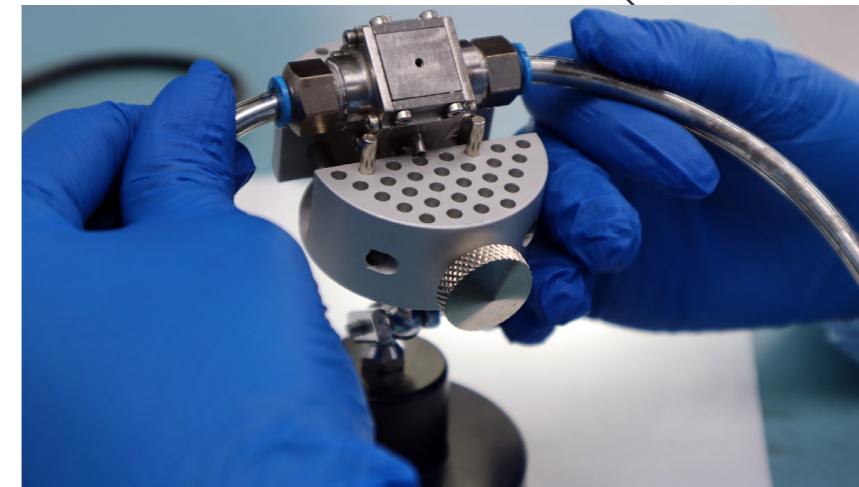
James Barrington-Brown –
jbb@newspacesystems.com

NewSpace Systems, an SMME aiming to disrupt the space industry, has been building and testing the flight readiness of a single-axis fluid loop inertial actuator for use on a 1U CubeSat. It has a magneto-hydrodynamic pump (with no moving mechanical parts) and a liquid metal (Galinstan) as working fluid, which has successfully been designed, manufactured and verified. The electrical design of the fluid loop inertial actuator is also complete. To prevent oxidation of the working fluid, ultra-low concentration of oxygen is required, and the team is working to achieve this milestone.

NewSpace Systems has embarked on the building and testing for flight readiness of a single-axis fluid loop inertial actuator for use in satellites, as compared to traditional mechanical actuators. This is the final step in this project to develop a novel and versatile alternative for attitude control actuation to the traditional reaction wheel technology. The novelty lies in the 3D orientation by which flowrate and flow changes are possible in three directions in the single fluid loop, generating angular momentum and torque, thereby acting as an actuator. This project serves as an excellent example of how AISI support can assist local SMMEs to create disruptive



Fluid loop being filled in glovebox



Close up of MHD pump

technologies for the sector, thereby contributing towards South Africa's competitiveness.

The initial two phases of this project successfully developed a mathematical model for sizing the fluid loop inertial actuator design parameters in line with the customer's satellite size and mission requirements. A single-axis fluid loop inertial actuator was built using components off-the-shelf and demonstrated; an air-bearing table was also built for its testing and verification. Next, a three-axis fluid loop inertial actuator with a single pump was tested during the second year of the project.

STEPS TOWARDS A FLIGHT-READY FLUID LOOP INERTIAL ACTUATOR

The next phase has been the design and manufacture of the flight-ready single-axis fluid loop inertial actuator. This focused on a magneto-hydrodynamic pump (with no moving mechanical parts) and a liquid metal (Galinstan) as working fluid. Its design specifications are for a 1U CubeSat (with dimensions of 10 cm x 10 cm x 10 cm) and it must deliver similar angular momentum and torque to equivalent 1U CubeSat reaction wheels used for three-dimensional attitude control. James Barrington-Brown, Chief Executive Officer of NewSpace System, points out, "To complete the verification of the single-axis fluid loop inertial actuator and prove its advantages over standard technologies, it must be deployed in space. Its flight and qualification of all its components and their configuration will be the final achievement in this project."

The development and verification of the magnetohydrodynamic pump involved the development of several prototypes. Barrington-Brown identifies the challenging physics posed by high magnetic fields and the requirement to send a current through the middle of these fields, and corrosion of the electrodes, as areas that required particular attention. These and other problems have, however, all been addressed, and the team is pleased with the final design and manufacturing and assembly of the pump which includes the fluid loop.

The electrical design of the fluid loop inertial actuator comprises the pump driver, firmware, control algorithms and electrical harnessing. The pump drive circuit has been successfully demonstrated.

The team encountered a challenge in preventing the working fluid in the fluid loop inertial actuator from oxidising. Oxidation changes the properties of the working fluid from viscous (a consistency between solid and liquid) to viscoelastic, a combination of properties that makes it useless in the fluid loop and limits the pumping force on the working fluid.

Barrington-Brown explains that the loop must therefore be filled in an inert atmosphere by using an inert atmosphere glovebox, a cost-effective and common method to resolve the problem. The glovebox is a sealed container that makes it possible for the team to fill the loop in an unreactive atmosphere, which in turn allows the fluid in the assembled loop to flow freely. "Ultra-low concentration of oxygen is required to prevent oxidation

entirely," he notes. "Recent experiments show that this milestone is well within our reach, and we expect to achieve the desired environment early in the final phase of this project."

In the meantime, NewSpace Systems is on the lookout for an opportunity to put the fluid loop inertial actuator into space to add to it the track record of space heritage. "We are looking for an opportunity to test the fluid loop inertial actuator on a satellite mission," says Barrington-Brown. "The single-axis fluid loop inertial actuator is small and light and has no additional resource requirements. We're confident that we may find a flight opportunity for it on a CubeSat."

The test flight and the qualification of all the components are the final steps before NewSpace Systems starts marketing its novel space technology. With the attention to detail and the commitment of its talented team of experts, this crowning achievement is not too far off.

2
JOBS
RETAINED

STRONG
SKILLS
DEVELOPMENT

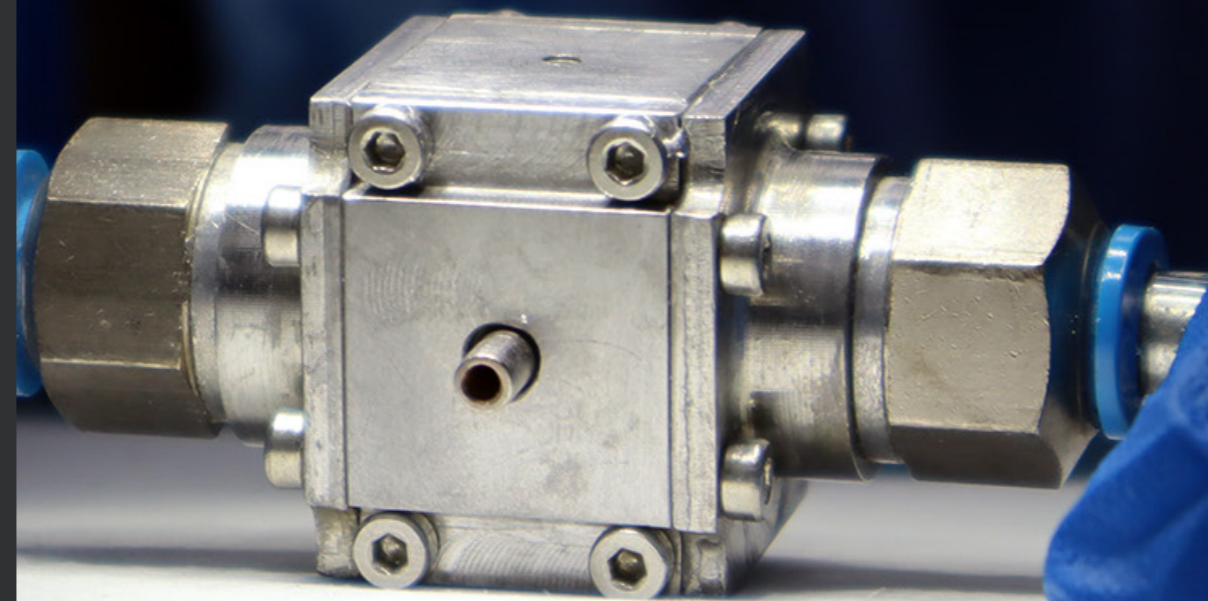
5
SMMES
INVOLVED

ATTITUDE

THE ORIENTATION OF A SPACECRAFT IN SPACE. THE ACTUATORS APPLY THE TORQUES NEEDED TO ORIENT THE SPACECRAFT TO A DESIRED ATTITUDE.

TORQUE

A MEASURE OF THE FORCE THAT CAN CAUSE AN OBJECT TO ROTATE ABOUT AN AXIS.



AEROSPACE AND DEFENCE STANDARDS AND ACCREDITATION

Support for attaining standards and accreditation by beneficiaries remains one of the main offerings under the AISI Technology Based Supplier Development Programme. In the aeronautics, space, and defence industries, quality management is critical for ensuring product safety, improving supplier relationships, increasing efficiency, as well as improving delivery to clients.

Through this intervention, the AISI exclusively supports SMMEs with the implementation and maintenance of relevant standards and accreditation related to the aerospace and defence sectors. It is critical for

local SMMEs to have accreditation for global quality management systems such as AS9100 and ISO 9001 in order for them to integrate into global supply chains. These standards also enable SMMEs to maintain and gain access to new business. Most original equipment manufacturers and higher-tier integrators make these standards a compliance and contractual requirement for their supplier bases.

In recent years, the AISI has mainly provided SMMEs with support to achieve the AS/EN9100 standard. A list of the companies supported in 2020/21 follows.

Table 3: SMMEs achieving their AS/EN9100 standard with the AISI's assistance

Company Name	Type of Support	Status
West Engineering	AS/EN9100 Surveillance Audit and Re-certification	Completed
Daliff Precision Engineering	AS/EN9100 Re-certification	Completed
Ti-TaMed	AS/EN9100 Surveillance audit	Completed
Production Logix	AS/EN9100 Gap Analysis and Implementation	On-going
B Engineering	AS/EN9100 Gap Analysis and Implementation	On-going
Kutteng Dynamic Electronic Systems	AS/EN9100 Gap Analysis	On-going

SUPPLY CHAIN OPTIMISATION

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 enabling the SMMEs to generate larger revenues. Where there are challenges experienced by SMMEs in generating revenues as a result of low product demand, either locally or internationally, optimisation of processes can prove critical for SMMEs in the aerospace and defence industries. Through improvement and optimisation of processes, SMMEs can generate significant cost savings that can mitigate against the negative impacts of low revenues. During the 2020/21 financial period, there were no projects undertaken as part of this offering of the AISI.

INDUSTRY DEVELOPMENT AND TECHNOLOGY SUPPORT

INTRODUCTION

The Industry Development and Technology Support Programme focuses on advancing the involvement of industry in sectors relating to advanced manufacturing in aerospace and defence. Industry is encouraged to industrialise technologies to the advancement of South African niche capability and value proposition. This is achieved through industry co-operation, access to infrastructure and expertise, partnerships, and technology interventions.

KEY CHARACTERISTICS OF THE PROGRAMME INCLUDE:

- Partnerships are established between organisations to achieve the above-mentioned goals.
- Access to national infrastructure and expertise is facilitated.
- Specific emphasis is placed on providing access to new and existing processes, products and methods into industry.
- Industrialising technology from universities and institutions and building on historical investments in research and development from other sources, such as from the Department of Science and Innovation, are utilised.
- Industry competitiveness is enhanced to ensure appropriate technology transfer of interventions.
- Original equipment manufacturers, integrators and sub-system suppliers are encouraged to include SMMEs as well as lower tier suppliers, to ensure the continuous transfer of knowledge, expertise, capability and technology, and in doing so, broadening the industrialisation base.

COMPANIES SUPPORTED

The following companies received AISI support in 2020/21.

Table 4: Industry development and technology support beneficiaries

Beneficiary name	Project title
Simera Sense	HyperScape50 Imager Project (Project in Progress)
Simera Africa	Electro-Optical Stereo Vision Aircraft Approach Tracker Project (Project in Progress)
Sparcx	Design and Development of a 2-6GHz DIFM System Project (Project in Progress)

Camera refinement for a unique South African hyperspectral imager opens up new market opportunities



TECHNOLOGY STREAM

Surveillance and sensor systems



PRODUCT MARKET

Space

BENEFICIARY

Simera Sense

PROJECT TITLE

HyperScape50 Imager Project
(Project in Progress)

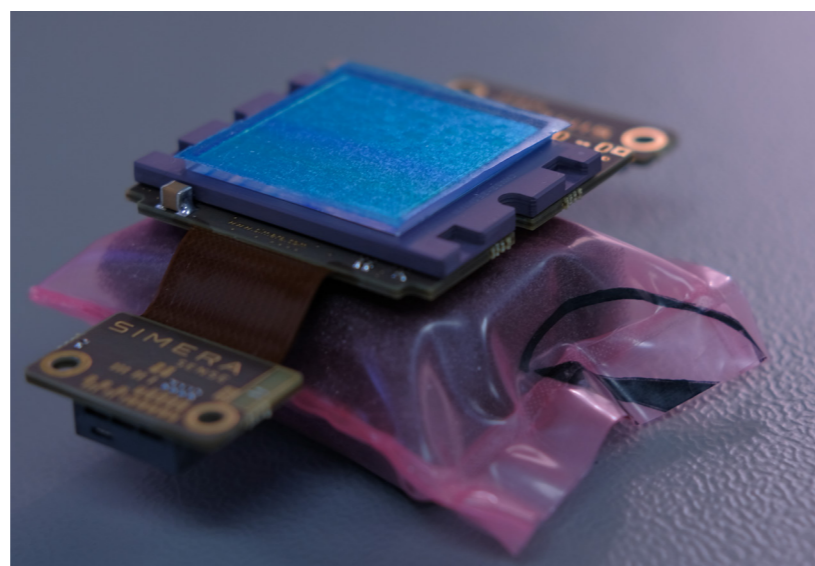
INDUSTRY PARTNERS AND COLLABORATORS

- Pink Matter Solutions
- Barracuda Holdings
- Astrofica Technology
- Daliff Precision Engineering

CONTACT

Ana-Mia Louw – mia@simera.com

Simera Sense has embarked on the development of the novel HyperScape50 product range aimed at a CubeSat 1U. The HyperScape50 is a camera system that collects and processes information from across the visible and near infra-red range of light. The images obtained can be sent to a ground station for further processing and can then be used for weather forecasting, to assist farmers, to assist town planners and numerous other applications. The HyperScape50 is based on previously sold larger versions which are currently used in a number of satellites and are a commercial success. The HyperScape50 imager is more compact, and images a field of 120 km at an orbit height of 500 km. The design and local manufacture of a smaller lens for the HyperScape50 product has been successfully completed. Existing firmware was adapted and the alignment of the continuous variable filter and its integration with the electronics were completed for pre-qualification by Simera Sense. Marketing has commenced and orders from international clients have already been placed. The development work performed during the design of the HyperScape100 (already a commercial success) formed a firm technical basis to develop the smaller HyperScape50.



Simera Sense CMV12000 Front-End Electronics

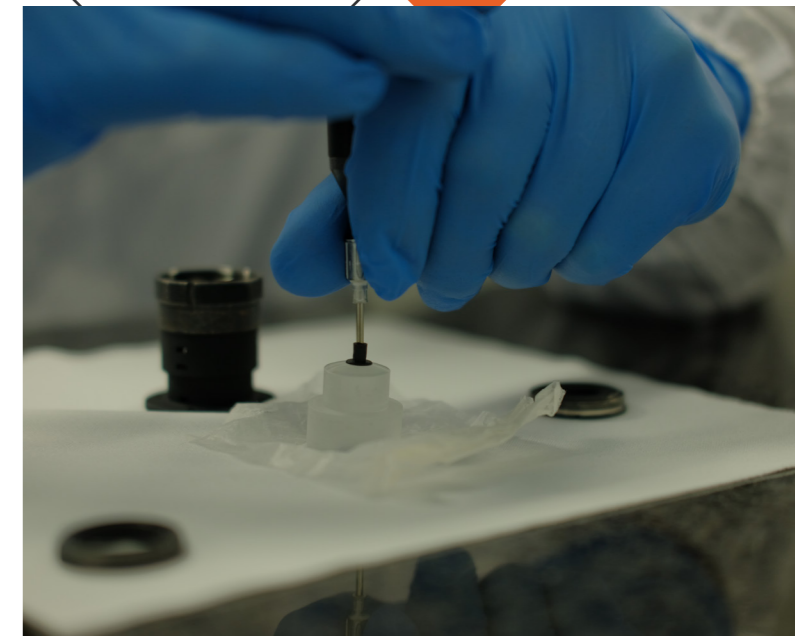
Simera Sense produces earth observation optical payloads for CubeSats in low earth orbit (below an altitude of 2 000 km). The latest of its xScape products under development is the new xScape50 range for CubeSats of 10cm x 10cm x 10cm (1U). The novel Hyperscape50 product range will open a whole new market as it is more compact compared to the xScape100 and xScape200 products already offered, and images a field of 120 km at an orbit height of 500 km.

Hyperspectral imaging collects and processes information from across the visible and near infra-red range of light. Compare this to the human eye, which sees colour of visible light in mostly three bands (long wavelengths, perceived as red; medium wavelengths, perceived as green; and short wavelengths, perceived as blue). Hyperspectral sensors look at objects using a vast portion of the electromagnetic spectrum. Ana-Mia Louw, General Manager, says, “We look at a slightly larger portion of the spectrum into the near infra-red, but we can image the bands in small increments, so it is possible to image very specific portions of the spectrum.”

Hyperspectral imaging has applications in weather forecasting, ensuring food and water security, marine monitoring, environmental and ecosystem sustainability, infrastructure development, smart governance and natural resources census.

Louw explains, “For the HyperScape50, we are able to use the same electronics as those of the xScape100 products, but we needed to develop a smaller lens. We offer clients three different types of imaging formats: normal colour imaging, multispectral imaging and hyperspectral imaging (which is the case for the HyperScape50) and can adapt our product to mission requirements.”

In brief, the HyperScape50 comprises the optical front-end (lens) focusing the incoming light. The sensor unit converts the light energy into a digital signal. The control electronics provide the control and the data interfaces to the satellite bus (supporting the payload) and perform sensor control, data handling, data storage, and image processing.



xScape50 Optical Front-End Integration

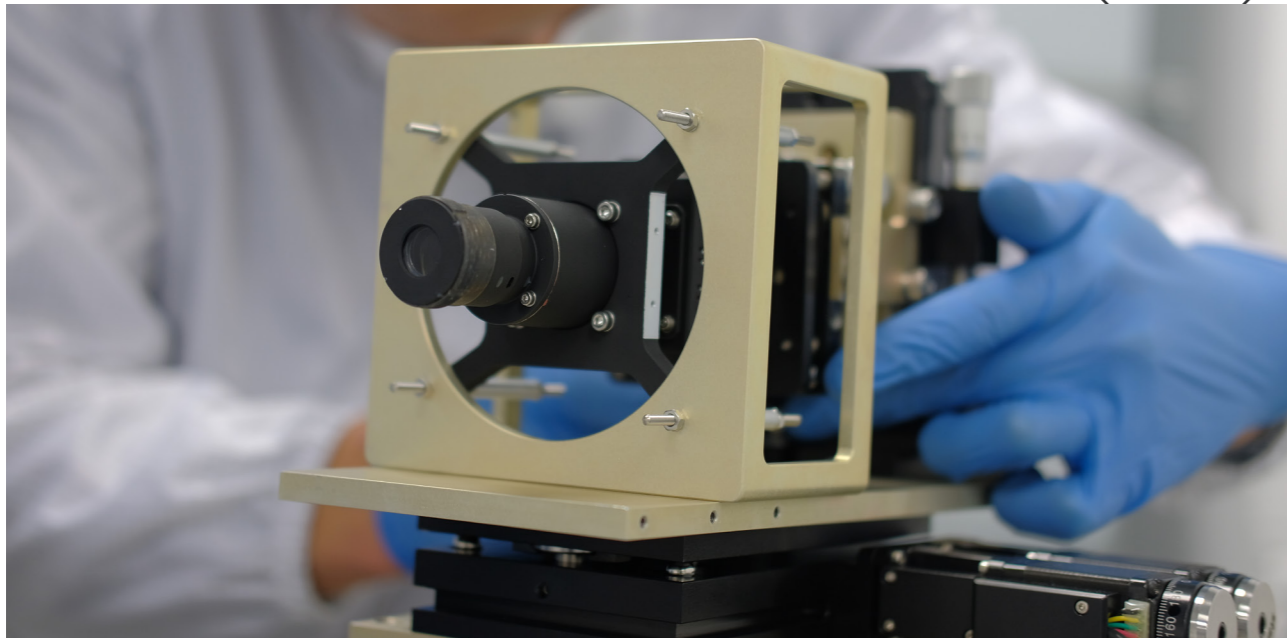
LENS DESIGN FOR QUALITY IMAGING

The Simera Sense team has undertaken the formal design of the smaller lens, which was manufactured locally and then tested for optical performance. “We are proud to say that we have made excellent progress in this regard. The lens design contributed to the ease of manufacturing and the time required for integration has been cut down considerably,” confirms Louw.

She says that cameras are the least expensive product of the xScape range, “Our new lens design for the HyperScape50 makes it affordable for our clients to better meet their mission needs.” Design parameters of the HyperScape50 are in line with the European Space Agency and NASA requirements: all components must burn up on re-entry.

Louw points out that existing firmware (software embedded in components) was adapted for the HyperScape50, and electronics sourced from Europe and China as well as components off-the-shelf were used.

Next is the integration with the electronics for pre-qualification by Simera Sense. Qualification is the process by which the system is tested to confirm survivability in space. This includes thermal vacuum cycling tests (from



Hyperscape50 Test Set
extremely high to low temperatures) and vibration tests to NASA's General Environmental Verification Standard to simulate launch conditions, thereby confirming structural robustness. Radiation testing is also performed to ensure performance during its low earth orbit lifetime. Facilities in the Western Cape are used for these tests.

The Hyperscape50 is a unique South Africa product in a niche market, with a superior lens design for use in space. This product is the output of a dedicated team of local experts who have sourced and manufactured materials locally and internationally, and equally importantly, planned and executed its integration, assembly and process development. The product range is being marketed, with accompanying datasheets and documentation. Positive feedback has been received on proposals and Simera Sense has engaged in earnest with international clients on delivery of orders and will proceed with product manufacturing once the flight qualification is completed with its implicit assurance of quality.

3
YOUTH JOBS
CREATED

5
SMMES
INVOLVED



Innovative technology to improve pilot training through stereo vision aircraft approach tracking



TECHNOLOGY STREAM
Other systems



PRODUCT MARKET
General aviation

BENEFICIARY

Simera Africa

PROJECT TITLE

Electro-Optical Stereo Vision Aircraft Approach Tracker Project (Project in Progress)

INDUSTRY PARTNERS AND COLLABORATORS

- G&R Electronics
- ItCognify
- TFASA
- RoRa Engineering
- Ti-TaMED

CONTACT

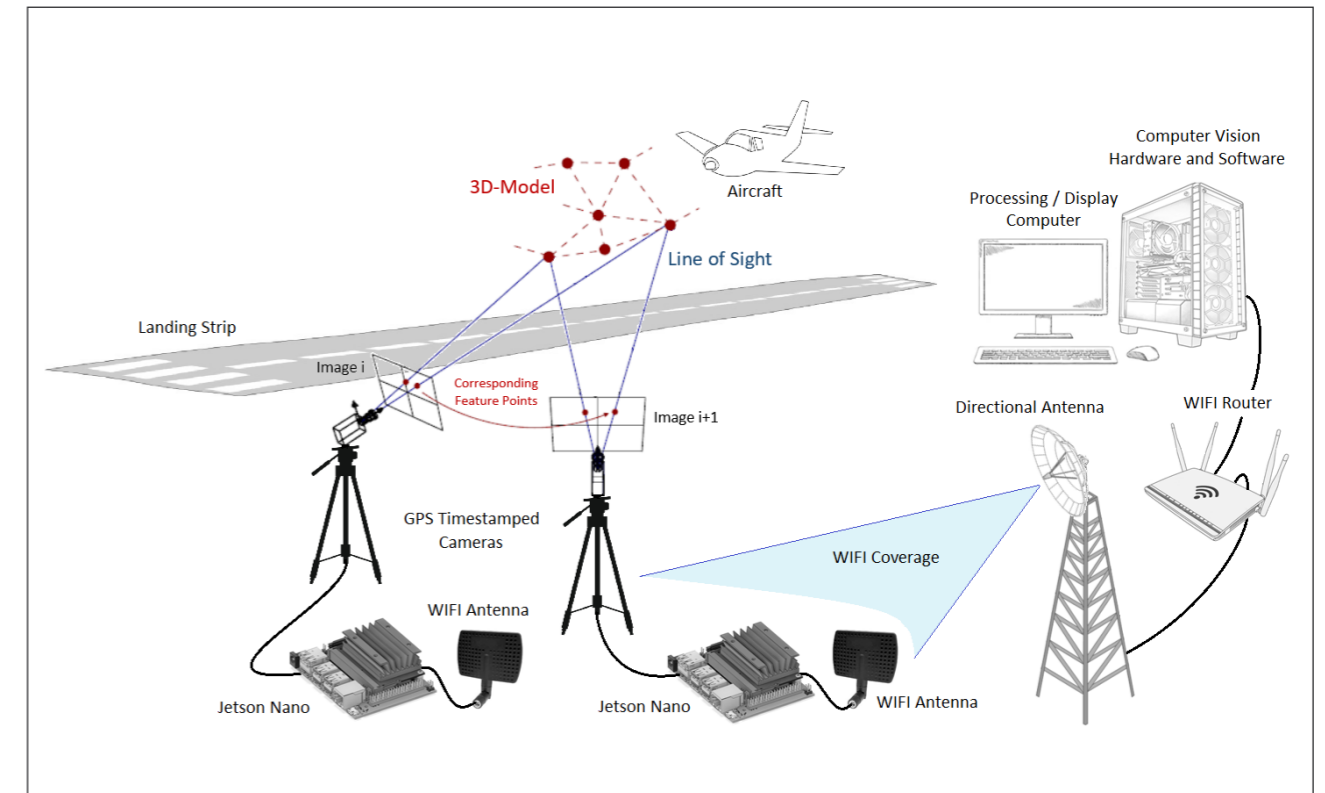
Lize Loftie-Eaton - lize.loftie-eaton@simera.com

Building on previous iterations of an aerial survey camera system, Simera Africa has developed an innovative technology to be used as a training tool by instructors and test pilots. Although the project has not yet been completed (some software development is still required), the post-flight debrief system has the potential to attract international test pilot training markets. The system will allow instructors to analyse a test pilot's performance using actual footage of the flown approaches. The system comprises two identical machine vision cameras, separated by a known distance, which simultaneously capture images of a single object that can then be used to analyse the pilot's performance.

Simera Africa (Pty) Ltd is developing a novel post-flight debrief system, allowing instructors to analyse a test pilot's performance using actual footage of the approaches that were flown. Dubbed an electro-optical stereo vision aircraft approach tracker, the debriefing system consists of two identical imaging units, comprising machine vision cameras, control electronics and wireless communication equipment that are separated by a known distance (the baseline).



First field test of the Stereo Vision Approach Tracker using a scale model plane to collect data for processing and machine learning



An overview of the Stereo Vision Approach Tracker system's flow of data

The imaging units simultaneously capture a series of co-timestamped images of the same target (in this case, the aircraft on final approach). The position difference from the co-timestamped images is analysed and using stereo-vision algorithms, the direction and range from the imaging units to the target is determined. Instructors then analyse the results to review a test pilot's performance.

Simera Africa has a wealth of experience and technical know-how in optical systems and was keen to tackle this technical development to assist a potential client, namely the Test Flying Academy of South Africa. In-house resources and expertise were available to address various aspects such as project management, development of the imaging and processing segments, as well as detailed mechanical design. The machine vision and machine learning aspect was subcontracted to ItCognify, a company that specialises in machine vision

and machine learning, Project Manager Lize Loftie-Eaton says. The partnership with ItCognify not only enabled Simera Africa to employ a junior team member (who was previously employed as an intern), but also provided an exciting learning opportunity for him to enhance his skills and knowledge by working alongside the ItCognify team. Furthermore, Simera Africa's technical team also benefited from the opportunity to take responsibility for the project management and systems engineering, with guidance from more senior staff.

Another collaboration that occurred during the project was the subcontracting of specialist micro soldering services. Simera Africa appointed technician expert, Roberta Petersen, co-owner of G&R Electronics to conduct soldering of electronic printed circuit boards. Peterson recently started her freelance career after being retrenched from her former employment due to Covid-19 cutbacks.

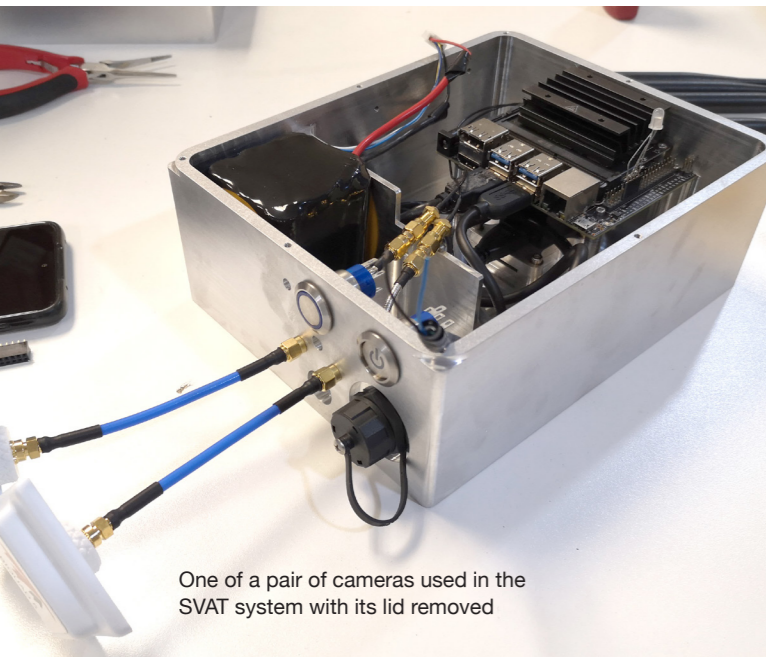
IMPROVEMENT TO THE VISUAL DEBRIEFING TOOL

What is machine vision and why is it important? In this case it is used for an application in which a combination of hardware and software creates the debriefing tool for instructors of test pilots in training, based on the capture and processing of images. Louwrens Marais, General Manager, explains, "During a debriefing, it would now be possible for the instructor and test pilot to see where the aircraft was at any moment during the final approach, compared to where it should have been. This quantitative evaluation is possible through the graphical user interface, which displays two lines: one for the ideal approach path and the second for the actual approach path."

Simera Africa was able to capitalise on previous experience, giving it an advantage in this project. Marais comments, "We were able to expand on existing building blocks that were developed for an aerial survey camera system and underwater vision enhancement system.

Marais elaborates on the operation of the debriefing system, "Two identical imaging segments are located on each side of the runway. Each contains a machine vision camera and lens, with the optical axis pointed in the direction of the approaching aircraft. Each imaging segment includes a global navigation satellite system receiver to determine the baseline separation between the imaging units, as well as to provide accurate timing.

"Each imaging segment will begin recording once a signal is received from the processing segment; timestamped images taken at exactly the same time are then stored at a predetermined frame rate. Once a stop signal is received, the recorded images are wirelessly transmitted to the processing segment. Image processing software running on the processing segment then post-processes the images to determine the distances from and angles to the target aircraft."



One of a pair of cameras used in the SVAT system with its lid removed



Scale model plane used to conduct fields tests

The detailed design and associated procurement for the project have been completed, while software development is nearing completion. This will be followed by the integration of hardware and software as the final step.

Testing of the system is planned with a radio-controlled aircraft which will be flown by in-house expert drone pilot, Josua Blom, who also led the imaging segment development for this project. Marais points out, "As everything in the system scales, it is much easier to do demonstrations with this small aircraft with lower cost and fewer risks than a full-sized one."

Several unexpected applications of this system are possible, through the adaptation of the machine vision

models, while the hardware remains the same. Loftie-Eaton explains, "The system could be used in agriculture to determine the ripening of fruit in orchards and vineyards. It could also be used to identify the size of alien plant species and the rate of coral reef bleaching that occurs as a result of climate change. We are really excited to see how the investment by Simera Africa, with support from the AISI, can be realised in different sectors."

On behalf of the team, Marais summarises the highlight of the project, "The technological advancements realised in this project enable the development of a highly capable, standardised machine vision architecture that can be used in various future product lines. In combination with the development of internal skills and knowledge, and the promotion of collaboration with industry partners, Simera Africa's position as a supplier of machine vision solutions to the aerospace and other industries has been significantly strengthened."



South Africa's first digital instantaneous frequency measurement subsystem in development



TECHNOLOGY STREAM

Surveillance and sensor systems



PRODUCT MARKET

Military systems

BENEFICIARY

Sparcx

PROJECT TITLE

Design and development of a 2-6GHz DIFM System Project (Project in Progress)

INDUSTRY PARTNERS AND COLLABORATORS

- CSIR
- Denel
- Sysdel

CONTACT

Lerato Sibande - info@spar.cx

Sparcx, a black veteran-owned SMME, is developing an indigenous digital instantaneous frequency measurement (DIFM) sub-system covering the frequency range from 2-6 gigahertz. This is in line with South Africa's strategic and sovereign requirements. The design of the DIFM receiver has been completed and is currently being implemented on a radio frequency system-on-chip. The next step is the implementation of the DIFM processing subsystem to clearly identify the radio frequency signals received, after which Sparcx will industrialise it. Sparcx is working closely with the local aerospace industry to ensure that market needs are addressed and will contribute significantly to capability development in the South African electronics industry.

Sparcx, a company with novel and creative ideas, is developing South Africa's first indigenous DIFM sub-system, which is in line with the country's strategic and sovereign requirements. The subsystem will cover the radio frequency range between 2 and 6 Gigahertz.

As part of the detection suite, the DIFM enables an aircraft to detect a signal that poses a threat; through the processing subsystem, the signal is identified, and a warning is issued to the pilot to react. The DIFM receiver is located in the aircraft near the avionics suite and needs to be of consistent high quality. Antennas on the aircraft are utilised to receive the signal.



Octavia Mlaba (Project Coordinator), Sujo Mulamattathil (Director), Lerato Sibande (Project Manager), Moorosi Motake (Lead RF Engineer), and Shivani Matabire (Project Accountant)

Sujo Mulamattathil, Managing Director of Sparcx, explains the importance of this technology development for the local market. "The reasons why South Africa needs its own DIFM subsystem are twofold: strategically, we need our own capability in this arena, and as a sovereign nation, we need to manufacture and control our own technology." While analogue instantaneous frequency measurement (IFM) technology is available, manufacturing problems and difficulties in terms of manual tuning make digital IFM the preferred option. In addition, South Africa has a reputation for the development of IFM technology, an advantage in Sparcx's favour.

DESIGN METHODOLOGY

Project Manager, Lerato Sibande, confirms that the project is still in the development phase. "Our intention is to achieve a visionary design methodology and manufacturing technique for DIFM that will increase production yields and decrease time to market. Our design methodology will improve performance of operation by setting a new industry benchmark in speed of detection and consistent performance."

Moorosi Motake, the lead engineer, states that the project architecture has been defined. "At this stage, we have completed the design of the DIFM receiver, and it is currently being implemented on a radio frequency system-on-chip. This will help us to refine the design." The next step is the design of the DIFM processing subsystem to clearly identify the radio frequency signals received. Manufacturing will be subcontracted.

Sparcx's choice of the radio frequency range between 2 and 6 Gigahertz RF spectrum was in response to a requirement by Denel Aeronautics, a South African original equipment manufacturer of a major defence platform. Through Sparcx's collaboration with Denel Aeronautics, it will be possible to qualify the product as part of a protection suite in a real environment. Other current collaborators are the CSIR which provides access to hi-tech resources, and the State Information Technology Agency which is keen to showcase the development to enable recruitment and drive a science, technology, engineering, and mathematics agenda.

Another potential application of the DIFM technology is in commercial aircraft. Recent events have demonstrated that these aircraft are vulnerable to unprovoked and devastating attacks and would benefit from a detection system.



Moorosi Motake (Lead RF Engineer) Performing firmware optimisation and simulation on Xilinx Vivado

Sibande confirms, "Sparcx is generating new intellectual property which will be assessed for formal protection. In the interim, we are documenting our know-how regarding the design and process and refining the product as it develops. We have had a great team since the start of the project and are looking to expand as the project progresses."

Speaking on behalf of the Sparcx team, Sibande describes the highlights of the project to date: "We are developing new intellectual property that is novel for South Africa. We also have the opportunity to be the first black military veteran-owned company to potentially have a sub-system on the Rooivalk helicopter which is an apex platform globally."

As its name suggests, Sparcx is set to deliver on this project with creativity and explosive energy.

2
ACADEMIC
INSTITUTIONS
AND SCIENCE
COUNCILS
INVOLVED

MARINE MANUFACTURING, ASSOCIATED SERVICES AND OTHER MANUFACTURING INDUSTRIES SUPPLIER DEVELOPMENT PROGRAMME

SUPPORT PROGRAMME FOR THE MARINE MANUFACTURING AND REPAIRS INDUSTRY GAINS TRACTION

The AISI's ring-fenced programme, Marine Manufacturing Associated Services and Other Manufacturing Industries Supplier Development Programme, is a pilot to assist suppliers in the ship and boat-building, maintenance and repair, and associated services value chain. The programme is aimed at assisting suppliers with support in terms of marine standards and accreditations and technology enhancements. The aim of the programme is to improve competitiveness in the local marine supply chain and to better respond to designated public procurements in the ship and boat-building industry.

This pilot programme is now in its second year and is establishing a footprint in the marine manufacturing and repairs industry. Projects initiated during the 2019/20 financial period continued in 2020/21. One of the key observations from the 2020/21 reporting period is the need to undertake technology roadmaps for beneficiaries, especially those that either serve multiple markets, or have the potential to serve multiple markets. The AISI will consider implementing technology roadmapping exercises, similar to that for the aerospace industry, in future.

The number of companies involved in the programme is growing as the programme matures. The marine companies to participate in the programme are identified through an Expression of Interest (EoI) or Call for Proposal (CFP) process that is advertised to companies listed on the existing marine database as well as CSIR and AISI platforms. Alternatively, companies are identified through a targeted approach. Companies on the designated marine component list that manufacture components are contacted directly to see if support is required. Participation in the programme has grown steadily in the past financial year, evidenced by expansion of the companies listed on marine database, as well as the number of applications received during the EoI and CFP

processes. This also illustrates growth in awareness of the programme, and its benefits in this strategic sector.

Dr Nicolene Roux, AISI Marine Technical Leader, confirms, "This growth in our relatively young programme is encouraging as we are making strides in supporting companies in the marine manufacturing and repairs industry with its extensive industrial linkages and recognised economic multiplier potential."

The programme aims to develop suppliers in order to improve competitiveness through localisation of technology and capacity, and thereby strengthen local industrial supply chains. Roux explains, "One of the most important opportunities for local companies in the marine manufacturing and repairs industry is to be in a position to respond to designated public procurement in the ship and boat-building industry. We assist them through our two sub-programmes, namely standards and accreditation, and technology enhancement."

While the main focus has been on assisting beneficiaries to obtain the relevant standards and accreditations to participate in the marine manufacturing and repairs industry, a technology enhancement project was identified as a niche capability for the local manufacturing industry.

Perhaps the most significant challenge encountered as part of the programme is that the local marine sector is small and participation in the global marine supply chain is challenging. The size of the industry is especially challenging when considering designated public procurement of working vessels. There is limited commercial demand for big build programmes that depend on government procurement. The manner in which the programme has set out to address this issue is two-fold.

On the one hand, the programme wants to enable the local marine industry to serve multiple markets rather than solely being dependent on marine manufacturing to sustain them. On the other hand, the programme in 2019/20 set out to include other industries by opening the programme to applications from non-marine companies that wanted to access the marine market.

The move by government to designate local procurement in 2014 in response to exemption requests by ship/boat builders has created the opportunity for the marine and other industries to benefit from local procurement opportunities. Bianca Mokuena of **the dtic's** Industrial Policy section says, "We believe our local component manufacturers – both big and small companies – can develop the capabilities to become local and global suppliers in the marine sector." From the interview with Mokuena, it is clear that one of the greatest challenges these companies have is obtaining the required standards and accreditations for their components to be considered for use in the vessels.

Andrew Mukandila, Marine Manufacturing Deputy Director, the dtic, affirms the value of this work, "We are working very closely with the Marine Manufacturing Associated Services and Other Manufacturing Industries Supplier Development Programme. This makes our task easier as market information gathering and penetration are much easier, and we receive feedback on our inquiries in record time. Our discussions are robust, and we are privileged to work with the team with the view to further fruitful collaboration."

TARGETED COMPONENTS

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

CHALLENGES TO SUPPLIER DEVELOPMENT IN THE MARINE SECTOR

While the marine sector is viewed as less mature than the aerospace sector, it has the potential to realise its competitiveness through localised technology and capacity and the participation in industrial supply chains. However, several constraints experienced by participants in the local market have been identified. The first is that various component manufacturers have noted difficulties in entering the supply chains of large (international) ship builders. These large operations typically have established supply chains and they view new entrants to the market as a risk, even if components are certified. Risks include the longevity of new entrants and uncertainty with regards to the levels of support available, such as maintenance and spare parts, and the compatibility with other vessels. Due to the high value associated with these builds, there is an understandable risk aversion.

Obtaining marine standards and accreditation are very technical, and generally involves multiple aspects (see next section for an elaboration on marine standards and accreditations). In order for the programme to deliver successful projects in the appropriate timeframe, the support requested by the beneficiary needs to be clear and complete. This requires the beneficiary to do background research on the requested support such as technical specifications and having an in-depth understanding of which class rules apply (which is not a simple matter). To complicate the process even further, some technical experts dealing with particular certifications might be in foreign offices. Once the scope of the certification has been established and confirmed, the certification process can commence.

Finally, the most significant challenge encountered is that the local marine manufacturing sector is small. This presents challenges regarding designated public procurement of working vessels, and there is therefore a limited commercial demand for big build programmes, which depend on government procurement. As a result, suppliers to other industries were targeted, to ensure that the beneficiaries of the programme serve multiple markets, rather than solely being dependent on marine manufacturing to sustain them.

STANDARDS AND ACCREDITATION IN THE MARINE INDUSTRY

The marine sector is highly regulated. There are many different marine certifications, for example, the International Maritime Organization (IMO) certifications, the Safety of Life at Sea (SOLAS) treaty standards, various International Organization for Standardization (ISO) marine standards, local South African Maritime Safety Authority regulations, and International Electrotechnical Commission marine requirements.

There are also classification societies and the various rules governing different vessel types. Within the International Association of Classification Societies (IACS) rules, there is a lack of standardisation, so, for example, the American Bureau of Shipping, Lloyd's Register, Bureau Veritas and DNV may have slightly different rules for the same component and applications.

The regulations that apply to a specific component are therefore highly dependent on where the component is used (for example, on a boat or ship, or in the oil and gas industry) or even how the component is used on a vessel (fuel systems and sewerage system valves have very different rules) and where the vessel operates (for example, in coastal waters or in deep sea).

As a result, beneficiaries are not always clear on which certifications are required for a particular component and uncertainty regarding associated testing requirements exacerbates this situation. It is not even clear who would issue certain certificates (a classification society can, for example, issue SOLAS certification).

With its existing linkages in industry and its understanding of certification processes, the programme supports beneficiaries to obtain certification to marine standards. These are companies active in the marine sector as well as others with a broader industry focus and offering. Companies that wish to obtain certification to non-marine-specific ISO quality standards are referred to the Small Enterprise Development Agency (SEDA) for assistance.

In 2020/21, the programme supported seven companies (contracted) that had indicated a need for certification. Three of these companies, Bantek Engineering, Paltechnologies and 6Sigma Shiyards, successfully completed the programme as they obtained their requested certifications during the financial year under discussion. These companies were interviewed and profiled in the 2019/20 Impact Report. Four additional companies were contracted to the standards and accreditation portion of the programme during the 2020/2021 financial year. Support at Marine Solutions is the most advanced and therefore this company has been profiled in the pages that follow.

Three companies were referred to SEDA for support on non-marine specific ISO certifications. These companies were AR Jones Engineering, Marine Solutions and Anchora Enterprises.



PROGRESS MADE IN 2020/21

Various companies were contracted during this period to benefit from the Marine Manufacturing Associated Services and Other Manufacturing Industries Supplier Development Programme and are discussed briefly in the following section.

MACC MARINE is located in Bayhead, Durban (KwaZulu-Natal). The company provides full marine and engineering services such as ship repairs, welding, boiler making, pipe repairs and renewals, mechanical and hydraulic repairs. This company was supported under the standards and accreditation intervention of the programme during the fourth quarter of 2020/21. Macc Marine will be supported to obtain various IACS-approved welding certifications.

BAYSIDE MARINE is located at the V&A Waterfront in Cape Town. The company specialises in the inspection, overhauling and servicing of several mechanical items as well as conducting steel repairs. The company was contracted during the second quarter of the 2020/21 financial year to become ISO 45001 certified.

ZERO° INDUSTRIES is located in Maitland, Western Cape. This SMME specialises in the supply of maritime gear such as personal flotation devices, wetsuits and personal protective equipment. The company requested support in obtaining SOLAS-approved certifications for its inflatable lifejackets (images on right).

CYBICOM ATLAS DEFENCE is located in Cape Town, Western Cape, and was supported under the technology enhancement initiative of the programme. Support was for the development of a ship ballast water treatment system. The company was contracted during the first quarter of the 2020/21 financial year.



Zero° Industries' manufacturing facility for life jackets



The Bladder (lime) and spray cover (orange), critical parts of the inflatable lifejackets manufactured by Zero° Industries

AISI - SEDA COLLABORATION FOR MARINE INDUSTRY COMPETITIVENESS IMPROVEMENT

SEDA provides information and support for financing small businesses through the Industrial Development Corporation. After establishing a collaboration with SEDA, the programme no longer supports ISO certification that are non-marine specific and therefore three SMMEs (Anchora Enterprises, Marine Solutions and AR Jones) were referred to SEDA for support. This collaboration is part of the AISI strategy to leverage other sources of government funding to support interventions that the AISI is unable to support.

ANCHORA ENTERPRISES offers a full range of professional, high-quality products and services for commercial, governmental and naval maritime applications. SEDA is supporting Anchora Enterprises for ISO 9001, ISO 14001 and ISO 45001. Due to the cost of and duration for ISO 14001, SEDA will only support compliance for this ISO standard, while supporting certification for the other two ISO standards. Implementation is expected by mid-2021, with auditing and certification pending after this step. Once certification through SEDA has been obtained, Anchora Enterprises will be included in the programme to obtain class approval for a new-built.

MARINE SOLUTIONS is based in Cape Town and was founded in 1999 to support the offshore industry in southern Africa. Its support now extends globally with its main areas of operation noted as sales, remotely operated underwater vehicles and associated equipment support; remotely operated technical and pilot training, and cable assembly, manufacturing and overmoulding. SEDA appointed a service provider to develop and implement ISO 14001 certification for Marine Solutions, while being supported by the AISI Marine Programme.

AR JONES ENGINEERING offers engineering solutions and equipment to a diverse range of sectors, including the steel, oil and gas, and maritime industries, and to municipalities in South Africa. The SEDA branch in Vredenburg has been contacted to assist AR Jones with upgrading its quality management system to the 2015 standard. Once this has been completed, support will be provided towards getting AR Jones ISO 9001 certified. AR Jones has applied to the programme and was preliminary approved for support in the next financial year.



CONTINUOUS SUPPORT RECIPIENTS

Two companies received continuous support, despite not being contracted:

PALTECHNOLOGIES is located in Kempton Park, Gauteng. This SMME specialises in advanced valve technology and the company can design and develop special valves that match the required operating conditions. Services offered by Paltechnologies include valve repairs, refurbishments and non-destructive testing. Up to this point, South Africa did not have a certified valve manufacturer to supply to the marine industry. The company was assisted to obtain Bureau Veritas and Lloyd's Register certification of Paltech 80mm, 100mm, 150mm, 200mm and 250mm single eccentric butterfly valves. Paltechnologies is now able to supply valves to the marine industry, as the company has recently acquired the necessary certification. The certifications were achieved during the second quarter of the 2020/21 financial year, but support continued through assistance for the company with improving its casting capability. The marine support programme is providing support with default castings to propose a way forward for foundries to improve the quality of their castings. This support is ongoing.

VEECRAFT MARINE is located in the Foreshore, Cape Town. Veecraft applied for support to obtain class certification for its watertight and weathertight doors and windows. Testing capability of the requested certification

is not available in South Africa and conducting the testing internationally falls outside of the budget of the programme. The programme is supporting Veecraft to obtain a better understanding on the requirements for class certification for the watertight and weathertight doors and windows.

LOOKING AHEAD

Various companies were approved for support with contracting to be conducted during 2021/22:

POLYFIX is a maintenance and repairs company located in Johannesburg, Gauteng. The company provides industrial and marine protection and repairs using polymer coatings. The company will be supported to obtain the development and implementation of an ISO 9001 quality management systems (with built-in ISO 12944-5) as well as ISO 14001:2015 (environmental management system).

AR JONES ENGINEERING is located in Vredenburg, Western Cape. The company provides engineering services in the form of fabrication and repair of vessels, pipefittings for vessels as well as service of pumps and valves. The company will be supported to obtain IACS-approved welding certifications for its welding procedures and welders.

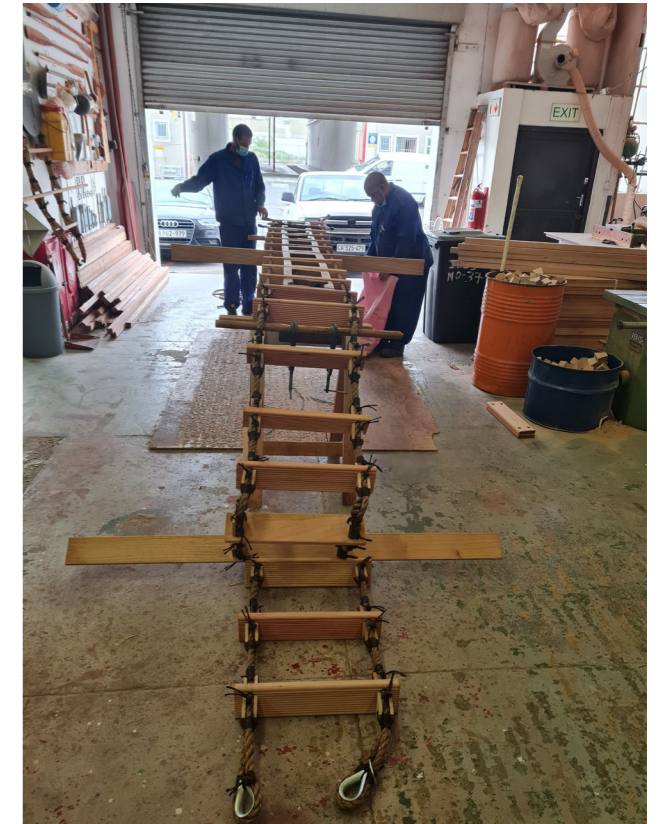
IBIS MANUFACTURING is based in Cape Town. The company specialises in the manufacturing of wood and steel parts for the marine industry. Examples of products are pilot ladders, pilot steps (rubber), dan buoys and supply lifting equipment. The company will be supported to obtain international certification for the pilot ladders they manufacture (images on right).

TREWFIT CONTROLS designs and produces an exciting range of products for the valve and automation industry. TrewFit requested international certification for its valve positioning indicators. Supporting TrewFit Controls to obtain certification for these is directly aligned to the key drive of the programme: marine supply chain development. TrewFit and Paltechnologies both operate in the marine valve supply chain.

DORMAC is a division of Southey Holdings (Pty) Ltd and a leading engineering company specialising in the delivery of full turnkey solutions to clients in the marine, offshore and industrial sectors. The company will be supported for welding certifications.

MARINE COMPANIES INTERVIEWED

Two marine companies were selected to be interviewed for the AISI Impact Report. One company, Marine Solutions, is participating in the Standards and Accreditation Intervention and the other company, Cybicom Atlas Defence, is participating in the Technology Enhancement Intervention. Both projects showed significant progress during the 2020/21 financial year.



Manufacturing of a Pilot ladder



Rubber step and tarred twine used to whip the rope to the components

Integrated quality systems and technology localisation boost Marine Solution's local and international competitiveness

BENEFICIARY

Marine Solutions

PROJECT TITLE

Implementation and Certification of ISO 45001 Occupational Health and Safety Management System (Completed Project)

Marine Solutions, a Cape Town-based SMME with a track record of 22 years in the international and local subsea industry, has started integrating its three quality systems, notably ISO 9001, ISO 14001 and ISO 45001, for quality management, environmental management and occupational health and safety, respectively. Kevin Bey-Leveld, Operations Director, explains the rationale for the decision, "The quality systems were put in place by different service providers over time and our decision to fund this systems integration will unlock immense value for our operations, logistics and procurement. Not only is the system easier to use but it covers all aspects of what we do and allows us to identify, trace and rectify problems." Marine Solutions received support from the AISI and SEDA for the implementation and certification of ISO 45001 and ISO 14001, respectively.

Dr Nicolene Roux, AISI, says, "Support towards ISO 45001 has motivated the company to obtain the integrated quality management system that focuses on its needs rather than a generic quality management system. Support for the project started in December 2020 and is expected to be completed early in the next financial year.

"The support for the quality management system certification will allow Marine Solutions to promote its manufactured products to a larger market, including an expanded export market. This certification secures confidence in the business by placing a health and safety management system at the heart of a sound business strategy."

Its strong technical skills base has put Marine Solutions in a unique position as both an agent for the import of remotely operated underwater vehicles (ROVs) and as operators (pilots) of these extraordinary machines used extensively alongside divers for inspection in the subsea oil and gas industry and diamond mining. Bey-Leveld confirms, "We are experts in piloting ROVs and can undertake major technical projects. More importantly, we are able to give feedback and advice to the manufacturers of ROVs on design improvements."

Marine Solutions has identified emerging applications for micro ROVs regarding the inspection of dam walls, fire water tanks or any water-filled reservoir. Bey-Leveld says, "It's small and light enough to take as luggage on an airplane, which allows us to offer a one-day inspection service."

Marine Solutions's ROV pilot training facility is internationally recognised by the International Marine Contractors Association. This facility has been operational for the past 20 years and has trained many ROV pilots who operate all around the world today.

Localisation of various equipment used in the subsea industry is a manufacturing success story. Marine Solutions prides itself on the development of numerous engineering solutions for its clients, i.e., De Beers, IMDH, ADS Marine, the South African Institute for Aquatic Biodiversity, the South African Navy and PetroSA.

Some of the subsea products that Marine Solutions manufacture locally are internet protocol cameras for subsea real-time viewing – these cameras are networked and security protocol-enabled; various LED lighting options and various other camera options, utilised in the commercial diving or mining environment.



A custom payload frame design for LED lighting on an autonomous underwater vehicle, produced by Marine Solutions

Lights are on the programme's targeted component list. Roux notes, "The integrated quality management system will make the products manufactured by Marine Solutions more appealing to both local and international companies."

Marine Solutions provides a cabling and over moulding (a unique injection moulding process that results in a seamless combination of multiple materials into a single part or product) for specialised equipment such as diamond crawlers and other subsea machinery. Cable assemblies are now manufactured locally and delivered directly to clients locally and abroad. Stock levels are managed accordingly to expedite manufacturing and delivery of orders in time.

The success of Marine Solutions vests in its commitment to its staff and its uncompromising promise of quality to its clients. Bey-Leveld notes, "There is no room for complacency. There is lots to learn and we are excited to move with the times and adapt and change our strategy and focus.

"Despite tough economic periods in the past, our staff numbers have remained constant, with the prospects of new projects in the future. Engineering students have always been welcomed for inhouse training." The company has a Level 2 B-BBEE status.



Remotely operated vehicle and associated equipment kept at their Marine Solutions' Cape Town facilities

TECHNOLOGY ENHANCEMENT

The programme has a technology enhancement component which aims to advance the technology readiness level of novel technologies in the marine sector. The programme aims to improve the competitiveness in the local marine supply chain, to better respond to designated public procurement in the ship and boat-building industry. This will enable local marine and other companies to address the large number of exemption requests in designated public procurement of working vessels.

The importance of technology enhancement should be seen against the backdrop of South Africa's commitment to the development of its marine and maritime resources and the growth of the ocean economy. Sustainable utilisation of marine and maritime resources is important, and the role and benefits of knowledge and technology must be balanced with this priority to the benefits of the oceans economy.

Current technology trends that promise changes and higher levels of efficiency include autonomous and smart ships, among others. The emergence of a high

level of innovation and change in the shipping and other marine industries brings with it new risks and significant opportunities. It is therefore important that the programme continues to seek and engage with companies operating at the forefront of technology.

One beneficiary (Cybicom Atlas Defence) was supported under the technology enhancement initiative of the programme. A second potential beneficiary, Stellenbosch Advanced Marine Craft, was identified in 2020/21, but the contracting followed in the subsequent financial year.

The customisation of an existing water treatment system by Cybicom Atlas Defence as a ship ballast water treatment system is the outcome of the identification of a niche technology capability in the local manufacturing industry. It has the potential to benefit the marine sector and to also address the need for an adaptable water treatment system with relatively low operational costs for land-based industries and socio-economic priorities. This project is profiled next.



Localisation of a ship ballast water treatment system for discharge of environmentally safe ballast water



TECHNOLOGY STREAM
Specialist Services to the Marine Industry



PRODUCT MARKET
Commercial (Marine); Water treatment (General)

BENEFICIARY

Cybicom Atlas Defence

PROJECT TITLE

Ship Ballast Water Treatment (SBWT) System Development Project (Project in Progress)

INDUSTRY PARTNERS AND COLLABORATORS

- ConEquipt
- Disa Scientific
- Merieux NutriSciences Laboratory
- Seapoint Research Aquarium
- Stellenbosch University
- Trailers4Shoots
- Water4All

CONTACT

Dave Viljoen – Dave@cadefence.com

Cybicom Atlas Defence (Pty) Ltd undertook significant research and development on a water treatment system to kill small aquatic organisms and microorganisms in the ballast water of ships.

Merchant vessels pump ballast water into tanks to maintain stability during a voyage on the open seas. This water must be discharged into the sea before entering a port. However, the discharge of untreated water from one location may contain small aquatic organisms of invasive species, plants, bacteria and viruses, and poses a threat to the environment and public health of another location. If suitable conditions exist in this discharge environment, these organisms of invasive species and plants will survive and reproduce to become invasive species, with dire consequences for the local marine ecosystem. Toxin-releasing algae and pathogenic bacteria (which cause disease) pose a danger to public health. New legislation in this regard by the International Maritime Organization has resulted in standards for all merchant vessels operating internationally.

The progress on this water treatment system for ballast water is promising as it will give ship operators without a ballast water treatment system the option to install a flexible and affordable technology to treat ballast water to accepted specifications before discharge. Dave Viljoen, Managing Director, highlights the challenges for owners of merchant vessels in acquiring a ballast water treatment system and the opportunity this presents for his team in customising existing technology. “This is a ‘grudge buy’ for older vessels without a ballast water treatment system. Expenditure on and operation of a ballast water treatment system are expensive for ship owners with no prospect of earning profit from this investment. Systems must also be adapted to the limited space available on a vessel.”

A LOCAL SOLUTION FOR A SHIP BALLAST WATER TREATMENT SYSTEM

“The technology that we are adapting to offer a potential solution, is the Hydrotron. It is a water treatment system that destroys pathogens and microorganisms, using the



Andrew Mukandila (Marine Manufacturing Deputy Director at the dtic) and Michael Phiri (Intern at the dtic)

principles of electrolysis. Electrolysis is a technique that uses direct electric current to drive an otherwise non-spontaneous chemical reaction.”

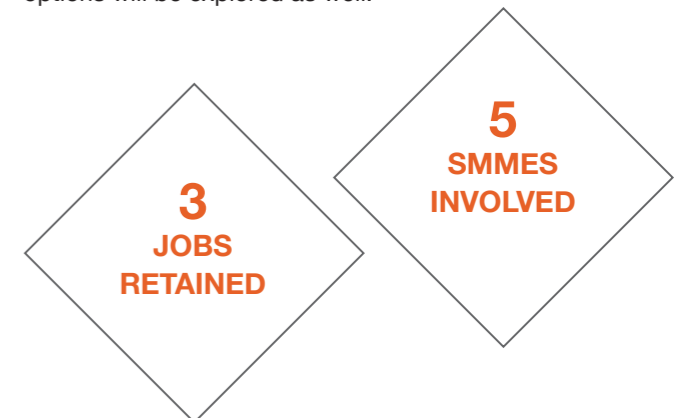
The core of the system is the direct application of an electric field between anodes and cathodes of specific material housed in reactors filled with water installed in-line. The continuous high-frequency, low-duty-cycle, high-current pulses applied to the electrodes drive electromotive forces that trigger a set of molecular and chemical reactions, with a low overall power consumption.

Viljoen explains that this technology has been implemented on land-based sites and developed in South Africa. It could therefore offer a ballast water treatment system at a significantly lower cost. “Our plan is to take this land-based water treatment system and convert it for use at sea, thereby reducing time to market, and with minimal disruptions in terms of installation and operation,” he confirms.

To date, the water treatment system under development has been shown to disrupt the membranes of microorganisms, thereby killing them. It also initiates a process of electrochlorination: the electrolysis of saltwater produces a chlorinated solution, which disinfects the water. Viljoen confirms, “We can therefore deduce that this process has the potential to kill a number of microorganisms and pathogens that are harmful to the environment and public health.” Further intensive water testing is ongoing with partners at universities and laboratories for validation of repeatable and calibrated testing methodology in line

with specifications. He confirms that two local shipyards are interested in participating in this project, but more work remains before this is possible. International accreditation of this water treatment system is a step that lies well in the future.

To demonstrate the working of the system, Viljoen and his team have built a demonstration model on a trailer (a mobile unit). He notes, “This water treatment technology has the potential for use on land to treat industrial wastewater and produce potable water, and these options will be explored as well.”



The Hydrotron kills organic organisms to allow for the safe discharge of ballast water

PROMOTION, COORDINATION AND AWARENESS

AESSA YOUNG PROFESSIONALS FORUM CONTINUES TO PROSPER DESPITE COVID-19 RESTRICTIONS

During 2020, the Aeronautical Society of South Africa (AeSSA) Young Professionals Forum strengthened the platform it provides for young professionals in the local aerospace sector to network and collaborate on technical and career-related matters. This was made possible on the back of the highly successful AeSSA Young Professionals Workshop held in October 2019 at Lanseria International Airport, Gauteng, as part of the AeSSA 2019 Annual Conference. The Young Professionals Forum and its activities are hosted by the AISI.

Busiswe Nkonki, AISI Economic Analyst, organised an interactive webinar in December 2020 on the theme, How the pandemic has affected the workplace: professional activity, future skills, for the AeSSA Young Professionals Forum. She explains, “As the AeSSA Annual Conference did not take place in 2020 due to the Covid-19 pandemic, we held a webinar at the end of the year to engage on this topic of great interest and current relevance to the aerospace industry. Twenty young professionals

participated in this online event to share work-related experiences of working during the Covid-19 pandemic, and to discuss future-fit skills.”

As part of the webinar, South African Civil Aviation Authority Executive: Human Resources, Thobile Masooa, gave an online keynote address on recruitment for the future. Ms Masooa emphasised the need to constantly re-evaluate recruitment processes, taking into account the forever-changing high-technology industries and an increasing demand of personnel with multidisciplinary skills. Next up was a discussion panel comprising Ana-Mia Louw, General Manager: Simera Sense; Ashlin Ramdas, Project Manager: Armscor; and Sinesipho Ngamile, Science Engagement Officer: South African National Space Agency, who described how the Covid-19 pandemic had affected business operations and activities in their respective companies. A consistent message emerged that constraints of the pandemic had necessitated changes to the business, which effectively led to a new way of work. Nkonki comments, “It was so clear that ingenuity, innovation and passion have been key to finding new ways to craft a future for these and other companies.”



Ana-Mia Louw



Thobile Masooa



Ashlin Ramdas



Sinesipho Ngamile

Several other strategies were already in place to ensure the continuity and value of the AeSSA Young Professionals Forum. During the 2019 AeSSA Annual Conference, the Young Professionals Forum presented the outcome of its activities from 2016 to 2018 during a plenary session, thereby embedding its role in the South African aerospace community. A decision to allow forum members registered for the AeSSA Annual Conference to invite two additional guests to the workshop resulted in the participation of a diverse mix of students, lecturers, professors, young professionals in the industry, and persons with a shared interest in aerospace. This collective with a desire to share and explore bold new ideas and collaboration possibilities enriched the engagement. Nkonki explains, “We’ve continued with this practice to broaden participation in the network while maintaining our primary focus of building a strong network of young professionals under 35 years of age. Once these members graduate out of this age category and forum, they remain active members of the aerospace community in South Africa.”

The AeSSA partnership with aviation awareness and skills development youth organisations, such as Sakhikamva Foundation and Wonders of Aviation, has benefited from association with the AeSSA Young Professionals Forum. On requests for assistance from these and other organisations, Nkonki is able to identify resources and call on young professionals based across South Africa to step up. “We are well positioned geographically to motivate and inspire the upcoming generation of aerospace enthusiasts wherever they are in South Africa,” she points out.

The AeSSA Young Professionals Forum was created in 2016. Initiated by Marié Botha, AISI Programme Manager,

it is loosely based on the International Programme Management Committee Young Professional Workshop which precedes the annual International Astronautical Congress. Its specific focus is to identify knowledge to better develop and empower the next-generation workforce. The AeSSA Young Professionals one-day workshops allow people to meet and network at this side-event ahead of the AeSSA Annual Conference. With workshop themes aligned to each conference, these workshops draw international keynote speakers from the respective conferences, who add a valuable and dynamic perspective to the event. The workshops include both a technical, multidisciplinary session and an informal session to encourage engagement and learning. Another benefit that Nkonki notes is that the workshops serve as an ice-breaker and that “young professionals support presentations by their peers during the conferences and also have access to more senior experts attending the event”.

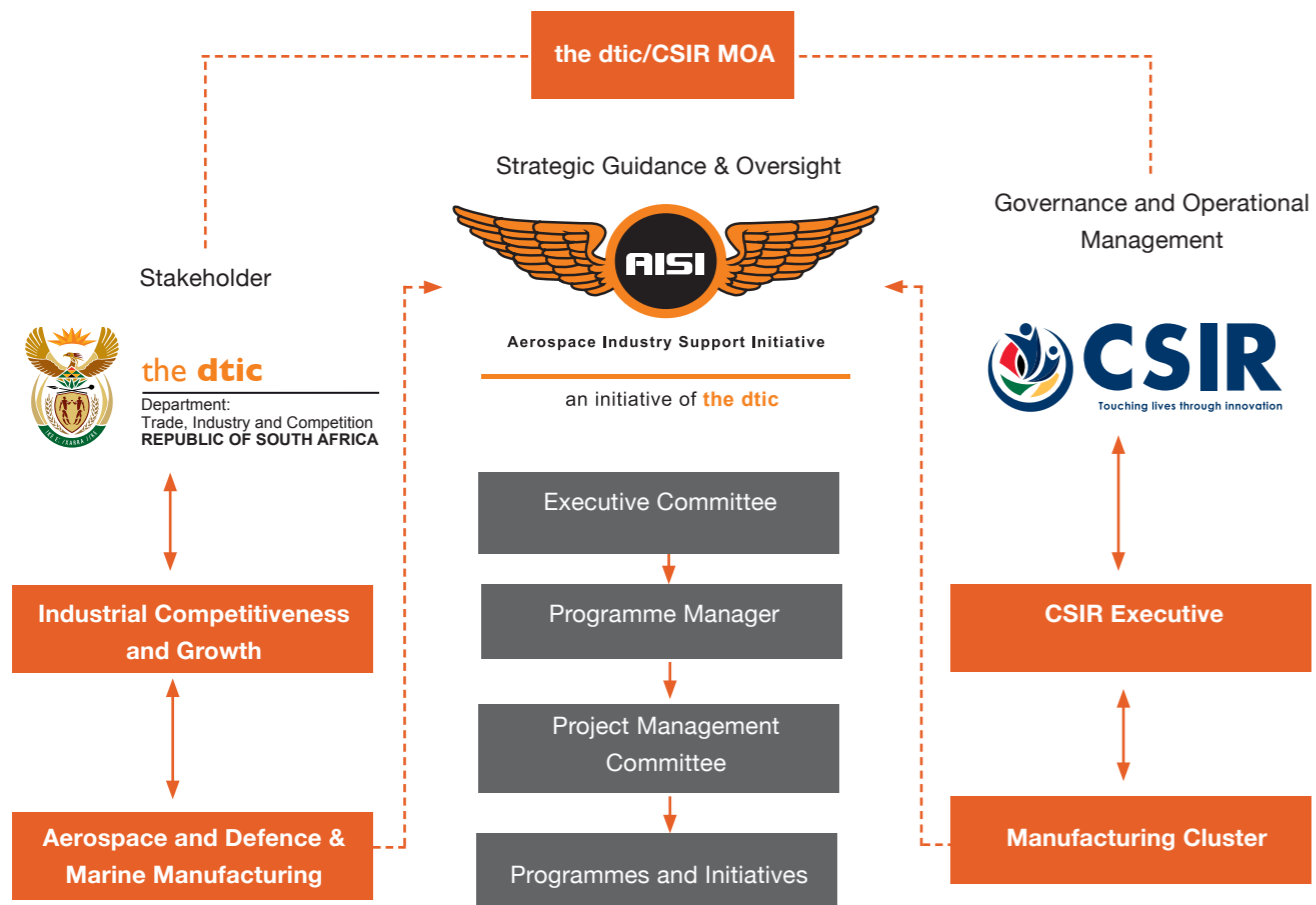
Nkonki is confident that the AeSSA Young Professionals Network will continue to thrive as it gives “a voice” to its energetic and innovative members. “We share ideas, we collaborate, and we care about South Africa’s aerospace as a competitive participant in the global aerospace sector,” she concludes.

AISI STRATEGY SESSION

As part of its preparation for the 2021/22 financial year, the AISI had a strategy session on 5 and 10 February 2021 with **the dtic**. The aim was to jointly reflect on and review the AISI programme and to ensure that the AISI’s programme objectives were formulated in consultation with **the dtic**.

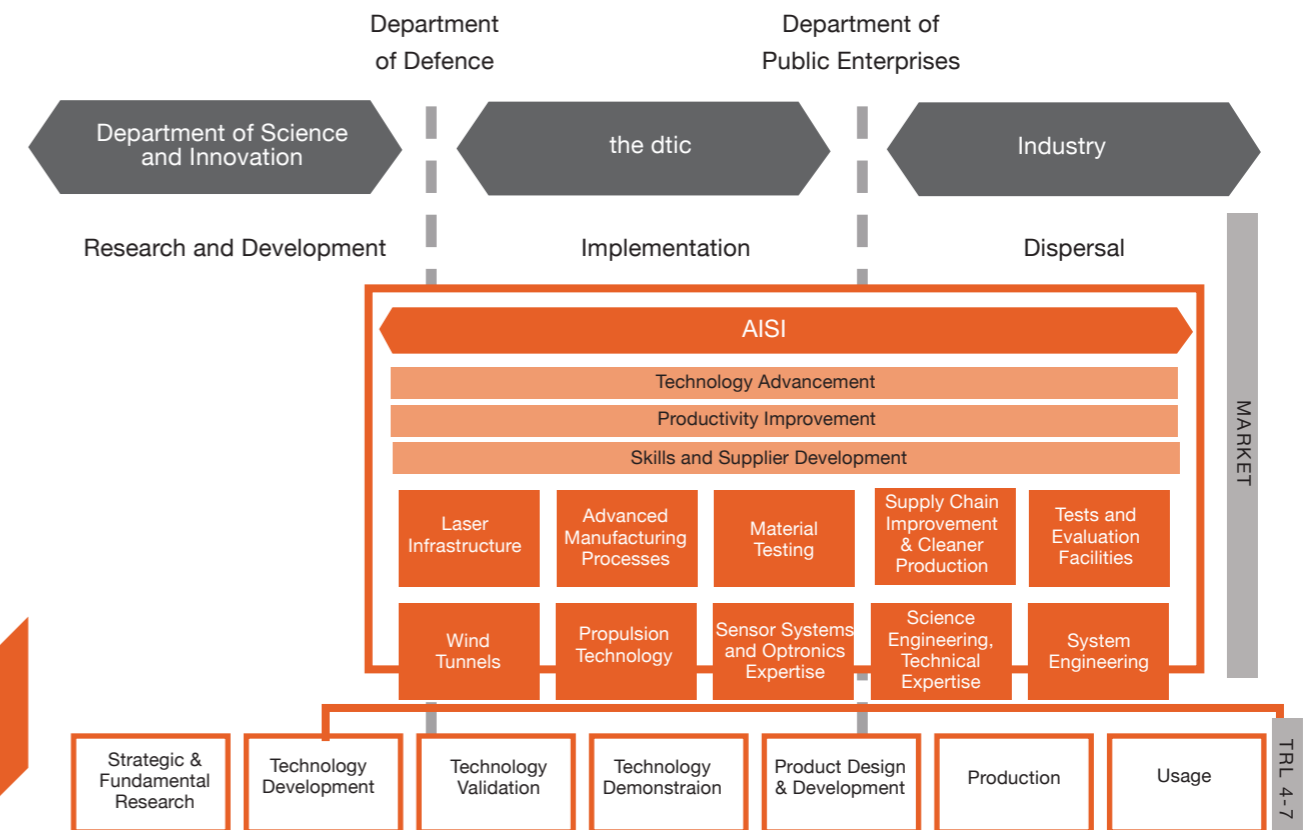
AISI GOVERNANCE

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.



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 in the following figure.



SUMMARY OF ORGANISATIONS BENEFITING FROM AISI SUPPORT 2020/21

Table 5: AISI-supported organisations at a glance

Beneficiary Name	Industry Partners and Collaborators (Service Provider)	Organisation Type	B-BBEE Level	Existing Certification/s 2020/2021	Project Name
Aerospace and Defence					
Aerosud Aviation	Persico Pioneer Plastics University of Pretoria	Original equipment manufacturer (OEM)	4	<ul style="list-style-type: none"> AS/EN 9100 European Union Aviation Safety Agency PA (Part 21G) 	Strategic Supplier Development: Rotational Moulding Project - Phase I, II and III (Completed Project)
Cape Aerospace Technologies		SMME	2	None	400N Gas Turbine Industrialisation Project - Phase I (Phase II in Progress)
Jonker Sailplanes	Advanced Composite Solutions Lektratek OnTrack Technologies North-West University	SMME	7	<ul style="list-style-type: none"> South African Civil Aviation Authority Type certification for JS1 "Revelation" all variants European Union Aviation Safety Agency Type certification for JS-MD variants 	24m Wingspan Open Class JS Project - Phase I (Phase II in Progress)
LambdaG	Metal Heart NewSpace Systems Stellenbosch University University of Pretoria	SMME	2	None	3D-printed Microwave Sub-Assemblies Project - Phase I and II (Completed Project)
Lantern Engineering	PdP Systems TME Close Corporation TraX Interconnect University of Cape Town	SMME	4	None	Lantern Technology Localisation Project
NewSpace Systems	StarkCNC Carbo3 RS Components (SA) Aerontec Clear Design Display	SMME	4	<ul style="list-style-type: none"> ISO 9001:2015 ISO 14644-1 European Space Agency Accredited Technicians 	Fluid Inertial Actuator Commercialisation Project - Phase I and II (Phase III in Progress)
Sentian Aerospace (previously Proceptworks)	Air Traffic Navigation Services Triwave Technologies University of Witwatersrand	SMME	2	None	Sentian UAV Project
Simera Africa	G&R Electronics ItCognify TFASA RoRa Engineering Ti-TaMED	SMME	2	None	Electro-Optical Stereo Vision Aircraft Approach Tracker Project
Simera Sense	Pink Matter Solutions Barracuda Holdings Astrofica Technology Daliff Precision Engineering	SMME	4	None	HyperScape50 Imager Project
Sparcx	CSIR Sysdel	SMME	1	None	Design and Development of a 2-6GHz DIFM System Project
B Engineering	(QRC Africa)	SMME	1	<ul style="list-style-type: none"> ISO 9001:2015 	Development and implementation of an AS/EN 9100 Aerospace Quality Management System
Daliff Precision Engineering	(Novo Star Management Solutions India)	SMME	2	<ul style="list-style-type: none"> AS/EN 9100 ISO 9001:2015 Airbus Certification 	AS/EN 9100 Aerospace Quality Management System Recertification Audit

Beneficiary Name	Industry Partners and Collaborators (Service Provider)	Organisation Type	B-BBEE Level	Existing Certification/s 2020/2021	Project Name
Kutleng Dynamic Electronics Systems	(QRC Africa)	SMME	2	None	AS/EN 9100 Aerospace Quality Management System Gap Analysis
Production Logix	(Aeronet of Things)	SMME	1	• ISO 9001:2015	Development and implementation of an AS/EN 9100 Aerospace Quality Management System
Ti-TaMED	(Novo Star Management Solutions India)	SMME	4	• AS/EN 9100 • ISO 9001:2015 • ISO 13485	AS/EN 9100 Aerospace Quality Management System 2nd Surveillance Audit
West Engineering	(Novo Star Management Solutions India)	SMME	2	• AS/EN 9100 • ISO 9001:2015	AS/EN 9100 Aerospace Quality Management System Recertification Audit

Marine

Cybicom Atlas Defence	ConEquipt Disa Scientific Merieux NutriSciences Laboratory Seapoint Research Aquarium Stellenbosch University Trailers4Shoots Water4All	SMME	1	Unknown	Ship Ballast Water Treatment (SBWT) System Development Project
6Sigma Shipyards Group	(Wescape Inspection and Quality Services)	SMME	3	• ISO 9001:2015 • ISO 14001:2015 • ISO 45001:2018	IACS (Lloyd's Register and Bureau) and ASME Section IX Welding Certifications, certified Welding Procedure Specification and Welding Procedure Qualification Records for several weld types
Bantek Engineering	(KTTS Vukani Projects and Construction) (TÜV Rheinland Inspection Services)	SMME	1	None	Development, implementation and certification of an ISO 9001 Quality Management System
Bayside Marine	(IQUAD Integrated Management Systems) (SLP Services t/a QMS Certification Services)	SMME	Exempt Level 1	Unknown	Development, implementation and certification of an ISO 9001 Quality Management System and ISO 45001 Health and Safety
Macc Marine	(Ultrascan Inspection)	SMME	2	None	IACS approved Welder Qualifications and Welding Procedures (Certifications)
Marine Solutions	(KTTS Vukani Projects and Construction) (TÜV Rheinland Inspection Services)	SMME	2	ISO 9001:2015	Development, implementation and certification of an ISO 45001:2018 Health and Safety System
Paltechnologies	(Bureau Veritas Testing and Inspections South Africa) (Lloyd's Register)	SMME	1	• ISO 9001:2015 • PED 2014/68/EU • ISO 14001:2015 • ISO 45001:2018 • SIL L3 61508 & Jaswic	Bureau Veritas and Lloyd's Register type certification of Paltech's single eccentric butterfly valves
Zero° Industries	(Hammar) (Halkey Roberts) (Yaw Liamy Enterprise) (Orafol Safety Systems) (American Cord and Webbing) (Viking Life-Saving Equipment) (Pascon SA)	SMME	4	• VC8032 001 (Skivest) • VC8032 003 (Souwester) • VC8032 004 (Souwester) • VC8032 041 (Occeanic)	The testing and certification of inflatable lifejacket according to SOLAS (USCG and MED regulations)

Beneficiaries Receiving Support through the AISI Management and Implementation Function

Paltechnologies	CSIR Vaal University of Technology	SMME	1	• Lloyd's Register and Bureau Veritas valve certifications	Optimising the casting process for marine valves
Veecraft	N/A	OEM	5	Unknown	Investigating the need for local testing capabilities for watertight and weather tight doors and windows
Jonker Sailplanes	CSIR	SMME	7	• South African Civil Aviation Authority Type certification for JS1 "Revelation" all variants • European Union Aviation Safety Agency Type certification for JS-MD variants	JSE Flutter Analysis for JS3

Disclaimer: B-BBEE statuses as per the date when the beneficiaries were contracted

ABBREVIATIONS AND ACRONYMS

AeSSA	Aeronautical Society of South Africa
AISI	Aerospace Industry Support Initiative
ATNS	Air Traffic and Navigation Services
CAASA	Commercial Aviation Association of Southern Africa
CFP	Call for Proposal
DIFM	Digital instantaneous frequency measurement
EASA	European Union Aviation Safety Agency
Eoi	Expression of Interest
IACS	International Association of Classification Societies
IFM	Instantaneous frequency measurement
ISO	International Organization for Standardization
N	Newton
OEM	Original equipment manufacturer
RES	Retractable electrical propulsion
ROV	Remotely operated underwater vehicle
SBWT	Ship Ballast Water Treatment
SEDA	Small Enterprise Development Agency
SMME	Small, medium and micro enterprise
SOLAS	Safety of Life at Sea
the dtic	Department of Trade, Industry and Competition
UAV	Unmanned aerial vehicle

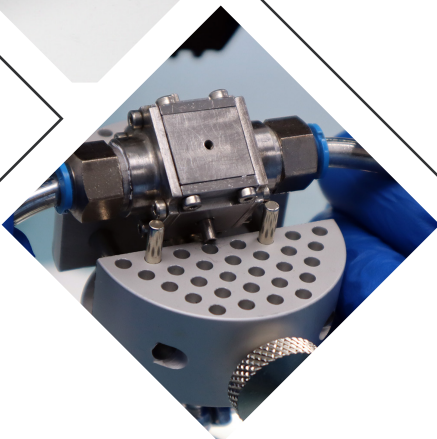




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