



Aerospace Industry Support Initiative

an initiative of **the dtic**

IMPACT REPORT

2021/22



the dtic

Department:
Trade, Industry and Competition
REPUBLIC OF SOUTH AFRICA



CSIR
Touching lives through innovation

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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The Aerospace Industry Support Initiative (AISI) is an intervention of the Department of Trade, Industry and Competition (**the dtic**). Created by the Advanced Manufacturing Chief Directorate, the AISI is designed to foster industrial development and competitiveness in the local South African aeronautics, defence, space and marine industries.

The initiative takes its strategic direction from government's objectives with emphasis on the industrialisation of technology, industry transformation, and job creation.

In presenting this Impact Report for 2021/22, the AISI management extends its gratitude to **the dtic**, the local aerospace, defence and marine manufacturing industries, the AISI team, and its host organisation, the Council for Scientific and Industrial Research (CSIR).

IMPACT ACHIEVED

During the 2021/22 financial year, the AISI supported 18 projects in the aerospace manufacturing industries, as well as nine projects in the marine manufacturing and associated services sector. Each of these projects serves one or multiple product markets.

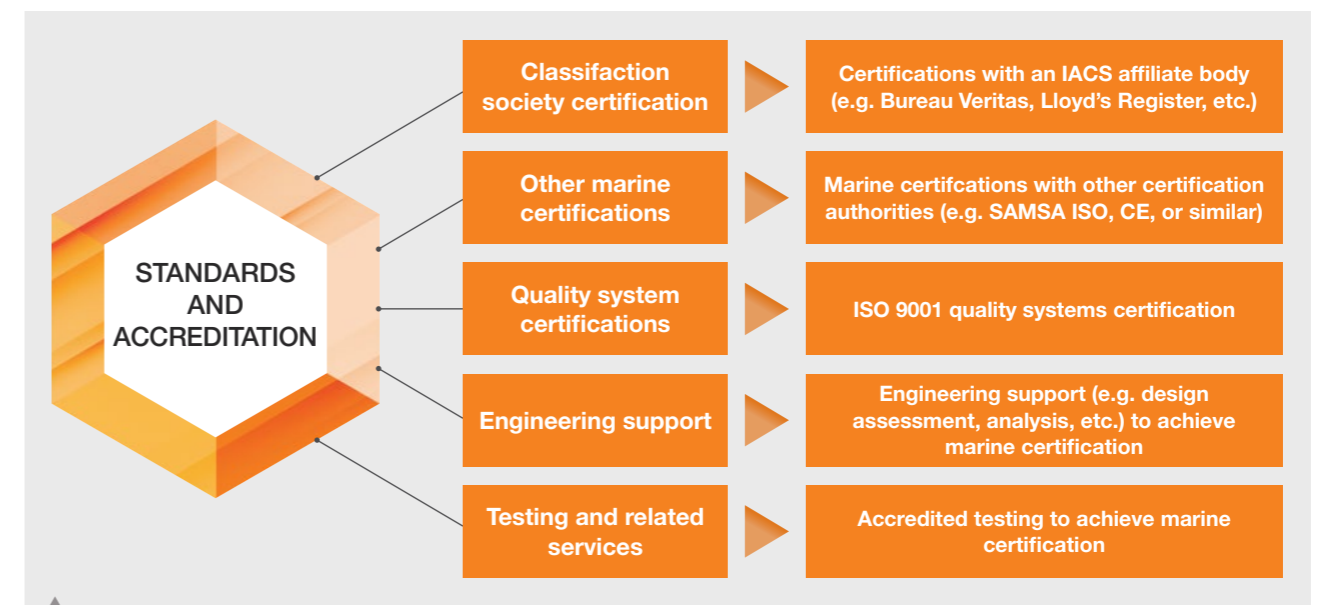
Significant progress was made in 2021/22 with respect to the development of local capabilities, advancement of technology

solutions, and exports. The AISI support extended to 48 SMMEs – directly and indirectly, it enabled the creation of 29 new highly skilled jobs and the retention of a further 164 highly skilled jobs.

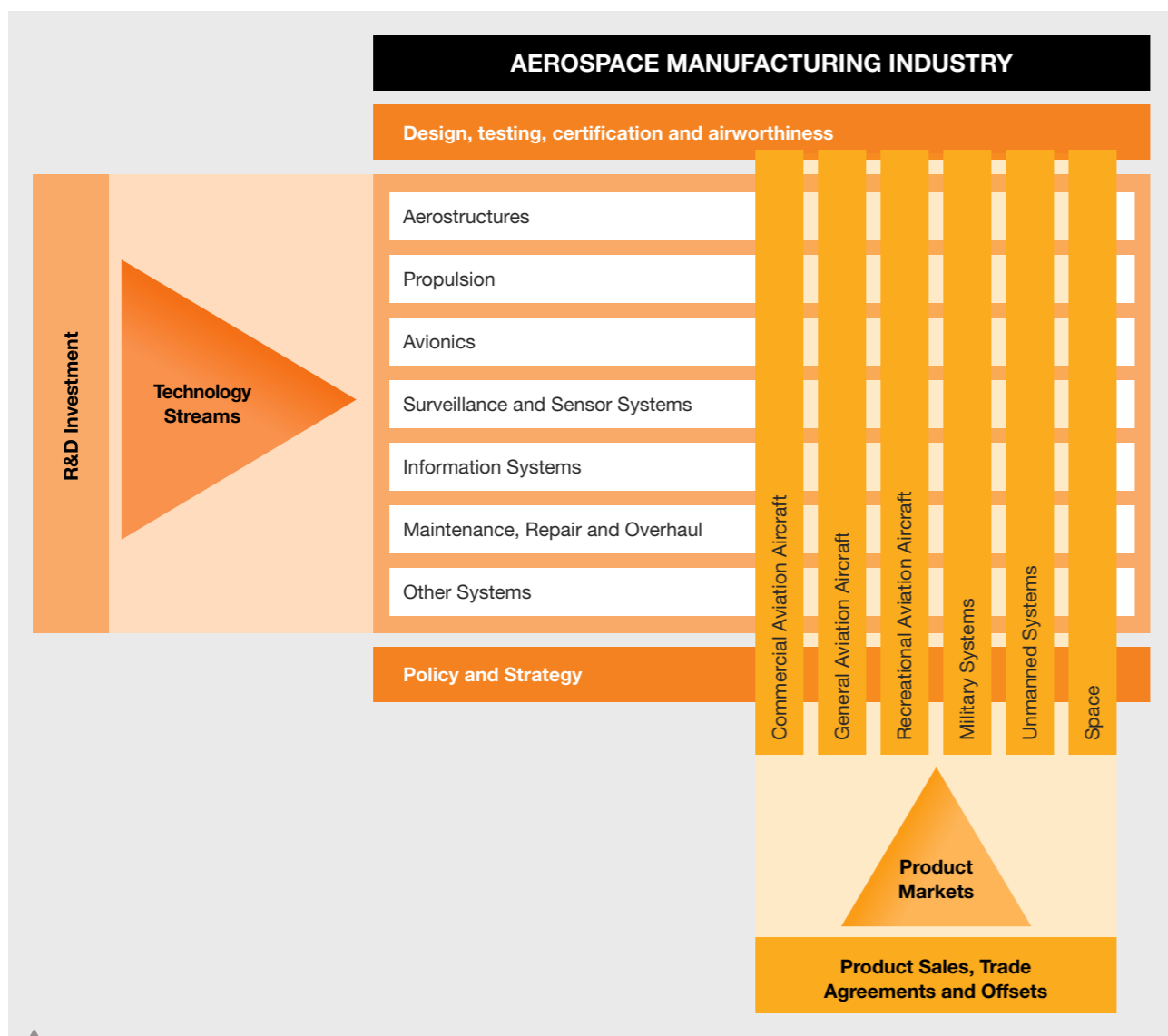
The AISI aeronautics, space and defence technology support thematic areas for 2021/22 ranged from aerostructures, to space, avionics, and propulsion, as well as surveillance and sensor systems.

The marine manufacturing and repairs supplier development programme promoted the maximisation of local content in manufacturing and supported South African maritime companies to acquire relevant standards and accreditation for integration into local and global supply chains, as well as support for technology enhancement.

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



Standards and Accreditation Interventions



Aerospace product and technology matrix
Source: Commercial Aerospace Industry Development Study

AISI PROGRAMMES

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

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

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

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

Technology-Based Supplier Development

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

Industry Development and Technology Support

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

Marine Manufacturing and Repairs Supplier Development Programme

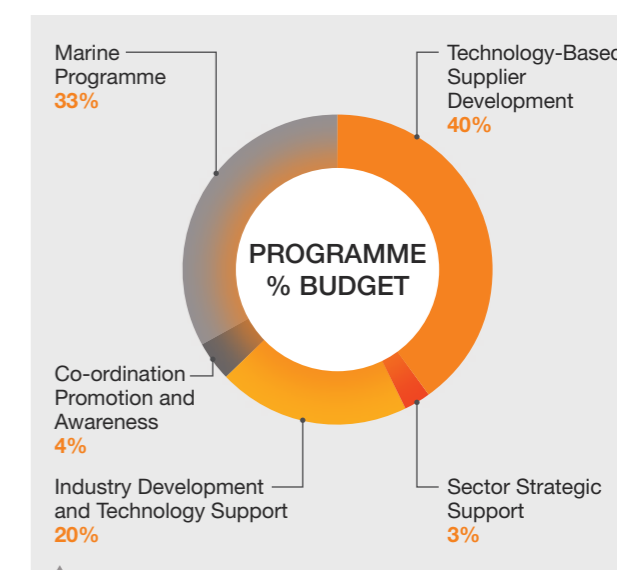
This programme assists suppliers in ship and boatbuilding, maintenance and repair, and the associated services industry to address issues that might hinder or prevent participation in the marine supply chain. The support is designed to enhance their visibility in local and global supply chains and increase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

Sector Strategic Support Initiatives

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




Coordination, Promotion and Awareness

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



Investment into AISI programmes in 2021/22

PROGRAMME 1: TECHNOLOGY-BASED SUPPLIER DEVELOPMENT

	AEROSPACE AND DEFENCE	MARINE
 New Technology Development & Advancement	11	2
 New Process Development & Advancement	8	0
 Highly Skilled New Jobs Created: Total number of jobs created due to the AISI intervention/support	15	14
 Highly Skilled Retained Jobs: Total number of jobs retained due to the AISI intervention/support	150	7
 Export Capability Achieved: Capability arising from the AISI intervention that initiates export activities or business	8	0
 Import Substitution Achieved: Capability arising from AISI intervention that initiates localisation	7	1
 Number of SMMEs involved in projects (direct & indirect): The number of manufacturing SMMEs which, according to the National Small Business Amendment Act, No. 26 of 2003, have less than: <ul style="list-style-type: none"> • 200 full-time employees; • R51 million annual turnover; and R19 million total gross asset value (fixed property excluded) that are either directly or indirectly working on the execution of the project 	36	16
 Industry-focused skills development (internal and external): Total number of personnel or students trained as a result of the AISI intervention/support in the benefiting company or companies that are working with the benefiting company	27	15
 Standards & Accreditation Support	11	23
 Facilitated access to national infrastructure (number of academic institutions & science councils involved)	10	0

INTRODUCTION

The Technology-Based Supplier Development Programme is the main programme through which the AISI supports the aeronautics, defence and space industries in South Africa. Its enabling mechanisms are crafted to assist industry to improve competitiveness, productivity and quality management systems. Through this assistance, industry optimises its operations and procedures, ensuring that the South African aerospace industry is easily integrated into global supply chains. The strategic focus remains on 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, greater customer satisfaction, as well as job creation and retention.

The programme was implemented with increased urgency to expedite the provision of support to SMMEs that were impacted by the Covid-19 lockdowns and restrictions. During the past year the programme has remained a crucial partner to South Africa's aeronautics, defence and space industries as they face ongoing post-pandemic challenges – notably the global microchip shortage. The AISI continues to play an important role in providing finances and networks to help these companies manage the often challenging project transition from mid technology development through to commercialisation.

AEROSPACE AND DEFENCE TECHNOLOGY ENHANCEMENT SUPPORT

The companies listed in the table received AISI support under the technology enhancement intervention in the 2021/22 financial period.

Table 1: AISI technology enhancement beneficiaries during 2021/22

BENEFICIARY NAME	PROJECT TITLE
Cape Aerospace Technologies	400N Gas Turbine Industrialisation Project – Phase III (Project in Progress)
Micromax	Beretta Frame Industrialisation Project (Project in Progress)
Jonker Sailplanes	JS Flutter Testing Project – JS2 GVT (Completed Project)
LambdaG	3D-printed Microwave Sub-Assemblies Project – Phase III (Project in Progress)
Kutleng Dynamic Electronics Systems	Chazon Smart Display Project (Project in Progress)
Jonker Sailplanes	24m Wingspan Open Class JS Project – Phase II (Project in Progress)
Paramount	Application of Additive Manufacturing for the Manufacture of Critical Aircraft Parts for Paramount Group (Project in Progress)
NewSpace Systems	Fluid Inertial Actuator Commercialisation Project – Phase III (Completed Project)

THESE INDIGENOUS PROPULSION SYSTEMS CAN IGNITE AN ENGINE IN AN INDUSTRY-LEADING SIX SECONDS

Product markets:
Recreational aviation aircraft and unmanned systems

► **Technology streams:**
Propulsion

Beneficiary:
Cape Aerospace Technologies

Project title:
400 N Gas Turbine Industrialisation (Phase II and Phase III)

Following its in-house, design-to-manufacture approach – and working with collaborators – Cape Aerospace Technologies (CAT) has successfully designed, developed and tested a micro gas turbine or turbojet engine with a static thrust of 400 newtons (N). The engine produces some industry-leading specifications and is garnering interest among local and international clients in the military and defence sector. Pre-orders have been placed for the engine.



▲ CAT's 400 N turbojet is mounted on a Jonker Sailplane for testing.

This project was a response to a strategic need for Denel Dynamics and Armscor to have an indigenous propulsion system that is lightweight, can operate between -25 and 50 degrees Celsius and at altitudes of up to 8 000 metres. They are intended for sub-sonic applications and can operate on diesel, kerosene or Jet A1 fuel. CAT invested its experience and know-how into the development of a sub-400 N micro gas turbine for use in a drone weapons system.

🔍 *Force, and thus thrust, is measured using the International System of Units (SI) in newtons (symbol: N), and represents the amount needed to accelerate 1 kilogram of mass at the rate of 1 meter per second squared. In mechanical engineering, force orthogonal (perpendicular) to the main load (such as in parallel helical gears) is referred to as static thrust.*

The lack of a propulsion systems capability in South Africa has been identified not only as a major shortfall in the value chain of state-owned Denel Dynamics, but as a missing element in the aeronautical industry. A major need therefore exists in South Africa to have a local turbine supplier, including maintenance and serviceability of components.

Strategic capability for the country

This project aims at addressing this by providing a small but sustainable industry capable of enabling much larger product offerings such as glider sustainer units, weapons systems and target drone developments.

Cape Town-based CAT provides the micro and small gas turbine industries with various propulsion system solutions and is known for designing, manufacturing and testing high-performance turbojet engines for use in model aircraft, high-speed target drones, unmanned aerial vehicles, experimental aircraft and full size gliders.

👤 ⚙️ **2 new jobs**

⬇️ **Import substitution achieved**

With support from the AISI, the 36-month project in three phases set out to design, manufacture and industrialise a 400 N gas turbine. "A sub 400 N micro gas turbine is still considered uncontrolled by International Traffic in Arms Regulations standards. Therefore, this would be an opportunity to develop a niche sector through support for a single product with potential to expand into a multitude of markets," explains CAT managing director David Krige who also heads up the propulsion systems unit.

High-altitude tests exceed expectations

Once system integration and testing in a working environment was complete, CAT moved onto the industrialisation phase, designing and streamlining manufacturing resources and processes to ensure a robust and reliable engine production line.

Thereafter, in the product-to-market phase, they procured all required stock items and identified key suppliers, as well as finalised the user interface to ensure a pleasant and easy user experience. These user interface systems were tested with industry players. The 400 N production line aims to produce a batch of engines for sale by project close.



▲ Final discussion before high-altitude testing of the micro gas turbine, which can be seen behind the pilot.

Once the sub-assemblies were tested, the team moved on to assembling the prototype engine and ancillaries, experimental testing and finalisation of the critical components. It was important to ensure quick and reliable starts.

Making use of Jonker Sailplane's platforms, CAT jumped at a window of opportunity to conduct the high-altitude testing of its 400 N turbojet in the skies above Potchefstroom. "The team at Jonker Sailplanes were impressed with the cosmetics," says Krige, "But when we fired up the turbojets, they were also pleased with the six- to seven-second startup time and overall engine performance. The CAT400 outperformed its international competitors on several levels. The inflight restarts too were highly successful."

CAT boasts the fastest micro turbojet startup time on the market: six seconds from 0 rpm to idle (32 000 rpm), compared to the industry's best at 25-40 seconds. Going from idle to full throttle takes three seconds, depending on altitude. The project has now moved into the industrialisation and commercialisation phase.

Reflections on participation

"The engineers at CAT are ever determined to place a product of superior class on the market. The AISI has assisted tremendously in making this happen. This allowed CAT to make a name for itself in the micro gas turbine, military and civilian industries. Apart from the fact that Cape Aerospace Technologies was started in 2013 through funding supplied by the AISI, the funds enabled CAT to streamline its design process to deliver world-class micro gas turbines," concludes Krige.

Major benefits of participation in the AISI include: six jobs retained, and a potential growth to 15 with successful production capability; continued assistance and knowledge transfer between CAT and students at Stellenbosch University; locally produced turbine and support; continued local SMME support; and a market presence for a South African product.

► INDUSTRY PARTNERS AND COLLABORATORS

- Jonker Sailplanes
- CSIR
- Stellenbosch University

LOCAL HIGH-PRECISION SMME INDUSTRIALISES MANUFACTURE OF 9MM HANDGUN FRAME FOR ICONIC ITALIAN FIREARMS MANUFACTURER

Product markets:
Military systems

Technology streams:
Other systems

Beneficiary:
Micromax

Project title:
Beretta Frame Industrialisation Project

A small and agile Boksburg-based manufacturing company, Micromax, is setting up a manufacturing process to fully industrialise the manufacture of the 9mm Beretta handgun frame in a cost-effective and profitable manner. The process should be able to manage an order of 3 000 units a year, and this would lead to a long-term relationship with the Italian firearms manufacturer.



The 9mm Beretta handgun frame.

Micromax operates within numerous industries and runs manufacturing lines on various precision products. The company specialises in industries where extreme attention to exacting detail is required. With large implications and technological requirements to reach this level of complexity, the SMME operates both inside and outside South African borders with numerous contracts on export products.

Micromax was approached by Beretta (Italy) to manufacture the 9mm steel gun frame in South Africa. Beretta has a requirement for 3 000 frames per year and has approved Micromax as its sole supplier for this product range due to the local company's history of supplying international clients with high-quality products. The main objective of the project is to create a local manufacturing process, which uses in-house technology, purchasable technology as well as selected sub-contractors to work together and develop the value chain that could deliver on the requirements.

"The project is proceeding well," says Micromax managing director Willem van der Merwe. "We have delivered 300 units to Beretta to date, and they are satisfied with the quality of the frame. This is a complex component to manufacture, so we are refining the process as we go along. Once we have produced 1 000 units and finalised the tooling, programming, setup and training on the new equipment, we will have the permanent industrialisation process finalised.

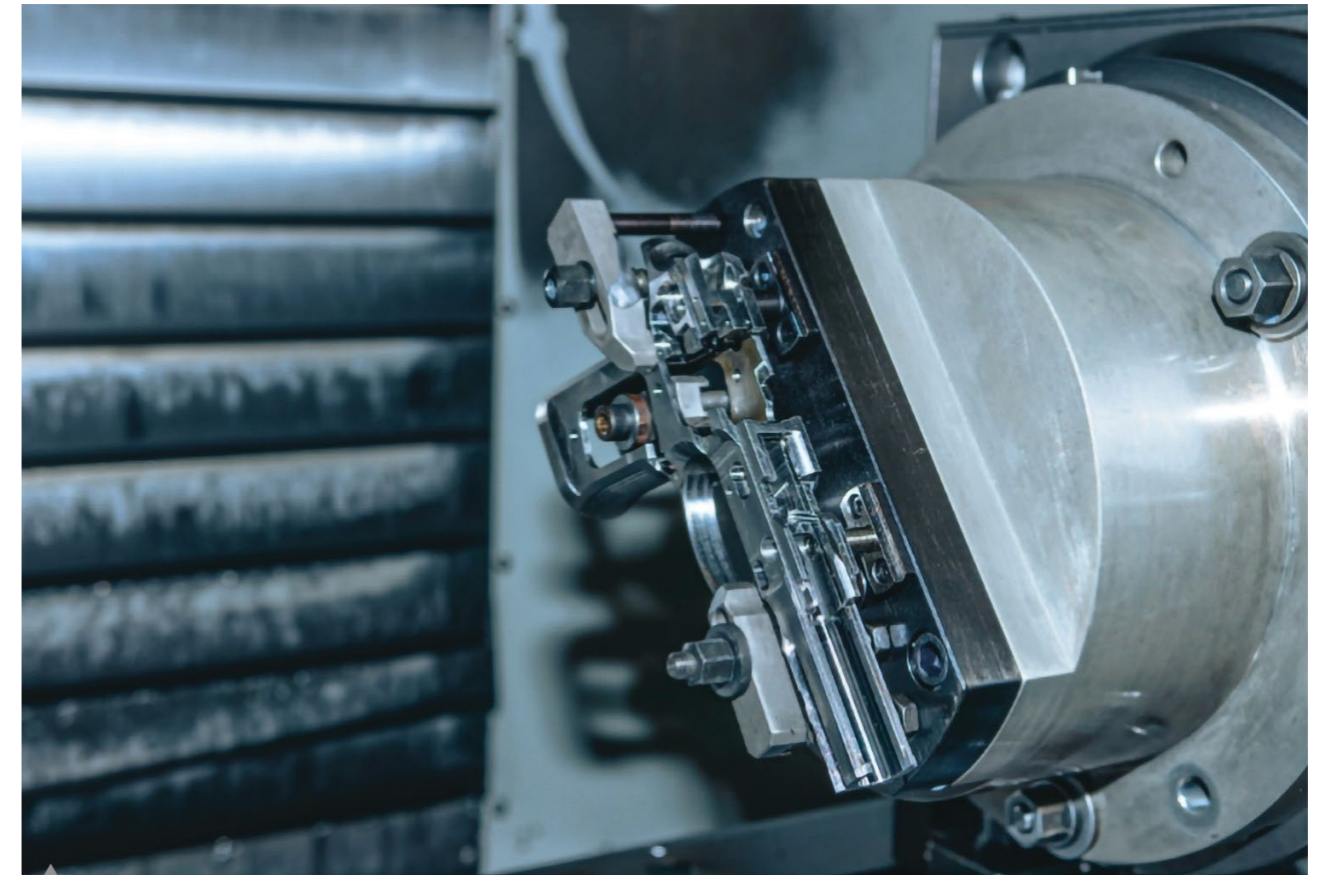
"As with any new industrialisation project, we have experienced unplanned teething problems. For example, we are still waiting for a slotting machine that will help us improve our processes and increase our output. Our plan is to deliver 200 frames per month. Once we achieve stable output with process optimisation, we move into the continuous improvement phase, where we monitor run time and unit costs. This allows for measurement of improvement after project implementation."



3 new jobs created



Export capability achieved



Micromax industrialised the process to meet the client's exacting standards.

Run times and set-up times are recorded and measured to determine the improvement required. For the steel frame, the machining time target (run time) is 6.2 hours per component. The Micromax team will have reached the goal of the AISI support when the first 1 000 frames have been delivered. After that, Micromax will run with the project and continue to build towards its goal of producing 3 000 units a year.

Reflections on support

Micromax operates primarily within the aerospace and military industries. Quality and precision are the focus here and a point for companies to stand out, all of which have prohibitive costs for product failure and the customers all expect excellence.

There are large industry barriers for the segment that Micromax operates in. Specifically, the technological costs of being able to compete in the precision manufacturing

markets, as well as the considerable experience curve to operate the machines to produce products at this high grade.

"The support provided by the AISI programme is appreciated, because when you start a programme like this, there is a long delay before the money starts coming through from the customer," says Van der Merwe.

"The AISI helped to finance the industrialisation phase, because you must invest a lot upfront in raw materials, tooling and training, and you only see the benefits two or three years later. On this project, for example, we had to invest in innovative technologies as well, because we are used to working with other materials, but not with steel. That has meant additional training for staff members. We have six or eight people working on the programme. We are convinced this effort will be worthwhile, and we are confident that if this project is successful, there is a good chance Beretta will add other components to our order book."

JS2 GLIDER SAILS THROUGH GROUND VIBRATION ANALYSIS AND AERIAL FLUTTER TESTS

Product markets:
Recreational aviation aircraft

Technology streams:
Aerostructures

Beneficiary:
Jonker Sailplanes

Project title:
Aeroelastic and GVT analysis of the JS2 Sailplane

In a successful, completed project, the CSIR has developed specialised equipment that was required to perform a Ground Vibration Test (GVT) on a South African-designed and manufactured sailplane or glider. In addition to the development of the equipment and the testing thereof, the CSIR team conducted a GVT on the glider itself. The data acquired during the GVT were subsequently used to perform a flutter analysis. The project team is delighted that the newly developed features of the GVT equipment performed according to expectation.



Extensive GVT and flutter analysis is required to ensure an aircraft is safe to fly. On this project, equipment that was developed allows for improved data acquisition when GVTs are performed.

The certification process on completion of the design of Jonker Sailplanes' JS2 aircraft required an aeroelastic investigation to ensure that no flutter is encountered over the flight envelope of the aircraft. This process entails performing a number of GVTs on different configurations of the aircraft and then using this data, perform the respective flutter analysis.

Aircraft flutter is the interaction between the structure and aerodynamic forces. Under certain circumstances, the vibrations that are induced due to the airflow can lead to a vibration of a part of the aircraft structure. The amplitude of the vibration can increase rapidly to such an extent that flutter occurs. During a flutter phenomenon the structure can be severely damaged, it is not uncommon for a part of the structure to detach itself from the rest of the aircraft. This phenomenon occurs very quickly and can lead to loss of life. In order to ensure that an aircraft is safe from flutter, a GVT and flutter analysis is performed.

"Ground vibration tests on a glider are challenging due to the low frequencies involved," explains the CSIR's Dr Louw van Zyl. "This has implications for the suspension of the aircraft – ideally with minimal support stiffness and damping – and the

amplitudes required to obtain good data. Our team provided the GVT equipment and expertise on this project, but we had to develop and test some new features. This included the long stroke exciters used to excite low-frequency wing modes with sufficient amplitude for proper measurement, and a suspension system with the same capability as the active air supports to completely eliminate the suspension effect on GVT results. This was a significant milestone for the CSIR's GVT capabilities, but it required more time and effort than a run-of-the-mill GVT."

No conclusions regarding the aeroelastic stability of the glider can be drawn from the GVT results by themselves (unless combined with an aerolastic flutter analysis). The GVT results are believed to be sufficiently representative of the production version glider for the purpose of a flutter analysis. The support system and the long-stroke actuator were used throughout the tests and performed as expected.

The equipment that was developed allows for improved data acquisition when GVTs are performed. The suspension system allows for no interaction between the ground and the aircraft, simulating the aircraft as if in flight. The long-stroke actuator allows for accurate excitation while being able to accommodate the increased amplitudes required for glider testing.

 **Export capability achieved**

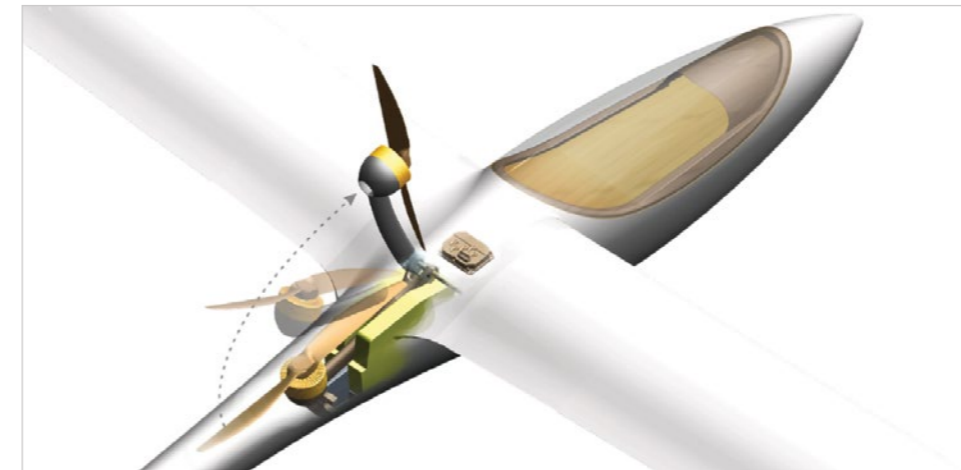


Diagram showing the sailplane's retractable engine mechanism.

The Jonker Sailplanes team is equally satisfied with the results.

The flutter analysis was followed by initial flutter testing above the skies of Potchefstroom where the commercial aerospace company is based. Dr Van Zyl identified flutter modes on the JS2 aircraft, and the team subsequently replicated these with full-scale in-flight testing. Jonker Sailplanes' CEO Uys Jonker adds, "The predictions as per the flutter analysis were very, very accurate and it's the first time we've ever experienced flutter in the air. Based on Louw's advice, we redesigned the airframe, successfully removing almost all flutter modes. It's been a highly successful project for us. If it were not for the CSIR, we would have to go to Europe or the United States to do these tests, or fly the experts here to do the tests. So we are extremely grateful to have this facility on our doorstep."

Opportunities and market access

This CSIR Defence and Security cluster's flutter prediction service is already one that is sold abroad and one that generates income for the council. This equipment, already used for a local GVT and flutter analysis, will also be used for other customers if the need arises.

The testing of the air supports and the long-stroke exciters will provide information on their suitability, especially when testing gliders. This may open new markets for the CSIR's GVT and flutter analysis service. The experience and expertise gained through the new GVT setup will greatly benefit the industry at large in cases where such expertise is required.

The project will assist Jonker Sailplanes to remain at the forefront of its market by offering a superior product in a reasonable period. It will also assist the CSIR to remain at the

forefront of GVT technology. Although beyond the scope of this project report, the imminent certification of the JS2 will allow Jonker Sailplanes to sell the aircraft and compete with it in gliding championships. "The sales revenues are already being ploughed back into the company to design additional variants of the aircraft or new designs," adds Uys Jonker.

What is the JS2 Revenant?

The JS2 Revenant is a high-performance 18/21-metre sailplane. Pilots can select the JS2 as a pure sailplane, or have a choice of propulsion systems:

- The Solo (Pty) Ltd fuel injection self-launcher system, or
- The MD-TJ 42 jet sustainer system

The JS2 is designed to be a world-class glider for the 'every-day' pilot in an airframe that has proven its pedigree in the highest level of competition.

Access to the European market will allow Jonker Sailplanes to generate enough revenue to be able to retain its current employees and even be able to hire more staff when required. This will allow the company to continue creating job opportunities for people based in Potchefstroom.

Skills and expertise in GVT and flutter analysis were enhanced for both CSIR Defence and Security and Jonker Sailplanes. The project also contributed to the establishment of internal flutter analysis expertise to be used during design of the aircraft to minimise the chances of flutter being experienced at a later stage.

INDUSTRY PARTNER AND COLLABORATOR

- CSIR

LOCAL START-UP PROVIDES ADVANCED COMPONENTS FOR SATELLITE MARKET AND SUPPORTS NEW SMME FOR 3D PRINTING IN THE PROCESS

Product markets:
Space

Technology streams:
Surveillance and sensor systems

Beneficiary:
LambdaG

Project title:
3D-printed Microwave Sub-Assemblies: Phase III

Advanced radio frequency and microwave components manufacturer LambdaG has its sights on the international market after improving its additive manufacturing (AM) capabilities in the development of antenna and radio-frequency components for the aerospace and defence industries. In addition to contributing to South Africa's global competitiveness, this Black-owned SMME has also supported the launch of a new SMME in the process.



The company's high-performance antenna systems are designed to meet the demand of 'new space' missions.

"The 'new space' approach in the satellite industry has led to a requirement for satellite components with low cost, mass and size," explains LambdaG CEO Dr Vernon Davids. "AM has been identified as a key technology to satisfy these requirements. With our know-how, experience and a supply-chain developed locally, LambdaG is developing capabilities to provide high-performance antenna systems to meet the demand of these new space missions."

Using the geometric freedom offered by AM, LambdaG is commercialising 3D-printed antenna assemblies that enable high data-rate satellite downlinks and uplinks from and to low-earth orbit, respectively.

The AISI support provided the funds needed for the development and manufacturing that was required for the project, consequently enabling LambdaG to access technical resources and

the infrastructure required to undertake the project. The project increases South Africa's AM capabilities and global competitiveness to manufacture high-value, high-performance communication components for the local and international space market.

LambdaG was founded in 2018 with a mission to address the modern small satellite requirement for lightweight, compact and sometimes integrated antennas. Leveraging innovations in AM, the company commenced with commercialising customisable microwave sub-assemblies and waveguide components in 2019. At the start of this three-year, AISI-supported project, LambdaG set out to develop a broadband microwave sub-assembly using AM. The sub-assembly and AM techniques are in response to a requirement in the satellite market for lightweight, compact, low-cost, waveguide components and systems with reduced lead-times.



2 new jobs created



3 SMMEs involved



The LambdaG team showcase the manufactured parts at international expos and trade shows.

LambdaG is strategically incubated by Cape Town-based NewSpace Systems (NSS), an advanced manufacturer of guidance, navigation and control products for satellites. This partnership de-risked the start-up phase of LambdaG by gaining access to a rapidly growing SmallSat market.

Key project objectives were met throughout. In year one, LambdaG manufactured individual components of the identified sub-assembly to characterise the manufacturing process. During the second phase in year two, individual components were 3D printed monolithically and underwent partial qualification and verification through vibration and temperature testing. These tests increase the technology readiness level (TRL) to a TRL 7 from a TRL 6. During the final phase, in year three, waveguide-to-coaxial adapters were designed and manufactured. These are complementary hardware to the identified sub-assembly and increase LambdaG's waveguide offerings and capabilities.

Local supply chain developed and optimised

Two adapter models were designed by a doctoral student from Stellenbosch University. A senior mechanical engineer re-evaluated the vibration test data of phase II and found that the data correlate with the simulated results. The same engineer produced the build models for 3D printing. A decision was made to develop a new AM supplier, HH-Industries.

Several iterations of the adapters were 3D printed to optimise the fabrication process with the supplier also developing the capability to provide surface finishing to the required specifications. Surface finishing of the printed adapters was done at Comatra, a supplier used during the previous phases.

Reflections on participation

"The project proves that lightweight, high-performance radio frequency components can be locally manufactured for spaceflight, at low cost, using additive manufacturing," concludes Dr Davids. "Although the technology can be used for South African or African space missions, the product is envisaged to primarily be an exported product for the global space market, available through our industry partner, NSS."

Dr Davids says the manufactured parts have been showcased at international expos and trade shows, which has led to technical discussions with interested clients and partners. LambdaG has received a letter of intent from a respected US satellite supplier for a demonstration of the technology and antenna assembly for future missions. "Speaking as a young South African engineer, a huge highlight for me is having international companies in the aerospace industry talk to me about our technology and receiving that credibility and respect based on actual, qualifying test results. More importantly, being able to do that, while having the hardware in your hands while you speak about it, is for me the absolute highlight of this experience."

As part of the technology transfer conducted between LambdaG and NSS, a female engineer was appointed as project manager by NSS for exploring the AM and plating processes of passive radio-frequency components.

NSS has proven the technology up to K-band (12 GHz to 18 GHz) frequencies for simple filters, resonators and waveguide sections.

The project manager was retained, as well as the partnerships with local suppliers.

INDUSTRY PARTNERS AND COLLABORATORS

- NewSpace Systems
- HH-Industries
- Comatra
- Stellenbosch University
- University of Pretoria
- Aeronet of Things

ORDERS FLOW IN FOR LOCALLY DESIGNED AND MANUFACTURED RUGGED DISPLAY FOR UAVS, DRONES, UNMANNED APPLICATIONS AND ROBOTICS

Product markets:
Commercial aviation aircraft

► **Technology streams:**
Surveillance and sensor systems

Beneficiary:
Kutleng Dynamic Electronic Technologies

Project title:
Chazon Smart Display

Kutleng Dynamic Electronic Systems designs, manufactures and assembles rugged displays for various applications including SmartCam products. Its Chazon embedded SmartCam display was designed and developed for unmanned aerial vehicles (UAVs) and other uses. As a result of support from the AISI, it received a purchase order from Armscor for the product¹.



The Chazon embedded SmartCam display.

An original design manufacturer of aerospace systems using field-programmable gate arrays, Kutleng saw an opportunity to design, manufacture and assemble rugged displays for its SmartCam products. The rugged displays come in varying sizes – from 10 inches to 24 inches. The Chazon serves as an accessory to the SmartCam for rapid field deployment, and inclusion into an all-in-one sub-system.

“We identified a gap in the market for a complete imaging solution that is portable and readily deployable to remote and harsh environments,” explains technology operations director Hector Hlophe. “These displays are usually costly and imported into the country as complete units to be integrated into a system. South Africa does not have a dynamic display technology that can be used in the field and on an aircraft, serving as a mission-critical component. Our displays will feature highspeed industrial grade connectors to take advantage of the highspeed processors built into the SmartCam and embedded computing platforms.”

Kutleng applied for support from the AISI for assistance with CoaXpress Certification and purchase of the CoaXpress components. Certification will allow the SMME access to the international market where interest for its products is high. Hlophe, who serves as digital design engineer on the project, says, “The versatility of the CoaXpress standard means the displays are not limited to serve as SmartCam displays, but can be integrated into other platforms that require a rugged, durable display for deployment in hostile environments.”

The project spans three phases: preparation; design and development; and demonstration. Progress to date on the preparation phase includes: completion of the software and firmware functional requirements and test specifications; and hardware functional specification. Work on building the software environment and firmware environment is ongoing.

On the design and development side, the block diagram detailing the integration of components is complete. Kutleng

¹ <https://www.defenceweb.co.za/aerospace/aerospace-aerospace/aerospace-industry-support-initiative-aisi-hosts-awareness-raising-industry-days/>



New technology development



New markets opened

has acquired the image processing module and integration is underway. The mechanical enclosure design for the 10.1-inch and the 15.6-inch display is complete and ready for manufacture.

Mechanical designs are done in parallel with the enclosure design, and these are 95% complete. The firmware is being customised to work on the hardware purchased.

Display properties and market opportunities

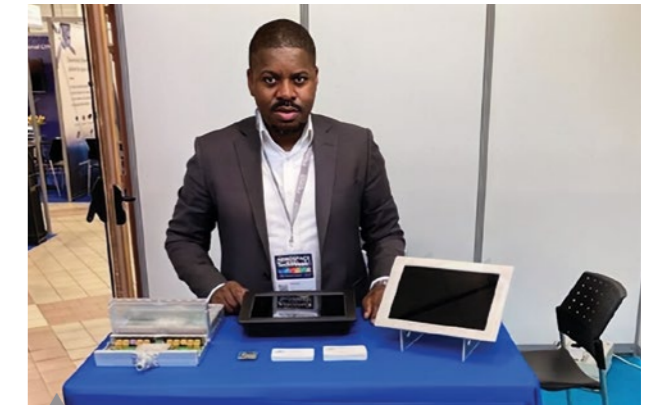
The Chazon display features high-definition resolution; a wide operating temperature (-20°C to 70°C); an anti-reflective surface treatment; a projected capacitive touch screen; a series 6000 aluminium enclosure with IP67 seals; and ethernet connectivity for video metadata interface.

Kutleng sees a need for this technology globally and has engaged other commercial companies to gauge interest. As a result, Kutleng has secured verbal interest for avionics glass cockpit displays; border patrol remote displays; airport surveillance displays; and vehicle mission computer displays.

The integration of artificial intelligence in surveillance cameras is projected to have a positive impact on the growth of the surveillance camera market in the coming years. The Chazon display is paired with the SmartCam to provide on-demand interaction with SmartCam where it is not possible, or it is costly, to rollout backend communication infrastructure. With a rugged build, the Chazon display can operate in extreme conditions ensuring that data captured from the SmartCam can be retrieved and analysed on site using the highspeed CoaXpress connection. With a built-in processing core, the Chazon display is capable of edge processing of complex data.

Through this funding, Kutleng has developed the capability to design, manufacture, and assemble complex and high-tech optical systems. There is a large demand for the SmartCam product due to the industry 4.0 automation. Intelligent and programmable cameras are increasingly in demand and being applied in running smart cities and smart villages. The Chazon display makes diagnosis, data retrieval and analysis possible regardless of the operating conditions and location.

Hlophe says the project proceeded smoothly despite the ongoing global shortage of chips (semiconductors) affecting availability of components. Kutleng decided to use commercial off-the-shelf components (COTS) that are already certified. The COTS components have no impact on expected functionality of the display.



Technology operations director Hector Hlophe at an industry expo with the display.

The 10.1-inch screen has already received orders from the medical industry as a spill-over effect from the technology and Kutleng continues to work on and refine the 12.3-inch display. The 12.3 inch is mostly for military application and will be ready as soon as global component supply chains are fully operational again.

The company took the 10.1-inch Chazon to the 2021 Aerospace Technology Week in Toulouse, France, where it was well received. The displays are now being sought by an international consortium for application on the German rail network.

Reflections on support

Hlophe says, “Despite the heavy reporting requirements, the AISI support assisted tremendously with roadmapping and building confidence within the company in its ability to produce high-tech products, certified for international application.”

The benefits of this project to the aerospace industry include improved availability of displays for rapid deployment; technological competitiveness; skills development; and reduced costs. Kutleng itself benefits through an improved ability to make informed decisions on cash flow forecasting; strengthened business relationships; improved awareness of the company’s expertise; and improved market penetration.

Another important intent of the Chazon displays is integration to other existing mission-critical defence systems. The development of such technology, which applies to critical defence infrastructure such as land borders, airports, and other ports of entry, gathers critical information while simultaneously limiting the impact on our daily lives.

HIGH-PERFORMANCE GLIDER WITH 24M WINGSPAN WILL ONCE AGAIN CEMENT SOUTH AFRICAN COMPANY AS GLOBAL LEADER

Product markets:
Recreational aviation aircraft

Technology streams:
Aerostructures

Beneficiary:
Jonker Sailplanes

Project title:
24m Wingspan Open Class JS

A complex project by Jonker Sailplanes to design and develop a new high-performance glider with a 24m wingspan is progressing well after early delays. Jonker Sailplanes' vision is to be the manufacturer of the most sought-after sailplanes in the world. The requirement to be a product leader is to produce the best-performing product at the highest manufacturing quality. Although Jonker Sailplanes has been surpassed as the product leader in the open class, this 24m wing project will enable the Potchefstroom-based company to re-establish itself as the product leader in the sailplane open class and regain its market position.



JS2 mid-flight.

Once completed, the project will make a major contribution to South Africa's export objectives, as the development of a 24m wing for the so-called JS platforms will allow sales into the open class, particularly in the European and Australian markets. In addition, Jonker Sailplanes' global position as a manufacturer and exporter of advanced, competitive and highly sought-after sailplanes will be cemented, as there are no other manufacturers currently taking on the daunting task of the design and development of a new glider in this unlimited performance class.

This three-year project was heavily interrupted by the Covid-19 pandemic, which delayed some aspects of the work, and caused delays in finding parts to run critical equipment due to international supply chain disruptions. The team is still playing catchup. Following completion of the design and tooling phase, they entered the prototype wing manufacturing or industrialisation phase, and they have also entered the certification phase. This includes European Union Aviation Safety Agency application and approval; GVT and flutter tests; flight tests; as well as certification, documentation and reporting.

In a separate project supported by the AISI, a GVT test and flutter analysis was done by the CSIR on another of Jonker Sailplanes' gliders, namely the JS2. Flutter was predicted and experienced. This impacted the 24m-wing JS5 project as well, because both aircraft are based on the same design. The fuselage has to accept two different types of wings. Flutter on one product would likely affect the other. This resulted in revisiting the moulds and tooling design on the multi-panel, 24m open class wing, to ensure the new wing will not have the same problems that were identified (and corrected) in the JS2.

"The achievements of the project include the upgrading of a separate development facility, as well as development work on the moulds for production of the 24m wing," says project leader AP Kotze. "Finite element analysis was done on the full model of the wing to remedy structure and layout to combat deformation of the 24m wing. A flutter model was then developed internally, which is now a new capability within the company that allows us, before manufacture, to predict the flutter characteristics of the airframe. As such, all projects going forward will be designed with flutter in mind."



New process development



Export capability achieved



5 SMEs involved



The 24m wing glider, currently under development, will enable Jonker Sailplanes to re-establish itself as the product leader in the sailplane open class and regain its market position.

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, which is 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."

Although several other design aspects still require investigation, work on this development is progressing well. Kotze says the aerodynamic design is completed; the structural design is completed up to a very high level, with additional input from the CSIR and some modelling on the airframe; and they have started with the manufacturing of the moulds. The wings comprise the main wing panels and the tip panels. Machining has started on the main wing panels.

Additional activities in the near future will include integrating the wing with the fuselage of the aircraft; compiling the certification test plans; and finally, conducting the flight tests.

At the time of writing, the project had entered the final stages of manufacture, to be followed by prototype flying by April 2023. The development of the JS5 will continue beyond the end of this AISI-funded project.

"Our financial existence requires us to consistently deliver products into customers' hands," says CEO Uys Jonker.

"A management-level team has now been set from both the AISI and Jonker Sailplanes sides to expedite the project."

Jonker Sailplanes has come a long way since it was first established by Uys Jonker and his engineer brother Attie. It seems their father Tienie, who in the 1970s built a Tern – an American wood and fibreglass glider with a 15m wingspan – in the family home's garage in Bloemhof, inspired his young sons to get involved in the world of soaring. Today they continue to dream of building new iterations of the perfect glider. Between the brothers they have over 2 000 gliding hours behind their names, both have been crowned national champions three times and have represented South Africa in the world championships on various occasions, where their flagship JS1 has been a global leader in the past.

Within the next few years, the JS5 is set to recreate the glory days of the JS1, retain jobs and bring in export earnings for South Africa. The market confirms that this product will be the class leader, as the order book for the JS5 is already full, despite the price tag. In the meantime, the design team at the company is kept busy working on a number of other new aircraft, while new products are fed into the production side of the company.

South African engineering at its best

At the latest World Gliding Championships held in Europe, South African engineering was on full display and this was truly the year of the Jonker Sailplane. No less than 37 of the 83 competitors flew a JS product. The JS3 completely dominated the 18m class – the equivalent of the Formula One Grand Prix class in soaring – while it also featured in the open class.

"In the 18m class, 60% of the gliders that participated were our products," says Jonker. "Our aircraft took 12 of the top 15 positions – including the first seven. Looking at the scoreboard one could see South Africa's design and engineering capabilities on display. Our sailplanes have been proven better than those of international engineering experts. This technology demonstration is significant and investors will look at the South African aviation sector in general with much more confidence."

INDUSTRY PARTNERS AND COLLABORATORS

- CSIR
- OnTrack Technologies
- Kusanii Composites
- Albatross Fly
- Nisa Composites

NEW DECISION MATRIX TOOL AND SKILLS KEEP RENOWNED RECONNAISSANCE AIRCRAFT LIGHT AND COMPETITIVE

Product markets:
Military systems

Technology streams:
Aerostructures

Beneficiary:
Paramount Aerospace

Project title:
Design Specification & Qualification of Metal Additive Manufactured Aerospace Parts

Using innovative design for additive manufacturing (DfAM) techniques, Paramount Aerospace is collaborating with the CSIR to develop strong yet light metal parts to improve its AHRLAC aircraft. By improving the aircraft and showcasing local AM capabilities, this project demonstrates to other local stakeholders in the aerospace industry the benefits of adopting this exciting and disruptive technology. The project involves the qualification of five parts manufactured through AM for the aircraft and is expected to improve the competitiveness of the AHRLAC.



Original upper rudder hinge bracket design and topologically optimised design.

All five metal parts that Paramount Aerospace is designing are being developed according to American Society for Testing Materials standards to produce flight-worthy components. One of the key advantages of DfAM techniques and AM to produce these parts, is the ability to produce complex shapes or geometries that would be otherwise impossible to construct by hand, including hollow parts or parts with internal truss structures that reduce weight without sacrificing tensile strength or fracture toughness.

The AHRLAC (Advanced High Performance Reconnaissance Light Aircraft) is a South African light reconnaissance and counter-insurgency aircraft. It is designed to perform as an inexpensive, more versatile substitute for UAVs and modern light attack aircraft.

“By using AM or 3D printing as an engineering process, we are able to develop a set of tools and software and create capabilities in a technology that’s described as disruptive,” explains Paramount’s chief technical officer Andries Uys. “This includes expertise in material selection; design for AM; applying stressors/loads and using algorithms to assist you to optimise the design for the loads stress and structural analysis; and mechanical testing.”

The CSIR Photonics Centre brings to the table its expertise in metal additive manufacturing (MAM) and mechanical testing. The centre has the capability and capacity to produce large, high-quality printed parts in multiple materials and at high speeds.

“The first step was to review and identify five qualifying parts,” explains the CSIR’s Duwan Bester. “We analysed 14 parts in total, reviewing the computer aided design models to see how suitable they are for AM. The review process considered the complexity of the designs and whether the design can be modified to better suit the AM process and potential reduction in manufacturing cost.”

Five parts were identified and shortlisted for the project. Each one was chosen on the basis that it addresses at least one of the benefits of AM. The five parts targeted and agreed upon for AM development and qualification were the upper hinge rudder bracket; the fuel strainers; canopy guide; forward cockpit control cable mount and the engine oil drainage bracket.

The project team started with the one identified critical part, namely the upper rudder hinge bracket, and one of the identified non-critical parts namely the fuel strainers (there are three fuel strainers on the aircraft).

New process development

Fuel strainer 1 DfAM result.

Fuel strainer 2 DfAM result.

The bracket was chosen as the critical part for the project, as its failure during flight could mean loss of ability to steer the aircraft, and the benefit it addresses is weight saving through topology optimisation. Another reason the bracket was chosen was to prove the process of qualifying critical parts, which will be used in the future on other critical parts.

The fuel strainers are used to keep larger particles out of the fuel line going from the fuel tank to the engine of the aircraft. They are currently machined from aluminium and each hole in each strainer is drilled during the computer numerical control machining process. Due to the ability of AM to manufacture much more complex parts at no extra cost, the distance between the holes in the strainers can be reduced. The same number of holes (to keep the same performance) can be incorporated on a much smaller area, decreasing the weight of the required parts.

Paramount Aerospace provided the required baseline information on the chosen parts, such as current cost of manufacturing, lead time, part material, and where necessary, load cases. The test piece built for the qualification of the upper rudder hinge bracket has been completed and sent to the CSIR for testing. The mechanical testing that is required to qualify the selected part depends on the part’s classification. Most classes require at least tensile testing and fatigue tests are added for high-risk parts such as the upper rudder hinge bracket.

The scope of the project has expanded with the focus shifting more towards the development and transfer of skills in DfAM. Thus, for now, the upper rudder bracket will be used to show the full roadmap of qualifying MAM parts for the aerospace industry, while the other parts will be used to develop skills in DfAM. The skills will not be held by one entity but transferred to multiple companies that form part of the project, which will be of greater benefit to the end user, Paramount.

“The redesigned fuel strainers incorporate more holes than the originals (meaning the parts’ performance is at least as good as or better than the original design), while being a lot lighter,” adds Uys. “Being lighter slashes the cost of manufacturing, as well bringing down the weight of the aircraft.”

The other parts that are undergoing the DfAM redesign and topological optimisation process are in various stages of refinement. The engine oil drainage bracket did not have to go through topology optimisation but did go through a redesign to consolidate all the individual parts into one. This eliminates some assembly work and additional manufacturing processes like welding. The team produced several iterations of some of the parts to ensure that they will meet the requirements and safety standards when tested.

Achievements

The goal of this project is to develop a decision matrix for the selection of additive manufacturable parts, as well as develop DfAM skills for designing metal parts for the AHRLAC. This promotes localisation and qualification of AM capability for aerospace applications. By contributing to the improved competitiveness of the aircraft, it also contributes to export promotion when the aircraft is sold outside of South Africa.

A custom DfAM course had to be created, by external service provider Simteq, to train two groups, consisting of 14 people from four different organisations (CSIR, PAI, PLS, Aditiv Solutions). The first round of training has been done and another is scheduled. The other planned activities include production of prototypes and validation by Paramount as well as mechanical testing and density inspection. Upon completion of the mechanical testing, fractography and metallography will be performed on the fractured specimens to characterise the fracture behaviour and failure.

Reflections on support

“The AISI is a great vehicle for small projects and if I look at where we are today especially in aerospace, the decline of the big parastatals has allowed us to re-establish some capability and focus on a new generation of young engineers capable in different technologies. I believe if the AISI can give them that exposure and opportunity to use world-class tools and obtain results, it becomes a great enabler and skills multiplier to retain the bright minds in South Africa,” concludes Uys. “We need more short-term programmes like this, and the AISI can play a role in making sure that there’s a convergence of paths between the CSIR and industry.”

“We all need to push harder now for more funding and support for the programme, because the funding does not account for time the industrial partners have to spend holding it together. The industrial participation is critical and the AISI is instrumental in bringing together all these parties to understand each other’s needs. They must find ways to bring industry on board in greater numbers and they can do this by buying their time.”

INDUSTRY PARTNERS AND COLLABORATORS

- AHRLAC
- CSIR Photonics Centre: Additive manufacturing and mechanical testing
- Additive Solutions: Additive manufacturing of parts
- Simteq
- Stellenbosch University

NOVEL TECHNOLOGY ENSURES MORE RELIABLE ATTITUDE CONTROL FOR SPACECRAFT

Product markets:
Space

▶ **Technology streams:**
Surveillance and sensor systems

Beneficiary:
NewSpace Systems

Project title:
Fluid Inertial Actuator (FLIA) Commercialisation

Advanced manufacturing company NewSpace Systems (NSS) is a leader in guidance, navigation and control products. The Cape Town-based, international company has successfully designed and developed a single axis fluid inertial actuator (FLIA) system to control a 1U cube satellite for commercialisation. A patent for the novel FLIA has been registered and a fully assembled single axis FLIA was successfully demonstrated, bringing this programme to a close. The solution will gain flight heritage on CubeSats but is designed to scale up for larger spacecraft.



The single axis FLIA system designed to control a 1U cube satellite.

Satellite attitude control is critical for a satellite's successful mission. Through attitude control, the satellite's orientation with respect to an inertial frame of reference is adjusted and controlled. In general, attitude control actuation is based on the principle of conservation of angular momentum and is currently implemented through reaction wheels.

A reaction wheel is an electromechanical device that has several moving mechanical parts that can fail and severely compromise the efficacy of operation, often leading to failed missions. There are many advantages to eliminating the moving mechanical parts of reaction wheels for satellite attitude control actuation. The FLIA was devised to do so.

The actuator was developed in three phases starting with mechanical design and manufacturing; electrical design and manufacturing; as well as integration and testing. The fluid used in the component is a liquid metal, Galinstan, which has as an extremely low melting point and a high density.

🔍 *The FLIA makes use of a magnetohydrodynamic pump with no moving parts, which uses interacting magnetic and electric fields to produce a force (the Lorentz force) through a working fluid to produce a torque to conserve the angular momentum offset by the force. For this to be possible, the chosen fluid must flow in a loop configuration and must be liquid at a broad range of temperatures to operate successfully in space.*

“While testing the system as a viable proof of concept, we experienced an oxidation challenge and therefore had to redesign some elements to more inert materials,” says James Barrington Brown, NewSpace South Africa founder and CEO. “Furthermore, Galinstan’s tendency to oxidise made it difficult to handle and fill the fluid loop. This was prevented by creating an extremely low oxygen environment using a glovebox, a vacuum pump, and inert Argon gas. This resulted in successful filling and operation of the FLIA. Once we overcame the oxidation challenge, test

 **New technology development**

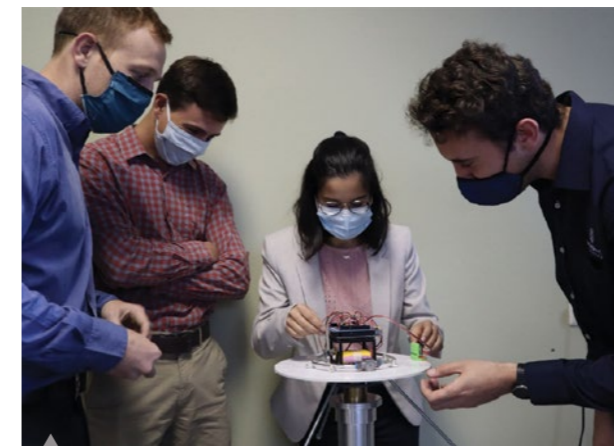
 **Good skills development**

results indicated that our actuator performance compares very favourably with current state-of-the-art reaction wheels.”

Barrington-Brown, an electronics engineer with 30 years of experience in the commercial satellite industry says, “The FLIA was demonstrated to produce visible movement in the form of a rotation on the air bearing apparatus, proving that it is suitable as a fine attitude control system for both CubeSats and satellites of larger sizes.” He says the company has been actively marketing the product, but it is always difficult to get an early adopter with disruptive technology. He is confident NSS will get the FLIA to market as it did with the Stellar Gyro – a star-based visual attitude propagator gyroscope – produced with support from the AISI on a previous project.

“To have our best shot at market penetration, we need to deliver not just a technology, but a well-packaged solution that can be integrated easily into the customer’s system,” he adds.

Throughout the design process, local vendors were prioritised in all manufacturing and design decisions as this contributed to the local GDP and overall economic empowerment in South Africa. Additionally, the unique processes and material choices of the project were an opportunity for skills development in space technology manufacturing within local industry, where it is currently lacking. This will enable the local industry to compete with those in more developed countries such as in Europe or the United States.



The NewSpace Systems team is confident that their novel FLIA will scale up for larger spacecraft, once it gains sufficient flight heritage on CubeSats.

NSS is a privately-owned, advanced manufacturer of robust spacecraft components and sub-systems with facilities in countries across the globe. As demonstrated by the FLIA project, the company is particularly strong in attitude determination and control solutions. NSS supports the majority of the commercial spacecraft manufacturers, including several blue-chip companies and constellations of 500 satellites and more. Exporting to 27 countries across six continents, NSS is rapidly increasing its market share.

Reflections on support

“I’m a huge fan of the AISI programme,” says Barrington-Brown. “It is straightforward and easy to apply, there’s rapid response, and its innovation/technology is focused on space. LambdaG, a start-up incubated by NSS, is a notable example of transformation in practice. The company is a spinoff of NSS and now designs and manufactures innovative radio frequency components for aerospace and defence applications.”

The FLIA project has been a human capital development success. NSS has supported three interns, a bursary and a PhD student. Four of the five have been young women, advancing gender representation and diversity of thinking in the engineering team, which remains a challenge in many companies.

“We’ve had some really good interns, who now go back out into the market, finish their degree and benefit the nation,” adds Barrington-Brown. “We just have to keep their skills in South Africa. That is why we need more programmes in South Africa like the AISI, to keep people doing interesting and innovative work inside the country. The AISI must remain sustainable and grow the budget to keep young talent in the country.”

▶ INDUSTRY PARTNERS AND COLLABORATORS

- **Casing and pump:** StarkCNC, Carbo III, Multi Alloys Mitsubishi Chemical Advanced Materials, Victory Electrical, Festo, Swagelok, Atlas Specialised Fasteners, Magnet Store, Magnets For You
- **Electrodes:** Carbo III, Nu World Plating, Metallica Electroplating, A&A Platers, Non-ferrous Metal Works
- **Electronics:** MicroRobotics, RS Components
- **Lab supplies:** Afrox, Chem Lab Supplies, Aerontec, Clear Design Display, MCL Monitoring and Control Labs, Industrial Gas Solutions

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 2021/22 financial period. Technology roadmapping exercises have been instrumental to AISI support in previous years and positive feedback has been received from participant beneficiaries. Technology roadmapping is a needs-driven technology planning approach that helps to identify, select and develop technology alternatives to satisfy a market need through enhanced products or capabilities. It ensures the alignment of technology investments and development of new capabilities to meet future market needs. The methodology considers the relationship between technologies, their products and services and the target markets. The tool also helps to verify that projects supported by the AISI fit into the strategies and technology plans of the benefitting company.

Companies that benefitted from the technology roadmapping exercise in 2021/22 are outlined in the following table.

Table 2: Companies that completed the technology roadmapping exercise in 2021/22

BENEFICIARY NAME	TYPE OF ORGANISATION	TECHNOLOGY STREAM	TYPE OF TECHNOLOGY ROADMAP
LambdaG	SMME	Space	Updating of an existing roadmap
Sentian Aerospace	SMME	Aerostructures	New roadmap
Simera Africa	SMME	Avionics and Sensors	New roadmap
Astrofica Technologies	SMME	Space, Avionics and Sensors	New roadmap
Motseni Hi-Tech Space	SMME	Space, Avionics and Sensors	New roadmap

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 9001:2015 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 2021/22 follows.

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

COMPANY NAME	TYPE OF SUPPORT	STATUS
Production Logix	AS9100 (Aerospace Quality Management Standard) implementation and certification	Completed
LEA Group	ISO 9001:2015 implementation through SEDA	Completed
Luvhone Engineering	ISO 9001:2015 and ISO14001 implementation and certification	Completed
Aero Metals	ISO 9001:2015 implementation and certification	Completed
Ti-TaMed	AS9100 surveillance audit	Completed
West Engineering	AS9100 (Aerospace Quality Management Standard) recertification	Completed

LEADING ELECTRONICS MANUFACTURING SERVICES PROVIDER PASSES AEROSPACE AUDIT TO SECURE AS9100 QMS CERTIFICATION

Beneficiary:
Production Logix

Project title:
AS9100 implementation and certification

Despite some early curveballs brought on by the Covid-19 lockdowns, Pinetown-based electronics manufacturing services provider Production Logix (Prologix), has seamlessly secured AS9100D accreditation for the contract manufacturing of electronic modules and assemblies.



An experienced lab technician meticulously hand places a prototype PCB before reflow.

Prologix produces to IPC Class 3 manufacturing standards. Its range of services include prototyping, surface mount assembly, leaded assembly, wire harness assembly and turnkey box assembly. Prologix's electronics manufacturing and supply chain solutions fall across a wide variety of sectors from the military, aerospace, industrial, consumer electronics industries, to the lighting, automotive, metering and telematics industries.

By implementing this aerospace quality management system (QMS), the SMME signals that it: monitors processes to improve efficiency and productivity; reduces waste; supports continuous improvement; and undertakes active risk assessment, while pursuing effective mitigation practices. AS9100D-certified companies consistently comply with regulatory, safety and reliability requirements.

"Prologix is a firm believer in complying with industry standards in our journey to constantly improve," explains managing director Ushir Mehta. "By investing in and complying with industry-wide standards and certifications, we hold ourselves to a high level of competence while also providing our customers with the peace of mind that they have placed their orders with a trusted and accredited company."

The AS9100D standard is acknowledged worldwide and specifies the QMS requirements for organisations that design, develop or manufacture aviation, space products. The AS9100 standard was developed by the International Aerospace Quality Group.



Good skills development



Standards and accreditation achieved



Pinetown-based electronics manufacturing services provider Prologix has secured AS9100D accreditation for the contract manufacturing of electronic modules and assemblies.

Implementation of any new management system requires dedication of management to the success of the project along with time and resources to accomplish the goal. It is the same with the successful development, implementation and maintenance of an AS9100D QMS. The numerous potential benefits include: greater efficiency and less waste; better and consistent control of major business processes; a better understanding of customer needs; regulation of successful working practices; improved risk management; and improved participation of employees.

Aeronet of Things (AoT) – a business that helps empower aerospace organisations – provided implementation, training, and readiness support for the certification audits at Prologix. Once the SMME passed the mock audits, certification procedures kicked in and AoT completed the required in-house training. American Systems Registrar Global Certification Services provided the final certification, which is expected to significantly increase Prologix's share of aerospace and defence work in the coming years.



Prologix produces to IPC Class 3 manufacturing standards.

INDUSTRY PARTNERS AND COLLABORATORS

- Aeronet of Things
- ASR Global Certification Services

ISO 9001 CERTIFICATION FOR BLACK WOMAN-OWNED SMME OPENS DOORS IN AEROSPACE INDUSTRY AND THROUGHOUT THE TRANSPORT SECTOR

Beneficiary:

Aero Metals

Project title:

The development and implementation of an ISO 9001:2015 QMS

Aero Metals is an elementary parts supplier in the aerospace industry. The company is part of the global value chain, supplying Aerosud with sheet metal elementary parts, including cutting, bending, forming, cleaning, and deburring sheet metal parts. Its recently acquired ISO 9001:2015 certification is assisting the organisation with quality assurance and access to new markets and opportunities.



Aero Metals specialises in the fabrication of high-precision, custom sheet metal components.

Aero Metals is the best dual source for manufacturing elementary parts and components that meets all the aerospace requirements such as accurate skills, infrastructure, equipment, tools, and training. The company specialises in the fabrication of high-precision, custom sheet metal components and is motivated to acquire various certifications including ISO 9001 to directly export its products to various clients all over the world.

Established in 2020, the company is led by a woman and employs eight permanent staff members. The business supports women in the science, technology, engineering, and maths fields. The company is currently at Broad-based Black Economic Empowerment (B-BBEE) level 2. Black woman-owned startup Dynamic Aerotech has a 51% stake in Aero Metals. The other 49% is owned by Aerosud. Dynamic Aerotech is a maintenance solutions provider and tech savvy

aerospace engineering and manufacturing company, while Aerosud has a strong interest in research and development and industry 4.0 technologies.

“Since 2021, we have made many visits to the transport sector of South Africa, namely aerospace, automotive and other sectors, to introduce our organisation and capabilities in sheet metal bending, forming, fabrication and de-burring,” says CEO Sibongile Sambo. “We were informed that in order to manufacture parts and or components, we needed to have various certifications including ISO 9001. In response to an advertisement by AISI, we applied for standards and training and became certified. There is no doubt that this project will open doors in the aerospace industry and throughout the transportation sector.”



Strong skills development



Standards and accreditation achieved



New process development



The Aero Metals team is motivated to acquire various certifications including ISO 9001 to directly export its products to various clients all over the world.

The project goal was to establish a quality system that is sustainable. The ISO 9001 system will help guide both the management and the employees; keep an open communication and feedback session with the clients; and develop confidence in Aero Metals' manufacturing activities.

The accreditation process was relatively seamless with the certificate issued within six months of project initiation. The QMS successfully implemented by Vukani projects was recommended for certification by TÜV Rheinland in May 2022, and the certificate was issued within weeks.

Reflections on participation

The impact of the project has been a contribution to skills development at Aero Metals with eight people trained. The success of the AISI programme is expected to contribute to the retention of these eight jobs and is expected to improve Aero Metals' competitiveness – while opening up new markets, such as automotive.

“Aero Metals champions transformation and woman empowerment. We firmly believe that an industrialised economy is what our society needs for sustainable and inclusive growth. Compliance ensures that our operations run at optimum levels at all times. The QMS ensures that we have more efficient working practices and focuses on our business objectives, thus offering our customers a good service and the best value for their money,” concludes Sambo.

INDUSTRY PARTNERS AND COLLABORATORS

- Vukani Projects
- TÜV Rheinland

BLACK WOMAN-OWNED, NEW SPACE COMPANY BOLSTERS QUALITY MANAGEMENT PROCESSES FOR EXPORT MARKET THROUGH ACCREDITATION

Beneficiary:
Luvhone Engineering

Project title:
Engineering: ISO 9001 and 14001 Implementation

With the support of the AISI programme, black woman-owned SMME Luvhone Engineering has successfully met all the requirements for DAkkS certification on ISO 9001 and ISO 14001. This achievement will assist the business to start bidding for domestic and international opportunities that have ISO certification as a prerequisite.



The certification will assist the business to start bidding for domestic and international opportunities that have ISO certification as a prerequisite.

Luvhone Engineering provides niche technology solutions with a focus on core engineering and ICT services for three industry sectors: aerospace and security; satellite and terrestrial broadcast solutions; and information and communications technologies. Deutsche Akkreditierungsstelle (DAkkS) is the national accreditation body of Germany. Luvhone went for the internationally recognised DAkkS accreditation since most of its international partners are certified with this body. The certification is also likely to facilitate access to other local markets, such as the automotive sector.

“The supply chain that we operate in, is of a calibre that has suppliers and customers with ISO certification in the aviation, satellite communications and telecoms industry,” explains founder and CEO Takalani Leago. “A growing number of our prospective international clientele have indicated the importance of certification to ensure integrity of their operating procedures.”


Not only does a certification process enable the business to acquire new customers, but it will also enable the operational cost efficiency inter alia insurance premiums, abatement of

risks that can cause reputational and financial harm to the business. The ultimate outcome of this process supported by the AISI is the long-term sustainability of the business.

Luvhone was established in 2015 by Leago, who is an engineer. The company also trades with countries across the globe in the Atlantic, Asia, and Europe regions. “We continually look for trade and technology partners across the globe that share in our company values and the premise of shared prosperity for the advancement of society,” adds Leago.

As a new space pioneer, Luvhone aims to be the preferred pan-African engineering technology partner of choice, and the inventor of solutions within aerospace, telecoms and satcoms that can be exploited for commercial use globally and shared for the prosperity of Africa and humanity. Therefore, a long-term outlook and sustainable approach are very critical in its project vetting process, including a thorough analysis of projects with the right fit and within the business strategy, values, investment viability spectrum, competencies and resources needed.

 Strong skills development

 Standards and accreditation achieved



The Luvhone Engineering team celebrates their successful bid to achieve DAkkS certification on ISO 9001 and ISO 14001.

Reflections on participation

“Due to the business being in its early stages of revenue generation, assistance from the AISI has been of great value as Luvhone was not in a position to fully self-fund annual surveillance audits from its own budget,” concludes Leago.

From a human capital development perspective, the project leader for this certification process was a young woman from a historically disadvantaged background. She was also previously sponsored by Luvhone to complete her BCom degree in Informatics, having recognised her disadvantaged background and potential for growth. She has recently graduated and has gained experience thanks to this project and will now be pursuing further initiatives in data analysis. Furthermore, Luvhone also plans to create a new position for managing the QMS in the organisation, as the business starts its exponential growth journey.

In its final report, Luvhone suggests that the AISI considers creating a research and development fund to support SMMEs that are already in the programme. This will be of immense value in driving sustainability of the organisations sponsored, particularly in the current geopolitical shifts and unprecedented times of crisis management.

What is ‘new space’ and how does it differ from traditional space?

New space is a movement and philosophy encompassing, but substantially broader than the emergent private spaceflight industry. The term refers to a community of relatively new aerospace companies working to independently develop faster, better, and cheaper access to space, space and spaceflight technologies, and space missions.

New space can also be defined by the democratisation of space, which is centered on making space systems and services reasonably priced and accessible to a diverse set of new customers or market entrants.

INDUSTRY PARTNERS AND COLLABORATORS

- Vukani Projects
- TÜV Rheinland

PROGRAMME 2: 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 advance South Africa's niche capabilities and value proposition. This is achieved through industry co-operation, access to infrastructure and expertise, partnerships, and technology interventions. Projects may produce novel technology and intellectual property (IP) to assist with meeting the country's strategic and sovereign requirements. Some projects have the potential to contribute significantly to capability development, as well as skills development and transfer in the South African electronics and engineering sectors. The programme has helped recipients weather the post-pandemic global supply chain disruptions experienced during the 2021/22 support cycle.

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.

The following companies received AISI support in 2021/22.

Table 4: Industry development and technology support beneficiaries

BENEFICIARY NAME	PROJECT TITLE
Simera Sense	HyperScape50 Imager Project (Completed Project)
Cybicom Atlas Defence	Development of an RPAS Test Platform for Aerial Release of Sterilised False Codling Moth Project (Project in Progress)
Avior Labs	Low Cost High Bandwidth UAV Datalink Project (Project in Progress)
Petrawell	Filament Winding of Low and High-pressure Vessels Project (Project in Progress)
Sentian Aerospace	Sentian UAV Optimisation Project (Project in Progress)
Simera Africa	Electro-Optical Stereo Vision Aircraft Approach Tracker Project (Completed Project)
Sparcx	Design and Development of a 2-6GHz DIFM System Project (Project in Progress)



OPTICAL PAYLOAD SOLUTIONS COMPANY PUSHES THE BOUNDARIES TO INCREASE THE DETAIL SENSED WITH SMALLER AND AFFORDABLE SATELLITES

Product markets:

Space

Technology streams:

Surveillance and sensor systems

Beneficiary:

Simera Sense

Project title:

HyperScape50 Imager

This project set out to design and develop a compact earth observation instrument for a nanosatellite that can cover an extensive area at a medium resolution and operate reliably in space across a wide temperature range at exceptional radiometric and spectral resolutions. At its conclusion, all goals were achieved and furthermore, the instrument improves data efficiency using advanced onboard image processing techniques.



The HyperScape50 allows the capture of the spectral content of every spot on the earth in an affordable and effortless manner.

Hyperspectral imaging with a lower resolution but a wider field of view has applications in weather forecasting, ensuring food and water security, marine monitoring, environmental and ecosystem sustainability, infrastructure development, smart governance and natural resources census. As our planet is evolving, we face new challenges to monitoring our environment and making timely decisions. It is the goal of optical payload solutions company Simera Sense to increase the detail that can be sensed with smaller satellites while making earth observation effortless and affordable.

General manager Ana-Mia Louw says the development work performed during the design of the 100mm aperture system, the HyperScape100 – already a commercial success – formed a firm technical basis to develop the smaller HyperScape50. The HyperScape50 shares the HyperScape100's electronic backbone but is more compact and images a field of 120 km at an orbit height of 500 km. The Simera Sense team designed

the entirely new, smaller lens, which was manufactured locally and then tested for optical performance before being integrated into the system.

Simera Sense also produces a larger 200mm aperture range.

The HyperScape50 camera system 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.

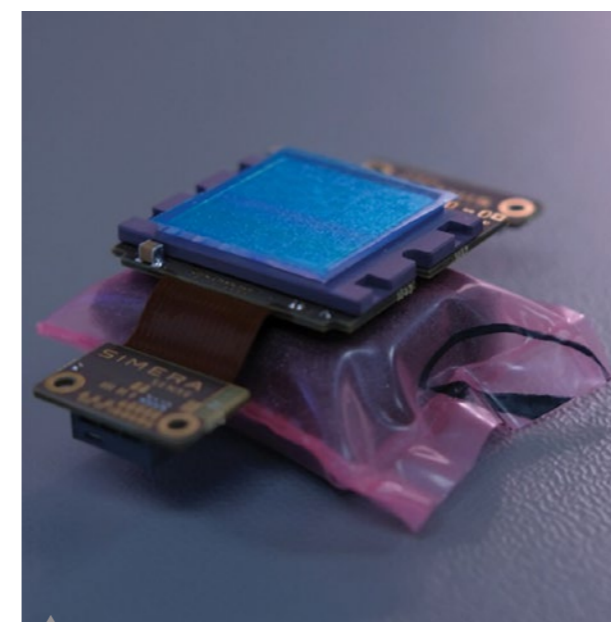
The market size for the new product range is compelling. In the 2012–2019 period, 1 126 CubeSats were launched, of which 71% were 3U/6U-size satellites, the target market of this product range. This is 68% of all small satellites (<600 kg) launched for targeted earth observation applications during this period.



3 new jobs created



Export revenue earned



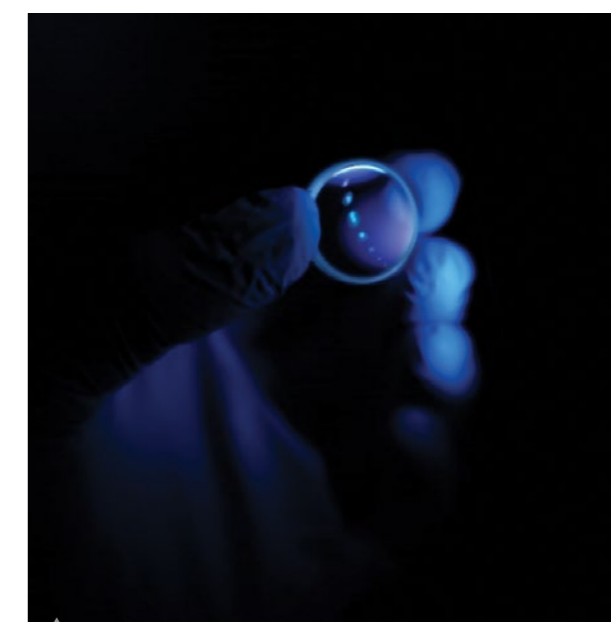
Simera Sense believes in pushing technology limits. The HyperScape50's optical front-end is a custom-designed lens system designed to address environmental challenges.

“Some equivalent imagers available on the market in this segment make use of commercial off-the-shelf lenses,” adds Louw. “Manufacturers do not design these lenses for the harsh space conditions, and therefore they underperform. The HyperScape50's optical front-end is a custom-designed lens system designed to address environmental challenges. Our imager underwent qualification testing to ensure its survivability during launch and operation in space and we were able to proceed with production.

“The imager covers an area of more than 100 km, making it the instrument with the widest swath width in our product ranges. Customers have the option to adapt the spectral resolution to their specific application needs.”

Simera Sense uses direct marketing to small satellite operators and manufacturers as a channel to the market. The company also targets earth observation application developers at international trade shows and utilises a partner network. Furthermore, Simera Sense uses an inbound marketing strategy by creating valuable content and experiences tailored to its target market.

These marketing efforts have paid off. The project was completed during the third quarter of 2021 and all the



The new, smaller lens was manufactured locally.

deliverables were met. Simera Sense has signed contracts with two international clients already, one of which has been delivered and received by the satellite integrator, as well as tested on their side and they are very happy with it. The other will be delivered before the end of 2022. These orders have generated over R2 million in revenue.

Reflections on support

“The co-funding that we received for development costs on this project was very useful, as was the support from the team in the AISI office,” says Louw. “The funding certainly contributed to assisting Simera Sense to retain its staff during the Covid-19 pandemic and one intern working on the project was also hired permanently out of the project, so that was great.”

Due in part to the contribution of this project, Simera Sense has now gone on to hire more people, thereby furthering job creation.

INDUSTRY PARTNERS AND COLLABORATORS

- Pink matter Solutions
- TiTaMed
- Barracuda Holdings
- Astrofica Technology

HARNESSING TECHNOLOGY-FOR-AGRICULTURE TO PROTECT SOUTH AFRICA'S MULTIBILLION RAND CITRUS EXPORT INDUSTRY

Product markets:
Unmanned systems

Technology streams:
Aerostructures

Beneficiary:
Cybicom Atlas Defence

Project title:
The development of an RPAS test platform for aerial release of sterilised false codling moth

South Africa's citrus industry sustains more than 140 000 jobs and generates export revenue of over 25 billion rand annually². Cybicom Atlas Defence (CAD) has partnered with UAV manufacturer Bronberg Dynamics to further develop a remotely piloted aircraft system (RPAS) suitable for testing the aerial release of sterilised insects in ongoing efforts to help control the numbers of insects that damage citrus and other commercial fruit, causing substantial economic loss every year.



The novel hopper/counter (front centre of the airframe) integrated with the VTOL drone ready for take-off and testing.

The false codling moth is a major pest of citrus and other commercial fruit in South Africa. It attacks fruit at all stages of development. The moth is not present in the Americas, Europe, and Asia, and therefore has phytosanitary implications, which impose severe limitations on potential South African exports. "Although the pest can be managed to some extent with insecticides, mating disruption, and orchard sanitation, a long-term environment-friendly solution was needed," explains CAD project manager Darcy Ocker.

"CAD and Bronberg Dynamics, in conjunction with CAD's long-term partners, FlyH2, and its subsidiary, Greenfly Aviation, a registered RPAS operator, are working with the Civil Aviation Authority on this initiative. X-Sterile Insect Technique (XSIT), a service provider to the citrus and table grape industries, is assisting as well."

Making aerial sterile insect releases safer

In 2002, research commenced on an area-wide integrated pest management programme in conjunction with the development of the sterile insect technique for the false codling moth. Over the years the status of this moth as a pest threat has been systematically reduced in areas where the technique was practiced. The programme is currently owned by the Citrus Growers Association (CGA).

Initially the sterile insects were released from all-terrain vehicles, but the method was inadequate. This led to aerial releases via rotary and fixed-wing aircraft. But releasing an accurate and constant number of moths remained a challenge. Unfortunately, five pilots lost their lives in the Citrusdal area between 2014 and 2016, involving gyrocopters as well as fixed wing aircraft, while performing sterile insect releases. With shrinking defence

New technology development

budgets, CAD – a company that has always operated in the low-volume niche defence sector – committed to preventing further loss of life by replacing the crewed aircraft with RPAS in these extremely dangerous operations.

CAD then developed its novel hopping technology for sterilised false codling moth release and performed ground-based testing. A trial project to evaluate the newly developed hopping technology focused on hand release, all-terrain vehicle release and installing counters at the XSIT production facility in Citrusdal. The CAD system can count, record and help visualise these moth releases providing the much-needed data for continuous improvement in this particularly important mission.

"We approached the AISI for support to develop an RPAS test platform for aerial release of sterilised insects to further industrialise larger RPAS platforms that would be better suited commercially to effectively service the agricultural industry while minimising the risk to human life," adds Ocker. "Bronberg Dynamics is providing the airframe for the project in the form of its COB vertical take-off and land (VTOL) UAV."

The project has progressed smoothly. In February 2022, after successfully integrating the VTOL drone with the hopper/counter, the team performed a full flight with a take-off, transition to forward flight, back-transition to hover and a successful land. "This was done with an empty hopper/counter demonstrating the COB can fly stably and reliably with the payload," says Ocker. "The COB can hover with a maximum take-off weight of 13 kg at altitude, which bodes well for the final payload of the delivered aircraft. Initially a maximum take-off weight of 12 kg was assumed."



Bronberg Dynamics is providing the airframe for the project in the form of its COB vertical take-off and land UAV.

Licensing and production

The user manual for the COB aircraft was submitted to the Civil Aviation Authority by Bronberg Dynamics. Currently, the feedback from GreenFly Aviation and the licencing consultants is that this is on track to receive licensing albeit only in early 2023.

The production of the delivery COB VTOL aircraft has commenced. Bronberg has committed to production moulds and has designed easily detachable wings. The production of the hopper/counter is underway with parallel MAVLink development. CAD decided to develop the hopper/counter into a MAVLink compatible device, as MAVLink is a widely implemented standard in the drone industry, with many drones implementing MAVLink-enabled flight controllers. The company believes that putting in this effort now will mean that the hopper/counter will be compatible with future versions of air platforms as they transition to commercialisation of this project.

Reflections on support

"Development projects like these are risky and time-consuming, and the business is often required to fund the unforeseen challenges that may arise," says Ocker. "The largest benefit went to Bronberg, as it has allowed them to take their prototype aircraft to licencing and production. This gives them a good track record and they have learnt a lot out of this process."

CAD is looking at getting the hopper/counter patented and the counting technology used in the production of the sterile moths.

"We are grateful to the AISI and the dtic for giving us the opportunity to trial this project. The support has provided focus and impetus to the project and has complemented the resources that the company itself has had to invest in the project," concludes Ocker. "The upside of this project is the opportunity to diversify from a defence-only space into the agritech space, which is being disrupted amidst the Fourth Industrial Revolution, where the farmers are looking for more tech savvy products and services that help to maximise their yields."

INDUSTRY PARTNERS AND COLLABORATORS

- Bronberg Dynamics
- X-Sterile Insect Technique
- FlyH2
- Greenfly Aviation

² CGA INDUSTRY STATISTICS – 2022 <https://www.cga.co.za/Page.aspx?ID=3207>

LOCALLY DESIGNED, LOW-COST EYE-IN-THE-SKY ONBOARD DATALINK SOARS THROUGH FLIGHT TESTS

Product markets:
Unmanned Systems

Technology streams:
Avionics

Beneficiary:
Avior Labs

Project title:
Low Cost High Bandwidth UAV Datalink

Avior Labs has successfully designed an affordable, integrated transmitter/receiver system that combines the telemetry and high-level command functions (i.e. the communication between the ground station and the autopilot system) of a UAV and the payload data stream into a single system. This stand-alone datalink system performs as an eye-in-the-sky that can interface with the popular ArduPilot-based autopilots and any video camera system that produces a digital video output. The product can be offered to the UAV or drone industry both domestically and internationally and has many potential Internet of Things (IoT) applications beyond UAVs.



The prototype transmitter/receiver system.

The use of small drones for a wide variety of commercial applications is growing rapidly around the globe. A requirement common for all such drones is communication between the ground station or operator and the flight vehicle. This communication serves a number of purposes including direct flight control communication (always required); telemetry and commands for high level functions (always required); and payload-related communications, such as video streams (optional).

Although the exact implementation of these functions may differ from one design to the other, they often result in three different transmitter/receiver systems with their associated weight, volume, antenna, and power requirements – along with potential interference between the systems. Avior Labs chief technical director Kreelan Padayachee explains that the team therefore set out in this project to combine the command functions and the payload data stream into a single system

to save mass, onboard space, and cost. He says the biggest obstacle was the associated bandwidth requirement and the need to combine and split the two data sources. The company was determined to produce an integrated system that resolves both these issues, while doing so at an affordable price.

And they have achieved just that.

“We have successfully demonstrated a prototype system in a relevant end-to-end environment by flying the system on a fixed-wing unmanned aircraft and demonstrating its functionality as integrated with an ArduPilot-based autopilot and two different video cameras,” says founder and managing director Dr Bennie Broughton. “The system met or exceeded all our performance targets. In addition to the objectives originally set forward, the project successfully progressed from TRL 4 to TRL 6 in just one year, and we now intend to develop the system further as a commercial product.”

New technology development

3 SMMEs involved



The onboard datalink provides communication between the ground station or operator and the drone in a single stream for a number of different purposes.

Since Broughton and Padayachee are both aeronautical engineers, with extensive experience in aircraft design and development, they understood the requirements for this project, but because this project was a little different from their usual work, they teamed up with experienced aerospace electronics expert Riaan Hoogenboezem of Bovancor Network Solutions to produce what is essentially an IoT solution with possible application in other areas.

The other SMME involved in the project was Lightweight Structures Technology (LST), responsible for the manufacture of the enclosures.

Although the product is still being developed and has not yet been promoted officially, the team has already had a number of enquiries about, and interest in, the product from a range of interested parties. The mining sector showed an interest in making use of the datalink, albeit without the video. A major electronics retailer that specialises in components for UAVs has indicated its willingness to market and sell the datalink on its website once it reaches commercial stage. Several commercial UAV operators have shown an interest in the datalink as part of the complete vertical take-off and land system to be offered by Avior Labs. Many performance-specific enquiries have been received via various social media platforms.

Reflections on support

“We are ready for commercialisation,” adds Dr Broughton, “This project has also allowed us to sustain four jobs at Avior Labs, Bovancor and LST, while assisting one intern to progress to become a postgraduate bursar. The individual is a female student studying towards her Master’s in Electronic Engineering at the University of Pretoria – specialising in flight control. This student participated in all test flights.”

Since the success of this project clearly confirmed the technical viability of the developed product, the next phases will focus on production refinements and its commercialisation. Once commercialised, a new production line will be set up creating positions for at least two skilled technicians, assuming low volume initial production, and increasing the number of employment opportunities as the production is scaled up.

A local content of between 40% and 50% is expected to be achieved for the product. The foreign content is limited to microchips and electronic components not currently produced in South Africa. All other items such as printed circuit board manufacture, electronic component integration, enclosure manufacture, final assembly, bench testing, packaging and marketing can potentially be done in South Africa – either by Avior Labs itself or by utilising other specialist local companies.

The team believes that the success of this project and further development of the datalink means that the avionics and surveillance and sensor manufacturing segment of the aerospace industry could be expanded by at least one other SMME in the near future, further diversifying the capability of the industry that so far has been dominated by military applications and broadening the range of products that it offers to domestic and international markets.

All the current commercial datalinks of this class (or close to it) that are commercially available in South Africa are entirely imported products. It could therefore potentially achieve import substitution over those products.

INDUSTRY PARTNERS AND COLLABORATORS

- Bovancor Network Solutions
- Lightweight Structures Technology

COMPOSITE PRESSURE VESSELS TO MEET THE STORAGE AND TRANSPORTATION NEEDS OF THE AEROSPACE AND HYDROGEN MARKET ARE READY FOR UPTAKE

Product markets:
Space

Technology streams:
Aerostructures

Beneficiary:
Petrawell

Project title:
Filament winding of cryogenic and high-pressure vessels

Centurion-based Petrawell – a leader in filament winding solutions – is on a mission to establish local expertise and demonstrated capabilities to support South African industry with composite filament winding of pressure vessels and associated processes. The focus is on composite vessels to address the storage and transportation needs of the aerospace and hydrogen market.



Close up of a vessel that has been wound with a composite filament.

To date the team has locked in the design parameters, completed the tooling and manufactured the first vessels to meet the specifications and objectives of the project. “We have demonstrated that we can build these vessels,” says Petrawell CEO Philip Venter. “We have refined the manufacturing techniques and resolved the material science, so we can definitely scale up production and focus on commercialisation which is the next phase of the project. The cryogenic vessels hold some real potential for us and we are really excited about being approached by industry leaders outside of the aerospace sector who are interested in placing orders for these vessels.

“With regards to high pressure vessels, there is still some way to go before commercialisation. We would like to get into the hydrogen hype, but I believe that South Africa may be lagging behind. We need the entire hydrogen industry and ecosystem to still develop, but when it does, we will be ready to supply

it with vessels. All is not lost, because what we have learnt in developing the high pressure vessels is applied to our other products as well.”

Petrawell specialises in filament winding technology. This is a niche product offering and the perfect fit for these products is the aerospace and other advanced technology markets. In an effort to grow its capabilities and relevant expertise to design, analyse, manufacture, test and deliver high-performance filament-wound composite products, Petrawell started collaborating with the Aerospace Systems Research Group (ASReG) at the University of KwaZulu-Natal.

The company approached the AISI for support when it recognised that to play a meaningful role in this industry it needed to improve its technology readiness levels. This has also allowed it to structure its research and development collaboration with industry partners and ASReG.



Strong skills development



Import substitution achieved

“Collaboration with industry role players was important for us on this project,” explains Venter. “That is why we included AMT Composites for material supply and training requirements and Aerosud for technical advice. Another important role player is ASReG. We are working with them to provide an effective and efficient solution that can create a sustainable partnership for the supply chain and to meet collaborative development requirements. This is not only for the aerospace programme but also the various industries at large.”

ASReG develops aerospace technologies related to rockets and space vehicles, and human skills in aerospace engineering. The company designs and operates technically complex engineering systems that employ high-pressure, high-temperature and chemically energetic processes. It was a natural fit for this project.

According to the project plan, Petrawell will develop the functional composite filament-wound high-pressure and low-pressure vessels. The company will manufacture and deliver a cryogenic composite pressure vessel and kerosene pressure vessel to the ASReG team. This will assist the ASReG team in its commercialisation efforts on its satellite launching platform, known as STEVE. The emphasis will be on cost-effectiveness, efficiency and functionality.

Project update

Petrawell aimed to deliver a high-pressure vessel and a cryogenic vessel in three iterations: the experimental demonstrator; advanced demonstrator; and the proof-of-concept iteration. The latter had to be within 5% of objectives or required performance.

“Progress was achieved on the manufacturing of the first high pressure vessel,” says Venter. “Tooling was manufactured for the high-pressure vessel and used in the first production run and proved to function as designed and anticipated.



The filament winding facility produces composite vessels that address the storage and transportation needs of the aerospace and hydrogen market.

The vessel was tested to destruction. The next step was to improve the vessel through a review of the failure mode and adjusting manufacturing techniques. The cryogenic vessel manufacturing was dependent upon the lessons learnt from the high-pressure vessel experimental phase.”

At the time of writing, Petrawell had done the destructive testing on the proof-of-concept iteration of the high-pressure vessel and was confident it would meet the deliverable of withstanding up to 350 Bar.

A risk identified with the cryogenic pressure vessel did occur in that the material for a type 5 solution is not available at all. This is the technology that the international space companies work with and they have the advantage of almost unlimited resources. Based on mutual agreement with the end user, ASReG, Petrawell decided to have the cryogenic vessel design altered to a type 3 vessel design. The company remains confident that it can solve the problem and deliver a cryogenic vessel as part of the project deliverables, and it has managed to procure cryogenic compatible resin systems that will help the team achieve its goals.

Reflections on support

“We have gained a tremendous amount of knowledge on the project,” concludes Venter. “We have proved that South Africa can manufacture a lightweight, price-competitive cryogenic vessel. This is a major milestone. We share the vision of the AISI to build these technical capabilities within the country so that we are not dependent on others.

“Petrawell is very grateful for the partnership with the AISI; it is very important to us as industry and we trust that we can remain aligned and work together to the benefit of the country.”

The project demonstrated that it is possible to do research and development as a collaboration with industry partners and academic research partners. Venter says no literature existed on the work they were doing, so they were working in unknown scenarios, this forced all the collaborators to work closely to evaluate the variables, brainstorm and take an agile approach to problem-solving.

INDUSTRY PARTNERS AND COLLABORATORS

- Aerospace Systems Research Group, University of KwaZulu-Natal
- Aerosud
- AMT Composites

PROTOTYPE, 'GENERATION SEVEN' DRONE REFINED AND WINGS OPTIMISED FOR LONG-RANGE MISSIONS WITH UP TO 20 KG PAYLOADS

Product markets:
Unmanned Systems

► **Technology streams:**
Aerostructures

Beneficiary:
Sentian Aerospace

Project title:
Sentian UAV Optimisation

The Sentian, an award-winning prototype UAV – designed and developed in a previous phase of support from the AISI – has been enhanced in this round. The prototype 2.0 drone now features optimised wings that were refined using an incremental approach to reduce weight, improve wing profile consistency, surface finish, and verify strength. The project team is highly satisfied with progress and when it found itself ahead of schedule, it expanded the scope of the project to begin assembling the second prototype for flight testing.



The prototype 2.0 drone.

Sentian Aerospace was founded by four friends who are all engineers. This young, entrepreneurial team decided to develop a multi-role UAV for long-range and long-endurance flights. Their motivation was to design and develop a low-cost aerospace platform that could be used for sustainable, green and efficient collection of valuable data.

The team describes the hybrid electric Sentian as a 'generation seven' drone, which is autonomous ready. These smart drones with built-in safeguards and compliance tech, smart accurate sensors, and self-monitoring are the next big revolution in drone technology that would provide new opportunities in various sectors. In 2019, the company won two awards: the Avi-Afrique award hosted by Air Traffic and Navigation Services and the innovation award from the Commercial Aviation Association of Southern Africa.

🔍 **Generation 7 drones**

Complete commercial suitability, fully compliant safety and regulatory standards-based design, platform and payload interchangeability, automated safety modes, enhanced intelligent piloting models and full autonomy, full airspace awareness, auto action (take-off, land, and mission execution).

Designed to carry multiple payloads, the Sentian, apart from the primary flight control video camera, can be fitted with various sensors or cameras; extra fuel tanks for long endurance; or a sonar system for depth analysis. It therefore has applications in various sectors from offsite asset inspection in remote and dangerous places; to surveillance for wildlife tracking or border patrol (thermal imaging will allow it to do surveillance at night); and stockpile or mine inspection. These services



New process development



4 youth jobs retained

can be rendered at a much lower cost than helicopters. The Sentian Aerospace business model allows for either leasing the drone or selling it to companies who may have a need for it.

The Sentian aircraft features VTOL capability like a helicopter, and then transitions to fixed wing mode for long-endurance flights. The UAV is modular in design for easy transportation and storage. The drone can carry a payload of 20 kg and features a range of 250 km. It can fly slowly for good data collection but can also fly extremely fast for delivery. It can stop and hover in mid-air to aid in powerline inspection and in search and rescue operations.

During the flight test with prototype 1.0, the Sentian successfully took off but there were problems with the transition to forward flight, the wings were unflightworthy, therefore in the current phase the team focused on refining the wings using an incremental approach to reduce their weight, ensure their strength, optimise the wing tips, and improve the production process to ensure an ideal surface finish.

"We built three pairs of wings to test different criteria including structural integrity," explains chief technical officer Nigel Nkundhlande. "Then we used that information to build the final pair of wings. Our goal was to ensure that at least the final two sets out of the four wings would be flightworthy. Additional work included improving the geometry to make sure that the prototype can carry the payload and weight of the aircraft itself.

"Since we had successfully defined the ideal dimensions, we were ready to assemble the second prototype for flight testing, so we extended the scope of the project to also fitting the wings to the smaller, more streamlined carbon fibre composite fuselage. Based on our analysis, the new fuselage will reduce drag by 24%, be 33% lighter and rigid. We have just finished creating the tail. The drone now has an optimised design, a new tail, updated wings and better landing gear design that allows for VTOL or runway take-off and landing."

At the time of writing, the team had the internal components, fuselage, wings and tail ready and were preparing for assembly for the next round of flight testing.

Benefits of participation

The funding covers the development of the aircraft, so most of the funding is channelled into the development of the drone. For now Sentian Aerospace is still a team of four engineers. Once the team gears for mass production, it hopes to be able to employ more people.

Aeronautical engineer Nkundhlande says the project has really consolidated the team's engineering skills, "We have had to learn computer-aided development and computer numerical control (CNC) programming to create the moulds. We had to learn to create the moulds using a convoluted production line and the team upskilled themselves in the art of making parts out of carbon fibre composites. To ensure the business thrives, we have also had to refine our business skills including project management, budgeting, procurement, supplier liaison and resource management. It has been a holistic growth experience."

Loadshedding has challenged their problem-solving skills, as the CNC machine is extremely sensitive to power cuts. The team is grateful for the loadshedding app that allows them to plan for these situations.



Designed to carry multiple payloads, the Sentian has applications in offsite asset inspection in remote and dangerous places, surveillance for wildlife tracking or border patrol, and stockpile or mine inspection.

Reflections on support

"Our progress to date would have been impossible without the support of the AISI. It is expensive to participate in the aviation industry. The AISI and the CSIR have been the backbone of our progress. Given that we started in a garage with conceptual drawings, we are thankful to them for putting their faith in us and guiding us. Once you have a passion for aviation, there's nothing like seeing your design come to life," concludes Nkundhlande.

► **INDUSTRY PARTNER AND COLLABORATOR**

- Paramount Group

MACHINE VISION TECHNOLOGY TRACKER HELPS TRAIN PILOTS TO ACHIEVE THE IDEAL GLIDE PATH FOR LANDING HIGH PERFORMANCE AIRCRAFT

Product markets:

General aviation

Technology streams:

Surveillance and sensor systems

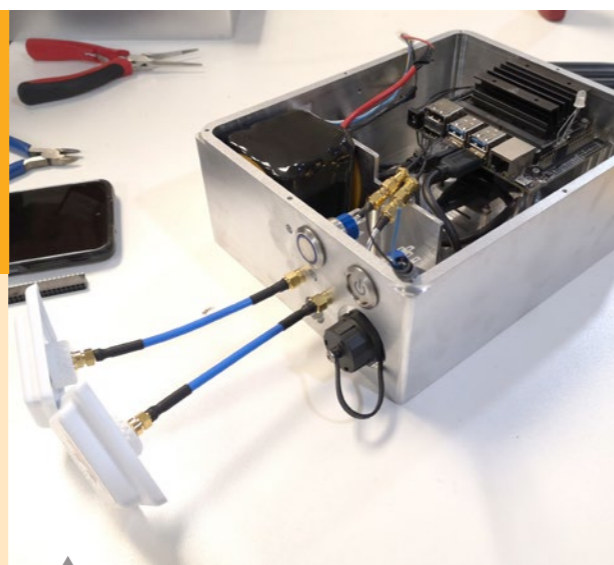
Beneficiary:

Simera Africa

Project title:

Electro-Optical Stereo Vision Aircraft Approach Tracker

Specialist engineering consultancy and bespoke product developer Simera Africa has developed an optical aircraft tracker system that uses machine vision technology to identify an aircraft on final approach and track its position and accuracy relative to the ideal glide path. This system tracks and records the aircraft approach in stereo vision, from the ground, for later playback and analysis between the instructor pilot and the student pilot during debriefing.



The optical aircraft tracker system uses machine vision technology to identify an aircraft on final approach and track its position and accuracy relative to the ideal glide path. A typical application would be on an aircraft carrier.

Simera Africa's expertise lies in optical system design, advanced structural design, simulation and optimisation, prototype production and testing. The team developed a modular machine vision architecture, whereby commercial machine vision cameras and lenses from industry-leading suppliers are combined with embedded processors and custom packaging to satisfy specific requirements.

Machine vision technology

Machine vision uses cameras to capture visual information from the surrounding environment. It then processes the images using a combination of hardware and software and prepares the information for use in various applications. Machine vision technology often uses specialised optics to acquire images.

In the case of the stereo vision aircraft tracker, two cameras displaced at a set distance from each other, are set up next to a runway. By simultaneous observation of an aircraft on approach, stereo-vision techniques are employed to determine the distance and range to the aircraft. This can be used to

reconstruct the aircraft's actual approach path and compare it to the ideal. The system would be useful to the landing signal officers who assist pilots in landing aboard an aircraft carrier using their vision alone. The system was designed to complement the company's optical precision approach system.

Results

"The prototype system was subjected to testing in our laboratories, as well as in field, using a scale model, remote-controlled aeroplane as a target," says Simera Group CEO Johann du Toit. "During the final off-site field test, the system proved to be capable of tracking the flight path of an approaching model aircraft through machine learning and stereo vision image processing techniques, and the resulting flight path was displayed in a rich graphical environment."

The accuracy of the stereo vision localisation was compared to GPS measurements from onboard the model aircraft, as well as manually recorded ground-truth measurements. The localisation results quantitatively proves that the stereo vision approach tracker can deliver positional and speed information of an aircraft on the final approach to landing. This justifies



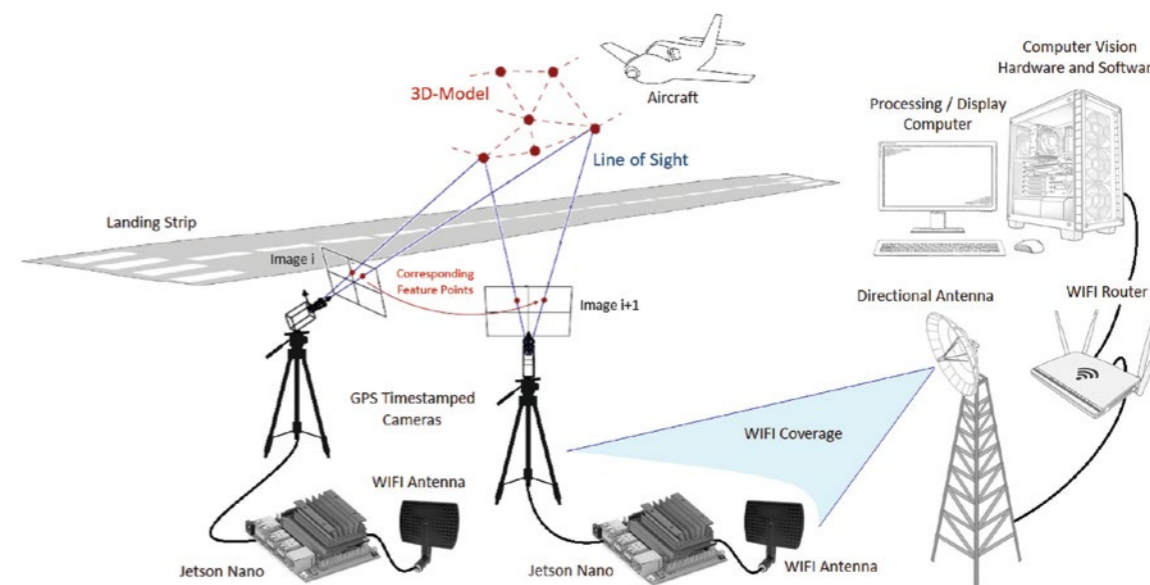
Strong skills development



4 SMEs involved



Putting the system through its paces with a model aircraft.



the selection of the proposed technologies and techniques, which include artificial intelligence through machine learning and stereo vision image processing.

"However, these results can be significantly improved by optimising specific data acquisition processes, using higher resolution cameras, and training more extensive and robust machine learning models," adds Du Toit.

The technological advancements realised in this project enabled 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 aerospace and other industries has been significantly strengthened.

Reflections on support

This phase of the project was successfully completed ahead of schedule over the course of approximately ten months using a detailed list of planned activities executed during several phases.

"The AISI funding was of great value to us, as it enabled us to align our core capabilities – which is building cameras – with where the global market is headed. The AISI support afforded us the luxury of elevating our company, opening up new opportunities and partnerships," concludes Du Toit. "It worked really well and we managed to upskill employees."

Simera Africa had planned to proceed to commercialisation by once again tapping into funding from the AISI to refine the system and add capabilities to prepare it for real-world implementation. However, a key commercial client pulled out, and Simera Africa had to reassign its team to income generating work and the project was put on hold.

Du Toit is confident that the IP is valuable and if he has the opportunity to reenergise the programme he will consider it. The IP is being maintained and he says the core team members are still in the ecosystem. "The data exist and we will keep the know-how current so that if the opportunity arises, we will be able to respond positively."

Further development would include upscaling the system to accommodate real-world aircraft and larger data models for machine learning that recognise numerous aircraft profiles shapes and sizes. Over time real-time data would allow the team to build a database of real-world cases for ideal flight paths – based on different aircraft types – and provide a library for comparison.

INDUSTRY PARTNERS AND COLLABORATORS

- G&R Electronics
- ItCognify
- TFASA
- RoRa Engineering
- TiTaMED

SOUTH AFRICA'S FIRST DIGITAL INSTANTANEOUS FREQUENCY MEASUREMENT SUB-SYSTEM TO ASSIST WITH MEETING THE COUNTRY'S STRATEGIC AND SOVEREIGN REQUIREMENTS

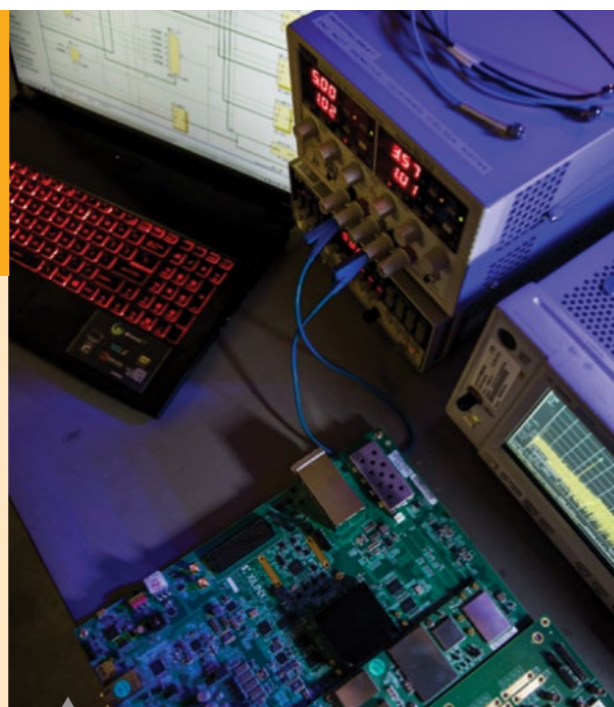
Product markets:
Military systems

▶ **Technology streams:**
Surveillance and sensor systems

Beneficiary:
Sparcx

Project title:
Design and Development of a 2-6GHz Digital Instantaneous Frequency Measurement System

There is an important need for South African-owned digital instantaneous frequency measurement (DIFM) sub-systems. Strategically, the country needs its own capability in this arena, and as a sovereign nation, it needs to manufacture and control its own technology. The design and development of South Africa's first 2-6 gigahertz (GHz) DIFM sub-system has been delayed by global component shortages. The project team at Sparcx is waiting for certain electronic components to become available again, to move to commercialisation, but they are confident that when the supply chain issues are resolved, they will be able to move quickly to finalise the product.



The DIFM is part of the detection suite on an aircraft, enabling it to detect a signal that poses a threat; through the processing sub-system, the signal is identified, and a warning is issued to the pilot to react.


Centurion-based multidisciplinary engineering company Sparcx, which focuses on the aerospace and defence sectors, is developing this novel South African IP for use in aircraft and water vessels. 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.

The use of the DIFM sub-system has become commonplace within the aerospace and maritime industries due to the increased threat potential presented to aircraft and water vessels, by weapon systems relying on modern radar technologies. In addition to this, the future battlespace will use the DIFM component on the land-based vehicles as well, and it will be a key source of tactical information within the deployed battlespace.

Sparcx is working closely with the local aerospace industry to ensure that market needs are addressed and will contribute significantly towards the development of relevant capability within the South African electronics industry. 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.

The company is developing its DIFM sub-system to be free of restrictions as per the International Traffic in Arms Regulations (ITAR).

"Our objective is to develop a design methodology and manufacturing technique for instantaneous frequency measurement receivers that will increase production yields, improve performance of operation – by setting a new industry benchmark in speed of detection – and provide consistent

 **3 new jobs created**

 **New technology development**



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

performance," explains managing director Sujo Mulamattathil. "The DIFM is part of the detection suite on an aircraft, enabling it to detect a signal that poses a threat; through the processing sub-system, the signal is identified, and a warning is issued to the pilot to react. The DIFM receiver is located near the avionics suite and needs to be of consistent high quality. Antennas on the aircraft receive the signal."

Project progress

Initial work on the project went smoothly and Sparcx completed the design of the DIFM receiver and were able to implement it on a radio frequency system-on-chip to refine the design. The team then worked on the design of the DIFM processing sub-system to clearly identify the radio frequency signals received and demonstrated the first frequency version at 2-2.5GHz. It was after this point that they ran into delays due to the global semiconductor chip shortage and component shortages in general. "We needed a particular component to finalise the designs for commercialisation. The Field Programmable Gate Array (FPGA) is a critical component that processes the digital data and figures out which signal has been detected. Due to the shortages, the unit cost of electronic components escalated, and long supplier lead times ensued. Since we could not get hold of the FPGA, and despite being quite close to the end, we were forced to put the project on hold at that point," says Mulamattathil.

"From a technical standpoint, our design is robust, we have had it vetted and it looks good in simulation form. We are confident there will be a demand for it when we are able to complete the project, as we had conducted a detailed market

assessment on the requirements for such a product, and we found those to be significant – particularly for an ITAR-free DIFM.

"For a small SMME we are doing an excellent job to manage the shortages and price increases, absorbing all the additional costs, and we have a plan in place to still deliver on the project. We are grateful to the AISI for agreeing to increase the project duration to accommodate the severe supply chain disruptions."

Reflections on support

According to Mulamattathil, this project was a terrific opportunity, because it opened doors for Sparcx to a number of other projects. "One of the spin-offs that we are working on now – that comes out of this DIFM work – is a very cool radio frequency-based scholar tracking solution that we are designing. It does not rely on GPS and the big advantage is that it notifies the parent or guardian when the child has physically entered the school, which is where the legal responsibility is transferred from parent to the school.

"We have presented it to the Technology Innovation Agency, and it is currently under review. The proposed system is passive and works without inhibiting the child's movement in any way."

▶ INDUSTRY PARTNERS AND COLLABORATORS

- CSIR
- Denel Aeronautics
- Sysdel – Electronic Warfare Systems (Potential partner)
- SAAB Grintek Defense



PROGRAMME 3: SECTOR STRATEGIC SUPPORT INITIATIVES

The Sector Strategic Support Initiatives Programme creates a platform for stakeholders in industry, academia and government to interact with each other to promote collaboration, and to engage with potential clients, partners and thought leaders to grow the industry. The AISI utilises existing mechanisms to promote the South African aerospace and defence industry, which enables both local and international role players to gain an understanding of the value proposition and competence offered in the country.

AEROSPACE AND DEFENCE INDUSTRY SUPPORT FRAMEWORK

In pursuit of strengthening of the local manufacturing and export capabilities of the aerospace, defence and marine industries in South Africa, **the dtic** commissioned the AISI to develop an Industry Support Framework as a guidance document for both financial and non-financial support offered in South Africa. The framework serves both the aerospace, defence and marine industries, as well as advanced manufacturing and other related industries.

The desired outcomes expected from the implementation of the framework include:

- Increased competitiveness, employment creation and export promotion.
- Human capital development and transformation.
- Increased market access and export opportunities for industry players.

- Improved ability of **the dtic** and the AISI to align with related work and support offered by other government entities and support programmes.

The latter enables **the dtic** and the AISI to better understand the mandate and responsibilities of other entities so that applicants to the AISI programmes could be redirected to appropriate support when appropriate. The Industry Framework will thus serve as a 'one-stop shop' for industry support.

The development of the Aerospace and Defence Industry Support Framework is still ongoing. Suggestions and recommendations are incorporated into the framework to ensure that it achieves the objectives as set out by **the dtic**.

AEROSPACE AND DEFENCE STATISTICAL UPDATE

The availability and analysis of current data relating to the aerospace and defence sector in South Africa is critical for its growth and competitiveness. **the dtic** – through its Industrial Competitiveness and Growth unit that is the custodian of policy development, strategy, and planning for the support of key economic sectors – has worked with the AISI to evaluate the South African landscape with respect to existing capabilities, active players in the industry, and to assess its strengths, weaknesses, opportunities and threats.

The AISI conducted a study through a survey to collect and analyse data from public and private enterprises in South Africa

to update the existing statistics database and to create a situational analysis report on the sector. One hundred and thirty-two companies were identified to participate in the study, with AISI being able to achieve a 36% response rate. The study report outlined the current activities and capabilities, economic data, and an analysis of the state of the sector.

The findings of the study pointed to a potential for growth in the sector and opportunities to diversify markets. Though several threats to the survival of companies operating in the sector were identified, the data showed that the growth of SMMEs and expanding support offerings could rejuvenate the sector.

PROGRAMME 4: MARINE MANUFACTURING AND REPAIRS SUPPLIER DEVELOPMENT PROGRAMME

South Africa's global strategic location – positioned at the gateway between the Atlantic and Indian Oceans as a fully-fledged maritime nation – is well positioned to serve the international maritime community. Its maritime history and heritage is rich, diverse and adaptive to the ever-changing global maritime environment. The South African Government has committed to maritime education and training to retain the highest level of competence and capability to ensure the competitiveness of the sector. The Marine Manufacturing and Repairs Supplier Development Programme is a ring-fenced initiative of the AISI that was implemented initially, as a pilot, to assist suppliers in the ship and boat-building, maintenance and repair, and associated services value chain. The programme supports local suppliers to attain relevant marine standards and accreditation, and to enhance their technologies. The aim of the programme is to improve competitiveness in the local marine supply chain and to better respond to designated public procurement in the ship and boat-building industry.

The AISI Marine Programme supported 15 beneficiaries during the 2021/22 financial year, i.e. 12 projects under Standards and Accreditation, and two projects under Technology Enhancement. Five of the supported beneficiaries successfully concluded their projects within the period, and a total of 14 certifications were achieved under the Marine Standards and Accreditation programme. Certification contributes towards localisation as a portion of the certified parts that were initially imported will now be manufactured locally with certification. Under the Technology Enhancement programme a green technology project was identified and supported that will contribute to the drive towards the local Blue Economy.

CHALLENGES IN THE MARINE INDUSTRY

- The AISI identified that applicants to the Standards and Accreditation Intervention of the Marine programme do not fully understand the type of certifications that could improve their competitiveness and/or efficiencies. This has resulted in extended communication between the applying companies and the AISI to determine what support is required. The AISI is committed to improving its own competence in this field to enable it to provide more customised guidance to applicants.
 - Welding has proven to be an important service for which the standards and accreditation are complex and differ from class society (e.g. Bureau Veritas and Lloyd's Register) to the next, as well as industry (American Society of Mechanical Engineers [ASME] for high pressure vessels and the International Association of Classification Societies [IACS] for marine). The AISI has allocated additional capacity to the welding component of the programme, enabling it to be more responsive to queries and improve accuracy of calls for proposals that are issued to the industry.
 - It has become evident that South Africa has a lack of certain testing facilities. Local IACS companies are not able to certify the manufacturing of marine watertight doors and windows. What is required, is local testing facilities for hydrostatic pressure testing that is currently not conducted in South Africa. The country does not have the required shore-based testing facility (or factory) with a test bulkhead and/or 'water tank'. The AISI is investigating the establishment of this capability.
 - Accreditation projects may take a little longer than planned in some instances when procedures for special applications are not catered for in South Africa's ports. Delays may also occur when there is a need to appoint multiple role players; have tests done at a mechanical laboratory; and procure less common materials for testing. Due to the erratic nature of the ship repair industry, a hard timeline may not be practical, and applicants may want to consider qualifying one procedure at a time, over a period of time.
 - During training for accreditation, it has been found that the hardest working and best performers may not have been in a classroom setting for a long time and struggle to learn theory, although they work extremely well in a practical setting. Some people are visual learners and struggle with theory. For people with reading disabilities, the theory may be hard to follow and when English is not one's mother tongue, learning theory is made that much more difficult. Companies applying for support from the AISI could consider having training sessions translated to ensure that the applicants receive full certification.
 - In order to elevate skills levels and productivity within a company through accreditation, management may be required to assist trainees as they are not academic personnel.
- This programme is now in its third year and is establishing a footprint in the marine manufacturing and repairs industry.

STANDARDS AND ACCREDITATION IN THE MARINE INDUSTRY

The South African marine sector has been identified as one of the local growth areas for manufacturing. The AISI Marine Programme was established to assist with this growth by addressing barriers to entry such as standards and accreditation. The local and international marine sector is highly regulated and by providing support to obtain the required standards and accreditation, the AISI Marine Programme has been making an impact in the industry.

Companies who received support during the 2021/22 financial period are active in the marine sector as well as others with a broader industry focus and offering. Companies that wish to obtain certification to nonmarine-specific ISO quality standards are referred to the Small Enterprise Development Agency (SEDA) for assistance.

The companies listed in the following table received AISI support under the standards and accreditation intervention in the 2021/22 financial period.

Table 5: Standards and accreditation intervention beneficiaries

BENEFICIARY NAME	PROJECT TITLE
Macc Engineering and Construction	IACS-Approved Welding Certification Services
Polyfix	ISO 9001 (with built in ISO 12944-5 compliance) as well as ISO 14001:2015 Development, Implementation and Certification
AR Jones Engineering	IACS-Approved Welding Certification Services
Nkosi Phendule Projects	Accredited Confined Space with Safe Permit to Work Unit Standard 15034 / 120359 Competency Assessment
Sonhar Projects	Banksman, Slinger and Rigger certifications
DORMAC Marine & Engineering	Welding Procedure Specification Qualification and Endorsement as well as Welder Testing and Qualification by an IACS Member
Trewfit Controls	IECEx Certification (for Valve Positioning Indicators) & Certificate Conversion to ATEX and SANAS

WELDING CERTIFICATIONS PLACE SMME IN FORMIDABLE POSITION TO SECURE FUTURE STEELWORK CONTRACTS AND PROJECTS WITH PORTS AUTHORITIES

Beneficiary:
Macc Engineering and Construction

Project title:
IACS-Approved Welder Qualifications and Welding Procedures

The marine services and repairs sector in Durban is not on a good footing due to the July 2021 riots; the unprecedented April 2022 floods; and the post-Covid-19 recession. However, South Africans are resilient, and so too is the local engineering sector. Macc Marine, located in Bayhead, Durban, has relentlessly pursued additional international welding certifications during this uncertain time, to ensure that once Durban harbour returns to full capacity, it will be ready to take on the work. This time with additional, international welding certifications.



A Macc Marine employee working on a docked utility vessel. The company is now in a formidable position to secure future steelwork contracts and projects having secured IACS certification.

Macc Marine 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 AISI Marine Programme after identifying a gap in the market. This gap was the lack of suitably qualified and certified welders and welding procedures among smaller companies in the ship repair industry, as required by the various IACS classification societies.

UltraScan Inspection, a leading quality surveillance service provider offering excellent third-party quality assurance and quality control welding inspection and non-destructive testing services was appointed to conduct the assessments. The international marine/shipping industry is regulated by IACS.

ASME IX, however, is the Boiler and Pressure Vessel Code, which is mainly used for industrial applications. It is for this reason that IACS certification was utilised for the project, and not ASME.

Macc Marine pursued and successfully achieved the IACS accreditation and certification and now boasts qualified welding procedures and qualified welders in accordance with Bureau Veritas Class Rules for MMA (111), FCAW (136) and P-GMAW (131) welding processes.

MMA: Manual Metal Arc (MMA) welding
FCAW: Flux cored arc welding
P-GMAW: Pulsed gas metal arcwelding (aluminium)

Standards and accreditation achieved

Managing director Eugene Sillifant is delighted with the accreditation and says the next step is to, “Get the work”. Macc Engineering and Construction is actively pursuing government tenders such as the manufacturing of a new Grab Hopper Dredger for Transnet. Sillifant said the difficult circumstances described earlier are exacerbated by the fact that Macc Marine – although the preferred bidder with Sigma Shipyards to design, manufacture and assemble the new Grab Hopper Dredger for Transnet – is not yet working on the project, as it has been put on hold. “We had prepared ourselves and purposefully aligned our activities with this project, but now the work is on hold.”

Macc Engineering and Construction was founded in 1972. Its main line of business in those days was maintenance in sugar factories and paper mills. In 1976, the company started with ship repairs, doing some pipe, plate and mechanical work. Over the years the ship repair business became its primary activity. Today it provides a full marine and engineering service while afloat and in dry dock. The company has worked in every port in South Africa, as well as in Maputo and Mombasa, repairing all types of vessels from fishing boats, general cargo and container ships, to dredgers and tugs.

Since completing the AISI programme, the company has already secured a steelwork project in Pemba, Mozambique, for Vessel ‘MAXI’ that requires IACS-approved welders and welding procedures. The company is now in a formidable position to secure future steelwork contracts and projects with the Transnet National Ports Authority and others. One international contract is in the negotiation phase.

Reflections on participation

When Macc Engineering and Construction put out the call for applications, approximately 80 new welder applicants arrived hoping to pursue the welding certifications. The company conducted pre-test skill assessments and a readiness analysis to determine skill levels and to select the most appropriate welders to participate. In total, 40 people were granted the opportunity to obtain certification. Ultimately, 26 welders qualified.

Results Welder Qualification

11/11 welders passed the MMA (111) certification
8/22 welders passed the (extremely difficult) FCAW 136 certification
7/11 welders passed the P-FMAW certification

In addition to expanded market access for the company, participation in the programme has benefitted the ship repair industry, these are not permanent jobs. However, there are newly qualified welders who can now be employed by Macc whenever a job requires their certifications and skills. One welder has already been employed by Macc and one job retained.

Workplace transformation is enhanced through the empowerment of 26 Black workers by way of IACS certification.

There will generally be a positive improvement in productivity as a result of AISI support.

“This has been an extremely worthwhile experience,” concludes Sillifant. “It expanded our footprint among our client base and in the industry. It allows the micro-enterprise to comply with industry requirements.”

INDUSTRY PARTNERS AND COLLABORATORS

- UltraScan Inspection
- Bureau Veritas

STRUCTURED QUALITY MANAGEMENT SYSTEM GIVES COMPANY'S MARINE CORROSION PROTECTION WORK A NEW COMPETITIVE EDGE

Beneficiary:

Polyfix

Project title:

ISO 9001 (with built in ISO 12944-5 compliance) as well as ISO 14001:2015 Development, Implementation and Certification

While visiting professional networking website LinkedIn, Nelson Oliphant of Polyfix – a maintenance and repairs company – spotted a post by the CSIR that piqued his interest. The post related to the AISI programme and, being a former CSIR employee, he read the article about the programme – aimed at developing SMMEs in the aerospace and marine arenas – with great interest. Polyfix had, at the time, engagements with the South African Navy in Cape Town and therefore pursuing additional marine certifications would be of great value.



Installing a heavy-duty vibrating screen on a mine. Polyfix has experience in various sectors, but wanted to branch into marine work. The accreditation allows for this expansion.

“Since 2017, we had visited Durban harbour, Cape Town Paarden Eiland and Simonstown dockyard regularly to introduce and showcase our solutions,” explains Oliphant. “The Navy Engineering Services Simonstown informed us that for Polyfix to conduct work on its infrastructure, we needed to obtain certification that speaks to the quality assurance and environmental impact of our business. When we saw the opportunity advertised by AISI-CSIR-**the dtic** for support, we applied for these standards and accreditation, and with success we have achieved our certification. This effort will definitely open the many closed doors we have been unable to access in the marine industry and the industrial sector as a whole.”

The support for the QMS certification allows Polyfix to promote its products and services to a larger market, including an

expanded export market. This certification secures confidence in the business by placing a quality assurance system at the heart of a sound business strategy.

Polyfix is located in Johannesburg, Gauteng, with branches from Cape Town to KwaZulu-Natal and all the way up to Phalaborwa in Limpopo. The company provides industrial and marine protection and repairs using polymer coatings.

The company received AISI support for the development and implementation of an ISO 9001 QMS with built-in ISO 12944-5, as well as an ISO 14001:2015 environmental management system. These systems were complemented by an ISO 12944-5 accreditation, which relates to corrosion protection of steel structures by protective paint systems. In addition, three staff members earned their National Offshore



Standards and accreditation achieved

Corrosion Assessment Training (NACE) certification, with a focus on marine coating technology. The NACE courses were delayed to 2022 due to the international Covid-19 travel ban, but have subsequently been completed.

The company successfully completed the training for ISO 9001 and 14001 in November 2021. Since then it has implemented the systems into its procedures, enhancing market access and networking opportunities. Polyfix foresees that the Navy and marine industry will be its main market. Transnet Ports, Southern African Ship Yard and Damen are all industry clients who will appreciate the certification to open up work opportunities. The mines and petroleum plants are also potential clients with this certification.

In addition to opening doors, the newly implemented QMS and the environmental management system have helped Polyfix to structure most of its work as well as enhance and simplify tender submissions. Polyfix's work now has a measurable and documented output that is aligned with international standards.

The process has also enabled Polyfix staff to work according to a structured plan. This means that teams no longer have to wait for instructions. When they arrive on site, they immediately know what to do and which procedure to follow. Even new employees are able to get up to speed quickly. Oliphant says that because the employees are working so much more efficiently, it frees him up to focus on additional tasks.

Reflecting on the certifications, Oliphant says the process does take significant time from regular business activities, which does not result in immediate income. “The certifying company would for example outline what is required but the company itself has to do the preparation. At that time we had less work, but if it had happened now, we would not have been able to do it.”

Reflections on participation

He says the other expenses such as purchasing and calibration of measurement equipment, fees for training and travel expenses do impact a small business like theirs in this struggling economy. However, the benefits of upskilling their staff and having a system that tracks their work and growth as a company is all worth the effort. Despite a challenging economic environment, their staff numbers have remained constant, with the prospects of new projects in the future.

Polyfix comprises three shareholders and ten permanently employed staff. The business promotes Black female growth with women in management and ownership, in an industry previously known for lacking greatly in this. The company is currently at B-BBEE level 1. It is 100% Black owned and 33% female owned.

The AISI programme has been of great value to Polyfix. It has entered into the mining space doing coating applications and new markets have opened up. Oliphant says that the marine space has been tough, because it operates according to two- to three-year cycles, and those contracts were awarded over a period time. However, he adds, “Our ears are on the ground and we are knocking on doors. As soon as opportunities arise, we will be there.”

INDUSTRY PARTNER AND COLLABORATOR

- Corrosion Institute of South Africa

CLASS-APPROVED AND CERTIFIED WELDING PROCEDURES ENSURE NEW OPPORTUNITIES IN THE VESSEL REPAIR SECTOR FOR SALDANHA BAY-BASED ENGINEERING FIRM

Beneficiary:
AR Jones Engineering

Project title:
IACS-approved and certified Welding Procedure Specification and Welding Procedure Qualification Record to class requirements

Vredenburg-based engineering services company AR Jones applied for welding certification services – to perform welding on the structure of vessels – through the AISI programme in February 2021 and by October 2021 had received its accreditation. This level 1 B-BBEE company whose target market is the fishing trawlers in the Saldanha Bay area is already on the vendor list for Sea Harvest and the Oceano Group. It has secured new business with Transnet, working on tug boats, and is exploring vessel repair opportunities to expand beyond Saldanha Bay and the West Coast.



With accreditation, the company is now able to conduct IACS-approved welding procedures.

AR Jones provides 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 company is also a certified service provider for the Saldanha Bay Industrial Development Zone (SBIDZ) vessel repair hub. The SBIDZ is the first special economic zone located in a port in South Africa and has attracted more than R3 billion in investment from international and local investors. It was at one of the IDZ monthly networking meetups that AR Jones founder and managing director Antonio Jones first heard about the AISI programme from a CSIR representative.

Jones is an inspirational business owner who leads from the front. He started his career working as an operator at the Saldanha Works and set aside money for studies. He later put himself through university, qualifying with a chemical engineering degree and subsequently worked for companies in various capacities. After completing project management and business management courses, this passionate entrepreneur decided in 2016 he was ready to run his own business and established AR Jones Engineering. The company is deeply embedded in the local community and serves to offer high-quality, reliable, and


authentic services and products to its customers, meaningful employment to staff and ensures that its business activities add value to the communities in which it operates.

AR Jones focused its activities on maintenance and repair of heavy-duty industrial equipment; sourcing and supplying premium OEM pumps and valves; and providing energy efficiency advisory services. The company has been pursuing greater involvement, skills and certification in the marine sector and now, as a result of being an AISI beneficiary, the innovative SMME holds accreditation for Bureau Veritas-approved welding procedures that allow it to do maintenance and repairs on class-approved vessels. In addition, ten welders have received their Welder Qualification Certifications.

What makes this project different is that it transfers internationally recognised skills to unemployed youth, improving their opportunities. These skills are not area-specific, ensuring that the employees have improved opportunities beyond the West Coast region as well. The ten certified welders include two young women and five young men, as well as three more experienced welders. They were featured in the local newspaper.

 12 new jobs created

 Strong skills development

 Standards and accreditation achieved



AR Jones Engineering is a local West Coast company that makes use of local talent, hence closing the skills gap in this region.

Eduardo Construction – an established market leader in the provision of competent skilled labour and services to a number of industries – was appointed as the accreditation service provider. They assigned a project manager, welding engineer, a senior welding inspector, and an IACS Member Classification Society surveyor and a welder to the programme. All welding procedures and welder qualifications were overseen by the IACS Member Surveyor and all welding procedures and welder qualification certifications were certified by the welding engineer, manufacturer and Bureau Veritas.

Impact and benefit

AR Jones' core values are trust, humility and integrity. These came to light during the AISI programme, as the company aimed to use the programme to have a positive impact on the community in which it operates. The West Coast area does not have a lot of companies with these standards in place, which usually requires companies outside of the borders of the West Coast to provide the services. These companies usually make use of their own skilled workers and does not transfer these skills to the local community. AR Jones Engineering, however, is a local West Coast company that makes use of local talent, hence closing the skills gap.

The impact and benefit of the programme is that employees are now able to improve productivity by planning tasks in greater detail than previously. This helps to ensure that jobs are done within the expected timeframe.

AR Jones can now conduct the cutting and welding on structure of class society vessels, deck and hull, opening up market access and networking opportunities. Revenue is expected to increase. The company has moved to a bigger workshop in 2022 (doubling the size of the workspace) and added four employees to the staff complement. The company has also started manufacturing utility trailers for transporting small vessels.

Specific to the Saldanha Bay area, the industry benefit of the certification is that an additional company will be able to conduct IACS-approved welding.

AR Jones is currently improving its ISO 9001:2015 system. In addition to pursuing new clients with the recently-acquired IACS welding procedures, AR Jones is looking at ship building of small vessels in future, and is seeking out strong partnerships to help it head in that direction.

Reflections on participation

“To work in this industry, you need passion, patience, persistence and a strong team to support your mission,” says Jones emphatically. “Never become complacent, and set new goals for every year to stay competitive in whatever environment you find yourself. Sustainable businesses have to be able to adapt to survive.”

INDUSTRY PARTNERS AND COLLABORATORS

- Eduardo Construction
- Bureau Veritas

CONFINED SPACE CERTIFICATION DOUBLES WORKLOAD FOR BLACK-, YOUTH-OWNED MARINE ENGINEERING SMME

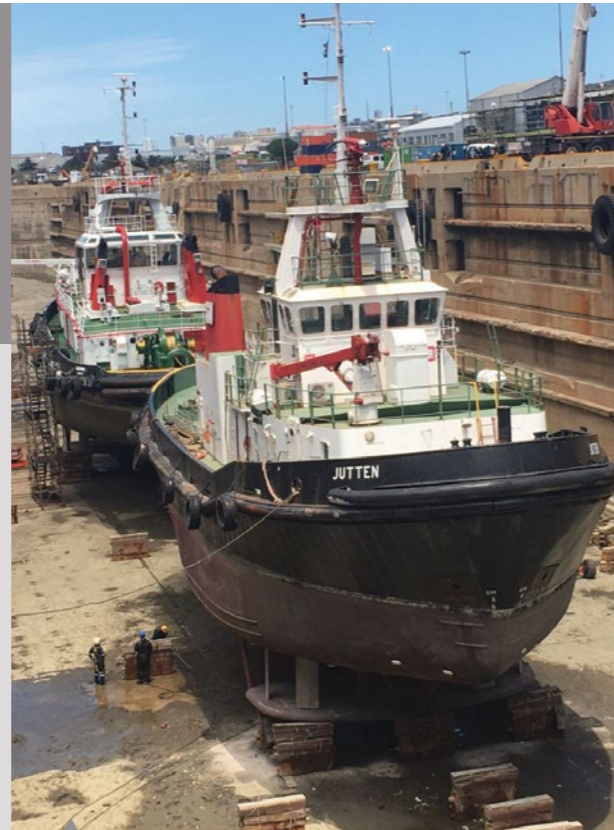
Beneficiary:

Nkosi Phendule Projects

Project title:

SAQCC Certification for painting and blasting & Tank Certificates: Marine Chemist & Accredited Confined Space with Safe Permit to Work Unit Standard 15034 / 120359 Competency Assessment

Established in 2014 by marine engineer Simthembile Kave and his brother Buntu Kave, Nkosi Phendule's main products and services are ship and tug repair and fabrication; painting; blasting; high pressure washing; pumping of tanks and bilges; tank cleaning and painting; non-destructive testing; and other marine and mechanical maintenance and services. In 2021, Nkosi Phendule applied for AISI support to gain marine chemist training and accreditation to work in confined spaces, which they subsequently achieved. This allows this Black- and youth-owned SMME to conduct testing of tanks and equipment to declare these safe before commencing any work.



Prepping the Transnet tugs for maintenance in the Saldanha dry dock.

Occupational health and safety training provider SHEQ-it was appointed to do the training, which comprised theory and practical exercises. This was followed by competency assessment and certification. Nkosi Phendule has successfully completed the training and accreditation and a number of its staff members are now able to demonstrate knowledge of safe working practices in confined spaces, opening up new possibilities for the business, whose clients range from ports authorities and ports users to maritime vessel owners and operators.

Nkosi Phendule spokesperson Obakeng Molelu, who is also a marine scientist, says the company is registered in East London but operates mostly in Cape Town. "We are currently working in the dry dock in Cape Town at the V&A Waterfront. We've worked at Transnet in East London, Saldanha and Simonstown." She says, "The market developments that guide our business are the national fishery vessels that require class repairs, and the Operations Phakisa Oceans Lab ship repair and ship building activities. We do minor repairs, but have also to date done some major repairs, and the accreditation to work in confined spaces significantly enhances our opportunities."

The services offered by Nkosi Phendule range from high pressure washing and sand blasting, spray painting, cabin refitting and refurbishing, engine repairs and services in the dry docks. It supplies fuel and lube, PPE safety wear, spare parts and crew. On behalf of the South African Maritime Safety Authority, it has worked on the vessels Lillian Ngoyi, Victoria Mxenge, and the Sarah Baartman. On behalf of Transnet, it has worked on the tugs Qunu and Umbilo and on PB Petrel. The company has secured contracts with the Robben Island Museum to repair an anchor chain, do calibration, repair vessels and for blasting, washing and painting.

The AISI support received was for training with SHEQ-it that included two days of theory followed by a one day practical in a confined space in Cape Town harbour. During the practical, the four candidates had the opportunity to work in confined spaces on vessels, including fuel tanks. They conducted blasting, washing and painting inside the tank. Since there is a risk of gas inhalation or drowning, the crew learnt how to use a multi gas detector to determine safe levels of operation. They received training on the need for chemist certificates to



High-pressure washing to clean the hull of the tug Qunu.

enable them to determine if it is safe to enter tanks before commencing work and which specialised PPE is required when working in confined spaces.

Definition of a confined space

A confined space is an enclosed area, often under atmospheric pressure, not intended for entry because of the existence of potentially excessive contamination levels or limited oxygen levels. The space also has a limited means of escape and entry. Spaces like this are common in mine shafts, cargo tanks and boilers.

A work area can be defined as a confined space if:

- It has limited openings for entry and exit;
- The space is not intended for continuous human occupancy; and
- The space is large enough for a person to enter to conduct work.

The dangers associated with working in a confined space make it non-negotiable that workers are equipped with protective safety gear – such as gas detectors, fall protection equipment, respiratory protection and head, eye and face protection – to ensure ultimate safety when working.

Working in confined spaces means facing hazards that could potentially involve injury. Therefore, there should be no compromise when it comes to the safety of the workforce; choosing the right safety equipment designed for confined spaces is imperative.

The impact and benefit of the support is that this promising marine engineering company has four staff members who are certified and more knowledgeable about safety when working in confined spaces. They have continued to enhance their skills and earned gas detection competence from Drager and learnt the importance of using the gas detector. Nkosi Phendule has purchased its own gas detector to ensure independent monitoring during work in tanks.

There have been highly beneficial spinoffs as well. During the first AISI Marine Industry Day, where networking is always encouraged, Molelu made contact with a retired diver. They are now exploring the possibility of doing underwater work and doing testing on the external side metal of ships. The company is investigating the use of innovative materials.

"The certifications make us more compliant when we go into the dry dock. Usually, we would work on two vessels a year," adds Molelu, "But this year (2022) we are working on four."

Reflections on participation

Since receiving its certification, Nkosi Phendule has worked for Transnet in Saldanha doing dry dock maintenance on Tug Cormorant, Tug Jutten and Tug Chardonnay for a 12-month period. Molelu says she believes the AISI programme played a major role in them getting these contracts, as they were able to include the new certifications in the mandatory safety file required by Transnet projects when submitting a bid for work. The company is adding to its accreditation through the subsequent AISI call by enrolling for the SAQCC PA 1 (painting and blasting) training and more staff members will be certified as spray painters.

The company looks forward to completing the painting and blasting certification as this adds to the diversity of skills among its employees and business. The more qualifications within the staff complement, the more options they have and the better their chances of securing longer-term contracts.

"Being part of this project has been invaluable, especially for our staff who come from disadvantaged communities in and around Cape Town. They have felt empowered by being able to demonstrate their knowledge of safe working practices in confined spaces. We learnt that safety requires teamwork and trust!"

Some of the lessons learnt and challenges faced included that some of the company's hardest working and best performers have not been in a classroom setting for a long time and struggled to learn theory, although they work extremely well with their hands. Some people are visual learners and struggle with theory. For people with reading disabilities, the theory was hard to follow and when English is not one's mother tongue, learning theory is made that much more difficult. Simthembile Kave showed leadership by taking time out from managing the business in order to attend the training sessions and translate what was being said.

INDUSTRY PARTNER AND COLLABORATOR

- SHEQ-it

BANKSMAN, SLINGER AND RIGGER QUALIFICATIONS OPEN NEW MARKETS FOR EASTERN CAPE ENGINEERING FIRM

Beneficiary:

Sonhar Projects, trading as Ocean Engineering

Project title:

Banksman/Slinger and Rigger Certifications

Ocean Engineering has been providing marine services to various shipping clients along the Eastern Cape shoreline for over 18 years. The company noticed an emerging gap in the market for banksman, slinger and rigger qualifications. However, the company's rigger certification at the time did not meet the oil and gas industry safety standard requirements. As part of the AISI programme, it therefore pursued the necessary training and certification from OPITO to open new markets for Ocean Engineering in the oil and gas industry, thereby promoting growth and employment.



Repair of hydraulic cylinders of the knuckle boom crane.

With the marine industry changing, requests from clients changed as well. To adhere to the client's needs, Ocean Engineering obtained the following certifications:

- IACS-approved welding procedures by Lloyds Register
- LMI and LME certification by the Engineering Council of South Africa
- Marine Engineering Diploma by Lloyds Maritime Academy
- Naval Architecture Diploma by Lloyds Maritime Academy.

However, the company earmarked banksman, slinger and rigger qualifications as a priority and approached the AISI programme for support. The programme identified Offshore Africa Training Centre (OATC) as the preferred service provider for the training. OATC is the first South African training centre to achieve OPITO accreditation in South Africa. It specialises in rigging and lifting operations and currently offers several OPITO courses that deliver skills for the offshore oil and gas industry. OATC is also the only OPITO-approved training centre to offer the OPITO Banksman and Slinger Stage 1-4 courses and the OPITO Rigger Stage 1-4 courses in South Africa – the bulk of other training centres are in the UK and Europe.

Banksman & Slinger:

Banksmen, or slingers, play a vital part in maintaining workplace safety. Banksmen/signallers direct the movement of plant, vehicles and or machinery around a site.

Rigger:

Riggers install and use pulleys, cranes, derricks or winches to hoist and move heavy material and equipment around a site.

OATC was appointed in October 2021 and the Ocean Engineering Stage 1 training activities kicked off shortly thereafter and will continue until 2023, when Stage 3 is completed. The structure of the courses comprises theory, practicals and tests. The OATC course director presents and coaches trainees, as well as conducts the pre-assessment to ensure that the candidates are properly prepared before proceeding to onsite training. The training is rigorous. In year one, the candidates complete the necessary training and start working with their log books while in year two, they complete their log books and subsequently get assessed.



Standards and accreditation achieved



Hydraulic cylinder being removed for repair at Port of Ngqura.

Four staff members are well underway having completed the training and are working on their log books. To progress to the next level of training, the log book containing 50 entries must be completed and co-signed. This process is estimated to be completed in one year after the awarding of the certification. Once all is found to be satisfactory, candidates progress to the level 3 assessment.

Reflections on participation

The relevant trainees are not academic personnel and need assistance from management in completing their training and completing the log book correctly. Management also conducts checks from time to time to ensure that the log books are completed according to schedule.

Ocean Engineering has observed an improvement in productivity.

The personnel have a better understanding of the tasks that fall under their training, and are sharing the learning with the other employees. These staff members with additional qualifications are more employable and they can earn a higher salary.

Enhance certification in the company has increased skills levels. The new certification fills a gap in the market and enables Ocean Engineering to offer this skill with certification.

As part of the programme, Ocean Engineering was also able to convert its Engineering Council of South Africa load testing certification to class society certification.

INDUSTRY PARTNER AND COLLABORATOR

- Offshore Africa Training Centre

WELDING CERTIFICATION HELPS LARGE MARINE ENGINEERING COMPANY DEVELOP EXOTIC SHIP REPAIR CAPABILITIES

Beneficiary:

Dormac

Project title:

IACS-approved Welding Certification services

More sophisticated technology is being built into vessel design and older vessels need to be upgraded, especially to comply with environmental performance expectations. Meeting these new standards and technical demands requires a shipyard to adapt its welding conformance standards for new materials and procedure requirements. Ballast water treatment plants and emission scrubbers are the current focal areas. Ship repair yards such as Dormac are engaged in these installations. However, the welding procedures that have served it well for many years, have had to be updated to comply with international expectations. Dormac applied for AISI support to develop its exotic ship repair capabilities, thereby earning an IACS-approved welding certification.



Durban-based Dormac's commitment to training and development of personnel is a matter of record and speaks for itself. Increased technical capabilities require increased skills. This is all a very positive cycle of development. However, the development of such procedures is both expensive and resource consuming. The AISI support has been key to progressing faster in acquiring the certification.

Dormac's safety, health, environment and quality manager Dave Swinburne says the more exotic procedures used to be sub-contracted to specialist welding contractors. Now the exotic is more the norm, and requires in-house capabilities to provide the service delivery levels required by the shipping industry. He says Dormac has been planning on securing IACS welding certification for some time in these exotic steel applications, but costs to achieve the certification made it difficult to pursue. "The AISI support therefore helped us to

leapfrog that process and Dormac – with the certification earned thus far – is able to meet current expectations. This has enhanced our local capabilities, encouraging owners and operators to bring their vessels to South African ports for service and dry docking."

Dormac Marine and Engineering is a leading engineering company specialising in the delivery of full turnkey solutions to clients in the marine, offshore and industrial industries. Its participation in the AISI programme is proof that larger companies do receive support alongside smaller entities. Dormac offers marine engineering services in all major port centres in South Africa and is the country's only shipyard to hold full Det Norske Veritas (DNV) certification for 18001, 14001 and 9001. It is a Black economic empowered company and operates both nationally and internationally under the direction of majority shareholders.

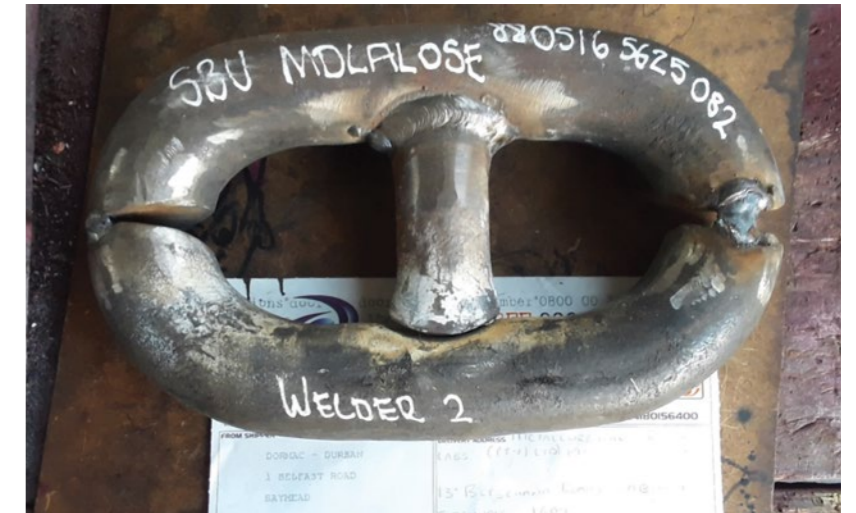


Standards and accreditation achieved



Dormac is pursuing Bureau Veritas-approved welding procedures and welder qualifications for:

1. Stainless steel 316L (low carbon, corrosion resistant steel)
2. SuperDuplex 2507 (stainless steel pipe)
3. Aluminium 5083 (sheet)
4. Carbon Steel EH 36 (low carbon steel plate) to Stainless Steel 316L
5. Cunifer pipe (copper nickel pipe mainly used in seawater for anti-corrosion)
6. Cast steel to carbon steel
7. Anchor Chain IACS Grade 3



Since Dormac has internal expertise in managing quality assurance and quality control, it decided to manage the entire process itself, liaise with the various role players and ensure completion of each project phase. Bureau Veritas fulfilled the role of Classification Society and IACS member society, with the primary role of reviewing the material and consumables employed as well as the procedure qualification; testing and approvals are carried out according to the relevant rule note requirements.

Two procedures are for special applications currently not catered for in the Port of Durban.

Despite a slow start – due to the need to appoint various role players, the need to have tests done at a mechanical laboratory and delays in procuring some of the less common materials – Dormac has since made significant progress. The company has already produced two IACS-approved welders who have completed the programme and qualified (as of September 2022) and a further five are in progress. "By training welders in new skills, which are also inherently valuable, we are able to offer a broader service to our clients," says Swinburne. "This is all a very positive."

Due to the erratic nature of the ship repair industry, a hard timeline is not practical, and Dormac's intention has been to qualify one procedure per month for a period of seven months, subject to resources being available. The process is still ongoing.

Reflections on participation

Swinburne has nothing but praise for the AISI programme and its execution. Dormac breaking the mould by not requiring a third-party service provider to manage the entire process, veered away from the usual AISI format. However, he adds, "The dedicated AISI support team in Pretoria adjusted and adapted to our needs and accommodated us at every turn to make the package work – even though this added significantly to their workload."

Managing the process internally also resulted in cost savings and possibly paves the way for other larger players to participate in AISI in this manner.

INDUSTRY PARTNER AND COLLABORATOR

- Bureau Veritas

INTERNATIONAL CERTIFICATIONS FOR HAZARDOUS INDUSTRY ENVIRONMENTS OPEN DOORS FOR LOCAL VALVE AND AUTOMATION SPECIALIST

Beneficiary:

TrewFit Controls

Project title:

IECEX Certification for valve position indicators (Type LSA, LSS and LSB)

IECEX QAR (Intrinsic Safety, Dust Ignition Proof)

Conversion of IECEX certification to:

- ATEX
- SANAS

Johannesburg-based TrewFit Controls designs, manufactures and distributes valve automation products and hydraulic components. The company operates a full CNC engineering facility where it assembles and calibrates valve packages. Through participation in the AISI programme, TrewFit has achieved a number of international certifications for hazardous industry environments, benefiting the company's performance and ability to operate in the marine valve supply chain – particularly in explosive atmospheres.



Assembling a valve position indicator.

TrewFit Controls has secured IECEX, ATEX and SANAS certification for valve positioning indicators and for hazardous area products. The company is now also a certified manufacturer under these standards and can offer a complete product with appropriate protection codes. The demand for TrewFit Controls' repair services has increased in 2022, particularly in the Cape Town harbour and it is able to export to Europe and Australia.

Managing director Adrian Penning heard about the AISI programme through one of his business partners and approached the CSIR for more information. "We were looking to improve our certification in adverse settings to satisfy the requirements of the export market," says Penning. "We have completed all the training and certifications we sought, even going beyond our expectations by adding certification as a manufacturer as well."

The certification

When electrical equipment is used in a potentially hazardous location – one that contains flammable gases, vapours, liquids, dust, or fibres – the potential for fire or explosion must be minimised. One way to do this is to use equipment that has been certified as suitable for that environment and not likely to initiate a fire or explosion. In the European Union, equipment

to be used in hazardous locations is certified according to ATEX directives, while in other parts of the world, certification is typically done according to the International Electrotechnical Commission Explosive (IECEX) system.

What does ATEX stand for?

ATEX comes from the description of the hazardous materials in question, as written in French – "Appareils destinés à être utilisés en Atmosphères Explosives." The translation into English reads, "Devices intended for use in explosive atmospheres."

The South African National Accreditation System (SANAS) is the official accreditation body for South Africa. ATEX is the European Regulatory Framework for Manufacture, Installation, and Use of Equipment in Explosive Atmospheres. IECEX is the International Electrotechnical Commission for Certification to Standards Relating to Equipment for Use in Explosive Atmospheres.

By pursuing a combination of IECEX, ATEX and IA (SANAS) certification, TrewFit Controls marked a significant milestone that now allows it to service all national and international markets, including Europe.

Standards and accreditation achieved



As a result of the AISI support, TrewFit staff received a lot of training, and the company has employed additional people.

As the largest Ex certification and hazardous location services company in southern Africa and the only international (IECEX) accredited certification body and test laboratory in the region, MASC was appointed to conduct the testing and assessment.

A participatory and co-creative company

TrewFit's core products revolve around the monitoring and controlling of valves used in marine, mining, manufacturing, food and beverage production processes. The products range from commodity items to high-end value add. The range includes products that are industry firsts. The company works closely with valve manufacturers to sell and distribute their products. It has an international footprint as well, distributing products to North America, Australia, Europe and China.

The company's manufacturing facility spans 700 square meters, packed with state-of-the-art manufacturing equipment and enabling it to offer custom manufacturing of engineering work requiring precision milling and precision turning. "By ensuring research, development, manufacture and quality control is undertaken inhouse, we are able to offer our products with confidence and pride," adds Penning. "This certification is recognised globally and gives us a boost in bringing South Africa forward in meeting world-class safety and industrial standards, especially working in hazardous and explosive atmospheres."

TrewFit operates six CNC machine centres for component manufacture. The company has a strong IT backbone and the latest design and computer aided manufacturing software. The owning and controlling of these assets are key to realising favourable cost, high quality and required delivery. TrewFit describes itself as a "quantum organisation" that encourages visionary and lateral thinking as well as being participatory and co-creative.

The South African annual market for valve and automation runs into billions of rand. Local manufacturers of products are supported throughout the industry. Automation remains a growing activity as the world continues to digitalise. Valve demand continues to grow around the world.

With the above opportunities in mind, it was important for TrewFit to make the most of these opportunities by achieving additional international accreditation. It decided to pursue a combination of IECEX, ATEX and SANAS certification.

Reflections on participation

Penning says the AISI certification project was a valuable exercise. "We have been engaging new markets and now that we have the necessary certification we are starting to get the enquiries. I believe a lot of these will turn to orders as

customers and our distributors have been asking us about such products over the years, and we have had very positive feedback. This adds to our basket of products and we expect orders and business on that side."

On the skills development side, Penning says a number of staff members have received a lot of training, and the company has also employed additional people. He expects the company will have to appoint and train many more people over the next two years as it increases its marketing and sales.

On the quality side, the certifications are an indication of a vast improvement that is now in place as the company was required to institute a QMS. Without certification Ex equipment usually needs to be tested again and re-certified to the acceptable standards, which will add to the equipment cost. By contrast, the IECEX scheme considerably decreases the need for re-testing and certification procedures by harmonising and conforming to international standards. As a result, international trade is made easier, faster, and more economical. IECEX certification can be utilised to support national compliance, thus averting the need for further testing in the majority of cases. This means TrewFit Controls can now manufacture the equipment and ship it.

"TrewFit Controls is grateful for the opportunity. As a growing manufacturing company, capital outlays are high. For manufacturing, even today, I have a list of 50 things I'd like to do. Through the AISI programme we were able to complete the certifications that we may only have been able to do in three or four years' time, depending on company performance. Although we have the knowledge, experience and know-how to do it, we did not, because the capital outlay was holding us back."

Looking ahead, Penning sees a silver lining for manufacturing in South Africa. "There is room for growth and people are opening manufacturing businesses again. We cannot compete with countries like China in the low-tech, high-volume market, but we do have the edge when it comes to medium- to high-tech and medium to low quantities. In that niche we are incredibly competitive. Markets dictate how many you make. If a market is only worth 20 000, most countries are not interested, but in South Africa setup costs are lower, so it becomes well worth it. It is also easy to register a business and get a tax number and VAT number. We need to use this to our advantage."

INDUSTRY PARTNERS AND COLLABORATORS

- Mining And Surface Certification (MASC)
- Paltechnologies



ADVANCED MARINE CRAFT MANUFACTURER SEEKS NICHE MARKET FOR CARBON FIBRE HYDROFOILS TO CREATE 'CLIMATE-SMART' VESSELS

Product markets:
Recreational/leisure

► **Technology streams:**
Manufacture components, parts, sub-systems or inputs for the marine industry

TECHNOLOGY ENHANCEMENT

The AISI Marine Programme has a technology enhancement component which aims to advance the TRL of technologies in the marine sector. The goal of the support provided to marine manufacturing companies is to improve the competitiveness in the local marine supply chain as well as setting them up to better respond to designated public procurement in the ship and boat-building industry. The support provided by the AISI Marine Programme 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 benefit of the oceans economy. During the last financial year, both the technology enhancement projects had green technology components indicating the AISI's commitment to sustainability.

The companies listed in the following table received AISI support under the technology enhancement intervention in the 2021/22 financial period.

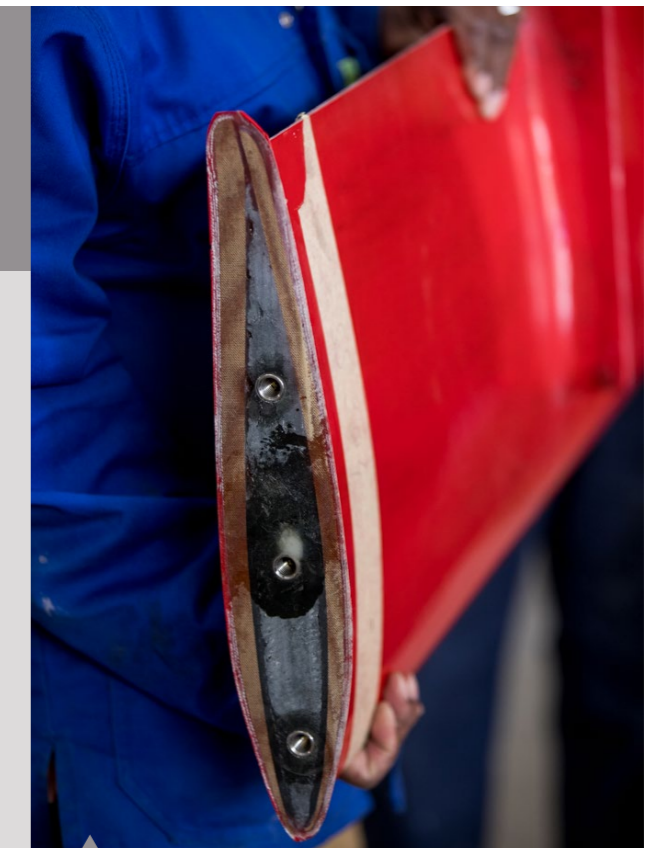
Table 6: Companies benefitting from the AISI technology enhancement intervention

BENEFICIARY NAME	PROJECT TITLE
Stellenbosch Advanced Marine Craft Development	Design, Manufacture and Supply of Hydrofoils for Sailing and Power Boats Project (Completed Project)
Cybicom Atlas Defence	Ship Ballast Water Treatment (SBWT) System Development Project (Completed Project)

Beneficiary:
SAMCD

Project title:
Design, Manufacture and Supply of Hydrofoils for Sailing and Power Boats

Stellenbosch Advanced Marine Craft (SAMCD) applied for AISI support to design, manufacture and supply carbon fibre composite hydrofoils for the local marine industry. Localisation through the integration of hydrofoil technology will benefit local companies that build powerboats and sailing boats. Through development and installation of hydrofoils on locally manufactured boats where applicable, the international competitiveness of local boats and thus the local industry will be enhanced, with the expectation of increased domestic and foreign boat sales.



The hydrofoil usually consists of a winglike structure mounted on struts below the hull, or across the keels of a catamaran in a variety of boats.

The development of locally owned IP, as well as the responsibility to market and drive commercialisation is a major driver of AISI support. The creation of IP such as patents together with existing know-how, improved aerospace design support and hydrofoils, could enable South African boat builders to manufacture and export more competitive power boats and sailing boats.

Practical use of hydrofoils in boats commenced in 1898 and peaked in the 1960s and 1970s, with emphasis on fast military boats and passenger ferries. Hydrofoils have been refined over the years. The HYSUCAT patent (1981) developed in South Africa succeeded in overcoming several limitations of earlier designs.

Hydrofoil defined
A hydrofoil is a lifting surface or foil that operates in water. They are similar in appearance and purpose to aerofoils used by aeroplanes. The hydrofoil usually consists of a winglike structure mounted on struts below the hull, or across the keels of a catamaran in a variety of boats. As a hydrofoil-equipped watercraft increases in speed, the hydrofoil elements below the hull(s) develop enough lift to raise the hull out of the water, greatly reducing drag. This provides a corresponding increase in speed and fuel efficiency.





SAMCD can now design, integrate, manufacture and supply hydrofoils to the boat building industry.

SAMCD was established in 2002 when the HYSUCAT patent expired, with the explicit objective of developing what became the new Alpha-Wing patent to overcome the limitations of the HYSUCAT patent. The Alpha-Wing patent was developed from 2002 to 2006 with a hydrofoil and steps in a catamaran hull for pitch stability required to enable 80% of the total mass to be carried by the hydrofoil. The Alpha-Wing patent achieves 60% fuel saving and has been validated by operation of several boats along the Cape Town and Durban coastline. Local boats can thus achieve a competitive advantage worldwide.

By 2008, the team's 9-metre Alpha-Wing boat inshore patrol craft (known as the Blue Crane) was operated over 5 500 km between St Helena Bay and Durban. However, payment obligations stemming from the arms deal precluded procurement of new inshore patrol boats by the South African Navy which was forced to instead refurbish its boats developed in the 1970s, while other agencies have not acquired any durable inshore patrol capabilities, on which basis South Africa remains unable to carry out inshore patrol in any practical form.

SAMCD and its associates developed several specialised boats for the South African Special Forces and the Department of Water Affairs. A seven-metre, 18-passenger Alpha-Wing fast ferry (the Flying Fish) was developed for public transport in the Maldives but a coup in the Maldives prevented execution of the

project, whereafter development activities were suspended. SAMCD, a level 4 B-BBEE company, has subsequently worked on the basis of a technology company in collaboration with boat builders in which human resources are subcontracted from specialist companies as required.

In 2017, ongoing development of the Alpha-Wing technology was transferred to Epsilon Engineering Services. Epsilon developed a new 12-metre Alpha-Wing boat that was tested extensively and evaluated at sea over 1 700 km between Richards Bay and Cape Town. The prototype was accompanied and operated by the engineering design and composites manufacturing team, which is also the design team for this hydrofoil design and manufacturing technology development project.

Outcomes of this project

Andrew Taylor, Managing Director of SAMCD, said, "As of 2022, hydrofoils are revolutionising sailing boats, creating a demand for their use in the types of sailing boats exported from South Africa. This project therefore expands existing design and manufacture expertise to supply the boat building industry with carbon fibre and other hydrofoils."

He says the AISI support enabled analytical and computational fluid dynamic analysis techniques commonly used in aerospace design to be applied for the design of boat hydrofoils together



New technology development



6 SMMEs involved

with the use of carbon fibre composite design, tooling and manufacturing processes to be applied for the manufacture of hydrofoils. SAMDC has developed, evaluated and demonstrated a complete process including:

- Selection of suitable hydrofoil sections using hydrodynamic analysis
- Analysis of complete hydrofoil systems
- Physical and structural design of complete hydrofoil systems
- Structural optimisation of hydrofoil systems using finite element analysis
- Design and manufacture of hydrofoil tooling
- Manufacture of complete hydrofoils
- Structural testing and design validation of carbon fibre composite hydrofoils.

During the final phase of the project, the hydrofoil test rig was manufactured, evaluated and used for testing of all three prototype hydrofoils.

Geometric (laser scanning) and structural testing (load testing) of the first prototype was used to guide refinement of structure of the second prototype. Laser scanning was used to evaluate the geometry of the first prototype and its conformance to design. Knowledge gained was then used to manufacture and test the second prototype. Testing of the second prototype was used to guide refinement of structure of the third prototype.

Knowledge gained was then used to manufacture the third prototype and geometric measurement and structural testing confirmed that the third prototype achieved the project objectives.

There is renewed interest in hydrofoils around the world as fuel prices increase. For ships that run on fossil fuels, the climate benefit could be significant, as similar hydrofoil technology could reduce fuel consumption by as much as 80%. In fact, Taylor says it is virtually impossible to operate a high-speed, long-range electric boat efficiently without a hydrofoil and advanced high-speed propellers. SAMCD thus plans to develop the capabilities to design and manufacture both hydrofoils and propellers to offer solutions for high-speed electric boats which is a rapidly growing market opportunity.

Project achievements

Knowledge, methods and processes were developed to provide hydrofoils and related services required by boat builders to exploit hydrofoil technology in their products to be more competitive.

The capability was established to offer the services of design, integration, manufacture and supply of hydrofoils not yet available to the boat building industry.

The primary goal was to develop these services around carbon fibre composite hydrofoils, which are used almost exclusively in modern hydrofoil boat installations. Through development and installation of hydrofoils on locally manufactured boats where applicable, the international competitiveness of local boats and thus the local industry has been enhanced, with the expectation of increased domestic and foreign boat sales.

Reflections on participation

"The AISI support has enabled SAMCD to respond to the need for supply of hydrofoils for new boats under construction, through which boats can now be equipped with carbon composite hydrofoils," says Taylor. "Discussions are underway towards designing and manufacturing hydrofoils for three new boats presently under construction and hopefully also for three boats already in service. There is a good prospect of commercial production orders."

The aerospace knowledge and skills of at least five engineers and technicians within Epsilon have been adapted and broadened to enable development of boat products which serves as a benefit to the sustainability of the aerospace and defence sector and a boost of the capabilities available to the marine sector.

New products and services for supply into the boat building sector have been developed to enable local boat builders to build more competitive boats offering improved speed, comfort, range and fuel efficiency.

The project has contributed to the SAMCD group companies having justified the appointment of an aeronautical engineer who will work with the Epsilon team in future boat development projects.

Taylor concludes that applying for AISI support was most definitely a worthwhile exercise and he would do it again. "Marine development in this instance fitted into an aerospace organisation. This was an important initiative to give business in South Africa an opportunity to take on competition and resolve a keystone technology capability, so to speak."

INDUSTRY PARTNER AND COLLABORATOR

- Epsilon Engineering Services

LOCALISATION OF A SHIP BALLAST WATER TREATMENT SYSTEM FOR DISCHARGE OF ENVIRONMENTALLY SAFE BALLAST WATER

Product markets:
Recreational/leisure

Technology streams:
Manufacture components, parts, sub-systems or inputs for the marine industry

Beneficiary:
Cybicom Atlas Defence

Project title:
Ship Ballast Water Treatment (SBWT) System Development

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.



The water treatment system is compact and designed to fit into the limited space available in vessels.

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 of CAD, 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."



Strong skills development



3 SMMEs involved



Even older vessels, retrofitted with the system, will be able to discharge environmentally safe ballast water.

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 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 electro-motive 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 electro chlorination: 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."

INDUSTRY PARTNERS AND COLLABORATORS

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

PROGRAMME 5: COORDINATION, PROMOTION AND AWARENESS

This AISI programme plays a critical role in coordinating information on the aerospace and marine sectors in South Africa. The programme enables the AISI to provide knowledge and insight into the opportunities available in these sectors and to promote industry capability to relevant stakeholders and interested parties through its networks. The AISI's offerings are promoted via the AISI's channels to ensure that **the dtic's** support of the South African aerospace and marine manufacturing industries is well represented at appropriate forums. Through this programme, the AISI also seeks to provide potential beneficiaries with information on application processes to be followed in order to apply for AISI support.

Highlights from the 2021/22 financial year included the following events:

- **SpaceOps Conference:** This was held from 3–5 May 2021. The 2021 edition was held virtually due to Covid-19 restrictions. The conference involved participation from some of the AISI beneficiaries, and was coordinated by the International Astronautical Federation.
- **Marine Webinar:** The first marine webinar was held on Monday, 27 September 2021. The webinar was presented by Albert Richard Bertrand, senior surveyor and auditor at DNV. The webinar had 57 attendees from industry, certification bodies and government. It consisted of an introduction session by Nicolene Roux (AISI) and Bianca Mokuena (**the dtic**). The main topic for the webinar was *Services offered by IACS societies*.
- **Marine Virtual Industry Day:** The AISI hosted a virtual Marine Industry Day on 22 November 2021. The aim of the industry day was to promote the Marine Manufacturing, Maintenance and Repairs, and Associated Services Development Programme through delivering beneficiary testimonials and providing breakout sessions for companies to network. Provision was made for questions to be addressed to the AISI and **the dtic** in relation to the programme and the marine industry in general. The industry day was attended by government organisations, industry stakeholders, accreditation bodies as well as academics. Four Marine Programme SMMEs presented project testimonials to the 65 attendees present, namely:
 - CAD on the SBWT system
 - Nkosi Phendule on *Working in confined spaces*
 - Polyfix on ISO 9001 and 14001 (aligned to ISO 12944-5)
 - AR Jones on IACS welding certifications.
- **Young Professionals Webinar:** The Aeronautical Society of South Africa (AeSSA) Young Professionals Forum continues to serve as an invaluable platform for young professionals

in the local aerospace sector to network and collaborate on technical and career-related matters. The AeSSA Young Professionals webinars are hosted by the AISI, and are associated with the AeSSA annual conference. These initiatives draw on the knowledge and experience of experts in the sector and promote the learning and growth of young professionals in the sector. These webinars and workshops allow people to meet and network ahead of the AeSSA Annual Conference. With workshop themes aligned with 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. Busiswe Nkonki, AISI Economic Analyst, notes that another benefit of the workshops is that they serve as an ice-breaker; they allow “young professionals to support presentations by their peers during the conference and to have access to more senior experts attending the event”.

Nkonki hosted this year's webinar themed *Technologies and skills that will gear up the aerospace industry post the pandemic* on 15 October 2021. Dr Linda Weiland, Associate Professor of Aeronautics at the Embry Riddle Aeronautical University in the US, delivered the keynote address. Sentian Aerospace – a wholly Black youth-owned SMME and beneficiary of the AISI – presented a case study on the development of its Sentian UAV to the 30 attendees. The session was a resounding success.

Nkonki is a huge champion for the AeSSA Young Professionals Network as she believes that 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.

- **Aerospace and Defence Virtual Industry Day:** The AISI hosted a virtual Aerospace and Defence Industry Day on 22 February 2022. A total of 66 attendees participated in the event – a great turnout. The event featured presentations from GrowthMap Informatics, **the dtic** and the AISI. Highlights included the presentation by GrowthMap on the *AISI Effectiveness and Impact Assessment Study* conducted on behalf of **the dtic**, as well as an AISI beneficiary testimonial from Cape Aerospace Technologies.
- **Aeronautical Society Lecture Presentation:** Another of the AISI beneficiaries, Jonker Sailplanes, presented a lecture at the AeSSA Annual General Meeting on 3 March 2022. Jonker Sailplanes' managing director Uys Jonker delivered the lecture titled *The Development Process of a High-Performance Glider*.

In addition, the AISI received media coverage in a number of publications including:

Quarter 1

- The AISI was featured in the May 2021 edition of *FlightCom Magazine*.
- The AISI advertised in the *Manufacturing in Africa* feature in *Engineering News*, Volume 41 No. 20, May 28-June 3, 2021.

Quarter 2

- The AISI advertised in the *Aerospace* feature in *Engineering News*, Volume 41 No. 35 of September 10-16, 2021. The AISI published an article in the same edition titled *Initiative helps companies diversify, mitigate supply shortages*.
- A marine article was published in the *CSIR Annual Report 2020/2021* titled *First small enterprise receive support in drive to increase local content in the marine sector*. The annual report was published on 5 October 2021.

Quarter 3

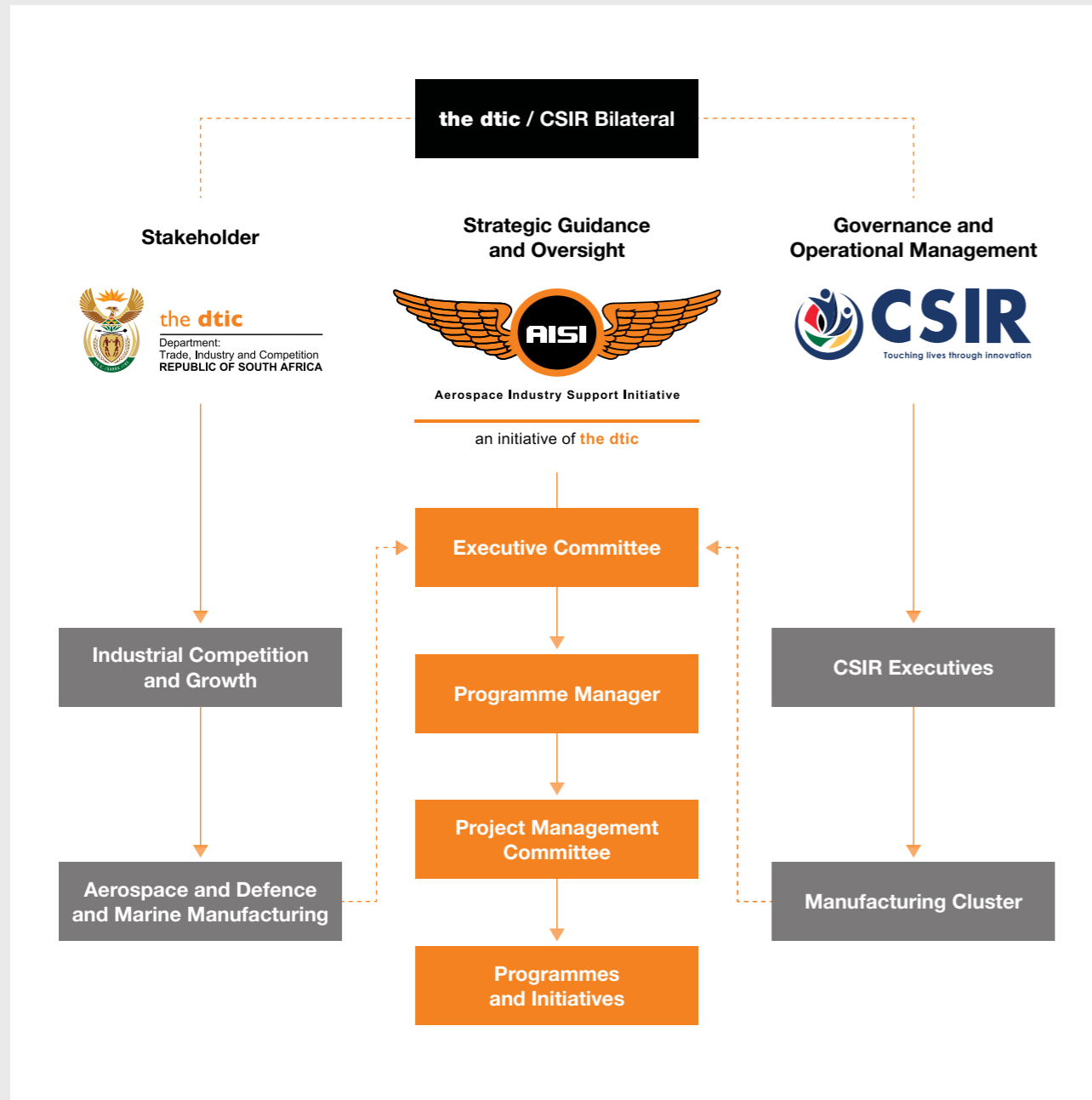
- The AISI programme manager Ms Marié Botha presented at the Manufacturing Enterprise Solutions Association conference on 17 November 2021.
- The AISI programme manager participated in a panel discussion with NASA at GEO Week 2021 on 25 November 2021.
- Local Vredenburg newspaper the *Weslander* published an article titled *Welders Attend Advanced Course* about the AR Jones marine project to certify welders.

Quarter 4

- *Maritime Review Africa* featured the AISI Marine Programme in an article titled *Developing the local marine manufacturing and repair sector* in its 2021 Mini Mag.
- On the 18th of March 2022 an article was published by *Engineering News* in its Water Week edition on the SBWT System Development Project of Cybicom Atlas Defence supported under the Marine Programme.
- An article was published in the *Defence Web* magazine featuring a presentation from an AISI beneficiary, Cape Aerospace Technologies, that presented at the Aerospace and Defence Virtual Industry Day on 22 February 2022.

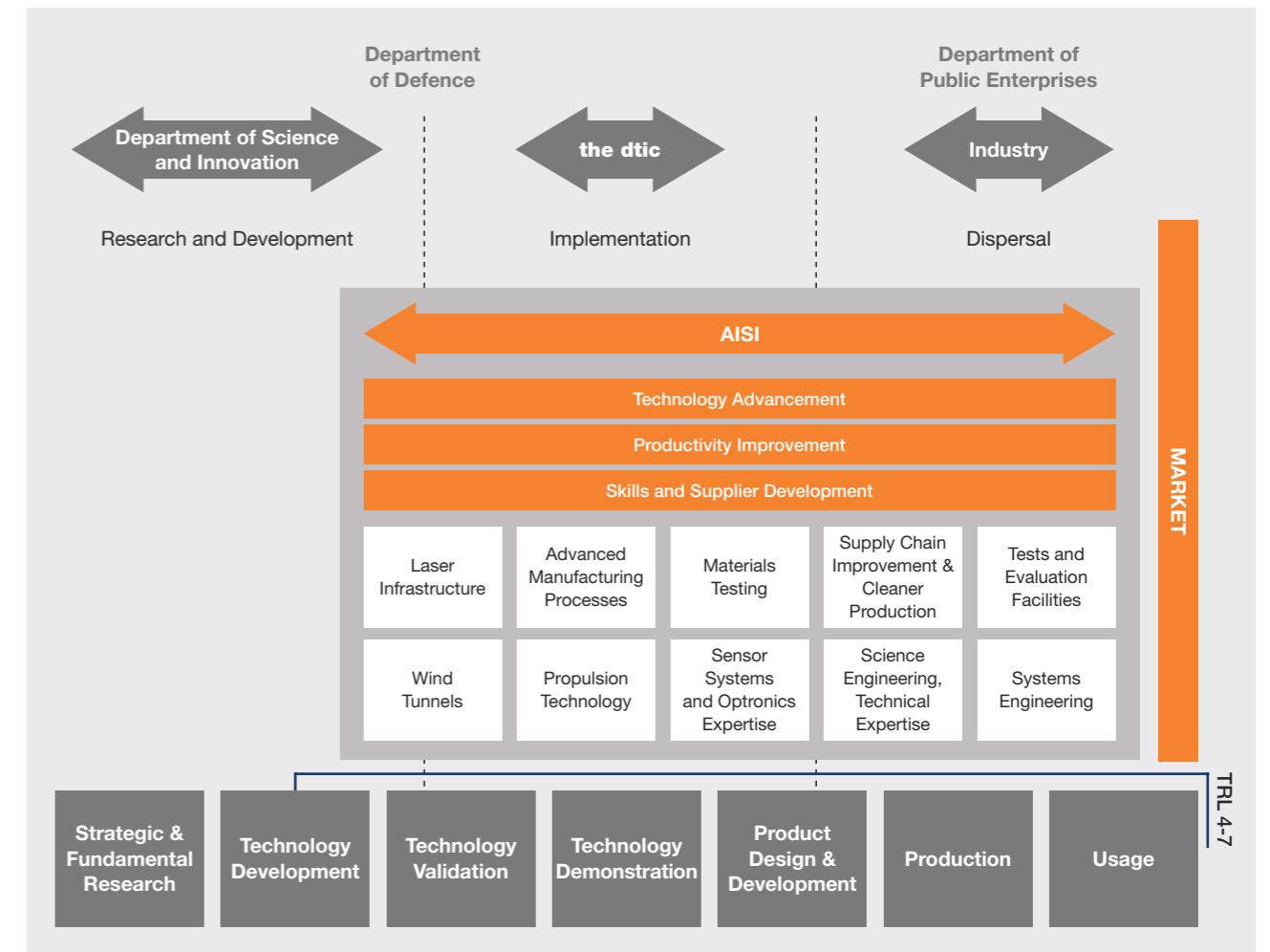
AISI GOVERNANCE

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 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 BENEFICIARY ORGANISATIONS 2021/22

BENEFICIARY NAME	INDUSTRY PARTNERS AND COLLABORATORS (SERVICE PROVIDER)	ORGANISATION TYPE	B-BBEE LEVEL	EXISTING CERTIFICATION/S 2020/21	PROJECT NAME
Aerospace and Defence					
Aero Metals	<ul style="list-style-type: none"> (Vukani Projects) (TÜV Rheinland) 	SMME	2	<ul style="list-style-type: none"> Unknown 	<ul style="list-style-type: none"> ISO9001 implementation and certification
Avior Labs	<ul style="list-style-type: none"> Bovancor Network Solutions Lightweight Structures Technology 	SMME	4	<ul style="list-style-type: none"> Unknown 	<ul style="list-style-type: none"> Low-Cost High Bandwidth UAV Datalink
Cape Aerospace Technologies	<ul style="list-style-type: none"> Jonker Sailplanes CSIR Stellenbosch University 	SMME	2	<ul style="list-style-type: none"> None 	<ul style="list-style-type: none"> 400 N Gas Turbine Industrialisation (Phase II and Phase III)
Cybicom Atlas Defence	<ul style="list-style-type: none"> Bronberg Dynamics X-Sterile Insect Technique FlyH2 Greenfly Aviation 	SMME	1	<ul style="list-style-type: none"> Unknown 	<ul style="list-style-type: none"> The development of an RPAS test platform for aerial release of sterilised False Codling Moth.
Jonker Sailplanes	<ul style="list-style-type: none"> CSIR OnTrack Technologies Kusanii Composites Albatross Fly Nisa Composites 	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 	<ul style="list-style-type: none"> 24m Wingspan Open Class JS
Kutleng Dynamic Electronic Technologies	<ul style="list-style-type: none"> Unknown 	SMME	1	<ul style="list-style-type: none"> None 	<ul style="list-style-type: none"> Chazon Smart Display
LambdaG	<ul style="list-style-type: none"> NewSpace Systems HH-Industries Comatra Stellenbosch University University of Pretoria Aeronet of Things 	SMME	2	<ul style="list-style-type: none"> None 	<ul style="list-style-type: none"> 3D-printed Microwave Sub-Assemblies: Phase III
Luvhone Engineering	<ul style="list-style-type: none"> (Vukani Projects) (TÜV Rheinland) 	SMME	1	<ul style="list-style-type: none"> Unknown 	<ul style="list-style-type: none"> ISO9001 and ISO14001 implementation and certification
Micromax	<ul style="list-style-type: none"> Unknown 	SMME	7	<ul style="list-style-type: none"> Unknown 	<ul style="list-style-type: none"> Beretta Frame Industrialisation Project
NewSpace Systems	<ul style="list-style-type: none"> Casing and pump: StarkCNC, Carbo III, Multi Alloys Mitsubishi Chemical Advanced Materials, Victory Electrical, Festo, Swagelok, Atlas Specialised Fasteners, Magnet Store, Magnets For You Electrodes: Carbo III, Nu World Plating, Metallica Electroplating, A&A Platers, Non-ferrous Metal Works Electronics: MicroRobotics, RS Components Lab supplies: Afrox, Chem Lab Supplies, Aeronetec, Clear Design Display, MCL Monitoring and Control Labs, Industrial Gas Solutions 	SMME	Non-Compliant	<ul style="list-style-type: none"> ISO 9001:2015 ISO 14644-1 European Space Agency Accredited Technicians 	<ul style="list-style-type: none"> Fluid Inertial Actuator (FLIA) Commercialisation
Petrawell	<ul style="list-style-type: none"> Aerospace Systems Research Group (ASReG), University of KwaZulu-Natal (UKZN) Aerosud AMT Composites 	SMME	4	<ul style="list-style-type: none"> Unknown 	<ul style="list-style-type: none"> Filament winding of cryogenic and high-pressure vessels
Production Logix	<ul style="list-style-type: none"> (Aeronet of Things) (ASR Global Certification Services) 	SMME	1	<ul style="list-style-type: none"> Unknown 	<ul style="list-style-type: none"> AS9100 implementation and Certification
Sentian Aerospace	<ul style="list-style-type: none"> Paramount Group 	SMME	2	<ul style="list-style-type: none"> None 	<ul style="list-style-type: none"> Sentian UAV Optimisation
Simera Africa	<ul style="list-style-type: none"> G&R Electronics ItCognify TFASA RoRa Engineering TiTaMED 	SMME	2	<ul style="list-style-type: none"> None 	<ul style="list-style-type: none"> Electro-Optical Stereo Vision Aircraft Approach Tracker
Simera Sense	<ul style="list-style-type: none"> Pink matter Solutions TiTaMed Barracuda Holdings Astrofica Technology 	SMME	4	<ul style="list-style-type: none"> None 	<ul style="list-style-type: none"> HyperScape50 Imager

SUMMARY OF BENEFICIARY ORGANISATIONS 2021/22

BENEFICIARY NAME	INDUSTRY PARTNERS AND COLLABORATORS (SERVICE PROVIDER)	ORGANISATION TYPE	B-BBEE LEVEL	EXISTING CERTIFICATION/S 2020/21	PROJECT NAME
Sparcx	<ul style="list-style-type: none"> CSIR Denel Aeronautics Sysdel - Electronic Warfare Systems (Potential partner) SAAB Grintek Defense 	SMME	1	<ul style="list-style-type: none"> None 	<ul style="list-style-type: none"> Design and Development of a 2-6GHz Digital Instantaneous Frequency Measurement System
Ti-TaMed	<ul style="list-style-type: none"> (Novo Star Management System Solutions India) 	SMME	4	<ul style="list-style-type: none"> AS/EN 9100 ISO 9001:2015 ISO 13485 	<ul style="list-style-type: none"> AS9100 Surveillance Audit
West Engineering	<ul style="list-style-type: none"> (Novo Star Management System Solutions India) 	SMME	8	<ul style="list-style-type: none"> AS/EN 9100 ISO 9001:2015 	<ul style="list-style-type: none"> AS9100 (Aerospace Quality management Standard) Recertification
Marine					
AR Jones Engineering	<ul style="list-style-type: none"> (Eduardo Construction) (Bureau Veritas) 	SMME	1	<ul style="list-style-type: none"> ISO 9001 	<ul style="list-style-type: none"> IACS approved and certified Welding Procedure Specification and Welding Procedure Qualification Record to Class Requirements
Cybicom Atlas Defence	<ul style="list-style-type: none"> ConEquipt Disa Scientific Merieux NutriSciences Laboratory Seapoint Research Aquarium Stellenbosch University Trailers4Shoots Water4All 	SMME	1	<ul style="list-style-type: none"> Unknown Directorate of Conventional Arms Control compliant 	<ul style="list-style-type: none"> Ship Ballast Water Treatment (SBWT) System Development
Dormac	<ul style="list-style-type: none"> (Bureau Veritas) 	OEM	3	<ul style="list-style-type: none"> ERP System – InforLN ISO 9001, 14001 and 45001 	<ul style="list-style-type: none"> IACS approved Welding Certification services
Macc Engineering and Construction	<ul style="list-style-type: none"> (UltraScan Inspection) (Bureau Veritas) 	SMME	2	<ul style="list-style-type: none"> None 	<ul style="list-style-type: none"> IACS Approved Welder Qualifications and Welding Procedures
Polyfix	<ul style="list-style-type: none"> (Corrosion Institute of South Africa) 	SMME	1	<ul style="list-style-type: none"> ISO 14001, SANAS 10177, NACECIP1 CORISA 	<ul style="list-style-type: none"> ISO 9001 (with built in ISO 12944-5 compliance) as well as ISO 14001:2015 Development, Implementation and Certification
Stellenbosch Advanced Marine Craft Development	<ul style="list-style-type: none"> Epsilon Engineering Services 	SMME	4	<ul style="list-style-type: none"> None 	<ul style="list-style-type: none"> Design, Manufacture and Supply of Hydrofoils for Sailing and Power Boats
Sonhar Projects, trading as Ocean Engineering	<ul style="list-style-type: none"> (Offshore Africa Training Centre) 	SMME	3	<ul style="list-style-type: none"> ECSA registration as an LME and 2 LMIs Lloyds Register coding welding procedures (WPS) 	<ul style="list-style-type: none"> Banksman/Slinger and Rigger Certifications
TrewFit Controls	<ul style="list-style-type: none"> (Mining and Surface Certification) 	SMME	4	<ul style="list-style-type: none"> None 	<ul style="list-style-type: none"> IECEX Certification for valve position indicators (Type LSA, LSS and LSB) IECEX QAR (Intrinsic Safety, Dust Ignition Proof) <ul style="list-style-type: none"> Conversion of IECEX certification to ATEX SANAS
Beneficiaries Receiving Support through the AISI Management and Implementation Function					
Astrofica Technologies	<ul style="list-style-type: none"> AISI 	SMME	1	<ul style="list-style-type: none"> Unknown 	<ul style="list-style-type: none"> Technology Roadmapping
Jonker Sailplanes	<ul style="list-style-type: none"> CSIR 	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 	<ul style="list-style-type: none"> Aeroelastic and GVT analysis of the JS2 Sailplane
LambdaG	<ul style="list-style-type: none"> AISI 	SMME	2	<ul style="list-style-type: none"> None 	<ul style="list-style-type: none"> Technology Roadmapping
Motseni Hi-Tech Space	<ul style="list-style-type: none"> AISI 	SMME	1	<ul style="list-style-type: none"> Unknown 	<ul style="list-style-type: none"> Technology Roadmapping
Paramount Aerospace	<ul style="list-style-type: none"> AHRLAC CSIR Photonics Centre: Additive manufacturing and mechanical testing Additive Solutions: Additive manufacturing of parts Simteq Stellenbosch University 	OEM	Unknown	<ul style="list-style-type: none"> Unknown 	<ul style="list-style-type: none"> Design Specification & Qualification of Metal Additive Manufactured Aerospace Parts
Sentian Aerospace	<ul style="list-style-type: none"> AISI 	SMME	2	<ul style="list-style-type: none"> None 	<ul style="list-style-type: none"> Technology Roadmapping
Simera Africa	<ul style="list-style-type: none"> AISI 	SMME	2	<ul style="list-style-type: none"> None 	<ul style="list-style-type: none"> Technology Roadmapping

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The Aerospace Industry Support Initiative has enabled organisations that it has supported to invest in the development of key skills and expertise, new technologies and processes and to acquire certification in core industry standards resulting in improved competitiveness, growth of exports, localisation of technologies and the ability to operate effectively in lucrative markets.

South Africa's aerospace and defence, and marine-related industry has benefitted significantly from the support of **the dtic** through the AISI programme. During the compilation of this Impact Report, positive feedback was received from the benefitting organisations, expressing their gratitude to **the dtic** for establishing this invaluable initiative.

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The aerospace industry in South Africa is a close-knit community with various role-players in the South African National System of Innovation all contributing to the growth and success of the industry. The AISI was able to engage with national government, industry and industry associations, and academia, leading to more impactful outcomes being achieved. The various promotion and awareness activities implemented by the AISI encourage networking and collaboration, and young professionals to actively engage with each other. The AISI is grateful to everyone who actively seeks to collaborate and grow this community.

The AISI wishes to acknowledge the various stakeholders across multiple industries and its technology streams with which it works, and is grateful for the continued support and constructive feedback provided, which ensures that the offerings of the AISI are directed towards achieving the desired impact.

The AISI team is acknowledged for their hard work and commitment in diligently pursuing the achievement of the AISI mandate. The success of the initiative is a testament to the team's dedication to making a meaningful impact in the local aerospace industry.

ABBREVIATIONS AND ACRONYMS

AISI	Aerospace Industry Support Initiative
AM	Additive Manufacturing
ASME	American Society of Mechanical Engineers
ASReG	Aerospace Systems Research Group
B-BBEE	Broad-based Black Economic Empowerment
CEO	Chief Executive Officer
CNC	Computer Numerical Control
DfAM	Design for Additive Manufacturing
DIFM	Digital instantaneous frequency measurement
DNV	Det Norske Veritas
EoI	Expression of Interest
FLIA	Fluid Inertial Actuator
GVT	Ground Vibration Test
IACS	International Association of Classification Societies
IFM	Instantaneous Frequency Measurement
IP	Intellectual Property
ISO	International Organization for Standardization
ITAR	Traffic in Arms Regulations
N	Newton
NSS	NewSpace Systems
OEM	Original Equipment Manufacturer
QMS	Quality Management System
RPAS	Remotely Piloted Aircraft System
SAMCD	Stellenbosch Advanced Marine Craft
SBWT	Ship Ballast Water Treatment
SEDA	Small Enterprise Development Agency
SMME	Small, Medium and Micro Enterprise
the dtic	Department of Trade, Industry and Competition
TRL	Technology Readiness Level
UAV	Unmanned Aerial Vehicle
VTOL	Vertical Take-Off and Landing



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