AEROAFRICA-EU
SA AEROSPACE R&D MAPPING (A03)

The National Aerospace Centre of Excellence
June 2009

			South African R&D Entities			
Key area	**Research and Technology area**	**EU - projects**	**R&D Entities**	**Core Capabilities**	**Infrastructure**	**Research Programmes**
Safety						
	* Accident research		CSIR Built Environment - Passenger Transport Group	Research into passenger transport service design and delivery. Operations research and modelling.		Development and improvement of accident research methods in the Southern African region.
	* Automatic onboard conflict recognition	Fly- safe				
	* Integrated Surveillance System	Emma 1/2				
	* Controller Pilot Data Link Communication (e.g. CPDLC).	iFly project Mediterranean Free Flight				
	* ADS-B (Automatic Dependent Surveillance -Broadcast)					
	* Weather Information Management System					
	* Integrated Situational Awareness (ISAS)					
	* Communications, Navigation & Surveillance (CNS)		ATE Aerospace	International systems house, integrating, developing and manufacturing complete systems. SA R&D focussed on avionics and navigation.	Large development and production facility.	Development and production of navigation systems.
	* Terrain Avoidance Warning System (TAWS)					
	* SMGCS (Surface Movement Guidance and Control System)					
	* Traffic collision avoidance system (TCAS)					
	* ASAS					
	* Autonomous Flight		SUN CoX in Autnomous Flight	Research into aircraft, underwater vehicle and spacecraft control and automation.	Electronic Systems Laboratory. HIL testing. Simulation. Flight testing. Test aircraft. Rate table. Wind tunnel.	Autonomous flight, take-off and landing control of fixed and rotary wing aircraft. Autonomous failure detection and recovery. Autonomous airborne refuelling of Airbus A330. UAV certificaton and regulation.
			Wits MIA	Aerodynamic and structural design. Control systems.	Wind tunnels. CFD. FEA.	Development of an ulatralight aircraft. Other examples of research include flexible wing tips, UAV in-flight refuelling.

			ATE Aerospace	International systems house, integrating, developing and manufacturing complete systems. SA R&D focussed on avionics and navigation.	Large development and production facility.	Development and production of tactical UAVs.
			Denel Dynamics	Development, integration and productiuon of electronic and mechanical defence systems. Relevance in development of UAVs.		
			CSIR Aeronautics Systems Aerostructures Research Group	Aero-elasticity, aircraft modelling and simulation, NDT research, vibration measurement, structures, UAV development.		UAV design and development
			CPUT			
ATM						
		Sesar	CSIR Built Environment - Passenger Transport Group	Research into passenger transport service design and delivery. Operations research and modelling.		Feasability of sky liberalisation in Africa.
		Open Sky (EuroControl)	ATNS	Air Traffic Control. Planning and implementation of CNS systems. Air traffic modelling and simulation.		
			Tellumat - radar systems	Development and manufacture of data communications systems.		
Security						
	* Data Links	**Sesar**	Tellumat - Tactical data, video and audio links	Development and manufacture of data communications systems.		
			Radiant Antenna	Development and manufacture of VHF and UHF antenna and mast systems.		
	* Communication		Cobham	International systems house. SA R&D focussed on avionics and communication.	Certified production facility and 45 engineers.	Development and production of mechanically and phase-steered L-band antennas, and avionics systems. Development and production of satcom and communication systems.
			SUN CoX in Autnomous Flight	Research into aircraft, underwater vehicle and spacecraft control and automation.	Electronic Systems Laboratory. HIL testing. Simulation. Flight testing. Test aircraft. Rate table. Wind tunnel.	Development of modular and integrated avionics. Fault tolerant avionics systems with built-in redundancy.
			ATE Aerospace	International systems house, integrating, developing and manufacturing complete systems. SA R&D focussed on avionics and navigation.	Large development and production facility.	Development and production of avionics systems.
			SAAB Grintek	Airborne HF communication system development and manufacture.		

	* Contraband detection		Mechem	Development of mechanical/chemical technology solutions for defence. Explosives and drug detection technology relevant to civil aviation.		Mechem Explosives and Drug Detection System (MEDDS)
			CSIR National Laser Centre Biophotonics Research Group	Primary focus is development and improvement of various therapeutic and diagnostic medical applications of lasers.	High power laser sources.	THz Photonics for passenger scanning (contraband and weapons).
Enviromental						
	* Service and network design		CSIR Built Environment - Passenger Transport Group	Research into passenger transport service design and delivery.		Efficient and sustainable air transport network design. Operations and business model design.
	* Low emissions combustions	Clean Sky	NMISA	Certification of gas materials. Analysis of trace impurities in gas mixtures.		Feasibility studies for stations for monitoring greenhouse gas emissions.
			UCT Sasol Advanced Fuels Laboratory	Application of synthetic fuels to current and future engine technologies. Fuel and engine based research.	Gas turbine test cell. Emissions monitoring. Combustion visualisation.	Semi- and fully synthetic jet fuel.
	* Sustainable and green engines		CSIR Aeronautics Systems Applied Aerodynamics Research Group	Numerical, experimental and strucutral aerodynamics research. Particularly, turbomachinery design and analysis, energy systems, CFD, and wind-tunnel testing.	Wind tunnels. Turbine test rigs. CFD facilities.	Environmentally friendly civilian aircraft engines - parnter in FP6 project VITAL.
	* Low drag aerodynamic concepts					
	* Low weight structures					
	* High tempertature materials					
	* Engine aeroacoustic					
	* Airframe aeroacoustic					
	* Noise control		Wits MIA Flow Research Unit	Fundamental research into flow phenomena with a focus on unsteady and compressible flows.	Specialised wind tunnels and shock tubes. Visulisation. CFD.	Shock wave dynamics (supersonic flight).
	* Green Rotorcraft					
	* Eco design					
	* Energy management system					
	* Trajectory optimisation					
	* Green Mission planning					
Health monitoring & management						
	* Fault taulerant system					
	* Aircraft condition monitoring systems		SAAB Avitronics	Development of avionics systems, airborne HUMS systems, reconnaissance systems and flight control systems.		

			ANSYS	Development of health and condition monitoring systems for vehicles, buildings and production process plants.		
	* Reconfigurable flight control * Sensor & Data fusion * Distributed sensors					
Innovative design and manufacturing						
			SAAT	SAAT's engineering group does work to address in-service technical problems on aircraft.	Certified NDT facilities. Engine test cell. Metrology and calibration facilities.	
			Centre of Excellence in Strong Materials	Fundamental research into materials with distinctive properties under extreme conditions, including carbon nanotubes, composites, hardmetals, ceramics, diamonds, alloys and new materials.	Network of researchers with access to facilities at a number of institutions.	
			CSIR Aeronautics Systems Aerostructures Research Group	Aero-elasticity, aircraft modelling and simulation, NDT research, vibration measurement, structures, UAV development.		
	* Smart materials		UKZN School of Mechanical Engineering Smart Materials Research Group	Focus on refining and improving properties of smart materials, primarily TRIP steels, for use as structural health monitoring sensors.	Conventional, vacuum casting and heat treatement facilities.	Development of smart bolts for mining and aerospace applications, amongst other smart load sensors.
			SUN CoX in Autnomous Flight	Research into aircraft, underwater vehicle and spacecraft control and automation.	Electronic Systems Laboratory. HIL testing. Simulation. Flight testing. Test aircraft. Rate table. Wind tunnel.	Smart material control surfaces for improving fuel efficiency of Airbus A320.
			CPUT			Piezoelectric smart materials.
			CSIR MSM Sensor Science & Technology	Research and development of smart structures and materials from strategic basic research through to industrialisation.		Piezoelectric actuators and motors.
	* Smart composites		UJ School of Mechanical Engineering		Established optical fibre sensor infrastructure.	Embedded fibre optical sensors in composite materials.
	* Composite materials		CSIR Materials and Manufacturing - Fibres and Textiles	Development and anlysis of fibre and textile based materials. Notable expertise in no woven technology, polymeric reinforcement.		Natural fibre reinforced composites for aerospace industries.

			CSIR Aeronautics Systems Aerostructures Research Group	Aero-elasticity, aircraft modelling and simulation, NDT research, vibration measurement, structures, UAV development.		Development of NDT techniques for composites.
			Wits MIA Reinforced Plastics and Composites Resarch Unit	Experimental and analytical modelling of composites.	Composite laboratory for testing and manufacture of materials.	Examples include residual stresses in composites, environmental degradation, dynamic stress concentration.
			Aerosud ITC - Advanced Composites Research Area	Research into continuous fibre reinforced thermoplastic and thermoset processes.		Examples of work include complex geometry parts and galley components for Airbus A400 and A380.
			SAAT	SAAT's engineering group does work to address in-service technical problems on aircraft.	Composite repair facilities, including large autoclave.	
			UCT BISRU	Analytical, computational and experimental analysis of blast events, including transportation accidents. Materials characterisation and development of new materials.	FEA. High Strain Rate Laboratory with blast and impact test equipment.	Fibre metal laminates.
			ATE Aerospace	International systems house, integrating, developing and manufacturing complete systems. SA R&D focussed on avionics and navigation.	Large development and production facility.	Development and production of composite helicopter rotor blades.
	* Rapid prototyping and direct manufacturing		CUT Centre for Rapid Prototyping and Manufacturing	Focus on development of rapid tooling and rapid manufacture technologies and use of such technology to support research in other areas.	Laser sintering machines; stereolithography machines; vacuum casting facilities; reverse engineering tools.	Development and mechanical testing of direct metal laser sintered titanium lattice parts. Alumide sintered moulds for press tooling in aerospace. Direct manufacture of parts for Aerosud and CSIR preogrammes.
			Aerosud ITC - Direct Manufacture Research Area	Development of methodologies and technologies for DM. Focus on laser sintering.		
			CPUT	Rapid manufacture.		
	* Light metals and metals processing		CSIR National Laser Centre Laser Materials Processing Group	Development of technologies for laser welding, laser metals deposition, laser surface engineering and laser micro-processing.	High power laser sources; robotic assistance; analytical and monitoring equipment.	Laser cladding and welding. Surface modification. of cermaics and intermetallics. 3D laser build up of Iconel alloys. Femtosecond laser micromachining. Partner in Fantasia FP6 programme.
			CSIR MSM Metals & Metals Processes	Reearch and development in metals and alloys, with a focus on light metals, production, processing, and charecterisation.	High pressure casting facilities. Metallurgical laboratory.	Processes for the primary production of titanium. Powder based processing of titanium alloys. Semi-solid metal forming of alumium and magnesium alloys. Casting processes for aerosapce components. Casting of thin-walled structures.
			NMMU			Friction stir welding and laser cladding.

			UCT Centre for Materials Engineering	Development of new metal alloys, polymers, ceramics and hard materials. Fracture mechnics research.	Heat treatment and specimen preparation. Corrosion, wear, and thermal testing facilities.	High temperature platinum alloys for aerospace applications.
			Aerosud ITC - Metal Technology Research Area	Fluid forming of aero metals. Process improvement and development in ultra-high strain or super plastic regions. Robot welding.		Work includes deep drawn aluminium sections, semi-solid fluid forming.
			UL Materials Modelling Centre	Materials modelling.		Computational modelling of precious metal alloys.
			Wits MIA	Modelling of metallurgy and materials.	Materials testing lab.	
			Centre of Excellence in Strong Materials	Fundamental research into materials with distinctive properties under extreme conditions, including carbon nanotubes, composites, hardmetals, ceramics, diamonds, alloys and new materials.	Network of researchers with access to facilities at a number of institutions.	
			Wits/NACoE AMPM	Programme for development of aerospace materials and manufacturing processes, with local and international partners.		Current research thrusts include titanium beneficiation (alloy development, processing, characterisation), Maching optimisation, and materials modelling (turbine and process modelling, life assessment).
	* Morphing technologies					
	* Nano technologies		NMISA			Nanomaterials measurement (emerging area).
			CSIR NCNSM	Design, modelling, synthesis, characterisation and fabrication of nano-stuctured materials.	Hot wire chemical vapour deposition equipment. Laser ablation and arc discharge facilities for highly-aligned carbon nanotubes. Rheomixer for nanocomposites.	Polymer nanocomposites. Silicon nanoparticle synthesis. Carbon nanotubes.
	* Hybrid materials					
Aircraft Design						
	* Aerodynamics and aircraft design		Wits MIA	Aerodynamic and structural design. Control systems,	Wind tunnels. CFD. FEA.	Development of an ulatralight aircraft. Other examples of research include flexible wing tips, UAV in-flight refuelling.
			Wits MIA Flow Research Unit	Fundamental research into flow phenomena with a focus on unsteady and compressible flows.	Specialised wind tunnels and shock tubes. Visulisation. CFD.	Relevant research in aeronautics and aerodynamics.
			UCT CERACAM	Theoretical and computational modelling of structural mechanics and fliud dynamics	FEA. CFD.	
			UCT Aeronautical Research Group	Flight mechanics and applied aerodynamics.		

			Aerosud ITC - Prototype Aircraft Design Research Area	Light aircraft design and prototyping for future product development.		
	* Flight testing		OTB	Flight test range serving local and international customers.	Flight test facilities supported by an array of telemetry, optical and radar systems.	
	* Design and manufacturing		Denel Saab Aerostructures	Design of metallic and composite structures and systems. Static, dynamic, impact analysis.	Accredited manufacturing facilities. Sheet metal fabrication, machining (5-axis HSM). Composites autoclaves and x-ray facilities.	
			Aerosud ITC - Digital Manufacture Research Area	Digital design and verification. CNC programming and optimisation.		Examples of work include parts and wingtip prototypes for Airbus.

Support and Implementation Bodies

Advanced Manufacturing Technology Strategy (AMTS)

The AMTS is a cabinet-sanctioned national strategy of the dst. It relies on collaboration between government, academia, science councils and industry, and currently focusses on the automotive and aerospace industries.

The implementation unit has the following objectives: the development of technology platforms that increase current and create new competitive advantages, the development of smart partnerships to ensure the uptake of South Africa technologies in the global arena, and relevant human capital development.

A number of programmes and initiatives acheive these abjectives. A number of these are particularly relevant to the aerospace industry.

The **Advanced Materials Initiative** (AMI), hosted by CSIR MSM, seeks to develop new and advanced materials for product or process development, develop technologies for the beneficiation of raw materials available in South Africa, and co-ordinate research efforts in relevant fields throughout the country. The **Light Metals Development Network** (LMDN), which includes research entities across South Africa falls under the AMI.

The **Light Materials Flagship Programme** which focusses on developing SA competency and capacity in composites and light metals.

Also notable are the **Advanced Manufacturing Technology Laboratories** (AMTLs), which are facilities that for the design, development and prototyping of new products, and the development and transfer of relevant skills to support industry. The AMTLs facilitate innovation and support entrepeneurs.

National Aerospace Centre of Excellence (NACoE)

The National Aerospace Centre of Excellence (NACoE) is a dti initiative, hosted by the University of the Witwatersrand, Johannesburg. The NACoE seeks to conduct leading edge R&D for the SA aerospace industry, enhancing the competitiveness and sustainability of the industry. Key outputs are new or more competitive technologies, new knowledge, technology transfer and highly skilled human capital. The NACoE will acheive its objectives in accordance with a long term strategy through a multi-disciplinary collaborative effort between government, industry, academia and research institutions.

Current research themes which the NACoE focussses on are Aerospace Manufacturing Processes and Materials (AMPM); Aerodynamics Modelling, Simulation and Control (AMSC); and Aero Design. Future themes include Space, UAVs, Aero Electronics and ATM.

Abbreviations

AMI	Advanced Materials Initiative (AMTS)
AMPM	Aerospace Manufacturing Processes and Materials (Wits, NACoE)
AMTL	Advanced Manufacturing Technology Laboratory (AMTS)
ATNS	Air Traffic and Navigator Services
BISRU	Blast Impact and Survivability Research Unit (UCT)
CERACAM	Centre for Research in Applied and Computational Mechanics (UCT)
CoX	Centre of Expertise in Autonomous Flight (SUN)
CPUT	Cape Peninsula University of Technology
CRPM	Centre for Rapid Prototyping and Manufacturing (CUT)
CSIR	Council for Scientific and Industrial Research
CSIR MSM	CSIR Materials Science & Manufacturing
CSIR NCNSM	CSIR National Centre for Nano-structured Materials
CSIR NLC	CSIR National Laser Centre
CUT	Central University of Technology
DSG	Dynamic Systems Group (UP)
the dst	Department of Science and Technology (South Africa)
the dti	Department of Trade and Industry (South Africa)
ESL	Electronic Systems Laboratory (SUN)
ITC	Innovation and Training Centre (Aerosud)
LMDN	Light Metals Development Network
MIA	School of Mechanical, Industrial and Aeronautical Engineering (Wits)
MTRC	Manufacturing Technology Research Centre (NMMU)
NACoE	National Aerospace Centre of Excellence
NMISA	National Metrology Institute of South Africa
NMMU	Nelson Mandela Metropolitan University
SAAT	South Africa Airways Technical
SUN	Stellenbosch University
UAV	Unmanned Aerial Vehicle
UCT	University of Cape Town
UKZN	University of Kwazulu-Natal
UL	University of Limpopo
UP	University of Pretoria
Wits	University of the Witwatersrand