EDITORIAL – Towards all electric powered flight

Like electric cars, the holy grail of the power source for aircraft is to be able to go all electric, with the efficiencies this brings as well as the resulting environmental impact improvements. It’s one thing to achieve electric power within the framework of the two dimensions of the road, entirely another in the air.

Airborne electric vehicles represent the most challenging environment for energy storage due to the increased need for reliability and lower weight, when compared to the simpler systems employed in electric cars. The power profile of electric aircraft is also more challenging than electric cars due to the extreme temperature variations as the aircraft climbs and the high power requirements during takeoff.

Developments in the full size electric powered flight arena are increasing, building on the successes emanating from the model flying fraternity, scaling up of course brings on whole new set of challenges. Larger UAV’s are also starting to appear with electric power options, but these tend to be in specialist roles.

The latest in achieving all electric powered flight is the Solar Impulse, which is a long range solar powered aircraft, developed at the École Polytechnique Fédérale de Lausanne in Switzerland. The project eventually hopes to achieve the first circumnavigation of the Earth by a piloted fixed-wing aircraft using only solar power. The project is led by Swiss psychiatrist and aeronaut Bertrand Piccard, who co-piloted the first balloon to circle the world non-stop, and Swiss businessman André Borschberg.

The first challenge in preparation for the full circumnavigation was the flight coast-to-coast across the USA, successfully completed on 6th July this year touching down at JFK. Solar Impulse cruises at 30,000ft (9,150m), and the complete 5,650km trip from San Francisco's Moffet Field took 105h 41min at an average speed of 28.8kt (53.3km/h).

A remarkable flight, partly flown at night on battery power alone, with the sun recharging during the day. The circumnavigation flight is scheduled for 2015 in a 2nd aircraft.

Solar Impulse – on the approach to JFK
The AeSSA’s enters a new Presidential Term
By Prof. Laurent Dala & Rob Jonkers

On the 29th May 2013, at the AGM of the AeSSA held at Denel Dynamics, Prof Laurent Dala was inaugurated as the next AeSSA President, taking over the helm from Rob Jonkers who has had the privilege of having completed a second Presidential term of office, and has so far served 8 years on council. Prof. Dala brings with him a wealth of Society experience from his tenure on various committees at the Royals in London, and will for sure bring a new dynamic to the society in the years to come.

The AGM afternoon started off with formalities of council member nominations and the treasurer’s report with a confirmation of the audited accounts for the 2012 book year, thereafter Rob provided an outgoing presidential speech, and introduced Laurent as the new president.

There were two student bursary assistance awards made for the best students who entered the essay competition, the winners were Carla Ubbink & Oscar Nouwens, both from UP.

After the AGM, Des Barker gave two very insightful lectures on General Aviation Safety and the fickleness of judgment in the low level display arena.

The council for the next term has the following members:

Prof. L. Dala (President)
Prof. A.J. van Wyk (Vice President)
Ms. K. van Breukelen (Hon. Treasurer)
Mr. G. Jansen van Rensburg (ECSA Rep)
Mr. G. Corderley
Mr. J. Monk
Mr. C. Butler
Lt Col. D.L. Frank ( SAAF Liaison)
Mr. B. Gerryts
Captain S. Poprawa

Mr. R.P. Jonkers (Immediate Past President)
Mr. H. Torlage (Hon. Secretary)
Mr. G. Snedden
Prof. J. Meyer
Maj Gen (Retd). W. Thackwray
Dr. A. Nelson (Western Cape Regional Chair)
Mr. D. Loots
Mr. D. Matthee (Flight Test Society)
Lt Col. R. Powrie (Western Cape)
Mr. K.P. King
Prof. Dala welcomed the audience with an incoming presidential speech, which is given below:

I would to express my deep gratitude to all my Peers for giving me their trust as the new President of the Aeronautical Society of South Africa. When my wife and I decided to move to South Africa two years ago, I did not expect to be today, in front of you talking about South African Aerospace. Maybe, you only wanted to create a bilingual AeSSA Council…..

For me it is a privilege, as a non-South African Aerospace Engineer to chair the Council for the next two years. I will try to do my best, at least to achieve the standard set by our former President Rob Jonkers.

Before talking about future initiatives, I wish to point out the huge achievements of our former President to sustain and develop the AeSSA in a very difficult economic situation for our Aerospace Industry, Research and Development Institutions. Rob did it not only using his technical knowledge, but also using his skill in managing people. The Initiatives highlighted by him do not need any more comment. I am glad that Rob will still be the Immediate Past President of the AeSSA. It will make my life easier.

The Aerospace (Aeronautics and Space) Industry is a global business. South Africa has got huge knowledge and capability to compete at the highest level in this market. I will just point out few examples such as UAV’s, Missiles, Systems, Manufacturing and Integration. Industry, Research Centre and Academia are in a phase of consolidation, as the Joint Aerospace Steering Committee proves it. The Aeronautical Society of South Africa has got a key role to play in this consolidation of our Industry, Research and Development Institutions.

As incoming President, I would like to highlight some of the initiatives that I would like to suggest to the Council and to the rest of South African Aerospace Partners. Some of the initiatives will be a consolidation of the existing events:

- The annual IASSA symposium will continue to be organized under the leadership of Karen van Breukelen. We will try to keep the balance between the Cape Region and the Gauteng Region. We will work on the budget to bring more sponsorship from South Africa, but also from abroad. In order to secure outside sponsorships, we will propose to dedicate the first part of the conference for specific technical topics such as Space Development.

- The Council will also arrange mini-conferences not only in the Gauteng Region, but also in the Cape and Durban Regions. I can already announce that Dr Askin Isikveren, Head of the Visionary Concepts, from the Bauhaus Luftfahrt in Munich (Germany) will be in Pretoria in November 2013. He has agreed to deliver seminars on Multi-Design Optimization and New Concepts. Furthermore, Professor P. Chinesta, EADS International Chair on Advanced Modelling of Composites and Manufacturing Processes, has requested to organize a technical symposium in 2014 in South Africa to meet our specialists.

- Following the success of the Intervarsity Model Aircraft Challenge under the guidance of John Monk, the Council will try to attract and keep new participants such as the University of Stellenbosch, CPUT and TUT.
The influence and the durability of the AeSSA will depend on the young members we attract. The Council will keep working to recruit new young members and will work to keep them. For that, I would like to propose to organize every year a one day Aerospace Fair in the Gauteng Region, the Cape Region and the Durban Region, involving all the aerospace players (Industry, Academia, and Research). The Council will also work on a support from the DTI, DST and DHET.

The links with the Royal Aeronautical Society must be strengthened, in keeping our South African Specificities. The AeSSA Council has managed to secure a Special Edition of the Aeronautical Journal dedicated to South Africa. So far, it is a success and the Council should be able to submit more than 14 technical papers by November 2013. The AeSSA Council would like also to propose a seat for a Space Representative in order to support Space Sciences Development, not only in South Africa, but also to find partnerships abroad. The Council will suggest getting a seat with some specialist groups, such as space, flight mechanics and control at the Royal Aeronautical Society in order to be informed about the business in Europe.

As Rob pointed out, we have had excellent support from our Corporate Partners. BUT we will work getting more Corporate Partners. We will start to investigate our partners from the BRICS Countries. The AeSSA could and should be the support for common collaborations between each other.

In order to promote our Aerospace Industry, Academia and Research, we would like to edit (every two years) a book providing all the details for each company, university and so on. This book will be fully supported by ad inserts. This book will be used to advertise our successes and our capabilities.

The Awards and Grants provided by the AeSSA Council will continue, but the criteria will be reviewed in order to maintain the requirements of the Aerospace Industry. The role of the Aeronautical Society is to motivate young talent and to make sure that they will stay in our Industry. The council will apply for an annual PhD Grant for a South African Student from the Royal Aeronautical Society.

In my dream, I would like to see the Aeronautical Society of South Africa with the main South African Key Players in the Business to be part of the Paris Airshow in order to promote our Industry and Know-How. It might be a huge step, but without any dream we cannot move forward.

In closing, I would like to use Rob’s words: I want to express my heartfelt gratitude to all the AeSSA Council members, without forgetting our administrative colleagues, Esther Torlage and Yvonne Raman for their confidence.

I will do all my best to respond to your confidence.

Outgoing President Rob Jonkers
Aircraft Fleet Selection - how does one work out which plane is best suited to an airline's needs?

By Captain Stefan Poprawa

Captain Stefan Poprawa is SAA's Chief Technical Pilot and Head of Flight Technical & Maintenance Standards. As such he has vital input into SAA’s hugely important decision as to which aircraft to buy for the much needed and delayed update to its long haul fleet:

Have you ever wondered why one airline orders one particular type or group of aircraft whilst the airline “next door” orders from the other manufacturer? After all, depending on who one asks, it is clear that the Company B product is the only possible solution. Or was that Company A?

The process of aircraft selection starts with the airframe manufacturer itself, with an assessment of what the world’s airlines require in terms of range and payload. Very soon they discover that it becomes impossible to develop a “one size fits all” aircraft to cover the complete spectrum. Wide-body aircraft, for instance, are needed from short people mover routes to ultra-long range 18 hour routes, from 800 seats to 200 seats and any conceivable combination in-between.

Whilst it is possible to develop a family of aircraft, the scope here is limited. Every time one deviates from the base model, shortening or extending the range and / or the fuselage, such derivatives becomes less efficient than the base model.

The airframe manufacturer is thus forced to identify a target market where he expects to place the most aircraft. This process requires a crystal ball to predict market trends and growth rates twenty or more years into the future. Designing an aircraft typically takes around seven years.

When market trends changed from point-to-point to hub-and-spoke services the range and payload requirements for aircraft as well as the mix between single-aisles and wide-bodies shifted substantially. Of late, with hubs becoming saturated, there is a partial shift back to point-to-point services concurrent with a drive towards larger capacity on the trunk routes. For many airlines this implies a need for two different aircraft families.

With the target market identified, the airframe manufacturer now has a range bracket and a payload bracket within which the aircraft needs to be designed. Constrained by the available technology, in particular engine capability, he is challenged to design an airframe that has the economics to cope with the ever increasing costs, particularly of fuel, and the ever decreasing yields, in real terms, that airlines struggle against.

Close cooperation with engine manufacturers is crucial here as the biggest fuel burn improvements currently are achievable through advanced engine technology, rather than further aerodynamic fine tuning.

The airframe manufacturers don’t always get it right either, as the 747SP and the A340-500 attest.
Sadly, but unavoidably, no single aircraft design will ever perfectly fit an airline’s needs, even with the narrowed down target market. The very large airlines and leasing companies might get close, though, by being able to influence the airframe manufacturer by virtue of their buying power. Thus when Steven Udvar Hazy of the International Lease Finance Corporation first saw Airbus’s designs for the A350, he said it was too narrow and sent them back to the drawing board. Airbus then widened the fuselage and called it the A350 XWB – (for extra wide body).

When an airline decides to renew its fleet, the process is initiated by inviting the airframe manufacturers to present their product, whether in-service or on the design board. Prior to that, though, the airline gazes deeply into its own crystal ball, trying to establish the shape of its future route network and the expected payloads and frequencies on such routes. This establishes the desirable range bracket, payload requirements and fleet size. This is best illustrated graphically:

![Graph showing payload vs range for different aircraft designs](image)

Shown here schematically are two different aircraft designs, one with a higher payload but shorter range capability than the other.

To recap, typically no aircraft type is capable of carrying full payload and full tanks simultaneously. Payload is initially restricted by the maximum zero fuel weight capability of the aircraft, an airframe structural limitation, until the combination of payload and fuel requirements reaches the maximum take-off weight, which is the aircraft (airframe plus wings) structural limitation. Beyond the maximum range at maximum payload point, the payload capability reduces to enable longer range flight, as illustrated.

Superimposed on the payload capabilities versus range graphs is the airline’s route network requirement. The schematic can take any shape. In this instance it reflects a combination of higher
payload requirements on shorter range routes with lesser payload requirements on the longer routes, somewhat representative of the SAA network. One of SAA’s current challenges arises from its largest capacity aircraft, the A340-600, also being the aircraft with the longest range.

In this illustrated example, aircraft type X is fully capable of meeting the airline’s payload requirements on the longest routes in the network, but is unable to provide fully for the high density shorter range routes. Passenger spillage will likely occur.

Conversely, aircraft type Y has some excess payload capability on the high density shorter routes, but falls short of providing for the long range route requirements. Excess capacity, though, results in extra aircraft weight carried around permanently which remains unused, but incurs costs.

Clearly neither type’s capabilities perfectly match the airline’s needs. Now what?

The only way to fully establish which of the types more closely match the airline requirements is to do scenario planning, letting each type ‘fly’, on paper, day-by-day each route with the projected payloads over the period the aircraft is expected to be in-service at the airline. Leases of new aircraft typically stretch over ten to twelve years, so one soon ends up ‘flying’ tens of thousands of flights. Of course, such an analysis can only be as good as the underlying assumptions.

Such analyses then necessarily need to feed into financial models to not only determine the potential profitability, but to also closely track cash flows. It is possible to be profitable yet run out of cash, thus becoming technically insolvent.

Thus, it can never be a clear-cut up-front decision that one aircraft type or family is better than the other. Rather, there is a place for all aircraft types that provide good operational efficiency within their design range, and airlines make different choices according to their needs.

Some airlines might even select more than one family of aircraft, even though they might seem closely matched. There are airlines that have ordered both the 787 and the A350 XWB, as their route network is such that both types can play an optimized role. Of course, that has other difficulties / costs associated with it: reduced operational flexibility, extra training, different spares sets, etc. Generally, this is less of a problem for large airlines with sizeable fleets, but smaller airlines can get hampered here.

Cabin layout becomes a crucial component of the analysis. Providing extra leg room might allow one to charge a premium depending on what the competition offers, as well as the price sensitivity of the target market. Flying ten abreast versus nine abreast, for example, substantially changes the aircraft economics. But would the target market accept a ten abreast configuration for a sixteen hour flight? Also, what is the right mix of business versus economy class? Will the configuration requirements change substantially over the ten or twelve year period? A fleet cabin reconfiguration easily costs hundreds of million Rand.
Price naturally also plays an important role, which is why airlines virtually never pay the list price for their aircraft. The amount of discount an airline or a leasing company can command is largely driven by its purchasing power and number of aircraft to be ordered, but can also be strategically driven by the manufacturers attempting to establish a foothold or even dominate a region. As the costs of wide-body aircraft run into hundreds of million USD, even when discounted, financing such capital outlays detracts significantly from the bottom line profitability of any new aircraft fleet.

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<th>AIRBUS PRODUCTS</th>
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Source: Flug Revue March 2013
2013 List Prices in Million USD

Availability of delivery slots plays a further role in this process. Aircraft X might turn out to be the better choice in the illustrative example above, but what good does that do if the aircraft is only available in ten years' time when the need to replace a fleet that has become inefficient needs urgent replacement?

I hope the discussion above has provided some high level insight into the complexity of aircraft selection. Naturally, there are various other contributing factors, but the process is exhaustive because they are multi billion Rand decisions that can seriously affect the success of the airline for many years to come.

![Aircraft Image](image-url)
First Flight of the Airbus A350

Airbus’s latest airliner design, the A350 XWB, carried out its maiden flight from Toulouse on the 14th of June 2013. Known as MSN1, it took off at 10 am SA time, and flew for around 4 hours. It carried a crew of six, two flight test pilots, and four flight test engineers. This first flight evaluated the basic handling characteristics with undercarriage lowered as well as retracted with various flap settings.

Throughout the flight, data was transmitted to engineers on the ground in the Airbus telemetry room. MSN1 was accompanied by a chase plane throughout its flight which filmed the jetliner through its various phases.

The flight test programme for the A350 will involve five aircraft and some 2 500 flying hours. This will result in the aircraft’s certification and entry into service, expected to be around the second half of 2014 with the first customer being Qatar Airways.

The A350 XWB can be described as an “all-new midsize long range” aircraft which will come in three versions the -800, -900, -1000, with seating capacities – assuming typical three-class cabin layouts – of between 270 and 350 passengers. The airframe is mainly made from composites (53%), with aluminium and aluminium-lithium (20%), titanium (14%), steel (7%).

The A350 programme has significant South African involvement. The CSIR has been involved in performance characterisation R&D, Aerosud has two manufacturing packages, one for primary structure composite thermoplastic frame clips fitted to the fuselage barrel, the second known as trackcans that house the mechanism for the slats on the wing leading edge, and Cobham SA that manufactures the satellite communications antenna.
The future role of the South African Aerospace Industry and my role in it
An essay for The Aeronautical Society of South Africa by Carla Ubbink – winner of the Student Bursary Assistance award – University of Pretoria

Looking at the global picture, the focus of aerospace is on a few main issues ranging from designing more ecologically friendly aircraft to developing new materials. South Africa has a role to play in the future of global aerospace, but in order to succeed, we must ensure that a few key factors are in place.

This essay will focus on the prerequisites necessary for aerospace development, discuss the current and future developments in aerospace, and lastly, discuss the role that I wish to play in these developments.

Development is only possible if suitable resources are available. These resources include expertise, materials, prototyping and testing facilities, and most importantly, funding. In the past, South African aerospace development was mainly possible due to government funding. For development to be sustainable, the aerospace industry should start to wean itself from government dependency. Politicians want a quick return on their investment, much quicker than aerospace generally can provide. This is not to say that government will and should not provide funding, but the feasibility of the industry should not rely on government incentives.

Globally, funding can be tackled in two ways. Firstly, the answer for aerospace development lies in larger corporations that are able to build up enough capital from core businesses to fund their research and development. In the United States, companies such as Boeing and GE are able to fund their research and development with their successful corporate activities. Their corporate activities then become more successful, and more funding becomes available. Secondly, and possibly more importantly, especially with government funding, global partners must be identified and established to take on bigger development projects.

The solution to weaning ourselves from government funds in South Africa lies in the manufacturing of parts. For a very long time, South Africa has mined and exported resources only to import the finished product. By not also contributing to the refining of products, South Africa misses loses its share in an industry. The statement should shift from "What is South Africa’s role in aerospace?" to "What is the role that aerospace can play in South Africa?" Manufacturing does not only give rise to a bigger industry, more capital, and job creation but it develops local skills. All of these aspects boost the economy and provide the necessary ingredients to ignite later development and innovation.

Furthermore, for larger initiatives, South Africa should identify and build relationships with global partners. This holds countless benefits. Capital costs and expertise are shared between countries and most importantly, as with the Eurofighter Typhoon, the client buy-in is ensured from the start.

The future of civil aerospace lies in a few key fields, which all boils down to more ecologically friendly and efficient aircraft. The first field is aerodynamic and airframe design. In future, civil aviation will move away from the tube and wing design, and look to newer concepts such as blended wing bodies. The second is investigating new materials, defining their properties and exploring the different applications that these materials could have. Newer materials and manufacturing methods can also have an impact on the strength of current materials, and manufacturability. And finally, there is a focus on innovating cleaner, lighter and more versatile propulsion systems.

Defence aviation focuses on a whole host of different aspects, of which unmanned aerial vehicles currently receive the most attention. In terms of aerospace, South Africa is extremely capable and could potentially play a large role in tackling the main focus of the industry. In terms of expertise and
facilities. South Africa is well placed. We have elaborate sets of wind tunnels, and recently, we have had the expertise to pull off an entire Rooivalk design. Currently, we are not stagnating and in the field of materials, Aerosud and CSIR are developing brand-new titanium manufacturing methods.

Now it could be asked, what role do I see for myself in all of this? I realise that before I can start making a meaningful contribution, not only to the field, but also to the industry, I would need to gain more knowledge and experience. Because I am extremely interested in research and tremendously enthusiastic about aerospace, I intend to pursue graduate studies in aerospace engineering. In the past year, I have realised that I have a talent in meeting and building connections with different people. Ideally, I would be able to further my studies at an international university with a diverse student body. I would like to go back to MIT’s Aeronautics and Astronautics Department. Because of the diversity, a place such as MIT is enormously beneficial in building international links.

Academic work, however, remains my priority and graduate studies would ideally relate to computer simulation in either structures and materials, or fluid flow and propulsions. Research fascinates me, and while at MIT, I spent time working with a structural simulation research group. I have never realised how much there is that we as humans do not know and it excites me that we can spend time looking for meaningful answers. As I have a bursary with the DPSS of the CSIR, after graduate studies, I would be able to apply the knowledge that I attained during my studies to do further research in an aerospace-related field. Not only is my hope that I will make academic contributions to the field, but that I will be able to make large contributions to the industry.

To conclude, not only must South Africa play a role in the global aerospace industry, but the aerospace industry must play a role in South African economics. The future role of South Africa in the global aerospace industry will not only be to innovate and develop, but also to manufacture and refine. South Africa must, however, ensure that enough emphasis is put on long-term investment and development and South Africa should not underestimate the power of international collaboration. In this, I hope to help build international links, make a worthwhile contribution to the field, while never neglecting to see the global picture.
FORTHCOMING EVENTS

The Intervarsity model Aircraft Challenge to be held at AFB Swartkops on Sunday the 20\textsuperscript{th} October 2013.

Join in an afternoon of fun while students try out their hard thought out designs to fly a 4 leg pylon race, it’s all about design efficiency and the optimum configuration.

The Flight Test Society of South Africa is planning to hold a symposium on the 25\textsuperscript{th} July 2013, and will cover the following topics:

- Flight Testing the Oryx, Project Drummer Upgrade – Graham Roughton
- The Cheetah – Life after the SAAF – Ivan Pentz & Derrick Matthee
- AC313 & 311 Helicopter Envelope Definition and HV Diagrams – Petrie van Zyl
- Challenges in Developing a Platform Based Instrument Approach for the Gripen – Charl Coetzee
- Panel Discussion, Test Pilot Ratings with the CAA

The run up to IASSA 2013 is in full swing, abstracts have been submitted and the programme is being developed. Registrations are now also open, details to be found on the website www.iassa.org.za. Please advertise to colleagues and acquaintances.

IASSA 2013 will take place at the Lord Charles, Somerset West, on 2 & 3 September 2013, and will take place in conjunction with the ICAS (International Council for Aeronautical Sciences) Planning Committee meeting and workshops.