THE MAGAZINE WITH INSIGHT
BUSINESSFOCUS

EVIATION
PUSHING THE ENVELOPE

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EVIATION IS DOING MORE THAN DEVELOPING AN ELECTRIC PLANE. THEY COULD CHANGE THE VERY NATURE OF THE FLIGHT.

PUSHING THE ENVELOPE

PROJECT MANAGED BY: TIMOTHY GARWOOD

"Getting talent on board is a unique effort we are investing in continuously. We have been blessed with a great story, a plane that will change travel," says Omer Bar-Yohay, the CEO of Eviation. "People want in on that even if you can't pay what the giants of Silicon Valley pay. But the other side of the equation is they need to feel they are doing something significant that pushes the envelope."

Pushing the envelope is an appropriate phrase. While it might conjure images of letters being slid across desks, the phrase has its roots in the aviation sector, where test pilots would push the atmospheric "envelope" of planet Earth. It means to test the limits, to try things nobody ››

›› **In Paris, Eviation Christens a New Era of All-Electric Aviation with the Debut of its Commercial-Scale Alice Plane**

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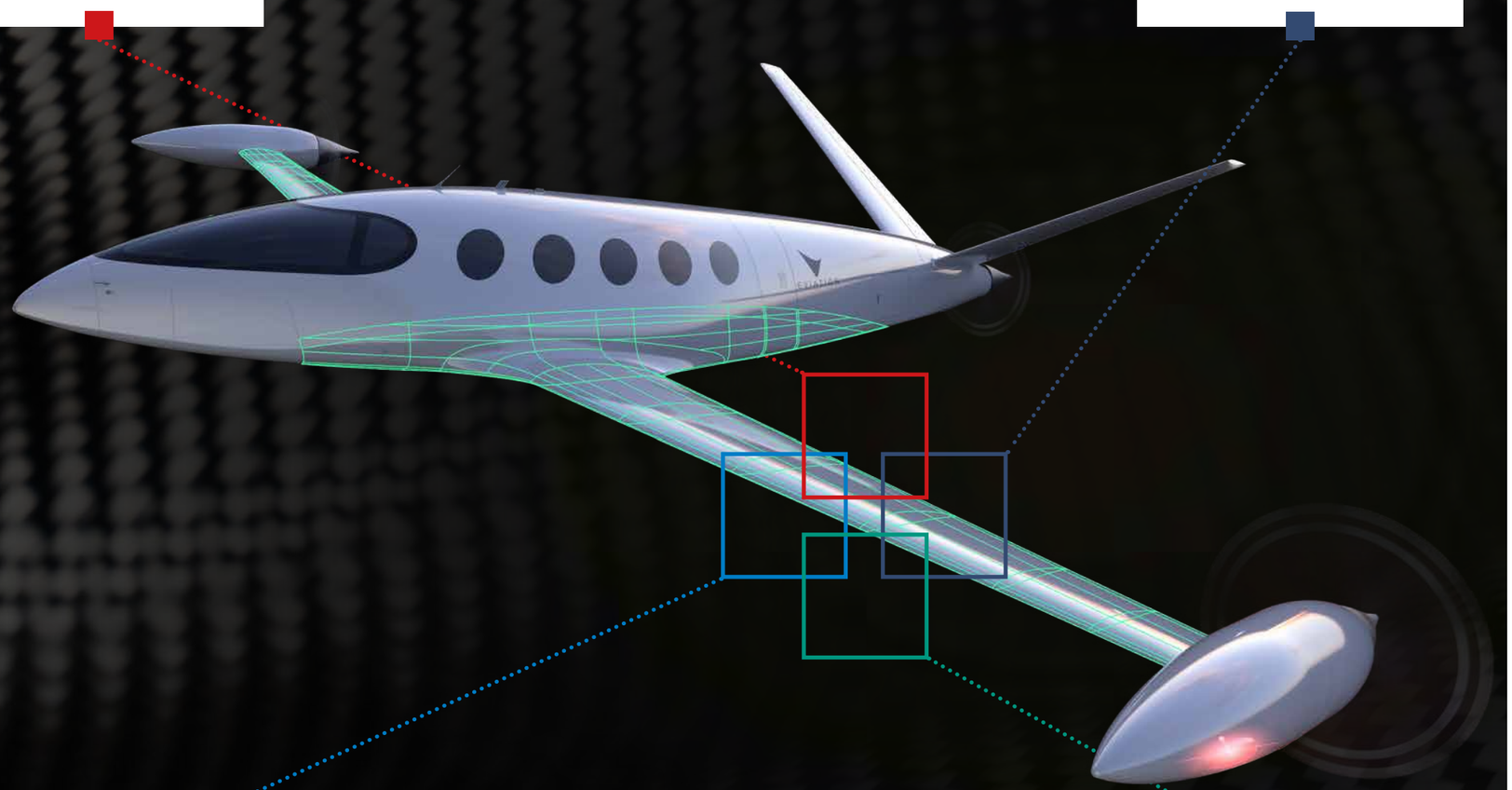

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Fraunhofer IGCV

Paving the Way.

For the future of highly automated composite manufacturing technologies..

igcv.fraunhofer.de

Four partners...

...one goal

To design the wing of the aircraft, an international team of four partners from Europe and Asia worked closely together to bring this ambitious aviation object...

"...FROM INCEPTION TO FINAL PRODUCTION IN A RECORD-BREAKING PERIOD OF 9 MONTHS"

A revolutionary project like the Eviation Alice allelectric commuter airplane places the highest demands on all companies involved in its design and manufacturing.

This is the story of four partners across two continents: two companies from Singapore, one German company and one German research institute, who were able to accomplish extraordinary work to design and manufacture the Alice wing regardless of language, borders, or time zone.

The individual team members working on this project hail from more than ten different countries.

"THIS IS GLOBALIZATION AT ITS BEST"

BUILDING ALICE'S WINGS

ZERO-EMISSIONS AIRCRAFT EVIATION ALICE IS READY FOR THE SKY IN RECORD TIME THANKS TO INTERNATIONAL TEAMWORK AND COLLABORATION

Introducing the four partners:

COMPOSITE CLUSTER SINGAPORE

Composite Cluster Singapore (CCS) is the prime contractor for this project. The CCS team, consisting of engineers, project managers and researchers is specialized in fibre composite technology, with aviation being one of several application areas.

CCS was responsible for the project management, technical coordination between partners and team disciplines, and streamlining design products for the manufacturing phase. Those latter activities revolved around the production effort: moulds & jigs design, preparation of detailed manufacturing instructions, on-site manufacturing engineering support, etc. Its engineers were actively involved in the design effort, with several features of the Alice wing originating from the CCS team, especially at the transition to the fuselage.

CCS and two other partners of the project (Fraunhofer IGCV and Admiralty) are part of the Composite Application Center (CAC). CAC, spearheaded by CCS, is a Singapore based consortium of companies covering the full spectrum of composites solution, and aiming to foster the development of advanced composites locally and globally. The Alice wing was the first successful project undertaken by partners of the CAC. The experience acquired from it ensures a bright future for similar joint endeavours within the consortium.

"Expertise and Partnership"

Composite Cluster Singapore (CCS) is specialised in engineering services related to advanced composite materials. Involved in all the aspect of advanced composite products development, our core activities range from structure design engineering to prototype manufacturing, including but not limited to numerical analyses, processes automation, MRO operations or business support.

Fostering innovative technologies development, our mission is to become a regional competence centre to enable local and overseas customers for global markets. Working with partners from several industries (aerospace, automotive, oil & gas, etc.) has enabled us to be versatile and adaptive, tailoring engineering services to every project in order to bring the most of what composites can offer.

KASAERO GMBH

Stuttgart-based Kasaero brings a strong theoretical foundation and years of practical experience in developing cutting-edge, high-performance aircrafts and aircraft components. From engineering studies, to fabrication and construction, to final testing and certification, the Kasaero team is comfortable and ready to take on the most demanding projects.

For the Alice aircraft, Kasaero took the technical lead on the wing structure design, including product data management and specifications for manufacturing engineering. The Kasaero team provided solutions for the basic structure, detail design, stress calculation, tool design, and material specifications. At the same time, Kasaero developed and coordinated the structural interfaces to the adjacent aircraft components including the fuselage, engine nacelles, landing gear, and other systems. Kasaero's flight-critical quality system and good manufacturing practices are a testament to responsible engineering and breakthrough results.

"We are passionate about creating aircraft for take-off"

From research and development to hands-on prototyping and testing, creating aircraft is our thing. Within all fields of aircraft design, we consider fibre composite technology as one of our strongest suits.

Kasaero draws top talent from one of the foremost aeronautical engineering departments in the world, the University of Stuttgart Institute of Aircraft Design (IFB). IFB is well-known as one of the Idaflieg centres, which combines academic learning and intensive practical hands-on projects. It is also home of the e-Genius, a winner of the 2011 NASA Green Flight Challenge sponsored by Google. The $1.65 million purse is the largest aviation prize in history. The e-Genius has gone on to set many records and gather countless accolades.

The Kasaero team combines their know-how of extremely light-weight construction with experience in designing, analysing, and certifying aircraft. With our knowledge in the field of aeronautical engineering and our experience in aircraft manufacturing, our team supports projects in aircraft design, aerodynamics, lightweight design, and composite technology from the initial concept to type certification and series production.

THE GERMAN FRAUNHOFER IGCV

The German Fraunhofer IGCV, based in Augsburg, Germany, specializes in basic research on composite fibre technology. For the Alice wing, the team not only developed and optimized the layup process, but they also went on to build a full-scale aileron in Augsburg to verify and validate the theoretical results.

"Paving the way for the future of efficient engineering, networked production, and intelligent, multi-material solutions."

Fraunhofer IGCV stands for application-oriented research that facilitates innovations in manufacturing processes and material sciences, machines, and process chains as well as factory and enterprise networks. Our unique selling proposition is highly automated composite processing technologies for light aircraft structures. With approximately 150 employees at our locations in the Augsburg and Munich areas, we are a reliable partner for Small and Medium Entrepreneurs, large companies, and corporate groups.

ADMIRALTY

Admiralty International Pte Ltd specialises in manufacturing advanced composites by various methods to suit specific applications. Our products range from deep sea buoyancy block suitable for deep sea ROV operates at 3000 m depth to light weight honeycomb sandwich panel structures and carbon fibre reinforced plastic cone for satellite. Our past projects include design and build fast rigid inflatable boats, CFRP car for research institutes, CFRP solar and electric car for tertiary institutions, UAV, Radome made of glass or quartz fabric honeycomb sandwich for vast spectrum of EM transparency. We have experienced engineers and work force, modern facilities, equipment, machinery and software to undertake the most challenging and complex projects.

We are located in Singapore, the gateway to the enormous Asia Pacific market.

Eviation CEO Omer Bar-Yohay stands in front of Alice, the first all-electric 9 passenger aircraft, during her unveiling at the 2019 Paris Air Show.

else has tried before. This is what Eviation is built to do.

"Eviation is an Israeli based start-up founded in 2015 with one goal: To find a way to travel to regional distances. Our solution was to make aviation a more day-to-day part of the transportation industry and we believe the key to that is making aviation electric," explains Bar-Yohay.

"THEIR GOAL IS NOT TO CREATE A PLANE THAT CAN REPLACE THE CURRENT AIRCRAFT IN THE INDUSTRY, IT IS TO **CHANGE THE WAY WE THINK ABOUT PLANES IN GENERAL**"

Their goal is not to create a plane that can replace the current aircraft in the industry, it is to change the way we think about planes in general.

"The reason is sustainability in the broader sense. We see sustainability as a three-faceted term," Bar-Yohay says. "The first one is economically sustainable- it needs to make economic sense over time. How much does it cost to move a person a certain distance? The second facet is it needs to be environmentally sustainable, emissions-free, a lower cost in energy. One of the most efficient ways to move weight is through the air at »

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Alice's sophisticated interior and zero-emission propulsion system, ensure a flying experience that is cleaner, quieter, and more cost effective than conventional travel.

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"IT IS BEST DESCRIBED THROUGH THE PROPERTIES OF THE AIRCRAFT. IT IS THE PLANE YOU WOULD LIKE TO SEE IN THE 21ST CENTURY, **BUILT FROM THE GROUND UP TO BE ELECTRIC**"

medium speeds and altitudes, it makes sense to move people that way. And the third facet is social sustainability- it must be a solution people want to use and want to live next to, coming further and further away from what is currently happening in aviation, where people would rather live away from airports because of noise and congestion. The electric transport revolution, when applied to aviation, could make aviation something that doesn't take us to one spot and spread us around but something that can take you from any point A to any point B."

BUILDING FROM THE SKY DOWN

Even that description doesn't fully encapsulate the scale of the Eviation project. They aren't just building a conventional aircraft with electric motors where you would normally find traditional piston engines. They are building a new kind of plane from scratch.

"It is best described through the properties of the aircraft. It is the plane you would like to see in the 21st century, built from the ground up to be electric," Bar-Yohay says. "The aircraft's estimated costs are less than 50% of its gas-guzzling equivalent while having ››

Eviation's zero emission, all-electric Alice sits on the tarmac at the 2019 Paris Air Show
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MA GROUP

Innovation, Integration, Influence. Over 80 years of leadership in the aerospace sector collaborating with the industry's Giants. Born in Naples and currently operating in Italy, the United States and Brazil, MA Group has produced more than 20,000 landing gear for more than 7,000 aircraft. MA Group is the holding company of a series of industry leaders in the aerospace sector. The Group has been able to expand promptly its technological, productive and geographical perimeter assets in step with the evolution of the competitive scenario.

Magnaghi Aeronautica, with more than eighty years of experience, designs, manufactures and develops landing gear and hydraulic and electro-mechanical actuation systems for fixed and rotating wing aircraft, for civil and military aviation. Salver specializes in the development and production of aeronautical structures in advanced composite materials such as wing movable surfaces; Hsm-Blair develops landing gear systems and complex aeronautical components; Metal Sud has specific know-how in external treatments and special processes for aeronautical components. Magnaghi Brasil is specialized in the production of aeronautical assemblies and components.

In 2018, MA Group signed an important memorandum of understanding with Eviation, the Israeli company that is developing ALICE, the first all-electric aircraft in the history of world aviation. Recently at Le Bourget, Eviation unveiled the first mock-up of ALICE, featuring our state-of-the-art landing gears system.

MA Group is developing a Landing System for the ALICE project consisting of electrically actuated Main and Tail gear legs, and Electrical Braking System based on the Electro-Mechanical Actuation state-of-art technology.

ALICE will reduce those carrier costs by up to 70%, while bringing travelers a cost-competitive, emission-free option. The culmination of four years of design and collaboration with an ecosystem of partners that spans France, Italy, Singapore, Germany, South Korea, Australia, the US and Israel, Alice represents a breakthrough on many levels.

"We are proud to be part of this project that could change the course of global air transport," says MA Group Senior Vice President, Giorgio Iannotti. "This confirms our capability to offer advanced technology products working closely with our customers and partners. On this program we will implement electrical brakes technologies as well as advanced materials applications to minimize overall maintenance activities".

Benefitting from its legacy of skills, MA Group will grow its global footprint, and position itself as one of the most innovative, reliable and respected contributor to the major aeronautical programmes. Our rich history with aerospace prime contractors such Airbus, Embraer, Leonardo, Lockheed Martin, Collins and Bombardier is a testament of our quality and the deal with Eviation is further proof that we are a valuable partner to the industry's most innovative projects.

Find out more and visit us at: **www.magroup.net**

Barrett Aerospace PTE Ltd employs cutting edge technology to make electric aviation possible.

While large aircraft powered by carbon-polluting fuels continue to play a major role in mass transportation on long haul routes, we think electric aviation will open affordable short haul routes that have been previously unserved or underserved. Countries with island archipelagos, such as Philippines and Indonesia, will benefit most from this technology.

In 2019, a demonstration version of Eviation's electric aircraft "ALICE" was launched at the Paris Air Show. This innovative 9-seater aircraft sports an ultra-modern design and is made from lightweight composite materials. This new aircraft significantly reduces the cost of flying, making this aeroplane the Uber of the skies.

Barrett Aerospace is proud to have designed, built and delivered the entire empennage tail assembly, using its accredited global supply chain. We aim to improve the lives of everyone and to make air travel more affordable to a larger selection of people.

"As little as 3 percent of the global population flew in 2017, and at most, only about 18 percent have ever done so. But things are changing."

Laurence Barrett
Founder of Barrett Aerospace PTE LTD

www.BarrettAerospace.com

Eviation's Alice on display at the 2019 Paris Air Show.

at least the same performance. It is a fraction of the cost of a piston engine aircraft, in a stylish package with a safer and more stable ride. It is the combination of a plane that is not more expensive than a new aircraft but costs so little to operate and gives you the ability to serve your clients in a better way and be more environmentally responsible and long term sustainable. It doesn't make any sense to buy anything else once this plane is out."

"THE MOST DIFFICULT THING IN BUILDING AIRCRAFT IS MOVING AN IDEA TO A CERTIFIABLE DESIGN AND A CERTIFIABLE PRODUCT AND THEN A CERTIFIED PRODUCT AND **THAT IS A BIG GAP SOMETIMES**, AND THEN FROM THERE TO BRING IT TO MARKET"

Of course, a project of this magnitude is no easy task.

"The biggest challenges are changing over time," Bar-Yohay tells us. "The most difficult thing in building aircraft is moving an idea to a certifiable design and a certifiable product and then a certified product and that is a big gap sometimes, and then from there to bring it to market."

Eviation has pushed through these challenges thanks to a strong sense of identity that has been baked into the company from day one.

"When we started, we had to decide who we are, what we are and what we aimed to deliver," Bar-Yohay says. "You've also ››

M4 ENGINEERING

M4 Engineering, Inc. works with inventors, startups, established companies and government agencies to solve "unsolvable" problems, and move their ideas from concepts to prototypes. We also develop software using our expertise in multidisciplinary design analysis and optimization (MDAO) to support our customers, and can help you save time and reduce the costs associated with the design, analysis and optimization of high-performance systems and structures. The complex systems typically found in electric aircraft, eVTOL, Urban Air Mobility, as well as more conventional aircraft and spacecraft present unique challenges that many new and established companies may not have encountered before. This is where M4 Engineering comes in. We have a broad range of capabilities to complement in-house engineering resources when either specialized knowledge or extra bandwidth is needed.

Our services and software include: conceptual, detailed and industrial design, analysis and simulation with an emphasis on structures, aerodynamics, flight performance and dynamics, and loads and vibration. We have special experience and software for key technical areas such as weight prediction, rotor dynamics, and vehicle optimization, as well as general design and analysis services and software.

Founded in 2001 by Dr. Myles Baker, M4 Engineering addresses the complicated challenges found in aerospace and mechanical engineering product development and manufacturing processes. M4 has offices in the United States and Germany helping companies connect the dots and make their ideas fly, providing safe transportation from city to suburb, around the world, or to reach for the stars.

Please call or email us today to see how we might be able to help you accomplish your goals +1 (562) 981-7797 or info@m4-engineering.com
www.m4-engineering.com

got years before we offer any income. Once the business is achieved and you understand the product and get enough financing to really cover the cost of the process, team building and building the plane, then the prospect of being certified in the prevailing regulatory environment Is the challenge and we needed a lot of engineering for talent. The next move is to certify the plane which is what we are doing right now. We are getting it qualified and eventually certified, and from that point on we are ramping up production and going to market in a responsible and scalable way."

"THE AIRCRAFT'S **ESTIMATED COSTS ARE LESS THAN 50% OF ITS GAS-GUZZLING EQUIVALENT** WHILE HAVING AT LEAST THE SAME PERFORMANCE."

PARTNERSHIPS TAKING FLIGHT

The important thing about a project like this is that it cannot be done alone. Eviation has turned the development of its aircraft into an international project.

"Today it is more of a global effort. The companies building aircraft at the scale we are talking about are few and far between so we are in a global competition for talent and we are looking for new people all the time," Bar-Yohay says. "We have a lot of top talent approaching us, but we need the right place for them so they feel they are part of the story."

That search for talent goes far beyond simply recruiting people into the company, Bar- >>

EVIATION

“WE ARE DOING VERY INTENSE WORK WITH EARLY-ADOPTING CLIENTS TO CREATE A SUCCESSFUL LAUNCH PROGRAMME FOR THE AIRCRAFT ONCE IT IS CERTIFIED”

Yohay explains, “People ask us how we started with 20-something employees, how do you build a plane when people are typically building a plane with thousands of people. And the answer is “with friends” and those friends are the heart of what we have been doing. Our partners and risk-sharing partners are part of our ecosystem. The group of companies that saw our vision and thought ‘maybe, just maybe these crazy guys from Israel are right’. A lot of those things were about finding global expertise. So there are a lot of things you don’t need to invent, or where someone has a clear advantage over what you are developing. We were able to work with them. We are very grateful for our partners; it is a collaborative effort rather than a competitive one.”

Indeed, right now Eviation is looking to shift their centre of gravity onto a more international stage.

“We are shifting our centre of gravity from our R&D arm in Israel to two sites in the West of the USA, and the idea is to move the effort of certification and management predominantly to the US. Our long-term dreaming capacity, together with something I would call an incubator for top engineers, will remain in Israel. Our challenge over the next year and a half is growing those two teams simultaneously. We are doing very intense work with early-adopting clients to create a successful launch programme for the aircraft once it is certified. So if I want to stand here and say we have built the first electric aircraft and it looks great I would get lots of orders but looking after those pilots with sales and maintenance would have been impossible for a business of our size. We are trying to grow as strategically and organically as possible.”

The Alice will feature exceptionally sized windows that’ll maintain the feeling of openness throughout the zero emission, soundless flight.

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