Join Our SMEs' Network!
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“SMEs are the motor of our economy and will be the engine of our recovery,” said European Commission President Ursula von der Leyen during her State of the European Union address in September of this year.

At Clean Sky, we could not agree more. SMEs power the economy – although small, they are mighty, which is why they are an integral part of Clean Sky’s programme.

The thirtieth issue of Skyline is a deep-dive into these engines of our recovery, and takes a behind-the-scenes look at the contribution that SMEs make to Clean Sky projects. Just over 37% of Clean Sky’s participants are SMEs, and their creativity and drive is an inspiring force within Clean Sky projects. At the same time, our programme provides a unique opportunity for SMEs to build their network within the European aviation sector, fostering future partnerships and strengthening the aviation ecosystem as a whole.

As MEP Henna Virkkunen, who sits on the European Parliament’s Committee for Industry, Research and Energy, says on page 4, “a resilient aviation industry can only be achieved through investments in research and innovation… for this, many SMEs provide innovative, tailor-made solutions.”

Indeed, the aviation sector is facing challenges today that we could never have predicted. I am confident that the industry will bounce back, stronger and more environmentally-friendly than ever before, but in order for this to pass we will need to harness the energy, inventiveness and fresh outlook of SMEs. In particular, SMEs can be pioneers in the rapidly growing fields of artificial intelligence, big data, computer modelling and digitalisation. They can even help to stem the spread of the COVID-19 virus – Villinger GmbH is currently developing an air decontamination system which can be installed in large passenger aircraft cabins. Read more on page 11.

However, despite playing an important role in tackling COVID-19 spread on aircraft, aviation SMEs are vulnerable to the economic fall-out from the COVID-19 pandemic. Steps must be taken to ensure that SMEs are supported and that they can survive these challenging times. These small-but-mighty powerhouses are, as von der Leyen said, the engines of our recovery and therefore we must ensure that they do not sink beneath the waves of an economic recession.

On a brighter note, we were delighted to see that the Clean Sky project CARING was awarded the Horizon Impact Award 2020 this year for its contribution to the development of the SkyBreathe® technology. The CARING project was led by SME OpenAirlines, and it saw the analysis of more than 10,000 flights to determine how multiple factors influence actual aircraft consumption, emissions and noise. In 2019, SkyBreathe® contributed to savings of US$150 million, and it reduced the aviation sector’s carbon footprint by more than 590 000 tonnes, equivalent to planting 75 million trees. Well done to OpenAirlines and CARING for this fantastic result!

Other SMEs that are leading the way in terms of digital innovation are Skylife Engineering, Ansys Granta and DREAM. Skylife Engineering, a spin-off SME from the University of Seville, is involved in nine Clean Sky 2 projects relating to the digitalisation of factories, electro-mechanical actuators, electrical power conversion and cognitive computing in the cockpit. Ansys Granta, on the other hand, is an expert in materials information management, and they have leveraged additive manufacturing and eco-design skills to contribute to two Clean Sky projects, PASSPORT and PLEIADES. The Dream Innovation (DREAM) SME focuses on consulting, digital analysis and simulations in various engineering fields relevant for aviation.

Electricity is also a hot topic for our SMEs. BrightLoop Converters has taken the reins in the Clean Sky 2 project SMARTCONVSYST, which involves designing, manufacturing and testing a new electricity generation concept for an aircraft’s Auxiliary Power Unit. Their end-product will be an energy-efficient, compact and lightweight system that can convert gas to HVDC electrical power.

IBK-Innovation, for example, is highly specialised in aeronautical flight physics. This small powerhouse’s niche and technical expertise gives it an edge, and it has been involved in no fewer than 15 Clean Sky projects! IBK-Innovation is currently working on a wind tunnel model for the PRODIGE project, which will be designed, manufactured and tested under cryogenic conditions.

Villinger GmbH is revolutionising in-flight ice protection systems. They have developed the first commercially available fully integrated propeller ice protection system, which improves both the aerodynamics of the wing and its de-icing capabilities. Their propeller yields a 9% improvement in efficiency which translates to a significant reduction in fuel consumption. Villinger GmbH is involved in several Clean Sky projects including InSPIRe, NO-ICE-ROTOR, and SEaSIDE.

Last but not least, Szel-Tech also works on de-icing installations for aircraft, as well as the structures of frames, trusses, air conditioning tanks and braking systems. As part of SAT-AM, the Polish SME is researching and analysing new methods and technologies for the manufacture of aircraft structure, helping to reduce weight.

Small but mighty SMEs are the backbone of any innovative research programme, and Clean Sky is proud to celebrate our SMEs in this edition of Skyline. Read on to find out more about how they are contributing to climate-neutral aviation goals, and how their unique innovations take us one step closer to zero-emission aviation!
INNOVATION DRIVES PROFITABILITY IN THE POST-COVID AVIATION INDUSTRY

Henna Virkkunen
Member of the European Parliament

“A resilient aviation industry can only be achieved through investments in research and innovation.”

The COVID-19 pandemic came as a shock to the aviation industry in Europe and all over the world. Many air carriers were forced to ground flights and some shut down their operations completely for weeks. This has a clear ripple effect throughout the entire value-chain, with many SMEs also taking a hard hit. Now, with the second and subsequent waves of the pandemic hanging over our head, it is more important than ever to take all necessary steps to ensure that the negative effects of the pandemic can be minimised.

For the time being, however, air transport will continue to face huge challenges. Overcapacity will continue as long as the market does not grow due to travel restrictions. To mitigate impacts of the crisis, many airlines will continue on the path of cost reductions, as they have been doing in the last years. For many, the main strategy to improve profitability is to minimise costs such as landing fees, fuel, and other traditional overheads. Although this might make sense in the short run, it brings limited value to the long-term competitiveness of the industry.

The pandemic will pass sooner or later, but it would be a misconception to just assume that the containment of the virus would result in business as usual. To bounce back from the crisis, the European aviation industry needs a jump in productivity and profitability. A climate-neutral EU by 2050 will require major legislative changes and implications to the aviation industry will be far and wide. For an industry with particularly long development and innovation cycles, regulatory stability is vital. A long-term vision is required from us decision-makers to ensure that the European aviation sector will be able to stay competitive while adapting to future challenges.

A resilient aviation industry can only be achieved through investments in research and innovation. The future belongs to those who use the latest digital technologies to push the boundaries of innovation in all areas of their business. As has been the case for Clean Sky programmes in the past, the involvement of the aviation sector in the new Horizon Europe is crucial for the industry’s ability to renew itself. Regrettably, the European Parliament’s demands to double the funding of the next framework programme was not accepted by the Council. Yet Horizon funding will continue to be available for aeronautical and related research, offering avenues for fruitful public-private collaborations enhancing the industry’s ability to transform.

When it comes to developing innovative technologies, it is critical that companies, researchers, regulators and manufacturers work in a collaborative and open manner. A strong European industry and a strong European industry ecosystem are required if we are to ensure innovation and the continued resilience of the aviation industry. It is time for businesses, trade unions, scientific institutions, public authorities and policymakers to deliver a clean sky – and I am confident that with the strong support of Horizon Europe, we will.

Further integration of new technologies into the industry is key in the transformation. Tapping into the potential of big data and artificial intelligence are good examples of the ways in which the industry can look forward. Pilots and air traffic controllers will need to become more automated to reduce the costs and increase efficiency. A greater focus on self-diagnosis and recovery systems will be required. Better and smarter data analytics and decision support systems will be needed to drive smarter flight operations. For this, many SMEs provide innovative, tailor-made solutions.

To achieve long-term competitiveness in a post-COVID world, the industry will have to put innovation into practice. We as policymakers need to stay up to speed with the challenges the sector is facing. That is the only way to ensure innovation-friendly regulatory framework for bigger players and SMEs alike.

“SMEs provide innovative, tailor-made solutions.”
On 24 September, OpenAirlines was awarded the Horizon Impact Award 2020. The winners were announced at the European Research and Innovation Days in Brussels. This prize, given by the European Commission, recognises and celebrates outstanding Horizon 2020 projects that have used their results to provide value for society. One of the winning projects was the Clean Sky project CARING, which indirectly led to the development of OpenAirlines’ flagship product SkyBreathe®, an eco-flying solution to help airlines reduce their costs and environmental impact.

Starting from the observation that nearly 660 million tons of CO$_2$ are emitted every year, i.e., more than 20 000 kilos of CO$_2$ per second, Alexandre Feray created OpenAirlines in 2006 with the willingness to assist airlines in optimising their operations and reducing their environmental impact.

From 2010 to 2014, OpenAirlines was awarded the lead of three Clean Sky projects. The CARING project (Contribution of Airlines for Reducing Industry Nuisances and Gases) was part of the first Clean Sky Call for Proposals. For a two-year period, OpenAirlines worked jointly with academics (ENAC – Ecole Nationale de l’Aviation Civile), SMEs (Envisa, Icon, Sustainavia), airline associations (FNAM), and airlines (Airlinair, Corsair, Thomson Airways and Transavia France) to develop advanced research in flight optimisation. The findings demonstrated how multiple factors influence actual aircraft consumption, emissions, and noise. As part of the project, OpenAirlines analysed more than 10,000 flights from the four airlines participating in the project covering most Airbus models, ATR, and Boeing fleets. This cooperation with industrial actors, professional pilots, SMEs, and academics has allowed for the development of the technology and for the identification of a sooner-than-expected industrial usage for the outputs of the research projects.

In 2013, capitalising on these findings, OpenAirlines was armed with a great product and a great team to officially launch SkyBreathe®, an eco-flying solution enabling airlines to reduce their fuel consumption and CO$_2$ emissions by 2 to 5%.

The fuel-efficiency platform uses sophisticated Big Data Algorithms, Artificial Intelligence, and Machine Learning to automatically analyse billions of records from all types of data sources, including complete FDR records, operational flight plans, ACARS (Aircraft Communications Addressing and Reporting System), etc. Combining them with environmental data from actual flight conditions (payload, weather conditions, ATC (Air Traffic Controller) constraints, etc.), the software identifies the most relevant saving opportunities. It provides a series of recommended actions to reduce fuel and CO$_2$ emissions. Accordingly, as jet fuel represents ~30% of airline costs, the fuel saved is usually worth tens of millions of US dollars per year with a rapid return on investment.

Transavia, a CARING project partner, has become the first airline to implement SkyBreathe® to improve their daily operations. They will be followed by many airlines attracted by the brilliant results of the software.

SkyBreathe® has been embraced by 44 airlines in 30 different countries and counts amongst its clients Air France, Norwegian, Malaysia Airlines, Cebu Pacific, and Flydubai. In 2019, the SkyBreathe® system contributed to saving 150 million USD and reducing the aviation sector’s carbon footprint by more than 590 000 tons, equivalent to planting 75 million trees.

Since the launch of SkyBreathe®, OpenAirlines have created 40 jobs in their headquarter in Toulouse and 5 in their subsidiaries in Miami and Hong Kong. These jobs are all a direct consequence of their participation in the CARING project, which has been a defining moment for the company’s future. OpenAirlines has enjoyed a steady 40% growth year-on-year, which means they expect to reach the 1 billion kg of CO$_2$ emission saved by 2021. Capitalising further on R&D, they are now developing a connected solution that runs in the cockpit (SkyBreathe OnBoard), and they also target the ATM market. Their goal is to become the #1 digital solution to reduce aviation CO$_2$ emissions and increase their impact tenfold, to help airlines save 6 million tonnes of CO$_2$ per year.
Dream Innovation (DREAM) is a young SME founded in 2013, bringing together a team of highly-skilled international experts from different European research institutions. Our aeronautics expertise covers consulting, digital analyses and simulations in different engineering fields such as Structural Mechanics, Automation and Control, Fluid Dynamics, Thermodynamics, Experimental Investigations, and Software Design. In Italy, DREAM is well-known for several collaborations across the Italian aviation sector: with universities such as ROMA TRE, Politecnico di Torino, Università degli studi di Napoli Federico II and Università degli Studi di Salerno; with research centre CIRA; and with Italian industry member Leonardo.

DREAM’s first opportunity to join the European programme Clean Sky 2 was through participating in the POLITE project, which ran from 2017 to 2019. The project successfully designed and manufactured a modular model of a regional aircraft to be used for low-Reynolds tests in one large non-pressurised wind tunnel and for high-Reynolds tests in a different, pressurised wind tunnel. We were involved in the experimental test campaign by performing the aerodynamic characterisation of the struts supporting the aircraft model in the wind tunnel. In particular, DREAM was in charge of investigating the aerodynamic interference effects of two different models of struts by means of CFD (Computational Fluid Dynamics) tools. Figure 1 shows that the effect of the strut is concentrated in the bottom part of the model.

Today, DREAM contributes as partner to 4 successful Clean Sky 2 projects (PRODIGE, ESTRO, GUDGET and CA3VAR) and one Italian project of the Regione Campania (DAVYD).

First, the PRODIGE project is developing a virtual certification scheme for assessing the aileron efficiency and hinge moment data predictions on a Falcon 8X business jet in transonic conditions. DREAM provides design support by performing CFD calculations on an FSI (fluid-structure interaction) procedure to evaluate aerodynamic loads and deformations. The aim is to improve the control surfaces design by predicting not only more realistic loads, but also the aerodynamic performance and the level of deformation that is expected during the experimental campaign (figure 2 shows the deformation of the wing for each iteration of the FSI procedure).

Moreover, Clean Sky 2 is giving DREAM the opportunity to increase its field of competencies by:
• developing new tools and in-house software to estimate laminar flow extension and robustness and the transition location (ESTRO project);
• designing and optimising a gust generator architecture by adopting innovative flow control concepts and new airfoil shapes (GUDGET project);
• performing aerodynamic analyses of a low-speed fan presenting aerodynamic and aeroelastic instabilities (CA3VAR project);
• developing new schemes to predict aerodynamic loads in innovative leading-gear configurations (DAVYD).

In all the Clean Sky 2 projects, the DREAM team is a member of several consortia involving industry, SMEs, research centres, universities and academia. In terms of collaboration, it is thanks to Clean Sky that we have been able to not only increase our expertise but also expand our network across Europe with the major industrial groups and industry leaders (such as Airbus, RUAG, ONERA, Dassault, and more).

Since our foundation, DREAM has supported the smart-working policy. When the COVID-19 pandemic broke out, our organisation didn’t suffer substantial changes because we are mainly involved in digital activities in Clean Sky 2 projects. This meant that our researchers could continue working on the projects without any substantial interruption. However, we are worried about the consequences that will affect the European aviation industry in the next years because they could also affect the future of DREAM. For this reason, continuing to increase investment in the aeronautical field is particularly relevant for DREAM and, in general, for the future of the SMEs in a context of financial and economic crisis.

Following our successes in the Clean Sky 2 programme, DREAM is looking forward to participating in more and more projects within the proposed Clean Aviation partnership and Horizon Europe framework programme, to make our contribution to the future development of incremental innovations and disruptive aircraft configurations.

Serena Russo, PhD
R&D Manager, Dream Innovation

1. POLITE: Comparison in terms of Cp contour distribution between the configurations with and without the strut
2. PRODIGE: deformation of the wing for each iteration of the FSI procedure
Skylife Engineering was founded in 2011 as a spin-off SME from the University of Seville. In these almost ten years of existence the company has evolved from only 2 employees to more than 40 last year. Due to its origin, research and development has been at the heart of every engineer working at Skylife from the very beginning.

The participation in Horizon 2020 calls is sometimes a big challenge for SMEs. Although many innovative SMEs usually have the expertise to collaborate in European calls, resources are sometimes too limited, especially in small companies, to spend time and effort writing a proposal which may not be granted. It is of utmost importance to have the appropriate technical background and writing skills to present a suitable proposal.

Our experience in Clean Sky started in 2013 with 3 proposals (which were all rejected). Within Clean Sky 2 we have applied for 27 calls since 2014 and we have been invited to sign the grant agreement in 9 of them (33% success rate). All of the projects are still under execution. Skylife is also the coordinator of 6 of these projects.

The topics of these projects are related to digitalisation of factories (ARIESS and DILECO); Electro-Mechanical Actuators (EMA4FLIGHT, VALEMA, AMULET); electrical power conversion (HEPODIS, HYPNOTIC, DCADE); and Cognitive Computing in the cockpit (HARVIS). All of these projects are in line with the objectives of the European Green Deal, in particular by enabling key technologies for decarbonisation, reduction of noise and efficient use of resources.

The TRLs (Technology Readiness Levels) that will be achieved in projects such as EMA4FLIGHT and HEPODIS is quite remarkable. The results of these projects will be pieces of equipment that are planned to be tested on the Flight Test Bed 2, an advanced C.295 from Airbus Defence & Space, thanks to the involvement of Clean Sky 2.

A great outcome of Clean Sky is the cooperation between organisations in different European countries, fostering the collaboration and research of shared know-how across Europe. Skylife is currently collaborating with 5 different SMEs from Spain, Italy, and France; and with 7 research institutes and universities from Spain, France, and Switzerland.

This collaboration allows the sharing of knowledge between European actors and brings more business opportunities than a company could achieve alone. The role of Core Partners is remarkable as well. They openly launch their technological challenges to the whole of Europe and the best answer is selected by technological experts from across the continent. Once the project is completed and the challenge is solved, the Topic Manager involved can benefit from that specific achievement, while the Clean Sky partner keeps the intellectual property of the solution which can be applied to other business opportunities. The cooperation of innovative SMEs with universities and research centres is an added value to those bigger partners that look for interesting collaborations in Clean Sky.

The framework of Clean Sky through the Call for Proposals topics is a very interesting funding scheme for SMEs. Small enterprises have very poor or limited access to other financial resources such as bank loans. Pre-financing is, in our experience, a key enabler to allow small companies to participate in European projects.

The duration and nature of European research projects also supports SMEs in difficult moments such as the COVID situation. Although the impact on private companies is still difficult to measure on a European level, in Spain it is very significant in the aerospace sector. Despite the efforts of the European and Spanish governments, the possible assistance measures will take some time to arrive to small companies. The involvement in research projects has been really important to overcome the delays and cancellation of other private projects while maintaining employment and – the most important asset for a small company – the employee know-how in this difficult situation.

In every research project, an SME expects to receive a monetary return in the mid-long term. Due to the nature of the aerospace industry, this return could be achieved in the long term after some extra investment to transform a technology at TRL6/7 into a commercial product. In our experience, the time it takes to raise a low TRL into a product ready for the aerospace market is about 10-15 years, where Clean Sky supports both low TRL through thematic topics and mid TRL through Calls for Core Partners and Calls for Proposals. There is still a missing financial GAP to achieve higher TRL that needs to be supported by other financial means.

The involvement of Skylife in Clean Sky is very promising from the company point of view. The results from on-going projects is forecasted to arrive in 2025+, multiplying by 100 the current turnover and the value of the company.
Despite the current downturn in travel due to COVID-19, aerospace companies remain committed to designing aircraft that will meet performance and efficiency needs. The need to reduce emissions, while maintaining performance, in the long-term has not changed. Modelon is proud to be bridging the gap between public interest and private industry to lead and advance this research.

For decades, aerospace companies have addressed emission reductions by focusing on component technology, such as a new heat exchanger or electric drive. Today, this alone is nothing. Model-based systems engineering is the key to understanding how a holistic system will perform. Modelon’s system simulation software, based on the open standards of Modelica, is the enabler for this advanced research and catalyst for innovation.

‘Modelon’s Modelica-based technology, along with our team of industry experts, is leading the way in integrated aerospace design. In Clean Sky, Modelon was appointed as the coordinator for the TRADE (Turbo electric Aircraft Design Environment) research project. What a privilege it has been!’ said Michael Sielemann, Aerospace Industry Director at Modelon.

For the last three years, the consortium with Universities of Mälardalen (Sweden), Nottingham (UK) and Berlin (Germany) worked on computational models for systems design and integration of hybrid electric aircraft. This research development was focused on configuring and analysing the capability of electric machines and batteries to add electric power to the fans of gas turbine engines – such as the boosted turbofan engine concept.

**Boosted Turbofan Engine Concept**

The boosted turbofan concept features a base configuration of a standard turbofan gas turbine engine. The “boost” comes from an electric drive that is mounted on a spool of the gas turbine or on an accessory drive shaft. Benefits of using the boosted turbofan concept include:

- Simple installation: The overall design of the aircraft does not require a lot of modification. For example, the aircraft can still have podded engines attached below the wings.
- Simple analysis: The aircraft design still features common propulsion devices, components are generally found in the same locations, and the balancing of jet fuel and electric energy occurs locally in electrified gas turbines.

**Subsystem Development and System Simulation**

In order to study this concept, the consortium developed a simulation and optimisation design platform with analysis models of higher fidelity for hybrid electric aircraft. Powered by Modelon’s Aircraft Dynamics Library we had the flexibility to build and layer multiple architectures and topologies, as well as fidelity and abstraction levels to validate the boosted turbofan concept.

In Figure 1, you can see a simple experiment that displays one aircraft and models of the surrounding, including:

- The flat earth or spherical coordinate system including ground and ambient conditions.
- The parametric aircraft model, including airframe, power and propulsion system, and consumer systems.
- And the landing gear.

Modelica-based technology enables multi-level configurations – separating the complete architecture from the model configuration for expert analysis.

Modelon’s Jet Propulsion Library and Electrification Library let the consortium implement parametric sub-system models. Once the complete system and all subsystems are in place (Figure 2), they allow the boosted turbofan concept to be tested and validated.

The TRADE models and engineering insights of this and the turbo-electric concept were provided to aircraft designers, who already master the engineering of other, more established aircraft concepts. Users included the German, French and Dutch aerospace centers as well as Airbus.

**Modelon Impact**

For the future, Modelon has big plans. After working on systems design and integration for more than 20 years, the company launched its cloud-based simulation platform, Modelon Impact. As evident from the above, a new age of engineering is upon us, where design and integration of future physical systems are especially complex. Until now, gaps in the physical modeling toolchain and high barriers to entry have prevented many organisations from fully leveraging the benefits of simulation. Modelon Impact is a platform that inspires collaboration and creates value in systems modeling and simulation. More minds bring more experience, creativity, and ultimately better results.

Learn more about Modelon Impact – www.modelon.com/modelon-impact
IBK-Innovation is a small enterprise located in Germany with two sites in Hamburg and Nürnberg. The company offers services with a strong focus on aeronautics, in particular addressing flight-physics topics. A strong emphasis on IBK’s daily work is on R&D. IBK supports the European aeronautic industry both in developing new technologies as well as developing and improving aircraft design processes and tools.

Clean Sky has been really important for IBK. We have been involved in 15 projects from the very first Call for Partners (CfP) in Clean Sky 1 right up to the current stage near the end of Clean Sky 2, cooperating with a large number of industrial partners, research institutes, universities and other SMEs.

One project that should be mentioned here is the CfP project PRODIGE. Within PRODIGE a wind tunnel model will be designed, manufactured and tested under cryogenic condition. The model represents a Dassault Aviation configuration and is specifically equipped with local balances to measure loads on a control surface. Apart from IBK, who is performing the model design, Deharde, another SME, is performing the manufacturing activities while DREAM, the third SME, is performing aerodynamic analysis supporting the model and balance design. Finally, TU-Darmstadt is performing the detailed design of the balance. PRODIGE is a very good example of a project in which experts from different domains work together. Since the model will be tested under difficult cryogenic conditions, we are facing a huge challenge. But Deharde has a track-record in processing the special materials needed for this application while experts from DREAM, together with IBK, were able to come up with a robust and very flexible workflow to implement CFD (Computational Fluid Dynamics)/CSM (Computational Structural Mechanics) processes in order to cope with fast design changes. The model is currently being manufactured and will be tested in Q1 2021.

As well as this, IBK is also part of the T-WING consortium, which is developing a wing for the next-generation civil tilt-rotor demonstrator led by Leonardo Helicopters. IBK’s role in this huge project is to provide loads and aerelastic analysis. Since the configuration of tilt-rotors mean they cannot be addressed either as a fixed-wing aircraft or as a traditional helicopter, the loads assessment is particularly challenging.

European aeronautical cooperation, in particular within Clean Sky, is extremely relevant for IBK. Due to the nature of SMEs as small companies, they need to be highly flexible and always on the edge of innovations to be successful. Clean Sky, as a private-public partnership, allows IBK to cooperate in a demanding environment and to develop technologies inside projects with a strong potential for industrial application. Thanks to this, IBK can not only stay on top of new technology developments but is also able to use this knowledge for industrial partnerships and new customers. Apart from this, Clean Sky has allowed IBK to set up a network of companies and universities which have demonstrated their competences and are open for commercial activities beyond Clean Sky. The consortium in PRODIGE is a very good example of experts with specific key competences working together in a setup that also works outside Clean Sky. Last but not least, the strong link with research institutes and universities all over Europe has helped IBK to present themselves, gain visibility and gain access to highly-skilled engineers. Currently around 30% of IBK’s employees have been hired out of the network established in co-funded cooperation projects.

For sure COVID-19 is a strong challenge in particular for small companies with a structure like IBK. Governmental support programmes tend to concentrate on highly-visible industrial companies but neglect SMEs. So far COVID-19 has not affected research projects - in fact, research programmes are a possible way to prepare companies like IBK for the time after COVID-19 when industrial cuts have been overcome.

Dr.-Ing. Stephan Adden
CEO, IBK Innovation GmbH & Co. KG

WT-Model designed by IBK inside PRODIGE to be tested in the ETW in Q1 2021
One of today’s main challenges in the aircraft industry is to shift towards more energy-efficient integrated electrical architectures, to optimise as well the non-propulsive energy generation and distribution. Designing Auxiliary Power Units (APU) that are able to interact smoothly with the main engines will allow fuel savings and to reduce CO₂ generation.

BrightLoop Converters is participating in the Clean Sky 2 programme under the SMARTCONVSYST project which is related to “High Density Energy Conversion System for an APU”. The main goal is to tackle the challenges brought by this shift to cleaner air mobility by providing an optimised integrated APU including gearbox, electric machine and power electronics to generate 540V DC that will be directly injected into the aircraft’s HVDC electrical network.

The project therefore includes the design, manufacture and test of a new concept in the generation of electricity in aircraft with an APU combined with high speed electrical generation. Thanks to the high speed architecture, the size and weight of the gearbox and electrical generator are much reduced, compared with state-of-the-art solutions. Also, the full reversibility of the system allows the starter machine – a previously necessary component – to be removed. This results in a very energy-efficient, compact and lightweight system to convert gas to HVDC electrical power.

BrightLoop Converters has taken on the position of coordinator in this project, putting to use its +10-year expertise in power electronics to lead the consortium formed together with two other SMEs, Akira and Erneo. The project, led by Safran, runs until 2023.

So far we have managed to choose among the most promising technologies to evaluate, define the architecture, and design the different elements. The first integration tests of the different elements will begin in early 2021, before integrating the turbo-engine generator in Safran’s facility.

Our two SME partners, Akira and Erneo, share BrightLoop’s capacity to deliver high power density and highly efficient solutions for aeronautics applications. Akira is specialised in the design and realisation of energy conversion systems and special test benches, while Erneo specialises in the design and manufacture of high performance electric motors, electric generators and magnetic systems.

Participating in the Clean Sky programme as an SME is a real opportunity for all of us. It is a unique occasion to develop cutting-edge technology, to connect with other SMEs that share the same passion for innovation and push us to surpass ourselves, and above all to have an opportunity to participate in defining the future of a cleaner, safer and more innovative aviation industry. It is great to demonstrate how smaller companies have a role to play in this change on a larger scale, alongside big players such as Safran and Airbus, and complementary to their internal R&T departments.

These past months have been both very challenging and very interesting for BrightLoop Converters and many other SMEs as we have gone through an unprecedented situation. COVID-19 has surely caused concerns as activity slowed down for many of us and uncertainty arose, especially on the civilian aeronautics market. Still, such a complex market requires long-term commitments, and programmes such as Clean Sky are therefore essential to allow us to get past such difficult times and prepare long-term innovations.

Clean Sky is a vehicle for cooperation between SMEs but also for job creation. In this sense, the programme clearly represents a support of the European industrial network. At BrightLoop Converters, we have faith in this type of programme, which enables us to build new technologies as quickly as possible to accelerate the development of cleaner aircraft, but which also gives SMEs a space in the industrial chain of a complex domain. We are proud to participate in innovation programmes of this type and thus be at the heart of European innovation.
It is a known fact that in-flight icing on aircraft may have serious consequences for flying performance and may lead to fatal accidents. Even very little surface roughness caused by a thin ice layer generates significant aerodynamic effects, such as a precipitous drop in lift caused by flow separation. Therefore, the improvement of in-flight ice protection systems has high priority for EASA and has been on United States’ National Transport Safety Board’s Most Wanted List of safety improvements since 1997.

Villinger GmbH has been dedicated to the development, production and integration of innovative in-flight ice protection systems since the get-go. Based on our unique electrothermal technology, formed by a 0.5mm thin heater layer, our systems are characterised by minimum power requirements, while providing unmatched Mean Time Between Failure and fail-safe properties. Starting in 2005, various types of ice protection systems for different aircraft components have been added to the portfolio.

We started off by developing the first commercially available fully integrated propeller ice protection system. We were astonished that, for propeller ice protection, even the most advanced propeller-driven aircraft (ranging from general aviation (GA) to regional aircraft) still relied on thick rubber boots with embedded heating wires that are bonded on the outer surface of each propeller. Creating a notable height gap between boot and propeller surface, this technology disturbs the airflow over the propeller’s aerodynamic profile significantly.

Since aerodynamic efficiency directly affects aircraft performance and fuel consumption, we were motivated to design a propeller ice protection system that guarantees a 100% clean and undisturbed aerodynamic surface while providing the same (in fact, better) de-icing capabilities.

This was achieved by integrating our heating technology directly into the propeller structure. In close cooperation with MT-Propeller, the first experimental tests at Rail Tec Arsenal icing wind tunnel, followed by flight tests, were executed in 2010. For direct comparison, a propeller equipped with conventional boots underwent exactly the same testing procedures. The conclusion: our propeller achieved a 9% improvement in efficiency resulting in a significant reduction of fuel consumption compared to the one with conventional de-icing boots.

Since then, a fleet of GA aircraft equipped with our propeller ice protection system has collected thousands of flight hours, without a single failure. Having proved the system’s durability, we hope for a future Clean Sky call devoted to the development of a novel propeller ice protection system for the Clean Sky Green Regional Aircraft platform, in order to contribute to future aviation’s greener footprint on a larger scale.

Until then, through the participation in and coordination of numerous Clean Sky projects aiming for new solutions to cope with in-flight icing (NO-ICE-ROTOR, InSPIRe, TRiCEPS & SEaSiDE), we are able to further improve our capabilities as a competent SME with a strong focus on aircraft ice protection.

Besides research and development in Clean Sky projects, in-house research activities and coopertions with partner organisations has been a high priority as well. Case in point: “RISP”. Developed during testing activities at the icing Spin Rig from Pennsylvania State University, together with its operator and personal friend Jose Palacios, RISP (Rotor Ice Shed Protection) solves a common problem that mainly applies to tilt-rotor aircraft, such as Leonardo’s Next Generation Civil Tilt Rotor: when in cruising configuration, ballistic shed ice from the spinning rotor blades can hit the aircraft’s fuselage – therefore creating a major safety concern. As a passive system, RISP is capable of reducing the size of such shed ice junks into small pieces, making them harmless to aircraft structures. A proper commercialisation of RISP is yet to come…

However, currently, just like every other organisation active in the aerospace industry, we are doing our best to work through the COVID-19 pandemic and adapt our plans for the next years. We are trying to fight the pandemic itself by developing an air decontamination system, to be installed in Large Passenger Aircraft cabins. In coordinating the Horizon 2020 project “CleanAir”, we can hopefully re-establish the population’s trust in commercial aviation and help overcome this difficult situation – luckily, once again, with support from the European Commission’s funding programme.
As the aerospace industry faces increasing challenges to provide resource efficient solutions, faster times-to-market, and transparent reporting of environmental risks, Clean Sky 2 funding has enabled Ansys Granta (formerly Granta Design) to develop a digital solution for the aerospace industry to address material and process challenges for topics on Additive Manufacturing, Eco-Design and Restricted Substances with an emphasis on early concept design phase intervention. Working closely with a Topic Manager who champions the project solution as part of a wider technical programme for the European aerospace supply chain is an exceptional chance to receive direction on what is needed today and in the future. Here we share our business motivation and outcomes of two Clean Sky 2 projects.

Granta Design was an SME for over 20 years (until February 2019 when it was acquired by Ansys Inc.), with a core business for design and development of world-leading software products related to materials information management, data, and tools (eco-design, circular economy, restricted substances, critical materials assessment, materials selection and substitution); several of which integrate with CAD/CAM/PLM. Ansys Granta contributes to networks and standardisation bodies and supports industry-standard commercial databases for materials such as metals, composites, polymers, and medical devices. Ansys Granta also produces and maintains several leading data products including Materials Universe (a database of over 4,000 commercially available engineering materials including technical, ecological and cost attributes for each material and its associated processes) and the Product Risk database which incorporates one of the leading resources on restricted substances as well as critical and conflict minerals risks and data needed for streamlined life cycle analysis.

Our core product is called Ansys GRANTA MI which supports enterprise-wide collaborative projects by providing a centralised materials information management system. For R&D projects this enables the pooling and consolidation of project knowledge which would otherwise be dispersed amongst the many partners. This approach enables standardisation and capitalises on the value in the project by avoiding duplication of effort and maximising results visibility to partners and external stakeholders.

Developing teaching resources is an important part of collaboration with leading researchers (MOOKS, Webinars, Case Studies, etc.) which can reach a significant audience at over 1400 academic institutions world-wide through our education tool for materials selection (Ansys GRANTA EduPack).

Ansys Granta has participated in two Clean Sky 2 projects since 2016:
1) PASSPORT (No. 785562, 2018-01 to 2019-06), Part Specific Process Optimisation for Selective Laser Melting, coordinated by TWI. The project addressed additive manufacturing design optimisation to ensure high-quality AlSi10Mg parts with complex geometry to improve the time-to-market for SLM (Selective Laser Melting) parts, by removing significant cost and time-intensive burdens associated with optimising SLM builds. The project undertook the development of a bespoke, stand-alone process parameter selection software solution (underpinned by the Ansys GRANTA MI system), which can communicate with multiple vendors’ SLM machines. The system captured experimental data/information provided by TWI (metallurgy and detailed experimental testing) for calibration and validation of state-of-the-art numerical modelling of SLM processing, and the creation of a process parameter database used to inform the optimisation algorithm. The algorithm relates different scan strategies with local part topology and geometry characteristics, and process parameters are assigned to different geometries in the STL (Stereolithography) file (You can watch the webinar on demand: A Case Study in Additive Manufacturing: Optimizing Geometry-Specific Process Parameters for SLM Builds).  
2) PLEIADES (No. 715775, 2016-08 to 2020-12), Project to Lead Ecodesign Integration with Aerospace Development and Engineering Systems. The project addresses eco-risk and how to implement data for decision-making at the early concept design phase, led by Ansys Granta (coordinator). The main objectives of the project are to:
a. Develop industry-focused eco-design tools that support actual aerospace engineering workflows.
b. Support development teams to take a combined view of engineering, environmental, sustainability, and business considerations.
c. Achieve this through a focus on the vital role of material and process decisions in product development.
d. Integrate and ensure effective use of both primary and secondary data on materials, processes, and products.
e. Remove the barriers to cost-effective use of life cycle assessment approaches in product development.

With the support from Ansys Granta the main outcomes from PLEIADES include:
1. A matured schema to manage sustainability data, alongside material and process data, and uncertainty within the Restricted Substances Data Module.
2. Produce business relevant reports on products and locations using a mixture of primary, supplier and reference source data.
3. The ability to exchange data with full LCA (GaBi/Endam).
PLAYING OUR PART IN GREENER AVIATION!

Paweł Balon, PhD Eng.
R&D Project Manager, SZEL-TECH

SZEL-TECH is a Polish SME which manufactures components for airplanes, helicopters, gliders, rolling stock and firearms. Our main products include structures of frames, trusses, air conditioning tanks and anti-icing installations (in aviation), as well as elements of firearms and braking systems for rolling stock. We supply countries throughout Europe, particularly Austria, the UK, and Germany, as well as Poland; and companies such as Diamond Aircraft, Sikorsky Company, ExtrimeAir, Zakłady Mechaniczne Tarnów, Mesko Skarżysko-Kamienica, and Fabryka Broni "Łużnik".

SZEL-TECH is proud to have been participating in European programmes since 2016, including several projects within Clean Sky 2 and Horizon 2020. This has given us the great opportunity to work with other companies throughout Europe. The projects we are involved in are:

1. More Affordable Small Aircraft Manufacturing (SAT-AM)

In SAT-AM, we are researching and analysing new technologies and methods for manufacturing aircraft structures, aiming to reduce the number of parts required and therefore the weight, as well as make the manufacturing process itself more efficient. The components being developed in the project will be tested on the cabin and nacelle of a PZL Mielec M28 engine. SZEL-TECH is part of the SAT-AM consortium, coordinated by the Institute of Aviation, consisting of 8 partners representing the aviation industry and research institutes (PZL Mielec, Eurotech, PW Metrol, Ultratech, Zakłady Lotnicze Margrafski & Myskowski, and the Italian research and development institute Centro Italiano Ricerche Aerospaziali (CIRA)). The completion of the SAT-AM project is scheduled for 2021.

2. HIGH speed civil Tilt Rotor wind tunnel Project (HIGHTRIP)

The goal of HIGHTRIP is to design, execute and conduct tunnel tests of an aircraft model in a mixed system (tilt rotor) developed by Leonardo Helicopters in cooperation with partners under the Clean Sky 2 programme. Here we are part of a consortium coordinated by NLR – we are working with them and PW Metrol on the production process, while the Institute of Aviation is taking part in the design process. NLR are responsible for the instrumentation and measuring equipment, and the tunnel tests will be carried out at the French ONERA Institute. The designed model will meet the requirements set by Leonardo Helicopters.

3. TRAIL

The TRAIL project consortium is tasked with designing, testing and delivering engine nacelles with an engine suspension for the Next Generation Civil Tilt Rotor Technology Demonstrator (NGCTR TD) developed by Leonardo Helicopters. The consortium, coordinated by the Łukasiewicz Research Network-Institute of Aviation (also responsible for the design, analysis and testing), consists of 7 partners, including Politecnico di Milano (vibration and noise reduction), Trelleborg Sealing Solutions (firewalls), NLR (VARTM process development), LA Composite (production of composite elements and integration), PW Metrol and SZEL-TECH (both companies responsible for the production of metal elements).

As part of these projects, we plan to create a R&D centre for research and creation of new truss- and frame-based structures for aircraft in the class up to a maximum take-off weight of 5700 kg. The optimised structure will enable reduced weight, improved accuracy of execution, and increased load capacity of these structures, bringing environmental and cost benefits. The ultimate goal of the projects is to develop new small and medium-sized airplanes with a wide range of applications, based on lattice structures developed in the laboratory. Small and medium-sized aircraft, which can be serviced by small local airports, are particularly important for the concept of 4 Hours Door-To-Door' air travel, and we aim to be as efficient as possible!

The COVID-19 business restrictions relied heavily on remote working and significant restrictions for the workshop. However, in this era of global economic slowdown, SZEL-TECH has managed to overcome the crisis by focusing on the diversification of production, which has actually allowed us to expand and enter new markets. At the same time, we have made investments to significantly increase our production capacity: we have built a new company headquarters and expanded the machine park, as well as implementing new technologies in the area of machining and precision welding. We are looking to the future with great optimism!
YOUNG INNOVATORS TAKE CENTRE STAGE AT CLEAN SKY’S BEST PHD AWARD 2020

On 6 October, representatives from the aviation industry, academia, research institutions, SMEs and the public sector gathered online to celebrate the brilliant young minds of three innovative students who won Clean Sky’s prestigious Best PhD Award 2020.

Each year, the Award recognises PhD candidates whose work reflects the values of Clean Sky and will bring us closer to achieving Clean Sky’s ambitious environmental goals.

Dr Hossein Balaghi Enalou (University of Nottingham) was awarded first prize for his innovative work on the “Electric Power Transfer Concept for Improved Performance of Multi-spool Turbofan Jet Engine”, while Dr Fedor Fomin of Helmholtz-Zentrum Geesthacht (HZG) came second, with “On the fatigue behaviour and modelling of fatigue life for laser-welded Ti-6Al-4V”. Third place went to Dr Pedro Magalhães de Oliveira of the University of Cambridge for his thesis: “Ignition and propagation mechanisms in kerosene spray flames”.

All three prize-winners are “moving the needle forward” – as Grazia Vittadini, the Chief Technology Officer at Airbus put it – towards sustainable aviation. Dr Hossein Balaghi Enalou’s new engine model, for example, showed a significant improvement in engine performance, resulting in a fuel consumption reduction of up to 2% and surge margin increase up to 5%.

The winners said that strong links between their universities, research institutions and the aviation industry were key to their success, and highlighted that Clean Sky is the ideal vehicle through which to channel innovative research in sustainable aviation thanks to its public-private structure.

The Clean Sky Best PhD Award is an initiative of the Clean Sky Academy, which aims to encourage young engineers and innovators to come up with solutions to the challenges of sustainable aviation. The Academy was represented by Dr Jean-François Brouckaert of Clean Sky and Joris Melkert of TU Delft. Both congratulated the winners on their well-deserved Awards.

“Young innovators have a huge role to play in sustainable aviation. They think creatively and explore new ideas and concepts. These students’ careers are just taking off – I wish them a smooth flight!”

Axel Krein – Executive Director, Clean Sky

“It’s very important to recognise the talent of our young scientists and they serve as an inspiration for the community. Today’s students are tomorrow’s scientists and engineers!”

Patrick Child – Deputy Director-General, DG Research and Innovation, European Commission
The aviation community is a close family, and Clean Sky provides a great platform to bring students and researchers on board.

Prof. Andreas Strohmayer – Head of the Department of Aircraft Design, University of Stuttgart; Chairman of the European Aeronautical Sciences Network (EASN)

Clean Aviation is THE R&D flagship! Nobody will manage on their own, no company, no nation. We cannot achieve these feats without a multilateral approach together with our European partners.

Grazia Vittadini – Chief Technology Officer, Airbus

There should not be any barriers between industry and researchers. We should challenge the young people – with moonshot programmes!

Michel Peters – CEO, Royal NLR; Chairman of the Association of European Research Establishments in Aeronautics (EREA)

The goal of the Clean Sky Academy is to stimulate young innovators. If we do not invest right now, we will have a problem in the future.

Joris Melkert – Senior Lecturer at TU Delft; Member of the Clean Sky Academy Working Group
Clean Sky 2 is headed for Aerodays 2020!

Join us on 24-26 November for Aerodays 2020! Our Executive Director, Axel Krein, is speaking at the Berlin Aviation Summit on 24 November and Clean Sky is also hosting a panel on 25 November on ‘Paving the way towards climate-neutrality by 2050’. Last but not least, for the first time ever Clean Sky will present our latest and greatest innovations virtually on an online stand. Make sure that you check it out! More details: [www.cleansky.eu/event/aerodays-2020](http://www.cleansky.eu/event/aerodays-2020)

Save the Date for Clean Sky’s Spring Event 2021 - 20-21 April

Preparations are underway for Clean Sky’s Spring Event 2021. Details to follow! For now, please save the dates 20-21 April 2021 in your calendars, and stay up to date on Twitter ([@cleansky_ju](https://twitter.com/cleansky_ju)) and LinkedIn ([Clean Sky Joint Undertaking](https://www.linkedin.com/company/clean-sky-joint-undertaking)).