1. Publishable summary

SARISTU – **S**m**AR**t **I**ntelligent Aircraft **ST**r**U**ctures (www.saristu.eu), is a level 2 project conducted within the European Union's 7th Framework programme addressing the air travel cost reduction aspect of the 4th call.

As such, SARISTU's principal aims target a reduction of the manufacturing and in particular the operational cost of civil airliners. For this purpose, it matures and integrates different concepts which enable further fuel burn reductions through aircraft drag and weight reductions, reduce aircraft downtime in case of unscheduled inspections and improve the manufacturing times and subsequent performance of advanced fuselage structures.

Organized along the major principal components of an aircraft, development and integration activities centre on wing specific applications on one hand and fuselage applications on the other.

With respect to the wing specific applications, the further maturation and development of conformal morphing technologies, which enable a smooth shape change of aerodynamic surfaces, as well as the integration of structural health monitoring are at the focus of activities. To date, conformal morphing surfaces could not be implemented in practice due to the conflicting requirements of a high required stiffness and the ability to be actively deformed. Furthermore, additional functionalities have to address specific aircraft requirements such as lightning strike protection, bird strike protection, erosion protection and a reliable integration of different sensor systems into the control architecture. By enabling the consideration of conformal moving surfaces at the aircraft design stage, SARISTU has shown these technologies capabilities to reduce the fuel consumption of future airliners by 6,5% while at the same time offering improvements in flight path noise of up to 8dB.

Fuselage specific applications centre on the integration of structural health monitoring technologies in the aircraft architecture as well as the further maturation of multifunctional structures and the improvement of a typical fuselage's robustness. By enabling a significantly more rapid damage assessment and categorization than is currently possible, aircraft structural inspections due to accidental damages are expected to be performed with a significantly reduced delay. This in turn was shown to result in a cost reduction of such in-service inspection activities of more than 1,33% for carbon fibre based fuselage structures. Furthermore, improvements are investigated and developed within SARISTU's multifunctional structures approach which, among other solutions, arise from integrating carbon nanotubes into the basic skin-stringer-frame system. The resulting gains can be exploited either directly for an improved structural robustness or translated into corresponding structural weight savings of 2,2%. Although short of the 3% objective, additional benefits coming from the possible exploitation of the increased electrical conductivity boost achievable weight savings to 5% versus the reference structure.

Multifunctional structures also utilise the conductivity of carbon nanotubes in order to enable a carbon fibre based structure to perform low level electrical functionalities. Together with further technological integration targeting the higher electrical functions such as electrical grounding and bonding, it was expected that the currently heavy and costly electrical structure network required for a black fuselage can be designed significantly lighter and installed approximately 15% more cheaply. Due to the difficult establishment of complex benchmarks, SARISTU could only determine a 4% cost improvement but, as it was unable to factor in the exact installation cost savings and had to rely exclusively on weight saving benefits, this is a highly conservative estimate.

Culminating in wing and fuselage specific demonstration and performance verification activities in its fourth and final year, SARISTU has shown benefits beyond its current scope of more affordable air travel. While conformal morphing can in principle be applied to further aerodynamic surfaces, it could also bring benefits to other industries where active aerodynamic or fluidic control is beneficial. Similarly, structural health monitoring can be expected to bring operational benefits wherever light weight construction is of primary importance. Last but not least, overcoming the technical obstacles of composite structures related to their electrical properties as well as the integration of data generation and transmission will be applicable well beyond the aircraft industry.

At present, SARISTU has successfully completed it active project phase, delivering 271 dissemination actions to the scientific community and well beyond through dissertations, published papers, conference presentations, press releases and attendance to trade fairs. The successful test completion of its three dozen significant structural demonstrators in the fourth year allowed the completion of 186 deliverables and milestones totalling over 10,000 pages. An early summary of the most significant results has been made available to the public in the form of the 1039 page Proceedings of the Final Project Conference.

Due to the focus on structural testing, the majority of the demonstration exercises resulted in the destruction of these test articles. However, the SARISTU Wind Tunnel Model used to verify morphing and load monitoring capabilities, the SARISTU Door Surround Structure used to verify damage detection, location and sizing capabilities, one smaller demonstrator for each of the morphing leading-, trailing- and winglet trailing edges as well as the demonstration panel for co-bonded metal remain with the respective project partners.

Publishable Summary: Images

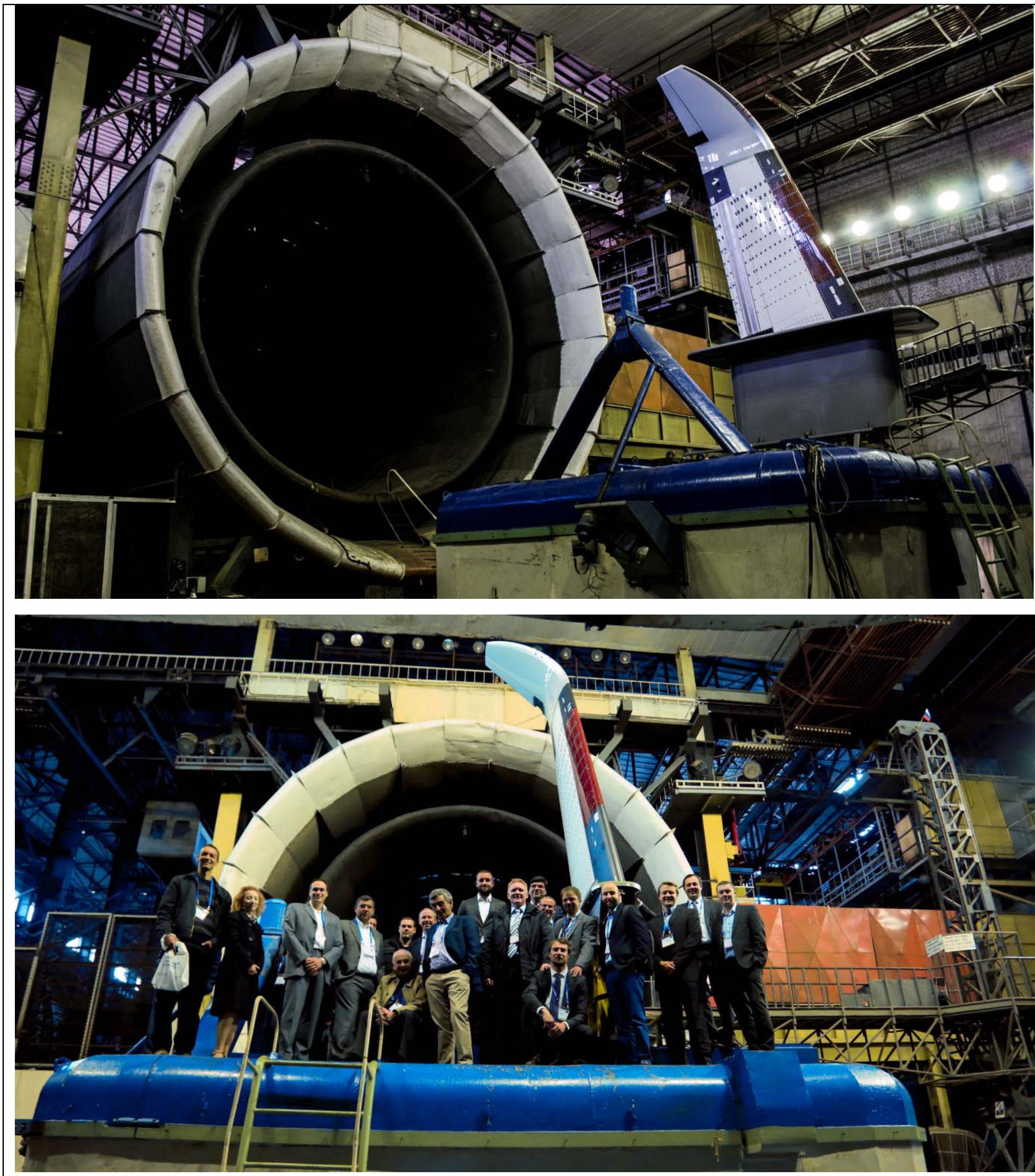

Figure 1: SARISTU Wind Tunnel Demonstrator in the T-104 Wind Tunnel at TsAGI

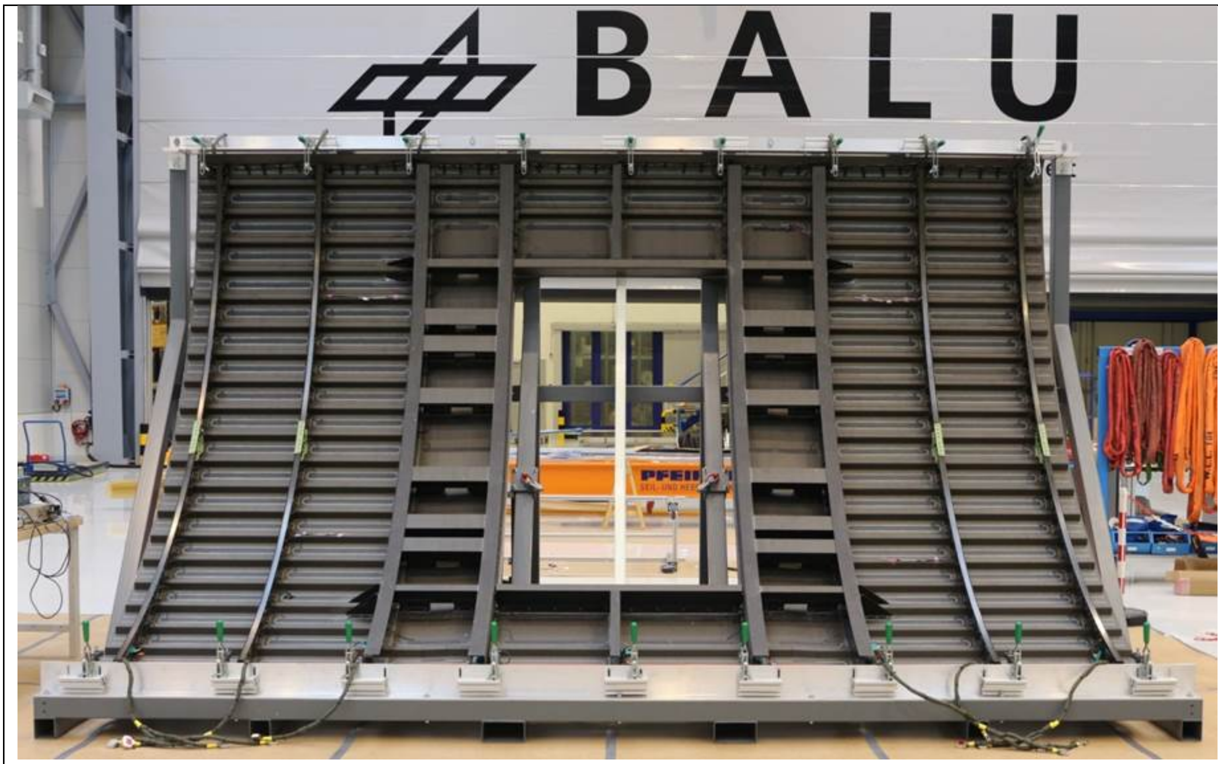

Figure 2: SARISTU 5 X 4m self-sensing Door Surround Structure at DLR

Figure 3: SARISTU 2,7m Nanocomposite panels at TAI prior to shipment to Airbus