...making excellence a habit.™

The future of aerospace through the lens of sustainability

Collaboration and integration

- Greater collaboration within the sector and across industries
- Data integration across and within companies
- Enabling full automated value chain

Manufacturing

- 3D printing, especially of parts and prototypes
- Enabling decentralized production and improved productivity

Design

- Circular economy
- Design for adaption

Data, analytics and augmented reality

- Comprehensive evaluation of vast amounts of data from multiple sources
- Real time decision making and optimization
- Information displayed in engineer's visual field
- Connected assets

A ‘new normal’ for Aerospace

As leaders in organizations across the world grapple with the forces reshaping our world, we find ourselves needing to learn from the past, ensuring we act in the present while trying to understand what may lie ahead. With uncertainty affecting many sectors, now is a good moment to take stock and understand what the future may hold, what will remain the same and what may be different in our futures for Aerospace.

Going beyond shareholder value

Changes that we know we will see, brought about by increased awareness and a higher degree of social consciousness of society/consumers—married with public demand for greater transparency, will result in Aerospace being held to account, both non-profit organizations as well as their shareholders. In a more connected and digitally productive world, the challenge isn’t about merely fielding a problematic question and publishing corporate reports; companies need to ensure that they also come up with the answers to the difficult questions asked by a much broader and more informed stakeholder group. This isn’t anything new, as the industry has always been under a high amount of public scrutiny and as a result, driven to evolve, ever since the day it became a genuine commercial enterprise. The effect of this driver is demonstrated by the fact that in the last 50 years there has been a 70% reduction of fuel/passenger/Km.

As we look forward, ensuring aerospace businesses are purpose-led, going “beyond shareholder value” will be an essential driver.

Enablers of growth

As we see restrictions lifted and organizations put an emphasis back on their core business, one development which we have seen during the pandemic and which will become even more significant, is that of increased collaboration, within the aerospace sector and across other industries. Such cooperation is a real enabler of growth and sign of corporate maturity. There are also, however, barriers to overcome to achieve full collaboration, such as competition law, as well as “collaboration fatigue”. Such an approach requires a very different way of thinking.

But what of the future? There’s little doubt that evolving technologies such as electric propulsion, smart new materials and manufacturing methods will bring further opportunities for the industry.

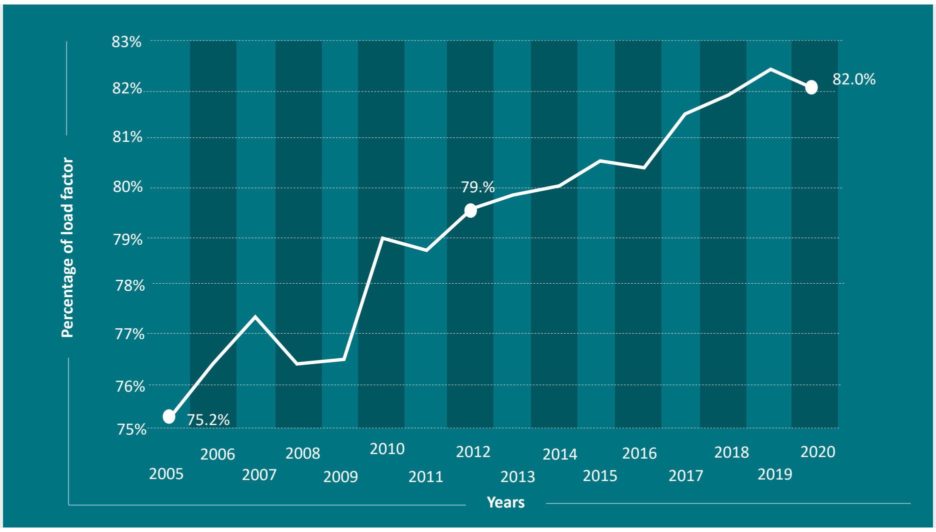
Although we will see new technology added to new aircraft coming into service, the challenge and the impact will come from managing and upgrading the existing fleet so we can make the most of the opportunities which are without doubt coming. Being able to adapt will be critical in our thinking, for both aircraft and the culture of organizations that operate in the sector. Equally, as some of the new technology and materials come forward into routine use, we do need to ensure we continue to maintain a balanced view. For example, the use of advanced materials, which will have a significant advantage in the reduction of weight/fuel consumption. If new materials and the components that they form are not well designed, they will not be able to be re-used due to the cost and complexity of the recovery process, leading us to a linear way of thinking: extract, make, use and dispose of. But by using the principles of the Circular economy from design through to re-use, repair, refurbishment, remanufacture and end of life recycling to create a closed system, we minimize the use of resource input. This approach also reduces waste, pollution and importantly, carbon emissions as well as keeping products, equipment and infrastructure in use for longer, thus improving the productivity of these resources. We must continue to ensure the principles of circularity are part of the design and management of the impacts on the industry.

New forecasts, new metrics

Although our habits will change, the latest projections before the pandemic from the International Air Transport Association (IATA) were that global passenger numbers would double by 2036, rising 7.8 billion annually. This prediction is almost certain to change, with a lower rate of growth, starting from a point of rapid reduction due to the pandemic.

Whilst we may see a change in the quantity of travel in a post-pandemic world, we will also see a continuation of the evolution of the design, operation and maintenance of our aircraft. With less travel, will come smaller margins and a drive for higher efficiency. Some of the battles for efficiency will be centred on materials and systems, changing not only component design, but also the shape and nature of aircraft themselves. We have seen some of this in the older variants of narrow-body planes which feature conventional aluminium wings and fuselages. The newer aircraft such as the A220, A350 and the 787 have significant proportions of composites in their construction. Although previous-generation aircraft have used composite material (around 17% of the 777 is carbon fibre), we predict that this proportion is only set to increase.

New design concepts such as the blended wing will focus on reduction in fuel consumption to increase the Revenue Per Kilometre (RPK), while also benefitting the environment. But this is countered by the effects of the COVID-19 pandemic, with operators having to consider social distancing, and so removing or not using middle seats, fitting screens between seats, perhaps carrying additional PPE for cabin crew, and deep cleaning of aircraft between flights. All these factors increase weight and reduce passenger capacity, while increasing turn-around time between flights. The net effects are higher fuel burn per passenger kilometre with a much-reduced load factor, increased costs and reduced numbers of flights in operation. So, technology has a steep hill to climb. In the meantime, resilience is key to survival.



Source: Passenger load factor of commercial airlines worldwide from 2005 to 2020, Statista, March 2020

The fight for efficiency and innovation

The fight for efficiency and innovation will be hard fought in the skies. It is however important that we see what we are trying to achieve here from a whole life and life-time cost perspective. The use of more advanced materials will have a significant advantage in the reduction in fuel consumption, but we will not be seeing materials such as aluminium being reused and put back into the supply chain. This leads us to a more linear way of thinking: extract, make, use and dispose of, which in turn may increase cost. But if we pause and consider circular systems, employ an approach which looks to reuse, share, repair, refurbish, remanufacture and at the end of life recycle to create a closed system, we have the potential of minimizing the use of resource input. This approach also reduces the creation of waste, pollution and importantly, carbon emissions. Such an approach also aims to keep products, equipment and infrastructure in use for longer, thus improving the productivity of these resources. We must continue to ensure the principles of circularity are part of designing and managing the impacts of the industry, ensuring longevity and therefore resilience.

Designing for adaptation

When looking at some of the sustainability challenges, it is also essential that we learn from other sectors. This will increasingly be the case as we see significant research and development in new technology, which won't deliver a return on investment unless deployed across multiple sectors. We have already seen the use of advanced battery storage technology, developed in the automotive industry, move into domestic properties. We've also seen Phase Change Materials (PCM) developed for the space program transfer to commercial buildings. Another area where there is also an opportunity to learn from others is in design for adaptability, using the principles of life-cycle assessment to ensure that the right materials are used for the service life of the product or environment in which they are placed and designed for adaptability. In an aerospace context, we need to ensure changing passenger demands – driven by the fast pace of development in consumer technology - have resulted in airlines operating fleets with increasingly different cabin layouts. If we take a more modular approach, it would be very easy to very quickly change the design without incurring high costs.

Increasing digitisation

With increased digitisation across the entire aerospace sector we will also see not only efficiencies in operation, but a need for a very different skill set. Technicians will be using VR to visualize a problem better and find the best solution while an aircraft is in flight or find a more efficient way to assemble by "stepping inside" or viewing the aircraft from multiple angles. Add to this the need to remove the trusted paper manual, understand if components are failing or have been poorly installed, or if further training is required, and it's clear so see traceability is key to information resilience. Being able to call up relevant data by the simple swipe of a finger on a handheld device, and data to be as quickly transmitted back to a single Common Data Environment (CDE), will become more critical.

Drones, 3D scanning and beyond

In the future of Aerospace, drones or unmanned aerial vehicles (UAVs) will play a significant role, from the delivery of small packages to their use for maintenance and inspection. Several airlines are already using drones to detect surface damage, thus reducing the time taken to inspect each aircraft, and freeing up technicians for other tasks. Comparing to the original scan of the aircraft as it left the factory, will lead to a greater understanding of how each aircraft is performing structurally over its service life. Allowing pro-active maintenance or investigation to the airframe where there are changes in the dimensions of a part of a scan of the aircraft will enable further studies to be triggered. If we add this technology to predictive maintenance, where an increased number of sensors are inserted into the design of components, we are seeing a very different maintenance regime coming into place. If we have access to data analytics to show the decay curves of performance of individual components, we can replace/repair them in advance to maintain optimum performance or conversely, extend their on-wing time, so getting more utility from components while maintaining safe operation. As aircraft systems become more complex, and satellite datalink coverage becomes more complete, aircraft are becoming able to share 400,000 data points, in real-time, presenting both an opportunity and risks.

Connected assets

As the evolution of the internet and Internet of Things (IoT) has clearly demonstrated, with increased connectivity comes the risk of data security and a potential risk to critical national infrastructure. In addition, increased emphasis on transparency/openness and interoperability, to allow new services to be developed and more agile ways of working to be implemented, means we need to seek specialist advice to ensure connected assets are managed securely and safely.

Moving to the power of electricity

Whilst fossil fuels are still an important part of aviation, the rapid evolution of alternative battery technologies and advances in electrification are set to change the future of aircraft propulsion.

From a sustainability perspective, this is good news for emissions, but as mentioned in previous examples, we must use the best technology with the lowest impact and ensure that we are mindful of the end of life phase, so that components such as batteries can be reused, or have a second life in less demanding environments. We have already seen progress in this direction for several years. Hydraulic systems are being replaced by electrical systems in the drive to save both weight and increase efficiency and reliability. This means that to meet consumer demand for use of electrical devices on board, as well as electrification of aircraft systems, additional onboard storage will be needed. There is still much to do, with the most significant challenge being weight and energy storage density.

The final stage in electrification is that of propulsion, where another revolution is currently taking place, starting with small aircraft. If an electrically-powered commercial aircraft is to be achieved, Airbus believes that there will be a need for 40MW of power for the take-off, dropping to 20MW during the cruise. The E-Fan hybrid electric engine will be an essential step in this process. Airbus and Rolls Royce had intended to replace one of the four engines on a BAe 146 jet with a 2MW electric motor, but due to the pandemic and financial constraints, this project has been cancelled.

It is very clear that the sector is undergoing enormous change. We're seeing how efficiency and technology go hand in hand and how we can so quickly learn from other industries. Opportunities are ripe; sustainability, transparency and greater collaboration will all be significant drivers towards resilience, and in securing the future of our sector. The needs of the future will be very different from those today. But one thing is for sure, we have an exciting prospect; an industry which will continue to attract the best talent inspired to drive change and innovate.

About the authors

Martin Townsend, Global Head of Sustainability and Circular Economy

In his career to date, Martin has worked as an environmental Regulator, advised UK Ministers, worked with City Mayors and worked with business of all sizes, ensuring Sustainability comes alive and is seen to be an enabler of business success. Martin joined BSI as Global Head for Sustainability and Circular Economy in November 2019 and sits on several advisory boards for public and private sector organizations to support them in their own success.

Brendon Hill, Global Head of Aerospace

With over 40 years' experience in aerospace and engineering Brendon leads the strategic direction of BSI's aerospace sector. Brendon collaborates with industry bodies to drive innovation and is an international speaker, leading the way for a safe, secure future for the sector. Previous experience includes 26 years as a British Army Officer and Aircraft Engineer, both writing and implementing the quality management system and providing technical support to British Army aviation. He has also worked at a senior level in manufacturing in aerospace and other high-risk sectors.

Why BSI?

BSI (British Standards Institution) is the business standards company that equips businesses with the necessary solutions to turn standards of best practice into habits of excellence. Formed in 1901, BSI was the world's first National Standards Body and a founding member of the International Organization for Standardization (ISO).

Over a century later it continues to facilitate business improvement and organizational resilience across the globe by helping its clients drive performance, manage risk and grow sustainably through the adoption of international management systems standards, many of which BSI originated. Renowned for its marks of excellence including the consumer recognized BSI Kitemark™, BSI's influence spans multiple sectors with a particular focus on Aerospace, Automotive, Built Environment, Food, Healthcare and IT. With 84,000 clients in 193 countries, BSI is an organization whose products and services inspire excellence across the globe.

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