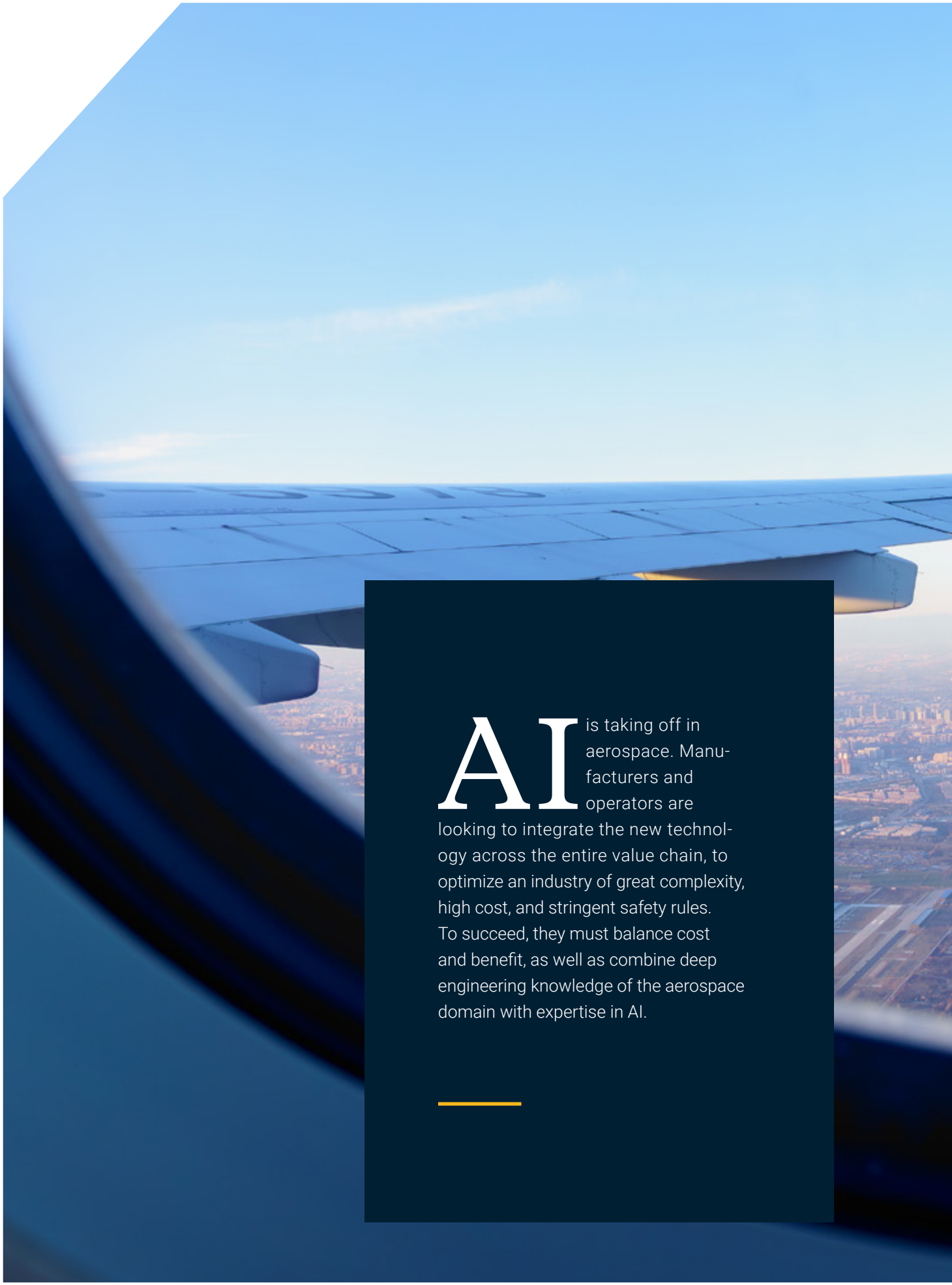
AKKODIS

AI In The Air

Time For Aerospace To Scale The AI Opportunity

Contents



AI is taking off in aerospace. Manufacturers and operators are looking to integrate the new technology across the entire value chain, to optimize an industry of great complexity, high cost, and stringent safety rules. To succeed, they must balance cost and benefit, as well as combine deep engineering knowledge of the aerospace domain with expertise in AI.

TRAFFIC GROWTH

+100%

Air traffic expected to double in 20 years – AI can help manage challenges and complexity

The aerospace industry has always been at the forefront of technological innovation, constantly pushing the boundaries of mobility. As a result of the industry's focus on continuous improvement, air traffic is now moving just below five billion travellers annually (2024). Commercial air travel will grow even further, with the number of aircraft transporting passengers and freight expected to double in the coming two decades.

But to sustain the rapid growth predicted, the industry must overcome several challenges, such as disrupted supply chains, geopolitical uncertainty, and rising operational costs. Together with slim profit margins and a growing focus on sustainability and emissions reduction, these factors will shape the industry's trajectory.

AI has much to offer, considering the complexity of aerospace together with the ability of AI to tackle large amounts of data and optimize processes.

AI-powered solutions are already emerging in several areas across design, operations, manufacturing and maintenance, with many more to come. Aerospace industry players are finding ways to infuse AI into their value chain, while at the same time balancing cost and benefit. Walking that tricky tightrope will require some effort, as the promises of AI are tested against the day-to-day reality of the aerospace industry with its relentless demand for precision and optimization.

To master all of this, two approaches need to be merged: deep engineering knowledge of the aerospace domain, and expertise in AI.

Will the aerospace & AI journey be smooth sailing? Probably not, as AI is an emerging technology breaking new ground in aerospace.

Nonetheless, the time is ripe to move to the next level of digital transformation. And considering the industry's track record of continuous innovation, aerospace is in a unique position to seize the opportunities AI is offering.

01

Optimizing Aerospace Product Design With AI

Much good can be said of the power of AI in digital engineering. It has the potential to improve and accelerate engineering tasks across the aerospace V-model, linking left-side development phases with right-side testing and validation.

Traditional aircraft design involves a combination of manual calculations, computer simulations, and physical testing. These methods can be time-consuming, resource-intensive, and error prone. New AI-powered design tools allow for faster optimization and simulation of aircraft geometries, thus reducing wind tunnel testing, to determine an aircraft's aerodynamic performance.

Also, AI has the potential to optimize the design of digital tools indispensable to the engineering value chain, such as digital twins. Aircraft developers rely on virtual models to simulate aircraft and their various subsystems in a digital environment. On one hand, these digital twins are speeding up product development timelines by reducing the need to physically build and test prototypes, thereby minimizing cost. On the other hand, digital twins are time-consuming and expensive to build. AI has the potential to change that, assisting engineers in constructing parts of a digital twin by analyzing text and image data automatically.

SOFTWARE COMPLEXITY

100 million

Lines of code in the Airbus A380, showing the complexity AI can help manage

AUTOMATED TESTING

AI models generate endless edge case scenarios

Copilots For Coding

Aerospace software is becoming increasingly complex and interdependent. As an example, the Airbus A380 has 100 million lines of code embedded in processors scattered throughout the aircraft.

AI can help handle this complexity. Looking at software development in general, programmers experience productivity gain by using GenAI tools to perform simpler code writing tasks, which allows the programmer to focus on more high-level issues that require human creativity.

Also, code review can benefit from AI-induced turbo power. Updating software and adding new features requires code review, and valuable time can be saved by enhancing code review with AI. Especially, when an older piece of software needs maintenance and updating, a specialized AI agent can ingest thousands of lines of code and point a developer to specific areas of focus.

Testing is emerging as another clear-cut use case. In testing, AI technology can be put to efficient use, saving time and allowing for a more fine-grained testing of edge cases. As an example, in the automotive industry, driver assist systems are tested using GenAI models automating the testing process from end to end. Rather than relying on engineers to manually devise test cases, AI models can generate a seemingly infinite variety of scenarios. The result is a significant increase in test coverage, simultaneously reducing testing time. The use of harvested real-world data and synthetic data generation allows companies to streamline their product development lifecycle. New features and platform launches can be achieved faster, as manual testing cycles taking weeks or even months are replaced by automated, AI-powered feature validation accomplished in days.

Modelling Physical Phenomena

AI can be used in nearly any application that implies mathematical optimization problems. It is well-suited for improving design processes, by optimizing the modelling of physical phenomena. Leveraging AI-driven simulation techniques, engineers can predict the performance of designs under various conditions without the need for extensive physical prototypes. For instance, the impact of design changes on aerodynamics can be tested much faster than before, as well as addressing challenges in fluid dynamics, structural engineering or electromagnetics.

SIMULATION SPEED

Faster

AI-driven simulations reduce the need for physical prototypes

DESIGN TESTING

Aero-dynamics

AI predicts impact of design changes in aerodynamics and fluid dynamics

PRECISION AI AGENTS

Expert-level

AI agents with deep domain knowledge support specialized engineering tasks

Already, AI is being integrated into software tools to accelerate engineering workflows. AI-applications such as copilots and digital assistants respond to commands given by engineers using natural language models. Instead of having to pore through extensive documentation, engineers speak to their tools and the copilot automatically completes mundane tasks, such as data management.

Furthermore, it is possible to build specialized AI agents and create agentic workflows to support the work of technical experts. At this level of expertise and precision, AI agents made for general consumption won't suffice. They are good at doing many different things, but they do not necessarily do them particularly well. Instead, engineers require precision AI-assistants with deep domain knowledge, able to perform a limited number of tasks extremely well.

02

AI Is Transforming Aerospace Manufacturing

Digital transformation has been top priority in aerospace manufacturing for decades. Now, AI is opening a new chapter in that era of transformation. It has the potential to optimize aerospace manufacturing processes by monitoring and controlling variables, improving quality control, and enabling predictive maintenance of manufacturing machinery.

Even more so, as there is a severe global aircraft shortage. While passenger demand has rebounded from pandemic-era lows and is projected to keep growing, delivery times for newly manufactured aircraft, together with maintenance turnaround times for aircraft in existing fleets, have slowed. According to McKinsey there is a current global shortage of roughly 2.000 aircraft.

AI can help bridge the gap and the three pillars on which AI stands – massive amounts of data, increased computing power and powerful algorithms – are already significantly affecting manufacturing processes and business models.

DEFECT DETECTION

~90 %

Faster and more accurate defect identification with AI-enabled inspection

ROBOTIC AUTOMATION

Cycle Times

AI-powered robotics improve drilling, painting and assembly efficiency

Quality Control

For instance, in quality control, which is particularly resource-heavy in aerospace, due to the stringent quality requirements of the sector. To accelerate quality control processes, AI systems leverage computer vision and machine learning (ML) algorithms to inspect and identify defects in components or assemblies, faster and with greater accuracy than humans. Several OEMs already use AI-powered computer vision systems to inspect aircraft components.

AI is also optimizing aerospace manufacturing through intelligent robotics and automation systems. For example, using AI-powered robotic systems for drilling, painting, and assembly operations, resulting in increased production efficiency and reduced cycle times.

Predictive Maintenance

Maintenance is another area that can benefit from AI-powered solutions. In order to optimize maintenance of production lines, more and more machines are being connected to the network, sending sensor data about their performance and state of health to centralized systems.

In the process of distilling actionable knowledge from that data, AI can help crunch it to identify anomalies and prevent breakdown by scheduling maintenance to repair critical components in good time before the advent of a crisis. These predictive maintenance systems can reduce—and, as they evolve and mature, potentially even eliminate—costly downtime.

Optimizing The Supply Chain

The aerospace supply chain is highly international and interconnected. An aircraft's engine might be produced in a joint venture between companies in two different countries. Its avionics might come from a third country. Its landing gear might come from a fourth.

Geopolitical uncertainty or trade wars can create turbulence in the aerospace supply chain. That turbulence can be tackled using AI, contributing to optimizing the manufacturing supply chain by predicting demand, managing inventory, suggesting modifications to workflows and identifying cost-saving opportunities.

Typically, manufacturers operate some type of supply chain control tower, merging data from the factory floor with key business metrics and information about the current state of their supply chain. Predictive analytics tools, leveraging AI technology, can optimize such a command centre and offer early warnings of quality or delivery issues. Supply chain analysts can then dig deeper into the issues using specialized AI agents to mitigate any emerging problems.

Much At Stake

However, there will be barriers to overcome. While the industry's curiosity about AI is significant, its willingness to integrate it into its manufacturing management systems seems to be less so. Why? Probably because there is much at stake.

Manufacturing is closely connected to a company's revenue and cash flow, and manufacturing and delivery hiccups can have serious consequences: for instance, an ERP migration run aground can bankrupt a company. Against this background, there can be some reluctance to implement a less known technology such as AI in a production plant. Therefore, the proof of concept of an AI-powered solution must be strong enough to justify the risk. Solutions must be thoroughly tested and retested prior to deployment, as failure and repeated iterations are not viable options.

AI-ENABLED CONTROL TOWERS

Early Warnings

AI predicts quality or delivery issues to mitigate supply chain risks

HIGH-QUALITY DATA

80%

of AI work lies in collecting, preparing and enriching high-quality data

One Step at a Time

Despite the high threshold, AI will transform aerospace manufacturing, one step at a time, enhancing without endangering and creating minimal disruption.

Often, it makes good sense to start the aerospace manufacturing AI journey with areas that are not directly mission critical. As an example, long-term forecasting, is a good candidate for AI-infused predictions. They can make a difference, when manufacturers want a long-term view of their market, based on heterogenous sources, with the AI analysing them quickly, pointing out trends and trouble spots, and recommending production adjustments for managers to consider.

High-quality Data Needed

While AI can be seen as an enabler in reaching the next level of digital transformation, the fact remains, that it puts high demands on the data it's running on. With digitalization and the advent of the industrial internet of things, the amount of data handled by production and maintenance organizations is steadily growing and with this, the need to rely upon AI to handle the data is increasing simultaneously. Put simply, there is no shortage in data, but there is a shortage in clarity.

AI can help distil actionable insights from massive amounts of data for instance via surrogate models (a simplified approximation of a more complex model), digital twins, and predictive maintenance systems.

When developing precise, AI-powered systems, high-quality data is the key to success. It is well known that data collection, storage, preparation and enrichment make up 80 % of the work in any AI application.

With that in mind, manufacturing engineers and managers will be on the right track to turn the AI buzz into profitable solutions for their specific domain.

03

Accelerating Aerospace MRO with AI

MRO accounts for 40-50 % of the overall aerospace market. Moreover, aerospace MRO is predicted to grow significantly, with a 5% annual increase from now until 2030, largely driven by increasing air travel and growing integration of digital technology.

These figures indicate there is a lot to gain by streamlining and optimizing MRO, thus increasing profitability. With its ability to crunch large amounts of data, AI is well suited to make a difference here.

MRO MARKET

40–50%

of the aerospace market depends on maintenance, repair and overhaul

GROWTH RATE

+5% Annual

MRO market predicted to grow steadily through 2030

For instance, to reduce aircraft non-operating time, technicians can save time by talking directly to repair and maintenance manuals via AI, instead of having to choose menus and scroll through pages of text.

The AI may even be able to suggest the best course of action for troubleshooting and maintenance, pointing to other factors that might need attention, as side effects created by the initial fault. Thus, the AI can create smarter job cards than before, improving overall planning and efficiency.

And, to guide less-experienced technicians, a camera can follow thier maintenance work, automatically detect any mistakes or skipped steps and guide them in the right direction.

Gen AI tools and learning models are also useful avenues for skills training. They can accelerate the onboarding of new maintenance technicians, support the upskilling of existing employees, and help ensure that knowledge and expertise remains in the company instead of disappearing when an employee retires.

New Level of Maintenance

With AI it is possible to reach a new level of aircraft maintenance, both scheduling and performing maintenance. Tools integrating both system data, maintenance rules and the user constant of an aircraft are being developed. Merging all these factors in one tool allows to provide the best maintenance scheduling to the user, and to follow maintenance on the aircraft in real-time.

A problem is identified automatically, and the aircraft communicates directly with the system to determine the corrective action and to schedule repair, create a job card etc. All the information the technician requires is automatically retrieved and presented to them, for instance drawings, the torque value of specific screws etc.

The aim of these tools is to improve trackability with certified data, as trackability and configuration is a pain point for aeronautics.

Such tools can be applied not only on single-aircraft level but on fleet-level as well, linking to parts and aircraft availability as well as providing economic information.

DATA COLLABORATION

Key Enabler

AI-powered maintenance needs cross-stakeholder data sharing for full transparency

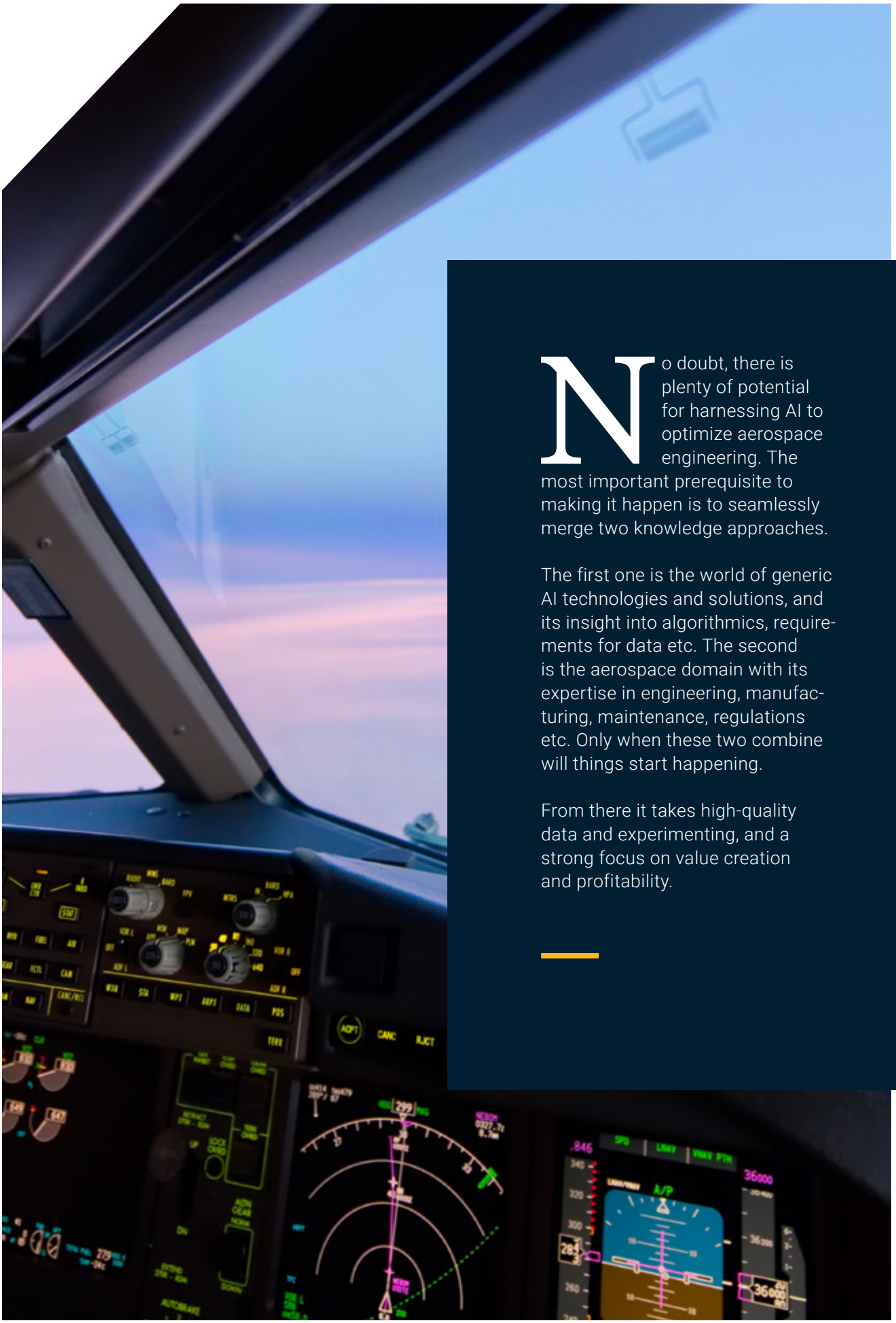
Transparency Requires Collaboration

Behind all this lies the ambition to harness the benefits of digital continuity between all environments in order to improve the complete process end to end - from design to the manufacturing of aircraft and parts until maintenance realization. To achieve such a holistic and transparent view, exchanging the right data is key. The aerospace industry generates large amounts of operational and performance data. To use it effectively for AI-powered solutions, airlines and MRO providers will need to have access to this wealth of data. This will require collaboration between numerous cross-functional stakeholders.

For instance, between manufacturers and operators, to merge the engineering and construction data about each aircraft, coming from the manufacturer, with the usage data coming from aircraft operators. They must exchange data regarding the state of the aircraft, not only as it was when delivered, but as it is now, including changes, updates, replaced components etc.

Conclusion

Mastering The AI Balancing Act



No doubt, there is plenty of potential for harnessing AI to optimize aerospace engineering. The most important prerequisite to making it happen is to seamlessly merge two knowledge approaches.

The first one is the world of generic AI technologies and solutions, and its insight into algorithmics, requirements for data etc. The second is the aerospace domain with its expertise in engineering, manufacturing, maintenance, regulations etc. Only when these two combine will things start happening.

From there it takes high-quality data and experimenting, and a strong focus on value creation and profitability.

Careful and Agile

Developers and managers looking at how to harness AI, must be both careful, agile, and able to walk the tightrope between the potential of AI and the specific aerospace business case at hand. While looking for meaningful use cases delivering value at scale, they must at the same time be aware of the fact, that AI-solutions won't be flawless. AI tools are still in an early stage, and until they've matured, they can't be blindly relied on in critical scenarios and must be accompanied with rigorous quality assurance and control.

That shouldn't however make the aerospace sector shy away from AI. The strict safety regulations of the sector can even have a maturing effect. Like a jet aircraft, generative AI is a powerful technology. But it needs guardrails in the form of trained operators, well-designed systems, and robust safeguards. By adopting rigorous safety protocols, air travel has become one of the safest modes of transportation. Likewise, AI's potential is undeniable, but its future hinges on addressing the safety risks emerging.

Aerospace can undoubtedly benefit from AI, and it might be the other way around as well: AI can benefit from aerospace.

AKKODiS

Engineering a Smarter Future Together.

Get in Touch with
Our Experts in Aerospace
and Defense

akkodis.com