

Look Out 2020+
Industry Trends
Aerospace

Meeting the pace of transformative growth

Thought
Leadership **Atos**

Megatrends in Aerospace: Disruptive innovations ahead



“Digital is profoundly transforming the aerospace industry and reshaping its value chains. Slowly but surely, aerospace is evolving from pure hardware companies into software and data-driven services players.”

Stephane Janichewski
Senior Vice President, Head of Defense & Aerospace, Atos

Over the horizon, the aerospace sector seems to be facing bright prospects. Following years of growth, demand for air travel continues to rise, with strong pushes from demographic changes and from wealth creation in Asia and the Middle East. Defense spending is experiencing a boost, fueled by the resurgence of global threats and increases in US, NATO and regional powers' security budgets. New markets are developing in domains such as unmanned aircraft systems (UAS) and space, providing new frontiers for growth.

Digital transformation taking shape

Beneath the surface, however, signposts show the industry is at an inflection point. It's not just that new players are appearing from the BRICS (notably China and Russia), new space (SpaceX, BlueOrigin,...) and the tech start-ups worlds with ambitious plans to disrupt competitive positions; but digital is profoundly transforming R&D, production and maintenance process, reshaping how value is shared between OEMs and equipment providers.

Towards a service-driven industry

As a result, the aerospace landscape is mutating, charting a course to innovation, software and services. Beyond new technologies and new value propositions, the changes are opening new possibilities in adjacent industries such as homeland security, telecom, smart cities, ... In these promising but challenging times, aerospace players must not just rethink the way they operate; they must reassess their customer relations, challenge their security strategies and adapt their business models.

Today's transformations are opening the way to strategic opportunities for aerospace players to be at the heart of tomorrow's disruptive growth domains and to find new avenues for value creation.



increase in passenger air traffic is observed each year



more funds have been allocated to US Aerospace Defense in 2018



aircraft orders will double in the next 10 years



of data are generated for each hour of flight



the commercial UAV market will quadruple in the next 4 years



commercial aircraft should be produced in the next 20 years



are spent on space programs each year
\$ = USD



of aerospace added value may come from software in 5 years



human missions to Mars may be scheduled within the next 2 decades

Four transformational challenges and opportunities for the future of Aerospace

1



Rethink customer experience

For years, aerospace has been pioneering advanced user experience technologies, such as virtual reality for 3D design or augmented reality in pilot helmets for next-generation combat aircraft. As digital has dramatically changed user expectations and behaviors, further advances are now needed.

As such, systematically enriching passenger experience with in-flight or on-board connectivity services is not enough. Aerospace companies should also generalize shared innovation platforms to help partner and customer engineers contribute to meeting specific request for personalizing jets, helicopters or unmanned aerial vehicle (UAV) equipment for individual airlines or armies.

Augmented reality can also be leveraged to provide crews with intelligent connected assistance and facilitate maintenance to reduce operational costs.

> The impact: Not just improving buyer convenience along with crew and passenger satisfaction, but furthering differentiation by supporting the launch of new services and the development of new monetization streams.

2



Boost productivity and reduce costs

As witnessed by its resiliency during the last recession, demand for aviation-related services has become increasingly inelastic in previous years.

However, continued pricing pressure along with product mix changes by competition and customers makes it more essential than ever that aerospace players continuously improve processes to reduce costs, respond quicker to cope with erratic production cycles, and invest more in product innovation.

This is particularly important as development cycles times are shortening while customers increasingly require craft to be tailored to meet their specific requirements. For civilian aircraft, each airline requires its own customization. For military craft, each equipment program must always incorporate complex multi-force and multi-usage requirements, which also need to be tailored to suit the missions of each specific country.

> Increasing automation can dramatically reduce the increasing complexity of aerospace products, manufacturing and supply chains. The potential impact is huge: reaching a further 5 to 15% cost reduction.

3



Break into new markets

Historically, the aerospace industry has created some of the most game-changing technology innovations, including human spaceflight, GPS navigation, satellites,... These innovations have changed the way we travel, live and communicate.

As digital is profoundly transforming all value chains, aerospace players now face massive opportunities to extend their business, not only at the hardware level but also at the software and services ones.

The challenges are not just launching new smart products and services around traditional segments (aircraft, jets, space launchers, satellites, helicopters,...), with data-driven services or models such as predictive maintenance, fleet management, flight scheduling, RFID tracking for baggage and cargo,... They are also breaking into new domains, such as with the commercial drones or sub-orbital transportation and space that may reshape whole industries. And, added to those, moving into adjacent industries.

> What's at stake: open new lucrative markets such as intelligent processing of satellite image data for weather forecasting, homeland security or precision agriculture, high-altitude UAV for telecom, etc.

4



Guarantee safety & compliance

Safety and security have always been at the forefront of aerospace innovation. New technologies not only bring aerospace into a new era but also multiply dangers, especially in highly-complex life-sensitive environments.

9/11 has shown how a simple absence of cockpit locks enabled terrorists to turn commercial airplanes into weapons of mass destruction. In the age of connected aircraft and Artificial Intelligence (AI), any security flaws may be even more dramatic if airplane, space or even UAV systems were hijacked.

Beyond aerospace systems themselves, R&D and production sites, IP secrets and commercial data are also targets of choice for hackers, mafias, competitors, terrorists or even hostile states. This constraint just adds to the complex set of global, regional, country and industry-specific laws and directives faced by Aerospace, which is one of the world's most regulated domains for safety as well as environmental factors.

> While aerospace security & compliance is one of the most critical domains for the next decades, trust is more than insurance - it is a major business differentiator.

Building next-generation platforms to succeed in next-generation aerospace ecosystems



“As physical and digital worlds blur, data and analytics will be at the cornerstone of next-generation aerospace systems.”

Thilo Stieber
Vice President Portfolio & Innovation,
Manufacturing, Retail and Transportation, Atos

Since its inception, the aerospace industry has been a pioneer and an early adopter of nearly all the most advanced technologies, including stealth, composites, computer-aided design and collaborative R&D platforms.

Adopting a new mindset

Now needing to extend its platforms to create smarter products and innovative digital services, the industry is on the verge of a fundamental change, requiring even deeper integration between mechanical, electrical and software components. Tight collaboration between design, development, production and aftersales, along with tight integration across the supply chain, will be vital for accelerating lead times and ensuring safe and efficient operations.

Preparing for a paradigm shift

To thrive in tomorrow's aerospace world, players must, therefore, be ready to make a new quantum leap:

- Become wholly **service-centric rather than purely aircraft-centric** to ensure 360° service for buyers and offer global 'as a service' models.
- Provide **intelligent connectivity and data-driven orchestration**, not just to optimize intelligent factories and shop floors but also to develop innovative services across the value chain and federate the largest ecosystem of co-innovation and go-to-market partners.
- Adopt **open platform foundations** and real-time process automation to provide the best solutions and services at the lowest cost while being able to adapt very fast to erratic production cycles, market change and specific demands.

The road ahead

To thrive, aerospace companies will also need to create the right partnerships and convene the largest ecosystem to enrich their offering and services. This makes it necessary for Aerospace to transition progressively to next-generation, data-driven aerospace design, manufacturing and service platforms, modernizing their legacy and fully embracing the latest IoT, Big Data, real-time and Cloud technologies.

Next-generation architecture for future-ready aerospace

CUSTOMER & USER CENTRICITY



IMMERSIVE EXPERIENCE

360° customer and workforce engagement



COGNITIVE ANALYTICS PLATFORMS

Smart data orchestrator, open innovation and service platforms



BUSINESS ACCELERATORS

Real-time ALM, SCM, PLM, MES, value-added services...



HYBRID CLOUD

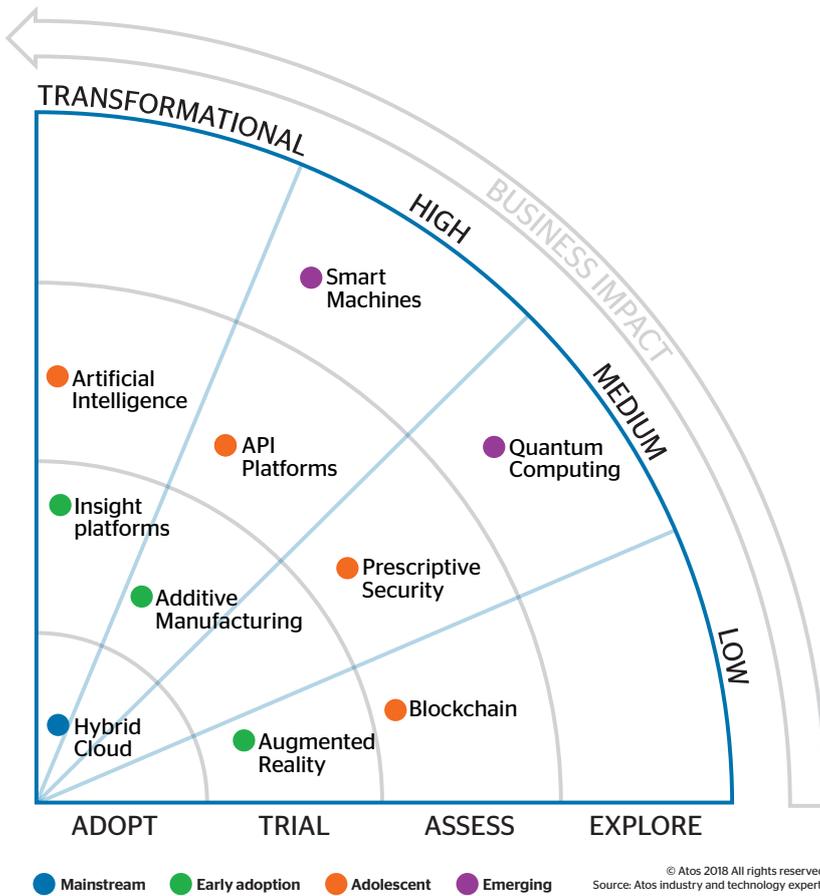
Software-defined infrastructures, microservices and DevOps

INTELLIGENT DATA-DRIVEN ORCHESTRATION

OPEN PLATFORM FOUNDATIONS

More disruptive technologies will emerge. While some may only appear as dots on the horizon today, they will turn out to be transformational in the years to come.

10 disruptive technologies that will shape the future of Aerospace



Aerospace Look Out 2020+ Radar: 10 key technologies set to impact aerospace companies over the next 5 years.



Want to know more? Examine the Look Out 2020+ Global Technology Radar to get deeper insights into these 10 strategic technologies and many more: atos.net/lookout

Hybrid Cloud is reviving cloud initiatives by enabling seamless integration of private and public cloud platforms. With this model, organizations can exploit the benefits of public cloud: pay-per-use, 'infinite' bursting resources, agility and innovation. Aerospace players must adapt their IT processes and prepare for related security implications.

Insight platforms enable aerospace players to capture, analyze and get insights from data along the entire value chain, across all silos. Leveraging the latest Big Data technologies, these platforms can be employed as the cornerstone for next generation aerospace smart services platforms.

Additive Manufacturing or '3D Printing' facilitates rapid prototyping and low-volume production. Beyond its potential in new model design and testing acceleration, aerospace players must consider its broader adoption for small series manufacturing, spare part management and aircraft personalization.

Augmented and Virtual Reality are blurring real and virtual worlds, allowing customers, partners and employees to engage with digital services within the context of their current environment. Aerospace players should develop use cases in crew experience, sales and maintenance as well as on the shop floor.

Artificial Intelligence promises to second human cognitive capabilities with virtual assistants, chatbots, knowledge engineering, smart machines and autonomous vehicles. It will impact customer experience, business models and operations along the entire value chain. Aerospace players must prepare for the business, human and legal impacts.

API Platforms allow data and services to be distributed across third parties. Aerospace players should put API platforms at the heart of their digital strategy to attract ecosystems partners and create multi-sided marketplaces.

Prescriptive Security uses real-time dark web monitoring, AI and automation to detect potential threats and stop them before they strike. Applications range from cyber-protection to safety and compliance. Aerospace players should explore integrating it into their IT/OT Security Operation Centers and the aircraft themselves.

Blockchain is a potential game-changer for conducting business with parties without prior trust relationships. Beyond aircraft or equipment identity management and history audit, it could revolutionize supply chain management, automated contracting and the microservice economy.

Smart Machines have the potential to disrupt parts of the industry as we know it. Beyond drones, driverless vehicles, such as robo air taxis, could ultimately provide completely new forms of passenger mobility or automated freight transportation. Technological, business and legal implications are huge and must be explored now.

Quantum Computing promises to break traditional combinatorial analysis limitations, bringing advances in High-Performance Computing for design and manufacturing. It will also elevate risk by potentially breaking current cryptographic standards. Aerospace players must start preparing for both quantum computing and quantum-safe cryptography.

A glimpse into the future of Aerospace: Expert views on best practice for digital transformation



Stephane Janichewski
Senior Vice President,
Head of Defense & Aerospace, Atos



Sebastien Gatti
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What could aerospace companies look like in five years?

It takes many years to design and test a new aircraft. Exploitation covers decades. So, aerospace evolves in the long term.

However, **we are at a crossroads today**. Aircraft orders should nearly double in the next ten years. This has strong implications for the industry: the critical size needed to succeed is driving a **wave of M&As**. The growing importance of the Asian/Pacific market favors the development of local players, notably in China, and may **change the competitive equilibrium**. The 'new space' segment also calls for **radical innovations** and is attracting new well-funded private players and very ambitious and futuristic projects.

Most importantly, **digital is disrupting the whole industry**. It is not just transforming design and production; it is also impacting business models. With connected products, players already sell 'hours of flight' or 'miles' instead of just equipment. **This 'servitization' trend will accelerate and may radically change value chains in the coming years**: selling data-driven connected services to the customer may be the battlefield of tomorrow. It will also favor the creation of new services in adjacent industries.

Overall, **technology disruption may put incumbents at risk in the long term**. Look at how SpaceX erupted the space launcher market. In just a decade, Elon Musk's company has gone from start-up to leader. Well-funded players from the tech industry may as well disrupt several segments, whether existing or new such as electric, supersonic or hypersonic aircraft, UAVs or even robo air taxis...

Which driving forces will help them succeed?

Aerospace players have major challenges to meet: accelerate design and production and create new services while increasing financial competitiveness. Digital will be the key for all.

To succeed in tomorrow's data-driven world and meet productivity challenges, **aerospace players must strive to capture, analyze and act on data across their entire value chains**, from design, supply and the shop floor up to aftersales services. This is already at work today. Aerospace players are beginning to build **data-driven factories**, leveraging the latest prescriptive automation and decision support technologies. They are generalizing predictive maintenance, as-a-service invoicing, new data-driven added-value services...

But most organizations still have a long way to go to fully unleash the value of data, across all IT and OT silos. **This is not just a technical issue; it is also an organizational one**. Who is in charge of data management along the whole value chain? How do you secure it end-to-end? How do you ensure the right balance between openness (liberate siloed data across design, production, maintenance, ...) and security? This has a strong HR impact too. Many digital tech-savvy people must be recruited, notably in domains such as **AI, IoT and security**.

“
For aerospace manufacturers, the secured liberation of data from 'silos' is at stake and requires strong cross-organization synergies.”

This is where the battle against tech disruptors will take place. At Atos, we contribute to bringing this expertise to the industry.

What should aerospace companies do today?

All today's mutations offer not only challenges but also many opportunities for aerospace players to differentiate and open new avenues for innovation and growth. Depending on where they stand in the value chain - equipment manufacturer, OEM, new space player, or even infrastructure and traffic regulation authorities - priorities may vary. We usually work with our customers around four key priorities, with our Digital Transformation Factory:

- **Develop smart R&D to boost game-changing innovation**, with advanced engineering, airborne avionics, IoT, digital twins, 3DPrinting... We are contributing to pioneering all that, and also bring unique expertise in Exascale-class and quantum computing for simulation.
- **Develop smart manufacturing** to boost Industry 4.0 production efficiency, from supply to shop floor operations and delivery, and including the augmented workplace. Beyond our partnership with Siemens Mindsphere, we have developed very advanced connected plant and connected machine solutions with our Atos Codex Cognitive Analytics technologies.
- **Develop smart aircraft and satellites to grow value**, from satellite structural design up to navigation systems and mission control centers. We are helping pioneers in this domain.
- **Develop smart control and airports to optimize navigation and services**. Beyond flight traffic or airport management, data services are major opportunities for aerospace players to create new monetization streams. With ESA, we have for example developed the first Earth Observation Data Platform to deliver new services to many industries.

To succeed, **security will be essential**, deeply embedded from IT to OT, from design to operations. This is at the heart of our approach.

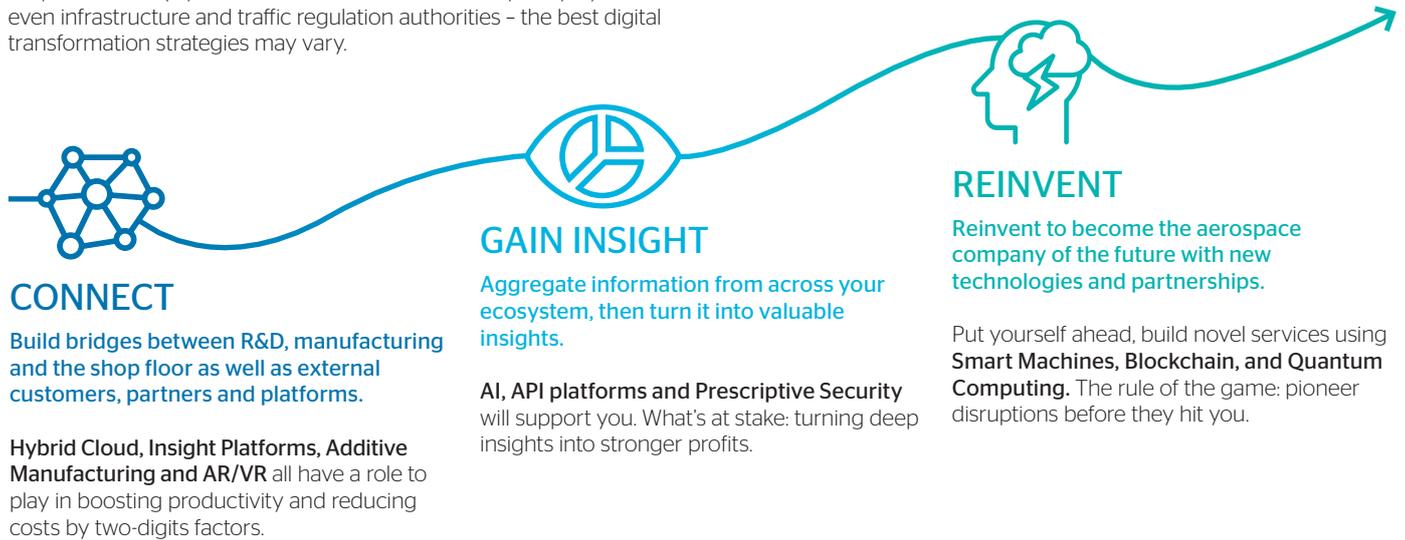
But the mother of all battles will be data management. This is what we are helping aerospace players to do, leveraging our expertise in digital, industrial ecosystems and our partnership with Google.

Creating your own Aerospace transformation journey

With all these changes converging at once, you must drive your aerospace company forward. Faced with rapidly advancing technology and an evolving business ecosystem, the questions you will be asking is not 'Why change?' but 'Which direction?' and 'How?.'

The first step is **figuring out your priorities and the role you want to play within next-generation aerospace ecosystems**. Depending on your role - equipment manufacturer, OEM, new space player, or even infrastructure and traffic regulation authorities - the best digital transformation strategies may vary.

Having made that strategic choice, you must next **embark on a journey of progressive and continuous transformation**, combining people, organizational and technology streams. Your journey requires a roadmap. We have drawn up a three-step approach, with steps that can be undertaken simultaneously.



Throughout these phases, an open approach to innovation - such as the **Digital Business Continuum** approach developed by Atos, plus co-innovation with start-ups - will be paramount to success. In an ecosystem world where new players appear and spread at internet speed, openness is the best way to capture collective intelligence. As aerospace companies strive to transform, **open innovation labs**, such as the joint Atos and Google Labs, will provide an ideal environment for bringing new ideas and new concepts to life - and creating aerospace services for tomorrow.

Where should you begin?

As the Trusted Partner for your Digital Journey, Atos can help. Meet our experts and stay one step ahead by getting hands-on experience of new disruptive technologies.



ENGAGE in a co-innovation workshop at one of our **Business Technology & Innovation Centers**.

Get off to a quick start with a personalized workshop. Ask for a meeting:
> atos.net/btic



EXPLORE how the latest technologies can boost your own practice.

Leverage our experts and labs to build POCs tailored to your own business:
> atos.net/aerospace



STAY TUNED with the latest trends and best practices in digital transformation.

Keep yourself informed. Follow the latest insights from the field on:
> atos.net/blog

This is an extract from the full Atos Look Out 2020+ report, which provides an in-depth analysis of the emerging megatrends, business transformation opportunities and technologies that will drive innovation in the years ahead. Explore the full report on atos.net/lookout.



About Atos

Atos is a global leader in digital transformation with approximately 100,000 employees in 73 countries and annual revenue of around € 12 billion. European number one in Big Data, Cybersecurity, High Performance Computing and Digital Workplace, the Group provides Cloud services, Infrastructure & Data Management, Business & Platform solutions, as well as transactional services through Worldline, the European leader in the payment industry. With its cutting-edge technologies, digital expertise and industry knowledge, Atos supports the digital transformation of its clients across various business sectors: Defense, Financial Services, Health, Manufacturing, Media, Energy & Utilities, Public sector, Retail, Telecommunications and Transportation. The Group is the Worldwide Information Technology Partner for the Olympic & Paralympic Games and operates under the brands Atos, Atos Consulting, Atos Worldgrid, Bull, Canopy, Unify and Worldline. Atos SE (Societas Europaea) is listed on the CAC40 Paris stock index.

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Let's start a discussion together

