CYIENT

DIGITAL TECHNOLOGIES WILL DRIVE THE NEXT ERA OF INNOVATION IN A&D

The aerospace industry has been at the forefront of embracing new tech, but the best is yet to come in the age of IoT, blockchain, reality technologies, and more.

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Abstract

While rapid growth in the commercial aerospace industry is driving revenues for OEMs, suppliers, and operators, the accompanying challenges can prove to be a showstopper. Growing demands also imply increased pressures to reduce cost and turnaround time for aircraft design and development, optimize fuel efficiency, rectify supply chain issues, improve technical training, and minimize maintenance costs. Smart players in aerospace are turning to digital technologies such as IoT, big data analytics, blockchain, and additive manufacturing to meet address concerns that afflict the industry and stay ahead of the curve.

New Frontiers for Aerospace

The year 2018 alone, saw more than 4.3 billion people world overtaking to the skies, bumping the load factor to an all-time high of 81.9% (a significant increase from 65% in the 1990s). According to Boeing's Market Outlook, this positive trend would continue for the next 20 years driving the need for more than 41,000 new aircraft valued at more than $6 trillion.

This demand surge and rising profitability is music to the ears for OEMs, their partners, suppliers, and operators, but it is not without challenges. The following chart describes some of the current and inherent problems across functional areas in the aerospace sector.

Functional Areas	OEM/Partners/Suppliers	Operators/Airlines/MROs
Design & Development	• High lead time for new programs and product development • High development cost • Fuel efficient airplanes/engines • Environmental targets to reduce emission & noise	
Build/Production & Assembly	• Supply chain disruptions • Productivity improvements to accomodate production rates • Aging workforce • Training new workforce	• High inventory costs
Maintenance		• High maintenance cost due to unplanned events/breakdowns • Fleet availability and utilization • Aging workforce

Fig. 1 | Key challenges in the commercial aerospace industry today

Technology has advanced at an unprecedented rate in the past few years. Things that were only seen in sci-fi movies are part today's real world—case in point: augmented and virtual reality, connected devices, unmanned aircraft, and more. Some of the new technologies that are available to us today and are driving innovative applications are listed below in Figure 2.

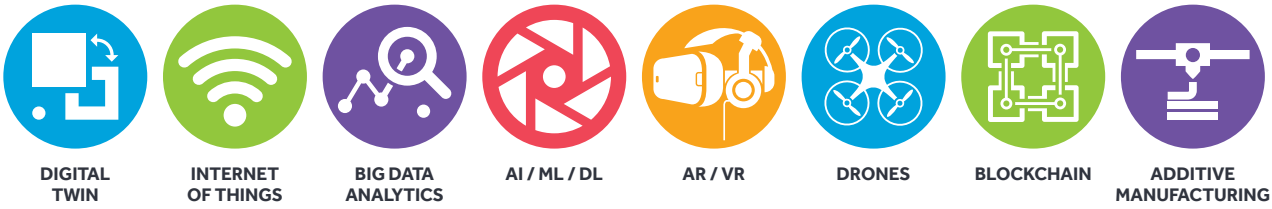


Fig. 2 | Digital technologies

In the following sections, we will see some examples of how these technologies are being used or can be used to solve aerospace specific problems.

How Digital Technologies are Solving Specific A&D Challenges

Reduced product development timelines and inventory costs

Product development in aerospace involves a significant amount of prototyping, testing, verification, and certification & inspection procedures. Industry estimates suggest that almost 30% of the overall program cost and a large amount of time is spent in the developmental phase. Additive manufacturing (AM) is one technology that helps minimize costs and efforts in this phase.

As most aerospace companies have digital networks in place including PLM tools to manage the workflow and use digital 3D models to manufacture parts, it is easier to introduce and integrate AM into the system. AM with its ingenuity offers unique ability for designers to think creatively from scratch and come up with innovative designs to reduce the weight of the parts that once was not possible with conventional design techniques. By applying AM, an actual part can now be built based on the design data within a fraction of the time as compared to traditional manufacturing methods thereby reducing design iteration cycle and associated tooling costs.

The ability to see and inspect the actual part with a much faster turnaround time than before reduces the overall development time. Besides new design development, AM can also be used to build existing parts of low volume which makes it a good candidate for MROs to reduce inventory costs.

Though additive manufacturing has come a long way in the last few years, there are some roadblocks for its wider adoption. One critical parameter is the compliance certification for additively manufactured parts. Nonetheless, with FAA advancing on its strategic roadmap for such parts, the certification process is expected to ease and pave the way for rapid adoption of this technology.

Increased fuel efficiency and focus on environmental targets and emission reduction

Research states that aviation accounts for about 2% of global carbon emissions. The industry has long recognized the need to address the global challenge of climate change and has been consistently worked toward reducing its carbon footprint and meeting environmental goals.

While there are some interesting concepts in the works including full/hybrid electric engines ('Double-Bubble D8'by Aurora science), it is too early to predict their performance. That said, the emergence of digital technologies now enables incremental improvements.

Internet of Things (IoT) in combination with data analytics, artificial intelligence (AI) and machine learning (ML) can work magic to improve fuel burn. Pratt & Whitney's geared turbine fan (GTF) engine does precisely that. It employs data from hundreds of sensors to predict the demand of engine to adjust thrust levels accordingly. With this analytics-driven approach to fuel consumption, Pratt & Whitney was able to reduce the fuel burn by up to 15% while improving the carbon emissions and noise levels as well. At its core, a cloud-based IoT platform with data analytics can collect information on parameters such as wind speeds, ambient temperatures, and thrust and weight of the aircraft through sensors. This data can then be analyzed in real-time or offline for deep insights. For instance, one such analysis can help track fuel load on an aircraft and optimize it for each route based on historical analysis.

This would not only cut costs for operators by reducing the overall weight, but also help in eliminating unnecessary fuel emissions. Additionally, when aircraft pass through areas with high turbulence, the fuel burn is instantly increased. One way to avoid this drag is to have real-time weather and turbulence forecasts or detection of weather threats along the flight path. With access to predictive insights, airplanes can plan proactively and avoid turbulence-prone regions.

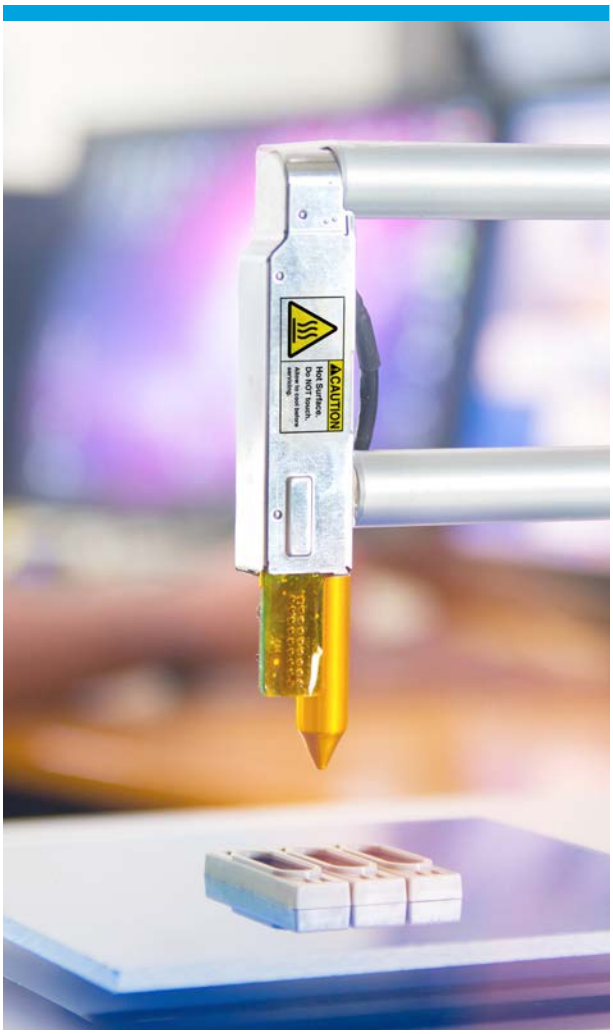
While digital technologies can bring in incremental improvements, other initiatives such as electric taxi-in/out, synchronized landing/take-off to reduce wait time, and better aerodynamic design could complement the initiatives taken by the aviation industry to achieve its environmental goals faster.

Minimized supply chain disruptions

When OEMs such as Airbus and Boeing increase their production rate to keep up with the growing demand, the pressure flows down to the entire supply chain creating a domino effect. For OEMs, it often boils down to visibility or

traceability of part status from each of its suppliers. Most OEMs lack complete visibility on their supply chain and often rely on secondary information. Though a significant portion of the supply chain is connected to the digital world through different ERP systems, information such as manufacturing status, potential delays, etc. are not accurately relayed to OEMs in real-time. This places a considerable risk on OEMs and could potentially disrupt their production rates.

One way to tackle this is by using blockchain for the enterprise in combination with IoT and data analytics. Given its inherent qualities, blockchain can help track components and parts across the supply chain, bring transparency into part status, and also streamline procurement processes along the way. It can also help prevent any counterfeit parts from entering the system thereby saving millions of dollars while increasing the safety and reliability of components. By having such a system in place, OEMs can access real-time data from individual suppliers to plan ahead, build contingencies, and minimize overall risks.



Many OEMs have already ventured into pilot projects that leverage blockchain and its capabilities. Several startups have also sprung up over the last few years providing bolt-on solutions to complement existing ERP systems. These solutions are often cost-effective and augur well for the industry. Blockchain as a technology is maturing fast and with many use cases showing promising results, it is sure to find rapid adoption.

Build workforce availability and optimization

Based on Oliver Wyman projections, between now and 2027, a significant number of mechanics and technicians are expected to retire creating a massive gap in supply vs. demand. This comes at a time when the industry is gearing up to meet the growing demand for new aircraft and a lack of skilled workforce could be considered as one of the biggest challenges for OEMs and MROs.

Augmented and Virtual Reality (AR/VR) seems to offer the most permanent solution to this problem. AR/VR has been used for simulated training for years now, but it is only in the last few years that we have come to understand its potential in addressing the real problem of skill gap. AR, for instance, can be used on the shop floor to provide an augment environment for technicians with all necessary information related to the task at hand. Processes such as wiring or installing the cabin of an airplane are laborious and this technology can prove to be very useful in providing technicians with instant access to critical information and reducing overall training requirements. AR also can be leveraged to provide remote assistance to the technicians anytime, anywhere.

Virtual reality is a great tool to conduct training. It can significantly reduce the training time and related costs without the need of any classroom. Technicians can use VR headsets for simulations and refresher training as and when needed. One of the main advantages of VR is that it can provide a multi-dimensional view of the problem that would be hard to duplicate in real-world conditions and thus is very useful in solving critical issues before they even occur. As is the case with many emerging technologies, several startups have emerged in this space and are positioning themselves as leaders. In an industry where skill levels are critical and when the skill gap is expected to rise, AR/VR finds many real-world applications and promises to be a technology that can help minimize the void left by a retiring workforce.

Ensured asset availability and reduced maintenance costs

Almost all of the technologies that we talked about earlier can be leveraged to cut maintenance costs. However, digital twin is one concept that stands out in its utility to minimize maintenance cost through the method of prevention rather than cure. The concept of digital twin is around since the Apollo-13 space mission, developed by NASA to monitor, repair, and operate assets in space. But it is only in the last few years, that the concept has gained traction driven mainly by improved sensor capabilities.

According to a Gartner study of global businesses, more than 13% said that they were already using digital twins, 62% were either in the process of establishing the technology or planning to do so in the next year (2020). Specifically in the aerospace industry, for instance, GE Aviation collects about 2,000 critical parameters of an engine to determine its performance. This data is then organized and transmitted to the digital twin, so it is consistent with actual engines on the field. It is estimated that, of the 65,000+ installed engines, GE collects these data on about 35,000 engines. Today, every engine that rolls out of GE's factories has a full-fledged digital twin. With this digital replica of the engine, GE uses predictive analysis to gain insights into when and what kind of services the engine will need. It then optimizes the turnaround time to get its engine back on the wing sooner while reducing overall downtime.

The same model can be applied to any physical asset such as a factory floor to monitor the health of the machines or even at the system level to see how the system behaves under certain conditions. With digital twins, unscheduled maintenance is replaced by predictive maintenance, resulting in reduced downtime, increased availability, and minimized operating costs. As companies increasingly try their hands on the digital twin concept, it is going to find a much broader adoption and is sure to become an integral part of every physical asset that will be out there in the years to come.

Digital Technologies as 'an Enabler'

Digital technologies including the ones discussed above have found heightened significance in the last few years. Many companies in the aerospace industry have one or many ongoing projects leveraging one or more of these technologies. However, it is still not at a level comparable to an industry of our size. While companies such as GE have covered a lot of ground and established themselves in competitive positions, others are unable to move beyond the experimental phase. As more case studies emerge, the ones that are successful in leveraging digital technologies to its true potential are perhaps those who recognize digital "an enabler" to solve specific problems.

THE CYIENT THOUGHT BOARD

Digital Technologies Will Drive the Next Era of Innovation in A&D

What are the common problems faced by OEMs, suppliers, and their partners in the aircraft manufacturing domain?

High lead time for new product development

Rising development costs

Supply chain disruptions

Poor fuel efficiency of aircraft engines

Compliance with environmental norms

How can blockchain help reduce and eliminate supply chain disruptions?

Track supply chain components

Provide real-time data from suppliers

Streamline procurement

Prevent fake parts from entering the system

Offer transparent supply chain status

How will augmented and virtual reality impact training and maintenance in aerospace?

Enable comprehensive simulated training

Support technicians with vital data

Facilitate guidance by senior engineers from anywhere

Multi-dimensional view to proactively resolve issues

Reduce training time and costs

How will deploying digital twins influence aerospace manufacturing?

Stay tuned to the real-time condition of assets

Reduce asset downtime and increase availability

Plan maintenance schedules proactively

About Cyient

Cyient (Estd: 1991, NSE: CYIENT) provides engineering, manufacturing, geospatial, networks, digital, and operations management solutions and services to global industry leaders. We leverage the power of digital technology and advanced analytics capabilities, along with domain knowledge and technical expertise, to solve complex business problems. As a Design, Build, and Maintain partner, we take solution ownership across the value chain to help our clients focus on their core, innovate, and stay ahead of the curve.

Relationships lie at the heart of how we work. With more than 15,000 employees in 22 countries, we partner with clients to operate as part of their extended team, in ways that best suit their organization's culture and requirements. Our industry focus spans aerospace and defense, medical, telecommunications, rail transportation, semiconductor, utilities, industrial, energy and natural resources.

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