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VOL 13 | MARCH 2022 | ₹ 100



THE FUTURE OF INDIAN MANUFACTURING: BRIGHT OR GLOOMY?

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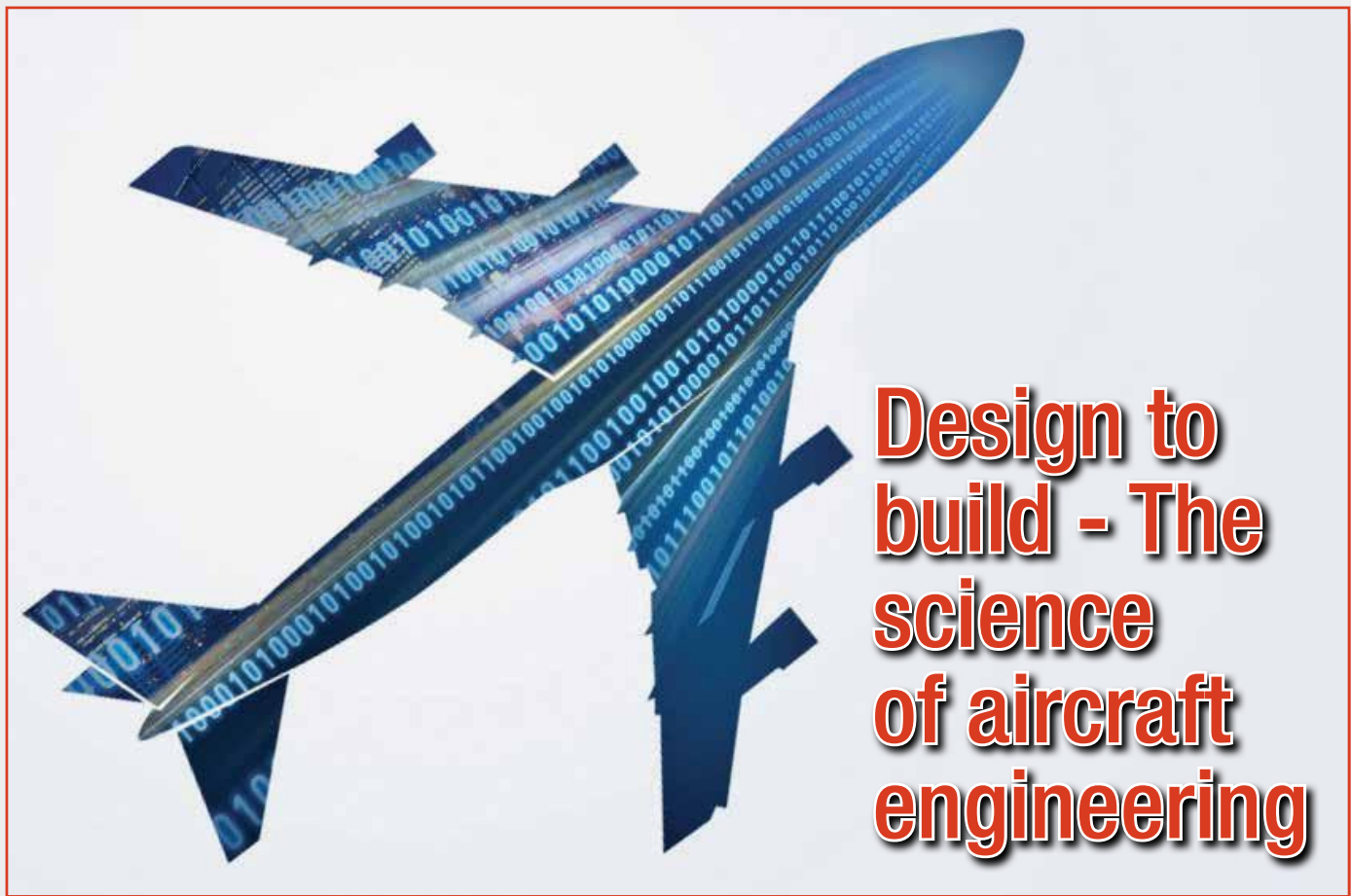
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The aerospace sector has been facing new complexity in designing while adhering to statutory, environmental, financial and operational requirements. Advances in technologies, such as AI, are helping various sectors adapt to the changes effectively, and the aerospace sector is no different. The article elaborates on how aerospace manufacturers use AI, ML and other associated technologies and how they can be applied effectively.



Arun Krishnamurthi,
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The aerospace industry is a diverse and dynamic sector that encompasses the design and manufacture of aircraft and spacecraft. Today's new aerospace designs have increased complexity and need to address more stringent statutory, environmental, financial and operational requirements. Aircraft manufacturers are looking for simpler ways to have complex systems designed. Advances in computing power, computational analysis and digital environments have also significantly transformed and impacted how design is conducted, bringing new challenges and opportunities to designing efforts.

The evolving technology landscape, like Artificial Intelligence (AI), has played a major role in altering the aerospace industry by providing valuable information that might otherwise be difficult to obtain via conventional methods. AI systems can evaluate feedback from multiple assets and process large volumes of data in a shorter span of time when

compared to manual inspections, and aid aerospace businesses to carry out effective and quicker inspections of multiple assets. AI plays a significant role in cutting costs, reducing the design cycle time, simulation, prototyping, optimisation, maintenance, manufacturing and updating products and is all set to drive many developments in the aerospace sector in the next 15 years.

AI aiding aerospace manufacturers

Advances in AI could help aerospace companies optimise their manufacturing processes. However, there is limited adoption of Machine Learning (ML) techniques in the aviation industry. The main reason for this is the lack of access to high-quality data, increased dependability on simple models compared to complex models and a lack of skilled workforce & partners to implement it effectively.

AI Solutions

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Advances in AI are helping various sectors adapt to the changes they go through

Key areas where AI is being used by aerospace manufacturers today include:

- **Predictive maintenance** - Aviation companies use predictive maintenance enabled by AI to resolve maintenance and safety issues. Predictive maintenance allows for faster identification and reports of potential failures in real-time. It predicts the repair timeline and ensures that the process is smoother & faster. A huge amount of data is given as the input, and with the use of AI and predictive maintenance solutions, data points and meaningful insights are deduced as output. The entire process helps in fixing an issue before it arises.
- **Optimised flight performance** - Fuel efficiency is one of the top parameters of aerospace OEMs, which can be optimised with the help of AI. It helps pilots during flights by analysing critical data like the fuel system, system status, weather conditions as well as other major parameters that can be assessed in real-time to optimise a flight path. Additionally, AI helps optimise time-consuming activities in the aerospace industry and paves the way to better human-machine collaboration.
- **Generative design** - AI is increasingly being used to create efficient, faster and lighter parts in the aerospace industry and is applied to find innovative ways to design them. Based on the existing requirements, new innovative product designs are created using ML techniques. In combination with AI, generative design software can enable product designers to explore numerous design options in a short span of time. Implementing AI in the supply chain makes operations in the aviation industry more streamlined. Increased supply chain efficiency enables maintaining the equipment and its regular repairs much easier than doing it manually and also saves money & cuts the downtime. Automated data collection makes it easy to improve the efficiency of supply chain management.
- **Improved quality control** - Quality assurance is all about ensuring that the desired level of quality in a product or service is maintained. This is done by giving a special level of

attention during each and every stage of production. Automating the QA with the help of an autonomous AI solution can save a lot of time and resources. Automating quality testing with the help of ML has increased the rate of defect detection by almost 90%. Training AI can enhance pilot training facilities, with pilots being provided with a realistic simulation experience using AI-enabled simulators coupled with Virtual Reality systems. These simulators can also be used to collect and analyse several data regarding training for creating personalised training data with biometrics to track an individual's performance.

ML integration in aerospace

The aviation industry relies heavily on data derived from a great deal of research, design and production of its products & services. ML has played a major role in developing the aerospace industry by providing valuable information that might otherwise be difficult to obtain via conventional methods. The integration of ML in the aerospace industry guarantees cost-effectiveness and safety.

Key examples of areas where ML is effectively applied in the aerospace industry today are:

- Smart concessions management
- Smart repairs management
- Automatic part geo-location
- Identification in a DMU or assembly line
- NC documentation device
- Knowledge-based engineering
- Alternative fastener selection
- Predictive maintenance of aircraft components
- Sizing of aircraft components
- Reverse engineering
- Prediction of in-service damages to an aircraft based on the region of operation
- Smart factory building
- Any repetitive non-engineering activities



Today, AI and ML are not just providing the best customer experience with automation but also self-service solutions

Today, AI and ML are not just providing the best customer experience with automation but also self-service solutions. The employee workflow is being optimised, and higher air safety is ensured with predictive aircraft maintenance. The smart use of data allows aerospace companies to make informed decisions about the price and market positioning.

Technology trends in aerospace

AI and ML are only a part of the massive technological advancements in the field of aerospace engineering, where several trends enabled by technology have emerged in the aerospace manufacturing industry. Some of these trends are set to revolutionise the future of the aerospace industry and will mark a new phase of growth for the industry.

Here are five emerging trends in the aerospace industry to look out for:

- **3D Printing:** The aerospace industry has moved towards 3D Printing to combat delayed and slow manufacturing processes. With the digital factory design, a builder/designer has a host of advantages apart from saving on resources. All the planning phases of the production and construction can be optically diagrammed by integrating animation and 3D simulation. Companies can now use 3D Printing to manufacture thousands of parts within a short duration of time. The industry faces a constant need for spare parts for replacement, and 3D Printing offers the right solution for this demand. It also helps cut the downtime taken to manufacture, the cost of manufacturing and the final product's weight.
- **Evolution of manufacturing materials:** Aircraft manufacturers are rigorously working towards advancements in material science. Graphene and carbon nanotubes are a few of the newest materials used in aerospace technology to improve the efficiency of aeroplane wings. These materials make aircraft more lightweight and fuel-efficient.

- **Zero-fuel aircraft:** Both civil and commercial sectors operating in the aerospace industry are looking into the concept of zero-fuel aircraft. These zero-fuel aircraft are gaining traction in the industry as they run on electric hydrogen fuel cells and solar energy. The global aerospace industry is exploring further research for developing and testing such aircraft. This emerging wing is set to gain and drive market growth in the coming years.
- **Space propulsion technology:** The propulsion technology is beneficial for the aerospace industry since it aims to reduce fuel consumption in spacecrafts and could enable long-term space missions in the future. With time, there have been many breakthroughs in propulsion system technology that prove beneficial to the aerospace industry.
- **Smart automation:** The aerospace manufacturing industry is ahead of every other industry in applying AI. Advancements have reached a stage where engineers can gauge the size of the bolt required to fit a specific part and the amount of torque required by simply scanning the metallic surface through a single command. A robotic prototype is being used to follow CAD instructions to design and build parts. This helps in maintaining the quality of the products & delivering on time.
- **The digital twin:** Strengthening the production digital twin, production lines can be simulated and validated digitally through virtual commissioning, which saves time and reduces risks. This can be perfected without interfering with ongoing production, maximising project capacity & potential revenue.

Continuing the innovation 'challenge'

To conclude, innovation is the key to any industry for advancing and keeping pace with the evolving ecosystem. The industry needs to continue its outreach in aiding the aerospace industry with innovative technologies to overcome the challenges of digital transformation and sustainable products. □