

Optimized application of artificial intelligence (AI) in aviation market

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Abstract- Businesses may now communicate with their consumers in new ways, make new strategic decisions, and create new workflows thanks to technological advancements. Things like making a flight reservation over the phone or conducting a survey exclusively in hard copy may appear archaic. Organizations may take educated moves toward operational efficiency when they have real-time access to data, the 21st-century oil. During the foreseen time period, Asia-Pacific is expected to be the most promising market. To attract more tourists to the Asia Pacific area, countries like China, India, Thailand, South Korea, Australia, and New Zealand are spending considerably in the development of cutting-edge airline infrastructure. The Asia-Pacific region is one of the world's most sought-after vacation spots. Enhanced air connectivity is being driven by the region's burgeoning tourist industry, which in turn is predicted to propel the expansion of the Asia Pacific artificial intelligence (AI) in aviation market.

Keywords—Data science, Airline, Machine Learning

I. INTRODUCTION

Despite the fact that the worldwide COVID-19 pandemic crisis has had a severe impact on the aviation business, reducing passenger traffic, air cargo demand, airport staff, and incoming income, the situation is beginning to stabilize, there is still more pain ahead.

More than a third of the world's trade in terms of value is transported through airplane, making aviation a vital component of the global economy and a fundamental part of business globally. The aviation industry creates 13.5 million employment worldwide and adds around \$ 880 billion to global GDP each year[1].

However, the modern technological era is having a huge effect on the airline and aviation industries. Growth in the aviation industry is just one sector that stands to benefit from the exponential advancements made possible by emerging technology. AI, robots, the IoT, aircraft systems, and hybrid and electric aircraft are just some of the new technologies altering the aerospace industry.

There will be far-reaching effects of artificial intelligence technologies on the aviation industry. The future of the aviation sector lies on artificial intelligence applications such as machine learning, machine vision, robots, and natural language processing. Participants in the aviation sector have been pushed by the epidemic to prioritize digital transformation programs that aim to improve the customer experience, streamline operations, and reduce costs, as well as investigate the potential advantages of implementing innovative technology[2].

Artificial intelligence can help with numerous customer service tasks, including facilitating check-ins. Airport security checks and passenger identification are two areas where AI technology may be put to use. Passenger identification procedures will be streamlined with the use of security scanners and biometric identification enabled by AI. An additional crucial duty at each airport is the inspection of baggage. The airports have deployed AI-based equipment to examine bags in many lanes[3].

The aviation industry can greatly benefit from the use of AI tools in order to improve operational efficiency in customer relationship management by using cutting-edge technologies. This is accomplished by taking a fundamental approach to improving customer feedback, suggestions, and AI algorithms that can identify real-time customer reaction on social media platforms. The company's AI algorithms monitor social media for mentions of relevant keywords, brand names, geographic locations, and issues connected to the company's core business and its rivals[4].

AI-based biometric security technologies, such as face recognition, fingerprint, and retinal scanning, are already in use at airlines and airports, and their tracking techniques assist predict passenger behavior changes through Big data analysis of purchase history. Dynamic pricing models powered by artificial intelligence are used by businesses to optimize ticket rates in response to historical passenger data.

Similarly, the airline sector has begun to see the potential of blockchain technology to enhance operational efficiencies, security systems, and even customer experiences by storing passenger data in a virtual, de-centralized database that is only accessible to authorized users. Blockchain technology may be tremendously helpful in developing a safe method for handling client information[5].

Hubs of international travel Beacons help passengers find their way between terminals, and they may provide information on everything from boarding gate locations and baggage claim status to nearby restaurants and retail options. Robots are also being used in the airline business to help with customer service, luggage handling, parking, etc.

Spencer Robot, a socially conscious AI, was presented by KLM Royal Dutch Airlines last year. This robot has the capacity to handle social situations involving humans, meaning it can perceive, analyze, and discriminate between individuals and groups using his sensors, as well as learn and abide by social standards, and eventually operate in a way that is kind to humans.

With the use of biometrics technology, aviation travel may be made more streamlined and safe than ever before. To facilitate a more rapid check-in procedure, Air New Zealand has

introduced a biometrically enabled bag drop. In order to free up more staff for dealing with passengers, Delta Airlines introduced the first self-service biometric-enabled luggage drop.

With the advent of IoT (Internet of Things), it is anticipated that all on-board "things" will be networked together, allowing for continuous real-time monitoring of critical systems like the engines and in-flight entertainment (IFE).

Seats equipped with sensors will allow flight attendants to keep tabs on each passenger and anticipate their demands, while other installed sensors will automatically identify and report malfunctions[6,7,8].

The Boeing 787 operated by Virgin Airlines features full Internet of Things integration, with data collected in real time from every device on board thanks to a wireless in-flight network. The passengers, airports, airlines, aircraft, and flight crew are all under constant surveillance and control. The "collect, detect, act" approach is utilized by United Airlines. With the use of machine learning algorithms, NASA and a few airlines have developed an automated system that can use massive amounts of data to flag irregularities and avert disaster. Artificial intelligence may utilize algorithms to anticipate flight delays and mechanical issues with planes. AI is also being used by aviation's maintenance crews, engineers, and pilots (flight engineers role has been replaced largely by computerized engine systems). If there is a problem, anomaly, or emergency, the computer will alert you to it on the screen and start fixing it immediately.

In order to help air traffic controllers see the airport more clearly, AI can be employed. A few airports feature air-tech ultra-high-definition cameras mounted on the top of the towers. Smart airport technologies are able to monitor airport traffic by using cameras and 3D sensors. Using AI can help with every aspect of flying, from preflight planning to flight path forecasting to automation in air traffic control to boosting operational efficiency.

Using machine learning, these aerial platforms can recognize planes in the sky, log their locations, and alert air traffic controllers so they can clear the runway for the next arriving flight. While machine learning isn't designed to take over for human air traffic controllers, it may help with jobs like pattern recognition and forecasting so that humans can focus on more high-level duties. Much of the data in the air traffic control system is still entered manually.

II. PROBLEM FORMULATION

Even if AI technology makes it possible for human pilots to spend less time at the controls, they will still spend most of their time in the cockpit monitoring the systems and keeping their skills sharp. Technology advancements in the fields of sensing, computation, and artificial intelligence are reducing the need for human pilots. Robots, according to the experts, may one day take the place of human co-pilots in commercial aircraft.

The contemporary jetliner's cockpit is where the influence of computers and other electronic devices may be seen and felt to the greatest extent. Display-management computers, which are in charge of the cockpit's instrument panel, are a crucial

part of the computer systems that ensure technologically effective flight. Dual flight-management computers, each of which acts as a failsafe for the other, are in charge of the whole operation.

Both computers have a tiny screen above the keyboards, where the flight plan's altitudes, speeds, and intermediate destinations may be entered simultaneously by the two-man crew before takeoff. The computers take over control of the plane, navigating it while continually monitoring its myriad complicated systems and transmitting data to subordinate computers.

The pilot's two side sticks are controlled by a different computer; their motions are converted into electrical impulses and then routed via the fly-by-wire system's moderation circuit before being sent to the wings and tail. When it comes to assisting pilots, computers have proven to be so reliable that aircraft can now be flown with only two pilots instead of the traditional three[9,10,11,12].

Fly-by-wire control is a major advancement in the development of fully automated passenger aircraft. Instead of using mechanical or hydraulic linkages, this technology uses digital signals to relay the pilot's hand and foot movements to the aircraft's numerous control surfaces. The performance of an airplane is monitored and recorded by Flight Management Computer Systems. Commercial airplanes now include autopilot and autothrottle systems that are microprocessor-based as well[13].

Artificial intelligence (AI) and, in particular, machine learning (ML), are providing immense promise by developing applications that might improve aircraft design and operation. Deep learning (DL) has several potential uses in the aviation industry, especially in the fields of computer vision and natural language processing[14,15,16].

Solutions like high-resolution camera-based traffic detection or a virtual assistant to the pilot might be brought about by these sorts of applications in the aviation industry.

Autonomous flying is the most crucial use case for ML. To guarantee a safe takeoff and landing, autonomous vehicles will need to rely on systems that can make complicated judgments. Full autonomy will be enabled by AI, but extremely robust algorithms will be required to process the massive amounts of data created by sensors and machine-to-machine connections. Self-piloted commercial aircraft rely heavily on AI-powered computer vision and machine learning technology for takeoff and landing, navigation, and obstacle detection on the ground[18,19,20,21].

More and more advanced military drones, and sadly the killer drones, are being produced with the help of artificial intelligence. Remotely piloted unmanned aerial vehicles (UCAVs) are used to launch strikes on the ground and are eventually expected to be fully autonomous. In the future, military unmanned devices will be able to function more independently and in tandem thanks to advancements in artificial intelligence[22].

During the Gulf War, such planes flew hundreds of kilometers on sorties carrying a variety of explosive payloads. Multiple individuals were killed when an unmanned aerial vehicle (UAV) from the United States attacked infrastructure facilities in Iran and other Middle Eastern nations. A data tsunami is reshaping flight operations, technical operations,

and customer interaction in the commercial and defense aviation sectors.

Data is useful because it increases productivity and boosts revenue. However, even cutting-edge technologies do not adequately safeguard data integrity inside and across aviation firms, retaining just the bare minimum of information required for any given operation. Already, the world's major airlines have begun to use AI applications across departments, including customer relationship management, airline operations management, autonomous machines and processes, fraud detection, and security management.

The European Aviation Safety Agency (EASA) is working on a data project that might benefit from the use of AI and machine learning, which could help with the organization's challenges in dealing with massive amounts of operational data, safety reports, meteorological data, and traffic data. Adding AI boosts the system's efficiency, but opens it up to a new class of cyber threats[23,24].

Electric airplane propulsion is the most promising technology. Numerous types of electrically powered general aviation aircraft are already in operation, and several categories of hybrid-electric aircraft propulsion exist, all of which require liquid fuel as their primary source. Improvements in aviation systems have the potential to produce net-zero carbon emissions by 2050, and can cut fuel usage significantly with the current design of aircraft.

A combination of a supersonic aircraft with an electric aircraft might result in the world's fastest ever electric aircraft. Supersonic air travel is being heralded as the dawn of a new era, but some people are skeptical. Problems with emissions and costs must be solved before supersonic aircraft may be used commercially anywhere in the globe. On the not-too-distant future, we could fly in planes with see-through ceilings, VR cabins, and biofuel power. The extraordinary triple-decker Sky Whale aircraft, which could seat 755 passengers, is destined to revolutionize Space tourism. It is one of the largest passenger planes ever built and has the latest in on-board technology[26,27].

Companies in the aerospace industry have 3D printed satellites, rockets, spacecraft, and other components. In addition to competing with the United States, China, and Russia in the production of cutting-edge drones, the Turkish defense industry also has ambitious plans to enter the space race by 2030 with the development and launch of a rocket capable of reaching the moon. Space X, located in the United States, is now in charge of satellite launches for Turkey. Turkey is working with Russia as well, and Turkish officials have even communicated with Elon Musk directly about possible collaboration.

III. AVIATION INDUSTRY

The aviation industry is undergoing radical change due to the rise of artificial intelligence.

There are several ways in which AI could be useful in aviation, from enhancing safety to improving efficiency.

Successful airlines are already designing and testing AI systems to boost passenger pleasure and efficiency.

The International Air Transport Association predicts that by 2024, air transport will have 4 billion passengers, surpassing pre-COVID-19 levels. Airline companies need to get creative

and use new technology, including artificial intelligence and machine learning, to handle the massive influx of customers. The use of AI in aviation might greatly enhance urban air mobility, airline safety, flight scheduling automation, and the ability to do predictive maintenance on aircraft.

Optimization of Flight Routes

There are a plethora of data points that are analyzed by AI algorithms, including the flight's route, altitude, length, fuel usage, aircraft type, and weather conditions. In order to cut down on both travel time and fuel consumption, the AI software evaluates flight data to find the most efficient route. Alaska Airlines is currently piloting an AI system that can determine the optimal flight path in real time. Its six-month pilot program saw a five-minute reduction in flight time and a save of 480 thousand gallons of jet fuel.

Automatic Plane Repair Prediction

The hefty expense of flight disruptions falls squarely on the airlines themselves. According to data compiled by the BTS, 35% of all aircraft delays can be attributed to issues with the airlines themselves. For airlines, unscheduled maintenance is the leading cause of flight delays. By monitoring airplanes and identifying irregularities, machine learning algorithms and the Internet of Things can help airlines reduce the costs of unscheduled repair. The aircraft's technical status will be monitored in real time by the machine learning algorithm, which will then alert maintenance staff to any problems it detects. Technicians in the aviation industry may plan ahead for maintenance tasks like the replacement of plane parts in this way[28].

With the help of an AI technology, maintenance activities can now be reported automatically to upper management, who can then monitor costs, stock levels, and operational insights. Having a streamlined reporting and analytics system allows airlines to save money on things like overnight shipping of components and paying more for crew members who work overtime[29].

There are exciting new breakthroughs on the horizon for the use of AI in aviation. Everything from flight management to air traffic control to crew scheduling to airport security is being revolutionized by artificial intelligence in the aviation industry. The aviation sector is undergoing a radical transformation as a result of the application of AI to the problems of passenger safety, operational efficiency, and customer satisfaction[30].

IV. ARTIFICIAL INTELLIGENCE (AI) IN AVIATION INDUSTRY

Artificial intelligence (AI) is expected to revolutionize the aerospace sector over the next several years by reducing costs, shortening design processes, removing duplication, augmenting, supporting, producing, and updating. The aerospace and aviation industries may benefit from improvements in AI in terms of improved manufacturing procedures. The aerospace sector has been slow to adopt AI techniques due to several factors, including a lack of access to high-quality data, a preference for simple models over complicated ones, and the need for more skilled people and partners to implement it efficiently. AI has the potential to be a game-changing breakthrough for aerospace firms with the

right collaborator. Machine learning, computer vision, robotics, and natural language processing are all areas where AI has proven useful in the aviation industry. Some of the benefits include automatic scheduling, customer feedback analysis, targeted advertising, pattern recognition, and predictive maintenance. When it comes to commercial aviation, artificial intelligence (AI) technology is making a world of a difference by vastly improving flight operations[31]. Artificial intelligence (AI) and other cutting-edge technologies are being adopted by the best airlines throughout the world to deliver personalised services and enhance the customer experience. A number of self-service kiosks have been installed at the airport to streamline and computerize various processes, including security screenings. These are, of course, only the most obvious uses; numerous others are mentioned below.

Acknowledgement of Passenger Identity

Thanks to advancements in biometric identification, machine learning, and security scanning, operational efficiency on the ground is expected to improve. Airports in the United States frequently employ AI to spot security risks. The passenger identification procedure can be sped up with the use of tools that use artificial intelligence.

Checking the Bags

Osaka Airport in Japan will soon have Syntech ONE, an artificial intelligence platform that filters bags for several conveyor belts. Integrating Syntech One with the X-ray security system enhances the system's ability to spot potential threats. Automated baggage screening will significantly lessen the strain of security staff by allowing them to more swiftly and accurately detect illegal items.

Creating Product Layouts

Cost-effective and dependable airplane parts are generally favored in the aviation industry. The use of generative structures and AI algorithms allows automakers to develop such parts. Using design requirements, limitations, and features such as materials, available assets, and a stated budget as input, technologists or architects can iteratively build a flawless product. Incorporating AI into sophisticated design software may speed up the process by which product designers analyze potential designs. This technological advancement might inspire designers to make new low-cost and portable items. As a result, AI has the potential to aid the aerospace sector in enhancing both the design and manufacturing processes.

Changes in ticket prices on the fly

Anyone who has ever bought a plane ticket will attest to the fact that it is unlike any other transaction they have made. The same flight may have different prices depending on the site you use to compare them. Prices vary depending on variables such as departure time, final destination, travel distance, and ticket availability. An individual's ticket price might change in the span of a single minute. The reason for this is the use of "dynamic pricing" by airline companies. It's a strategy for adapting prices so as to maximize profits in light of the present market situation. In order to be effective, dynamic pricing algorithms employ cutting-edge methods like machine learning and in-depth data analysis.

Delayed Prediction Best Practices for Machine Learning Models

Delays occur often and are typically caused by a number of different factors. Up-to-date ML-based apps can aid airports and airlines all around the world in foreseeing delays and swiftly informing passengers. The airline industry's UX (User Experience) will greatly benefit by giving customers additional time to reschedule flights or make alternate reservations[32,33].

Use of Fuel Efficiently The aerospace industry is very picky about its fuel, and even a little reduction in aircraft fuel consumption may have a major influence on a company's bottom line.

Artificial intelligence (AI)-enabled products might help cut down on energy use. For instance, the machine learning tool developed by a French business called Safety Line may aid pilots in optimizing their ascent trajectories before every trip. Ascending consumes the most gas, so if you can improve that part, you'll save a lot of money.

Solutions for a Successful Supply Chain

The aviation sector is becoming more streamlined because to the use of AI in the distribution network. Increased supply chain competence makes regular maintenance and repairs more accessible than they would be with manual competence. The cost of repairs is reduced and downtime is kept to a minimum when they can be scheduled in advance. Automating data gathering paves the way for rapid enhancements to be made to supply chain management capabilities[34,35].

Guidelines & Instruction

Flight simulators may be built with the help of AI. Together, AI simulations and interactive virtual frameworks provide pilots with a comprehensive simulation environment. A student's academic achievement can be utilized in conjunction with data collected and analyzed by AI-enabled simulators to create individualized training plans. In the long run, this has the potential to be a solid foundation.

Customer Happiness

Both client happiness and the quality of service provided are key in the commercial aviation industry. The use of artificial intelligence (AI) is one strategy airlines may adopt to raise consumer involvement and provide superior service. Chatbots powered by AI are automated systems that can simulate human interactions with customers in real time. In theory, chatbots might streamline customer service for companies with an online presence. That goal can be reached in a variety of methods, some of which are:

- Guidelines for facilitating precise and tailored purchasing by consumers
- Support chatbots powered by AI might respond quickly and politely to user queries.
- Help would be available at all times, automatically.
- Potentially fruitful conversations with customers.
- Preventative Maintenance

Airbus, the largest airplane manufacturer in the world, is implementing AI technologies to make their aircraft maintenance process more reliable. Skywise, a cloud-based solution, is helpful for storing data in a practical manner. Massive volumes of data are continually collected, recorded, analyzed, and stored on a cloud server by the fleet. With the

use of AI and predictive analytics, the airline sector may select a reliable approach for servicing aircraft in a systematic way. Artificial intelligence has only been used on the ground in aircraft thus far. Massive data sets have been downconverted from airplanes and engines, and machine learning has been utilized to discover patterns and abnormalities in these datasets. Although the aviation industry has begun its transition toward AI, complete adoption of AI will be difficult and may take some time. But nowadays, technological progress is being made at a dizzying rate. Companies that successfully undergo digital transformation are ones that are quick, efficient, long-lasting, and productive. The aviation and travel industries will benefit from the introduction of AI[36,37]. Support companies may give more personalized service to their customers by utilizing chatbots, instant messaging applications, and other intelligent technologies driven by artificial intelligence (AI).

V. SIZE OF THE AVIATION AI MARKET FROM 2021 TO 2030

The worldwide market for aviation AI was valued at \$653.74M in 2021 and is projected to reach \$9,985.86M by 2030, expanding at a CAGR of 35.38% between 2022 and 2030.

Forecasts show that the aerospace industry's increasing reliance on big data analytics will drive considerable growth in the worldwide AI in aviation market over the next several years. The global market for aviation AI is growing fast thanks to the increased spending of aerospace firms on cloud-based technology and services. Airports and airlines are increasingly using cutting-edge innovations like AI to modernize their services and streamline their processes. Adoption of AI is being encouraged by the aviation industry's growing operating expenses and the desire to improve profitability. Consequently, the need for AI in the aviation sector is growing rapidly as the importance of air travel continues to grow throughout the world. The use of artificial intelligence-based chat bots to assist travelers in making online ticket purchases has increased dramatically in recent years.

Air traffic control and predictive maintenance are two areas where AI and machine learning are projected to have a positive impact in the near future. The use of artificial intelligence in observational tasks including time series analysis, NLP, and CV. It is anticipated that the number of AI applications in the many complex operations of the aviation sector would increase as a result of continuous innovations and increased investments in the research activities. Airbus and the Chinese firm EHang are working together to advance artificial intelligence in navigation. Airbus has successfully performed a taxi, takeoff, and landing utilizing the vision based AI used by EHang in its autonomous aircraft. As a result, the increasing interest in using AI in many aspects of the aviation sector is driving the expansion of the worldwide AI in aviation market.

The Artificial Intelligence in Aviation Market Report's Scope Companies' Offering, Technology, Application, and Geography Segments Coverage in the Most Promising Asia-Pacific Market Over the Base Year 2021 and Forecast Period 2022-2030 Mentioned Intel, Xilinx, Thales, IBM, Amazon,

Nvidia, Microsoft, Garmin, Lockheed Martin, and Samsung Electronics

Presenting New Understandings

In 2021, the worldwide market for artificial intelligence in aviation was led by the software subsegment. Exponential expansion of the software market may be attributed to the widespread use and increasing investment in artificial intelligence (AI) based software for its application in airport operations, surveillance, and flight operations. Software APIs for things like speech, sensor data, language, vision, and machine learning algorithms are all a part of the AI systems that make these aviation software applications a reality[38].

Over the projection period, services are anticipated to increase at the quickest rate. The increased demand for services supplied by trained professionals who are able to effectively manage AI systems is largely responsible for this expansion. During the forecast period, the services segment of the worldwide AI in aviation market is predicted to increase at a faster rate than the hardware sector.

Perspectives on Technology

In terms of technology, machine learning was the most lucrative subsegment of the artificial intelligence (AI) in aviation industry worldwide in 2021. The aviation sector throughout the world is seeing a considerable increase in the need for machine learning technology due to the expanding demand for big data analytics and the growing requirement to collect data. The machine learning subsegment of the global AI in aviation market has been growing at a rapid rate due to the technology's improved ability to conduct difficult and impossible calculations.

During the foreseen time period, the natural language processing (NLP) market is anticipated to be the most lucrative subsector. Ticketing, invoicing, and other legal papers are just some of the text types that may be easily scanned and converted using NLP technology. Words and phrases may be encoded using deep learning. In addition, the Recurring Defects Management may be used by the NLP to predict which planes will have the same problem again. The aviation sector is rapidly expanding its use of natural language processing (NLP) for revenue management, drone aircraft control system, flight safety, customer engagement measurement, and feedback analysis, among other applications[39].

Some Thoughts on Its Use-In 2021, the worldwide market for artificial intelligence in the aviation industry was led by the virtual assistants subsegment. Artificial intelligence (AI)-powered virtual assistants help pilots save time and effort by automating mundane activities like reading weather reports, locating their aircraft when requested, and switching radio stations. The virtual assistant is in high demand since it facilitates a reduction in the pilots' regular workload. Furthermore, throughout the projection period, this sector is predicted to increase due to the increasing use of virtual assistants to enhance customer support and provide answers to simple queries about the services or goods and flight status. The airport has started using virtual assistants to better help their customers. In the airport, for instance, virtual assistants can be set up in the security checkpoint to guide travellers through the maze of procedures.

Perspectives on Regional Development

In 2021, artificial intelligence in aviation was a huge business in North America. The North American artificial intelligence in aviation market is expanding due to the region's well-established air transport infrastructure and increased expenditures in the adoption of newest and sophisticated digital and innovative technologies. Significant expenditures in the implementation of AI technology at airports and aircrafts are anticipated in light of the region's high demand for air travel and growing number of air passengers. International flights departing from the United States and Canada have increased in popularity as a result of the effects of globalization on the business community. The aviation sector in North America is one of the first to embrace AI-based technology. Market expansion in North America is being fueled by the increasing use of AI technology by the airline industry[40,41].

The percentage of the aviation industry's total revenue that is expected to be generated by artificial intelligence in 2021, broken down geographically.

Important Changes in the Market

Tata Power and Autogrid formed a cooperation in July 2021 so that the former could establish a home demand response program to increase customer acceptance of demand response.

In June of 2020, an AI business by the name of SparkCognition partnered with aviation giant Boeing to launch SkyGrid, with the goal of developing an aerial operating system to facilitate the next generation of autonomous aircraft.

VI. MAJOR FINDINGS AND CONCLUSION

Over the next 15 years, AI will play a pivotal role in the aerospace industry, driving many innovations in areas such as cost reduction, design cycle time reduction, simulation, prototyping, optimization, maintenance, production, and updating of products.

Technological progress in artificial intelligence may one day help the aircraft industry streamline its production procedures. Unfortunately, the aviation industry has been slow to adopt machine learning techniques due to a number of factors, including a lack of access to high-quality data, an increased reliance on simple models rather than complex ones, and a lack of skilled workforce and partners to effectively implement it.

AI has the potential to be a game-changing technology for the aerospace industry if it is paired with the proper collaborators.

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