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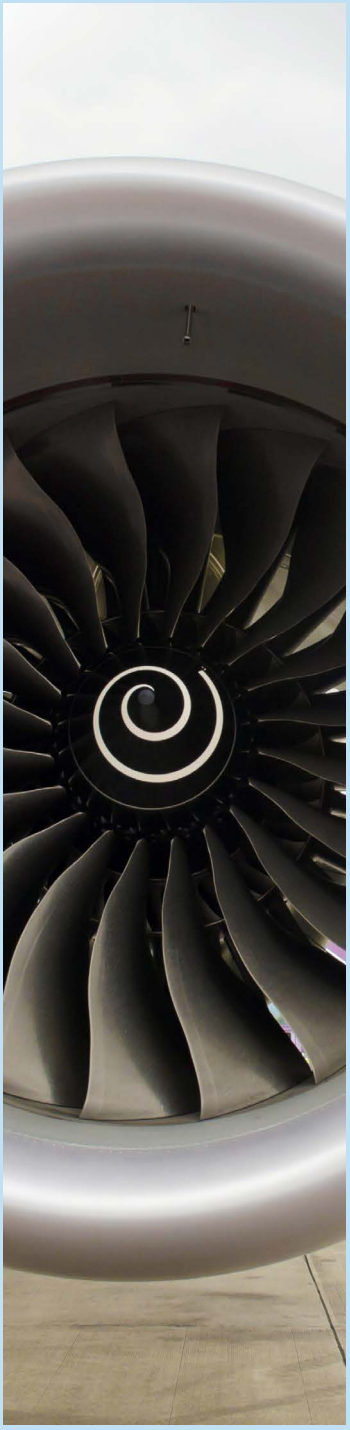

COMMERCIAL AVIATION MRO – GROWING WITH GAPS

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The world is getting smaller each day. Extreme distances like Doha to Auckland are covered in a single 9000+ mile hop. On the opposite end of the spectrum, turboprops and single aisles are taking inter-city buses off the road. Flight in its second century is undergoing a rapid physical and digital revolution.

Boeing estimated in its 2018 Commercial Market Outlook that airlines would need 42000+ more aircraft valued at $6.3 trillion by 2037. The technology in these new aircraft gets more complex with each passing generation. The latest aircraft incorporate IoT enabled sensors, new composite materials, carbon fiber structures and enhanced connectivity features like inflight Wi-Fi. New technologies entail more complexity in maintenance with a need for new inspection and repair procedures, equipment and technical skills. Maintenance, Engineering, Parts, and Upgrades spend for the industry is expected to near $2.365 trillion over two decades from 2018 to 2037. MRO organizations have to evolve in order to be prepared for the volume of requirement as well as the changes in technology.

It isn't just technology that is changing. The epicenter of the global aviation market is also shifting. Team SAI forecasts Asia to be the largest MRO market by 2024. OEMs and MRO facilities, however, have traditionally been located west of the Caspian or in the Far East. For example, in India, one of the fastest growing aviation markets in the world, KPMG estimates only 5-10% of heavy maintenance work of domestic carriers is carried out within the country. This is both due to a shortage of maintenance facilities as well as apprehension on the part of leasing companies and financial institutions about the competence of local facilities. Training and maintenance facilities in collaboration with OEMs and legacy MRO operators are being set up at a rapid pace to meet the growing demand.

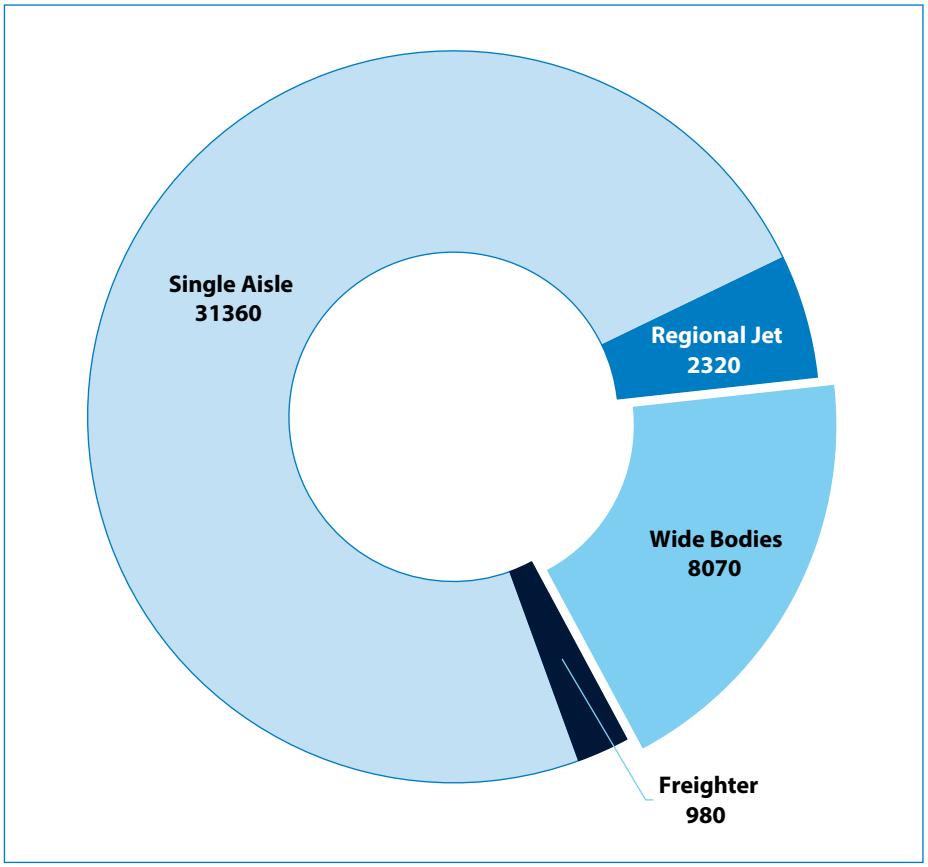

Figure 1 *Expected Aircraft Demand 2017-2037 (Boeing Commercial Market Outlook 2018)1*

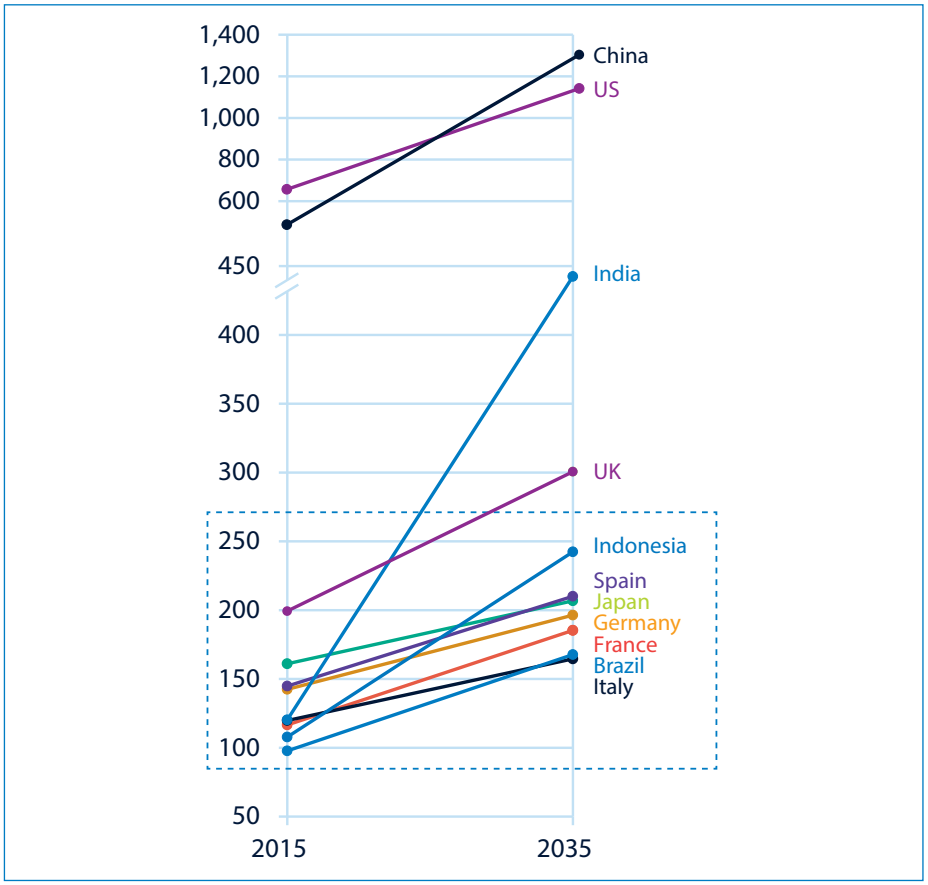

Figure 2 *Top 10 Passenger Markets by millions of O-D Passenger journeys (IATA)*

Forecasting & Inventory

From rivets and bolts, to seats and engines, an A380 is made up of about four million individual parts produced by 1,500 companies from 30 countries around the world. Managing the inventory and forecasting the demand for such a large part variety is extremely challenging. In 2016, researchers at King Abdul Aziz University in Jeddah, Saudi Arabia studied the frequency and cost of AOG situations of the Boeing 777 fleet of an undisclosed airline X over a period of one year. A total of 146 AOG incidents occurred with an average part replenishment cost of $8785; but average flight delay cost of $22754. The airline thus lost over $3.32 million in delay costs alone. Though few parts cause most AOG situations, the question that arises is, where and how much inventory is to be stocked. Stocking inventory ahead of time entails capital expense and inventory holding cost, and the cost of AOG must be carefully weighed against these expenses. KPMG estimates that Indian carriers hold an estimated $3 Million worth of inventory for each aircraft up to 20 aircraft fleet. India had 570 commercial aircrafts in April 2019, which adds up to over $1.5 billion in inventory held.

What can further mess up the inventory equation for airlines and MRO companies is operating cost volatility. Fuel is one of the biggest operating expenditures (23.5% of operating expenses in 2018) for airlines. An airline's choice of fleet mix is thus dependent on the price of fuel. When prices move up airlines retire or ground older less fuel-efficient aircraft. It isn't just fuel that affects retirement. With rapid advances in technology, aircraft are reaching obsolescence quicker with older models unable to meet passenger or airline expectations. From 1991 to 2000 a total of 1700 aircraft were retired while 1800+ were retired in the 3-year period from 2012-2015 alone. These factors affect the inventory forecast and schedules for the MRO companies.

Big Data and Analytics

Data analytics allows airlines and maintenance providers to pre-empt any failures, prevent unscheduled ground time, and optimize inventory levels. By 2026, the newest generation aircraft are expected to generate between five to eight terabytes of data per flight that can be mined. By knowing in advance the possible time window for a part to fail the aircraft's maintenance and part replacement can be scheduled. All the sensor and IoT data are also driving the adoption of digital twin technology. GE has already built digital twin engine components for its GE60 engine family. Boeing is using the digital twin asset development model for the 777X and claims a 40% improvement in first-time part quality. Real time monitoring and predictive analytics can help detect defects earlier. Early defect detection will enable safer flying and help supply chain managers plan their purchases and inventories better, reducing both airline down time and inventory holding costs.

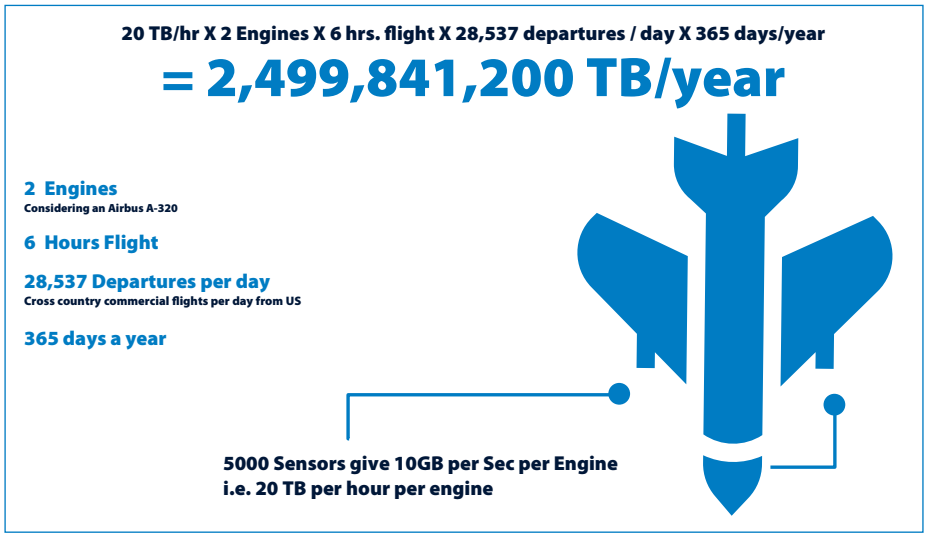

Figure 3 *Sensors data from a cross-country flight*

Competition from OEMs

Manufacturers and OEMs are now intruding into the MRO turf with their own aftermarket offerings. Airbus Flight Hour Services (FHS) is covering spare part availability, maintenance and logistics. Boeing has set itself a target to triple revenue to $50 billion from its Global Services business by 2026. 52% of Rolls-Royce Civil Aerospace division's revenue in 2017 came from services. To further their service aspirations, OEMs are attempting to protect their intellectual property with increased vigor. In the 2018 Oliver Wyman MRO survey, 97% of respondents reported increased material cost due to increase in OEM prices and restrictions on OEM designed parts. MROs are attempting to combat competition from OEMs by partnering with them and increasing reliance on Used Serviceable Materials (USMs).

Labor Imbalance

The MRO industry needs highly trained and certified technicians, demand for whom is set to grow manifold. Boeing estimates the global airline industry to need 754,000 new technicians by 2037. Complex systems also mandate increased training requirements. The Aeronautical Repair and Service Association (ARSA) estimated that 11000 technician positions were unfulfilled in 2017 leading to a $1.95 billion loss to the industry. Maintenance technician schools also have to be prepared to impart new skill sets. Industry executives rate composite material repair and manufacture, collection and reporting of data for advanced analytics, big data and predictive maintenance, and having competencies in the newest avionics and electrical systems as the top areas of focus. Rolls-Royce and Qatar Airways, for example, have introduced Virtual Reality headset based instructions to help train engineers to disassemble Trent XWB engines for shipment. An Augmented Reality application for the technicians is the overlaying of technical information over real components.

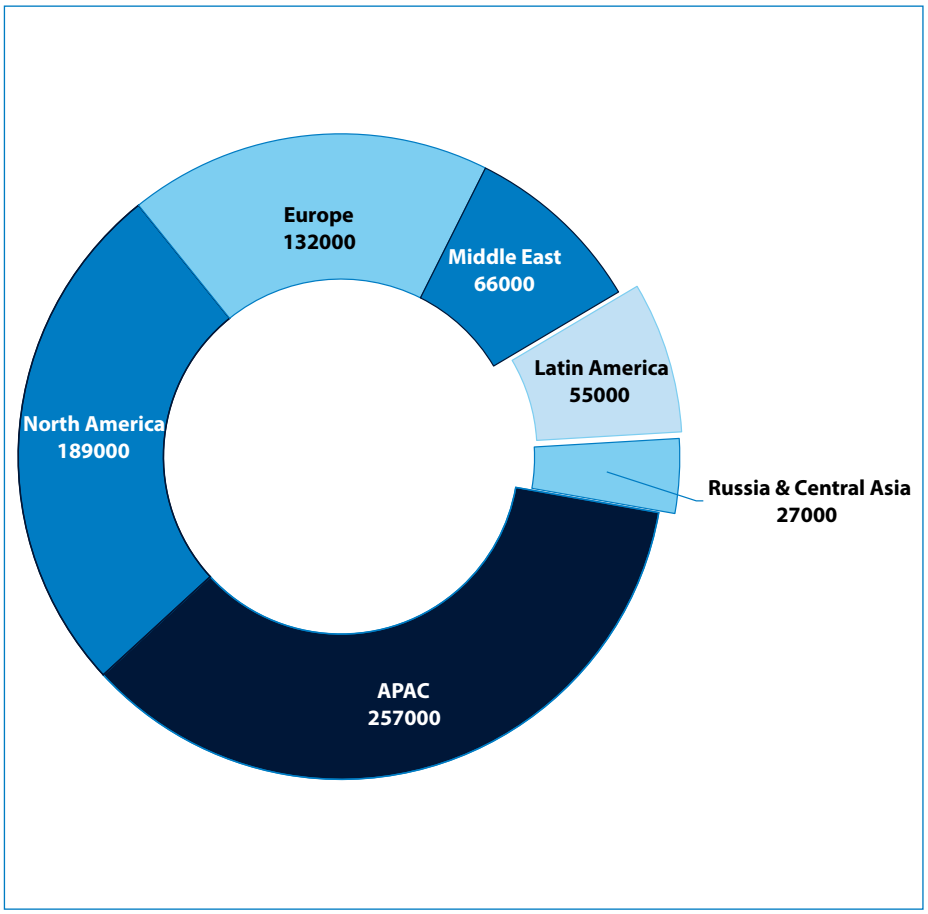

Figure 4 *Expected Technician Demand by 2037 (Boeing Pilot & Technician Outlook 2017-2037*

Data Visibility and Security

A major issue faced by the entire aviation industry for decades now is the prevalence of counterfeit components. These can have fatal consequences as seen with the crash of Partnair Flight 394 in 1989 that killed 55 people. The non-standardization and complexity of record-keeping, in addition to the number of operators in the system, is a major contributor to the fake part crisis. Investigators found that the battery on the emergency locator on the MH370 had expired more than a year before the fatal flight. A good record keeping system should have flagged this critical safety oversight. IATA has identified blockchain as a critical component in Part and Maintenance Provenance and Certification.

Blockchain adoption will contribute to making the record keeping system immutable and tamper proof. Widespread adoption though, will take regulatory changes that mandate such a system. The ICAO and IATA, in partnership with member states, airlines, OEMs and MROs will have to unanimously agree upon, and adopt a common set of standards and guidelines to be followed by all involved.

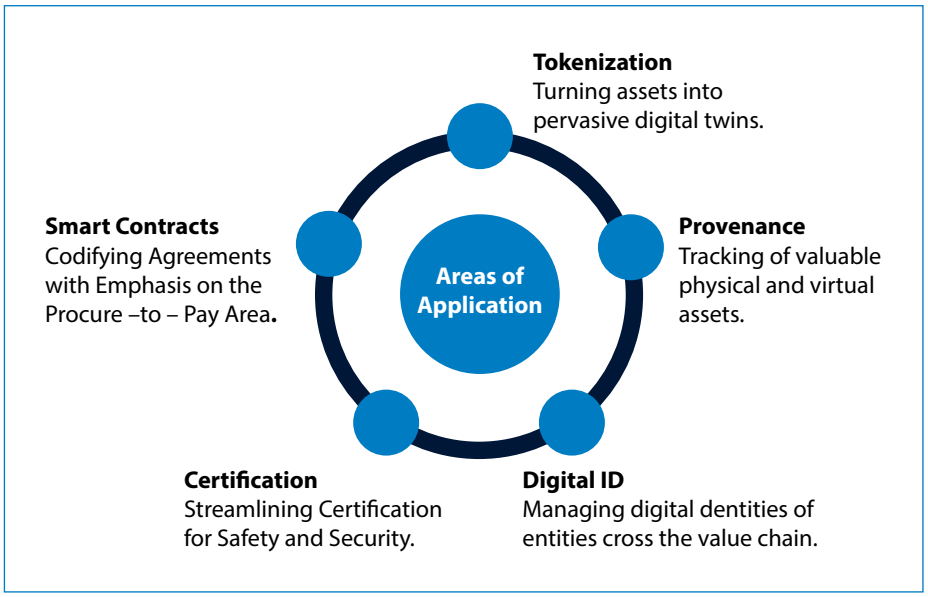

Figure 5 *Blockchain areas of application (IATA)*

Summary

It is less than 120 years since the Wright Brothers first took flight, and the airplane has already evolved way beyond what early pioneers could have imagined. Today's airplane is an always connected digital machine. Aircraft maintenance is no longer the fiefdom of physical tools and hardbound manuals. Algorithms and data mining predict when a part needs replacing, the technician gets all his information on a heads-up display, and parts are 3D printed on the job site. The gas turbine itself is on its way out as Rolls-Royce, Airbus, and Siemens are preparing for the first flight of their hybrid-electric technology demonstrator E-Fan X in 2020. All of these are rapidly changing the airline operations and maintenance landscape.

Digitalization of the industry also brings a dangerous new opportunity for malicious elements. The access MRO companies have to airlines and OEMs makes them a vulnerable entry point for hackers . Cyber criminals could steal customer information, access records and allow spurious parts to be falsely authenticated, all with dangerous consequences. Worryingly, only 30% of MROs, OEMs and operators said they had ever carried out a cybersecurity threat assessment in the 2018 Oliver Wyman MRO Survey. Netscout, an application and network performance management provider, found that cyber-attacks against airlines increased by 15,000 percent between 2017 and 2018. The digital revolution is an opportunity as well as a threat and the industry needs to be prepared on all fronts.

About the Authors

Amitav Chatterjee

Amitav is responsible for growing the Aviation Consulting footprints for Infosys. He brings with himself firsthand aviation experience across Defence, Commercial and General Aviation streams. Most recently he has been involved in building point solutions for aviation business by leveraging IT. Firmly believing in improving the life of every member of the aviation fraternity, he has been a key contributor in building various solutions across the complete value chain. Some of his contributions are towards very large technology transformation assignments involving some of the world's largest and most complex organizations.

Amitav has deep understanding of aviation after-market activities including aircraft operations & management, maintenance, inventory, leasing, livery etc. Presently he spends most of his time in conceptualizing new solutions for aviation that can resolve existing business challenges.

He has studied Mechanical Engineering and International Business. His interests include photography, painting and teaching.

Jai Kasanwal

Jai has more than 9 years of experience in various area of supply Chain which includes, Logistics, Warehousing, Inventory management across CPG (Consumer Packaged Goods), Pharmaceutical, Logistics and other sectors. His experience involves consulting services for digital transformation, requirement gathering, business process modelling, Project Management, Industry Analysis and customized solution designing. He is also CSPO certified.

During his tenure as market research expert, he has written couple of articles, advisory and thought papers viz. "Article on Indian Logistics Challenges", "Article on World Air Cargo Market-2012 and Beyond", "Advisory on Impact of New Dry Bulk Terminal@Kandla Port". He had also been awarded with Best Advisory Award for advisory written on "ILA Labor Strike – Impact on the US market " while working as a market research expert at Beroe Inc.

Jai is a MBA in Operations from Department of Management Studies (National Institute of Technology), Trichy, India. He has done his graduation in BS Marine Engineering from BITS Pilani, Rajasthan, India.

As a Marine engineer, Jai had an opportunity to work across vibrant cultures of nationalities like Americans, South Koreans, Filipinos, Chinese etc.

Ajil

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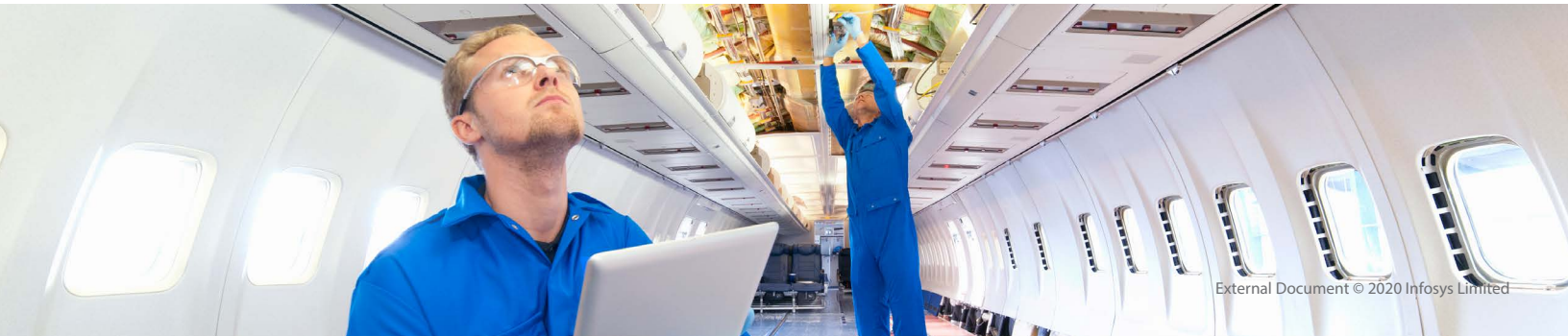
He has an MBA from IIM Lucknow and a Masters degree in Mechanical Engineering"



Abhinav Anand

Abhinav is a Mechanical Engineer and MBA qualified professional. He has completed his engineering from KIIT University Bhubaneswar and MBA from Brunel Business school, London (AMBA, AACSB, BGA, PRME accredited). He has over 9 years of work experience. He has worked as Consultant and Operation Manager in the Energy and Manufacturing sector in UK & India. Currently he is working as a Team lead for Daimler project (manufacturing) in Infosys

His past assignments include Reliance Energy, Reliance Infra & Start up firm as Sr. Operation Manager, managing end to end supply chain. He has also visited the client location in London and Shanghai as a part of previous assignments. He has also done projects in Tata steel and Tata Motors as a part of Btech Assignment. His profile got featured in Alumni section of business school website.

Abhinav is certified Six Sigma Green Belt from Indian Statistical Institute, New Delhi and also has project management experience and knowledge. He is Prince2 Practitioner certified from Peoplecert (Axelos). He is also certified CSPO professional. He has been awarded with Insta awards twice in Infosys during one year of his working tenure.

He was a part of Multimodal Logistic summit and supply chain summit, strengthening for Make in India in Mumbai during May 19-20 2016 for which he was featured in 'Members in News' section of IEI epitome magazine for July 2016 edition.

He is an Associate Member of The Institution of Engineers(India) (AMIE). He is Professional Member of Indian Society of Mechanical Engineers (MISME). He has been awarded certificate of 'Chartered Engineer' from Institution of Engineers (India). He is a Graduate member of Association of MBA's (AMBA). He specializes in the following areas: Procurement, Strategy & Planning, Operations & Supply Chain, Logistics, Materials Management/Inventory, Project Management, quality management.

His hobby includes Playing Tennis, Swimming, Travelling and he has also learnt Djing.

References

1. http://www.boeing.com/commercial/market/commercial-market-outlook/
2. http://www.boeing.com/resources/boeingdotcom/commercial/market/commercial-market-outlook/assets/downloads/2018-cmo-09-11.pdf
3. https://www.iata.org/pressroom/pr/Documents/TopTenPaxMarkets_graph.pdf
4. https://www.slideshare.net/reyyandemir/2015-2025mroforecasttrendsmroasia20151025
5. http://www.indiamro.in/pdf/KPMG-Report-2016.pdf
6. http://edition.cnn.com/travel/article/airbus-a380-parts-together/index.html?sr=twCNN012318undefined0935PMStory
7. Badkook, Basem. "Study to Determine the Aircraft on Ground (AOG) Cost of the Boeing 777 Fleet at X Airline." American Scientific Research Journal for Engineering, Technology, and Sciences (ASRJETS) [Online], 25.1 (2016): 51-71. Web. 26 Jul. 2019
8. http://www.knowindia.net/aviation7.html
9. https://www.pwc.com/us/en/industries/transportation-logistics/airlines-airports/predictive-maintenance.html
10. https://www.mro-network.com/airlines/rising-fuel-prices-could-trigger-retirement-jump
11. https://www.iata.org/pressroom/facts_figures/fact_sheets/Documents/fact-sheet-fuel.pdf
12. https://aviationweek.com/awin/mro-industry-girds-aircraft-retirement-tsunami
13. http://www.spsairbuz.com/story/?id=505
14. Informatica Economică vol. 22, no. 1/2018 – Big Data in the Aerospace Industry
15. https://www.mro-network.com/maintenance-repair-overhaul/no-afterthought-rolls-royce-and-aftermarket
16. https://www.mro-network.com/airframes/boeings-50-billion-mro-play
17. https://www.topaviationnews.com/boeing-ceo-talks-digital-twin-era-of-aviation/
18. https://fsd.servicemax.com/2018/06/12/aircraft-maintenance-and-the-generation-z-challenge/
19. https://www.mro-network.com/maintenance-repair-overhaul/rolls-royce-qatar-airways-debut-vr-mro-training
20. https://www.aibn.no/aviation/reports/1993-02-eng
21. https://www.iata.org/publications/Documents/blockchain-in-aviation-white-paper.pdf
22. https://www.travelpulse.com/news/airlines/research-shows-hackers-are-attacking-airlines-more-than-ever.html
23. https://www.aviationtoday.com/2018/01/01/digital-twins-ai-mobile-apps-drones-4-tech-developments-set-hit-commercial-aviation-2018/

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