NAVIGATING THROUGH OPERATIONAL TURBULENCE

Applying Data and Analytics to Improve Efficiency

A Frost & Sullivan Report

FROST & SULLIVAN

INTRODUCTION

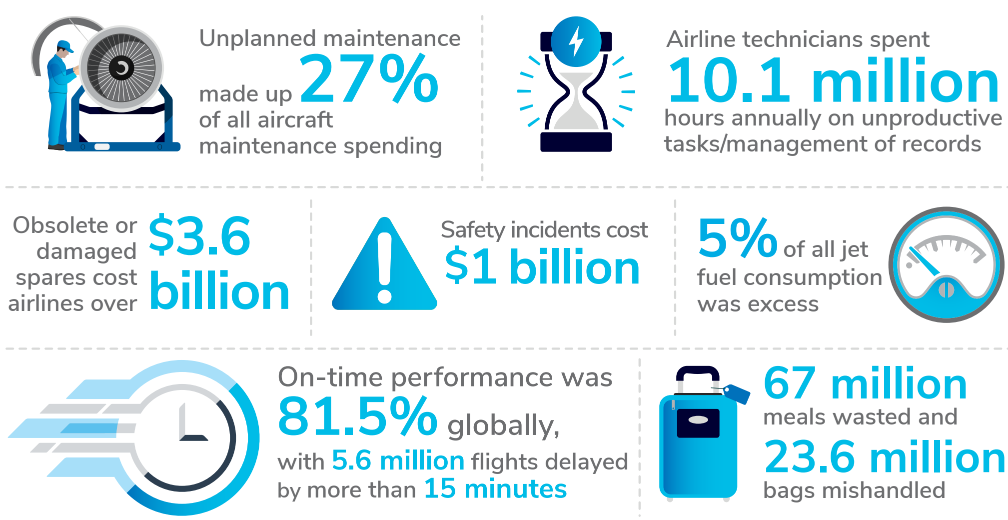
With the exception of 2009, airlines made money every year from 2010 to 2018 while registering modest operating margins of 5.5%. They also recorded improvements across key performance indicators (KPIs):

- Passenger traffic expanded by almost 80%, growing from 2.5 billion passengers in 2009 to 4.4 billion in 2018, as a result of air travel becoming more affordable and accessible.[1]
- Passenger load factors rose by 5.8%, from 76.1% to 81.9%, with airlines becoming better at managing capacity to meet demand growth.[2]
- Flights increased by 47%, but the average fuel consumption per Available Seat Kilometer (ASK) dropped by 20.9%[3] due to fuel efficiency programs and more fuel-efficient, new-generation aircraft.

Over the past 10 years, therefore, the aviation industry has grown steadily while becoming consistently profitable, significantly safer, and considerably more efficient in managing capacity and fuel consumption.

Nevertheless, substantial operational challenges remain that cost airlines approximately $74.2 billion per annum or roughly 1.5 times the industry's operating profit for 2018. These challenges are holding back airlines from achieving higher profits, safer and more punctual operations, and pose a major threat in the event of an economic downturn in the future.

More importantly, however, operational challenges were responsible for underperformance across the full spectrum of airline operations in 2018:



These inefficiencies will only intensify in a rapidly growing industry; over 8.2 billion passengers and 47,000 aircraft will be moving through the aviation ecosystem by 2037.

This white paper investigates the financial impact of operational challenges on airlines worldwide while attempting to quantify the cost savings and productivity gains enabled by new integrated platforms, software applications and technologies such as cloud computing, big data insights and analytics. It considers digital investments made to date and determines that if airlines had invested in further digitization, they could have reduced global inefficiencies by up to 34%, saving nearly $25.3 billion in the process.

1, 2, 3 IATA

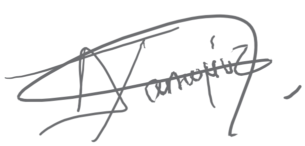
FOREWORD

Airlines understand the directional value from applying data and analytics to address operational challenges. However, it is difficult to quantify these challenges or the value from digital technologies. It is no surprise then that the lack of a business case is often cited as a significant barrier to digital adoption.

This report attempts to offer a unique perspective on quantifying digital value in airline operations. Here my team at Frost & Sullivan and I quantify some of the largest challenges across airline technical operations, flight operations and network operations. We then determine the realistic potential of data and analytics to address these challenges and quantify their impact.

This quantification is based off a bottoms-up calculation, leveraging industry-recognized databases such as IATA, Cirium, Flightstats, Eurocontrol and national Civil Aviation Authorities. Our team also interviewed leading airline industry executives to prioritize challenges and form baseline assumptions of their impact and the value from digital solutions. We triangulated these inputs with claims from technology solution providers through their customer case studies. We discounted relevant outcomes appropriately to avoid any bias and ensure the outcomes defined are realistic. The benefits have then been extrapolated across the global aviation industry for one full year (2018). It helps even out any variances due to airline business models, scale or regions. Since many airlines have been applying data and analytics to make operational decisions for a long time, we excluded the benefits of ongoing digital initiatives to our modeling. Hence the figures in this report present the incremental value from digital technologies, over and above initiatives already underway.

Airline operations are complex and this report is by no means a comprehensive sizing of its challenges. This first step is an effort to apply research rigor to quantify operational challenges and the value data and analytics can offer to navigate the industry through its turbulent phase. In true digital spirit, we hope the report spurs data-driven conversations for your digital transformation journey. I look forward to hearing from you on how you use this report.



Diogenis Papiomytis
Director of Commercial Aviation,
Frost & Sullivan
Email: diogenisp@frost.com

About the Author
Diogenis heads Frost & Sullivan's global commercial aviation business practice, based in Dubai, UAE. With 15 years of experience in commercial aviation research and strategy consulting, including leading market intelligence activities at a large aviation group, Diogenis' expertise lies in the development of business and corporate strategic plans, new market entry and diversification strategies. Diogenis comes with an in depth understanding of the digital transformation of the airline and airport business environments.

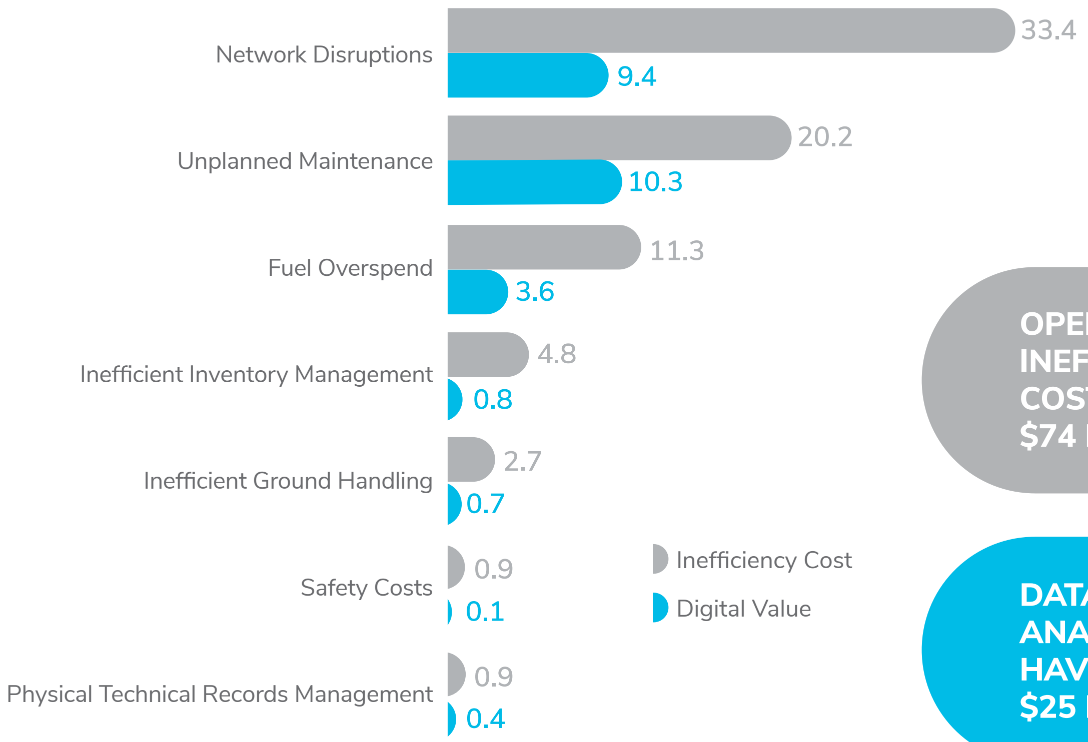
CONTENTS

EXECUTIVE SUMMARY

The three biggest operational challenges facing the industry in 2018 were network disruptions, unplanned maintenance and fuel overspend.

AIRLINES COULD REDUCE CASK BY 0.27 CENTS.

GLOBAL AIRLINE OPERATIONAL CHALLENGES, 2018 (IN $ BILLION)



OPERATIONAL INEFFICIENCIES COST AIRLINES $74 BILLION.

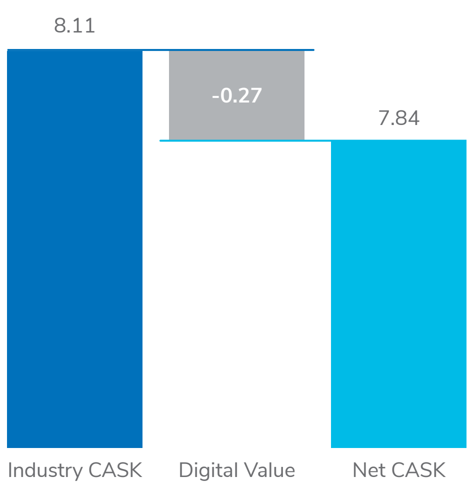
DATA AND ANALYTICS COULD HAVE SAVED $25 BILLION.

CASK Impact

The 2018 industry inefficiency impact of $74.2 billion translated to a Cost per Available Seat Kilometer (CASK) impact of 0.79 cents out of an industry CASK of 8.11 cents. This paper argues that airlines could have saved up to 0.27 cents per ASK had they employed data and analytics ubiquitously in their technical, flight and network operations.

The industry CASK would then be 7.84 cents, an overall CASK improvement of 3.3%, driven by a reduction of 34% on the industry operational inefficiency cost. This figure is the added value of analytics, over and beyond what airlines have already achieved through implementation of efficiency programs, software solutions and other business improvement initiatives.

VALUE OF DATA AND ANALYTICS IN INDUSTRY CASK, 2018 (IN CENTS)



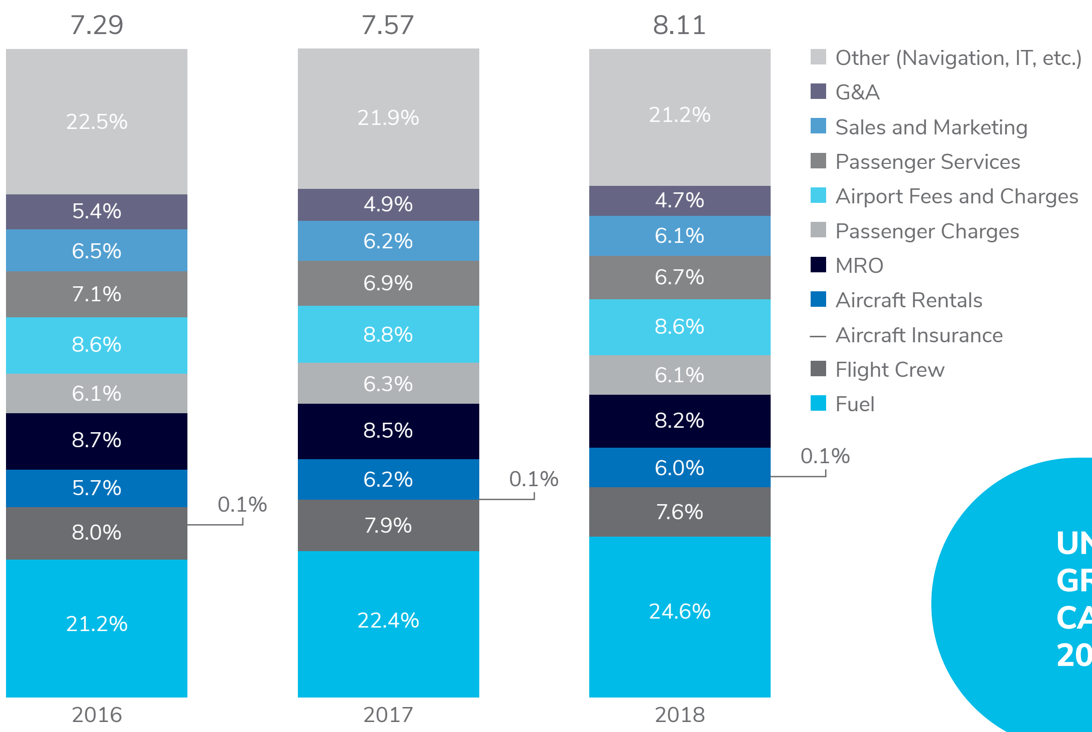
Note: columns not to scale

THE AIRLINE ECONOMIC MODEL

Despite fluctuations, airlines have become more efficient at managing their costs over a 10-year period from 2009 to 2018.

Fuel costs have grown the most over the period 2016-2018 and make up the bulk of an airline's costs (25%). Together with fuel, airport expenses at 9%, maintenance, repair and overhaul (MRO) at 8%, and flight crew at 8% comprise the most important cost categories for airlines globally.

AIRLINE UNIT COSTS (CASK), 2016-2018 (IN CENTS)

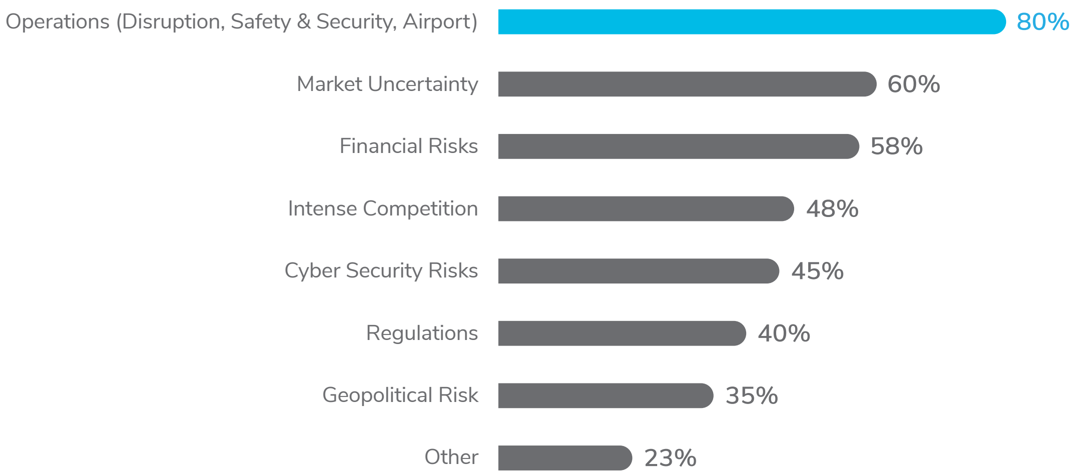


UNIT COSTS GREW AT 5.5% CAGR OVER 2016-2018.

There is a direct correlation between airline costs and airline cost inefficiencies as the top three cost inefficiencies for airlines relate to top cost categories. Network disruptions, which amount to an annual cost of $33.4 billion, have a direct impact on airport expenses (in the form of higher airport fees) and passenger services (through passenger compensation). Unplanned maintenance, which cost airlines $20.2 billion in 2018, impacts MRO costs. Fuel overspend amounted to $11.3 billion and had an impact on the size of the fuel cost for airlines in 2018.

In addition to airline costs, it is important to evaluate the business risks faced by airline operations worldwide. A review of the annual reports of 40 carriers reveals the following risks as having the biggest potential impact on costs and the sustainability of the airline business:

RANKING OF AIRLINE RISKS (N=40)[4]



Operational risks are the main concern for most airlines. These relate to airport capacity constraints, flight and schedule disruptions, labor disruptions, aircraft incidents/accidents, and emergency response processes and systems.

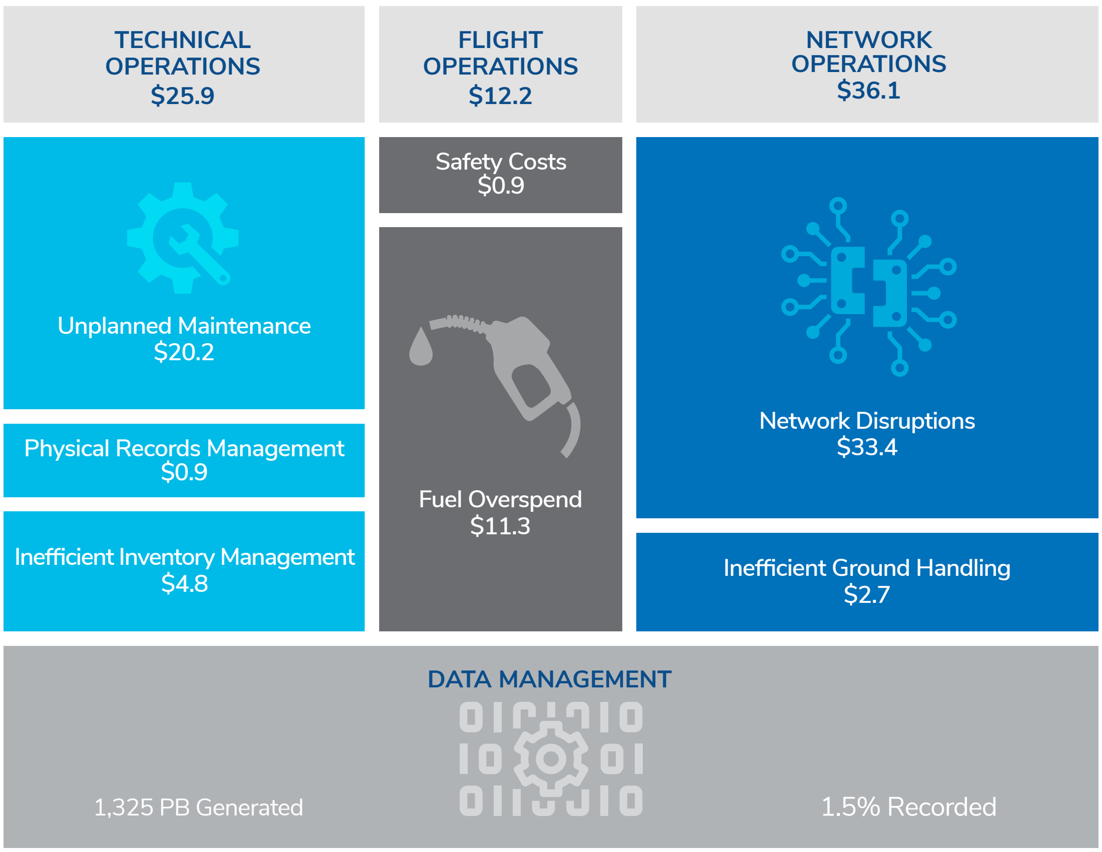
The effectiveness of data and analytics can be measured by their impact on cost reduction and risk mitigation, as well as in enabling new and more sustainable business models and revenue streams. This paper focuses on the impact of data and insights gained using analytics on costs and risks, mainly within flight, technical and network operations.

4 Frost & Sullivan, Airline Annual Reports

AIRLINE OPERATIONAL CHALLENGES

The most important operational challenges for airlines worldwide relate to technical, flight and network operations. As airlines embrace data and analytics, challenges linked to communication and management of operational data are also coming to the fore.

GLOBAL AIRLINE OPERATIONAL INEFFICIENCY COSTS, BY FUNCTION, 2018
(IN $ BILLION)



1. Data Management

The value of data in the airline business environment is immense. Airlines aim to enable seamless passenger journeys and are in the process of integrating datasets to create a single source of truth for their customers. Within operations, airlines' objective is to extract value from data sources to facilitate intelligent operations. They want to know where their assets are, what their condition is, and predict their future state to adjust their operational processes accordingly. There is a correlation between the ability to manage Big Data volumes, extract meaningful value from data, and use data-driven insights to improve operations. Along with the evolution of cloud and edge computing, improved data integration and harmonization practices, the exponential increase in computer processing power, and the ever-growing capabilities of artificial intelligence (AI) and machine learning (ML), extracting value from Big Data is emerging as key for airlines to gain a competitive advantage.

Today, airlines are inundated by massive amounts of data generated by aircraft, passengers, suppliers and their own internal operations.

In 2018, the total volume of data generated by aircraft, passengers, suppliers and employees was estimated at 1,325 PB

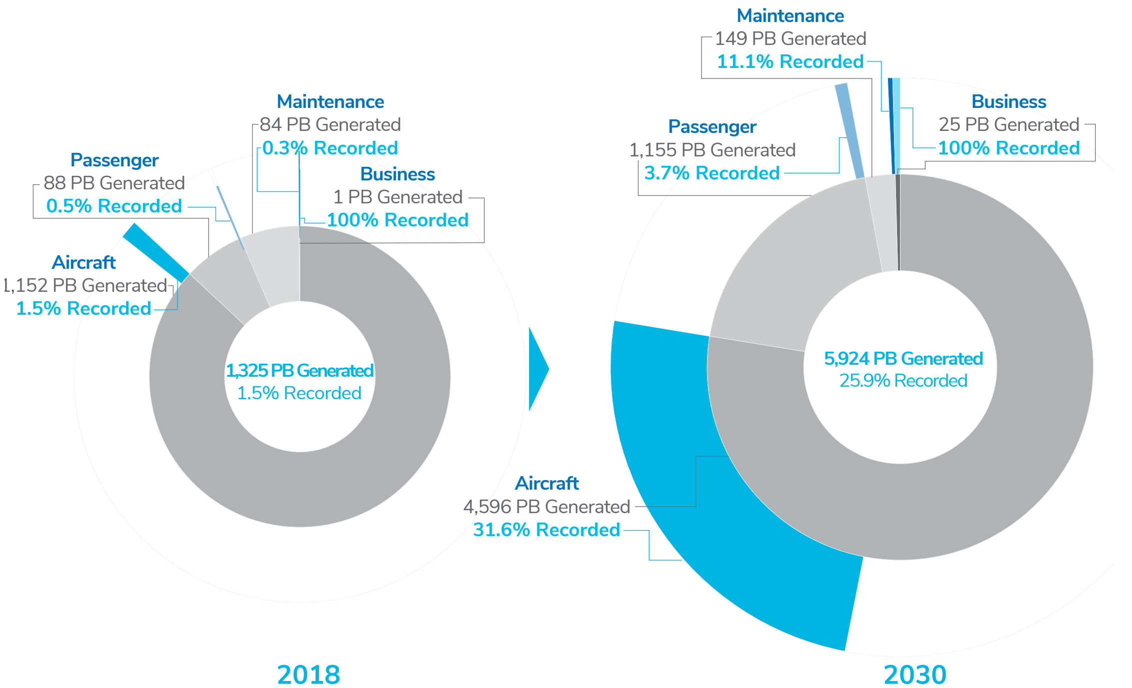
This is the very definition of Big Data, as it equates to approximately... 17,650 years of HD video

This would equal the storage capacity of 280 million DVDs

In 2018, airlines recorded only a small share of total generated data, estimated at 1.5% or approximately 20 PB. This means that they lost 98.5% of all data generated by aviation assets and passengers. The gap between generated and recorded data is substantial in three out of the four types of data found in an airline environment, i.e., aircraft, passengers, and maintenance. The problem is even more acute when the portion of recorded data that is subsequently analyzed for insights is considered. This differs greatly among airlines, with many relying on aircraft original equipment manufacturers (OEMs) and maintenance suppliers to perform analytics on flight and maintenance data records.

This paper contends that inefficiency costs remain significant despite the abundance of available digital solutions analyzing massive volumes of data in technical, flight and network operations.

GAP IN DATA BEING GENERATED VERSUS THAT BEING RECORDED (IN PETABYTES)



Among the more prominent reasons for the apparent inefficiency in recording and analyzing aviation data include:

- The large volumes of mainly aircraft data, that are software generated and unsuitable for analysis.
- The lack of appropriate large-capacity recording tools for structured and unstructured data, either in the form of onboard flight recorders or passenger data stores or repositories.
- The low capacity and high costs of data communication/connectivity, particularly inflight bandwidth of radio communication and high costs of satellite communication.
- The historic lack of sufficient data storage capacity in private data centers, as most airlines have yet to leverage the full benefits of cloud storage and computing.
- The lack of a structured approach (data governance) and capacity to apply analytics within the airline, particularly where analysis is performed manually.

A consistent increase in the number of aircraft sensors has resulted in aircraft systems producing large data volumes. However, available recording technology is unable to record all generated data for communication and subsequent analysis.

This is gradually changing as new-generation quick access recorders (QAR) can capture up to 2-3 GB per flight hour, compared to 2-3 MBs per flight hour in the past. Hardware manufacturers have stepped up to develop data recording solutions that are lightweight and incorporate increased storage, capturing a progressively greater number of data parameters and hundreds of flight hours with wireless communication. Furthermore, new recording units can send data directly to onboard crew applications, typically running within electronic flight bags, therefore enabling edge analytics.

Only about 10% of aircraft data, which makes up the majority of all data volumes captured by airlines, is transmitted in real- or near-real time to the ground. The remaining data is stored on the aircraft and transmitted hours after being recorded, when the aircraft is parked at an airport gate.

Real-time data is invaluable for airline operations, as it can be used in multiple ways:

- In safety, for monitoring flight performance and assessing potential flight safety risks.
- In maintenance, for monitoring aircraft health and predicting system and component failures.
- In flight operations, for real-time monitoring of aircraft and crew performance (e.g., fuel consumption, identification of irregular operations) as well as analysis and filtering of flight/weather data by airline ground staff for communication back to the aircraft cabin (e.g., to avoid weather-related delays).

It is evident, therefore, that airlines are missing out on substantial efficiencies as only extremely limited volumes of data are transmitted in real time to ground operations for analysis. Although efforts to employ edge analytics on aircraft are intensifying, the need for real-time air-to-ground (ATG) communication will continue to increase. At the same time, industry onboard communication initiatives, such as the Seamless Air Alliance, will focus mainly on non-critical passenger communications.

AIRLINES RECORD JUST 1.5% OF ALL DATA BEING GENERATED.

Critical aircraft data and airline information services are still constrained by available radio and Satcom technologies. In the future, airlines will need to install systems that work with a multitude of connectivity solutions, including NextGen Satcom and ATG, as well as airport gate-based technologies (e.g., 5G and Wi-Fi), to enhance real-time, ATG communications.

The combination of higher bandwidth connectivity with lightweight, multi-channel Satcom link systems onboard the aircraft will provide multiple benefits to airline ground operations and aircraft crews alike, as more data will be transferred from the databus to the ground for analysis and uploaded back to the aircraft.

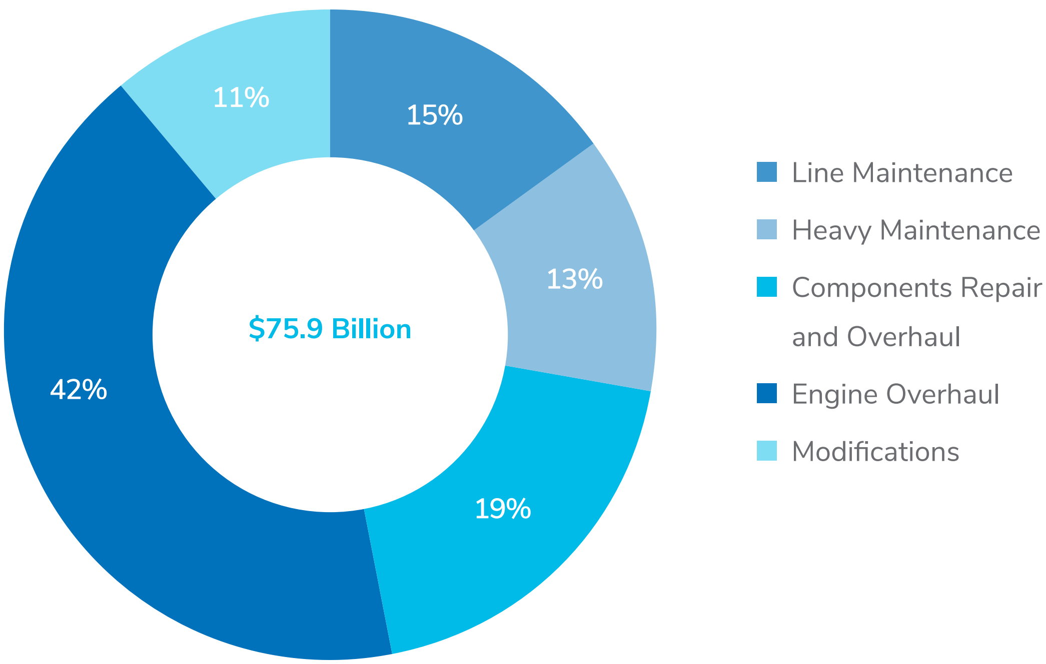
2. Technical Operations

Technical operations departments are responsible for managing third-party or in-house maintenance; procuring equipment, spare parts and services; ensuring compliance with Civil Aviation Authority (CAA) regulations and international safety agencies; controlling continued airworthiness of aircraft and equipment; and ensuring cost-effective management of all operations.

Technical operations are concerned with the reduction of aircraft technical delay costs and minimization of direct maintenance costs through optimization of maintenance processes. The two most important KPIs for technical operations are technical dispatch reliability and unplanned maintenance.

In 2018, airlines spent $75.9 billion on MRO activities, which comprised the third-largest operating expenditure after fuel and airport expenses.

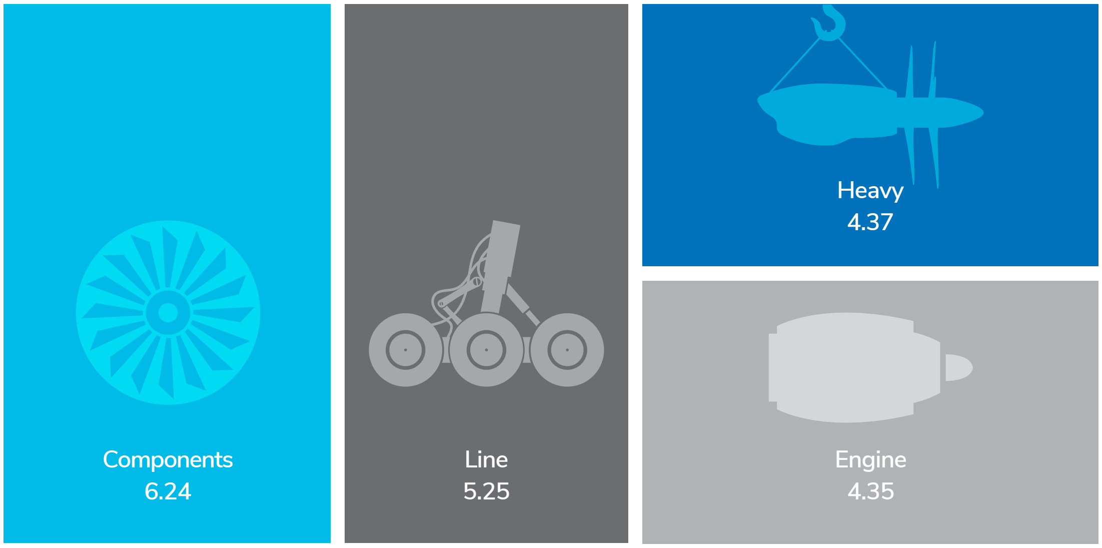
GLOBAL COMMERCIAL AIRCRAFT MRO MARKET, 2018



2.1 Unplanned Maintenance

In 2018, unplanned maintenance costs were estimated at $20.2 billion or approximately 27% of all maintenance expenditure. The impact of unplanned maintenance events on airline operations is felt in increased labor costs, additional inventory expenses, and premature shop visits for components. They also have a ripple effect on network operations as Aircraft on Ground (AOG) events are responsible for 3.8% of all flight delays and cancellations. This equates to an industry technical dispatch reliability of 96.2%.

UNPLANNED MAINTENANCE COSTS, 2018 (IN $ BILLION)



While planned maintenance actions continue to incur costs, they are substantially less expensive than unplanned events. Consequently, an ideal target for savings is to collate as many maintenance discrepancies as possible to deal with them as planned, rather than unplanned, events.

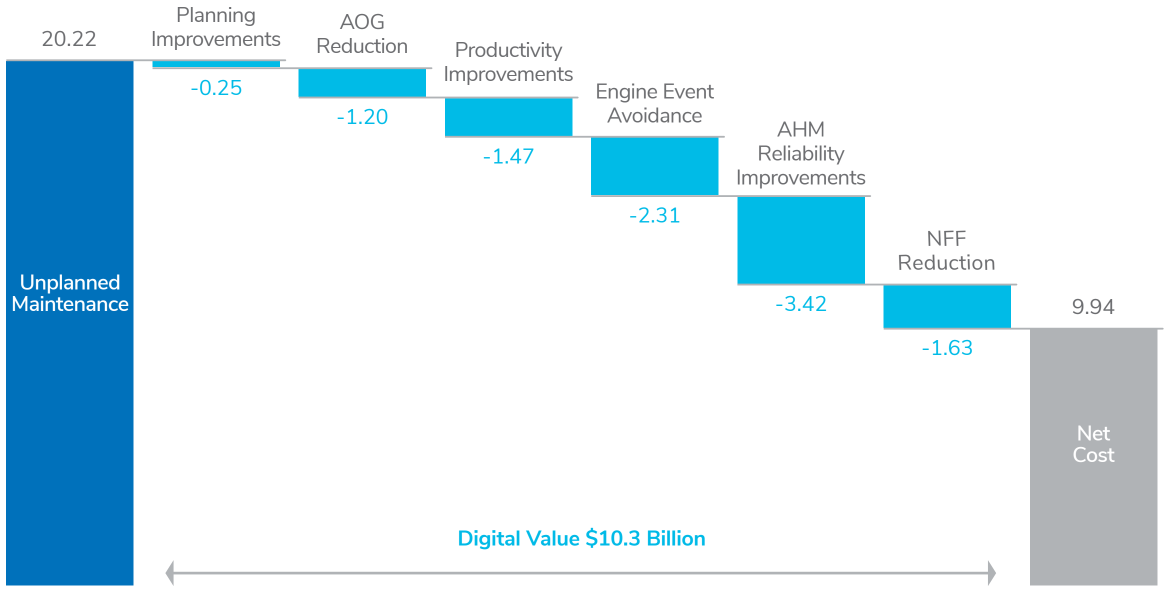
Traditionally, airlines have tried to reduce the impact of unplanned maintenance through legacy maintenance and engineering (M&E) software, targeting efficiencies in workflows and reduction in hangar time.

On the other hand, shifting or eliminating unplanned maintenance events can be realized through advanced solutions such as aircraft health monitoring (AHM), predictive analytics, and asset performance management (APM) software. These solutions are powered by large aircraft datasets to prioritize events and faults, investigate issues, predict component failures, reduce delay minutes, automate job assignments, and identify work bottlenecks. They can deliver a host of benefits if they are universally applied:

- Reduce AOGs and overnight technical delays by up to 30%.
- Reduce No-Fault Found rates by up to 70%.
- Avoid unplanned engine events by up to 45%.
- Improve technician productivity by up to 15%.

Considering the above efficiencies, Frost & Sullivan estimates that data and analytics can provide benefits of $10.3 billion, reducing the size of unplanned maintenance by over 50%, from $20.2 billion to $9.9 billion. Of the $10.3 billion benefit, a cost of $2.6 billion is unavoidable and will be transferred to planned maintenance, while $7.7 billion will be eliminated from the Airline Profit & Loss (P&L) accounts altogether. An additional benefit associated with the use of advanced solutions is the extension of the useful life of aircraft assets.

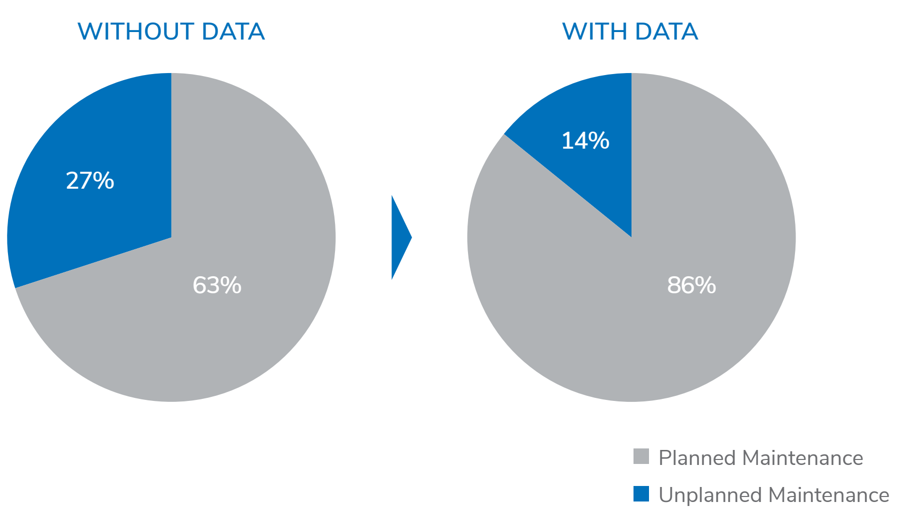
UNPLANNED MAINTENANCE - VALUE OF DATA AND ANALYTICS (IN $ BILLION)



Overall, if the industry were to adopt data and analytics and use them to their full capability, maintenance costs would reduce from $75.9 billion to $68.2 billion.

From a unit cost perspective, the maintenance CASK in 2018 was $0.67 cents. From this, $0.18 cents was attributed to unplanned maintenance. Data and analytics could offer airline operators savings of $0.07 cents per ASK.

Operationally, data and analytics would allow airlines to reduce unplanned maintenance costs from 27% of all maintenance expenses to 14%.



REDUCE UNPLANNED MAINTENANCE COSTS FROM 27% TO 14%.

CASE STUDY: EMIRATES

Challenge

Emirates is one of the world's largest international carriers, operating the largest fleet of Airbus A380s and Boeing 777s. At its Dubai hub, the airline's fleet is subject to the hot and harsh environment of the Middle East, which has a direct impact on engine utilization and reliability, with engines coming offline for maintenance earlier than the prescribed cycle.

Solution

Emirates has had a long-standing relationship with GE Aviation as more than 150 of its aircraft fly with GE engines. Emirates has been very open with sharing terabytes of engine, aircraft, and environmental data with GE every year. By leveraging Big Data and ML algorithms, GE provides actionable recommendations to Emirates. The algorithms can predict which engines are due for maintenance and which are safe to continue operations despite being due for cycle-based maintenance.

Outcome

Open data sharing enabled maintenance efficiencies. Since employing analytics-based maintenance (ABM), Emirates has seen a 20% increase in time-on-wing (TOW) and a 56% reduction in unscheduled engine repairs (UER). It has avoided 14 shop visits in a year, saving millions of dollars in costs and revenue losses.

Source: https://www.youtube.com/watch?v=zQ0S8Ae24mo

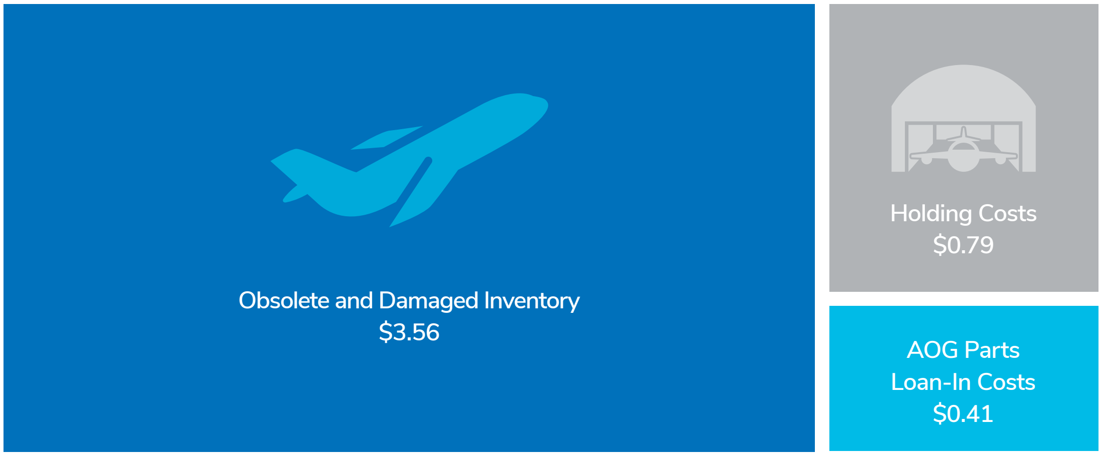
2.2 *Inefficient Inventory Management*

The commercial aviation supply chain, directly serving technical operations, provides parts and materials required to maintain an airworthy fleet. Having items available when needed is critical to minimize technical delays and increase aircraft utilization. In 2018, airlines flew 26,000 aircraft and held a spare parts inventory worth $35.6 billion, or roughly $1.37 million per aircraft. They also incurred holding costs of $7.9 billion, covering financing, overheads, personnel, and warehousing.

Although most spares find their way onto the aircraft, inventory that goes obsolete or is damaged in the warehouse or in transit results in costs estimated at $3.6 billion annually, with an additional expenditure of $0.8 billion related to holding such inventory.

At the same time, airlines unable to find the right part at the right time during unplanned maintenance activities incurred additional loan-in costs of $0.4 billion. In 2018, therefore, inefficient inventories cost airlines approximately $4.8 billion.

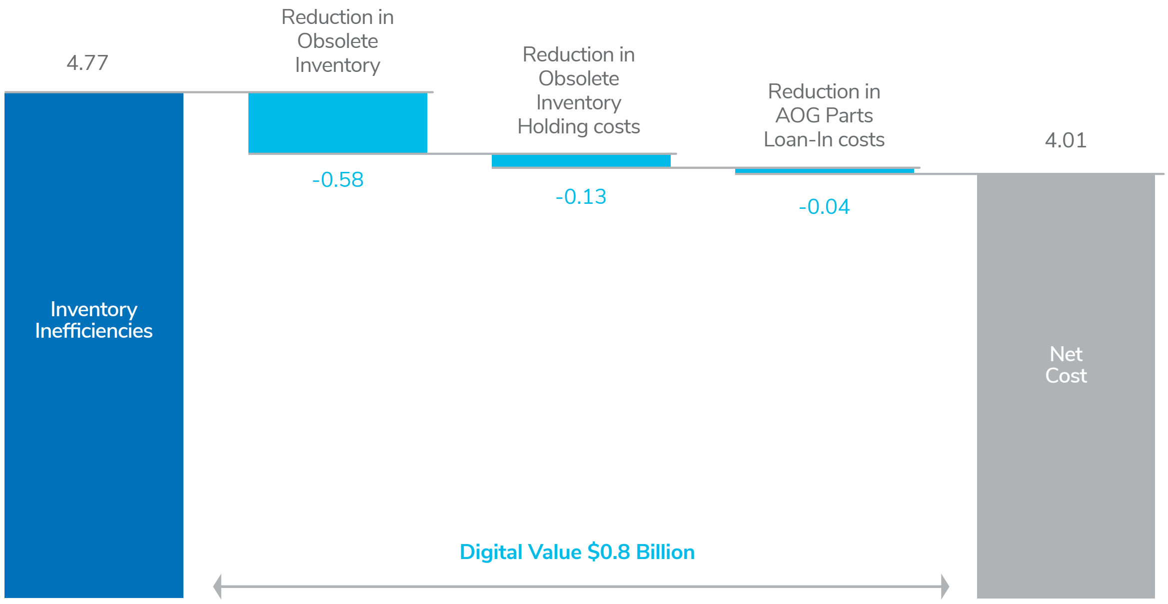
INVENTORY INEFFICIENCIES, 2018 (IN $ BILLION)



Based on Frost & Sullivan estimates, data and analytics could save the aviation industry $760 million per year, or roughly 16% of the total inventory inefficiency cost. These solutions can assist airlines in optimizing inventories through digitization of maintenance records and implementation of predictive analytics, projecting availability needs and reducing required stock levels.

REDUCE INVENTORY BY $22,400 PER AIRCRAFT.

INVENTORY INEFFICIENCIES: VALUE OF DATA AND ANALYTICS (IN $ BILLION)



Operationally, data and analytics would allow airlines to reduce the average aircraft-held inventory by $22,400 per aircraft.

2.3 Physical Technical Records Management

In 2018, over half of the global commercial aircraft fleet was on operating lease contracts with an average duration of 10 years. During the same year, over 770 aircraft were returned to the lessor after their lease expired. The costs for end-of-lease returns are substantial, particularly when the aircraft's technical records are paper-based since technical teams need to spend weeks trying to assemble and work through technical records. Overall, we estimate that manual records management costs airlines $31,000 per aircraft annually and $560,000 specifically for each lease return.

REDUCE DOCUMENTATION TIME FROM 37 MINUTES TO 25 PER FLIGHT.

The digitization of technical records is seen as a major efficiency improvement, both in regular maintenance management and for extraordinary events such as aircraft lease returns or sales, as it allows searchability, security, and accessibility.

As of 2018, 54% of the global commercial aircraft fleet's technical records were still manually maintained. Even for those airlines that have deployed digital records management systems, digitization only applies from the day of implementation onward. This translates to significant inefficiencies for the industry, as manual records have associated printing, physical storage, and personnel costs as well as substantially higher costs related to processing lease returns.

The deployment of a fully digital technical records management system alleviates storage, printing and personnel requirements. In the case of lease returns, the benefit is even greater as productivity improvements of over 50% are expected. Savings of at least $0.5 million per lease return have been reported by airlines, not including the added value accrued from protecting the residual value of the aircraft.

Based on the above, savings of over $447 million are achievable against inefficiency costs of $890 million. Half of the savings are one-off items, such as the elimination of physical storage for technical records, while the rest are recurring.

Operationally, data and analytics would allow airlines to reduce labor time spent on technical records management from 37 minutes to 25 minutes after each flight.

3. *Flight Operations*

Flight operations is responsible for the safe, compliant, and efficient use of operations personnel, aircraft, resources, facilities, equipment, and other material. The main functions of flight operations include crew resource planning and training, operations logistics, safety and quality, aviation security and compliance management. Most importantly, however, flight operations manages important airline costs, such as safety and fuel.

3.1 Safety Costs

The aviation industry has improved its safety record over the decades, with the average number of fatal accidents falling to 15.4 during 2010-2018 from 27.4 over 2000-2009. Even so, there were 62 aircraft accidents in 2018, including both fatal and non-fatal, compared to 46 in 2017[5]. In 2018, airlines paid aircraft insurance premiums of approximately $1 billion or 0.11% of revenues. Overall, the safety cost of accidents and incidents resulting in aircraft damage or passenger compensation is estimated at $915 million.

5 Cirium Ascend

Airlines employ several solutions to track and mitigate safety events. They are moving from cumbersome paper-based reporting to digital reporting tools (safety management systems) and are increasingly performing analysis on data captured by flight recorders. Flight data monitoring (FDM) and flight operations quality assurance (FOQA) programs assist in the design and delivery of dynamic training programs for flight crews. However, progress has been slow as only about a third of the global airline fleet is covered by end-to-end digital FDM/FOQA solutions.

Data and analytics utilize the full spectrum of recorded flight data to identify and analyze historical patterns to predict future safety performance. They can help reduce the number of safety events, allow the seamless sharing of flight data between airline departments and airline partners, and enable the customization of crew training. Although flight data analysis provides many benefits to airlines, including a lowering of fuel consumption and improvement in aircraft utilization, there is also a tangible benefit in helping reduce accidents and incidents. Frost & Sullivan estimates that dynamic training programs enabled by digitized FDM programs could reduce safety costs by $82 million annually.

DATA HELPS REDUCE SAFETY INCIDENTS BY 9%.

CASE STUDY: CHINA EASTERN

Challenge

China Eastern is one of the biggest airlines in China and Asia-Pacific, flying over 121 million passengers on its fleet of 692 aircraft. With the introduction of new Airbus and Boeing aircraft, it has one of the fastest-growing and youngest fleets in the region, with an average fleet age of 5.7 years.

The airline's safety management team had been constrained by having to manage an expanding fleet with limited resources. With a near-perfect safety record across its B737 fleet, the airline was finding it a challenge to apply its B737 method to assess tail strike risk on its A320 fleet.

CHINA EASTERN AIRLINES HAD ZERO SAFETY-RELATED EVENTS ACROSS ITS A320 FLEET SINCE ADOPTING THE SOLUTION.

Solution

The airline engaged GE Aviation's Digital Group to deliver a more accurate method for assessing tail strike risk by calculating tail clearance using trigonometry. GE analyzed data from over 560,000 flight hours, captured on its Event Measurement System (EMS) data platform, to create a historical risk score. It delivered an online tool that allowed safety analysts to view safety risk scores and diagnose the root cause of each flight's risk while also providing a list of recommended actions.

Outcome

China Eastern has used data and analytics to systematize processes and prevent future safety-related events. The airline has had zero safety-related events across its A320 fleet since adopting the GE solution. In addition, the airline receives actionable benchmarks for pitch angle, pitch rate, and pitch commands based on anonymized data from over 409 million flight hours captured in the EMS data platform.

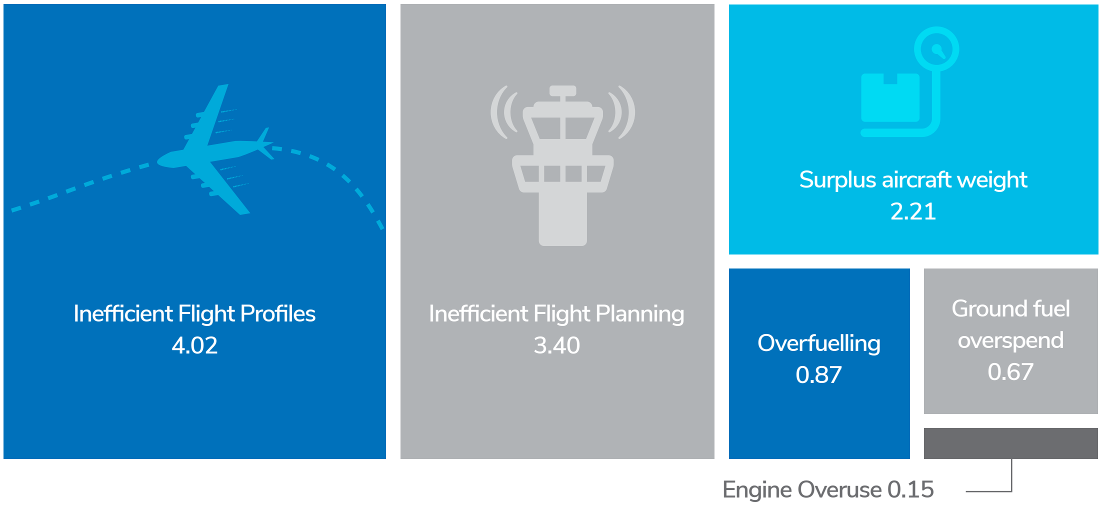
3.2 Fuel Overspend

Fuel cost is one of the most volatile factors in the aviation industry and can account for up to 40% of an airline's cost base during periods of high fuel prices. In 2018, with jet fuel prices averaging $86 per barrel, airlines' fuel bills reached $220 billion or 24.6% of their operating expenses.

Managing fuel and associated carbon emissions is a complex and continuous area of focus for airlines. Most airlines run fuel-efficiency improvement programs, analyzing fuel procurement and consumption performance to identify optimization opportunities. Even though these programs have resulted in substantial efficiencies, fuel overspend remains one of the most significant operational challenges. In 2018, Frost & Sullivan estimates that airlines overspent $11.3 billion on fuel, amounting to 5.4% of the total fuel bill for the and releasing 52.8 million metric tons of unnecessary CO2 in the atmosphere.

Most overspend today happens because of inefficient flight planning and flight profiles, followed by a lack of aircraft weight optimization, overfueling and engine overuse.

FUEL OVERSPEND TYPE, 2018 (IN $ BILLION)



Direct and digitalized data feeds and analytics enable real-time decision-making about flight planning and fuel procurement.

Airlines using advanced solutions could unlock immense value through live streams of data from various systems and databases such as flight planning/scheduling, FDM/FOQA, ACARS, fuel accounting, and technical logs. The use of additional digital sensors and predictive tools could further lead to revolutionary practices that replace existing methods of fuel management.

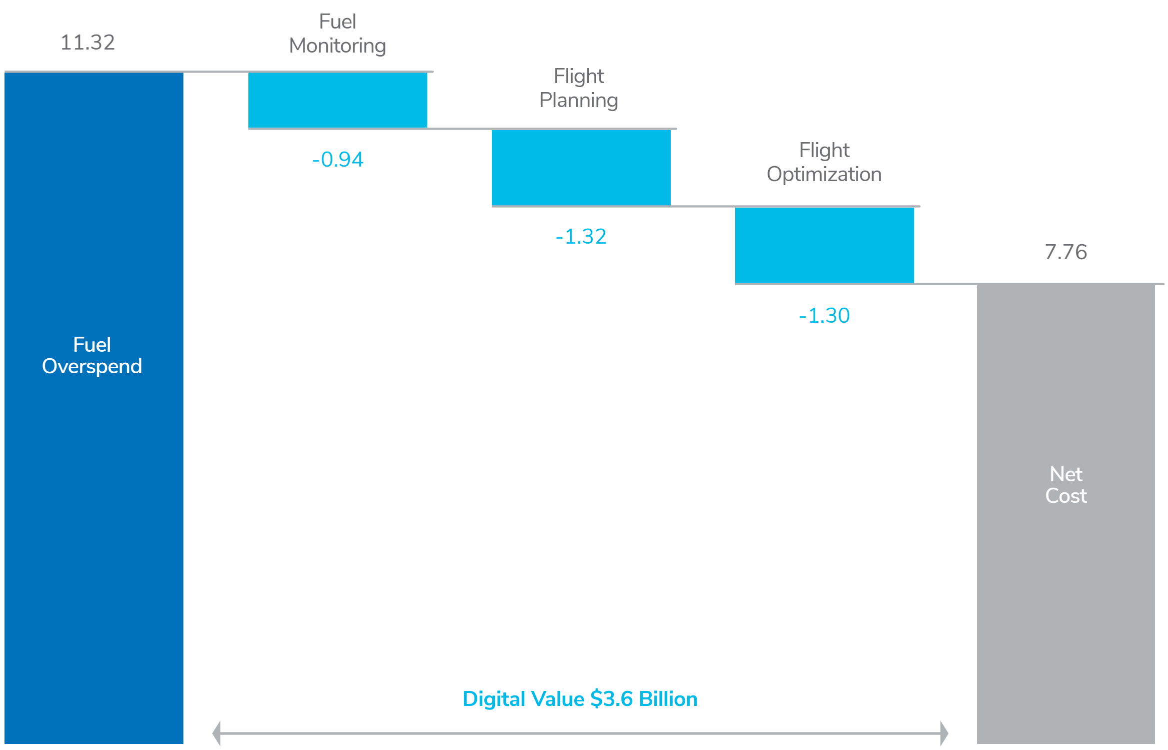
Frost & Sullivan believes that there is still significant value to be achieved through the use of data and analytics to reduce the aircraft weight, reduce engine use during taxiing and auxiliary power unit (APU) burn, reduce fuel procurement (taxi out fuel, pilot fuel orders, contingency fuel and supplier overfueling) and in optimizing aircraft center of gravity (CoG).

In addition, the optimization of flight paths using required navigation performance (RNP) procedures would provide tremendous value in overall fuel consumption patterns. With global airspace congestion, performance-based navigation (PBN) technology is fundamental to the transition from existing ground-based, voice-controlled air traffic management to time- and space-based digital systems. This would help airlines reduce flight time, carbon emissions and community noise on both approach and departure.

DATA HELPS OFFSET 80 KG OF FUEL AND 252 KG IN CO_2 EMISSIONS PER FLIGHT.

Overall, the industry has the potential to reduce $3.6 billion in fuel overspending through better use of existing technology and advanced data and analytics.

FUEL OVERSPEND: VALUE OF DATA AND ANALYTICS (IN $ BILLION)



Operationally, data and analytics would allow airlines to reduce fuel consumption by 80 kg and CO_2 emissions by 252 kg per flight.

CASE STUDY: AIRASIA

Challenge

Malaysia-based AirAsia is one of the largest low-cost carriers (LCCs) in Asia. It flies over 390 routes across 22 countries with 226 aircraft and has one of the lowest CASKs in the industry at $3.67 cents.

As the airline expanded operations, it was particularly limited by constrained airspace capacity over Malaysia. The Malaysian Air Navigation Service Provider (ANSP) had no quantifiable inputs on airspace inefficiency and was, therefore, unable to consider AirAsia's airspace design requirements. This was evident from poorly designed approach and departure procedures, leading to severe airspace congestion and areas of sub-optimal activity.

Solution

In 2012, the airline partnered with GE Aviation's Digital Group to deploy the world's first network of International Civil Aviation Organization (ICAO) Required Navigation Performance Authorization Required (RNP AR) flight paths. GE Aviation designed, deployed, validated, and now maintains a network of precise RNP procedures to utilize the performance characteristics of AirAsia's A320 fleet.

Moreover, GE delivered a web-based airspace analytics app to visualize full flight, surveillance, terrain and navigation data on a single pane of glass and evaluate operational waste in a given airspace.

Outcome

In 2018, AirAsia performed RNP procedures across 14 airports in Malaysia. Highly precise paths improved operating efficiencies by reducing track miles and fuel burn, while also providing aircraft with precise lateral and vertical arrival and missed approach guidance.

In just one year, the airline saved 1.27 million kg of fuel and 4,013 metric tons of CO_2, while saving 34,657 minutes of flight time. Overall, efficiencies were estimated to be worth $1.7 million per annum.

4. Network Operations

Network operations is responsible for the management of ground operations at the hub airport(s) and across an airline's network of outstations. The primary objective of the department is the successful delivery of the airline schedule through the operational control of the fleet at the network level. It is also responsible for ground handling at each airport in the airline network.

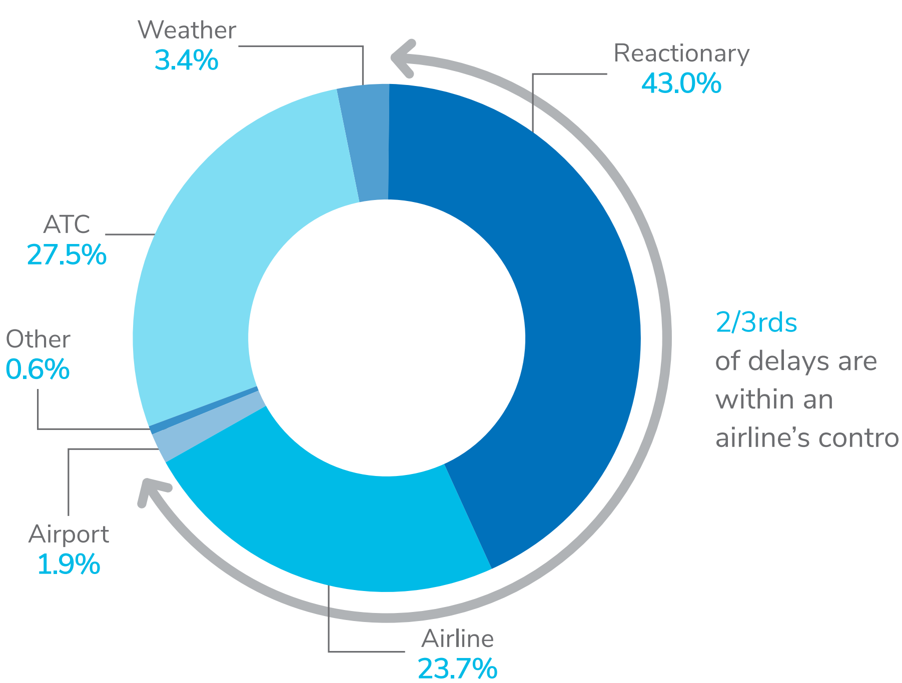
The key operational metric for network operations is on-time performance (OTP). The department is also concerned with ground handling performance, measured in mishandled baggage rates and catering wastage.

4.1 Network Disruptions

Barring a slight deterioration in performance over the past year, airline OTP has improved considerably over a five-year period from 78.9% in 2014 to 81.5% in 2018. Such improvements notwithstanding, network disruptions represent the most significant inefficiency cost to the aviation industry. According to industry statistics,[6] 5.6 million departing flights were delayed for an average of 57 minutes, 436,000 flights were canceled, and the travel plans of over 655 million passengers were disrupted in 2018. Irrespective of any gradual improvements, such statistics reflect poor performance. Moreover, disruptions are now commonplace, affecting airline branding, airline costs, and passenger loyalty.

There are many reasons for network disruptions. Infrastructure constraints such as airport and airspace are important, but the reality is that two-thirds of all delays and cancellations are within an airline's control. Indeed, almost half of all delays (43%) are reactionary in nature and caused by the primary delay.

CAUSE OF DELAYS



6 Flightstats, Frost & Sullivan analysis

Delays cost airlines approximately $97 per minute and cancellations cost them an average of $68,000 per flight. Furthermore, there is a ripple effect on customer satisfaction and brand loyalty, measurable as a deterioration in the airline's net promoter score (NPS). Frost & Sullivan estimates that a 1% reduction in OTP in a given year, results in a reduction of up to 0.6% of an airline's NPS.

Collectively, delays and cancellations cost airlines $33.4 billion in 2018 or, in unit cost terms, about $0.37 cents per ASK.

COLLECTIVELY, DELAYS AND CANCELLATIONS COST AIRLINES $33.4 BILLION IN 2018.

NETWORK DISRUPTION COSTS, 2018 (IN $ BILLION)

Disruptions will intensify as airspace becomes more congested, airline seat factor continues to trend upward, and ground capacity and infrastructure fail to keep pace with passenger demand.

Most airlines have established processes that are cross-functional to minimize the impact of disruptions on both customers and operations. The focus of disruption management teams is to enable seamless communication during disruptions.

Recovery from disruptions requires complex optimization with multiple data sources—flight schedules, connections, aircraft data, interline passengers, arrival/departures, cabin class, turnaround times, maintenance schedules, and airport restrictions, among others—all contributing to network operations network operations.

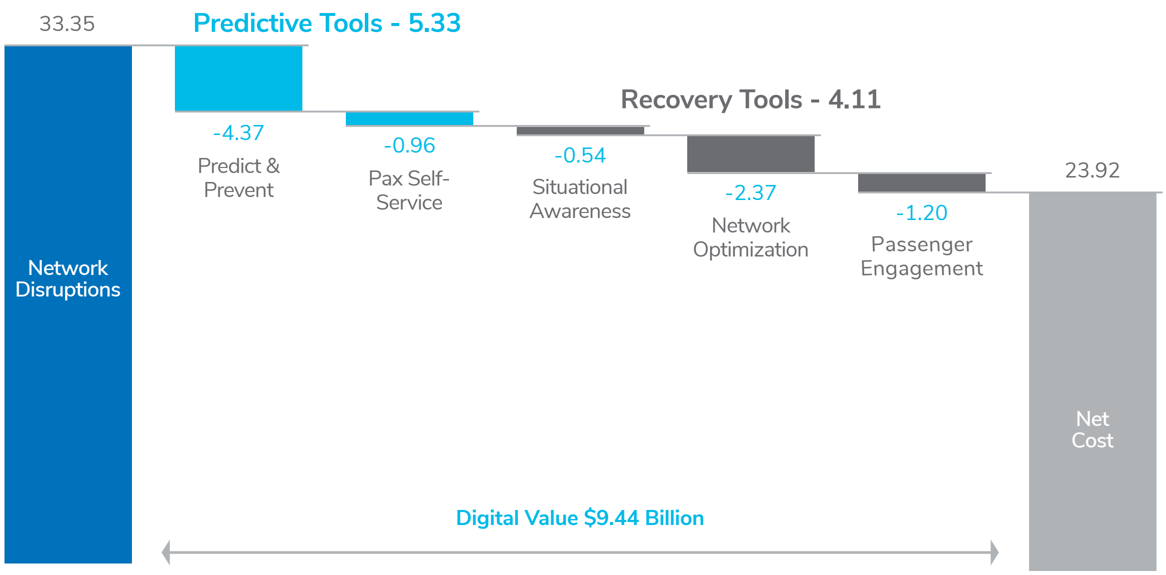
Disruption management requires a mindset change that focuses on longer-term, holistic recovery beyond 48 hours to resolve passenger, crew and aircraft movements, simultaneously.

Data and analytics can help solve part of the problem, mainly with predictive tools and recovery tools. Predictive tools allow operations to preempt potential disruptions, ensuring an optimal outcome for aircraft and passenger handling. Recovery tools provide faster and better decision-making, based on business rules and multiple data streams, enabling network optimization, improved customer engagement and situational awareness.

EVERY MINUTE OF DELAY COSTS AIRLINES $97.

Frost & Sullivan estimates that data and analytics could enable cost savings and cost avoidance worth $9.4 billion. This would reduce the cost of network disruptions from $33.4 billion to $23.9 billion.

NETWORK DISRUPTIONS - VALUE OF DATA AND ANALYTICS (IN $ BILLION)



From a unit cost perspective, the value would translate to savings of $0.08 in the airline CASK.

Operationally, data and analytics would allow airlines to improve their OTP by 2.1 percentage points, from 81.5% to 83.6%.

DATA HELPS IMPROVE OTP BY 2.1% POINTS.

4.2 Inefficient Ground Handling

Mishandled Baggage

In 2018, 4.36 billion bags were checked in and passed through the baggage handling system, roughly equal to the number of passenger trips for the year. In the same year, the mishandled baggage rate reached 0.54%, as more than 23.6 million bags were lost, stolen, or delayed. Efforts by airlines, airports and ground handlers, coupled with industry initiatives, have resulted in a gradual reduction in the mishandling rate, although it remains a significant cost.

REDUCE MISHANDLED BAGGAGE RATE FROM 5.4 PER 1,000 TO 3.9 USING DATA.

Frost & Sullivan estimates that mishandled bags cost the aviation industry almost $2.3 billion in 2018. Some airlines and airports have introduced smart tags, which incorporate additional layers of digital baggage tracking. While this technology has been present for almost a decade now, airlines and airports globally have been slow to adopt these systems.

By continuing down the existing path of operational improvements, enabled by data and analytics, airlines can further reduce the mishandling rate from 0.54% to 0.39% with savings of $633 million.

Operationally, data and analytics would allow airlines to reduce the mishandled bag rate, from 5.4 to 3.9 per 1,000 passengers.

Catering Wastage

Catering wastage ranges from 1.4% in economy class to 3.7% in business and 5.2% in first class, with differences depending on airline business models and customer service levels. There is a direct correlation between wastage rates and passenger satisfaction levels, which partially explains the levels seen in different cabins.

To reduce catering wastage, airlines have traditionally employed forecasting tools using statistical model analysis at the hub airport, while relying on manual top-ups of meals at outstations. Nonetheless, the problem remains significant, with over 67 million meals wasted in 2018 at a cost of $462 million for airlines.

New solutions employ analytics to predict meal consumption patterns, based on flight demographics as well as other passenger information. Intelligence is gathered across multiple passenger touchpoints such as the booking engine, customer transaction history or loyalty programs. This data about a customer's preference could be used not only to reduce wastage but also to provide the customer with a personalized experience. In addition, historical information of passenger flows between city pairs, seasonality and customer segmentation provides useful insights into customer behavior and choice at a flight level.

Frost & Sullivan estimates that using analytics based on passenger profiles and flight demographics to predict meal demand has the potential to reduce global catering wastage costs by $115 million.

Operationally, data and analytics would allow airlines to reduce the meal wastage rate from 1.5% to 1.1%, saving over 17 million meals that would otherwise have gone to waste.

DATA CAN REDUCE MEALS WASTAGE RATE FROM 1.5% TO 1.1%.

TECHNOLOGICAL DISRUPTION IN AVIATION

Several technological advancements are expected to completely transform the aviation industry, airline business models, and the passenger experience. To respond to these trends, airlines need to be forward looking and assess actions they need to be taking today to transform and grow.

The following are some of the most important technological developments, along with their impact on airline operations.

From the Internet of Things (IoT) to Ubiquitous Connectivity

By 2025, there will be 120 billion connected devices worldwide and over 5 billion internet users. An ever-increasing number of aircraft is becoming e-enabled, passengers are demanding ubiquitous connectivity throughout the passenger journey, and millions of aviation motorized and non-motorized assets are becoming connected in smaller or larger IoT ecosystems. This trend will be further driven by the proliferation of satellites and the introduction of new-generation cellular technology.

The amount of data generated by connected devices and the rise of the "connected traveler" will drive the development of new digital services and digital business models.

Aircraft Autonomy and Urban Air Mobility

Autonomy is growing with every new aircraft generation. As the aviation industry debates a long-term move to single-pilot operations, which would require a complete redesign of the cockpit and other aircraft systems, more than 100 established aerospace manufacturers and start-ups are investing in the new Urban Air Mobility (UAM) market segment.

UAM commercial services are likely to make their debut by 2025. Initially, the market will rely on hybrid multi-passenger aircraft to act as air taxis on set routes until all-electric, autonomous platforms are certified and integrated at scale. UAM aircraft have the potential to replace ground transportation and short-haul transportation modes, with their most promising use case as air taxis. In addition, they could complement airline travel by offering true door-to-door services.

But perhaps their most significant impact will be felt in their data generation, recording and analytics capability. An autonomous ground vehicle will generate over 4 TB of data per day, over 8 times the amount of data generated by a B787 today. Autonomous aircraft will be generating many times that amount of data. With companies investing in the development of autonomous platforms, including Airbus Urban Mobility, Uber Elevate and Boeing NeXt, they will inevitably drive the development and adoption of related technologies, such as IoT, big data and analytics, and artificial intelligence. Indeed, the path toward greater aircraft autonomy is one of exponential and universal use of data and analytics and artificial intelligence.

Blockchain

Blockchain is a rapidly evolving technology, working like a distributed ledger, and is seen as representing the next stage in the evolution of databases. While databases were built for individual companies or users, blockchain is built for ecosystems. Immutability, transparency and cryptography are built into the blockchain and do not need to be developed as an add-on.

Aircraft maintenance is bound by numerous challenges, the most important of which include the ongoing use of paper-based maintenance logs, the penetration of counterfeit components and the lack of component traceability.

Blockchain is seen as a transformative technology with multiple applications—from airline ticket distribution to baggage tracking, catering to food safety, passenger identity management to loyalty—in airline operations. The main attributes of a blockchain are its traceability and security, making it a fitting technology for aviation. Eventually, the technology has the potential to enable a self-sustaining aviation ecosystem with trusted data.

Regarding maintenance, aircraft components could be registered on a blockchain after they are manufactured, together with all relevant "birth" data, such as serial codes, and all subsequent installations, repairs and modifications. This back-to-birth traceability is an enabler of other transformative technologies, such as additive manufacturing.

CASE STUDY: MTU MAINTENANCE

Challenge

MTU Maintenance is an established global player in the MRO industry and the maintenance division of leading engine manufacturer MTU Aero Engines.

GE Aviation and MTU Aero Engines have a revenue share partnership on CF6 and GE90 engines. In this relationship, significant staff time is spent on reconciling financial accounts manually, as there are multiple versions of the truth for engine part volumes across engine records.

Solution

The two partners employed Microsoft's blockchain platform to create visibility and accountability over each reconciliation step. New records created in parallel workflows at GE and MTU Maintenance are stored in the blockchain and act as a single source of truth.

The blockchain solution became the new adopted process, replacing emails, phone calls and lengthy reviews, and is now used to retain payment history and settle volume rebate discrepancies in real-time. Leveraging a proven blockchain platform from Microsoft helped accelerate the development process and hence time to value.

Outcome

The partners have avoided months of volume rebate reconciliation and have improved team productivity by avoiding months of negotiations, email exchanges and legal reviews. They have also released significant unsettled cash worth over $10 million.

Artificial Intelligence

Artificial intelligence (AI) is the simulation of human intelligence processes by computer systems, such as learning, reasoning and self-correction. The value of AI is greater in business environments dominated by big data.

Artificial intelligence powers predictive analytics and helps organizations by providing informed recommendations, making predictions on future events, creating personalized services and optimizing processes. While the technology has numerous applications across aviation, its biggest value is found in flight and airport operations. AI can be used to analyze large aircraft, aeronautical and passenger datasets, whether machine- or user-generated, structured or unstructured. Today, it is used to answer specific questions, such as when will the next flight arrive, what is the optimal gate allocation for this flight, when is an aircraft component likely to fail and how many meals should I load onto the aircraft to minimize wastage? Over time, AI will be used to solve more complex problems, such as recovering from a flight disruption, optimizing resource planning weeks in advance and creating optimal flight paths to free up airspace capacity.

Mixed Reality

Mixed reality is the evolution of augmented reality, blending the real and virtual worlds in a headset-based environment. While many airlines have already implemented augmented reality and virtual reality (AR/VR) in marketing and customer service, few have used mixed reality in operations. MR has unique attributes that can be used to solve operational problems, such as allowing technicians to complete maintenance tasks faster, improving decision-making time during disruption events and reinventing the training of pilots, engineers, air traffic controllers, airport agents and other staff across airline operations.

LEARNINGS FROM OTHER INDUSTRIES

An asset-intensive, regulated industry like aviation could learn a lot from technology adoption in other industries. Here we look at how other industries are deriving value from digital transformation and, specifically, the adoption of data and analytics.

Blockchain in Construction and Mining

Blockchain has been implemented in some pilot projects in the construction and mining industries, leading some companies to develop new supply chain finance ecosystems, incorporating dealers, distributors, and manufacturers. The equipment purchasing process for fleets using blockchain brings all the relevant stakeholders onto a common platform, enabling them to share and view information in real time. Investing in blockchain is expected to streamline fleet operations by improving overall operational efficiencies and reducing costs.

Reality Technologies in Healthcare

Reality technologies can be applied across a broad spectrum of health-related activities, end users, and customers. These solutions can be used both for therapeutic and non-therapeutic purposes and are sold to the enterprise—medical schools, hospitals, clinical practices, technology vendors, drug and device manufacturers, etc.—as well as directly to consumers via mobile apps. VR in healthcare has been used for more than two decades to support medical training, improve clinical interventions, and promote health and wellness. Additional emerging use cases include patient experience, telemedicine and e-visits, and clinical documentation.

A notable example is the CAE VimedixAR, which is the first ultrasound simulator to integrate Microsoft HoloLens. Freed from the limits of a two-dimensional environment inside a monitor, healthcare professionals can display, enlarge, turn, and rotate realistic-looking anatomical parts, or command them to return into the manikin body. Users and those learning with this technology are able to witness (in real time) the ultrasound beam as it cuts through human anatomy or view 3D holograms of a fetus as it descends the birth canal.[7]

Reality technologies have a well-recognized and growing presence in medical education, particularly in surgical training, where many established and emerging vendors serve the market. Many of these vendors focus on specific, complex procedures or designated therapeutic areas such as orthopedics or neurosurgery. Mixed Reality allows tutors and students to engage in a range of learning and assessment activities previously only possible when using actors or by encountering patients in real life. By some estimates, this new way of learning could apply to half of all surgical training in the near future.

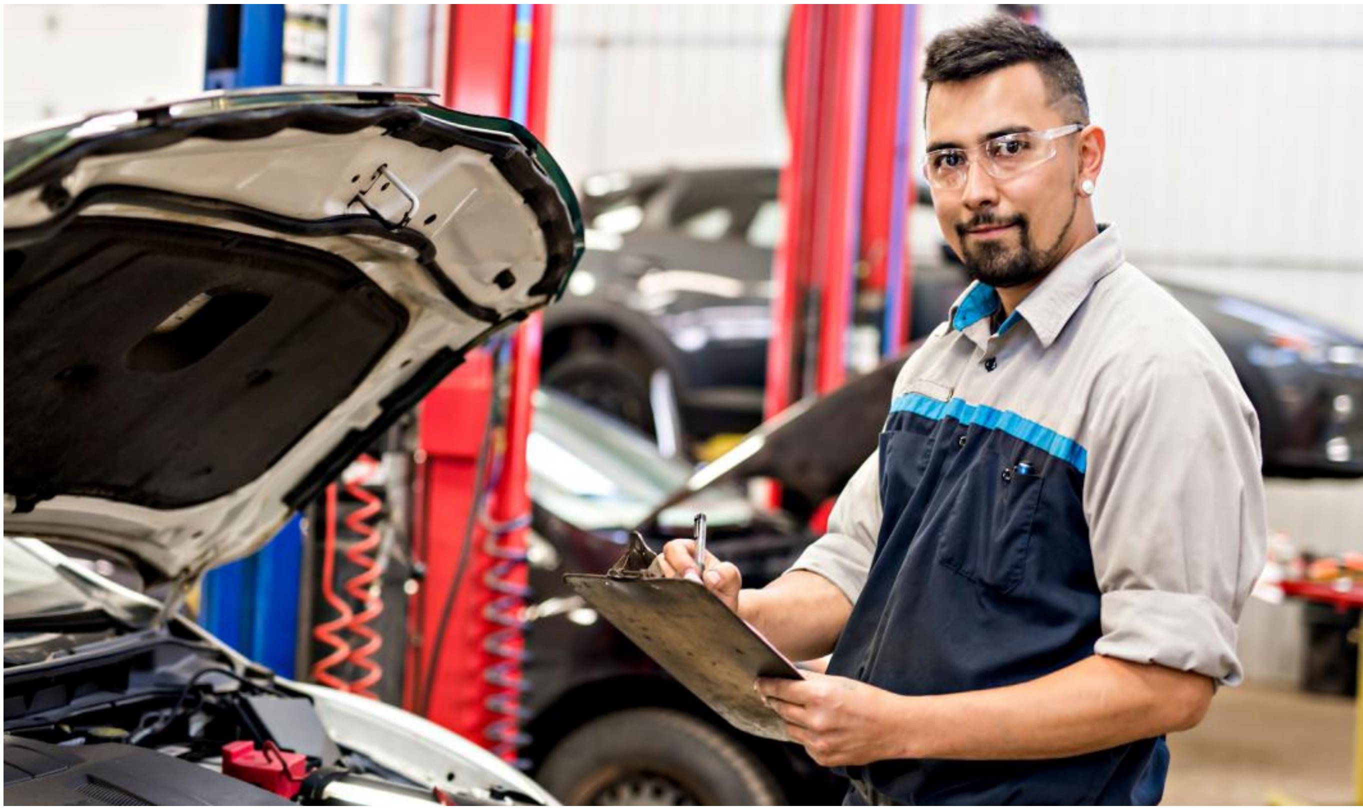
7 https://blogs.windows.com/windowsexperience/2018/03/08/how-mixed-reality-is-changing-the-game-for-healthcare-from-performing-live-surgeries-to-delivering-ultrasounds-in-3d/

Conversational AI in Finance

The payment market is being rapidly disrupted. With services ranging from peer-to-peer (P2P) to cross-border payments, the variables and complexities in the system and the need to offer value-added services to customers are prime considerations. Conversational AI has the potential to be a key differentiator—using a simple question to do everything from making payments to understanding the status of a bank account balance. Use cases across healthcare, travel, insurance, banking, and P2P transactions abound; customers can use a single interface to complete a transaction that may begin by asking questions and end up with a transfer of funds. Such solutions work in tandem with nascent solutions such as instant payments, cross-border payments, and invisible payments. For companies offering financial services, conversational AI payments are another channel to engage with customers. While the value of transactions may be low, user data (e.g., purchase decisions, usage patterns, and other behavioral aspects) allow systems to learn faster.

Service Marketplaces in Vehicle Servicing

Service marketplaces are a direct outcome of the digital wave disrupting the automotive aftermarket service industry. Frost & Sullivan estimates that nearly a million repair jobs were booked online in France, Germany, the U.K., and the U.S. through service marketplaces in 2018. The ease and breadth of service access and increased transparency through peer reviews are its biggest benefits and are driving adoption by car owners. Optimized bay utilization and digital job management tools are some of the key advantages for workshops.



CONCLUSION

Airlines are immensely complex organizations, competing in a highly cyclical, regulated and safety-critical business environment. Large carriers with long histories have built their operations on the back of legacy systems that are difficult to modernize or replace without incurring significant business disruption. Furthermore, they have numerous data siloes and find data integration and data value extraction particularly challenging. Newer airlines do not face the same challenges and have employed modern solutions and new technologies, but they also face issues with data availability and lack of industry collaboration.

DATA AND ANALYTICS COULD SAVE AIRLINES 0.27 CENTS OFF THEIR OPERATING CASK.

This paper contended that operational inefficiencies and a lack of universal application of data and analytics have resulted in an annual global inefficiency cost of $74.2 billion. This inefficiency cost is split across technical operations, flight operations and network operations, with unplanned maintenance, fuel overspend and network disruptions being the biggest operational challenges for airlines. Furthermore, it concluded that through data and analytics, airlines could save $25.3 billion off these inefficiencies, reducing their CASK by 3.3% and improving operating profits by an equal amount.

Digital transformation is imperative on the path toward toward efficient operations, improved passenger experience and sustainable profitability. It is enabled through a culture of excellence in data integration, engagement with the ecosystem and empowerment of crew.

Excellence in data integration

In a hyper-competitive industry, maximizing the extraction of value from data provides a distinct competitive advantage. Airline assets, passengers and employees generate large data volumes, yet airlines only record and analyze a small share. Being able to record more relevant data, integrate it into a data platform and run real-time analytics is key in optimizing processes and automating decisions.

Engagement with the ecosystem

Working with suppliers to achieve improved performance is essential. To succeed and grow, airlines will need to either create their own or join an existing partner ecosystem.

Empowerment of crew

Organizations can extract more value out of digital transformation programs when their employees already possess a minimum digital skillset and digital mindset while empowering them to make informed decisions in their jobs. This applies to all employees, irrespective of their role and job specifications, from the fuel agent making fuel procurement decisions to the pilot assessing relevant information to optimize flight paths.

CASE STUDY: QANTAS

Challenge

Qantas is Australia's national carrier, serving destinations throughout the Asia-Pacific region, the Americas, Europe and Southern Africa. With 7,300 flights per week and 55 million passengers per year, Qantas has a unique mixture of long and short-haul flights and a 99-year history of innovation in the aviation industry. Safety is always Qantas' first priority, and the airline has used flight data as one of the many ways it manages risk for some time.

Through a collaboration with GE Aviation's Digital Group, the airline started looking at broader applications for data, particularly looking at flight operations efficiencies. It realized early on that empowering pilots and engaging with them on a regular basis is an important step in identifying and realizing efficiency gains.

Solution

Qantas saw the value of putting data into the hands of pilots to empower them to make decisions to improve their fuel and flight plan efficiencies. It made sense to develop something that was easy to use and specifically designed to provide personalized operational data, and move away from simply sharing aggregate fleet information.

Qantas worked with GE to design FlightPulse®, a flight analytics tool which uses recorded aircraft data to enable pilots to securely access their individual operational efficiency metrics and trends after each flight, helping to reduce significant amounts of fuel as well as carbon emissions. The aim in designing the tool was to develop something that could provide meaningful information to help crew with their everyday decision making and wasn't going to be just another app on their iPad. Pilots were involved in every step of the design and development process; their input fundamentally shaped the product.

2,715 QANTAS PILOTS SAVED 5.71 MILLION KGS OF CO_2 EMISSIONS WITH FLIGHTPULSE®.

In the end, the tool empowered pilots to conduct their own analysis and peer comparisons, discover areas to optimize operations and efficiency, while reducing risk, fuel consumption and carbon emissions.

Outcome

Today FlightPulse® provides flight insights to 2,715 pilots, with one in three of them regularly engaging with the app. Since introduction the airline has witnessed an up to 15% increase in adoption of fuel efficiency techniques, which has resulted in a reduction of 5.71 million kilograms of CO_2 emissions.

The next iteration of FlightPulse® will help pilots before they take off. During preparation, pilots will be able to flip to a new pre-flight module on the app that aggregates historical data from other Qantas flights and pilots relating directly to their upcoming journey. This will allow them to find key details such as what safety-related issues at a specific port or runway may have occurred, if conditions prevented past flights from climbing to cruising altitudes—thus forcing them to burn more fuel—or what general traffic flow issues might affect arrival or takeoff times.

In Qantas, FlightPulse® has evolved into a collective knowledge pool, allowing pilots to learn from the experience of thousands of other Qantas pilots.

Sponsored by

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SILICON VALLEY | 3211 Scott Blvd, Santa Clara, CA 95054
Tel +1 650.475.4500 | Fax +1 650.475.1571

SAN ANTONIO | 7550 West Interstate 10, Suite 400, San Antonio, Texas 78229-5616
Tel +1 210.348.1000 | Fax +1 210.348.1003

LONDON | Floor 3 - Building 5, Chiswick Business Park, 566 Chiswick High Road, London W4 5YF
TEL +44 (0)20 8996 8500 | FAX +44 (0)20 8994 1389