

Digitalization, AI in Aviation and the Human Factor

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Digitalization, Artificial Intelligence in Aviation and the Human Factor

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The Need for Change

Global passenger traffic reached 8.8 billion in 2018 and is expected to double by 2037¹. Aviation provides the only rapid worldwide transportation network, which makes it essential for global business and tourism. It plays a vital role in facilitating economic growth, particularly in developing countries.

This anticipated scale of growth necessitates systems and processes that are up to the task of tomorrow's facilitation and security challenges. The challenge for aviation is to manage performance and growth, contain costs, make better use of resources and find efficiencies, all while increasing sustainability, improving passenger experience, and maintaining safety and security.

Airports are complex ecosystems, with multiple stakeholders performing time-critical functions in a highly regulated environment. Responsibilities are shared or split between stakeholders, requiring a high degree of communication and coordination. Airports, therefore, lend themselves perfectly to the digitization of complex processes and the leveraging of technologies such as artificial intelligence to become more flexible, responsive and proactive in managing activities across multiple stakeholders.

Digitization versus Digital Transformation

Airport leaders acknowledge that business success is not just about the deployment of new technologies. Instead, success will come from transforming the business of airports, adapting to customers, staff, community and cultures while leveraging existing and new technologies to meet strategic objectives and goals.²

Digitization implies the transformation of an analogue or manual process into an equivalent digital process. Rather than focusing solely on digitization, we should think rather about digital transformation – business transformation in a digital world.

Digital transformation involves both the implementation of new technologies and the integration of existing technologies, processes and services to deliver a better experience to all stakeholders. It embraces the integration of systems and services, including those provided by partners in the airport ecosystem such as airlines, security, border control authorities, concessions and ground handlers.

Digital transformation leverages the use of technologies such as indoor geolocation, identity management, flow management, data mining and the Internet of Things (IoT). It requires making these digital technologies secure in the cyber world to ensure that every system works as intended.

Major business drivers for airports are customer experience, enhanced services, improved collaboration and increased revenue. Furthermore, digital channels and distribution will also create completely new business models such as the commercialization of data.

¹ *World Airport Traffic Forecasts (WATF) 2019–2040*

² <https://aci.aero/about-aci/priorities/airport-it/digital-transformation/>

Customer Experience

Similar to other industries, airports are experiencing a digital evolution to help maximize business and operational objectives. Today's technologies can allow airports to do something that was unimaginable just a few years ago: deliver personalized and individual services to millions of passengers. Today's digital devices bring this personalized information in real time directly to the customer, such as real time flight information, wayfinding in the airport terminal, levels of road congestion for the journey to the airport, and electronic payment for goods and services.

Artificial intelligence (AI) and the use of algorithms now make it possible to give the right information to every passenger at the right moment, based on location, time before flight, profile and preference.

In addition, over fifty airports and their partners globally are already leveraging biometrics to provide a seamless, document-free passenger journey (in addition to the government authorities already using biometrics for immigration purposes.) As standards emerge and multilateral agreements are made, we expect to see the end-to-end journey revolutionized by touch-free walk through identity checks that enhance both security and customer experience.

Operational Efficiency and the Power of Data

In terms of internal gains, digitization, data and in particular AI, offer opportunities to improve productivity and efficiency. Airports are collecting and monitoring vast amounts of data every hour of every day. Harnessing this data can provide an airport with invaluable data to optimize performance.

Predictive modeling and artificial intelligence will enable swifter real-time decisions using a wider array of data than could be performed by any human. Awareness of the changes to a passenger's journey, the status of aircraft, cargo or baggage will enable the airport to optimize the decision-making across their whole operation, and airlines to coordinate their activities across their entire network:

- Real-time metrics can provide immediate feedback on usage or occupancy of a given passenger touchpoint, to correct inefficiencies as they occur
- Short-term metrics are collected periodically with the aim to track performance over a limited period of the time. This may be for management and executive reporting, or to monitor service level agreements against actual performance
- Long-term metrics are collected periodically with the aim to track long-term performance and trends to identify projected infrastructure development triggers or as a means to assess the impact of systemic changes on operational and financial performance.

Predictive analysis enables the creation of forward-looking information based on historical data. Because it has yet to occur, it is still a projection. However, the availability of historical performance monitoring information combined with parameters specific to the period ahead (e.g., rostering and flight schedules) can provide more reliable and sophisticated predictive analytics.³

The output from this analysis can be used to reduce operational costs and increase revenues. Examples include developing models to optimize resourcing allocation, whether at a passenger touchpoint or an aircraft at a gate.

³ ACI World Passenger Facilitation Performance Metrics Handbook, 2020

Metrics can also be used to optimize area occupancy and measure throughput or processing rates. This data enables business intelligence solutions to optimize future performance and improve terminal design.

The exchange of accurate, real time data between airlines, airports and air navigation service providers offers opportunities to improve performance of the whole aviation ecosystem. Airport collaborative decision making (A-CDM), for example, aims to improve the efficiency and resilience of airport operations by optimising the use of resources and improving the predictability of air traffic. It achieves this by encouraging the stakeholders to work more transparently and collaboratively, exchanging relevant accurate and timely information.

In order to achieve this level of collaboration, a common vocabulary for data exchange is needed. ACI's ACRIS data model aims to provide exactly that – through ACRIS, all stakeholders can exchange data with the confidence that they are speaking the same language. This also enables standard APIs (application programming interfaces) to be provided by airports who wish to provide their data to third parties.⁴

Safety

Over and above the improvement of the passenger journey, automation brings the opportunity to improve operational safety. The deployment of autonomous or semi-autonomous equipment and systems has the potential to save millions of dollars that are lost by damage done to aircraft and other assets on the airside. Modifications to the ground service equipment (GSE) is being explored by many manufacturers, airports and airlines.

Working with airline partners, airports are looking at how to make the aircraft gates safer by scanning the aircraft environment with cameras using AI and machine learning. This way, it ensures that all the equipment around the aircraft is located at the right place and that the area is clear and exempt of foreign object debris.⁵

Still, challenges need to be overcome around recreating real life conditions. These challenges include the impact of external variables (weather related, lighting and visibility) and the interactions of different AI systems of the various stakeholders involved in the traveller process, such as ground handlers, airlines and airports.

Furthermore, human factors that pose a threat to operational safety can be mitigated by autonomous vehicles. For example, some airports have deployed autonomous snow clearing equipment to ensure fatigue, hypothermia or frostbite do not impact the frequency of required snow control.

Self-driving vehicles and systems must guarantee the safety of human drivers, passengers and pedestrians, however. To ensure safety, numerous sensors will monitor the external environment, geolocation and advanced analytics will predict road conditions.

Security

There are many examples where digital transformation can assist in security activities. Deploying artificial intelligence in combination with video infrastructure can enable enhancements such as

⁴ <https://aci.aero/about-aci/priorities/airport-it/acris/>

⁵ ACI World Autonomous Vehicles and Systems at Airports Report, 2019

biometric recognition, unusual behavior detection, unattended-baggage management and monitoring and control of building and fencing access.

Artificial intelligence can also be used for automated threat detection, providing an aid to human image analysis, by enabling x-ray machines to automatically detect potential threats, or clear trays that clearly do not contain potential threats to aviation security.

ACI's Smart Security programme⁶ aims to provide airports with options for optimizing the security checkpoint in the short term by leveraging technologies such as advanced cabin baggage screening, while striving for future solutions that offer a truly walkthrough security gateway, where passengers are screened according to risk. This vision relies on a combination of advancements in screening equipment, such as stand-off screening technologies, and fully leveraging data to optimize the screening experience.

Autonomous machines can also offer a useful layer of security to a security programme at an airport, such as automated perimeter monitoring and robotic surveillance.

However, the use of automation introduces an additional security risk, especially concerning cybersecurity. This will be a key consideration as more processes are digitized, IoT technologies are deployed and systems are linked. ACI is working with the International Civil Aviation Organization (ICAO) on an action plan for aviation cybersecurity, as well as providing guidance to airports in best practices, training and a tool to help airports assess their cybersecurity readiness.⁷

Sustainability

Digital transformation is also rapidly becoming an essential component of sustainable practices. A deep understanding and monitoring of passenger flows can help to optimize the capacity of airport infrastructure as well as offering predictive maintenance that will reduce costs and maximize airport-asset utilization. Intelligent building management can also significantly reduce electricity and gas usage.

The deployment of autonomous vehicles will also provide opportunities to reduce the use of traditionally powered vehicles in favour of electric passenger vehicles, baggage and cargo dollies and ground service equipment.

Barriers to Change

The aviation business landscape is changing in all regions of the world and the way airports do business needs to be adapted to accommodate these changes. Solutions are needed for airports both big and small, with different regulatory and operational realities.

To keep up to speed and to capitalize on all the benefits of frontier technology, the aviation industry needs a clear framework with government in which to operate, and regulatory permission to change. Innovation can not thrive in an over-regulated environment. There are many areas where there are significant opportunities within the purview of States and their national authorities to encourage innovation.

⁶ <https://aci.aero/about-aci/priorities/security/smart-security/>

⁷ <https://aci.aero/about-aci/priorities/airport-it/cybersecurity/>

One key area is enabling faster clearance of the majority of passengers through security, customs and border control, promoting adoption of new technologies and simplifying inspection points throughout the passenger journey.

Examples include:

- i. allowing for different, performance-based approaches to border and aviation security to adapt to operational realities, and
- ii. promoting adoption of automated and electronic processing for all passengers for security, customs and border control processes.

These can be achieved through innovative approaches to funding, resources and the facilitation of regulatory amendment and encouraging the use of emerging technologies and innovation such as biometric entry and exit clearance, artificial intelligence, digital travel documents, electronic and mobile customs declaration and mobile boarding passes.

Endorsement of greater data sharing between all stakeholders in the aviation ecosystem, including between agencies such as customs and immigration services, law enforcement and security agencies, airports, airlines and service providers, will remove duplication, increase efficiency and strengthen security.

With technology rapidly changing, testing and certification of new equipment need to be accelerated, along with regulatory support for new technology trials.

Capital investment will also, of course be a challenge, with solid business cases developed for the adoption of new technologies. Airports will need to consider future digital infrastructure requirements alongside building design as they prepare for digitalization. This includes secure high-speed networks to support systems such as biometric verification, as well as technology to enable indoor geolocation and support for autonomous electric vehicles.

As more trials and pilots emerge, ACI plans to collect further case studies to be able to share lessons learnt amongst its airport members and start to develop best practices.

Human Factors

When innovative solutions and processes are implemented, it is easy to forget the needs of the user. Bradley Rubenstein, Manager, Industry and Regulatory Relations at the Port Authority of New York and New Jersey, recently cited the perfect example in the non-digital world: the propensity of architects and designers to conceal paper towels in bathrooms. This may be aesthetically pleasing, but is incredibly frustrating to passengers in a hurry. This equally applies to digitization.

Paul Chavez from Arup endorsed this view at a recent ACI facilitation meeting. He says that “Designers must consider that this technology is ultimately at the service of people - attempting to get themselves or their cargo from one place to another. The user’s goals and their capabilities should always be at the root of any technology project. This is the practice of User-Centered Design (UCD), the discipline that has evolved from software and product design into systems, services and immersive experience design.

Solutions might range from changes in the physical layout of a space to digital solutions such as mobile apps, biometric sensors or video displays. User-centered designers consider the user’s cognitive and physical limitations as well as their mental models (how they believe a system to

work). Any technology that is deployed to help the user achieve their goal is driven by focusing on the user's needs – and not by the feature set of a pre-built product. Through middleware or custom integrations, off-the-shelf technologies can be integrated to reduce complexity and achieve user's goals more simply. When spaces and services are designed with user-centered design methods, people make fewer errors, feel less stress and become more autonomous ultimately benefitting their wellbeing.”

The industry also needs to give attention to workforce capacity, both in terms of attracting tomorrow's workforce as well as the capacity of the current workforce. We must keep track of larger trends in the labour market that have the potential to influence future skills. We will need to forecast how such changes will interact with those in our industry as we fight to get our fair share of talent. This includes how technology is going to change the workforce. A greater number of staff will be needed for more complex, skilled tasks that require a human touch or use of judgement, rather than repetitive tasks that may be easily automated.

Growth will also require recruitment, support and promotion of careers for women in aviation. ACI, along with others in our aviation industry, understand that we cannot ignore half of the world's population and expect to fill our workforce demand. All businesses will need to start planning for training and retention of staff with these new sets of skills.

Enabling and Encouraging Innovation

Innovation is about the practical implementation of something new to have a meaningful impact. It needs vision, partnership and a clear path to adoption. Embracing the new is important, but not for its own sake. Organisations need to experiment, implement and learn from new technologies but also make sure that they use them to create value.

If implemented correctly, innovation can produce great returns and competitive advantage, but energy also needs to be directed towards integrating technology within the wider organisation and addressing the challenges presented by legacy technologies.

Development and adoption of consumer technology has vastly outpaced corporate technology. Organisations need to understand that mobile technologies are no longer treated as a tool – for many, it's part of the way they operate.

Some of the conditions needed to achieve innovation are better regulation, with an adaptable, flexible framework within which innovation can thrive; partnerships between industry, manufacturers, entrepreneurs and government and providing support and regulatory space to foster pilots and trials.

Time and time again, these key ingredients have proven successful in moving the air transport system forward, proving concepts and technologies that have now become the new normal.

Alignment and cooperation between public and private stakeholders, between States and between agencies within States is a critical factor to realize the benefits of bringing innovation to the heart of aviation.

The Role of Industry Associations

ACI, its members, and airport stakeholders are already leading many initiatives that can address capacity issues, improve customer experience and optimize resources.

In this context, ACI and the International Air Transport Association (IATA) launched in 2017 a joint initiative known as NEXTT - New Experience Travel Technologies - to look at the future of travel, thus creating a common vision that encompasses all individual projects and concepts.

NEXTT provides a vision and, while it will not create a single product to be deployed to the travelling public, it is an initiative that allows the industry to challenge the ways in which it operates and aim for a common goal.⁸

Through NEXTT and with our airport members and World Business Partners, ACI is aiming to foster innovation and bring together a community that can benefit from each other's experiences.

An Imperative for Change

Airports are set to welcome over 20 billion passengers by 2040. This will only be possible if the industry makes the necessary preparations, not just in the long-term, but in the now and in the short-term.

Many airports are facing congestion without having a way to increase capacity. Airport leaders are faced with pressure to manage performance and growth, without constantly adding infrastructure and cost, while striving for environmental sustainability and robust security.

All players in the value chain, in every area of airport operation, will have to become more responsive and efficient. There is no doubt that there are already crowded skies and crowded airports, industry and government need to work together to make sure that we can sustain this growth.

Consumer demands for great experiences enabled by digitalization are forcing businesses in all sectors to re-evaluate their strategies and approach digital transformation in a new way. Aviation is no different.

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⁸ www.aci.aero/nextt