WAVESTONE

SMART AIRPORT

HOW TECHNOLOGY IS SHAPING
THE FUTURE OF AIRPORTS

WAVESTONE

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Wavestone is a consulting firm, created from the merger of Solucom and Kurt Salmon's European Business (excluding retails and consumer goods outside of France) Wavestone's mission is to enlighten and guide their clients in the most critical decisions, drawing on functional, sectoral and technological expertise.

The airport industry is developing at a very fast pace, supported by a solid and continuous growth of the total number of passengers processed per year (the worldwide passenger traffic increased by 64% between 2009 and 2016). Major European and Asian hubs are continuing to grow, with Middle Eastern players developing quickly and new comers appearing in Latin America (e.g. Santiago) and Africa (e.g. Addis Ababa).

This rapid growth of the industry has put airport operators under pressure to face important challenges such as increasing their capacity, optimizing their processes, diversifying their revenues, being part of the passenger global experience and, of course, providing top security and cybersecurity measures. In this context, digital solutions gave airports the unique opportunity to address all these issues. The digital transformation started at the beginning of the 1990s and led each airport to move onto different levels of digital maturity, where each level is characterized by the set of technologies adopted.

The different levels of airport digitization have certain trends depending on the region of the world. In Europe, Middle East and Asia, airports are particularly digitally mature. Their needs in terms of IT&T are further steered towards cutting-edge technologies and innovations. In North America, the airport industry seems to be late in its digital transformation and mainly requires common self-service solutions. Africa and Latin America are at the beginning of the digital era and will show an important need of legacy IT systems in the next few years. Globally, the airport digital era induces a substantial growth of the investments made in IT&T[1]. The market size grew twofold since 2011, reaching USD 9.07 billion in 2016.

As for operations, the general trend within the industry consists in going for live and predictive operations in order to maximize the capacity of terminals and runways. In this domain, the A-CDM[2] initiative seems to get serious interest, even outside the European market. Self-service solutions are now very mature and some of them even reach their limit with the massive introduction of online and mobile check-in solutions. Hence, airports should readapt their strategy and use further automations in their processes to improve the quality and the safety of operations.

On the other hand, passengers look further into an augmented airport experience in which digital technologies co-create, with the personal assistance, a "phygital experience". An experience enriched with personalized content and available seamlessly through different channels to provide the so-called omnichannel experience.

However, these digitally enhanced services require a robust and advanced network infrastructure, able to carry

1. Information Technology & Telecommunication
2. Airport-Collaborative Decision Making

huge amounts of data generated from the newly deployed solutions. For this, both the professional 4G/LTE network and the access to free public Wi-Fi offer an ideal environment to leverage IT and propose new innovative applications. Furthermore, to accelerate innovation, airports are adopting open innovation, based on providing API[3] platforms to the developers' community.

Integrating the airports' systems within the global ecosystem, giving third parties access to the airport's critical systems, associated to the fact that operators are willing to migrate to the cloud in the next five to ten years, will dramatically increase the risk of cyberattacks. To face these new challenges, where the airport is obliged to innovate and at the same time protect its own legacy systems, the industry must develop additional expertise in the field of cybersecurity, such as putting in place a SOC[4] and thoroughly testing the vulnerability of its infrastructures.

Finally, in this continuously moving IT&T sector, airports should adapt their organization in order to follow the change better by reducing the risks and uncertainties related to the rapidly emerging cutting-edge technologies. To do that, innovation should be put at the heart of their strategies, and management should find its equilibrium between conventional and new agile methodologies that are capable of delivering better quality, faster, cost effectively and most importantly on a lean start-up basis.

Thus, being a Smart Airport is not about complete digitization of the airport, but much more about the ability of the company to make the most of innovation and technology, in order to develop a competitive edge and face international competition.

3. Application Programming Interface
4. Security Operations Center

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INTRODUCTION
OF THE STUDY

CONTEXT

In 2016, train operators showed some signs of weakness due to security and political concerns raising across Europe. Eurostar for example, the operator of the high-speed train that crosses the English Channel, processed 4%[5] less traffic than in 2015. On the other hand, air transport continued to show its strength globally with an impressive 5.5% growth in 2016, confirming the resilience of the air industry to political instability. In this flourishing state of air travel, airlines and airports are required to deliver high standard services for their customers in order to be able to improve their attractiveness and provide the passengers with a personalized travel experience.

Today, we are witnessing a continuous reshaping of the air travel industry in order to face not only common challenges such as cost reduction and competitiveness improvement, but also newly emerging challenges such as digital transformation and passenger experience. In fact, digital transformation is impacting all players of the ecosystem including airlines, hotels, travel agencies and airports. However, this impact occurred at different paces for each stakeholder:

/ Historically, airlines faced serious issues with their competitiveness early on. Airliners are generally known for their low financial margins, moving operating costs due to a high exposure to fluctuant fuel prices and for having "demanding" customers. These constraints have put airlines under pressure to reassess their business model and their value proposition earlier. This "under-constraints" evolution, has made the airlines embrace the potential of digital solutions early on, in order to find new ways of generating revenues, reducing costs and improving the customer experience.

/ Later on, travel agencies were, in a certain way, engaged in the digital makeover in response to the rise of passengers' connectivity and access to the Internet. They embraced this change by going massively online, providing mobile-based reservation applications and recently launching chatbots to improve customer service (i.e. Expedia launched its Facebook messenger-based chatbot in June 2016).

/ Nevertheless, airports were rather late in their digital transformation and in leveraging information technology. This difference can be explained by the following circumstances:

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5. Source: Press releases

- Putting aside regional and international hubs, the majority of airports in the world process less than one million passengers. This limited passenger traffic makes these airports less exposed to complex operations that require IT and digital assistance to become optimized and smoothened.

- Airports are generally known to be financially robust. Their average net profit margin is around 16%[6] and can go up to 20% for airports processing more than 40 million passengers. This healthy financial status made airports adapt late innovations and solutions to improve their competitiveness because they were not in need of that, unless the case of airlines.

- From a management and an operational point of view, airports are extremely complex structures where different stakeholders co-exist and operate: public services, airport operators, airlines, ground-handlers, suppliers, etc. This complexity can make technology deployment sometimes difficult due to a divergent set of interests held by each player and a lack of collaboration.

In order to go ahead with digital transformation and confirm their substantial role in passenger journey, airports decided to invest massively in technology over the last decade. These investments doubled between 2011 and 2016, increasing from USD 4.42 billion to USD 9.07 billion according to the airport IT provider SITA.

This acceleration of the airport digital market has faced the industry players with new challenges:

/ Airport IT departments are now obliged to adapt their working environment to deliver in an agile way, more suitable for disruptive solutions and technologies

/ Airport operators are used to collaborating with big IT companies but and must now work with start-ups and small companies, who are new major players in the innovation and digital landscape. Many structures, unknown to the industry a few years ago, had to be created: digital department, customer experience digital department, innovation department, etc.

This digital "shock" has pushed airports to leverage IT solutions, become smarter and be more efficient, and has revealed to the public a new concept: the "Smart Airport". Does this concept have an exact definition? Can we define an airport as a smart one or not a smart one? What about the regional trends? The following white paper tries to provide the reader with some answers to these questions.

6. Source: ACI 2015

METHODOLOGY

In this current study, Wavestone proceeded with the following three approaches:

/ **Airport survey**: Wavestone addressed a questionnaire to more than 25 airports around the world regarding their IT&T systems and digital strategy. The sample of airports ranged from very small local ones like Durango airport (DGO) in Mexico to important international hubs such as Dubai airport (DXB) in the United Arab Emirates, Charles de Gaulle airport (CDG) in France and Frankfurt airport (FRA) in Germany.

The survey is divided into four main parts:

1 The status of the current IT&T solutions deployed at the airport

2 The future deployments planned for the short and long-term

3 The major issues that digital solutions may address within the airport industry

4 The airport's strategy in terms of IT&T and cybersecurity.

/ **Large data analysis**, including press releases, annual reports and various studies

/ **Interviews with a range of experts in the IT industry, airline and airport IT** in particular.

The three elements mentioned above, gave Wavestone enough material to draw up trends appearing on a regional basis and major digital challenges to come in the next three to five years within the airport industry.

THE IT&T SYSTEMS CONSIDERED IN THE SCOPE OF THE STUDY

The following study deals with all the IT&T front office systems including mobile applications, self-service applications, airport operation systems, network, infrastructure and cybersecurity.

As for mobiles, they included smartphone applications but also mobility solutions deployed massively in between the ground agents and ground handlers on airside and landside.

For the self-service applications, they are present nowadays throughout the passenger journey on terminal side, including check-in, bag drop, security & boarder control and boarding.

Network and infrastructure are the backbones of any digital transformation. We are witnessing a generalization of legacy solutions like WLAN[7] and Wi-Fi, but also an increased interest in new solutions like the Internet of Things (IoT), 4G/LTE for professional use and iBeacons.

7. Wireless Local Area Network

THE FUTURE OF THE AIRPORT INDUSTRY

A BRIGHT FUTURE FOR THE AIRPORT INDUSTRY

Following the fall in air travel demand in 2008, resulting from the economic crisis that had hit at the time (the growth of the number of passengers transported dropped to 0.1% in 2008), the industry started to show strong results year-on-year: starting 2009 to present, the number of passengers transported by air made an impressive growth and reached a 9.2% CAGR[8] for 2009-2016.

Number of passengers transported per year
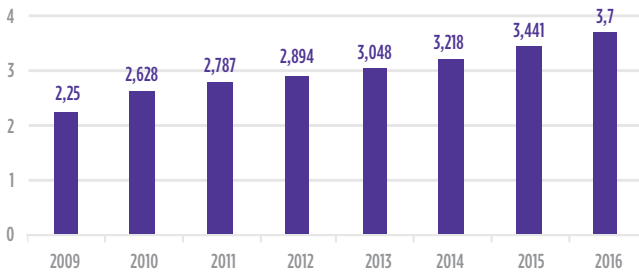
Source: International Civil Aviation Organization (ICAO)

This variation of the number of passengers transported seems to be closely linked to the GWP, allowing us to confirm that the global economic growth is a key driver for air travel. As a result, on the one hand, positive financial trends are coming out from Russia and China in 2017 where respectively the industrial production went up and the household consumption increased. On the other hand, a fuel barrel price stabilizing around 50 to 60 USD, is just as perfect to improve the economy and pull up the consumption index in Gulf countries and the US (where shell oil companies are showing good signs of financial resilience).

These two major factors prefigure a GWP[9] growth for 2017 higher

8. Compound Annual Growth Rate

than in 2016, and therefore an important increase in the number of transported passengers in the coming few months, maybe years.

This sustainable increase in the number of passengers fueled the revenues of the airport industry, which for about 55%[10], come from aeronautical revenue[11]. Thus, airports saw their revenues increase by around 50% between 2011 and 2016. At the same time, the immense volume of passengers, baggage and freight to be processed made airport operations significantly more complex and less secure. On the one hand, the complexity of the operations tends to generate additional costs due to an increased solicitation of ground agents (i.e. servicing, processing and quality control agents), while on the other hand, the security issue is getting more problematic with the considerable increase in terrorism-related risks, especially in public congested places like airports.

Global revenues of the airport industry (in $billions)
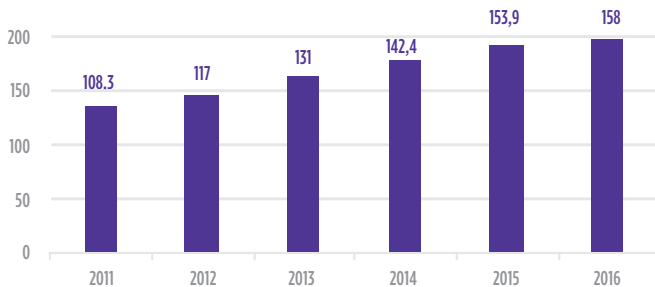
Source: ACI

The regular growth of revenues mentioned above, matched with an important net margin of the industry ranking, according to ACI, between 12.9% for small airports (1 to 5 million passengers/year) and 20.6% for major hubs (more than 40 million passengers/year), give the airport industry the unique opportunity of being able to invest massively in construction, innovation and digital solutions.

9. Gross World Product

10. According to ACI

11. Aeronautical revenues are the ones generated exclusively from the air transportation activity (passenger charges, landing & parking charges, terminal rentals, security charges...), whereas non-aeronautical ones are generated by ancillary services (retail concessions, car parking, real instate income or rent, food and beverage, advertising...)

MAJOR HUBS AND REGIONAL TRENDS

The air transport volume in terms of passenger traffic is expected to explode with an annual cumulative growth rate of 4.9% until 2040. However, this boom will be mainly driven by four leading markets:
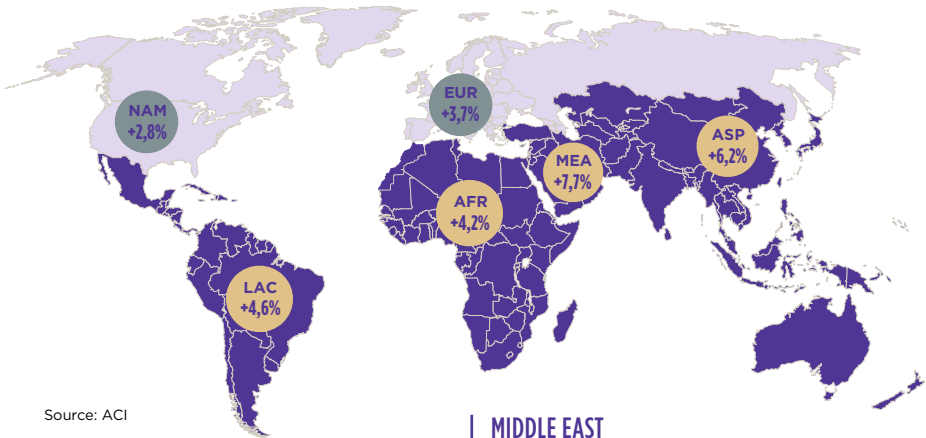
Source: ACI

ASIA-PACIFIC

The region is expected to confirm its leadership by having almost double the air traffic of the European market in 2040. This is possible due to the surge of the middle class in both China & India, and the attractiveness of many countries such as Thailand & Indonesia as major tourist destinations.

AFRICA

It will experience solid growth profiting from Nigeria as a business hub, Ethiopia for its hub potential, South Africa & Kenya for their tourism and business; mostly supported by growing trade with China.

MIDDLE EAST

Being both strategically and geographically well placed between Europe and North America on the one hand, and Asia on another, dynamic platforms like Dubai in the United Arab Emirates and Doha in Qatar will continue to act as major international hubs, boosted by the great performance achieved by Emirates and Qatar Airways respectively.

SOUTH AMERICA

Recently, the social and political context deteriorated in Latin America, mainly in Brazil and Columbia, due to corruption and economic issues. This will definitely lead to a review of the growth of air traffic projected by ACI for the region. Nevertheless, the consolidation of the air travel market by LATAM Airlines and the emergence of Santiago de Chile as a hub for the region, will support the local traffic growth for the next decade.

This air traffic concentration that will be migrating, by 2040, from the North (Europe and North America) to the South (Latin America, Africa, Middle East and Asia-Pacific), will change the configuration of the airport industry in the world:

/ Today, major hubs are located in Europe (e.g. Frankfurt, Paris and London), Asia (e.g. Singapore and Seoul) and in the Middle East (e.g. Dubai, Istanbul and Doha). Most of them are facing serious capacity issues: their current maximum capacity is nearly reached and any extension in the near future is hard to get due to public and environmental policies that are limiting the possibilities of extending current infrastructures.

/ In the future, hub cartography will move following the air traffic shift projected for the next decades as shown in the map above. There is no doubt that the historical hubs will keep their market place in the short and medium run, but a considerable number of hubs, either regional or international, will be appearing in Latin America and Africa. Airport operators within these regions will face a surge of operations and an increasing complexity in their processes.

High concentration of regional and local hubs at present

High potential of developing air hubs for tomorrow

High concentration of international and regional hubs at present
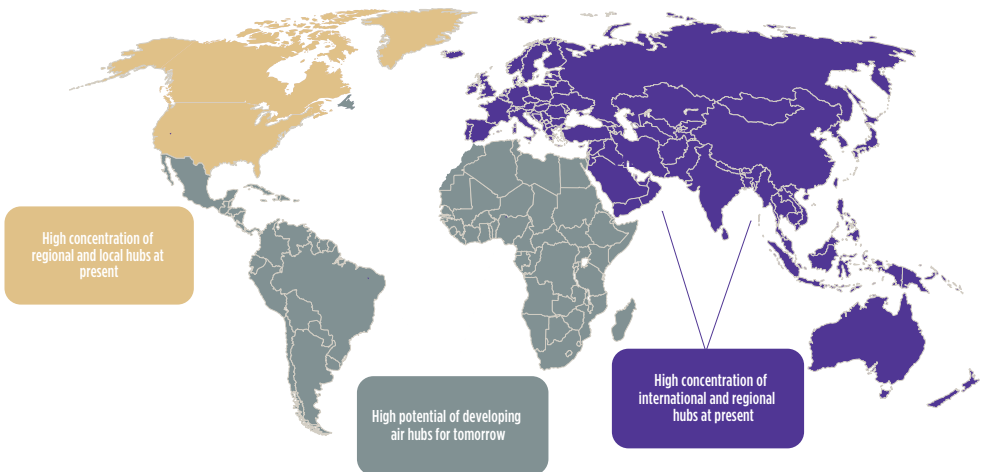
FUTURE CHALLENGES OF THE AIRPORT INDUSTRY

Facing the generalization of air transport in society, the airport industry has been able to absorb the continuous growth of the traffic. In the late 2000s, the value proposition of an airport changed drastically by shifting from a processing platform serving airlines and ground handlers (i.e. security checks, baggage processing, etc.), to a travel experience provider serving passengers: lounge services, travel retail, entertainment corners, business areas, online shopping, etc.

This fast transformation that occurred in the ecosystem forces airport operators to find innovative and new solutions to enhance virtually the entire capacity of their infrastructure and improve passenger journey by offering an airport experience as a way of living.

RAISING THE CAPACITY

Five major European airports are already facing capacity issues (Düsseldorf, Frankfurt, London Gatwick, London Heathrow and Milan) and 19 other airports are expected to have the same problem in less than two decades, including hubs like Paris-CDG. Based on the expected air traffic evolution and the fact that international traffic will overcome domestic ones by 2028, the "physical capacity" of these platforms will be reached. Knowing that these airports are in regions where extensions are almost impossible, they should deploy new processes and solutions capable of treating passengers faster. Nonetheless, the emerging air transport market in South America and Africa won't face such constraints, since airport areas in these zones are still extendable by adjusting runway and terminal volume.

PASSENGER EXPERIENCE

The airport journey is now very important in the door-to-door passenger experience. The average time spent at the airport counts for more than 60%[12] of the overall time spent during the travel in certain cases. The value proposition of an airport or a terminal to attract additional flight connections, is no longer exclusively linked to the minimum connection time (MCT)

12. For short haul flights

(historically, airlines used to choose an airport as a hub or connection, based on the accessibility and transfer time between each flights), but it is also linked to the quality of the in-terminal experience that the airport is able to provide.

MOBILE OVER CONNECTIVITY

Passengers are connected : whether business traveler or tourist, passengers are looking for Internet connectivity "everywhere"

This over connectivity is for airports at the same time a cost generator (i.e. network investment) and a **great opportunity to make revenues out of this ancillary service**

PERSONALIZED SERVICE

Passengers are looking for **services matching their needs and preferences**

Airlines adapted their model to let the passenger feel unique**. Now it is up to the airport to do the same in order** to ensure the loyalty of their clients

SEAMLESS EXPERIENCE

The airport and the travel experience are **a series of steps which are similar across the globe**

Passengers look to make these procedures as seamless as possible so that they **won't feel the disruptions on their way**

In addition, passengers' needs are changing under the global connectivity boost within the travelers' population: according to the airport IT provider SITA, 83% of passengers carry a smartphone today. This over-connectivity, caused the traveler to change his attitude during his travel, to look for a seamless travel journey and to ask for a personalized experience: in this competitive landscape, an airport must adapt his merchandizing strategy and propose the right service for the right passenger at the right moment. These three conditions should all meet in order to maximize the value created by a passenger.

PROCESS OPTIMIZATION AND COST REDUCTION

As mentioned before, airports are able to deliver high financial performances. However, privatization is occurring fast within the business, leading to private ownership of major airports requiring additional cost reductions and better financial margins than the public one. Airports have already deployed lean processes that showed encouraging results in the last two decades, but now the tremendous increase in the number of passengers to be processed has challenged the efficiency of such legacy processes inherited from lean management: the industry is no longer looking for big budget cuts or huge process redesign, but it is increasingly chasing every small improvement to be done throughout the passenger journey (i.e. automated security checks), the aircraft journey (i.e. industrialized apron processes), the baggage journey (i.e. automation, reliability, loss reduction), etc.

DIVERSIFICATION OF REVENUES

The industry understood early on the potential of the passenger dwell time inside the airport and how this time can be turned into a new source of revenue. Historically,

the only two sources of revenues for airports were the airport tax and the landing fee. However, knowing that the runway capacity is limited, and therefore it is for the terminal, the so-called aeronautical revenues are limited as well. Therefore, airport operators are turning, like airlines did years ago, towards ancillary services including VIP lounges, fast track lanes, Internet connection and other services.

Hence, by diversifying its business, the industry shifted from a B2B player (serving airlines and ground handlers) to a B2C one (serving directly the end-user). This change is crucial in terms of marketing and merchandizing, since delivering in a B2C mode requires the need to know the customer very well, his/her preferences and his/her profile. The new digital era penetrating the industry, gives the opportunity to know the customer and thus to propose an adequate service.

SECURITY AND CYBERSECURITY

For the last five years, the international geopolitical landscape has changed. The world witnessed an unprecedented rise of terrorist attacks, especially in Europe. Knowing that public places as congested as airports are a privileged target of such attacks (a major attack happened

recently in Brussels airport, also in Paris-Orly to a lesser extent), the security procedures are being tightened drastically both around and inside airports. This change in procedures has had a serious impact on passenger experience, on the waiting time at security checks and therefore on the dwell time in the duty-free area. Therefore, operators are facing a challenge of optimizing security for the staff and passengers, and keeping the airport journey as smooth as possible.

On the other hand, many airports are embracing the benefits of open data and technology. However, steering airport's solutions towards open APIs and their integration with external systems widens their exposure to an increased risk of cyberattacks. Noting that according to the IT provider SITA, less than 19% of airports are ready to face any kind of cyberthreats, there is a major challenge that the industry must overcome and the roadmap to achieve that is certainly at its starting blocks.

A DIGITAL ERA FOR A BETTER AIRPORT EXPERIENCE AND SMOOTHER OPERATIONS

The airport industry started its digitization process under the pulse of airlines. Indeed, in the mid-1980s, airlines and ground handlers wanted to share IT facilities across the airport in order to reduce the required investments when opening new routes (especially seasonal ones or charter flights). At the same time, new space and thus, new check-in agents in the airport premises, was becoming harder to find and very expensive for operators. Therefore, through common interest for airlines and airports, CUTE (Common Use Terminal Equipment) offered the opportunity to drastically reduce the space required to install check-in areas and to partition the investments in-between the airport and all the airlines using these desks. This massive CUTE deployment that carried on until the beginning of the 2000s is considered to be the first wave of the airport industry digitization.

This wave was then followed by the deployment of self-service check-in starting in 2003: a compact solution capable of replacing check-in agents and processing faster passenger check-in. This wave continues in a wide range of airports across the globe, especially in certain zones where the manpower cost is very high (Europe, US, Asia-Pacific). It is to be noted that by 2016, 91%[13] of the airports in the world were equipped with at least one self-check-in kiosk.

A third wave of digitization started to take place around 2010. It consisted of deploying self-service throughout the customer journey in the airport: for baggage deposit, border control and boarding. This generalization of self-service marked an important milestone for the passenger experience: travelers became the master of their own experience, being able to choose the moment to check-in, to pass through border control and to board. Mastering all the processes to be done on terminal side gave the passenger the possibility to better manage his/her own time, and in a certain way to extend his/her dwell time in the entertainment and duty-free area.

13. SITA

Finally, the fourth wave of digitization arrived earlier than expected, around 2012. This wave was supported by the over-performance achieved by tech giants like Google and Facebook who gave birth in the technology ecosphere to the concept of open data and big data. This last wave of digitization is still at its very beginning, and is carried by very few airports around the world.

DIGITAL MATURITY: A KEY CHARACTERISTIC OF AN AIRPORT

The four waves of digitization clearly distinguish airports according to their digital maturity. Why?

The analysis of the airport landscape, at first glance, lets us think that the IT&T penetration is closely correlated to the size of the airport. Yet this assumption is potentially irrelevant: when looking closer into the digital performance of different airports, we spot that the most innovative ones are in many cases small to medium airports, more agile than big ones or hubs. Also, when comparing two major hubs (i.e. Atlanta and Dubai), both the size and the platform complexity are almost the same but the digital deployment is not at the same level in both. This leads us to confirm that the airport segmentation, based on passenger traffic or freight volume, is not
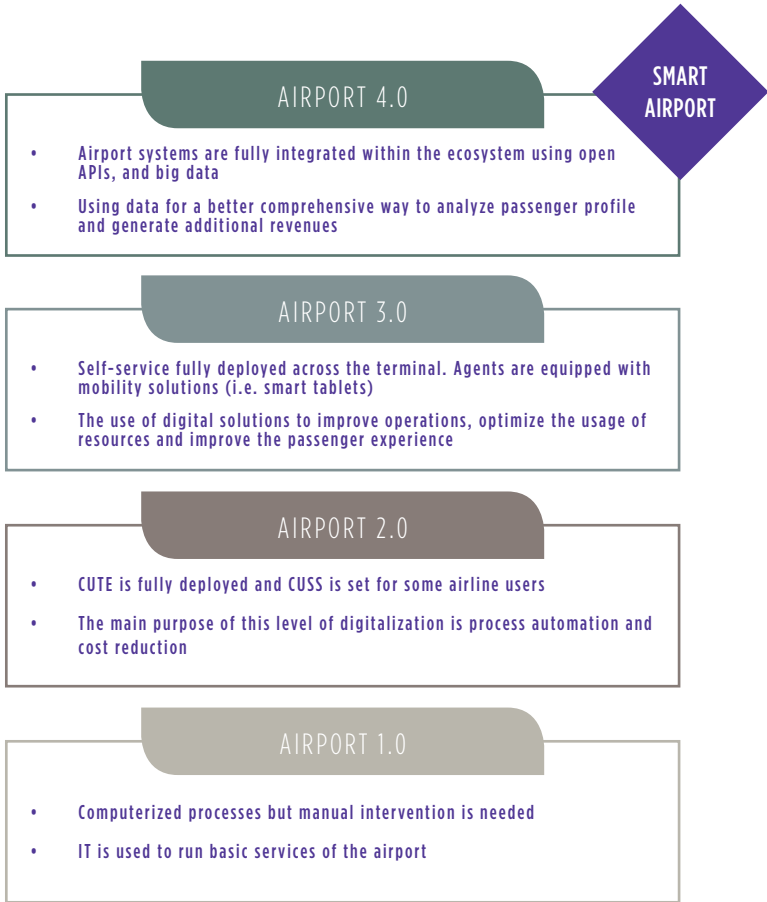
relevant to identify digital trends.

We should rather focus on "digital maturity", which represents the level of technology adoption within an airport. The four waves of digitzation led to the emergence of four types of airports:

/ **Airport 1.0**: the typical "traditional" airport where all processes are done manually. The IT penetration is limited to certain solutions such as CUTE or basic resources management solution. These types of airports normally run a B2B business without any service marketed directly to the passenger.

/ **Airport 2.0**: the main factor defining this type of airport is self-service and massive CUTE deployment. Airports 2.0 are adopters of partial self-service, limited just to check-in process and Wi-Fi technology being deployed in these airports.

/ **Airport 3.0**: self-service is deployed across the passenger journey at all levels. Operations management is automated and predictive and mobility solutions are largely used on terminal side and air side (particularly in apron areas).

/ **Airport 4.0**: the 4.0 airport leverages big data and open data to enhance its innovation. Operators try to create value out of data, by adapting processes to real-time passenger flow, anticipation and by knowing the customer profile better. This family of airports clearly sees its business shifting from B2B to B2C.
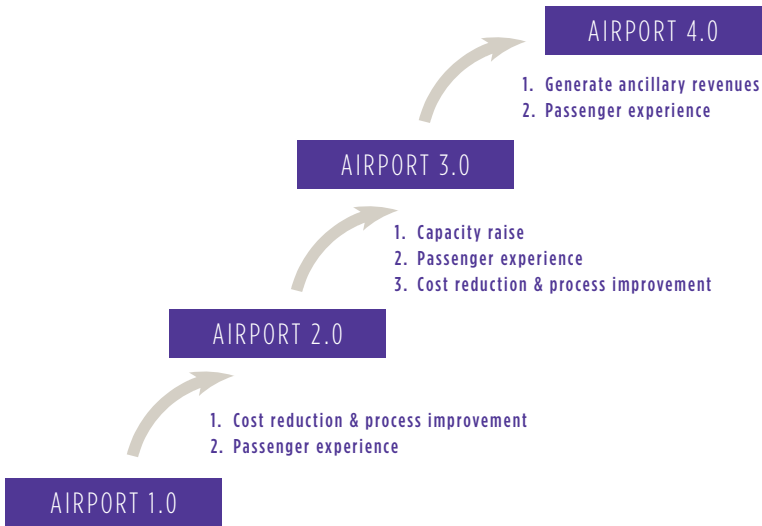
BUSINESS TYPE

B2C
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AIRPORT 4.0

SMART AIRPORT

- Airport systems are fully integrated within the ecosystem using open APIs, and big data
- Using data for a better comprehensive way to analyze passenger profile and generate additional revenues

AIRPORT 3.0

- Self-service fully deployed across the terminal. Agents are equipped with mobility solutions (i.e. smart tablets)
- The use of digital solutions to improve operations, optimize the usage of resources and improve the passenger experience

AIRPORT 2.0

- CUTE is fully deployed and CUSS is set for some airline users
- The main purpose of this level of digitalization is process automation and cost reduction

AIRPORT 1.0

- Computerized processes but manual intervention is needed
- IT is used to run basic services of the airport

B2B
++

The airport transition between the different digital maturity levels is driven by the challenges that the industry is facing. However, each challenge motivates the choice to go from one level to another differently. The transition operated from 1.0 to 2.0 digital grade is driven almost exclusively by the will to improve the processes and reduce cost, whereas starting 2.0 level, the main objective shifts onto the passenger: to generate additional revenues and improve the customer experience.

AIRPORT 4.0

1. Generate ancillary revenues
2. Passenger experience

AIRPORT 3.0

1. Capacity raise
2. Passenger experience
3. Cost reduction & process improvement

AIRPORT 2.0

1. Cost reduction & process improvement
2. Passenger experience

AIRPORT 1.0

THE TRENDS ARE QUITE SPECIFIC TO EACH REGION

The global trend of airport digitization seems to be very heterogeneous. Nevertheless, it is obvious that there are some regional trends that can be grouped into three main categories:

/ **The zone including Europe, Middle East and Asia-Pacific** is a very dense area in terms of air traffic. The airports of these three regions suffer from serious problems of congestion which lead them to push the digitization process to its limit by targeting the airport 4.0 model. In the f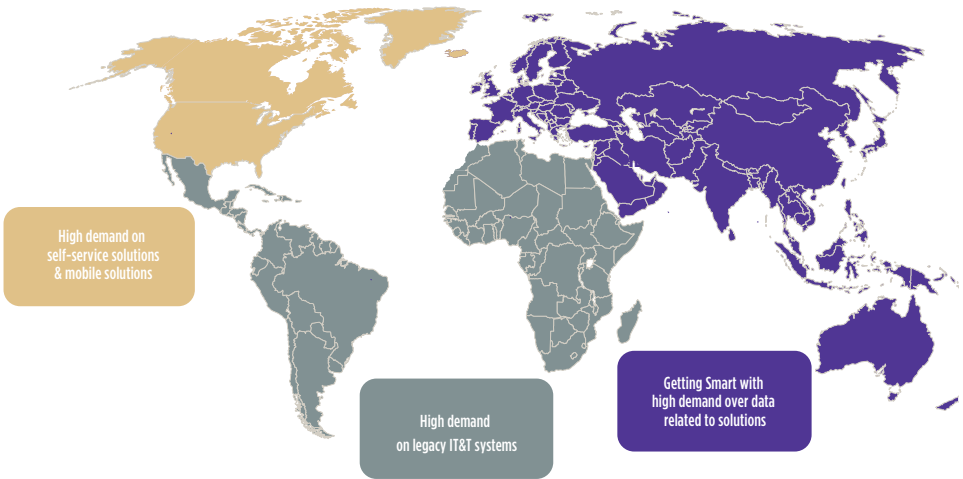uture, we will be seeing a rise in the number of airports which are digitally advanced, running important transformation programs based on data analysis, mobile technology and open innovation.

/ **North America**, a specific region where airports (and airlines) seem to struggle to impose a digital disruption in their industry. It might be linked to the American passengers' state of mind for whom the travel is still considered as just a way of transport and not as an experience. Regional airports, which are for the most considered to be at 2.0 level, will be potentially migrating to level 3.0 by deploying largely self-service at security checks and

boarding and by equipping their ground handling teams with mobility solutions capable of enhancing quality, customer service and ground operations.

/ **South America and Africa**, two regions where the digital penetration

in the airport industry is for the time very low. These airports are running with overcapacity, but the air travel potential of these two continents is very high, that is why the demand for legacy IT systems like CUTE, CUPPS and CUSS is expected to explode in these continents.

High demand on
self-service solutions
& mobile solutions

High demand
on legacy IT&T systems

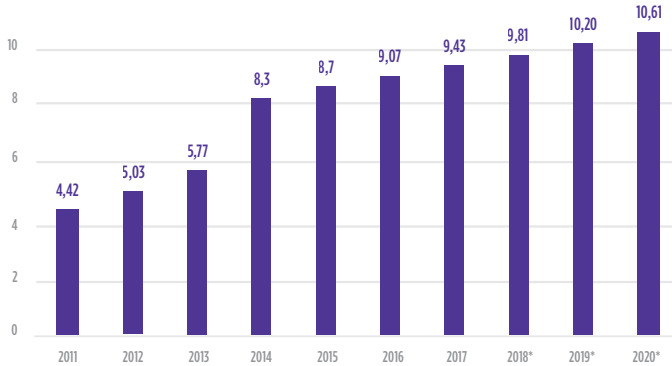Getting Smart with
high demand over data
related to solutions

GLOBAL DIGITAL TRENDS WITHIN THE INDUSTRY

The airport IT&T industry achieved growth seven years in a row since 2011 and achieved double-digit growth each year between 2011 and 2014.

Total airport IT&T build and run expenses (in $billions)
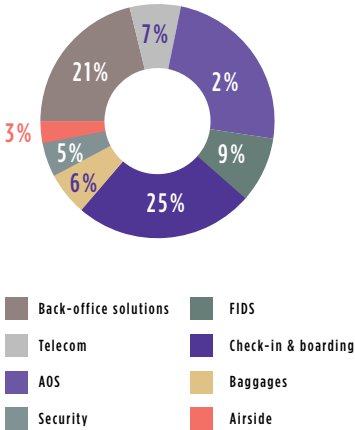
Source: Estimation based on SITA communications

The major growth of the market was recorded in 2014 with an increase of 43%[14], due mainly to a high number of greenfield airport constructions achieved by 2014 and the generalization of the self-service technology, known to be very expensive (hardware & software). This growth is expected to persist with a cumulative annual rate of 4% until 2020, at least. This increase in the total IT&T expenses is accompanied with an increasing IT&T budget allocated by airport operators: IT&T average budget went up from 4% of the average airport turnover in 2011 to 5.7% in 2016.

14. According to figures communicated by InfraDeals

THE MAJOR INVESTMENTS STILL GO TO AIRPORT OPERATION SYSTEMS AND CHECK-IN SOLUTIONS

New technologies like digital solutions for staff mobility and new services still account for a very small amount of the industry's market volume. Until present, the Airport Operation Systems (AOS), including RMS (Resources Management Solution), AODB (Airport Operation Database) and check-in solutions counted for more than 40% of the global IT&T spending.

IT&T expenses distribution

- Back-office solutions
- Telecom
- AOS
- Security
- FIDS
- Check-in & boarding
- Baggages
- Airside

Source: Amadeus, SITA, Wavestone analysis

As shown by our estimation of the market value and distribution, the investments in security systems are still low (around 5% of the total IT&T investments). This is driven primarily by IATA and ICAO restrictions and airport standards. However, according to SITA, 2016 was an important milestone for the fast change happening in the security field: more than 50% of the surveyed airports pointed out that security is in the top 3 priorities for the coming years.

Across this IT&T panorama, cybersecurity is achieving an exceptional growth of 9.9%[15] per year with USD 2.4 billion of airline and airport cybersecurity market (out of which 31% is directly related to the airport IT industry), knowing that the legal framework is extremely propitious for a stable growth of the sector for the five to ten years to come.

START-UPS: A SERIOUS CONCERN FOR HISTORICAL PLAYERS OF THE IT&T INDUSTRY

Historically known for its airport IT solutions, SITA is still the leader of the market, controlling almost 25% of global IT&T deliveries (SITA's market share accounts for four times the one of the second market player ARINC). The airport IT segment is also held by smaller players like RESA, offering a large portfolio of specific airport products.

But these airport IT specialists are facing the arrival of new actors on this increasingly attractive market:

/ **IT integrators**: these players have been active in the industry for a while and are reinforcing their positions by having an innovative brand powered by a large international presence. A few samples of these actors are the Spanish IKUSI or INDRA, the American UNISYS or the German T-SYSTEMS (better known as a telecommunication specialist).

15. According to Gartner

/   **Airline IT editors**: this is the major risk of airport IT pure players. Groups like AMADEUS or SABRE evolve in a similar airport environment so they know the ecosystem very well. They have important connections within the industry (airlines, ground handlers or airports) letting them easily enter the market. They also have very important investment capabilities due to a very strong financial performance (these actors are still recording double-digit growth year after year).

/   **Start-ups and small companies**: two characteristics define these new competitors, innovation and agility. Their very small structure and organization allows them to propose disruptive solutions for airports of type 3.0 and 4.0. Their agile deliveries are something particularly requested by airports when it comes to new technologies inducing a great level of uncertainty (i.e. uncertain business model, uncertain need, uncertain technical feasibility, etc.). These new players are mainly specialists of certain cutting-edge technologies, for example Vision-Box for security solutions, Foxstream for intelligent video surveillance, BLIP Systems for indoor geo-localization and Pacifa Decision for 3D modelling and flow management.

THE GLOBAL PREDICTIVE AND SMOOTH AIRPORT OPERATIONS

The rise of airport management complexity due to the democratization of air travel (as shown before, causing the tremendous increase in the number of transported passengers) and the arrival on the market of a large number of airlines and ground handlers, have put the airports in face of complex procedures to perform, very important number of assets and resources to manage and increasing risk sources to control, where cases of travel disruption have increased significantly.

To counter these newly appearing issues, and to optimize the usage of the airport assets (i.e. apron occupation, check-in desks attribution, etc.), airport operators are no longer looking for a legacy solution capable of managing resources on a day-to-day basis, but more for real-time and predictive solutions capable of adjusting the operational performance according to the actual and predictive needs.

/ **Predictive operations**: particularly important for "seasonal airports" where the passenger and flight numbers are tightly linked to seasonal fluctuation (e.g. the activity of Parisian airports is considerably higher for summer holidays than for random days in the year, the activity of certain airports like the one in Mauritius is concentrated around the western seasonal breaks, etc.). Airports have to be able to predict the operational needs based on the number of scheduled flights, and the flight occupation status as well. This operational visibility allows the airport to adapt its human and physical resources to be as close as possible to the peaks of demand.

/ **Real-time operations and centralized steering**: predictive operations are not sufficient to run an airport nowadays. Disruption risks are very high (i.e. terrorist attacks, weather uncertainty, etc.), so the operators are forced to have a real-time status of all the actions done around the platform, to share this status with all the involved stakeholders in order to adjust operations and guarantee quality and safety.

The outcome of the study confirms that the so-called "operations IT" including RMS (Resources Management System), AODB (Airport Operational Database) and FIDS (Flight Information Display System), are well consolidated directly by software editors like RESA (France) and SITA (Switzerland). The benchmark validates the fact that relational proximity between the airport and the editor is well appreciated by the airports for several reasons:

/ Unlike local or international integrators, editors are capable of providing all levels of support on site or offshore, whereas integrators provide support only at level three or the second level at their best.

/ Editors have greater expertise in the solution that they designed and implemented.

/ When dealing directly with the software editor, sometimes airports benefit from some "community evolutions" of the solution where the costs are shared by all members of the community (SITA and AMADEUS models, for example).

/ These systems are considered as "critical" for the industry. Having direct support from the editors is an important criteria very well appreciated by the questioned airports.

MOST OF THE AIRPORTS PREFER MARKET SOLUTIONS OVER IN-HOUSE DEVELOPMENT

At the beginning of the first wave of airport digitzation in the 1990s, many airport operators chose to develop, in house, their own "operations IT" solutions. This was the case for major airports such as Groupe ADP and Fraport. With the fast evolution of these solutions, "in-house" adopters faced a continuous rise in the IT&T cost, whereas sharing platforms like SITA and AMADEUS continued to propose very competitive solutions in terms of cost, technology and innovation.

Almost 100% of questioned airports have their IT operation systems provided by a third party, and in the future this trend doesn't seem to get reversed.

COLLABORATIVE DECISION MAKING (A-CDM) AND THE TARGET OF SHARING INFORMATION

Initiated by the intergovernmental organization EUROCONTROL, A-CDM intends to share information between all the stakeholders of the airport (i.e. operator, ground handlers, ATC, airlines, and external stakeholders like weather condition providers, etc.). This initiative makes every supplier serving at the airport an actor of the decision made across the platform.

The benchmark confirms that A-CDM is more adapted for 3.0 and 4.0 airports where digital maturity is high enough to deploy such a tool for all of the stakeholders. Historically, this solution registered high demand in Europe (it was even conceived for the European air traffic zone), but the study clearly shows a certain interest in the subject in airports located in the Middle East and Asia. These regions will record an important demand for this solution in the next few years.

A-CDM benefits

EXCHANGING DATA

- Airport configuration and resources
- Arriving & departing flights information
- Planned activities and events
- Network constraints
- Weather forecasts

PLANNING IN ADVANCE

- Adapting demand to capacity
- Adapting slots to flight plans
- Adapting infrastructure to predictable flows
- Adapting resources to predictable abnormal situations

SHARING
ANTICIPATING
OPTIMIZING
UPTADING

**Aircraft Operators
Airports
Ground Handlers
Air Navigation Service
Providers**

UPDATING DATA

- Updating the AOP/NOP with the latest data received
- Arriving & departing flights information
- Planned activities and events
- Network constraints

REDUCING COSTS AND IMPACT ON ENVIRONMENT

- Optimizing aircraft turn-arounds and departure & arrival processes
- Reducing delays

| BETTER AND ACCURATE INFORMATION | RIGHT DECISIONS AT THE RIGHT TIME | SAFER ENVIRONMENT | IMPROVED TRAFFIC AND USE OF INFRASTRUCTURES | AIRPORT EFFICIENCY AND PERFORMANCE |

TOWARDS THE LIMIT
OF SELF-SERVICE

The first self-service check-in kiosk appeared around the beginning of the 2000s. At the time, it was considered as a revolution for passenger experience. The technology provided major improvements for the delay spent checking-in, and important cost reduction opportunities, especially in countries where the labor cost is high.

But the labor cost is not the only driver to implement such a solution. The nature of the traffic is fundamental: airports having an increasing number of low-cost airlines are facing high pressure to implement automatic check-in solutions. The profitability of low-cost airlines is indeed directly linked to the ground handling costs, in particular the check-in cost.

ONLINE AND MOBILE CHECK-IN IS A MAJOR THREAT FOR KIOSK SOLUTIONS

The rise of low-cost carriers who limit the number of checked luggage by making it an ancillary paying service, has pushed travelers to deeply change their behavior. The number of passengers carrying checked luggage on medium or short haul flights is getting too low: the average length of vacation is being shortened, especially for young travelers who prefer short breaks over long holidays.

This change in traveler behavior has limited the actions to be done at

COST OF LOCAL LABOR

For countries with a high cost of labor, the demand of these solutions is much important

AIR TRAFFIC TYPE

Airports receiving low-cost carriers have a higher demand over automated solutions

the airport to passenger check-in and possibly on-board seat changes or other option changes. However, the mobile and online technologies have made it possible to perform all operations from reservation to on-board service purchase. This technological improvement, associated to the traveler behavior change, has made the usage of in-terminal automated check-in kiosks very limited.

Knowing that the funding of these assets is based on a model of "per checked-in passenger fee", the business model of the airport is being directly and negatively impacted. Some airports, especially in South East Asia where passengers are "over-connected", decided to stop investing in check-in kiosks (the average cost of a single kiosk is €20,000 to €30,000) and instead, to invest in mobile check-in technology, but here they face another issue: the use of the airport website and mobile solutions is too low in comparison to the ones provided by the airlines.

AUTOMATION IS SHIFTING TOWARDS QUALITY INSTEAD OF PASSENGER SERVICE

Although it is not generalized yet, automating passenger service is showing its limit. Major tourist airports (like in Mauritius) and major hubs (like Singapore-Changi) are

going back to manual services where the human impact and added value is largely pointed out by passengers of all kinds (business, tourists, technophiles, etc.). This human-based customer service is perhaps making these airports appear in the top performing airports in terms of passenger satisfaction, but it is not challenging, in any case, the fact that digital technologies are essential for the airport operations management and efficiency. The key is likely to be able to mix self-service equipment for basic operations and human presence for added value services.

For that, the use of technology is shifting towards the quality of operations. The benchmark confirms a trend of leveraging technology to increase accuracy, especially in complex and major hubs where luggage and cargo management is critical to match particular conditions of a large number of flights and in some cases very short connection time. In this domain, solutions like Baggage Reconciliation System (BRS) are driven by both an improved accuracy, a considerable reduction in luggage loss and most important, the IATA resolution 753 making BRS mandatory for all IATA airlines by 2018. Airports are complying with these constraints by massively deploying scanning and reconciliation solutions, but still small airports processing less than 1 million passengers seem to be late regarding this issue.
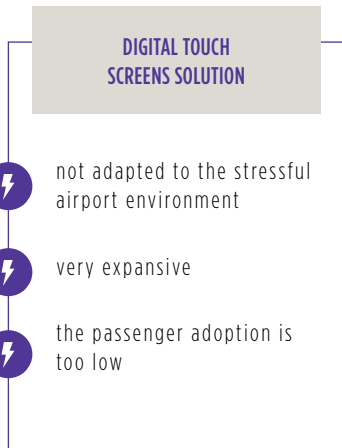
THE AIRPORT PASSENGER EXPERIENCE: A MAJOR CHALLENGE

Beginning in 2010, a new concept emerged in the air travel industry: airport experience. The airport terminal is no longer a place only intended to process check-in, luggage and to go through security checks, but it is more a day-to-day living space where passengers or visiting people can shop, visit and be entertained.

In order to answer this new form of "augmented travel" better, airports multiplied entertainment corners and shopping areas in the terminal. The resulting complexity of the airport design induced a lot of new passenger needs like indoor guidance, CRM, e-marketing, etc.

INDOOR GUIDANCE: FROM DIGITAL SIGNAGE, TO INTERACTIVE SCREENS, TO MOBILE POWERED NAVIGATION

Major hubs benchmarked in the scope of this study have deployed indoor interactive screens allowing passengers to find points of interests, access to flight schedules and in certain cases to connect to remote customer service (e.g. Munich airport deployed their famous Infogate, capable of merging between information technology and human assistance). This mix of digital solutions and personalized service seems to suit the needs of the clients much better. Airports that have already deployed "digital only" interactive screens, are facing the reluctance of the passengers where these solutions are impersonal, having some technical limitation (in particular for their "touch" capabilities) and not adapted to the passengers need in such a critical place as airports: passengers are often stressed in the terminal and at duty-free and when they need assistance they prefer a human-based one over purely digital solutions. The "phygital" solutions are more adequate to the airport environment, they can definitely have a better technology usage factor.

DIGITAL TOUCH SCREENS SOLUTION	DIGITAL TOUCH SCREENS SOLUTIONS ASSOCIATED TO A REMOTE ASSISTANCE
⚡ not adapted to the stressful airport environment	⚡ very expansive
⚡ very expansive	☀ mixing digital solution with human virtual presence
⚡ the passenger adoption is too low	☀ more personalized
	☀ achieving better usage factor

As for the indoor mobile assisted navigation, the projects seem to be at their very beginning and at PoC stage (less than 20% of the benchmarked airports have already implemented indoor mobile localization or plan to implement it). Partially, this is due to the inaccuracy of the Wi-Fi technology that has been used until now as a primary technology. This technic shows serious limitations inside complex infrastructures like airports, but some PoCs who are merging it with Bluetooth or IoT solutions are showing promising results.

Another important point to mention is the user experience of indoor mobile-based guidance applications. The particular context of the passenger going through the terminal induces very limited time lapses where the passenger is able to manipulate his mobile phone. For instance, at the check-in and security areas, that account for as much as 36%[16] of the time spent at the airport, the ability or the willingness of the passenger to check his phone for guidance is extremely limited.

Then come the other moments of the experience where the passenger proceeds with his own discretionary activities. These periods are divided in two parts: the first one between the check-in and security checks, and the second one between the customs and boarding. As for the first one, the stress of the passenger is at his highest level and the

15. According to a research by Kirk (2013)

passenger won't use his mobile since he knows he is going to have to give it in to be checked at security. Therefore, the only phase where the potential of using the mobile phone for a long period is high, is actually between the customs and boarding. But here, another factor appears, the complexity or the simplicity of the dwell-time zone:

/ In many cases, the duty-free area is a straight zone where the need for indoor guidance is very limited. The duty-free at Dubai airport is a perfect example to illustrate that, the architectural design is so straight that the passenger will probably use the conventional signage over mobile-based guidance.

/ In other cases, the terminal design is more complex, including circular, straight and cross levels areas. In those particular cases, the passenger adoption of mobile-based indoor navigation can be effective and high.

The development of new mobile personal solutions such as connected watches, digital glasses and other wearables, will have a positive impact on the technology adoption by the passengers. Without any doubt, airports should start preparing the post smartphone era. PoCs in this futuristic domain are still at a very early age: they are oriented for operational use but not for passenger experience. For

example, the airports in Frankfurt and Copenhagen are testing some use cases applied to these hardwares in the maintenance and repair activities.

CRM AND E-MARKETING TO BETTER REACH THE PASSENGER

As stated before, the improving digital maturity of an airport leads it to change from a business-to-business model to a business-to-customer model. This migration immensely changes the way airports approach passenger needs.

In a B2B configuration, the airport is not looking to serve the end user: therefore, knowing the passenger, their profile and their needs is not of great importance. But when it comes to serving the customer directly, airports should look to know the passenger very well, at least as much as the airline does. To ensure that is the case, airports have tried many times to obtain passenger data (for instance through the PNR, Passenger Name Record) from airlines, but these were always opposing this requirement. Facing this reluctance, airports decided to launch their own CRM and loyalty programs.

/ It is clear that the CRM penetration within the industry is still low and mainly concerns airports of 3.0 and 4.0 digital maturity (for example, Paris, Frankfurt, Dubai,

Singapore-Changi and Seoul-Incheon). Thanks to new services directly provided by the airport to the passengers (e.g. Internet parking booking, a mobile app, loyalty program), these airports acquire passenger data, increase their customer knowledge and develop personalized e-merchandizing through personal messaging or notifications sent via IoT or i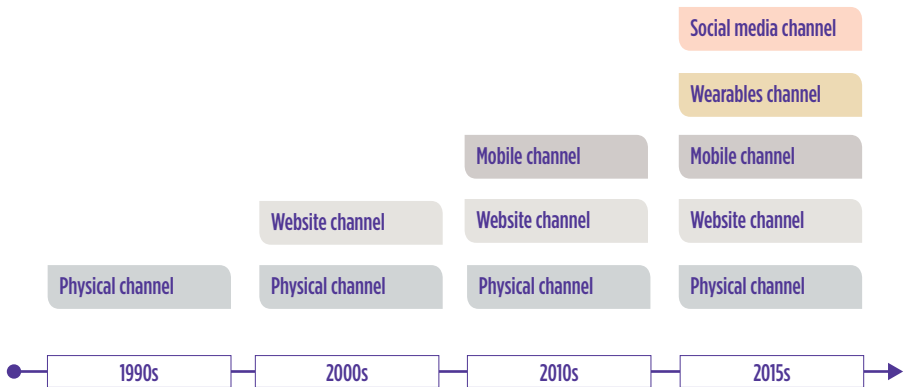-Beacons infrastructures. The fact that the passenger is now better known by the airport operator offers new opportunities to generate additional revenues, either through targeted marketing with higher added value than the conventional one, or by selling passenger data (in accordance with local and international rules) to third parties interested in such kind of data (retailers, advertisers, etc.). Data use is key and still needs to be developed by airports.

THE OMNICHANNEL CUSTOMER EXPERIENCE

The evolution of the traveler's modes of consumption has led the airports to readapt their conventional channels of interaction with the passenger. Nowadays, a traveler is a big consumer of data, he/she is over-connected via smartphones and is always ready to change his/her channel of interaction with the airport.

The mobile device, for instance, is the second most used channel after the website for retrieving flight information, or buying additional services. Therefore today, and to keep their market share in terms of services sold in terminal or outside (parking slots, taxi service, etc.), airports should multiply the channels that lead to the customer.

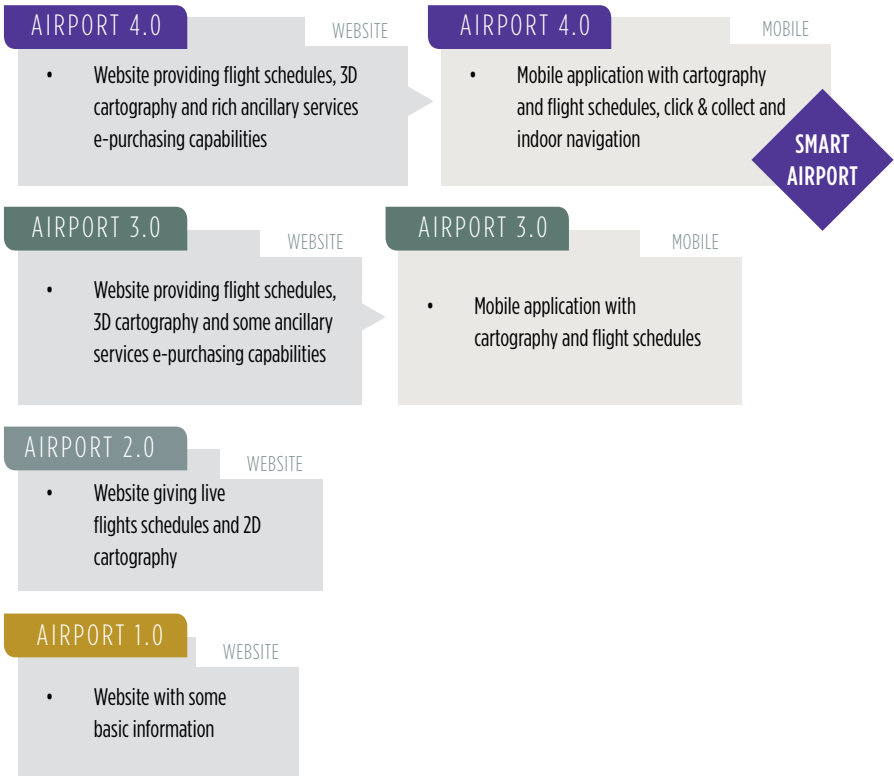|			Social media channel
			Wearables channel
		Mobile channel	Mobile channel
	Website channel	Website channel	Website channel
Physical channel	Physical channel	Physical channel	Physical channel
1990s	**2000s**	**2010s**	**2015s**

SMARTPHONES ARE THE BACKBONE OF THE PASSENGER EXPERIENCE

Airports that understood the importance of the mobile channel in the passenger experience and started to implement a mobile application are generally the bigger and digitally mature ones. Indeed, the performance of these mobile applications depends on the digital maturity level of the airport.

The level of digital maturity of the airport characterizes the functionalities provided, whether by the phone application or the website as shown in the following diagram:

AIRPORT 4.0   WEBSITE
- Website providing flight schedules, 3D cartography and rich ancillary services e-purchasing capabilities

AIRPORT 4.0   MOBILE
- Mobile application with cartography and flight schedules, click & collect and indoor navigation

SMART AIRPORT

AIRPORT 3.0   WEBSITE
- Website providing flight schedules, 3D cartography and some ancillary services e-purchasing capabilities

AIRPORT 3.0   MOBILE
- Mobile application with cartography and flight schedules

AIRPORT 2.0   WEBSITE
- Website giving live flights schedules and 2D cartography

AIRPORT 1.0   WEBSITE
- Website with some basic information

As shown in the graph above, the transformation of customer service and care has been accelerating since 2010. Before this critical year, the momentum of new transformations within the airport and travel industries on a wider scale was around 10 years. Starting in 2010 (and the democratization of mobile and other cutting-edge technologies since 2007) the landscape of customer experience has deeply changed.

Innovation was since generalized to all industries, either service or product ones (banks, airlines, insurance companies, retail, etc.), and the number of customer touchpoints has become "limitless": mobile app, wearables app, chatbots through social media, personalized emailing, e-chat etc.

Airports should follow this trend and frequently provide new innovative touchpoints in order to maintain their capacity to be the main source of information for the passengers, at least during the final three days before departure and at best during the entire travel experience. Airlines have the capabilities and most importantly they have the will, to do that. A great example of an airport leveraging technologies to the maximum is Frankfurt: some months ago, it launched a new chatbot application to serve passengers in collaboration with a start-up.

THE REAL CHALLENGE IS NOT TO PROVIDE MULTIPLE CHANNELS, BUT TO MAKE THE EXPERIENCE SEAMLESS WHEN SHIFTING FROM ONE CHANNEL TO ANOTHER

Indeed, providing a new technology or a new channel of customer service is important to show the digital maturity of the airport and improve its client perception. But the most important thing is to provide certain continuity between every tool: it is not of a tremendous use, to provide a functionality or a computerized process that you can perform through the airport website, and that you cannot follow-up or modify later on during the journey. The passenger should be able to switch from one channel to another without disrupting his/her process.

The principles of a successful omnichannel experience

1	**Multi-device & multi-channel**	• Devices' technology is moving very fast: digitally mature airports should innovate permanently and look for what's next. • Airports should not focus on airport application only: they should look for new channels in order to reduce the risks of losing passenger's connectivity and access.
2	**Functional**	• Passengers are now looking for interactive interfaces and are not interested anymore in "passive" applications where they can only find and read information. • They are willing to interact with every interface, perform processes, purchase products and services across all channels.
3	**Seamless**	• Any process or functionality proposed via an interface should be accessible from any device and any platform. There is nothing more frustrating than an ancillary service bought on the Internet and not accessible for modification on a smartphone. • Along the travel experience, the passenger is invited to use multiple devices and interfaces: the website through his desktop, the application through his mobile phone, another application through the tablet available at some corners of the terminal... these "digital jumps" should be as seamless as possible.

This new approach of passengers' services was long awaited by the airport business departments. However, the digital and IT departments inherit major challenges to manage in this complex and multi-platform environment:

/ **The system architecture should be done to support the evolution towards new platforms and devices**. The legacy one is extremely costly to adapt and integrate whenever a new channel has to be implemented

/ **Platform alignment**: having unsynchronized processes through all the devices and channels is a major risk induced by the omnichannel experience. Any small change applied to a channel should be assessed for all the other channels.

MOBILITY SOLUTIONS FOR AN ACCURATE AND SECURED TERMINAL OR AIRSIDE OPERATIONS

Mobility technologies did not only change the user and passenger habits, but also the way ground agents achieve their day-to-day work. Certainly, digital solutions provide more accuracy in the operations by providing live and up-to-date data and more possible actions to achieve by bringing the working tool to every corner of the airport. According to IT provider SITA, 47% of the airports worldwide plan to equip their staff with mobile phone or tablets over the next 2 to 3 years.

Used to exchange operational data (up & down) or interact with customers, these mobility solutions are productivity tools which are mainly present on terminal side around the check-in and security areas, in baggage handling activities and at air side around the aircraft. The aim is not the same for all these areas:

/ **Mobile solutions on terminal side are used to provide accurate assistance, especially in disruption cases.** Nevertheless, these solutions

are getting some enriched content allowing the ground agents to propose and sell ancillary services across the terminal. The level of penetration of these solutions is still low: across the benchmarked airports, Paris Airport seems to be the most mature regarding this technology through their in-house developed solution Vasco (which is developed in partnership with a start-up).

/ **Mobile solutions at baggage handling and apron side**: in this case the aim of such tools is to improve the efficiency and the quality of the operations. The benchmark shows that mobility solutions in these "technical" areas have a penetration level higher than in terminal. This is due to the will of airports to ensure a safer air side environment through precise mobile assets and objects traceability.

The benchmark was not able to identify a trend regarding in-terminal mobility solutions. The characteristics of airports planning to deploy these solutions are so

disparate. Indeed, they have at least a 3.0+ digital maturity level before adapting these mobile devices. But it identified a clear trend for operational mobile solutions at apron and air side: the adoption of tablets in these areas seems to be directly correlated on the one hand, to the number of passengers processed annually at the airport and on the other the number of assets.
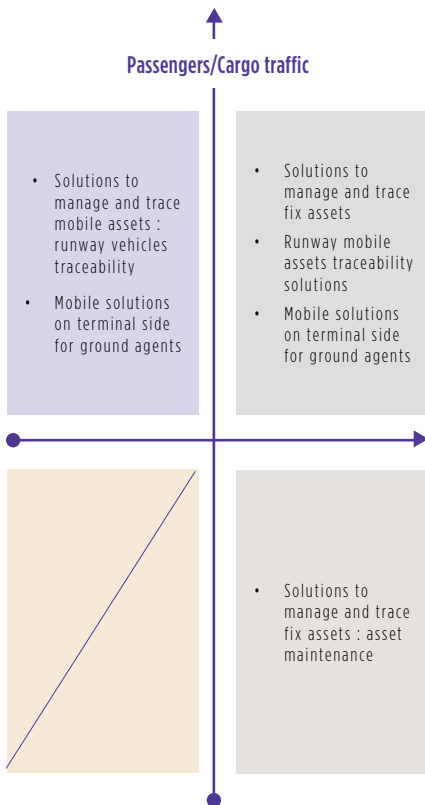
THE GRADUAL REPLACEMENT OF PERSONAL DIGITAL ASSISTANTS (PDA)

The analyzed airports show that the demand over the legacy personal digital assistants is still high, especially for operational agents. These devices ensure robustness, a very good price-quality ratio and they require light data infrastructure. PDAs are still the main device used in technical areas of the airport, for example in baggage handling and apron activities. But the problem of this solution is that it is esthetically not suitable for passenger-facing processes.

For these customer-facing activities, airports have chosen lighter solutions such as tablets or smartphones. However, the actual issue of the airport technology department is to offer a combined solution capable of answering the requirement of customer-facing businesses and a tough operational environment. That is why the market is witnessing the advent of reinforced heavy tablets inspired by a mix of tablet flexibility and PDA robustness. The only remaining issue that is slowing down the market adoption of this technology is the price: for now, a heavy tablet is a lot more expensive than the PDA and is priced on average up to double the price of common tablets.

Passengers/Cargo traffic

- Solutions to manage and trace mobile assets : runway vehicles traceability
- Mobile solutions on terminal side for ground agents

- Solutions to manage and trace fix assets
- Runway mobile assets traceability solutions
- Mobile solutions on terminal side for ground agents

Airport complexity and air side assets number

- Solutions to manage and trace fix assets : asset maintenance

NETWORK, CONNECTIVITY AND THE CLOUD ARE THE BACKBONE OF AIRPORT DIGITIZATION

Any business or customer oriented IT solution requires an efficient network to support its performance and evolution. Telecommunications and networks are the backbones of the airport IT. To ensure the level of quality, many airports developed, in the past, their own local networks either for phone calling functions or internet connectivity, and they were acting as a monopoly actor distributing access to the network to different airlines, ground handlers and other travel actors. However, things are changing, this local network is being opened to competition and we are seeing the arrival of new telecommunication low-costs on the market.

This new competition is definitely impacting historical actors (like HubOne[17] for Parisian airports and Deutsche Telekom for the Frankfurt airport), but it is pushing innovation to its boundaries. telecommunication operators are largely investing in new technologies like IoT networks and professional 4G/LTE in order to keep their market share, by proposing high-end offers (more data, faster and more secured).

4G IS MAKING ITS ENTRANCE TO THE PROFESSIONAL WORLD

Professional Wi-Fi and Tetra Solutions are still very common in the airport industry (100% of questioned airports are still using these technologies), but many airports are running tests on 4G with some promising results in some of the most complex airports (e.g. positive results in terms of coverage and data capacity were reached in the scope of the tests ran by HubOne in CDG airport).

Starting in 2018, 4G technology should make a large appearance in the airport industry, which will have a positive impact on leveraging innovation and IT.

17. HubOne is a subsidiary of Groupe ADP, specialized in telecommunications

Mutualisation of infrastructure and cost reduction

Optimisation of apron operations by having a higher bandwidth

Higher capacity of data exchange
(more adapted for airports of digital type 3.0 and 4.0)

PUBLIC WI-FI IS WIDELY AVAILABLE AND IT MUST BE FOR FREE, TO SUPPORT THE DEVELOPMENT OF NEW PASSENGER-ORIENTED APPLICATIONS

Public Wi-Fi is available in all benchmarked airports. Providing an Internet access for passengers and visitors is no longer an option during the travel lifetime. Airports' Wi-Fi connection landscape is quite similar to the public hotspot accesses available in common places like malls, but the cybersecurity concerns are much higher because the network access is used for operational solutions and activities. That is why airports adopted the dual Wi-Fi networks where the professional channel is completely separated from the public one.

As for the commercial offering, major airports with a high level of digital maturity (3.0 & 4.0) go for a free Wi-Fi model. This free access is used by the airport as a base to develop new ancillary services (e-shop through mobile applications, indoor localization and notifications push, etc.) with higher added value than making the passenger pay for the Internet connection. However, some of the airports are opting for a mixed model of free and paid access, where the offering is dependent on the usage time and/or the data volume and/or the bandwidth.

The Wi-Fi is generalized to all airports studied in the scope of the benchmark, but the business model differs from an airport to another

Free Wi-Fi funded by advertisement

[This model is specific to the digitally mature airports]

Mixed Wi-Fi models based on the access time to the internet

"Freemium" funded by the advertisement and a premium paid offering

[The premium level is either modulated based on the bandwidth or the amount of data allowed]

INTERNET OF THINGS

Like other industries, IoT has not yet found its use cases within the airport industry. Very few airports with a very high digital maturity (e.g. Dubai and Copenhagen) are testing some use cases of these connected objects. These use cases can be grouped in three streams of usage:

/ **Environment quality**: IoT is used to deliver remote environmental data like temperature, humidity, noise etc.

/ **Safety**: some PoCs are implemented to test the feasibility of remote safety checks using IoT (ex: intrusion detection, door lock check etc.)

/ **Asset management**: some PoCs are applied in certain airports to assess the potential of IoT in the field of predictive maintenance (e.g. machine's vibration level monitoring, heat level monitoring etc.).

Today, the main problem facing a massive deployment of IoT is notably its maintenance: the limited battery lifetime of these devices and their difficult accessibility in certain cases, would generate considerable maintenance cost. This additional cost is making the ROI of these devices very low, at present. Perhaps, the emergence of newer battery technologies and the technology mastering improvement will have a serious push to the IoT in the complex airport environment.

## THE AIRPORT INDUSTRY IS GOING TO THE CLOUD

Historically very reluctant to the offsite data housing, airports are reassessing their strategies regarding outsourcing data centers. Space is becoming very limited on the premises and operators prefer to use these areas as rental or retail zones, financially more interesting than a data center.

Around 45% of airports have a plan to develop their cloud connectivity, to migrate their applications, starting indeed by non-critical applications (e.g. back office applications).

Recently, Frankfurt airport decided, for instance, to outsource all its onsite data center to T-systems. This kind of move is a clear sign that airports want to redirect the effort of their technology teams from legacy IT issues to innovation solutions and more added value activities.

Another example of such a trend is the partnership between Copenhagen airport and Amadeus, which aims to deliver all operational systems through the Amadeus cloud (RMS, A-CDM, AODB, BRS etc.). This "cloudification" of the airport IT&T is a reality, but it could in some cases face some political and national security constraints, as airports are considered as vital and strategic national assets.

Airport maturity in terms of cloud and offsite hosting

Test or no plan — 55%

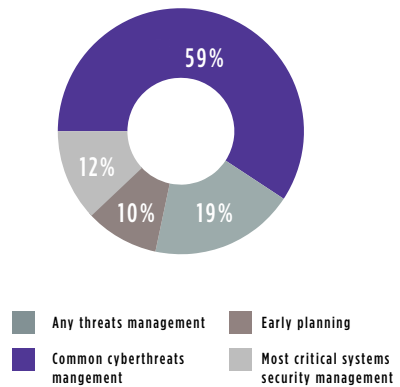Major migration programs — 45%
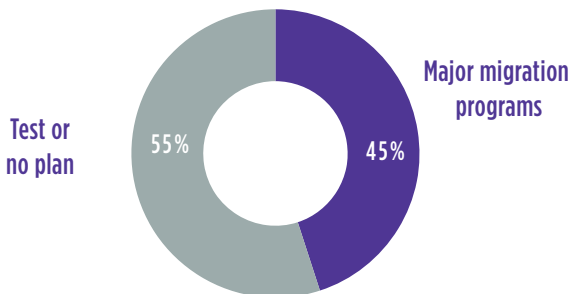
Source: SITA

HOW ARE AIRPORTS DEALING WITH GLOBAL CYBERSECURITY ISSUES?

The IT&T landscape is mutating rapidly. Data exchanges are becoming bigger and bigger with new solutions deployed like CRM, loyalty programs, mobile devices, facial recognition, etc. The airports tend to open and share the accessibility of their systems, including critical systems like Airport Operation System (AOS) and Flight Information Display System (FIDS). And finally, the airports are planning to migrate to the cloud in the next 5 to 10 years.

In 2016, 55% of airports had fully developed an operational cybersecurity plan and only 19% were prepared to deal with any threats.

Major airports now address this strategic issue by putting in place dedicated, but still under-sized, teams (due to the lack of available skilled manpower).

Airport cyber security status

- 59%
- 19%
- 10%
- 12%

Legend:
- Any threats management
- Common cyberthreats mangement
- Early planning
- Most critical systems security management

Source: SITA

TWO CRITICAL CYBERSECURITY KNOW-HOWS TO DEVELOP

Before the emergence of open data and big data, airport systems were not commonly targeted with cyberattacks since the systems were independent, isolated and not accessible by third parties. At present, giving access to the airport systems through dedicated APIs, in order to empower innovation and development, multiplies the risk of cyberattacks.

Despite there being few small airports (of less than 1 million passenger/year) which have a serious lack of cybersecurity expertise and solutions, major airports, which are digitally advanced, have a good knowledge and expertise in this field. However globally, the industry will develop an important need in the few coming years for two areas:

/ **Cyberattack detection centers**: the number of attacks will, without a doubt, increase within the industry, carried on by the global terrorist threat. To counter this, airports will have two options: either to develop internally the required expertise or to choose outsourcing. The second option is more likely to happen, since the shortage of adapted profiles for such a domain is a fact.

/ **Penetration tests**: the same analysis applies for this domain, where airports will most likely outsource this activity in the future years.

ORGANIZATIONAL IMPACT OF THE DIGITAL TRANSFORMATION

All changes and new trends impacting the airport systems have a direct impact on airport organization, in particular the IT&T department.

The IT department, which used to be considered as a support function, is not one anymore. IT has become strategic, and generally the airport Chief Technology Officer (CTO) is now present at the executive board of directors. The additional weight given to CTOs allows them to transform the function from an IT developer to a solution provider. In other words, the airport IT department has, henceforth, the responsibility to be proactive instead of receiving and implementing requirements coming from the different business divisions.
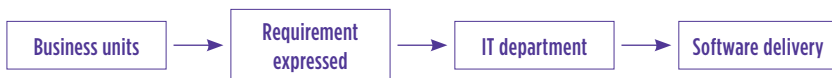
INNOVATION HAS BECOME THE MAIN EXPECTED SERVICE OF AN IT AND DIGITAL DEPARTMENT

The IT department has the technological knowledge and skills to drive innovation. Other business units, more focused on delivering service to clients, expect digital people to lead innovation.
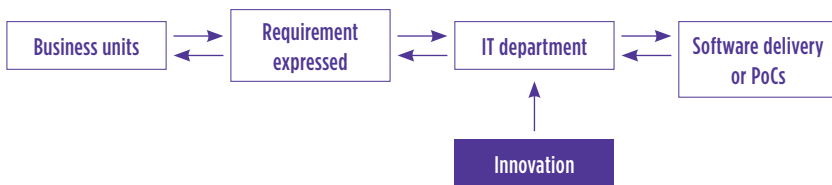
For this innovation to be economically viable and businesswise, it should be shared across all the departments. That is why innovation must be transverse.

To speed up innovation, it would be better for airports to increasingly turn to startups and small companies in order to get greater flexibility and agility, especially during the experimental phase.

HISTORICAL ORGANISATION BETWEEN BUSINESS & IT DEPARTMENTS

Business units → Requirement expressed → IT department → Software delivery

CURRENT ORGANISATION BETWEEN BUSINESS & IT DEPARTMENTS

Business units ⇄ Requirement expressed ⇄ IT department ⇄ Software delivery or PoCs

Innovation → IT department

AGILE OR V-CYCLE?

Innovative projects have, by definition, a higher level of risk. We even call it uncertainty. Performing such developments in a V-cycle development mode can induce enormous financial loss if the project is not successful at the end. In those cases, agile methodologies and going step by step in a lean startup mode is more adapted.

Many airport systems are not that innovative in areas necessary for the functioning of the airport: check-in, RMS (Resources Management Solution) for operations and so on.

This type of baseline program can be managed globally in a V-cycle mode as the uncertainty is very low, and for small additional innovative functionalities the development teams can go for agility.

Finally, airports should find their equilibrium between traditional project management methods and newly emerging agile ones.

CONCLUSION

Today, new technologies have a clear impact on airports: they facilitate and accelerate their mutation. Digital transformation is happening quickly and gradually pushing the limits, by offering new solutions to the airports' challenges. Technology is almost limitless: identifying relevant use cases, checking acceptability and adapting the organization to provide quick answers is clearly what is at stake today.

However, airports' digital transformation is still at the beginning: knowing how to use abundant data, being more responsive to new uses, developing new safety & security solutions, generalizing PoCs in order to leverage the full potential, having a flexible organization able to manage technologies in constant development, are many topics which still need to be improved!

In the end, being a smart airport appears much more complex than just being digitized or innovative. A more appropriate definition would certainly be to be ready to make the most of technological potential, to take up strategic priorities, according to strengths and weaknesses and considering airport context and constraints.
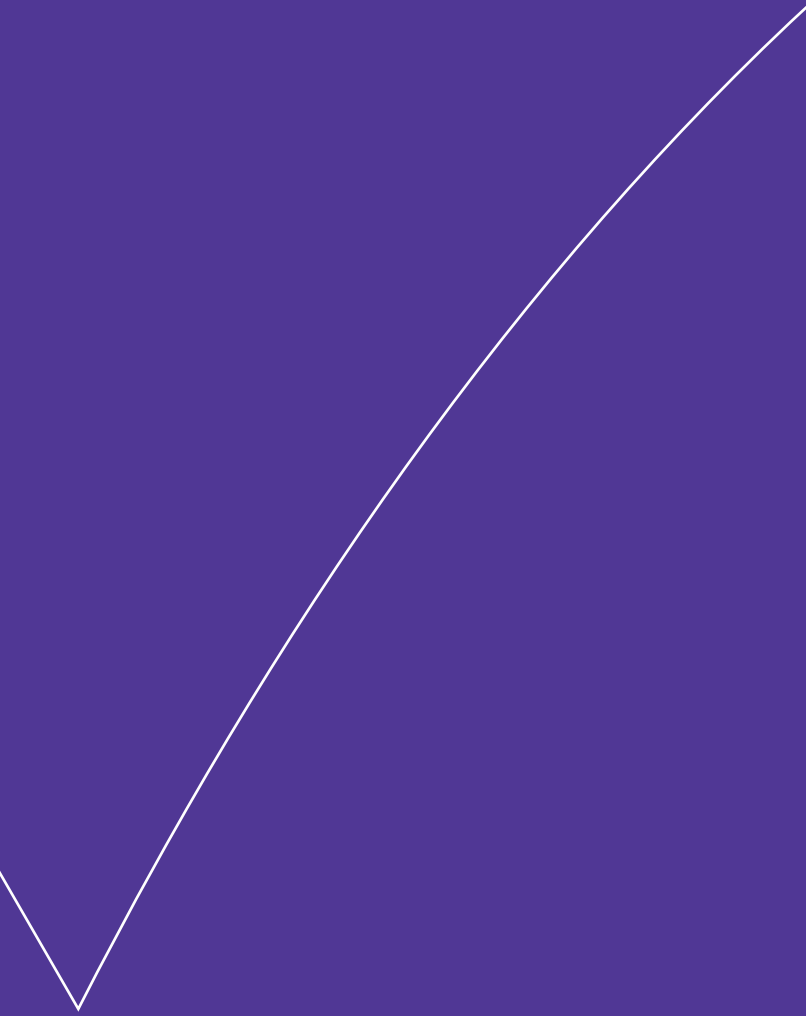
As Albert Einstein said, *the difference between stupidity and genius is that genius knows its limits*. Consequently, positioning as a smart airport will first require a strategic review, in order to define the most relevant bricks to develop to meet the airport strategic goals. A smart airport is not about complete digitization of the airport, it is more how it can provide a competitive edge to the company. A roadmap will help to prioritize and coordinate the implementation of solutions which are more and more interconnected.

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