waisL

The Digital Airport Company

HOW DATA CAN AUGMENT THE AIRPORT THROUGHPUT

WHITE PAPER

Introduction

An airport is a complicated system where disparate contributors (Airport Operators, Airlines, Govt Authorities, Security Agencies, Staff, and Passengers) actively participate in moving/transporting people and goods across the globe.

Today, airports are addressing increasingly complex operational challenges with exciting business and technological innovations. Smart digital investments demonstrate an attractive business case for airports, offering the potential to increase revenue and lower costs, at the same time, offer a great travel experience. Airports are undergoing pivotal transformation, and digital tools are enabling new thinking, be it personalizied advertising, enhanced passenger loyalty, or mobility for passengers.

Digital transformation at airports leverages multiple technology solutions, such as indoor geolocation, identity management, passenger flow management, data mining, artificial intelligence (AI), and automation & real-time monitoring of machines via the internet of things, to not just improve safety and security but also streamline their operations and enhance revenues.

Airports have achieved impressive efficiency gains by implementing digital technologies. Saving minutes of time per passenger processing time from terminal check-in to the security hold area by leveraging facial recognition technology, reducing minimum connecting times by accelerating baggage handling for selected priority bags, and reducing infrastructure costs by up to 10% through energy efficiency systems are just a few of the more prominent examples.

To make more out of available data, airports need to consolidate data, break the data silos, and form an open, interoperable, and collaborative system across participants and procedures. Harnessing the power of data, it is in the best interest of the airports to deploy full-fledged Digital Twins, not just for Airport Operations, but to also address sustainability needs through solutions for Infrastructure, Energy, and Water Management. Deploying the digital twin breaks down information silos and helps access the right information at right time, enabling situational awareness. Inspection data, work history, and extremely large datasets can be used in the context of a digital twin. Using extensive graphics and dashboards and real-time and reliable information helps to reduce the total cost of assets; better manage, make changes, and obtain accurate returns; and ensure better asset performance and return on investment (ROI).

To accomplish this all the shortlisted airport-related data streams – from all participants together are required to bring in a single central data lake that is simultaneously accessible to airport stakeholders. This will create a single source of truth to refer to for airport operations. Actionable, real-time information on everything going on in the airport will be provided in dashboard views to everyone who needs to know so that well-informed and quick decisions can be made in a crisis.

The digital twin also carries the necessary tools for advanced prediction and simulation of future developments to which airport operators can then respond proactively. In other words, the twin delivers effective decision-support tools for everything from short-term scenarios to infrastructure expansion decisions. Additionally, since data is already located in one virtual space, new use cases, and applications can be developed on the fly by all interested parties. Potentially, the digital twin of an airport could even be visualized in a 3D model that would be accessible via virtual or augmented reality.

The digital twin of an airport is a high-value use case that unlocks the full potential of data for airports – and aligns with the vision of smart airports of the future.

Data-driven technologies that airports use to improve performance and master current challenges

In line with Airport 4.0, there are several data-driven technologies that airports are using to improve performance and address current challenges. Some examples include:

• **Predictive maintenance:** Airports take help of data analytics and machine learning to predict the maintenance needs of their equipment and infrastructure, allowing them to proactively address potential issues before they arise. This helps reduce downtime and improve the overall efficiency of airport operations.

• **Baggage tracking:** Many airports use RFID tags and other tracking technologies to improve the accuracy and efficiency of baggage handling. This helps reduce the number of lost bags and improve the overall customer experience.

• **Real-time surveillance and monitoring:** Airports use a variety of sensors and cameras to provide real-time surveillance and monitoring of the airport environment. This helps improve safety and security, as well as enables the efficient management of airport operations.

• **Predictive analytics:** Airports use data analytics to predict demand for various airport services, such as parking and food and beverage. This can help to optimize the allocation of resources and improve the overall efficiency of the airport.

• **Customer experience optimization:** Airports are using data analytics to improve the customer experience by providing personalized recommendations for shopping and dining, real-time flight information, and customized loyalty programs. This can lead to increased customer satisfaction and loyalty.

• **Environmental sustainability:** Airports are using data analytics to optimize energy usage, reduce emissions, and implement sustainable practices, helping them to meet their sustainability goals and reduce their environmental impact.

Where are we at with the use of data to enhance airport ecosystems

The use of data to enhance airport ecosystems has come a long way in recent years, with many airports adopting data-driven technologies to improve efficiency, safety, and customer experience. However, there is still room for growth and development in this area.

• One challenge faced by airports is the integration and management of multiple data sources. Ensuring that data is accurate, up-to-date, and secure can be a complex and time-consuming task. In addition, airports must also consider privacy and regulatory issues when using data, in line with region-specific data protection laws.

• Need for skilled personnel continues to be a challenge, to reap the benefits of a data-centric strategy. As the use of data continues to grow in the airport ecosystem, there will be a need for professionals with strong data analysis and management skills in the short run.

• The fear of losing control over data is yet another factor. Essentially, stakeholders are wary of losing control over a hard-to-grasp resource – data is the new oil, remember – and fear that, once shared, data will lose value and other players may be able to exploit it for their own commercial ends. Since the prospect of remaining in the driver's seat is limited, data sharing remains the exception rather than the norm.

• Despite these challenges, the use of data to enhance airport ecosystems is expected to continue to grow in the coming years. As data analytics and machine learning technologies become more advanced, airports will be able to leverage even more powerful insights and predictions to improve their operations and better serve their customers. Also, with the availability of low-code and no-code platforms, this scarcity of skills and talent shall also soon be addressed through the new generation of citizen data scientists.

How data analytics can be used in the airport ecosystem

Decision-makers have clarity on the outcomes. They need to synergize the need with an understanding of the power of data and how it can be harnessed in connected and complex environments… Data – especially in large sets – gives us the opportunity to gain and act on insights that typically would need extensive efforts to unlock. With the Internet of Things, this typically means gathering different types of data over time (e.g. temperature, humidity, vibration, usage, etc.) and analyzing patterns. Using statistical tools, the data can be better described, and different sets of data compared using regression analysis to discover correlations between and/or the causes of specific observations. Based on the insights gathered, decision processes can be defined and automated in the form of digital applications (software).

Illustrating with an example. By combining data collected through applications and IoT, a digital twin of a baggage handling system can help optimise the operating process and remove bottlenecks.

Typical Data Analytics Solution Architecture

Data analytics architecture refers to the framework and components that enable organizations to collect, store, process, and analyze large amounts of data. It typically involves several layers, including data acquisition, storage, processing, and analysis, as well as visualization and reporting.

Here is an overview of the components that make up a typical data analytics architecture:

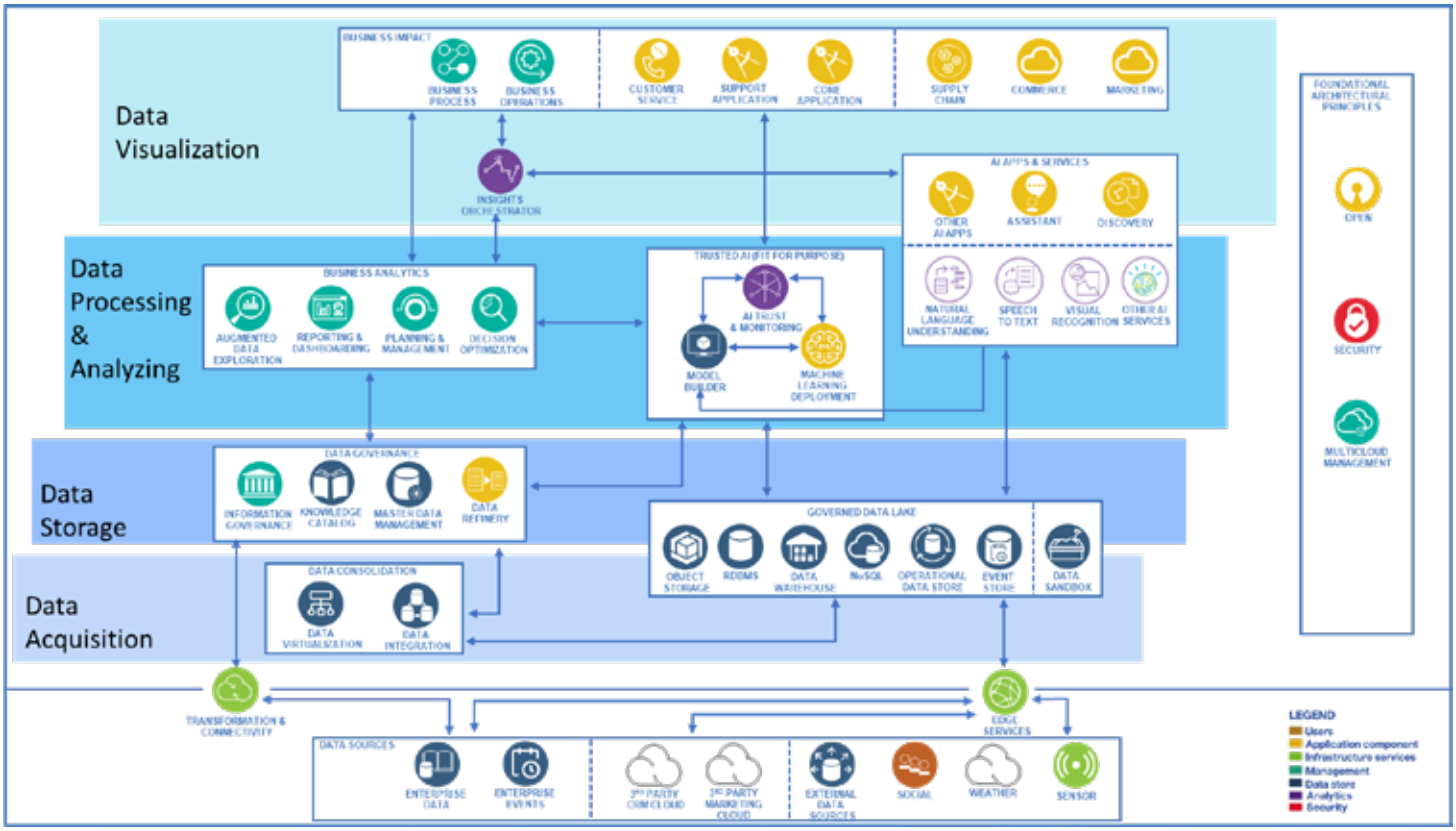
1. **Data sources:** This refers to the various sources of data that an organization collects, including structured data from databases and applications, as well as unstructured data from social media, sensors, and other sources.
2. **Data acquisition:** This involves collecting and ingesting data from various sources and preparing it for analysis. This may include processes such as data cleansing, data transformation, and data enrichment.
3. **Data storage:** This refers to the infrastructure used to store large amounts of data, which may include data warehouses, data lakes, and other storage systems.

4. **Data processing:** This layer involves processing data to extract insights and value from it. This may include data mining, machine learning, and other techniques to identify patterns, predict trends, and make recommendations. The data processing layer includes solutions such as Hadoop, which is a distributed computing system for storing and processing large datasets, and Spark, which is a fast and general-purpose cluster computing system for big data processing. The data processing layer includes AI and ML tools such as TensorFlow, Keras, and PyTorch, which are popular deep learning frameworks used for building and training neural networks.

5. **Data analysis:** This involves analysing data to gain insights and inform decision-making. This may involve the use of dashboards, reports, and other tools to visualize and explore data. The data analysis layer includes solutions such as Tableau, which is a data visualization and business intelligence tool, and SAS, which is a statistical analysis software suite.

6. **Data visualization:** This involves presenting data in a way that is easy to understand and interpret. This may include the use of charts, graphs, and other visualizations to convey key insights and trends. The data visualization layer includes programming languages such as Python and R, as well as visualization libraries such as D3.js. The AI/ML Tools layer includes popular libraries such as Scikit-learn, XGBoost, and H2O.ai, as well as automated machine learning platforms such as DataRobot and Amazon SageMaker.

7. **Reporting:** This involves generating reports and communicating findings to stakeholders, such as executives, analysts, and other users. The reporting layer includes solutions such as Excel, which is a spreadsheet program that can be used for data analysis and reporting, and Crystal Reports, which is a reporting tool that can be used to create customized reports. Other solutions at this layer include SAP BI, which is a business intelligence and analytics platform, and MicroStrategy, which is a business intelligence and analytics tool.



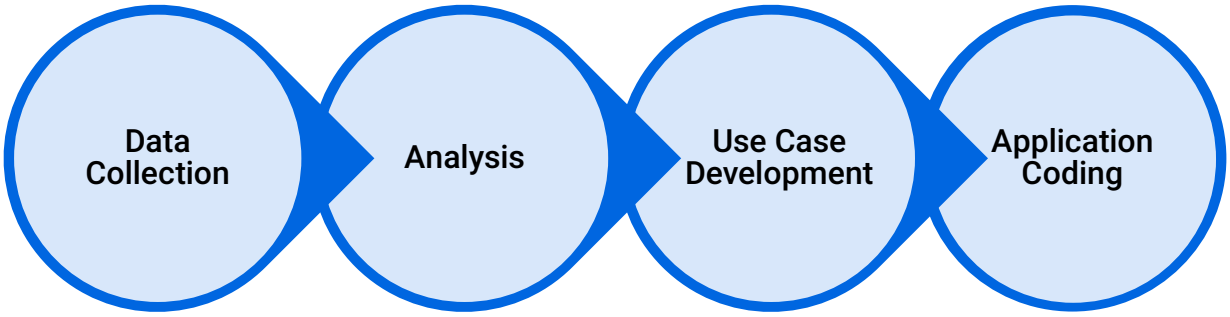
Overall, a well-designed data analytics architecture should provide organizations with the ability to collect, store, process, and analyze large amounts of data, enabling them to make data-driven decisions and gain a competitive advantage

Utilizing data's full potential across inter¬faces on a unified, IoT platform

The Internet of Things is making its way into every facet of our daily lives — the vehicles we drive, the cities we live in, the way we shop, how we take care of ourselves, etc. Although all the opportunities this innovation offers are yet to be explored, business owners and public offices can already benefit from gathering more data about customers and community residents than ever.

There's a lot of power in being able to collect and process insights in real-time. However, with great power comes great responsibility, and tech teams need to approach data collection and management responsibly, designing reliable and secure application architectures.

In the Internet of Things, this typically means gathering different types of data over time (e.g. temperature, humidity, vibration, usage, analyzing patterns. Using statistical tools, the data can be better described, and different sets of data compared using regression analysis to discover correlations between and/or the causes of specific observations. Based on the insights gathered, decision processes can be defined and automated in the form of digital applications (software).



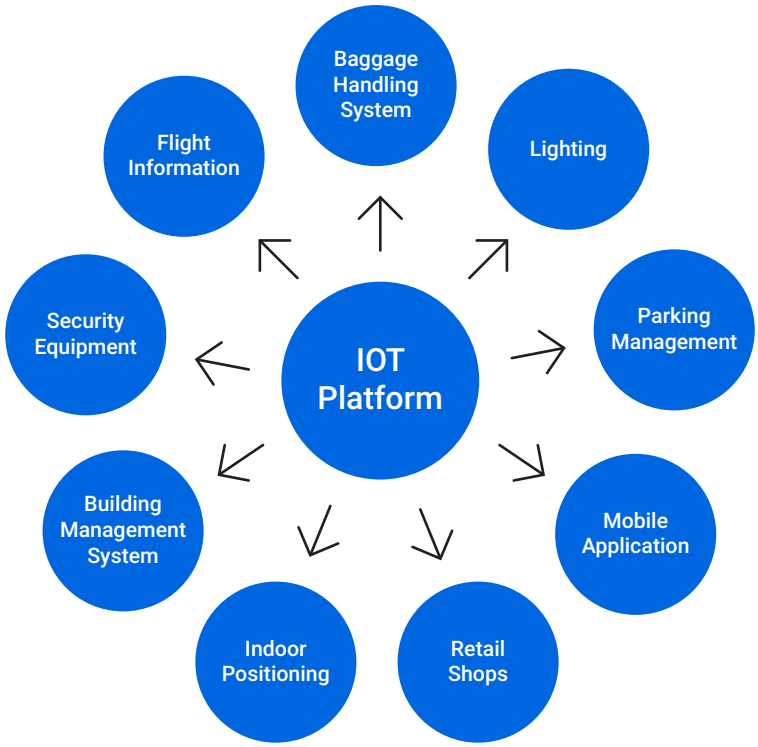
To use the full potential of data across interfaces on a unified, Internet of Things (IoT) platform, there are a few key considerations:

• **Integration of data sources:** An integrated, IoT platform should be able to gather and integrate data from a variety of sources, including sensors, cameras, and other devices. This allows for a more comprehensive and accurate view of the data being collected.

• **Interoperability:** An IoT platform should be able to seamlessly communicate and exchange data with other systems and devices, enabling a more integrated and efficient ecosystem.

• **Security:** Ensuring the security of data is critical in an IoT platform. This may include the use of encryption, authentication, and other security measures to protect data from unauthorized access or tampering.

By considering these factors, organizations can effectively harness the full potential of data across interfaces on an integrated, IoT platform, enabling them to make better-informed decisions and improve their operations.



Possible systems to be connected to an open IoT platform

Moving toward the vision of the airport's digital twin

A digital twin is a virtual model of a physical system or process, typically created using data from sensors and other sources. In the context of airports, a digital twin can be used to simulate and optimize various aspects of airport operations, such as baggage handling, ground handling, aircraft turnaround, and maintenance. All this is done on the technological backbone of the IoT operating system, as described above, to form an open, innovative airport ecosystem that permits the end-to-end integration of processes and stakeholders. As such, it is more than a static, virtual copy of the airport: It is constantly fed with real-time live data about systems, processes, actions, vehicles, and people, and it runs in parallel to the real world. The digital twin thus enables coordinated and collaborative action across all ecosystem stakeholders and processes in three key areas: monitoring, prediction and use case development. It enables "one version of the truth" for all ongoing activities and system statuses to be monitored permanently. It allows each stakeholder at any time to receive customized dashboard information on the performance of systems and processes. Better still, it creates opportunities for joint, collaborative, and speedy decision processes as all actors have the same information at their fingertips.

The digital twin of an airport facilitates predictive analysis of events that may disrupt operations and acts as an early-warning system. At short notice, it can provide valuable decision-support information based on predictive analysis of potential outcomes (e.g., which parking position/gate to allocate for each plane?

How will that influence other turnarounds?). On top of short-term prediction, it can also help to simulate trends, scenarios, and expected gains from infrastructure updates. An airport's digital twin also empowers stakeholders to optimize system performance and realize synergies – saving everyone the trouble of duplicating data collection. If a joint approach is adopted, new service offerings can be developed by all ecosystem partners.

To move toward the vision of the airport's digital twin, there are a few key steps that can be taken:

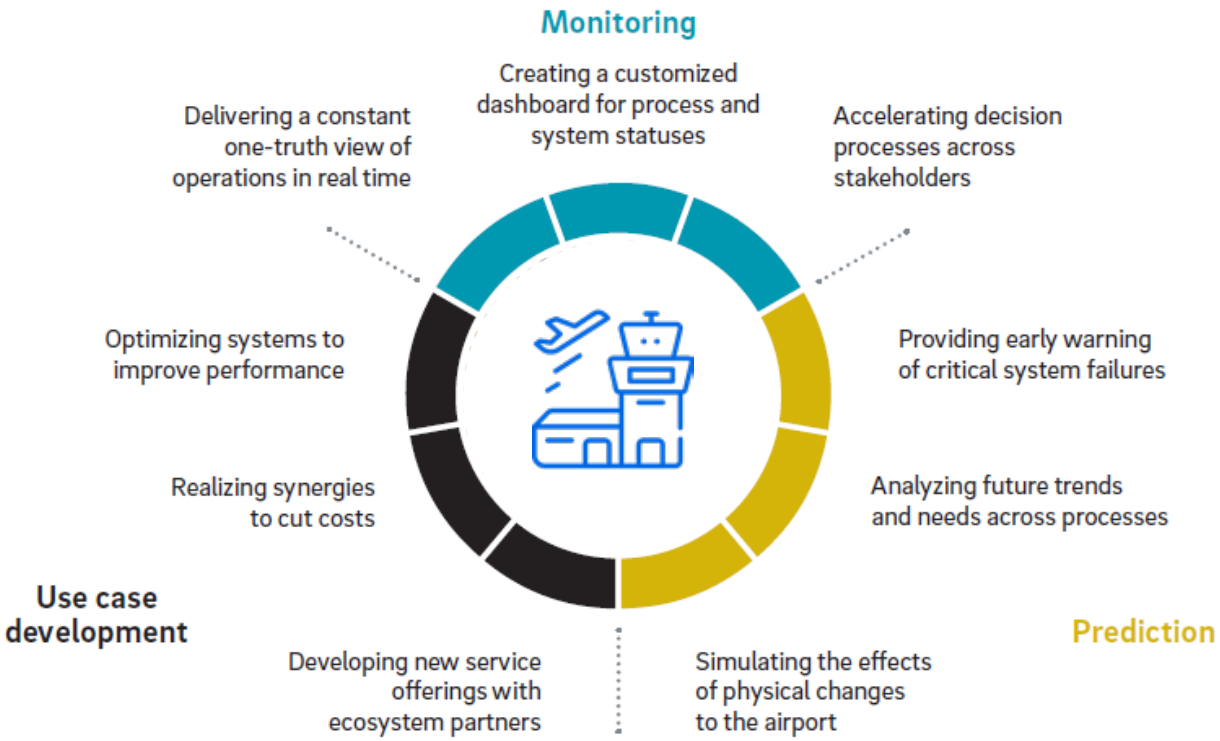
• **Gather and Integrate data:** The first step in creating a digital twin is to gather and integrate data from a variety of sources, including sensors, cameras, and other devices. This data can be used to create a virtual model of the airport's systems and processes.

• **Analyse and Visualize data:** Data analytics and visualization tools can be analysed and visualize data from the digital twin, providing insights and predictions that can be used to optimize operations.

• **Test and optimize:** The digital twin can be used to simulate different scenarios and test different optimization strategies. This can help to identify the most effective approaches for improving efficiency, safety, and customer experience.

• **Implement and monitor:** Once the most effective optimization strategies have been identified, they can be implemented in the physical airport. The digital twin can then be used to monitor the impact of these changes and make further adjustments as needed.

By following these steps, airports can move toward the vision of the airport's digital twin, using data and analytics to optimize their operations and better serve their customers.



The Capability of Airport Digital Twin

It remains to be seen whether integrating operational data or virtualizing the physical airport infrastructure will be the most efficient way to create an airport's digital twin. That said, taking a digitalized physical infrastructure – e.g. a 3D map of the airport buildings – as our point of departure, a digital twin can be built by integrating more and more data streams in the platform: information on smoke alarms and ventilation from building automation systems, energy management data, data from the baggage handling system, input from the passenger flow management system, even aircraft and ground handling performance data. Once all data streams are harmonized and integrated, the digital twin becomes a reality.

The way forward: Where airports need to go from here

In this white paper, we have focused on the technological side of driving digitalization forward. We have highlighted the importance of an open IoT solution as the enabling tech for this journey. The enabling tech will facilitate secure, selective data integration to create a plug-and-play type background for the open innovation ecosystem. Airport operators need to find an IoT solution that is ready to work with them on the technology. They must also build a network of trusted airport ecosystem partners – airlines, ground handlers, authorities, and other airport users – who are willing to invest in launching the data integration process.

The current status of digitalization in airports, however, we also made the point that implementing technology alone will not be enough. Airports still have work to do to adopt a digital culture that enables employees to drive change forward, ensures that all employees harvest the benefits of digitalization, and bridges the generation gap that still exists in so many airports.

To push forward, the simple organizational trick of installing a "Head of Digital" will not suffice. Instead, airports need a comprehensive digital change management process, dedicated digital teams to drive concrete projects forward, and dedicated, successful airport apps with a convincing, user-friendly design to give ease of use to employees.

Hand in hand with this cultural change, the project selection and investment decision processes need to be reviewed and adapted. They must allow for digital projects to include proof-of-concept and technology demonstrator phases in a stage-gate process and postpone the business case discussion. That will give digital technologies the opportunity to "get somewhere" technologically while figuring out the business model along the way.

The enabling solution, a digital mindset, and careful project selection will determine airports' success in advancing on their digital journey and utilizing real data strength.