Innovation at Airports in North America

A study of airport innovation enablers and barriers

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Purpose

The purpose of this whitepaper is to provide an overview of recommended best practices from a selection of airports in North America. Information used was from secondary sources, such as government reports, press releases, industry reports, and websites. The primary data source for the research was qualitative semi-structured interviews with employees from thirteen airports. The research was able to identify innovation activities across the participating airports. This followed by mapping recommended best practices, successes, and challenges to provide a detailed understanding of airport innovation.

Acknowledgments

An amiable thank you to all the airports that participated. They provided valuable input needed to produce meaningful conclusions for the research.

Terminology

The research focuses on a limited selection of airports in the United States and Canada that agreed to participate. However, there are undoubtedly many more innovative projects and programs in North America and around the world, and unfortunately, there was not enough time to research additional airports.

Authors

Detecon, Inc. and Airports Council International – North America (ACI-NA) jointly identified a need for research on airport innovation.

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Abstract

To innovate means to create, detect new ideas, and pursue their implementation. Innovation is an uncertain process with unclear outcomes. Innovation is viewed as a crucial means to provide an organization with enhanced capabilities to sustain its competitiveness.

Airports play a crucial role in the economy, and in North America, the demand for commercial air travel has risen faster than anticipated. Innovation can help airports with outdated physical infrastructure and bottlenecks to improve the passenger experience. However, airports in the United States are public entities, and this involves tedious procurement requirements when trying to source resources for projects and future investments related to innovation.

The whitepaper explores innovation recommended best practices at airports in North America. The theoretical research builds on common organizational innovation frameworks, and a case study approach was used for the analysis. Semi-structured expert interviews were used to conduct airport interviews. From the interviews, industry-specific recommended best practices were developed. Each airport interview focused on internal and external innovation, with a qualitative innovation assessment.

Furthermore, aggregated industry-specific enablers and barriers were categorized into three fields.
The main barriers for airport innovation are a risk-averse culture and procurement requirements. The main enabler for airport innovation is the strategy based on the airport's unique selling points that define the organization's core values for innovation. Airports can promote innovation with an open culture, willingness to take risks, and fostering of employee engagement. Leadership commitment and change management drive these initiatives throughout the whole airport.

Keywords: airport industry, North America, airport innovation, internal and external innovation, innovation management, innovation strategy

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1 Defining Organizational Innovation

1.1 Understanding the term Innovation

Understanding the term innovation is a necessary prerequisite to determine the topic. The term "innovation" has differentiated variations, and there are many definitions and concepts of innovation [1].

> "*Innovation is the process that takes an invention, discovery, or insight about a new device, process or system to its first successful commercial application. As such, it can apply to new products, processes, and services, to new markets, to new sources of supply and to new forms of organization*." [2]

Innovation activities aim to create and capture value. Unusually for an organization, innovation management involves any process that implies changes in planning, ideation, execution, and provision of resources in a way that can make the organization or system more functional for end-users [3]. In its whole, innovation describes the process of transformation as well as the final outcome [2]. The following definition tries to grasp the impact of innovation for an organization:

> "*Innovation is production or adoption, assimilation, and exploitation of a value-added novelty in economic and social spheres; renewal and enlargement of products, services, and markets; development of new methods of production; and the establishment of new management systems. It is both a process and an outcome*." [4]

1.2 Innovation Depends on the Problem

The four types of innovation are called "the 4P's": Product, Process, Position, and Paradigm (see Fig. 1.1). Each of these types has a different scope, such that it focuses on a sphere on its own, although the 4P's can also intersect [5]. Product innovations concern changes in the product or service that an organization offers, while the surrounding business model of the organization is not changed [6]. A broader scope encompasses the organization's business model and how the organization positions itself and its products or services within the industry that are addressed with innovation [5]. Therefore, position innovations change an organization's business model, which touches an organization more holistically than product innovations [6]. However, the real innovation usually entails a faint line and includes several types of innovation into one. Certain services often merge product and process aspects [7]. Process innovation describes changes in ways in which something is done, created, and delivered [9]. Lastly, paradigm innovation refers to changes in the underlying mental models which frame what the organization does [9]. Innovation can have different aspects of novelty [7]. Radical innovations entail significant changes in an offering, and they have the potential of a market shift. In contrast to that, incremental innovations are subsequent innovations following other radical innovations [6].

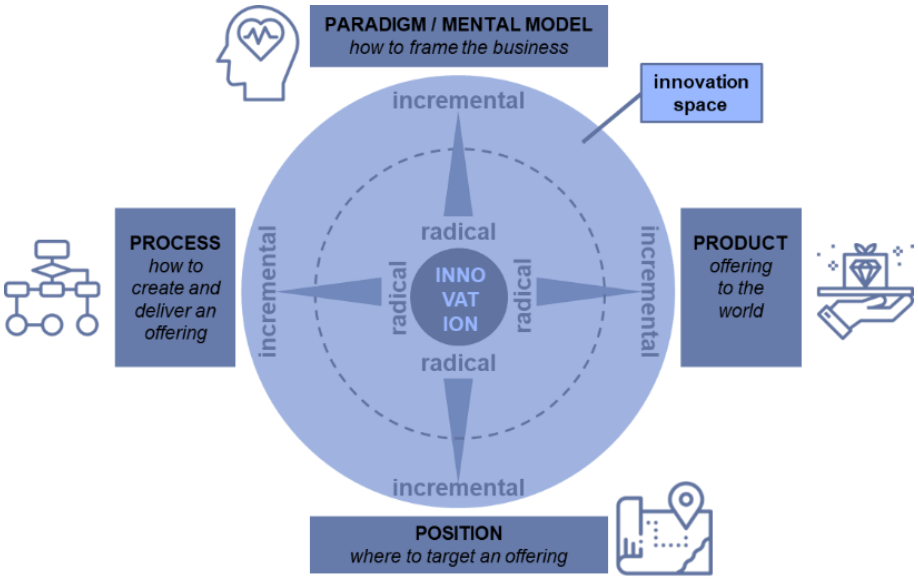

Fig. 1.1: The 4P's of innovation dimension ([5], [6], [7]).

In a broad sense, design thinking theory suggests that three domains shape any innovation: technology, business, and human values (see **Error! Reference source not found.**). Innovation is not necessarily involved in all three categories, but for the most part, any innovation can be associated to some degree with all three domains [8].

2 Airport Innovation Recommended Best Practices

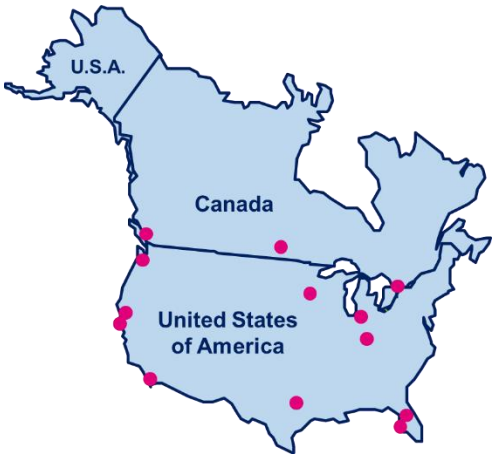

Fig. 2.1: Locations of airports included in the research

The target group for this research was airport employees in North America who are related to the airport's innovation activities. These airport employees provided knowledge and opinions that provided valuable and meaningful insights regarding the topic. The results of the expert interviews helped to develop recommended best practices. In total, thirteen airports were interviewed for the research; eleven from the United States and three from Canada (see Fig. 2.1).

According to Pavitt's taxonomy, airports are part of the service-dominated industry. This theory states that it is hard for organizations from the service-dominated industry to innovate because they depend on other companies extensively [10]. This section provides an overview of each airport's structure and how innovation is executed. The findings extracted from content analysis practices are presented using a case study approach. This includes selected innovative projects the interviewees discussed and the findings were analyzed into the concepts of internal innovation and external innovation.

2.1 Internal Airport Innovation

2.1.1 Organizational Structure

The structure of an organization can help or hinder the progress toward their innovation goals. Organizational structures affect the favorability of developing innovative products and processes. Regardless of size and industry, any organization will be able to achieve its goals by correctly matching their needs with the structure they use to operate the organization. Therefore, innovation is not an easy task because it involves the creation of organizational structures and processes, which enable change to make progress. [11]

In this regard, success factors are effortless information flows and cross-functional cooperation. When dealing with innovation, flexible, defined structures gain importance because its activity differs from the business-as-usual. Innovation can be complicated, unforeseeable, and uncertain. Innovation-favorable organizations require insight and judgment, where decisions associated with innovation have to be made. Activities of this kind are unlikely to be routinized, structured, and formalized [11]. Instead, they require extensive interaction and flexibility. In contrast, rigid hierarchical organizations tend not to be supportive of the changes needed by innovation. [7].

2.1.2 Leadership Commitment

The commitment of executive leadership plays a crucial role to induce a changing mindset within an organization. Management influences the performance of an organization, while leaders assess the environment, make strategic decisions, and provide support for innovation. Studies have demonstrated the significance of contributions that leaders can make to the performance of their organizations.

Therefore, the management needs to embrace innovation. The leadership team has to communicate a clear commitment and a shared organizational purpose. Innovation is not free from risk and the management demonstrates the acceptance of risk. Innovation involves failures, as well as successes. Successful innovation management requires the organization to be prepared to take risks and to accept failures as an opportunity for learning, growth, and development [9].

AIRPORT EXAMPLE – LEADERSHIP SUPPORT TO LEVERAGE EMPLOYEE INNOVATION AT SAN FRANCISCO INTERNATIONAL AIRPORT (SFO)

Innovation at SFO is not the remit of one single department. Instead, the airport runs an organization-wide program – Reaching for Number One (R4N1), which typically focuses on different inter-departmental teams to work on specific themes that require an innovative solution. The R4N1 program is sponsored directly by SFO's CEO. Teams are formed around various themes. Each team has its own executive or senior management sponsor.

(More details in the appendix)

2.1.3 Innovation Strategy and Core Values

Defining what innovation means is a discussion that every organization needs to have, so there is a common understanding. It is hard to define innovation for any organization, and this is why an organization may find it hard to start with innovation efforts. However, defining innovation within an organization is only the first step. The definition of an innovation strategy includes making sense of the buzz word "innovation" and creating a formal way to generate and address ideas.

AIRPORT EXAMPLE – INNOVATION STRATEGY AT CINCINNATI/NORTHERN KENTUCKY INTERNATIONAL AIRPORT (CVG)

CVG's innovation strategy is used to identify and assess the potential of any innovation idea:

- ***Secure*** focuses on any aspects of enhancing security.
- ***Clean*** addresses the efforts of being more sustainable.
- ***Transport*** looks at anything that makes transport more efficient.
- ***Connect*** focuses on platforms and IoT technology that allows their employees to perform their job more efficiently regardless of the task.

(More details in the appendix)

2.1.4 Employee Engagement Programs and Incentives

Innovation through the involvement of employees focuses on incremental change, which might seem to have a marginal impact at first. However, studies have shown that over time, these changes lead to significant improvements and have a lasting impression. Integrating and enabling improvements suggested by frontline employees within the organization have been subject to scientific studies, which revealed a correlation between those incentive systems and higher economic benefits for a company [12]. These improvements include lower operating costs, a higher rate of return on capital, higher turnover of sales per employee as well as higher profits per employee [13]. Therefore, employee innovation can be crucial for the strategic development of an organization [14].

AIRPORT EXAMPLE – THE SHARK TANK PROGRAM AT SEATTLE-TACOMA INTERNATIONAL AIRPORT (SEA)

Employees are actively encouraged to hand in ideas via a web-based suggestion box. Everybody who enters an idea gets a little reward in the form of an “innovation” lanyard.

SEA runs a “shark tank” like an employee innovation event. The airport started to facilitate these events in 2017 and now runs three to four events with five to six presenters each year. The event is based on the ideas from airport employees who present their concept and try to convince the leadership team. The whole airport is invited to sit in the audience during the event.

(More details in the appendix)

AIRPORT EXAMPLE – SIX DIFFERENT WAYS TO GET ENGAGED AS AN EMPLOYEE AT VANCOUVER INTERNATIONAL AIRPORT (YVR)

YVR launched several employee engagement programs at the airport. Thus far, they have launched 6 different programs encouraging employees to engage in innovation by bringing ideas forward and thinking differently.

(More details in the appendix)

2.2 External Airport Innovation

Many variations of definitions are available for the term external innovation. To the extent to which an organization involves external innovation varies. In its overarching idea, external innovation is often a partnering strategy.

External innovation uses the knowledge of external service providers to make internal innovation processes external. External Innovation opens up new ideas and expertise in both directions. Several advantages are associated with external innovation that can include a reduction of time and cost of

innovation projects. Furthermore, external innovation enables the incorporation of solutions, which would have never been generated by the organization due to a lack of time, knowledge, and technological resources. These solutions can take the form of ideas, patents, products, and technologies.

2.2.1 Partnering with Federal Agencies

Airports need to work daily with federal government agencies. In this regard, innovation can aid processes to improve the passenger experience. For example, the Transportation Security Administration (TSA) has selected several airports as “innovation sites”. These are airports where TSA is testing technologies before implementing them at other airports.

AIRPORT EXAMPLE –TSA’S INNOVATION TASK FORCE – DALLAS/FORT WORTH INTERNATIONAL AIRPORT (DFW)

Since the beginning of 2019, DFW has been an official TSA innovation site. Being a test site allows for regular meetings with members of the TSA’s Innovation Task Force. This relationship enables DFW and the TSA to collaborate on mutual areas of interest to improve the security and experience of travelers. This is especially necessary because the TSA usually tests a solution with only a few airports first, and DFW de-sires to be among these.

(More details in the appendix)

2.2.2 Partnering with Academia

Today, universities are embracing innovation as part of the academic experience. Airports can work with academia to provide distinct opportunities and further airport innovation. Local academic partnerships also foster local community engagement. Engaging university partnerships can yield great ideas, but intellectual property management challenges may emerge from universities or even start-up companies.

2.2.3 Local Community Engagement

The local community represents an important stakeholder to the airport. Apart from using the airport to travel, the local community can work with the airport collectively to address local issues.

AIRPORT EXAMPLE – THE COMMUNITY HELPS TO CREATE THE NEW TERMINAL BUILDING AT PITTSBURGH INTERNATIONAL AIRPORT (PIT)

The most prominent current project at PIT is the construction of a terminal building that is scheduled to open in 2023. This project provides PIT the opportunity to build everything from scratch and imbue that culture of innovation in the very buildings themselves. For example, PIT is testing a lot of technology to determine what to include in the construction process and for what reason. In 2018, PIT created advisory groups, and almost every department such as a group to discuss best practices.

Each advisory group deals with one specialized topic. There is a lot of excitement in the community about the project, and it is not hard to find various experts from the community who like to participate in these advisory groups.

(More details in the appendix)

2.2.4 Selected Technology Projects

Implementing technology for automating processes can improve operational efficiency. In this regard – since being a technology provider is not the primary mission of an airport – an airport is usually required to purchase or partner with other organizations to provide products or services.

AIRPORT EXAMPLE – THE ULTIMATE OPEN INNOVATION SUCCESS FROM VANCOUVER INTERNATIONAL AIRPORT (YVR)

YVR is known for an innovation that became an international success: BorderXpress – a border control self-service kiosks used by arriving passengers when they enter the country. These kiosks were designed by the technology team for use at YVR to help with passenger growth. Initially used at YVR, BorderXpress has now been commercialized and the kiosks are at 43 airports and seaports around the world. This success story is a good example of the complex aspect of airport innovation because it came from an internal idea, and YVR had to collaborate with government and airport stakeholders.

(More details in the appendix)

2.2.5 Selected Non-Technology Projects

Innovation does not only mean including technology within the infrastructure. It can also mean reinventing the way things are done at the airport. It can be a strategic mindset, which the airport relies on to make and justify its choices.

AIRPORT EXAMPLE – INTRODUCING "LOCAL FLAVOR"-ONLY AT OAKLAND INTERNATIONAL AIRPORT (OAK)

A significant change that OAK is currently undergoing is a redevelopment of the concessions program. At the moment, the gastronomic areas are being renovated and modernized. OAK has developed an innovative concept for food & beverage operators.

(More details in the appendix)

3 Factors Influencing Airports Innovation

In this section, enablers and barriers to innovate at airports were identified from the expert interviews. An enabler facilitates and supports the implementation of an innovation. A barrier can be anything that impedes or hinders the conduction of innovation-related activities at the airport. Three main thematic fields were identified from the interviews: Organizational Setup, Resource Management, and Airport Business Structures (see Fig. 3.1).

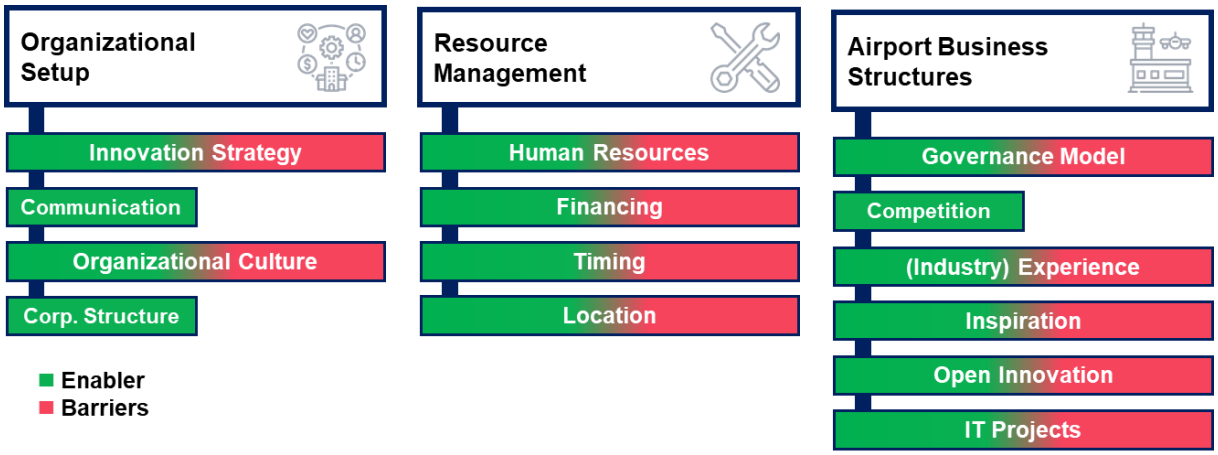

Fig. 3.1: Categories for airport-industry-specific enablers and barriers to innovation

3.1 Enabler of Airport Innovation

The following enablers were extracted from the interviews with airport employees. The qualitative analysis provides insights for innovation at airports.

3.1.1 Organizational Setup

Innovation Strategy

▶ Define the Airport Innovation Strategy

A crucial success factor to airport innovation is having a unique corporate innovation strategy defined, which is like an organization's branding. Setting an airport strategy allows the airport to evaluate why innovation is important for the airport. The strategy should include how projects can be pursued and formalized within the airport.

Having formalized ways of dealing with specific situations helps to streamline efforts and move projects forward because of the guidance it provides. Moreover, such a strategy should include how money is allocated for innovation. Having a focus and defined vision for the airport innovation strategy concerning

Business-to-Business (B2B) and Business-to-Consumer (B2C) interaction is helpful to determine which projects can be pursued.

One of the primary stakeholders for airports is passengers and it is crucial to know the respective passenger base, or "personas," that are common at the airport. In the expert interviews, some interviewees mentioned they think about their airport's strategy from the perspective of customer experience and improving customer satisfaction.

Other primary stakeholders include airlines, concessionaires, ground transportation providers, and, contractors. These stakeholders should be included in the airport's innovation strategy because they have the relevant expertise, equipment, and resources to help the airport achieve its innovation goal.

Another element of the airport's innovation strategy should include an employee engagement program that rewards employees who have good innovation ideas that can be implemented.

Communication

▶ Enable Effective Communication

In general, an innovation strategy needs to be communicated and accepted by several stakeholders to be meaningful. It can be helpful to have designated staff assigned because introducing a new strategy includes an enormous change to the organization. Therefore, thorough and careful change management should be accompanied by the introduction of the strategy.

To enable innovation projects, leadership commitment is crucial for buy-in, and they need to disseminate the strategy to the whole organization. One success factor that drives the adoption and interest might include having the CEO talk about the innovation strategy and promoting it to the entire organization.

Organizational Culture

▶ Establish the Right Mindset within the Airport Culture

The communicated strategy should become part of the overall organizational culture. It is important to note that the diffusion and adoption of an innovation strategy or project does not happen overnight. Adoption needs to happen organically. Therefore, the organization needs to allow time for adoption. Usually, employees who are more progressive towards novel ideas are open to embracing change first. Then, when ideas and concepts have proven to be beneficial, more people embrace them. The cultural aspect also includes having an open mindset and willingness for change. One interviewee stated that they did not have any failures or problems with innovation because new ideas and projects are always introduced organically.

Also, the cultural fit needs to be apparent when working on projects. Part of this shift in mindset can be enforced by promoting a supportive environment and creativity. Employees should be encouraged by

the organization to pursue ideas, such as leveraging an open-door policy that allows direct communication.

Once ideas are available, there should be a willingness to pilot solutions in quick and creative ways. For example, adopting a solution that is unconventional and inexpensive for quick and easy trials. One interviewee stated that once employees use such an approach a couple of times, they see the benefits and become accustomed to the procedure. To some extent, being risk-averse can also lead to success in innovation. Preparing the necessary, relevant, and thorough research favors successful innovation projects because it ensures solid preparation and feasibility.

Corporate Structures

▶ Put Appropriate Organizational Structures in Place

There are different ways of how innovation can be successfully included within an organization. It needs to be part of the innovation strategy to determine how the structure of the airport organization needs to be rearranged. There is no one-size-fits-all recommendation of what the structure should look like. When an airport wants to determine it for the organization, it will be helpful to include knowledge about how things get worked through in a specific organization. Based on the desire that organizational silos need to be broken up, setting the organization up towards a hybrid structure can be a suitable approach. Enabling a more collaborative working structure allows open exchange within the organization about innovation projects. It fosters more collaboration among departments to pursue projects with employees who have different expertise and the needed skillsets for a particular innovation project.

Among the interviewed airports, some of them have designated employees into an innovation department that coordinates everything concerning innovation. Other airports have adjusted employee job duties to be more innovation-related and thus dedicating personnel to innovation areas.

3.1.2 Resource Management

Human Resources

▶ Establish a Diverse Pool of Human Resources and Identify Champions

A vital part of innovation is the airport employees. From an organizational standpoint, there is a need to have designated employees assigned to the innovation topic who assess, plan, structure, and steer innovation efforts in the organization. To promote innovation within the organization successfully, it is favorable if an employee knows the organization well.

Airports intending to hire should look for versatile, internal advocates other than the CEO, who can develop and promote the innovation program. These employees usually bring along certain abilities and characteristics. The key attributes of people who are in favor of innovation are curiosity, creativity, motivation, and open-mindedness. Additional important attributes are respectfulness and a certain

background (e.g., education and experience). They should have a natural desire to be innovative. One interviewee especially stated that the vital thing for innovation is that employees need to be curious and ask questions. Asking questions is important to ascertain if the innovation is feasible and good enough. To complement each other, the innovation team should include people with diverse backgrounds, and perspectives. Another aspect mentioned which is uncommon for the airport industry is hiring outside the industry, for example, people who worked in the startup industry.

One resistance to change is based on different professional backgrounds and previous expertise of different employees. There is potential for clashes among employees with diverging experiences when trying to make innovation projects work in an airport environment. One interviewee described it as follows:

CASE STUDY – DIFFERENT CAREER PATHS DERIVE A DIFFERENT UNDERSTANDING TO INNOVATION

Employee A – has worked in the industry for a long time and has an extensive aviation background. The employee can understand what aviation-related changes mean for the airport. But employee A may lack an understanding of new services and technologies. Employee A does not really understand the potential that new technologies provide.

Employee B – is relatively young and new to the airport. Previously, the employee worked in a consulting company. The employee is more familiar with the impact derived from introducing new services and technologies. However, employee B lacks a deeper understanding of the aviation industry.

▶ **Mix airport experience with non-airport experience –** Employee B does not have previous airport experience but enriches the airport organization with a needed perspective outside of the airport industry to be able to innovate within the industry.

This example illustrates how different expertise can reveal itself in the airport environment. Convincing each other as well as challenging and changing each other's mindset to be more accepting of the unknown is a challenging process. The innovation strategy should address these issues, and break down old ingrained paradigms, thereby enabling people to take a new look at opportunities from different perspectives.

"The challenge with innovation is: It's not scheduled. It's not in the budget plan. It's not in the financial plan. It's this thing where someone had a brilliant idea…!"

Financing

▶ Find Ways to Finance Innovative Projects

The general advantage when pursuing innovative projects is that it usually saves money because of improvements provided and efficiencies gained. However, this requires initial investments, which often leads to internal discussions. It should be part of an innovation strategy to define how investments can be allocated to fund innovation projects. This eliminates the black box of where and how funding can be generated. For instance, one interviewee mentioned that many corporations in the area provide capital to a venture capitalist fund. This fund helps local startups to pursue novel business ideas. Such corporations in the area are a crucial part of fueling the local startup scene. In turn, some of these startups provide novel solutions, some of which can be of interest to an airport. However, interviewees stated that those can be "tedious to apply for".

At many airports, the IT department is allocated a budget that includes resources for new projects. A few interviewees stated that they were able to fund innovation projects that were not related to IT by using allocated IT budget. Another interviewee stated that the airport has funds in a project management budget that they could leverage for innovation projects.

Another aspect is that some airports could not find a suitable off-the-shelf solution that sufficiently fits their needs. Therefore, the airports might be able to create a solution on their own with an appropriate technology partner. Working with technology partners to develop a solution can be an inexpensive approach for airports because they can tailor their needs specific to the solution. The disadvantage of off-the-shelf solutions is that they may not be tailored to the airport's needs, and they may require the airport to look at turnkey solutions.

"Funding innovation projects at airports is about future-proving tomorrow's capital."

Timing

▶ Timing, Preparations, and Coincidences

Being able to pursue innovation successfully has a lot to do with having the right idea at the right time – and talking to the right people. A mentality, which many interviewees share, is a "fail fast" attitude: it is important not to overthink but to act fast. For example, if an airport takes time to produce comprehensive analysis and schedules numerous meetings before starting the trial, the idea can become irrelevant.

However, legitimate preparation should be included to a certain extent to have the right quality of projects. Once an idea seems logical, a "scrappy" proof of concept (POC) should follow quickly, even if some things in the POC need time to be developed. There is a need to implement an idea and generate a quick answer from the pilot. Ultimately, this gives a profound basis for the decision on whether the airport wants to continue with the innovation, or only take the lessons learned. An airport stated that the

majority of trials and proof of concepts had been implemented and in production, although the airport was concerned that not all employees are willing to accept the “fail fast” mentality yet.

Innovation is also about encountering coincidences. One interviewee mentioned that they were lucky and the timing was just right for one major innovation project they ran. This project had derived from a crucial business need that had not been appropriately addressed. Therefore, it should be emphasized that it is in favor of finding such coincidences and airports should be open to unusual opportunities once they appear on the radar. Even if it fails at some point, lessons learned will remain valid for the airport. If something does not generate a positive impact as anticipated, it might be implemented at a later date. Since resources were put into the project, an organization should not merely end the project without learning from it first. One airport mentioned that if the new solution does not require too many resources to stay alive, it remains on the airport’s list to evaluate.

Location

▶ Leverage the Local Community

A resource that is also available and at hand is the community in the airport’s proximity. An airport should be aware and mindful of what the strengths of its local area are. Going face-to-face has many advantages and the local community should be actively leveraged in order to source and include ideas.

There are many ways as to how this can be done. For example, in a project specification, there could be processes established to include community feedback. Feedback could be sourced in an ongoing manner and be used to improve an area where needed.

▶ Create an Interactive Space for the Innovation Team

The leading paradigm is to design spaces to inspire and for collaboration. At one airport, part of their strategy is to physically segregate the employees working in innovation from the airport facility. Their office space is still close by but outside of the airport. The thought behind it is that in order to do things differently and be different they cannot be located within the airport.

Another airport has created an office for its innovation department within the airport’s facility. This office serves as a meeting hub for everything around innovation: it is an office space, meeting facility, co-working space for startups who run projects at the airport. All airport employees are encouraged and invited to show up with ideas and to have a chat. There are many ways to go about this topic. The leading paradigm is to design spaces to inspire and for collaboration.

3.1.3 Airport Business Structures

Governance Model

▶ Leverage the Advantages of Airport Business Structures

Airports are government entities, which means that they are public entities and have to follow state guidelines when pursuing their business, which has positive and negative aspects. There are different kinds of ownership structures in place, such as an authority. One interviewee stated that they have more control over their processes because they are an “authority.”

Some interviewees praised the transparency in the industry. Many government contracts are available online. Some organizations leverage this and screen official documents from organizations that have been previously successful. By doing this, they are able to observe how other contracts have been written about partnerships.

Another interviewee does not see being a government entity as a hindrance, but praised the credibility it provides to partnerships. One of the airports was in favor of being a public entity because it is known that as a public organization, an airport cannot spend tax money deceitfully.

As a government entity, having a procurement department is a prerequisite. Especially nowadays, it is perceived that some traditional procurement processes are no longer suitable for the business environment. Some projects are hard to categorize, therefore having a mutual understanding of each other’s processes helps make the best of the situation and see how innovation can be made possible. Furthermore, the procurement department should be leveraged as a strategic partner to pursue innovation as it can provide guidance and parameters on how to deal with external partners.

Competition

▶ Understanding Competition

The airport industry appears to be different from many other industries because there are many variables within the airport business. Among the interviews, the larger airports do not perceive that there is a competition among airports. The leading mantra among the industry is that it does not help if one airport is great for itself. As they are all part of an interdependent network, each airport has to ensure that the business is operational, keeping the airport network strong.

For the larger airports, innovation is less of a make-or-break decision concerning B2B airline relationships, as larger airports are served by many airlines. However, larger airports are more prone to capacity problems because the infrastructure was planned several decades ago when air travel demand was forecasted to be lower. Therefore, deriving from the interviews, innovation at larger airports is primarily focused on improving customer experience its capacity constraints. Here, innovation and

technology come well into play, enabling more B2C projects and are not necessarily tied to improving B2B relationships because this side of the business already works well.

However, the interviews highlighted that smaller airports perceive a sense of stress and competition within the business because it is harder for them to secure air service, which is crucial for the surrounding community. Therefore, innovation is seen as a way to improve the airport's processes. With exciting innovation projects, airlines may be attracted to what the airport can offer. Part of this is their quest to reduce costs for the airlines and improve processes that an airline can build upon if they locate to the respective airport. Therefore, among smaller airports, there is a higher likelihood for those types of innovation projects.

Industry Experience

▶ Build on Industry Experience

A crucial success factor is that an airport has to build on its tacit knowledge and industry-experience. The interviews reveal that most interviewees have built their careers for quite some time in the airport industry, with some having worked at their respective airports for a long time. The most common fields of the interviewees were IT and business. This expertise helps them to assess the feasibility of innovation projects and how to use technologies. They did not have an innovation-focused background. Rather, they were recently appointed to the innovation topic, or the innovation topic is a side part of their overall job.

Airport industry knowledge, while helpful to the success of projects is not sufficient alone. A comprehensive background can bring along a lot of natural curiosity in external circumstances, willingness to move the needle, and an open mind (as described in the cultural part of the enablers section). Part of this tacit knowledge that the interviewees bring along is knowledge about lessons learned, which they incorporate when thinking about the feasibility of new innovation projects.

For example, an interviewee mentioned that a crucial project was run "skunk work" style in the beginning. The term "skunk work" describes a group within an organization that works on a secret project. The advantage is that with a limited amount of people working on pursuing a specific project, it can be done with a higher degree of autonomy, unhampered by bureaucracy. Bureaucracy can kill a project before it would have been trialed or even started. Therefore, the skunk work approach enables the pursuit of projects that would have never been able to exist in its form otherwise.

In the context of industry knowledge, several interviewees also highlighted the value of airport industry airport associations to ease the exchange with peers facing similar business challenges. Furthermore, interviewees new to the industry find it extremely important to have these associations, with some having found great mentors within the industry through this platform.

Inspiration

▶ Embrace External Inspiration

The interviewees highlighted the importance to find inspiration from the outside world. An important aspect is continuous reading:

- to stay informed about the undertakings that other airports are doing,
- what technologies are developing or how they are evolving.

Especially for innovation-related jobs, it is important to “educate oneself about what’s out there” in order not to miss innovation opportunities. Especially for smaller airports with limited resources, it may be helpful to see where the big players are going. Besides airports, it is also interesting to see how technology is advancing and what new use cases are being seen. This can be achieved by reading articles from technology-related magazines and other innovative periodicals.

To future-proof the airport’s facilities, a few interviewees emphasized the need to be on track on how technologies will develop, and create a roadmap of actions that are to be derived from it. Nobody can predict technological development 20 years out, but there are tendencies one can include (e.g., Moore’s Law) and dramatic changes can be anticipated. Novel technologies are important for an airport because it is a highly technical field. An interviewee mentioned one action that drives the airport is anticipation. Whenever there is a construction site somewhere at the airport, his team ensures that more fiber optic cables are added in anticipation that it will be crucial in the future.

Another essential aspect of this is attending conferences. This brings the advantage of participating face-to-face in a vivid exchange with peers, as well as hearing about valuable solutions and exciting topics. Airports and aviation conferences provide industry-related input. However, some interviewees stressed that they prefer to attend conferences that are not focused on the aviation or airport industry because one can learn a lot from other industries and how they are approaching solutions. One should be aware that interesting advancements are happening in other sectors as well that can have a similar use case for an airport, especially on enhancing the customer journey, which includes aspects of the overall customer experience and satisfaction. There are many conferences out there that are perceived as highly inspiring according to the interviewees. In general, attending conferences may help deal with the current challenges the organization faces.

Table. 3.1: Innovation Conferences

AIRPORT CONFERENCES	NON-AIRPORT / NON-AVIATION CONFERENCES	

• ACI-NA Innovation@Airports
• Passenger Terminal Expo
• Future Travel Experience
• Airport Innovation Forum
• AAAE Airport Innovation Forum
	• Any conference relevant to airports, e.g.:
	  • IoT World
	  • CES
	• Any conference adjacent to the airport business
	• Startup week (local event)
		• It depends on want the airport seeks to improve. For customer experience, e.g.:
		  • Hotel / Concierge conference
		  • Retail conferences
		  • Maintenance and assets conferences

Several interviewees stated that they derived inspiration from visiting other airports. That does not mean to copy, but to observe and leverage inspiration form this.

- Airports in the same country can serve as a role model for some solutions because they are reliant on the same political conditions.
- One interviewee mentioned preferring to compare their own airport with other airports that have a similar organizational structure and ownership model – even though the other airport might be much larger in size. This is because these airports face similar challenges for procurement and approval processes.
- Additionally, some interviewees mentioned that they conducted site visits and meetings with officials from European and Asian airports. Interviewees highlighted the more advanced facilities and new solutions that can be found at European and Asian airports.

External Innovation

▶ Form Strategic Partnerships with Innovation Stakeholders

Innovation projects touch several airport stakeholders. For any innovation endeavor, a critical aspect of a B2B relationship is the selection of a suitable strategic partner. After all, the choice for a respective partner is to enable innovation endeavors. Commonly, partnerships are relevant to acquire the missing capabilities due to a lack of internal resources or missing knowledge due to a lack of internal expertise. It is of interest to everyone involved if that partnership works as seamlessly as possible. To fill these gaps, the interviewed airports are pursuing paid or unpaid partnerships. For the interviewees, it is of strategic importance to move the innovation agenda of an airport forward by finding ways to include this external workforce and add their input.

Within the interviews, several aspects were mentioned around what partnerships entail. The basis of this business relationship is a mutual interest and excitement around the projects and topics, as well as showing respect for each other. Knowing and trusting each other and having a common interest sounds straightforward, but these are crucial prerequisites and have to be established organically.

A crucial part is to look for partners in the relative proximity of the local community. Many startup hubs have now been established in many areas around the world, often with proximity to universities, which could be of interest. Innovative startups and outstanding tech talent can be found anywhere and local communities are establishing ways to ensure that this talent does not start to disappear. Airports that partner with local startup communities can support this by leveraging the local community and startup ecosystem themselves.

CASE STUDY – CHARACTERISTICS FOR A GOOD PARTNERSHIP (AIRPORT PERSPECTIVE)

- ✓ The partner has extensive experience in their field
- ✓ The partner is perceived as a leader in their country (e.g., verified through official awards)
- ✓ There is a cultural fit (which is always essential to a successful partnership)

An important strategic partner for airports is the federal government agencies such as the TSA and U.S. Customs and Border Protection (CBP). All interviewees emphasized that for partners that operate within the airport, it is important to know their requirements and future plans in order to make the right decisions for the airport. Another strategic partner is the airlines who operate at the airport. The innovators and change-makers within federal government agencies and airlines need to be identified and congenial relationships established with them. The innovators are the ones who are on the cutting edge and have innovation-decision power. Interview partners mentioned that they run monthly meetings with these stakeholders to discuss current developments and maintain a good working partnership. It is also one of the main means to learn what systems are likely to attract them and where they perceive the most value in technology for their customers and processes.

All in all, some interviewees mentioned that they noticed a positive change in the last couple of years: people are more apt to change and innovation, unlike before. This helps greatly in enabling innovation projects, but it also means you cannot maintain the status quo if you want to be on top of the game.

According to some interviewees, partnering with universities is perceived as more difficult to set up and pursue. Not many of the interviewed airports are engaged in it. Because of their nature of work, airports are very operational and are high-security areas. Also, academia pursues its work in a more theoretical world, in contrast to the practical world of airports. However, depending on the academic institution or department, a lot of basic research is done at universities concerning novel and exciting technologies. An airport can serve as a great testing environment and provide use cases that could be investigated with academic tools and technologies. If an airport manages to engage in such a strategic partnership, it enables the airport to gain easy access to these latest technologies. These technologies can be interesting but also provide access to an unbiased view of a new generation.

Local universities provide a great partnership opportunity due to their proximity. However, airports may also seek academic partners who do research in a field the airport is highly interested in. This means forming a partnership even if the research institution is located further away.

All in all, yielding positive experiences and results enable the thirst for more partnerships. Also, being able to state an industry example as "being the first" and constituting a role model is a valid incentive for an airport to pursue innovative projects and respective partnerships.

"Have people outside the airport industry to take a look at how things can be done differently at your airport."

Airports are increasingly focused on running their own dedicated programs to innovate with external partners. Advantages to this are manifold – with the main advantage that the airport gets suitable solutions tailored to the airport's specific needs. However, interviewees stated that setting up these programs is a lot of work that has to be handled on top of the normal airport's business and can, therefore, be difficult to justify.

Information Technology

▶ Innovation Projects are Technology Related

During many interviews, it has been emphasized that innovation is not only about IT and digitization. As much as an airport is an institution designated to enable aerial transportation, IT is an indispensable part of ensuring seamless operations. Many interviewees work in the IT department and many innovation projects are around the implementation of technology. In order to enable technology-based innovation projects, it is important to have a strong IT infrastructure in place to provide the needed service in a highly reliable manner. Solid data needs to be sourced at the airport to feed the systems and derive trustworthy decisions from it.

One airport mentioned that an integral part of their strategy is to gather any data sets available to the organization. The airport had a case where they had gathered data from a project as a side deliverable. A few months later, this data became highly valuable for testing a novel solution because it was exactly as needed and easily accessible. This example was partly coincidental but it highlights the importance of the availability of data in today's world. Therefore, it is beneficial to capture as much data as possible and have the necessary people ready to organize and process them.

"What we really do with innovation is, we try to target really specific problems that don't have obvious solutions. It is not innovation if you do an RFP, and there are 10 vendors out there who can do it. That is not new! "

3.2 Barriers to Airport Innovation

The following barriers were extracted from the interviews with airport employees. The qualitative discussion provided insights into the various factors that can hinder innovation at airports.

3.2.1 Organizational Setup

Innovation Strategy

▶ No Innovation Strategy Equals No Innovation

There are disadvantages of having no innovation strategy defined by airports. If there is no innovation strategy, the airport will find it challenging to improve the passenger experience and operational efficiency. Airport employees should develop an innovation strategy and then communicate this strategy to their stakeholders. The case study below provides an example of an airport with no innovation strategy.

CASE STUDY – BUREAUCRATIC COMMUNICATION CHAINS HINDER TO PURSUE NEW IDEAS

One interviewee emphasized that the airport's organization is exposed to lengthy and bureaucratic communication chains when they have an idea to propose:

An employee with an innovative idea has to go to their manager. The manager has to talk to their superior, and then the superior has to decide who they should talk to about the idea.

Numerous potential breakdowns can happen in this communication chain. In this case, the barrier is represented by bureaucratic processes and a missing formalized process to leverage employee's ideas. If employees are not encouraged to speak up, it can result in the missed potential of unaddressed improvements. Due to the high operational work at airports, employees usually have many insights and perspectives that can help to shape and improve airport operations. As a recommended best practice, when defining such a strategy, employee engagement should be considered.

Organizational Culture & Communication

▶ Not in Favor of Innovation

One fundamental prerequisite of starting innovation is to achieve a mindset shift within the organization. Starting with new innovation projects can be subject to a lot of discussions and internal resistance. If the ideas for innovation projects are very new to the organization, resistance can obstruct new projects because of too much uncertainty. If strength and a lack of willingness and understanding prevail, such projects are often eliminated in their infancy. Effective communication of an overall innovation strategy should be implemented for airports to succeed with innovation.

3.2.2 Resource Management

Human Resources

▶ Missing Crucial Human Resources and Talent Management

Several aspects concerning the airport workforce were mentioned in the interviews that create a barrier to airport innovation: the lack of and migration of talent in the workforce. Some airport innovation projects get neglected in their infancy due to an organizational lack of human resources to pursue those. A solution to this problem could be to have designated staff responsible for the organization's overall innovation efforts. Planning to hire staff for innovation should be coordinated and designed with the airport's overall innovation strategy. Many of the interviewed airports mentioned that they reconsidered their organizational structure when they addressed the topic of innovation. Another challenge for airports is attracting and retaining talent. Some airports have experienced airport employees leaving for Silicon Valley in California for more career opportunities.

Financing

▶ Justify Financing Uncertainty and Risk

Innovation projects are usually in competition with other airport projects. Often, it is uncertain if innovation projects will succeed. Therefore, airports may be hesitant to provide financial resources to fund innovation projects. Another barrier can be seen in the uncertainty of research grant funding when working on innovation projects with universities. Academic research is conditional to receiving grant money. Airports make a great research partner because they provide a specific testbed for data generation and use cases. However, writing research proposals to receive grant funding can be time-consuming and may not be in the best interest of the airport to allocate resources.

Timing

▶ When the Timing is not Right

Interviewees mentioned several aspects related to timing and why an innovation project did not work out, such as a downturn when projects take significantly longer than initially planned. Therefore, it is crucial to identify bottlenecks at an early stage to better address them in the future project management of innovation projects. One interviewee stated that for almost all innovation projects the timing did not work out due to cybersecurity concerns. Another interviewee mentioned that innovation projects need thorough clarification and explanation to all stakeholders – especially to those employees who approve them.

"Timing is everything…Building a new terminal is still going to take one year to plan, one year to design, and one year to build it. Technology moves fast in 3 years! That's the challenge in innovation at airports. Airports need a longer plan compared to the private sector. When the airport completes the terminal in 4 years, you can't use technology that is two years old."

3.2.3 Airport Business Structures

Governance & Industry Experience

▶ Innovation is not really in the DNA of Airports

There are historical entry barriers to break into the airport industry: The procurement mechanisms are complicated, slow, and difficult to negative. The procurement process could entail approximately 15 different steps. This makes procurement in the airport industry extremely long and tedious. The biggest hurdle to include external innovation at an airport, is the regulation of the minimum qualification and previous airport experience. Furthermore, it makes it extremely difficult for startups who are lacking this experience, no matter how desperately the airport would like to include their solution.

"Sourcing only after high scrutiny
– that's tough when you try to be innovative…"

Another challenge is that airports need to receive permits from local agencies. This can be challenging because many agencies have antiquated frameworks and processes that they follow in granting licenses. As a result, when an airport seeks a permit for new technologies, sometimes the local agencies find it challenging to accommodate the airports' request because it does not fit into the pre-established frameworks. One interviewee stated that these challenges led the airport to be more engaged in working together with the local agencies to update the frameworks and permit documentation.

Inspiration

▶ Airports Need to Escape the Industry Bubble

One interviewee mentioned that airports almost exclusively communicate within the industry itself, which the airport perceives as a weakness in the industry. Meanwhile, there is a tremendous amount of innovation outside aviation, for example, in retail, healthcare, banking, and stadiums, which have ingenious solutions that can be adapted to solve an airport challenge. Airports in other regions may have innovative solutions implemented at their airport. However, those solutions might not work out at airports in North America because of different regulations.

External Innovation

▶ Too much Planning can lead to Obstacles for External Innovation

Partnerships require contractual agreements. However, one interviewee stated that an approach that was too stipulated hindered their innovation capability. For one project, the innovation team ended up rewriting an agreement between the airport and their innovation partner. The goal is to be flexible with current technologic developments and dynamics of a market place.

Most airports do not have experience with startups, therefore it's difficult for airports to leverage new concepts and technologies from startups and implement them at airports. Equally, external companies

outside the industry – mainly startups – do not have experience with the requirements to work within the airport environment. Often this hinders these companies from winning competitive contracts.

Partnering with universities is not perceived as ideal by some interviewees because the nature of work is very different at academic institutions. Often, it's difficult for airports to identify solutions that have been developed by universities. When establishing a university partnership, it depends on what the university focus area is because airports don't want to allocate time and resources for a solution that may take 3 to 5 years to develop.

Information Technology

▶ Projects Fail because of Technological Constraints

Many airports face business challenges they need to solve. In some cases, technology is perceived to be the ideal solution. However, there may be times when the technology does not work and is unable to meet the solution needs. The solution might be a good idea in concept, but the technology has not been developed or is not mature. Sometimes, airports may find the need to drive an innovative solution internally by developing their own solution. Another IT-related barrier is the need for reliable data. Frequently, necessary data is not available or difficult to gather. Sharing of Personally Identifiable Information (PII) is often not permitted, and with data privacy regulations, it is a highly political and sensitive topic.

4 Conclusion

4.1 Airport Innovation Research

This whitepaper studied and determined the recommended best practices of airport innovation in North America. Throughout the expert interviews, qualitative research was generated to subjective answers. The interviewees' responses emphasized that managing innovation is a highly complex process for any organization, involving many stakeholders with various interdisciplinary backgrounds, varying responsibilities, and different goals. In the case of airports, there is not just the organization itself and its B2B or B2C customers, but also other government agencies (e.g., CBP, FAA, and TSA). Due to multiple stakeholders, there is a broad scope of different opinions and potential conflicts that need to be harmonized. Relatively recently, many airports in North America have started to define the innovation of the structure at their respective airports. The recommended best practices revealed interesting examples of successful and failed innovation projects.

A realization that could be derived from the research is that Canada and the U.S. are not entirely comparable concerning the enablers and barriers of airport innovation. This is mainly because of the governance models. Canadian airports appear to have more resources to fund innovative programs and they are more flexible and less bound to regulations. Since funding is crucial, this enables a higher propensity for Canadian airports to be innovative.

In general, the presented enablers and barriers are specific to North American airports because these are crucial factors to the success and failure of innovation projects for these airports. However, these findings can apply to other organizations and industries as well.

Looking back at this research study, airports do engage in some sort of innovation. However, airports are not the typical radical nor disruptive innovator: most airport innovations are incremental innovations. Airports provide their use cases that determine how existing technologies and products can or need to be tweaked in order to work in an airport environment. Most projects declared as innovation are actually problem-solving initiatives with existing technologies provided by an external company. Nevertheless, innovation is not determined by one static definition. The introduction of new technology might be a radical change to the airport business and the particular organization itself. But more broadly, it is not real innovation in the sense of introducing something completely novel or never seen before. Airports do not need to be and cannot be radical innovators because that is not their main purpose. It lies in the nature of their business that the real innovations come from other types of organizations.

This research has been undertaken to summarize and reveal examples of recommended best practices on how innovation can be conducted and managed at airports in North America. However, the challenge for any airport remains:

- How to continuously address the building of needed capabilities to successfully source ideas.
- How to match innovations to improve the passenger experience and airport operations.

It is clear that there is no simple recipe to follow, and there is never a guarantee for success. But the odds in favor of successful innovation can be improved for any airport. In this regard, several recommendations can be made that reflect on the expert's knowledge and exchange with airport partners.

4.2 Recommendations from the Findings

The following recommended best practices can help airports to pursue innovation activities.

1 – Focus on Solving Actual Airport Problems

An airport organization should initiate an innovative structure "solely for the sake of innovation". To have success with innovation, it proves to be helpful to streamline the number of innovation projects that are being pursued by the organization and focus on a few major projects only. A defined set of an airport's own core values may aide in deciding which projects are solving the most urgent airport problems. Staying close to the business unit helps to focus the work on solutions that provide real value for the airport.

2 – Collaborate with the Airport Industry to Ease Innovation

Some airports in North America have identified the topic of innovation as a strategic part of their operations. Tackling airport innovation makes everyone realize that it is a very complex and diverse venture. Therefore, it is challenging to put innovative initiatives into words and actions to create success stories. The airport industry needs these success stories to scale useful solutions from one airport to another airport. Every airport is unique, but many airports are also trying to implement the same or similar projects. There should be a well-established framework where the exchange of ideas and best practices can occur in the airport innovation community.

▶ Collaborate with Government Agencies to Overcome Outdated Processes

The interviews revealed that innovation projects at airports rarely happen in a timely fashion. Airports should work together closely with government agencies to overcome this barrier. Streamlined interaction and communication will help to foster innovation.

Update Permit Documentation	***Update Bidding Prerequisites***	***Establish Leaner Procurement***
Regulations and licenses in the airport sector are outdated and do not apply to modern-day projects and state-of-the-art products and technologies that airports want to adopt.	To get an airport contract, often companies need previous airport experience. There is a need for a more flexible process.	Consider streamlining necessary steps for the procurement process to allow for innovative solutions.

3 – Formulate your Airport's Compelling Innovation Strategy

 **URGENCY** *high*	 **TARGET** *airports new to innovation*	 **SCOPE** *internal innovation*

An airport should define its unique innovation strategy. It should reflect and represent the airport's unique organizational culture. This innovation strategy will help to enable the mindset to shift towards more progressiveness and creativity within the airport. The strategy should include several aspects, for example:

Innovation Department	Innovation should not be tied to the IT department. Instead, designated people who oversee innovation activities should be appointed to promote and drive innovation.
Unique Strategy	Definition of aspects that make the airport unique.
Core Values	Aspects that are important to the organization and community should be included.
Documentation & Knowledge	A lot of decisions happen in the course of the lifecycle of project management, which creates a lot of knowledge. Finding a way to preserve this knowledge can help to understand the dynamics of decision-making.

The innovation strategy should include a decision on these aspects as well:

▶ Airport's Employees Have Great Ideas

An incentivized employee engagement program should be considered. Within the airport, there should be one or more programs in place. Incentives do not have to be financial but provide opportunities for employee recognition. Employee engagement programs provide the airport the chance to leverage ideas from frontline workers who face the airport's challenges in their daily operations.

▶ Undertake more Innovation in Conjunction with Universities

Even though universities are more theoretical-oriented institutions and airports are operational, airports should engage in university research partnerships. Innovation is about ideas as well as an accidental discovery. Refining technologies and products out of university labs to the airport environment encourages incremental innovation but can also lead to radical innovation. Another advantage for airports is that these types of partnerships can be inexpensive but are an excellent way to source external input and resources.

▶ Work with and Support Your Local Community

The local community is one of the most important stakeholders for airports. There is a variety of opinions and ideas that can be leveraged from the local community that can influence and improve the offerings at an airport.

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Appendix: Airport Innovation Case Studies

The following case studies demonstrate the various ways airports across North America address innovation successes and challenges from facilitating a culture of innovation, implementation, to the long-term vision. Each airport case study focuses on internal and external innovation programs or projects.

5.1 Cincinnati/Northern Kentucky International Airport

Cincinnati/Northern Kentucky International Airport (CVG) is a medium hub airport as defined by the FAA and handled 8.86 million passengers in 2018 (ACI World Traffic Report).

Internal Innovation at CVG

According to CVG, they are an ideal airport to test solutions because they are a medium-sized airport. Once a concept is tested there, it can be more easily scaled up or down for implementation within other airports. CVG has been actively working on innovation and approaches the work in different ways.

CVG established an innovation department at the beginning of 2018. It consists of four designated full-time employees. The team structure is diverse, with complementary skills and backgrounds. The employees of this team have been with the airport for a period of time, ranging from one to twenty years. In general, CVG's approach is that an innovation team helps catalyze change across the airport.

CVG takes the view that silos should not exist in an innovative organization. Therefore, CVG seeks out solutions that can improve all areas of the airport. At the time of the interview, a dedicated area for an innovation office was currently under construction. The main purpose of this space is to house employees of the innovation department. However, it has been turned into a place where all CVG employees are encouraged to come and ideate.

CVG has an innovation strategy that they use to identify and assess the potential of any innovation idea. It consists of four pillars: Secure, Clean, Transport, Connect. Secure focuses on any aspects of enhancing security, like cybersecurity, preliminary and perimeter security. Clean addresses the efforts of being more sustainable, such as advancing efforts around waste reduction and more efficient use of energy. Transport looks at anything that makes transport more efficient such as autonomous vehicles, unmanned aerial systems (UAS or drones), and other forms of transportation. Finally, connect focuses on platforms and IoT technology that allows their employees to perform their job more efficiently regardless of the task, for example introducing new robots to housekeeping or a new platform for marketing. This strategy is communicated to the organization and other stakeholders; one month prior to the expert interview, a video had been published educating stakeholders on the strategy. The CVG

strategy points to a broad direction without over-strategizing their efforts as this would hinder the necessary creativity for innovation. The interviewee also stated that they seek out any projects that improve employees' jobs and workflows because they believe if they have an easier time pursuing their tasks, this momentum around innovation will enable a focus on enhancing the passenger experience.

Selected External Innovation Projects at CVG

At CVG, there is a constant flow of projects that are in the ideation and creation phase that then funnel into pilots that are executed for 3-6 months depending on the project. Upon completion, it is then decided whether they move onto full implementation at the airport. At that time, it would be discussed with their procurement team as to whether to go to RFP (request for proposal) or if there is shared intellectual property. If there is shared intellectual property the airport will look at a revenue share with the company. CVG is openly pursuing partnerships with different kinds of companies from early-stage startups to big corporations. The interviewee stated that innovative solutions could come in many forms: off-the-shelf, also known as plug-and-play, up through venture building. CVG is looking at technologies that can improve the airport experience. Many of these solutions come from outside of the airport industry. A key element in determining success is analyzing how technology can be used in the industry.

CVG aims to provide value to its home region. Apart from partnering with the local baseball team, the Cincinnati Reds, they also have partnerships with six local universities and the local startup community. A key partner is a startup hub in Cincinnati called Cintrifuse. The idea of Cintrifuse is to build a tech-based economy where startups can grow and locate in the region. Cintrifuse does this by connecting startups to mentors, funding, and mostly to their next customer, CVG uses this relationship to source startups that have promising solutions that could integrate at the airport. Unique to the region is the number of Fortune 500 and soon-to-be Fortune 500 companies.

CVG is the first American airport to launch autonomous sweepers and floor scrubbers. These autonomous vehicles allow for more efficiencies and produce a cleaner environment. It also allows the passengers to engage with new technology and become accustomed to it in a non-threatening way. You will see more autonomous vehicles in the future at CVG.

An important partner for CVG is the TSA. Together, they collaborate on projects that aim to improve passenger flows. This includes testing and deployment of technology, as well as analyzing situational data gathered with different technologies. In this regard, CVG and the TSA executed a project to estimate wait times at the airport's security checkpoints lines. This project uses technology that can absorb smartphone Bluetooth signals, thereby determining how long a respective phone with the corresponding passenger is waiting in line. Via monitors and the airport website, the current wait time at the security checkpoint is communicated to passengers, which helps lower anxiety. Furthermore, the information helps to improve TSA staffing levels, and it does not collect or store personally identifiable data from passenger smartphones. CVG highly values this partnership because they are one of thirteen airports that are considered an innovation partner by TSA.

Another improvement that was implemented at CVG focuses on IoT (Internet of Things). Whether alerting housekeeping to attend to high traffic areas, informing maintenance when equipment is down, or alerting passengers to when trains that connect the buildings are arriving, IoT has proven to be very useful. CVG has gone even further with IoT by connecting it to smartwatches that allow the employees to be less burdened with large, loud radios.

Although technology is an important aspect of innovation, CVG knows that innovation is much more than this. CVG strives to be good stewards of the community. This is seen in the LIFT® (Leading Individuals Forward Together) program, which they created in partnership with airlines, hospitals, and associations. LIFT is a shared-learning opportunity professionally designed for those with developmental disabilities, including those on the Autism Spectrum. Participants gain first-hand airport familiarization and encouragement to travel by air. Participants and up to three family members experience a guided tour including check-in, security, departure gate, aircraft boarding, and baggage claim. It again allows CVG to be an ultimately unforgettable positive experience for everyone.

5.2 Dallas Fort Worth International Airport

Dallas Fort Worth International Airport (DFW) is a large hub airport as defined by the FAA and handled 69.11 million passengers in 2018 (ACI World Traffic Report).

Internal Innovation at DFW

About their own uniqueness, DFW stated that their business works a little bit different compared to other airports. For example, DFW is aware of the fact that their airport has the main function of being a transportation facility. They own a lot of land and, therefore, do not have any constraints in regards to land. Furthermore, they have a revenue share model with their concessions.

With their stake to be the most innovative airport, DFW started to build up a central core innovation team from scratch in the last half of 2018. This team will consist of up to nine people by the end of 2019. The team's primary role is to deliver new products and services that improve the customer experience, increase efficiency or generate additional revenue. The team defines the innovation strategy, their definition, manages a portfolio of ideas and oversees the standardization of its process for the organization. The team's role also ensures the innovation pipeline aligns with the airport business strategy. Furthermore, the team is responsible for fostering a culture of innovation at DFW. The team's strengths are the different backgrounds and capabilities of its members. The team is divided into two functions: the front-end and backend teams. While the team is accountable for innovation, everyone at DFW is responsible for innovating. The team works closely with the business units to define problems, create value propositions, brainstorm solutions, assess technology, develop a business case and test and pilot solutions. The higher the risk of an idea, the more the innovation team is involved. As an idea becomes more defined, the business takes on more responsibility with a successful pilot being transferred to the business unit to operationalize.

There is no formal employee engagement tool established in the organization yet. However, it is part of the future development that a program is planned to take place a few times per year. The proposed structure for this program will be that the innovation team calls out a challenge around a specified problem statement to which employees can respond with solution ideas. In the next step, all employees can vote on the ideas for a few weeks. Winning teams will be allowed to take some time and work on the idea and, ultimately, pitch it to airport officials.

For the innovation team, it is important to focus and differentiate between all given opportunities: Projects the team takes in their area of responsibility are primarily Horizon 2 or 3 ideas. As a directive, DFW plans to have above 50 projects in their pipeline, and there are currently 55 projects in their funnel. All of these projects are at different project stages. Out of these, thirteen projects are active. Most projects tend to have a technology focus but that is not a prerequisite. An important aspect of testing a solution is to decide before testing upon which KPIs to measure the solution's success.

Selected External Innovation Projects at DFW

Since the beginning of 2019, DFW has been an official TSA innovation site. Being a test site allows for regular meetings with members of the TSA's ITF (Innovation Task Force). This relationship enables DFW and the TSA to collaborate on mutual areas of interest to improve the security and experience of travelers. This is especially necessary because the TSA usually tests a solution with only a few airports first, and DFW desires to be among these. DFW's unique design is an advantage. Their facility has five terminals with each terminal having its own parking, check-in and security checkpoints. Hence, DFW can test a solution in one terminal without affecting the other terminals. There are 15 checkpoints with multiple lanes, enabling flexibility to find the right environment for testing. Therefore, the rest of the airport can operate normally, whereas, at one specific terminal, a solution can be tested extensively. As an example, recent tests they have done in this regard include technology around the detection of explosives and a new way to screen airport employees. It's a truly collaborative effort as both parties are actively involved in approving and testing all solutions.

An innovative solution which Dallas recently tested at two locations within the airport is dynamic glass. This glass tints itself automatically when exposed to sunshine. The tests received positive uptake for the passengers as well as the airport businesses. This justified the project's business case, and DFW will now install it within the whole airport.

Recently, DFW sought for external innovation partners through an RFP. The reason was to extend its innovation bench strength. In this regard, they sought for different organizations that can augment the skillset of DFW's innovation team as well as add manpower – whenever needed in the innovation process. This flexibility will be helpful in the future to help manage the funnel of ideas and support the business units. Hence the different partners onboard. The team has its own budget so if a certain skill is required; they can source it through one of the partners. This format was chosen because the

innovation team was established relatively recently, and DFW is still trying to optimize the innovation process to meet the business needs.

DFW also has a partnership with universities. It is a member of the Texas Research Alliance and works with specific universities such as TCU (Texas Christian University). The students from the MBA program can work on various projects such as business model definition, market research, and concept validation. The students get a chance to understand better the airport business and its challenges and DFW has a chance to lay the groundwork for future interns or employees!

5.3 Minneapolis-Saint Paul International Airport

Minneapolis-Saint Paul International Airport (MSP) is a large hub airport as defined by the FAA and handled 38.11 million passengers in 2018 (ACI World Traffic Report).

Internal Innovation at MSP

MSP does not have a formalized innovation program within the organization. However, innovation is rooted in MSP's culture. According to the interviewee, leveraging innovation is about constantly asking "why?" to promote a culture of innovation. Asking this question helps them to look at why processes are the way they are so they can better understand and seek to change. Innovation, in its entirety, is not in the role of any particular person; it is the role and expectation of all employees at MSP. At MSP, the technology department has a centralized structure in order to better oversee all projects and distribute the available resources. Innovation projects lie mainly in this department from the perspective of execution.

The IT department has an unofficial strategy they follow with their daily work—especially where these projects are concerned. Their mantra is around simplicity. Their strategy foresees the rule that simplicity and elegance are better, and it is what the team strives for. They also believe it is better to have fewer "moving parts"; formalize solutions into one system instead of several.

A major change within the IT department has been the implementation of more flexible and digital solutions for the workforce, ultimately impacting how employees can pursue their daily jobs. This has served as a role model for the whole organization, allowing the IT department to act as a test-case before technology and solutions are rolled out and implemented by other departments. One example of this is the discontinuing of wired phones in most IT work areas, with communication instead of being done wirelessly via software on smartphones and laptops. The ability for employees to stay connected from anywhere also puts less importance on an employee's need to be connected to a single space or location. With this in mind, one of the offices IT works from also has the ability to be quickly converted to an emergency center if ever needed; employees are able to evacuate the space but remain connected through the various modes of technology.

Selected External Innovation Projects at MSP

At present, one very large project MSP is dealing with is the remodeling and reconfiguration of MSP's facilities, in particular, their entrance lobby hall. This includes many different projects that all fall under this umbrella. One of these projects includes MSP's desire to integrate the latest assistive technology. To create a better passenger experience, MSP plans to install a coordinated digital content management system (comparable with stadium technology) to make announcements and present information to passengers in a futuristic way. The new lobby will also include a project around the standardization of airlines' check-in kiosks. Currently, these kiosks are installed and branded by the airline. Because of the varying models of these machines, all of them function in slightly different ways. This is yet another area in which MSP seeks a simpler solution which also has the benefit of a more flexible system.

The interviewee mentioned that innovation projects are created in collaboration with other stakeholders, which include the CBP, TSA, airlines, and concessions. Often, what is considered an innovation project is a solution to make these stakeholders' work at the airport easier and more efficient. How the projects are facilitated also depends on the needs the airport has with the respective partner. At the time of the interview, extensive pilots concerning self-bag drop devices were underway. These were coordinated with major U.S. airlines as well as different self-bag drop machine providers. Through this project, IT helped to enable the physical installment and required technology for the pilot. Ultimately the usage and perceptions of the machines will be up to the experiences the airlines have with these products. Airline testing of these self-bag drop devices during the pilot phase will continue in conjunction with the various other projects MSP continues to manage in their ongoing effort to foster innovation.

5.4 Oakland International Airport

Oakland International Airport (OAK) is a medium hub airport as defined by the FAA and handled 13.59 million passengers in 2018 (ACI World Traffic Report).

Internal Innovation at OAK

OAK is a medium-size airport which is run by around 256 Port employees. The airport doesn't have an official innovation strategy nor any formalized innovation program. Rather what is happening at OAK with regard to innovation is happening organically in the day-to-day operations. Since OAK's focus is on sustaining the day-to-day, OAK is open to embrace new solutions whenever it makes the operations easier and safer.

Once a year, the management meets for a so-called "speed dating" event where the managers compare each other's work plans for the upcoming year. It helps to see each other's priorities as well as to detect dependencies among each other. This meeting provides a venue to discuss larger, strategic, and innovative opportunities for the airport. This happens organically during the event.

There is no formalized innovation team at the airport, but innovation is seen as a group effort. There is also no formalized way for how employees can submit ideas. However, OAK has an open-door policy, and managers should encourage their employees to bring ideas forward. If employees have an innovative idea, the employees can go to their manager who will bring it to the next level of the organization for discussion.

A recent innovative solution that OAK implemented is for its operations center to monitor the status of critical IT Infrastructure. The Aviation IT group, understanding that the operations group has two critical systems that must be monitored 24/7, did not want to bring another solution into their environment. Aviation IT instead digitized systems such as their network monitoring solution and displayed them as cameras in the video management system. This allows the users to use a system they are very familiar with to view the current state of IT infrastructure. Furthermore, no new tool had to be introduced to the organization, which is always incurred with further implementation costs, change of processes, and training.

Selected External Innovation Projects at OAK

Oakland has been chosen as an innovation site from several external stakeholders (CBP, TSA, Southwest). In this regard, OAK was one of the few airports for the early tests to let passengers self-scan their mobile boarding pass using their own smartphones. Nowadays, this technology and process are common across North American airports.

One way that OAK gets exposed to new innovative solutions from external companies is through Plug & Play events, which some of OAK's managers attend when the event focuses on airport solutions. OAK managers see these as great events to attend in order to learn about new solutions and technologies available.

A major change that OAK is currently undergoing concerns all of the airport's concessions and the passenger experience the airport shops reflect. At the moment, the gastronomic areas are being renovated and modernized. In this regard, OAK has an innovative concept around the new restaurants and cafes that are being included at the airport. OAK wants these to be of "local flavor" and only include businesses from the Bay Area. Some passengers have already complained that they were missing certain chains at the airport. OAK makes sure that their employees know about the direction of the change and can explain it to the passengers for their understanding. Part of improving the passenger experience at the airport includes increasing play areas for children because the airport realized that more and more minors are traveling.

5.5 Orlando International Airport

Orlando International Airport (MCO) is a large hub airport as defined by the FAA and handled 47.70 million passengers in 2018 (ACI World Traffic Report).

Internal Innovation at MCO

The organization's customer service goals are for an "easier, safer, faster, more comfortable passenger experience." The term innovation and how the airport can be innovative has been in the mind of the organization's executive leadership for years. In general, the mindset around culture is shaped by a progressive board that expects its organization to be first and leaders in innovation. By communicating this from the top, it follows through to all the other parts of the organization. Technologies are often critical elements of innovation so it is not surprising that the IT department has been a leader or participant in numerous innovations, including several "firsts" in the application of technologies in airports.

MCO is close to many theme parks, and this affects their organizational culture as well. Many people who work at the airport have experience in the theme park business, where it is common to provide an outstanding customer experience. The airport has a community partner relationship with the theme parks and other businesses and strives to be an extension of the "Orlando Experience" that includes them.

MCO has an employee recognition program that stresses providing an excellent airport experience. This is a training and reward program that focuses on MCO's 25,000 employee's awareness of continuously enhancing customer service. The idea of this program is to make people sensitive about good customer service at the airport and recognize if they are doing something great for a passenger. Employees can get rewarded if their outstanding act is seen by someone else and is submitted in a form. Each month, employees who did something above and beyond are invited to a luncheon just for them.

MCO facilitates internal IT governance meetings where they bring internal employees to the table to have a forum where everybody can speak up and bring in their thoughts about projects. These meetings facilitate ideas, teamwork, and technical resources that other departments often need to implement their ideas.

Selected External Innovation Projects at MCO

MCO has several partnerships with airlines, tenants, and federal agencies to engage in external innovation and they value these relationships highly. Part of this is monthly meetings with partners where everybody has the ability to bring opportunities to the table to be discussed.

An important aspect for MCO is to avoid building larger facilities but instead improve the processes that take place at the airport. In this regard, they were the first to implement biometric-enabled Advanced

Passport Control (APC) in their federal inspection stations. A project like this has a very large impact on the airport's processes and included intensive partnering with CBP, TSA, and a technology partner.

The new terminal facility that MCO is building includes numerous innovations that have major IT elements, including biometrics, navigation, and other sensors, visual communications, and entertainment. The Directors of Engineering and IT traveled to a number of top-ranked airports in the world and met with their counterparts to discuss technologies in those airports that seem to be good candidates for introduction into the new MCO terminal, as well as innovative combinations of technologies. One suitable innovation that arose from this was the effective and flexible allocation of check-in counters for airlines to ensure optimum use of these expensive and scarce resources. This enables the airport to adjust the number and location of check-in counters and equipment without compromising airline processes and branding. Rather, instead of providing check-in counters and kiosks dedicated to the exclusive use of one airline, an adaptable shared-use design was implemented. The design used standard dimension modules that could be re-arranged to suit each airline. It includes an uninterrupted full-motion high-resolution video wall behind the counters. This ensures outstanding branding opportunities for the airline using those counters at that time and for a different airline at a different time depending on the need at that time. These adaptable accommodations enable each airline to use their preferred processes and branding. That means that airlines can also include airport-owned and allocated computing and communications equipment to access their host reservation systems from any counter in order to print (e.g., boarding passes and bag tags) and to update the status of their passengers' travels. When no airline is using the counters, community content is shown (e.g., showing the landscape of Central Florida).

Since December 2015, MCO has provided turn-by-turn indoor navigation on an MCO mobile application. This was another first for US airports. As for most first implementations of technologies, there are no commercial off-the-shelf products, so finding a development partner is a necessity. In this case, the partner was Aruba, now a Hewlett Packard Enterprise company. Aruba, the source of MCO Wi-Fi access points, provided Bluetooth beacons from their first manufacturing run and their navigation engine that MCO incorporated into their mobile app. The pilot was successful and continues to provide indoor navigation throughout MCO terminals. Additional features have been added including the location of the travelers' car in the parking structures and voice navigation instructions.

Since summer 2018, MCO also partners with local universities to leverage bright and unconstrained thinking of young individuals, mostly students studying engineering-related subjects. One project that has been worked on is in the field of asset management, the integration of asset management systems with 3-D building design and construction models, and related information management.

5.6 Pittsburgh International Airport

Pittsburgh International Airport (PIT) is a medium hub airport as defined by the FAA and handled 9.66 million passengers in 2018 (ACI World Traffic Report).

Internal Innovation at PIT

PIT describes their organization's "Pittsburgh Culture" as being very transparent and active to facilitate outreach within the organization as well as the community. In 2017, PIT began to push the concept of innovation to the forefront of its decision-making and planning. This included a cultural shift toward being more innovative as an entire organization. PIT's approach to an innovation strategy relies on (a) mechanisms in place to allow people to express their ideas and capture them, and (b) the organizational structures to act upon these ideas. According to PIT, this is needed in order to infuse the organization's culture with an innovative mindset. That way, the entire organization (which encompasses 470 employees) is asked to engage in innovation.

Central to the organization are several channels designed to inspire and engage the entire organization via employee engagement. Among those channels are ideation workshops set up for employees. Also, there are several physical idea mailboxes installed in the facilities where employees can submit their ideas. These ideas go directly to the CEO, who reads through them. In addition, there is a "CEO message" delivered once a week that every employee can listen to on an internal phone line. Afterward, employees can leave a voice message for the CEO.

PIT considers these communication channels fast and responsive because employees do not have to fill out long forms or wait six months for an answer. PIT considers their mechanisms for employee engagement a success because many employees use them. The reason these different channels were put in place is that PIT realized many of their employees work in a variety of different environments at different hours with different duties. Hence, PIT sought ways to engage everyone. Employees appreciate knowing that their insights matter and that they are being heard. The reward for participating in these channels is job satisfaction as well as a social reward.

PIT carefully considered how to implement innovation functions within their organization. They have decided that this function should not live in a separate side department but rather span the whole organization. PIT realized some ideas could not be allocated to just one specific department, and in order not to lose any of these ideas, these can be handled by a general innovation team that spans the whole organization. Therefore, the innovation function has been set up within the executive office. This also makes it clear that PIT believes innovation is not just technology, although technology can be a solution used to generate innovation. In that regard, IT is part of almost every innovation project that PIT undertakes.

The Airport of the Year award served as a validation for the organization's culture. A success like that makes it easier to move forward with innovation and engage all employees.

Selected External Innovation Projects at PIT

There are various ways in which PIT engages with external innovators. The most prominent current project at PIT is the construction of a terminal building that is scheduled to open in 2023. This project provides PIT the opportunity to build everything from scratch and imbue that culture of innovation in the very buildings themselves. For example, PIT is testing a lot of technology to determine what to include in the construction process and for what reason. In 2018, PIT created advisory groups and almost every department has such a group to discuss best practices. Each advisory group deals with one specialized topic. There is a lot of excitement in the community about the project, and it is not hard to find various experts from the community who like to participate in these advisory groups. Each group meets in their own cadence since each topic needs to be active at different times during the construction process. PIT leverages these gatherings to gain insights and expert knowledge which will be included in the terminal project. The aim is to create an even more innovative new airport for the Pittsburgh area.

PIT is interested in people's opinions and concerns about the current and future airport facilities. Therefore, the terminal project has a website where the public is encouraged to send in ideas. Additionally, PIT is doing passenger surveys to gain further insights.

Since PIT assumes that there will be empty gate space available in the existing Airside Terminal, to which the new Landside Terminal will connect, the ACAA plans to repurpose it and provide a physical innovation space that can be used by the community. This "innovative maker space" will include a demo lounge and design space. It is meant to be used for partners such as startups. This space will become a flexible area where further airport innovation can happen.

Another way PIT explores innovative technology and what it means to the airport is through ideation workshops. For example, a workshop about IoT (Internet of Things) technology and the role it can play at the airport generated 40 initial ideas, out of which five projects were chosen. One of them, an AI-powered system that determines passenger wait times at security checkpoints with an accuracy of around two minutes, is now live at the airport. The system is simple, fast, and inexpensive, and provides a huge value for passengers as well as to the airport's overall safety system. In another example, with the help of an external partner, PIT held workshops teaching human-centered design with selected employees. The aim is to include more of these concepts within the daily work of the organization.

PIT also has several interesting partnerships. Among those is an organization formed in 2018 with the Pittsburgh Technology Council to seek startups focused on improving travel and hospitality. These startups are given the opportunity to pitch their ideas in events hosted in the airport's Airside Terminal once or twice a year. PIT leaders, as well as members of the corporate community, are invited to watch the pitches. PIT also has established partnerships with local universities, including Carnegie Mellon

University (CMU), the University of Pittsburgh and others. PIT has signed a memorandum of understanding with CMU which has led to several cooperative projects.

Other innovative airport projects involve, oddly enough, food. PIT has a partnership with a local startup that collects unused food from its concessionaires and redistributes it to needy families in surrounding communities. This helps alleviate food scarcity and eliminates food waste. PIT also works with a beekeeper who maintains three apiaries, or collections of beehives, at the airport. There is an advantage here for both parties: the beekeeper harvests honey from the apiaries to sell, and the airport gets a professional who cares for the property's bee population sustainably.

5.7 San Diego International Airport

San Diego International Airport (SAN) is a large hub airport as defined by the FAA and handled 24.24 million passengers in 2018 (ACI World Traffic Report).

Internal Innovation

The interviewee has been working in the airport industry for many years, and at SAN for almost a decade. The interviewee is part of the Customer Experience (CX) team, which in turn is part of SAN's Customer Experience & Innovation department. This department has been formed within the airport authority in order to pursue innovation activities at SAN. The CX team consists of twelve people who fall into the sub-teams of data analytics, customer experience design and innovation, and the arts. All employees have very diverse skill sets, the reason the interviewee brought them on the team. The interviewee emphasized that data and the arts are very different things that are combined within the team, but under the umbrella of customer experience, it all fits together and is necessary and helpful. Furthermore, the interviewee described the team as highly adaptable. The team has defined its brand promise as "Bringing good feelings to everyone nonstop."

Currently, innovation projects are happening in many departments of the airport, and innovation is assessed by the value it generates among diverse aspects. There is a cross-functional team of about twelve members that look at innovative and generated ideas for SAN. However, the interviewee's CX team has their own perspective on how they assess if an idea is worth pursuing. The innovation strategy that the CX team established and works with is four-fold. Any innovation opportunity that is assessed is benchmarked according to the following: (1) if it could make SAN more operationally efficient, (2) if it increases revenue, (3) if it helps to reduce costs, (4) if it is really a novel idea that has never been done before, and/or challenging a current process. If so, they keep it in their innovation portfolio. If it does not meet their innovation assessment, it is handed off to a different department.

At SAN, there is no formal process for how employees can submit their ideas. Instead, SAN hands out an internal award called "Innovator of the Year" since 2018. The award is organized by SAN's Talent, Culture, and Capabilities department, which deals with human resource matters. For this award, people

can submit an application with their project. A separate committee then looks through these and upon certain criteria, chooses a winner. This committee is organized by the Talent, Culture, and Capabilities department as well and includes employees from the San Diego airport authority. The first award went to a project that installed water vales in the pipes, which helped to reduce a substantial amount of water. This year, the award went to the airport's Innovation Lab, which the CX team runs on behalf of SAN.

Selected External Innovation Projects at SAN

A unique program can be found at SAN, called the Airport Innovation Lab, which is more like an accelerator program at SAN itself. In the Airport Innovation Lab, external startups can participate in streamlining their respective business idea and testing them at the airport. No other airport in the world operates a program like this.

The lab program itself is created and run by an external company, Detecon Inc. The SAN CX team's role is to coordinate lab activities among stakeholders at the airport. The program involves a series of workshops tailored to the startup's needs, and the different topics are meant to help them evolve and grow their idea. During the program, the respective companies have the possibility to test their solution 'live' in the real airport environment at SAN. At the end of the program, the startups present the selection committee with their results and solution. The selection committee decides if they want to move forward with the company to negotiate a contract for a continued partnership. Participation in the program includes a revenue share between the company and SAN. On the last day of the program, the startups present their solution at an event called "Demo Day," which is open to anyone to attend.

The program structure is not fixed and is continually refined and improved upon. As of now, two official batches have taken place, and each program ran for 16 weeks. Currently (as of July 2019), the third 16-week batch is being planned. One iteration to the program based on their learning is the establishment of a one-year-long program, which will run in parallel to the two 16-week programs per year.

The initial idea for the lab grew from the interviewee and a few other people. Three aspects speak for the facilitation of the innovation lab: teaching the community, overcoming industry barriers, and creating new sources of revenue. Firstly, local communities are not familiar with the airport industry. Participating in the lab helps local businesses to get exposure to it and learn about it. Secondly, there are certain entry barriers when trying to do business within an airport. Due to their government background, there are tedious procurement procedures. Businesses can only take an airport contract, which is a government contract if they meet the minimum required years of airport experience for the given contract. This limits the possibility of incorporating highly innovative Horizon 3 ideas within an airport environment in its germination. Thirdly, the lab aims to enable the generation of non-airline revenue. In general, the lab facilitates exposure to the airport industry for early-stage companies, which would otherwise be hard to obtain. Participating in this lab will help them gain knowledge that the external provider, as well as the airport authority, provide them with.

At first, the lab was a side project of the IT team because the innovation department did not exist. The lab exists in its form is not to be taken for granted and can be tied to certain steps by C-level staff. Firstly, in order not to be crushed by bureaucracy, the team who wanted to pursue this idea persuaded the executives about the idea and then worked on it furtively. Secondly, due to the interviewee's role back then, some of the original IT budgets were reallocated to help to fund some aspects of the Innovation Lab, including building the space. Thirdly, once the construction was done, they presented the idea to the board of directors, who were immediately also excited about the project. The team has a high level of trust within the organization because they delivered well on other projects before. Therefore, they have good standing and credibility within the organization.

It is free for startups to participate in the Airport Innovation Lab. However, they do not get paid, so applications the program received become more localized with each batch. Consequently, the interviewee maintains that such a program should be duplicated at other airports as well to help the local community learn about the airport sector. And even more so, for the airport industry to be able to source capabilities, talent, and the latest emerging technologies.

Another project is about to take off at SAN, where an external company will be hired and taken inboard to help them to improve the customer experience at the airport. SAN will start working with a company once they have been selected. One part of this project will be to collect more data about their passengers in order to know more about users of the airport. Part of this involves collecting more data than what CX team the data analysts is capable of analyzing.

5.8 San Francisco International Airport

San Francisco International Airport (SFO) is a large hub airport as defined by the FAA and handled 57.74 million passengers in 2018 (ACI World Traffic Report).

Internal Innovation at SFO

The airport's mission is to provide an 'exceptional airport in service to our communities.' For SFO, innovation is the cornerstone of developing and delivering exceptional service. In a recent interview, the airport described some of its approach to innovation.

Innovation at SFO is not the remit of one single department. Instead, the airport runs an organization-wide program called Reaching for Number One (R4N1), which typically focuses on different inter-departmental teams to work on specific themes that require an innovative solution. The R4N1 program is sponsored directly by SFO's CEO. Each year, the CEO consults departmental heads on key themes to pursue annually and to include in that year's R4N1 program. A team is formed around each theme. Airport staff are invited to volunteer to work in any of the teams and their immediate supervisors are encouraged to approve their participation. In any given year, the program may have up to ten teams of typically eight members each. Each team presents a progress report on its respective theme six months

into the program and a final report at year-end. Themes can vary as widely as delivering charity events to support a local community for solving a complex airport business issue.

Each program team has its own executive or senior management sponsor and an appointed lead. Teams typically meet monthly and are free to determine how they would like to tackle the mission at hand. Participating in the program is a career-enhancing opportunity that allows staff to work with colleagues that they might not typically meet in their day-to-day job and on issues that are outside of their usual remit. Participation is celebrated with the entire program at the end of the year. Frequently, a project that commences as part of an R4N1 initiative may need to continue beyond the end of the annual program. In this case, the project will be turned over to the airport department which is responsible for this type of implementation.

As innovation is a focus of the R4N1 program, technology often plays a role in several teams' solutions. Sourcing technology solutions as part of an R4N1 initiative ensures a focus on best-of-breed solutions rather than on specific technologies. Monitoring the technology marketplace for potential solutions to apply at the airport is a year-round activity for the IT team at SFO. This 'background' task can help ensure that R4N1 teams are not starting from scratch when looking for solutions. Collaborative projects and experience-sharing visits and conferences are commonplace. These practices provide airports with significant head-start when exploring innovative options to address challenges.

A recent and notable R4N1 project focused on finding ways to reduce the consumption of water at the airport. The Airport and its stakeholders, including restaurants and stores, use large quantities of water in the course of day-to-day operations. The team was very resourceful and came up with very innovative ways to conserve water and also discovered how water was wasted through their in-depth study of the use of water at the airport. Their approach included talking to the restaurants at the airports about saving water, applying technology in pipes to quickly identify leaks, and talking to horticulturalists to identify which water-efficient plants the airport should plant. All in all, their efforts accounted for a 30% reduction in the consumption of water at the airport.

While R4N1 teams do not have their own budgets and mainly rely on staff time outside their day jobs, they are well-supported by various enterprise resources should they need them, including procurement, finance, and HR.

Selected External Innovation Projects at SFO

A topic of considerable interest at SFO is autonomous technology. SFO has previously collaborated with the international aviation community through IATA's Simplifying the Business initiative on researching the potential uses of autonomous technologies at the airport. Concepts explored include autonomous jet bridges, aircraft inspections using autonomous air vehicles (drones) and autonomous bussing operations between aircraft and terminal. SFO sees the possibility of removing the risk to humans from potentially dangerous tasks and the opportunity to focus airport workers on more highly-

skilled jobs. An area of interest for many airports is the development of autonomous vehicles for landside operations, including taxis, ride-hailing, ridesharing, and bussing operations.

SFO actively seeks to work with airlines, federal agencies and local community stakeholders on innovations that deliver benefits for all involved. The airport is a designated TSA Innovation Task Force airport in the U.S., which means that the airport works hand-in-hand with TSA and other airport stakeholders, including airlines, on ways to improve the safety, security and passengers experience.

Although SFO has the advantage of proximity to Silicon Valley and top universities, its innovation teams work with education and research from around the world. The airport recently participated in an academic partnership with Ph.D. candidates from Texas A&M University to study the topic of landside traffic management. The airport is also a collaborator on research projects with the World Economic Forum (WEF) and working groups of Airports Council International.

As an active member of Airports Council International – North America (ACI-NA), SFO is working on an initiative to create a worldwide data-sharing platform for airports, airlines, and other aviation sector stakeholders. The need to share data responsibly across the aviation value chain is important to improving not only the efficiency and effectiveness of airports and airlines but also the passenger experience. For example, airlines' ability to provide security checkpoint wait time information through their passenger app using real-time information from the airports is a very valuable service to passengers. For airlines, this data must be available in an agreed standard form from all airports. The data-sharing platform must enable the exchange of data uniformly. Although every airport is different than the other and has its own physical characteristics, the SFO team believes that the digital characteristics should be openly standardized and openly shared in order to create value for the industry and its customers.

5.9 Seattle-Tacoma International Airport

Seattle-Tacoma International Airport (SEA) is a large hub airport as defined by the FAA and handled 49.85 million passengers in 2018 (ACI World Traffic Report).

Internal Innovation at SEA

SEA considers its **3 million square foot airport a live lab** that different companies can use to test their new products. The airport's aim for innovation is to target specific problems or opportunities which "move the needle" on their priorities. Hence, they have a large portfolio in very diverse projects. To promote innovation and projects, the Airport's Managing Director created the Innovation Accelerator program and a new team to manage the initiative. The team's designated role is to promote innovation within the organization and build an innovation culture. This team looks at the feasibility of an idea from a business perspective. Furthermore, every director has a minimum of one innovation project on each of their agendas for each year.

Employees are actively encouraged to approach the innovation team with their ideas. This is enabled through a **web-based suggestion box**. Everybody who enters an idea gets a little reward (in the form of an "innovation" lanyard). This suggestion box is the basis for all employee ideas generated at SEA. Once ideas have been reviewed and categorized, the innovation team will then reach out to the idea initiators. They help employees discover the feasibility of their ideas and a path to implementation. The innovation team's effort is based in part on coaching other employees on techniques in analysis, conducting research on their ideas, and creating a "lean canvas" business case. The best ideas are prepared in a way to be presented in a **"shark tank"-like employee innovation event**. SEA started to facilitate these events in summer 2017 and now runs three to four events per year with five to six presenters each. This event is based on ideas from SEA employees, who present their concept and try to convince the SEA leadership team about their idea in order to receive funding for it. The whole airport is invited to sit in the audience during the event.

At the time of the interview, over 100 employee innovation projects had been handed in already, and 32 were presented at the event, out of which nine were put on the airport's agenda. One of the most popular ideas that came out of it thus far was an assistive technology solution to help visually impaired people to navigate. More specifically, the impaired person wears these glasses, and through a camera, someone abroad provides an assistive service, such as explaining to the person where to walk and what lies ahead.

Selected External Innovation Projects at SEA

Around 40 (innovation) projects are on the general airport's agenda, with three of these considered as major projects. Large capital projects change and enhance the infrastructure, like SEA adding more gates for additional aircraft capacity. According to the interviewee, since these projects are sometimes sourced through an RFP, they cannot necessarily be called innovation because RFPs usually source already available technology. When SEA is looking for a technology that they want or need to implement, the airport will issue an RFP that describes the business case and SEA's requirements. SEA is one of the first airports that implemented a camera runway radar system. It does not directly support the passenger experience but overall airport operations. Usually, an airport uses vehicles to detect debris on the runways. SEA, though, installed a millimeter-wave radar body detection solution for runways.

What is very innovative is that a lot of the other SEA projects deal with testing and introducing new technology at the airport. For example, SEA recently installed a **passenger wait time system** based on computer vision technology. Also, SEA is extensively testing **dynamic signage technology**, such as smart signs that use voice signals or project signs onto the floor. One area of implementation for this technology is to **prevent escalator falls proactively**. This is especially targeted at their eight-story parking garage because it is where there is an extremely high need for passengers to move between stories. Preventing escalator falls is meant to be done by enhancing and promoting the use of elevators instead. Since innovation is a lot about testing, SEA is trying different things. After each test period,

employees look into the data and see how much a certain solution has increased or decreased elevator usage.

A system SEA considered recently and that was approved for funding in summer 2019 is that the airport will buy an **app to report** any sort of **incident at the airport**. Reporting anything requests a service to handle it at the right department of the airport. Incidents can be unattended bags, broken equipment, and dirtied areas. The idea is to be quicker in handling these concerns and ultimately improve the passenger experience.

A project that is aiming to improve passenger experience without technology, but requires more coordination, is an **Airport Trusted Visitor pass.** It enables non-passengers (people without a ticket) to be able to go beyond security to bring a family member to the gate or pick someone up. For this program, SEA quickly realized its success when they did the first pilot program because all available tickets were taken in an instant. The SEA Visitor Program was launch in December 2019.

All in all, SEA has the quest and advice for airports that it is very important to test each project – including to make projects "future-proof." This includes thinking ahead in the development of technologies and trying to anticipate the future. One way how SEA seeks to become more "future-proof" is to install more fiber cables every time there are infrastructure changes at the airport.

5.10 Tampa International Airport

The Tampa International Airport (TPA) is a large hub airport as defined by the FAA and handled 21.29 million passengers in 2018 (ACI World Traffic Report).

Tampa International Airport's distinction as one of the most passenger-friendly airports in the country dates back to the airport's first – and longest-lasting – innovation: The original airport design. Featuring an efficient hub-and-spoke layout, TPA was the first airport in the world to use automated people movers to connect landside and airside terminals to ensure that passengers did not have to walk long distances. The new technology helped TPA earn the designation as the "airport of the future" when the doors first opened in 1971 and the design has served the airport well for nearly five decades. TPA now accommodates more than 21 million passengers annually while offering a guest experience that is second to none. In the past few years, the airport has received top awards on the state, national and international levels, including being named the Number 2 domestic airport in reader polls by both Travel + Leisure magazine and Condé Nast Traveler. The airport recently completed its largest construction program: expanding its main terminal and opening a 1.4-mile people mover extending to a new, state-of-the-art rental car facility. The airport also completed a concessions redevelopment, adding 70 new shops, restaurants, and services with an emphasis on local flavor, brands, and designs.

These major capital projects serve as a backdrop of change and innovation that permeates every department at Tampa International Airport. Whether adding new passenger-facing amenities or behind-the-scenes technology, TPA is frequently innovating to improve the passenger experience and streamline internal operations.

Internal Innovation at TPA

Innovation is all around at Tampa International Airport – from impactful new technologies to incremental process improvements. Through all these efforts is one common thread: A desire to improve the guest experience. In some cases, these changes are highly visible (e.g., new remote bag check facilities), while others remain invisible to the passenger's eye (e.g., predictive analytics). The initiatives highlighted here demonstrate the importance of creating a culture of innovation that begins at the top with clear and frequent support from the C-suite and members of the Executive team. At TPA, the Executive team has embraced innovation, codifying “Innovation and Process Improvement” as one of the airport’s five strategic objectives. With the support of the CEO, the airport has adopted “Engage. Innovate. Transform.” as an unofficial slogan and the message is frequently repeated in town halls, team briefings, and other internal communications. The airport team has seen that innovation can come from anywhere, but for it to be truly successful across the organization, it must enjoy strong support from the top of the organization.

Office of Innovation: Tampa International Airport has enjoyed widespread organic innovation without much of a formal structure in place. In 2019, the Airport’s Executive team decided to formalize the process of innovation with the creation of an Office of Innovation.

While not yet fully established, the Office of Innovation aims to create additional channels for employees of all levels to bring forward innovative ideas, promoting a more active innovation mindset, and serving as a destination for ideas to be developed and nurtured. The initial idea came from a person within the C-level who, due to the organizational structure at TPA, oversees several departments: HR, IT, and legal. This manager realized it would be beneficial to use these different assets of people and their different viewpoints.

Once fully established, the idea of the Office of Innovation is to communicate to the whole organization that there is not a small innovation team, but rather to encourage all of TPA’s employees to innovate. TPA’s management is aware that this requires a big shift in everyone’s mindset. Therefore, part of the new strategy is to communicate that every employee’s innovative idea will be heard. To do so, the Office of Innovation will include several mechanisms for vetting ideas and bringing the best to fruition. This part will also include a reward for the employees.

Selected External Innovation Projects at TPA

These five innovations and the story behind them demonstrate how the organization is improving the airport for its passengers, guests, and employees:

Paperless initiative: Tampa International Airport is in the process of moving to a new office building to help make room for additional passenger traffic. As part of that move is a transition to a digital workplace with a 30 percent reduction in copy paper usage for the Fiscal Year 2020, which runs from Oct. 1, 2019, through Sept. 30, 2020. The goal, which began with the airport's Procurement Department, has been integrated into the airport's Fiscal Year 2020 Employee Incentive Program, giving it added weight by tying it to end-of-year bonuses. For many, the goal simply means cutting back on printing and copying when digital documents will do. Practical changes include reducing paper handouts at meetings, using video screens, tablets or laptops for shared documents at meetings, and, generally, thinking twice before printing.

The airport has come up with several technological improvements to support this initiative:

- All employees are being transitioned to laptops, phasing out desktops whenever feasible for the new office spaces.
- The Airport has adopted a file-sharing software with a goal of ultimately storing all of TPA's internal airport documents in the cloud.
- All conference rooms, huddle rooms, and many of the airport's other shared spaces will be outfitted with monitors to allow for easy digital collaboration, eliminating the need for paper, and opening access to a suite of digital tools.

Predictive analytics: Tampa International Airport's predictive analytics is the best innovation that guests will never see. Using actual passenger data and coupling it with robust algorithms, TPA's predictive passenger analytics tool provides real-time analytics for customer movements. The Operations team first identified the need for predictive analytics during a benchmarking visit to Dallas Fort Worth International Airport. Led by Executive Vice President of Operations and Customer Service John Tiliacos, the Airport quickly realized the value of the software for planning and real-time operational insights – something that could not previously be quantified.

The tool was discovered through conversations with organizations that were interested in working with airports to develop solutions that could solve problems and increase the efficiency of their operations. A partnership was formed to put together a proof of concept (POC), and this led to the development of the intelligent airport management system which is now in production at TPA. It allows TPA's Operations team to get a live look at passenger flow, helping to manage everything from the Airport's security checkpoints and curbsides to restroom maintenance. It also assists with staffing management, helping managers to understand where and when to deploy the team. The program is credited with helping maintain smooth operations during a period of record passenger numbers in 2019, including peak volumes upwards of 80,000 passengers a day – a large increase from the normal daily passenger numbers.

Remote bag check facilities: The Airport's innovative remote bag facilities debuted in 2018 with the opening of the new Rental Car Center. Located a short 5-minute ride away on the airport's new SkyConnect people-mover, the facility moved the Airport's rental car operations away from the Terminal

curbsides to reduce congestion, eliminating some 3.8 million vehicle trips per year from the roadways. The move also meant that guests would need to travel a bit farther to get from the Main Terminal to their rental cars.

To maintain Tampa International Airport's high standard of customer service, Airport CEO Joe Lopano and the Planning and Development team came up with the idea for a new remote bag check and boarding pass printing kiosks. The twelve kiosks print boarding passes and luggage tags for all domestic passengers on American, Delta, United, Southwest, and Spirit. These airlines represent the vast majority of all passengers.

With this service, guests can print their boarding pass and check their luggage without ever heading to the ticketing level. The kiosks were an instant hit with passengers. Since they debuted in 2018, guests have checked more than 581,000 bags, led by Southwest, Delta, and American.

Express curbsides: TPA's Master Plan expansion allows the airport to expand its capacity to 34 million annual passengers. Express curbsides for passengers without checked luggage are a key innovation that makes this possible. Led by the Airport's Planning and Development team and consultants, the airport came up with a plan to add eight pick-up and drop-off lanes to each side of the airport to decongest the Airport's existing curbsides.

These curbside lanes allow departing passengers to bypass ticketing and head directly to the gate, helping reduce congestion at the ticket counters and on the ticketing level. The express curbside lanes, believed to be the only such type of curbside in the country, addresses the growing issue of curbside congestion due to growing passenger numbers and increased presence of rideshare vehicles head-on in a unique and out-of-the-box way.

TPA All Access: In 2019, TPA became one of the first airports in the country to launch a program to allow non-ticketed passengers past TSA security to enjoy some of the Airport's unique shops and restaurants. The program, launched in May 2019, has enjoyed widespread attention in the local, state and national news (e.g., USA Today, Washington Post, Los Angeles Times).

The idea for a post-security program, which was first offered at Pittsburgh International Airport, was led by the airport's Communications, Operations, and Guest Services team as a way to show off some of the airport's new concessions concepts. The airport recently completed a complete overhaul of all 70 of its shops and restaurants, including a focus on more local offerings, and other unique locations not found elsewhere in the state. The community has jumped at the opportunity to get this unique view of the airport and about 1,500 people have taken advantage of the program to date. The program expanded in January 2020 from Saturdays only to every day now, giving greater access to the Tampa Bay community for shopping, dining – or simply spending time with loved ones before a flight.

5.11 Toronto Pearson International Airport

Toronto Pearson International Airport (YYZ) is a Canadian airport that handled 49.51 million passengers in 2018 (ACI World Traffic Report).

Internal Innovation at YYZ

At the time of the interview, YYZ is currently developing their broader, overall innovation strategy for the airport. This is led by the Strategy and Growth team, which is a department within the Greater Toronto Airports Authority (GTAA). The IT department is a key partner in the development of their innovation strategy. In this initiative, the role of IT is to advocate for the IT-related perspective because this is the mandate they cover. As soon as the innovation program is finalized, it will be communicated with the rest of the organization. The idea of the final program will be to leverage ideas from anybody working at the airport. This project is meant to capture ideas from approximately 1,800 employees at GTAA as well as approximately 50,000 employees who work at airport operations and in businesses at the airport. Therefore, the authority sees the value and insights that these frontline employees gain from working with the customers every day. The idea about the innovation program is to include and encourage all employees and try to make sure that innovation is on top of their mind. The purpose of the innovation program is to foster and support creative ideas at the airport that the GTAA has never seen before.

The GTAA is pursuing a balanced innovation portfolio, with a mix of initiatives from those considered to be an incremental improvement to those that are leading edge. Although the overall organization's innovation strategy might not be finalized yet, the interviewees stated that they had a head start dealing with innovation, supported by a partnership with their IT Services outsource provider, Wipro Limited. That means that on the IT level, they are already actively dealing with innovation. The IT department's innovation will be incorporated into the overall GTAA innovation strategy structure. The IT department already started with its innovation strategy and will continue with it the way it is currently set up.

Selected External Innovation Projects at YYZ

Currently, there are around 50 innovation projects running at YYZ in total. These are in different project stages: from early on in the ideate stage, to having been deployed and tested. The GTAA primarily gains their ideas to solve problems and do projects from three main sources. Firstly, from various aviation industry sources, as well as aviation-related or non-aviation-related conferences. Secondly, talking to and working with internal and external stakeholders that operate the airport who have problems that need to get solved. And thirdly, ideas are provided by Wipro. Wipro is a very important strategic partner for YYZ and was brought in in 2016. What YYZ has done was to outsource their IT operations to this company. The contract with Wipro includes providing and delivering IT services but also partnering on innovation, which is contractually specified. Hence, Wipro is involved with innovation projects at YYZ. YYZ does proof of concepts and pilots together with them. The GTAA is very satisfied with Wipro because they bring in special technical expertise and experience from projects they did elsewhere.

A fully implemented project that is seen as very successful is centered around improving the passenger experience. At YYZ, one of their connection processes at the airport involves bussing passengers airside. Passengers using this connection process take an airside bus to quickly arrive at their gate so they can catch a connecting flight. Not knowing where these connection buses are at any given time and how long it takes to travel to their gate created a negative passenger experience because the uncertainty created anxiety. With the help of Wipro, YYZ addressed this problem by retrofitting their airside buses with the Internet of Things (IoT) technology. Now, there are monitors at the airside bus stops. Passengers can see in real-time where the buses are, when the next one shows up and how long travel times to the other gates are. This project generated different successes for the airport. Most importantly, the passenger experience was improved based on the fact that passengers' anxiety levels were reduced. The interviewees understand the fact that IoT can be used in similar ways at an airport to resolve other common problems.

Another project was concerned with mainly the airline's operations when facing passengers. The problem was that it could take several minutes to **report a broken kiosk or workstation** within the airport. The old process required an employee to call the IT operations helpdesk (which included time to tell them the location, device, and the problem). To solve it, the idea was to add NFC tags to the airport equipment. Therefore, when a device is broken, employees can simply tap their phone onto the equipment’s device, and via a website, the problem gets reported to the helpdesk ticketing system. This process takes only 10 seconds, which directly translates into time-savings for airline agents and IT help desk agents. This is especially helpful when employees are faced with many passengers who need to check-in. A further benefit YYZ discovered once the system was running was the accurate information that gets fed into the IT system. This means that they can better analyze their equipment and make a trend analysis, such as around the maintenance schedule of airport equipment.

5.12 Vancouver International Airport

Vancouver International Airport (YVR) is a Canadian airport that handled 26.02 million passengers in 2018 (ACI World Traffic Report).

Internal Innovation at YVR

YVR has four core values for the organization, with innovation being one of them as well as Accountability, Team Work, and Safety. The intention is to put innovation in the mindsets of the whole organization and not just a specific team. In 2020, YVR plans to engage employees through an innovation management website that will track the progress of innovation projects while giving employees the ability to co-create, collaborate and participate in the various stages of each project.

Part of YVR’s innovation portfolio is Innovative Travel Solutions (ITS), which is one of the departments at the Vancouver Airport Authority. This department was formed at the end of 2014, and around 30 people, either full-time employees or consultants, are dedicated to working on innovation projects. The

primary objective of this team is to manage the corporate innovation program which looks at solving challenges at YVR in alignment with YVR's strategic objective. ITS's office space is intentionally *not* located at the airport, but a short drive away from it. Part of the idea around this is to be able to think differently. Historically, innovation at YVR is categorized into "Big I" and "Small i" innovation. "Big I: innovation projects that YVR considers as transformational and disruptive technologies. "Small i" innovation are such projects that are great to have at the airport, but are not disruptive in the industry, and which are not going to be commercialized by YVR. Through the various iterations of formalized innovation programs at YVR, most departments do their own small i innovation projects, while ITS tends to focus on more of the "Big I" innovation projects.

Leadership at YVR encourages "trial and error" around how to support being innovative, and that is why they try a lot of things around innovation and how to bring the message out to the larger organization. For example, the main driver in YVR's quest to be an innovative organization is that it launched several employee engagement programs at the airport. Thus far, they have launched six different programs encouraging employees to engage in innovation by bringing ideas forward and thinking differently.

One example of an innovation program initiative was to give employees "space to think". This allocated a few hours every Friday where people had to keep their morning free, with no meetings allowed. The idea here was to enable people to free up time from their daily routines, tasks, and meetings and give them the ability to work on a project that they wouldn't necessarily have the time to do so otherwise.

Selected External Innovation Projects at YVR

If YVR doesn't have capabilities themselves, they engage external innovation partners to help. It is important to source the most suitable strategic partners for projects. Suitability is based upon expertise and knowledge, experience from past projects, and, if possible, being located within the community.

For Innovative Travel Solutions, external partnerships also support future generations, through internships and co-ops. This is seen as a way to give back to the community, as well as a chance to engage with the future generation to work at the airport and offer new perspectives and question processes currently used to see if there are better alternatives.

There is one major innovation that YVR is very famous for because it became an international success: BorderXpress. These are border control self-service kiosks used by arriving passengers when they enter the country. These kiosks were designed by ITS for use at YVR to help with growing passenger numbers, but BorderXpress has been commercialized and they are now in 43 airports and seaports around the world. This success story is a good example of the complex aspect of airport innovation because it came from an internal idea, but YVR had to collaborate with government and airport stakeholders whose processes this solution touches as well. The idea for this product came from a challenge YVR faced in 2008. When arriving passengers were met by long lines, which led to agitation. To tackle this situation, the first idea was to enlarge the customs facility and create more border check posts. But looking into the costs, coordination, and duration it would take, this solution was identified as

too protracted. Instead, YVR's employees went and conducted studies observing the customs hall; they identified that in order to free up the officer's tasks for the qualitative part of their job, tasks of administrative nature could be eliminated. And these administrative tasks could, potentially, be done with the help of technology.

YVR worked together with a hardware manufacturer from British Columbia. The first machines were launched in 2008, and in an instant, the lines were much shorter. Other airports heard about this success and contacted YVR because they were also interested in this technology. This is how the idea was created to patent and commercialize the product. Now, many airports worldwide use these kiosks as well. Profits from the sales are reinvested into the Airport Authority. The machines are manufactured in Canada, and the product is continually enhanced with regard to the hardware as well as software.

Following this success and based on their experience, YVR continued to work on a new project in this direction. They developed a bag drop called CheckitXpress in collaboration with Glidepath, an external partner, who handles the marketing and sales for this product. YVR based this product on the advantages of having the conveyor very low on the ground and to provide very high read rates to enable quicker reads on bags and, hence, their check-in process and passenger flow at the airport.

5.13 Winnipeg James Armstrong Richardson International Airport

Winnipeg James Armstrong Richardson International Airport (YWG) is a Canadian airport that handled 4.48 million passengers in 2018 (ACI World Traffic Report).

Internal Innovation at YWG

The organization started to include the topic of innovation in a more formalized way in 2017. At the time of the interview, the interviewee was about to finalize a comprehensive innovation strategy for YWG to present to the executive board. Overall, their strategy focuses on improving customer satisfaction and foresees ways to engage with external partners. According to the interviewee, this strategy is heavily influenced and inspired by the Innovation@Airports conference that he attended in January 2019.

Currently, the innovation efforts are driven by an internal team of about nine employees, led by the interviewee. These nine people have been chosen by the executive team to take part in an initial rollout for internal innovation activities. At the time of the interview, the focus was on formalizing ways to structure the internal innovation more in order to drive an innovation mindset within all of its employees. To do so, YWG hired an external consultancy, Invision Edge. With them, they are conducting Blue Belt workshops, which the innovation group participated in at the time of the interview. In future, all employees of the YWG organization will be included and participate in these Blue Belt workshops.

Selected External Innovation Projects at YWG

YWG has several external partners that they include to fulfill innovation projects such as the consultancy that will facilitate Blue Belt workshops with all YWG employees. So far, the kick-off has been done with one group, but the plan is to have an organization-wide rollout. These workshops are meant to sensitize, inspire, and encourage all employees at YWG to come up with innovative ideas.

The project that was the result of the first workshop deals with the crucial topic of creating a single passenger profile. YWG is investigating it, with the help of an external consultant that they hired. In their futuristic vision, this passenger profile would be enabled by facial recognition technology. At every step of the passenger's garage-to-gate-journey, this technology ensures and serves as the seamless gateway for any services or checkpoints along the way. YWG has started thorough investigations, such as speaking to technology providers and aviation associations. They concluded that it involves many stakeholders to create such a seamless integration. They are currently working with the consultant on the feasibility of the project and how to process it.

An innovative project that was executed at YWG with an external partner concerned the trialing of autonomous snowplows. This project was initiated because the VP of Operations had been introduced to two different companies on different occasions: one snowplow company from Norway and a robotic company from Canada. From this, he had the idea to combine the company's capabilities with his use case, asking them if they would like to create a tri-partnership. Apart from the two external companies, employees on the airside played a crucial role in enabling test runs with the autonomous snowplows. The solution has been thoroughly tested but is currently not in use at the airport.

The airport is currently developing a pipeline for idea generation in order to prioritize focus for commercially viable project seed money. This will then permit idea generators to be seconded to complete their vision as well as provide opportunities for employees to work on projects that might normally be outside of their day-to-day routine.