Implementing Integrated Self-Service at Airports

DETAILS

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AIRPORT COOPERATIVE RESEARCH PROGRAM

ACRP REPORT 136

Implementing Integrated Self-Service at Airports

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AIRPORT COOPERATIVE RESEARCH PROGRAM

Airports are vital national resources. They serve a key role in transportation of people and goods and in regional, national, and international commerce. They are where the nation's aviation system connects with other modes of transportation and where federal responsibility for managing and regulating air traffic operations intersects with the role of state and local governments that own and operate most airports. Research is necessary to solve common operating problems, to adapt appropriate new technologies from other industries, and to introduce innovations into the airport industry. The Airport Cooperative Research Program (ACRP) serves as one of the principal means by which the airport industry can develop innovative near-term solutions to meet demands placed on it.

The need for ACRP was identified in *TRB Special Report 272: Airport Research Needs: Cooperative Solutions* in 2003, based on a study sponsored by the Federal Aviation Administration (FAA). The ACRP carries out applied research on problems that are shared by airport operating agencies and are not being adequately addressed by existing federal research programs. It is modeled after the successful National Cooperative Highway Research Program and Transit Cooperative Research Program. The ACRP undertakes research and other technical activities in a variety of airport subject areas, including design, construction, maintenance, operations, safety, security, policy, planning, human resources, and administration. The ACRP provides a forum where airport operators can cooperatively address common operational problems.

The ACRP was authorized in December 2003 as part of the Vision 100-Century of Aviation Reauthorization Act. The primary participants in the ACRP are (1) an independent governing board, the ACRP Oversight Committee (AOC), appointed by the Secretary of the U.S. Department of Transportation with representation from airport operating agencies, other stakeholders, and relevant industry organizations such as the Airports Council International-North America (ACI-NA), the American Association of Airport Executives (AAAE), the National Association of State Aviation Officials (NASAO), Airlines for America (A4A), and the Airport Consultants Council (ACC) as vital links to the airport community; (2) the TRB as program manager and secretariat for the governing board; and (3) the FAA as program sponsor. In October 2005, the FAA executed a contract with the National Academies formally initiating the program.

The ACRP benefits from the cooperation and participation of airport professionals, air carriers, shippers, state and local government officials, equipment and service suppliers, other airport users, and research organizations. Each of these participants has different interests and responsibilities, and each is an integral part of this cooperative research effort.

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Once selected, each ACRP project is assigned to an expert panel, appointed by the TRB. Panels include experienced practitioners and research specialists; heavy emphasis is placed on including airport professionals, the intended users of the research products. The panels prepare project statements (requests for proposals), select contractors, and provide technical guidance and counsel throughout the life of the project. The process for developing research problem statements and selecting research agencies has been used by TRB in managing cooperative research programs since 1962. As in other TRB activities, ACRP project panels serve voluntarily without compensation.

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The members of the technical panel selected to monitor this project and to review this report were chosen for their special competencies and with regard for appropriate balance. The report was reviewed by the technical panel and accepted for publication according to procedures established and overseen by the Transportation Research Board and approved by the Governing Board of the National Research Council.

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Japan Airlines (JL)
WestJet Airlines (WS)
Copenhagen Airport (CPH)
Genève Aéroport (GVA)
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FOREWORD

By Theresia H. Schatz
Staff Officer
Transportation Research Board

ACRP Report 136: Implementing Integrated Self-Service at Airports provides guidelines for considering, evaluating, and making strategic decisions for implementing and optimizing a comprehensive passenger self-service experience for a variety of sizes of U.S. airports and their stakeholders. These guidelines include an inventory of self-service applications and technologies with their respective benefits; establishment of a decision-making roadmap to implement self-service; identification of associated infrastructure and airport/airline/other stakeholder integration requirements of multiple self-service applications; guidance for developing business cases for various stakeholders; determination of operational requirements to include staffing and maintenance; consideration of regulatory requirements and industry standards; identification of potential integrations of other non-passenger self-service applications to facilitate employee and tenant services; and demonstration of how various stakeholder technologies can combine into one cohesive system.

Bound into the report is *CRP-CD-168*, which provides tools to assist the user in developing an integrated passenger self-service program. The tools include the Business Case Development Guide, the Passenger Self-Service Inventory, the Passenger Self-Service Environment Map, and Summary Descriptions of Enabling Technologies.

The commercial aviation industry has and will continue to rapidly adopt self-service models for passenger service functions, but this has been done largely in a case-by-case manner. Examples include remote check-in, baggage tagging and screening, off-site baggage check-in, mobile boarding passes, dynamic way-finding, self-boarding, parking payments, concession advance purchases, border clearance, and baggage tracking. With passenger traffic growing and funding sources shrinking, airports need a coordinated and strategic approach with their stakeholders to implement self-service processes to optimize overall efficiencies and satisfy individualized passenger preferences.

Under ACRP Project 10-17, research was conducted by Barich, Inc., in association with Airport Process Design, Trevor Clark, Carolyn Binder, and Ricondo & Associates, with graphics provided by DaSaR Productions. Key contributions were provided through several airport site visits including Amsterdam, Frankfurt, Geneva, Montreal, and Tokyo airports; The Port Authority of New York & New Jersey airports; Orlando International; and Seattle-Tacoma International among others. Several airlines and industry associations also contributed to the research effort.

This report and accompanying tools are also available on the TRB website at www.TRB.org/main/blurbs/172418.aspx.

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Note: Photographs, figures, and tables in this report may have been converted from color to grayscale for printing. The electronic version of the report (posted on the web at www.trb.org) retains the color versions.

SUMMARY

Implementing Integrated Self-Service at Airports

Airport operators around the United States and the world are challenged with determining what role they should play in the movement toward a greater level of passenger self-service. Facilitating passenger self-service has primarily been driven by airlines, specifically with regard to passenger processing; however, airport operators are increasingly aware that they play a vital role in developing an end-to-end, integrated passenger self-service strategy. The question for airport operators is how to consider, evaluate, and make strategic decisions for implementing and optimizing a comprehensive passenger self-service experience for a variety of sizes of U.S. airports and in cooperation with airlines and other stakeholders.

Commercial air travel depends on passenger identification and passenger capacity to make financial transactions. Every passenger is required to provide identification for travel and to pay for it. As would be expected, the evolution of passenger self-service is closely tied to these two items. As air travel has matured, a third item has grown in importance for airport operators, airlines, and regulatory agencies: the ability to predict information about the passenger and what he or she intends to do. Technological advancements have facilitated all three of these items coming together in a "virtual" environment of connected (networked) computers and databases. These advancements have not only resulted in improved means of passenger facilitation, but have also given more control to passengers in shaping their travel experience. The result is a passenger-customized travel experience that is facilitated and monitored by airport operators, airlines, and regulatory agencies in what can be called the passenger's virtual record.

Passenger self-service has been a part of the industry for decades and has largely advanced through technological breakthroughs and innovations, similar to those found in the manufacturing process. This guidebook develops this comparison by categorizing the advancement periods in both the manufacturing and aviation industries into stages, with Stage 1 indicating the initial periods of both industries. Each stage is mapped out using graphical images and brief descriptions showing the progression from agent-driven, one-at-a-time processing of passengers to the multiprocessing of passengers through self-customization and personalization of the travel journey.

With this understanding, the airport operator must still manage the airport as a "common environment." Environment in this context is a general term referring to the facility, information technology systems, policies and procedures, and all elements needed to manage the cohesive asset known as the airport. By managing the airport as a common environment, the airport operator can facilitate services for the passenger and the experience as he or she travels through the various process areas of the airport (arrival, airside, etc.). It is through this means that the airport operator works with its airlines and other tenants, managing and accommodating the variations within each operating model.

The industry is now considering a far more simplified view of the passenger journey. Rather than analyzing every potential functional step (check-in, bag drop, etc.), airport operators, airlines, and industry associations are focusing on how to accommodate passenger travel requirements as they move through the processing areas. As the airport operator, airlines, and other major tenants consider how passengers travel through the processing areas, planning across a common environment must take on an integrated approach.

Every airport operator has a unique perspective through which its passenger self-service strategy should be designed. These perspectives are shaped by aspects such as business drivers, airline operating models, passenger profiles, and industry involvement. Defining the perspective for a specific airport will help the airport operator develop a passenger self-service strategy and make a valid case to obtain the required level of management support.

Executive management support for a passenger self-service strategy is absolutely critical for creating a vision and enabling the long-term viability of a successful program. Operations, planning, and information technology all play a fundamental role in the planning and implementation of passenger self-service initiatives and must have active executive support from the beginning in order for the airport-wide process changes to be accepted.

A formal organization is needed to plan and govern an integrated passenger self-service program. This organization serves as the center hub for stakeholder engagement and performs and/or oversees the planning, implementation, and review of passenger self-services airport-wide to ensure a consistent approach toward achieving passenger self-service objectives that are fully aligned with the airport business objectives.

Without a means to measure performance, passenger self-service initiatives and the program as a whole may function for years without ever producing the outcomes necessary to achieve their objectives. In order to evaluate success or failure and to make necessary adjustments, key performance indicators must be developed, monitored, and reported.

Several key factors play a pivotal role in the design of passenger self-service initiatives that, if not adequately considered, can result in failure. Stakeholder consensus, regulatory and legal issues, and privacy concerns are a few of these key factors. It is also imperative to evaluate the likelihood of achieving the expected benefits and of experiencing potential risks.

There are a number of fundamental impacts within the airport environment that must be understood and addressed to support a successful implementation. These include the management of data, provision of connectivity, use of enabling technologies, changes to the facility, human resources, and communications with passengers. A proactive approach to addressing these items from a high-level strategy standpoint will greatly increase the probability of success.

A well-conceived and thoroughly justified program can quickly lose support as a result of a single poorly implemented initiative. When there has been a significant investment of resource time in strategy development and program planning, project implementation is not the time to start cutting corners. Each project must adhere to a structured implementation process that applies the appropriate depth of planning for the size and scope of the project.

Monitoring and reporting the defined performance criteria for each and every initiative is necessary to ensure that needed adjustments are made to continue progress toward achieving the stated objectives or that initiatives are halted before further resources are wasted. This is a critical component of the quality management process.

As passenger self-service projects are closed out and transitioned to steady-state operations, the focus cycles back to the planning steps, where data are analyzed, objectives are tweaked, key performance indicators are adjusted, and corrective actions are taken. Each component of the integrated passenger self-service program will continue to change as fundamental impacts change, new factors for consideration emerge, and perspectives evolve.

PART I

Overview

ACRP Report 136: Implementing Integrated Self-Service at Airports was developed under ACRP Project 10-17. The report includes a summary and four parts: Part I: Overview, Part II: Reference Guide, Part III: Integrated Self-Service Tools, and Part IV: Appendices.

Following this overview is Part II, which includes Chapter 1: The Passenger Self-Service Vision, Chapter 2: Applying the Vision—Planning, and Chapter 3: Applying the Vision—Implementation. Part III: Integrated Self-Service Tools includes Chapter 4: Business Case Development Guide, Chapter 5: Passenger Self-Service Inventory, and Chapter 6: Passenger Self-Service Environment Map. Part IV provides Appendix A: Glossary of Terms, Appendix B: Annotated Resource Guide, and Appendix C: Acronyms and Initialisms.

Bound into *ACRP Report 136* is *CRP-CD-168: Integrated Self-Service Tools for ACRP Report 136*, which includes the Business Case Development Guide; the Passenger Self-Service Inventory spreadsheet matrix; the Passenger Self-Service Environment Map executable application; and one-page, printable summary descriptions of enabling technologies. (Also, an .iso image of *CRP-CD-168* is available on the TRB website at http://www.trb.org/Main/Blurbs/172418.aspx.)

The information to develop the content of *ACRP Report 136* was collected through various research methods, including a literature review, interviews, conferences, and on-site case studies. This research was done to provide guidance to the reader based on the industry's most current implementations, experiences, and best practices. Primary research subjects included airports, airlines, and related industry associations, as well as technology vendors. Secondary resources included publications from airport and airline industry associations, other ACRP reports, and various aviation technology, self-service, and travel-related websites.

The purpose of *ACRP Report 136* is to be a comprehensive, easy-to-use resource that will provide the user with the information and tools necessary to meet the project's primary objective: "considering, evaluating, and making strategic decisions for implementing and optimizing a comprehensive passenger self-service experience for a variety of sizes of U.S. Airports."

While many of the references and examples of self-service applications may represent scenarios at large airports, the concepts discussed and the Roadmap presented are universally applicable and scalable to the unique characteristics of any airport. In addition, the Business Case Development Guide (Part III, Chapter 4) makes no assumptions regarding the availability of resources or the applicability of particular solutions, but rather provides guidance toward a fully tailored evaluation of a given opportunity.

Every effort was made to develop this resource as to be useful to a variety of airport (and stakeholders) personnel at various levels of responsibility, ranging from executive management to information technology (IT) division staff members.

ACRP Report 136 was prepared and structured keeping in mind the varying information needs of different types of users. With that in mind, the following general user needs have been identified:

- **Reference/knowledge.** This user is interested in learning about self-service at airports. The primary objective is to gain knowledge and understanding of the industry as a whole as well as the various self-service applications and technologies. To meet the need of this user, *ACRP Report 136* functions as a research and educational tool. The Reference Guide (Part II), the Passenger Self-Service Inventory (Part III, Chapter 5), the Passenger Self-Service Environment Map (Part III, Chapter 6), and Appendices A–C (Part IV) will all be of significant value.
- **Program planning.** This user is familiar with passenger self-service and wants to know what it takes to develop an overall passenger self-service program. The primary objective is to gain insight into how to develop a long-term integrated passenger self-service strategy. The Reference Guide (Part II), the Business Case Development Guide (Part III, Chapter 4), and the Passenger Self-Service Environment Map (Part III, Chapter 6) will be of primary interest.
- **Project implementation.** This user is ready to engage in a self-service initiative, but is not exactly sure what all must be addressed. The primary objective is to get direction on what must be considered to maximize the value of an overall passenger self-service strategy. Self-service is looked at from a holistic perspective with a strong focus on integration aspects. The Reference Guide (Part II) and the Passenger Self-Service Inventory (Part III, Chapter 5) will be of primary interest.

PART II

Reference Guide

CHAPTER 1

The Passenger Self-Service Vision

Passenger Self-Service Vision

- Progression of Passenger Self-Service
- Stage 4 Reality
- The "Applying the Passenger Self-Service Vision" Roadmap

Airport operators around the United States and the world are challenged with determining the role they should play in facilitating the movement toward a greater level of passenger self-service. Facilitating passenger self-service has primarily been driven by airlines, specifically with regard to passenger processing. For example, in 2012, Iberia Airlines initiated a program known as Ágora, providing more than 100 initiatives and aimed at improving passenger services around the airport. The focus for Iberia is customer experience, on-time performance, and airport operations efficiency. For customer experience, Iberia's programs include the following:

- Facilitation of check-in
- Self-service
- Mobile applications
- Lounges

It is not only airlines that are paying attention to passenger self-service, airport operators are becoming increasingly aware that they play a vital role in developing an end-to-end integrated passenger self-service strategy. The question for airport operators is how to consider, evaluate, and make strategic decisions for implementing and optimizing a comprehensive passenger self-service experience for a variety of sizes of U.S. airports and in cooperation with airlines and other stakeholders.

Commercial air travel depends on passenger identification and passenger capacity to make financial transactions. Every passenger is required to provide identification for travel and to pay for it. As would be expected, the evolution of passenger self-service is closely tied to these two items. As air travel has matured, a third item has grown in importance for airport operators, airlines, and regulatory agencies: the ability to predict information about the passenger and what he or she intends to do. Technological advancements have facilitated all three of these items to come together in a "virtual" environment of connected (networked) computers and databases. These advancements have not only resulted in improved means of passenger facilitation, but have also given more control to passengers in shaping their travel experience. The result is a passenger-customized travel experience that is facilitated and monitored by airport operators, airlines, and regulatory agencies, in what can be called the passenger's virtual record.

Progression of Passenger Self-Service

Four Historical Stages of Industrial Processing

To understand the progressive stages of passenger self-service, it helps to first take a look at the historical stages of industrial processing. In the beginning (Stage 1), manufacturing focused on the production of each item in a singular fashion. As illustrated in Figure 1-1,

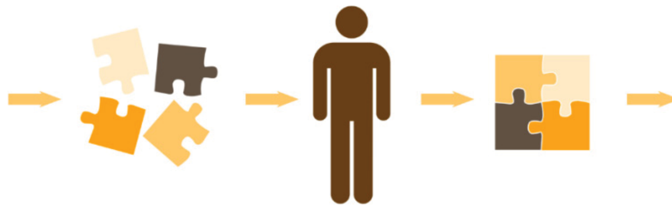


Figure 1-1. Manufacturing Stage 1.

a single worker was responsible for manually assembling the individual components into a final product.

In Stage 2, the manufacturing steps were simplified and the assembly line was created to speed up the overall assembly process. In Stage 2, as reflected in Figure 1-2, each worker was responsible for a singular component and properly adding that component to the growing assembly until the final product assembly was completed. Here, through the use of conveyor belts workers could perform their function on many assemblies in a quick fashion. In Figure 1-2, the improved efficiency of the Stage 2 process is conveyed by the increase in the number of completed boxes as compared to Stage 1 (Figure 1-1).

In Stage 3, instrumentation and robotics were added to the process to improve the speed and efficiency of product assembly, reducing the reliance on personnel and resulting in the processing of many more products in a given amount of time. In Stage 2, an assembly line worker was responsible for a specific component being added to the product assembly; in Stage 3, automated processes perform that same function. Figure 1-3 illustrates this Stage 3: a specific puzzle piece is associated with a specific point in the automated process.

Again, the increased efficiency of the Stage 3 process over the Stage 1 and 2 processes is illustrated through the increased number of assembled boxes at the end of the assembly line. In Stage 3, the worker assumes the role of quality control, only ensuring that the final product is acceptable.

The Stage 4 process revolutionizes the process. Instead of making incremental improvements to the manufacturing process, automated intelligence is added to the overall management of

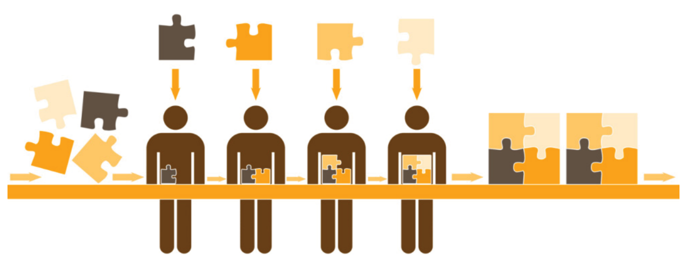


Figure 1-2. Manufacturing Stage 2.

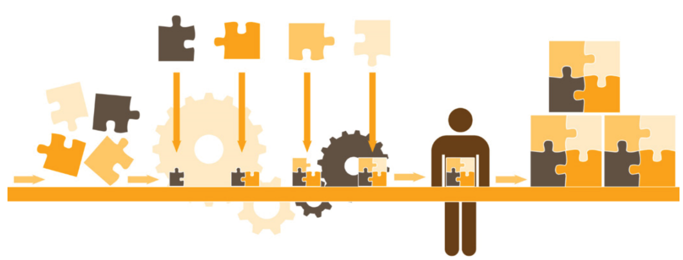


Figure 1-3. Manufacturing Stage 3.

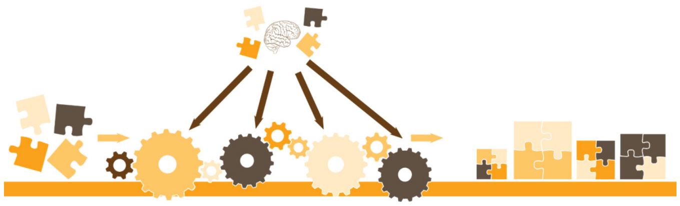


Figure 1-4. Manufacturing Stage 4.

the process. In Stage 4, the assembly line is made flexible so that now different products can be created on the same assembly line without the need to shut the assembly line down and retool and reconfigure the specific component process steps. In Figure 1-4, the brain and the surrounding puzzle pieces represent the ability of the system's automated intelligence to understand the manufacturing process for each unique product and the batch of steps that need to be performed to create that particular product.

The addition of automated intelligence and the flexible assembly line allow for the same speed and efficiencies of Stage 3. However, Stage 4 also creates a means to produce different kinds of boxes through the processing of one product differently from other products on the assembly line. This is illustrated in Figure 1-4 at the end of the assembly line with the different sized boxes and different component make-ups.

This description of the evolution of the manufacturing process provides context in which to understand the historical progression of processing of passengers through an aviation journey. The section that follows describes the aviation industry as currently in the inception of Stage 4—working through the maturation of passenger process sequencing in response to passenger demands for greater control and the ability to efficiently create a customized air travel "product," just as the flexible assembly line has allowed manufacturers to create several different products simultaneously.

Application to Passenger Self-Service at Airports

Passenger self-service has been a part of the airport industry for decades and has advanced through technological breakthroughs and innovation in much the same way that the manufacturing process has. Building on the example of the evolution of manufacturing, this section first describes how the processing of airline passengers has evolved from the earliest days of commercial air travel to the present. It then discusses how the characteristics that define Stage 4 aviation processing require the industry as a whole to embrace a new perspective, a paradigm shift, to continue to achieve organizational business goals and success in this new, ever-changing environment.

Stage 1

Much like the initial stages of the manufacturing process during the mid-1920s, in the early days of the commercial airline industry, the processing of the passenger was a very manual, linear, and specified process. There was very little variance in the processing of passengers; every passenger was treated exactly the same way.

Stage 1 is defined by its completely linear workflow that was confined by the paper-based system it relied upon and the airport building and stations where each step was conducted. As Figure 1-5 shows, the passenger had the option of either reserving a seat on a flight by calling an airline in advance of the travel date or purchasing a ticket at a counter upon arriving at the airport on the day of travel.

Telex machines were used by the airlines to telegram a passenger reservation to the appropriate airports, where the reservations were managed using paper cards. Upon arrival at the airport,

Figure 1-5. Stage 1: 1920s–1950s passenger processing.

the passenger would check in for the flight and pay for the ticket. If it was necessary to check any luggage, the passenger would do so at the check-in location. Upon obtaining the paper ticket at the check-in counter, the passenger proceeded in a prescribed and sequenced manner, without any deviation, through the boarding process and onto the flight.

In Figure 1-5, the solid line represents the clearly defined linear process of the passenger at the airport. The preceding dotted line indicates any off-airport activity. In Stage 1, the only off-airport activity that the passenger had the option to initiate was booking (reserving) the flight. As indicated in the illustration, the passenger moved from the check-in counter to the boarding area and was able to proceed to the flight as a result of the paper ticket in hand. The paper ticket served to convey the necessary information about the passenger's itinerary at each station.

In this earliest of passenger processing stages, airlines reserved passenger seating at the booking stage, solely on the word of the passenger's "confirmation of intent" to fly on the noted day and time of the reservation and on the passenger's ability to pay for the flight. At this point in the process, the airline had only the word of the passenger regarding his or her identity, ability to pay for the flight, and commitment to fly on a given date and time. Airlines did not have any money in hand yet, but had the commitment to provide a seat on a plane and plan for the travel of the passenger. The passenger committed very little in the way of resources to be able to fly on a particular date and at a particular time, yet a large commitment had been made on the part of the airline to reserve resources for the passenger's flight. Check-in not only served as a means for a passenger to pay for a flight, but also to provide further "confirmation of intent" to fly or to give the airline a last-minute opportunity to sell the seat to another passenger and maximize per-flight revenue.

At this stage, provision of passenger identity information was minimal, the information was not readily accessible, and it was short lived in the "database" of the airline. On the day of travel, the passenger information (the ticket) physically traveled with the passenger.

Stage 2

Stage 2 started in the late 1950s and early 1960s and proceeded well into the 1990s. Spanning four decades, Stage 2 is significant as it is the timeframe during which an almost completely paper-based system was modified to incorporate an electronic reservation system, the computerized reservation system (CRS). With the introduction of the CRS came also the passenger name record (PNR). The CRS enabled airline agents to have real-time access to passenger travel information in the form of the PNR. This had not been possible before. For the first time, there was now an electronic, or virtual, record of a person and the associated itinerary that stood separately and operated apart from the physical person within the airline system.

Stage 2 included continuous incremental advancements throughout its four decades and is therefore divided into four sub-stages of passenger processing: Stage 2a—1960s, Stage 2b—1970s, Stage 2c—1980s, and Stage 2d—Early 1990s.

Stage 2a—1960s

As in Figure 1-5, the solid line in Figure 1-6 represents the clearly defined linear process of the airport, and the dotted line indicates off-airport processes. The newly added cloud represents

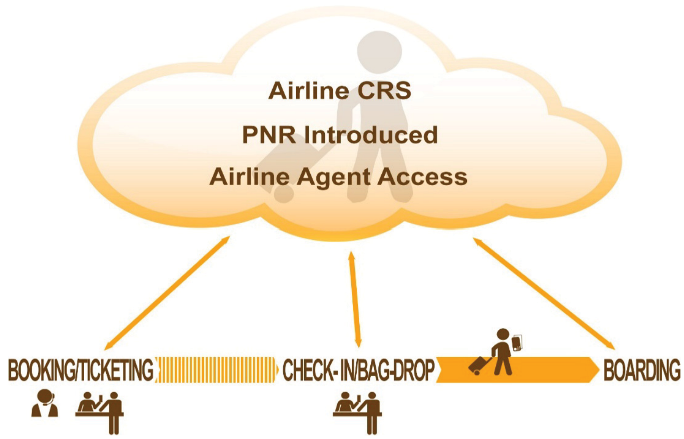


Figure 1-6. Stage 2a—1960s passenger processing.

(1) the collective system(s), (2) the information that is listed within the cloud, and (3) the parties that interact virtually with this information as part of the passenger's journey (much as the Internet "cloud" is synonymous with representing the collective form of the Internet and its interconnected systems). In Stage 2a, the cloud consists of the CRS, the PNR, and the airline agent access.

These systems grow as the passenger self-service process evolves, but, at this point, the cloud represents only these three elements. It is in the cloud that the PNR, the passenger's virtual record, moves freely throughout the journey and is accessible by any airline agent at any time, apart from the passenger's physical person and location. The virtual record and the free movement within the cloud are represented in the figure by a somewhat transparent version of the passenger.

To obtain a more committed "confirmation of intent to fly" on the part of the passenger, airlines established centralized ticketing offices where passengers could make a flight reservation and pay for the flight. Obtaining payment from the passenger at this stage provided a stronger passenger commitment to fly. This also somewhat mitigated the risk of lost revenue when passengers would not show up to fly. The risk of cancellation was only somewhat mitigated, however, as airlines still offered refunds to passengers for cancelled flights.

Stage 2b—1970s

In the 1970s, the global distribution system (GDS) was developed, and the CRS and PNR data were now available to airline agents. For the first time, real-time access to flight inventory and reservations was available to all agents around the world. It was also during this time that a level of security screening in the form of a checkpoint was added to the process to address some of the early threats of attack being seen at that time. Additions of these two elements are represented by the GDS in the cloud and the "checkpoint" location in the linear process shown in Figure 1-7.

Stage 2c—1980s

GDS access was extended to travel agents in the 1980s. As with the airline agents, this meant that travel agents could now access real-time flight inventory and reservations information. There was a contractual relationship between the travel agents and the airlines, which marked the moment in time when airlines allowed this information to be accessible to external organizations.

A short time later in the 1980s, access to the CRS was made possible for customers that had computers and the capability to go online. An early form of this connectivity was through the CompuServe Information Service via the Easy SABRE brand. Although only a few passengers were able to use this advancement at the time, it was quite significant because it was the earliest form of passenger self-service made possible through IT. No longer was a physical agent necessary

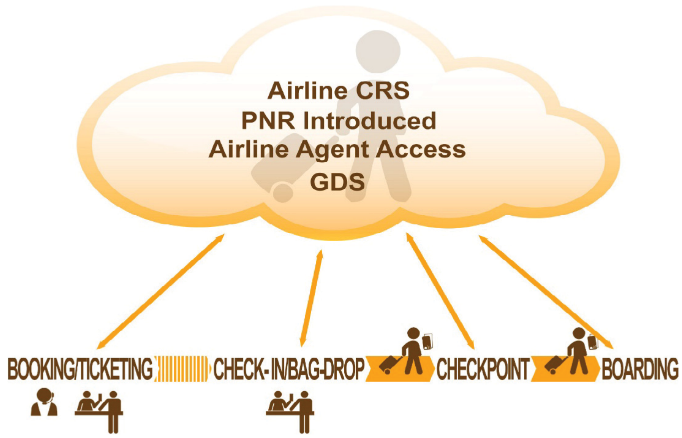


Figure 1-7. Stage 2b—1970s passenger processing.

for a passenger to view available flight options and book a reservation. The passenger could now self-serve these two functions from home, as indicated in the booking/ticketing part of Figure 1-8. Also, passengers were now establishing their own PNRs.

Stage 2d—Early 1990s

Online reservation systems greatly matured in the 1990s when a more modern form of the Internet, the World Wide Web (www), began to take hold and online travel sites emerged. As illustrated in Figure 1-9, when this happened, these options replaced the Easy SABRE type solutions as the at-home solution for self-service.

Stage 3

Stages 1 and 2 saw great innovation in the off-airport booking and ticketing process; however, the on-airport process remained largely the same until Stage 3. Stage 3 begins in the mid-1990s; extends to the year 2010; and is divided into three sub-stages: 3a—Mid-1990s, 3b—Late 2000s, and 3c—Early 2010s (present day).

Stage 3a—Mid-1990s

As seen in Figure 1-10, the implementation of airline-owned kiosks in the check-in process in the mid-1990s ushered in Stage 3, which in many ways, still is used throughout the aviation

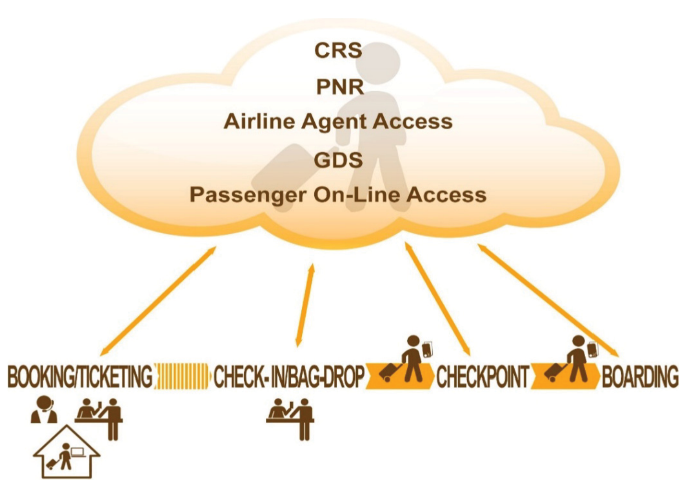


Figure 1-8. Stage 2c—1980s passenger processing.

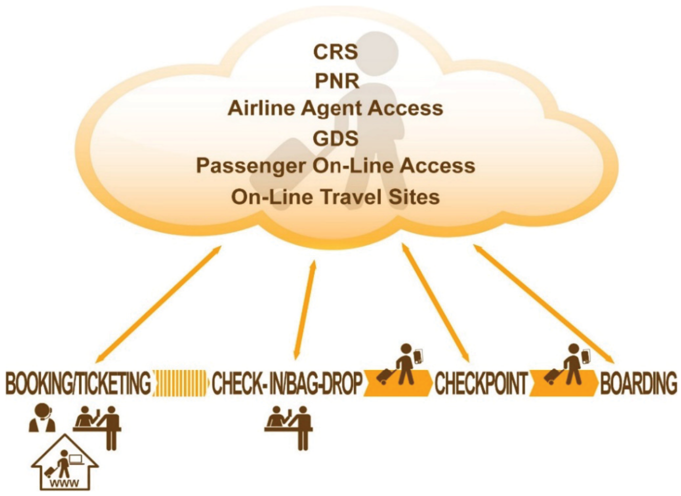


Figure 1-9. Stage 2d—1990s passenger processing.

industry. Stage 3 added automation and a passenger self-service opportunity to the on-site services in much the same way that manufacturing made automation advances. Passengers were now able to bypass the airline agent for check-in and could print their boarding pass at a kiosk. These self-service kiosks helped to alleviate the previous long queues and allowed the check-in process to be conducted in a series of smaller steps. The kiosk model also served as a springboard for extending passenger self-service into other areas of the airport terminal.

At about this same time, online travel sites began to gain traction, airline websites and their service offerings materialized, and early forms of web check-in were started.

Stage 3b—Late 2000s

The attacks of September 11, 2001, initiated a heightened security level never before required in the United States, resulting in the formation of the Transportation Security Administration (TSA) and the U.S. Department of Homeland Security (DHS). As Figure 1-11 shows, the lighter security "checkpoints" that previously constituted airport security were replaced with more thorough security screening of passengers and 100% screening of baggage. As the aviation industry

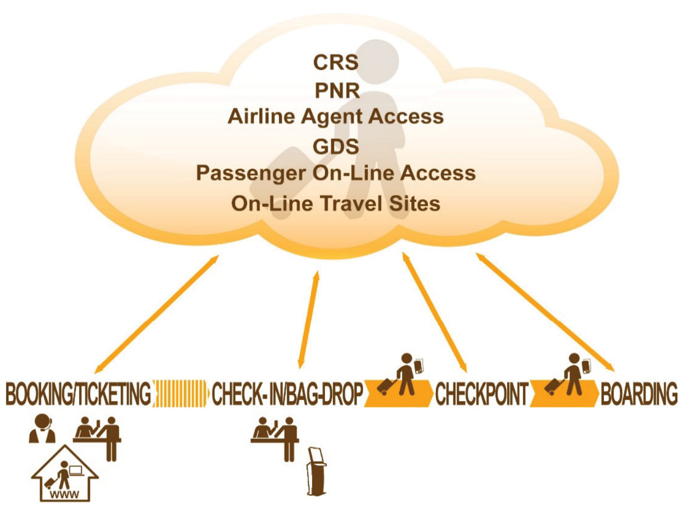


Figure 1-10. Stage 3a—Mid-1990s passenger processing.

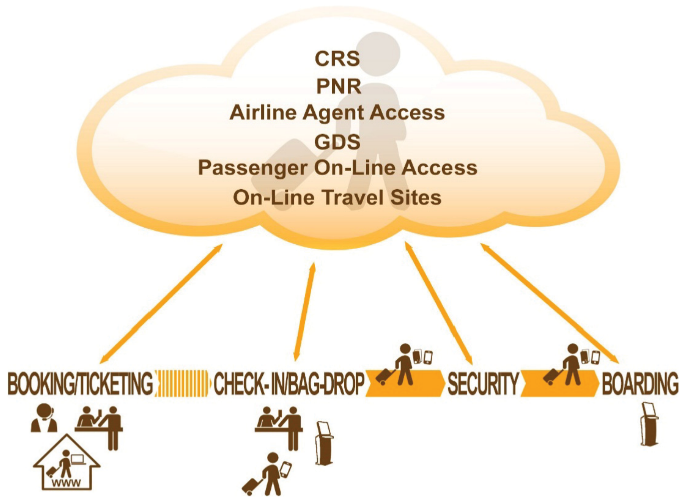


Figure 1-11. Stage 3b—Late 2000s.

was focused on shoring up security around terminals, technology innovators were developing a reimagined smartphone that would come to play a key role in the further evolution of the passenger self-service model.

The introduction of this new smartphone was significant to passenger processing due to its use of applications designed for the mobile interface. This interface allowed users to interact with online content on a cell phone while on the go, as opposed to using websites designed for personal computers. Shortly after the smartphone was introduced, Continental Airlines, in coordination with the TSA, began beta testing the delivery of boarding passes to mobile devices. These digital boarding passes were designed to be used in lieu of paper tickets at all stations throughout the travel process, from check-in, to security, and through boarding of the flight.

Figure 1-11 reflects the adoption of mobile devices by the passenger from check-in through boarding. It also illustrates the continued use of the paper boarding pass should the passenger prefer that alternative. Despite the smartphone advancements, years later, paper boarding passes are still used when last-minute flight changes are made out of necessity or convenience.

At this time, two changes had a very significant impact on the passenger processing model and the use of the passenger identity and payment options discussed earlier: (1) the introduction of online travel websites and (2) the airlines' desire and ability to collect payment from passengers at the initiation of the travel process without the obligation to refund the cash. Online travel sites (such as Orbitz, Expedia, TripAdvisor, etc., represented in the cloud of Figure 1-11) and their databases exist outside of the airlines' and the airports' data systems, and yet the sites communicate with the systems because data are transferred directly and indirectly between them. Online travel sites are also partnered with non-aeronautical travel service companies such as hotels and rental car agencies. This is noteworthy because in previous stages, although the virtual passenger existed and moved about, the virtual passenger was contained within aviation industry systems. Once online travel sites joined the travel journey process, the cloud that had previously referred only to aviation systems expanded to represent the Internet as a whole. The aviation industry systems are now just one part of that broader data environment, or "cloud." Another result of this cloud expansion is that the passenger's information, in the form of the virtual passenger, now moves throughout this larger cloud and can be accessed by these growing non-aeronautical services and systems.

The airlines' desire for a firmer passenger "confirmation of intent" to a specific flight date and time through up-front ticket payments is a stark contrast to the Stage 1 processing. By Stage 3b, the payment and commitment model has been flipped completely around. Where the passenger previously had a very low level of commitment to the airline flight reservation at the time of the booking, the airline had a very high commitment. The importance of the passenger's "confirmation of intent" for the airlines is minimized once they have payment in hand, and they are able to manage their level of commitment to the passenger.

Stage 3c—Early 2010s (Present Day)

In spite of some system limitations, passenger self-service process alternatives further accomplish the goal of reducing congestion points at the airport and reducing overall costs to the airline. As these new self-service processes began to gain passenger adoption, the industry began to provide further definition and introduced new means of self-service. For example, the International Air Transport Association (IATA) analyzed each step of the "passenger journey" which resulted in a "14-step passenger journey," as shown in Figure 1-12. IATA then began a campaign to systematically introduce new means of self-service and technology efficiencies at each of these 14 journey points.

Although the aviation industry benefited as a whole from these innovations, and high levels of efficiency were realized, the sequential nature of the process remained. Even with these advances, the process remained highly linear.

New innovations continued to mature this Stage 3 model, where the 14 steps no longer necessarily required linear processing. The steps could be taken at various points of the passenger's journey and in a variety of off-airport and on-airport locations. Clearly, the rapid adoption of mobile technologies has helped to develop this stage, resulting in a further breakdown of the passenger journey steps. An example of the further breakdown of passenger journey steps is shown in Figure 1-13, which helps to tell the story of the complete passenger journey from an airport perspective.

Compounding the complexity of the service are the tagging options that are simultaneously in development (paper printed tags, permanent bag tags, etc.). On the other side of the aisle, airlines are experimenting with in-flight self-services. One current focus is on video entertainment: airlines are experimenting with what video services to provide, how to charge for them, and even how to display video entertainment. Some airlines provide video displays in the rear of the head rests while other airlines wirelessly broadcast the video signal via Wi-Fi using the passenger's own mobile device, whether it is a laptop, a tablet, or a smartphone.

International flights have many opportunities to increase in-flight passenger self-service offerings. As an example, Emirates Airline has a limited form of in-flight spa services on some of its A380's. Emirates allows passengers to make their own spa reservation using the Emirates website and the mobile application while in flight or at any other pre-travel step. Passenger self-tag bag drop and in-flight self-services have emerged as new process options in the traditional passenger process flow. This emergence is illustrated by the transparency of the process steps in Figure 1-14.

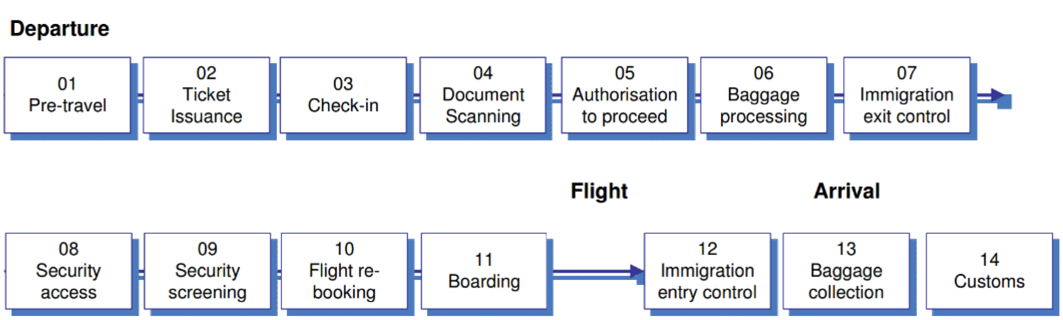


Figure 1-12. IATA 14-step travel journey.

Figure 1-13. Complete passenger journey.

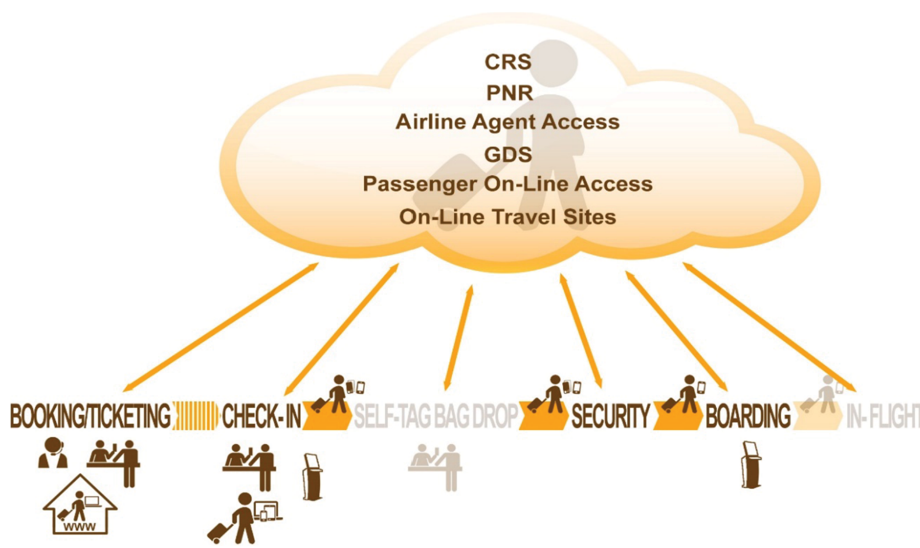


Figure 1-14. Stage 3c—Early 2010s (present day).

Stage 4

The changes described in Stages 3b and 3c—broader access to and use of passenger data; earlier payment and confirmation of travel; and the addition of more service purchase options—have been joined by still more new technologies adopted by passengers around the globe. Industry studies performed by SITA, TripAdvisor, and FlightView all point to an increase in demand for self-service and mobile facilities for passengers. So the aviation industry again finds itself in a transition phase, this time driven as much by the passengers' desires as airline desires for a more flexible experience. These expectations for a more personalized travel experience don't always align with the older, mostly linear prescribed journey processes described in Stages 1 through 3 that airlines and airports have followed since the birth of the industry. There appears to be growing pressure for a new stage, one in which process steps do not have to be taken in the traditional linear fashion and where the passengers are enabled to predefine the journey as it best suits them. This is especially true of airports and airlines focused on improving their passengers' experience. As proven by different airports around the United States and the world, many of the 14 or 21 journey points described above have either changed or are slowly going away in response to these new pressures.

Passenger check-in and document check are two such examples. Check-in was most important to airlines during the time when they needed to confirm the last-minute intent of the passenger to fly and when the airlines would refund passenger payment for cancelled flights. Now, airlines are more open to skipping certain steps in the traditional process, and, in some cases, they are driving it. In actuality, many airlines perform the check-in process of some passengers automatically without requiring input or confirmation from the passenger.

In the case of document check, airports and aviation associations have worked with U.S. Customs and Border Protection (CBP) to deploy Automated Passport Control (APC) kiosks and most recently the Mobile Passport Control (MPC) smartphone application. Each offers an airport different solutions for managing and improving the document check process as well as offering options for the passenger on how to interface with CBP.

More than providing an alternative means for accomplishing a task, APCs and MPCs also provide an alternative means for when and where to accomplish the task. Consider the United Airlines mobile application. The passenger no longer has to wait until arrival at the airport to have passport validation performed. Validation can now be performed at a convenient time for the passenger away from the airport. Similarly, with the MPC mobile application, the passenger no longer has to wait until arrival at the destination airport to begin the customs declaration process. This process can start even before arriving at the originating airport.

Due to alternative means for checking in and check documents as well as the introduction of new technologies and service programs, the industry is stepping back to review all processes, and their respective roles are being re-evaluated for necessity, optimization, and alternative passenger self-service processing opportunities. Airports that do not recognize this need to re-evaluate all processes and roles and instead continue to view and approach passenger self-services from the traditional vantage point of the airport directing the passenger into a pre-prescribed journey may lose the benefits of this change. These airports further risk losing the growing segment of the passenger base that seeks to customize and personalize their journey and the airlines that seek to maximize the business benefits that flow from this new paradigm.

Stage 4 is defined by the passenger's ability to self-customize and personalize the travel journey steps and, consequently, the journey itself. In order to better understand the Stage 4 airport, some discussion is needed on the Stage 4 passenger. Just as moving from Stage 3 to Stage 4 for the manufacturing industry meant realizing that a process could be established for a single product apart from the other products in the assembly line, so too is the aviation industry reaching a new understanding that passenger self-services must be considered from the viewpoint of the processing of a single passenger.

The aviation industry is beginning to realize that the passenger is pre-setting how he or she will travel through the passenger journey. To illustrate this, Figure 1-15 shows a passenger icon to represent the passenger as he or she exists in the physical world, and, as in previous figures, the cloud above the passenger icon represents the Internet, its collective systems, and the parties that interact virtually with the data flowing between these systems. Inside the cloud resides factual data about the passenger, i.e., the passenger's virtual record. Much of this is PNR data similar to the data gathered back at Stage 2. However, with more regulatory agency involvement, some will now also be TSA, CBP, and possibly other DHS data, all of which will be inserted without the express selection or knowledge of the passenger.

This virtual record information is shown in the larger, darker cloud outline but outside of the inner lighter cloud in the illustration. Icons within the light cloud outline represent the choices available to the passenger as part of the journey and include everything from how to check-in for the flight and how to perform passport validation with the airline, as well as whether to use a mobile boarding pass for boarding. In this report, the information in this lighter colored cloud will be referred to as "the virtual self." The choices available to the virtual self are dependent on the identity of the person because the person's identity and background are filtered through regulatory agencies (watch lists, pre-check, etc.) and travel programs (airline rewards programs, airport rewards programs, etc.).

As some of the options have costs associated with them, the choices available to the virtual self are also dependent on the capacity and willingness of the passenger to pay for them. In Stage 4, everything is driven by identity and money. Depending on the passenger and what he or she is willing to pay, certain processes are made available. More so than ever before, for the common passenger, identity and money are the fundamental enablers of a person's travel experience.

Together, the virtual record and the virtual self combine to make up the virtual profile so named because it is a profile developed from factual and interpreted data. This virtual profile is represented by the transparent passenger in the cloud. Note that this is a change from what the

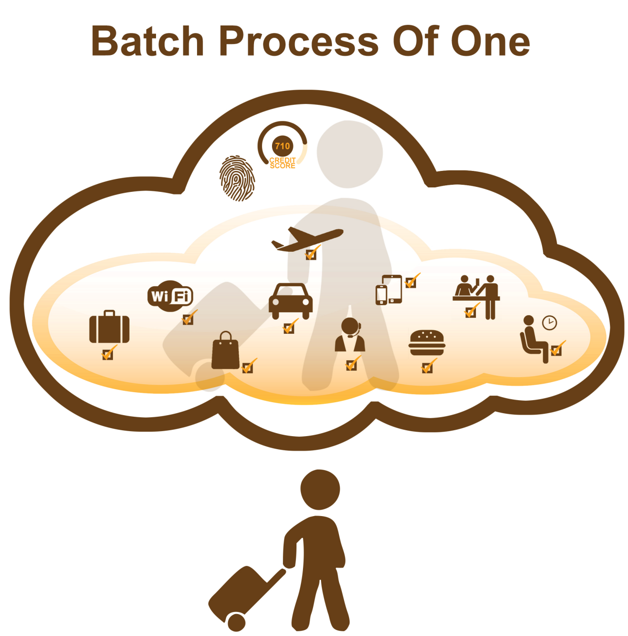


Figure 1-15. The batch process of one.

transparent passenger represented in Stage 2. In Stage 2, the transparent passenger could only represent factual PNR information because that was the only type of information in the cloud at that time.

As the industry progresses into the future, the cloud may contain more subjective interpretations of the passenger based on social media sites, moving the definition of the virtual self to be more in line with where the term originated. The virtual record will likely also expand to include biometric, personal historical, and other types of data. Airport, airline, and other third-party information will only add to this virtual profile. Unlike Stage 1, where the passenger record is factual, simple, and short lived, the Stage 4 passenger profile will be made up of objective and subjective information and will be more complex.

The passenger's virtual profile exists and moves around within this world of data. It used to be that the industry controlled and manipulated these data throughout the journey and funneled the virtual passenger from station to station in the same way the physical process funneled the physical passenger. Now, in Stage 4, the passenger chooses in real time whether to step through a process as his or her physical self or as his or her virtual self. For example, walking up to a restaurant concessionaire the passenger realizes the line is too long to physically wait and order the meal. The passenger opts to proceed to the gate and, through the virtual self, order the meal via the airport concessionaire application on a mobile device and have it delivered to the gate. In this way, the passenger is physically sitting at the boarding gate and interacting virtually with the concessionaire through the process of ordering and paying for food.

A Stage 4 passenger will choose to self-serve as much of the travel journey as possible, limiting human interaction processes to those for which there is no other option. A Stage 4 passenger will opt to use a Stage 4 airport at every opportunity.

Stage 4 Reality

Unlike the transitions into previous stages, the shift into Stage 4 is not the result of a single new technology. Instead, the shift is the result of a number of integrated organizational efforts that further embrace the capabilities introduced by mobile technology in Stage 3. These efforts provide airport processes and personalized experiences on the passenger's mobile device as much as possible and at the convenience of the passenger. Stage 4 capabilities separate a process step from its traditional time and place in the airport process order and instead provide the passenger with alternative options for how and when to perform processes and, in some cases, through whom to perform them. During this period of infancy, this process shift has been greatly driven by the influx of third parties (Google, mobile device application developers, Uber, flight data providers, etc.) that have not traditionally played a direct role in the processing of passengers.

Now that so many passengers have mobile devices, and real-time, passenger-specific information (flight data, airport maps, passenger location, etc.) is readily accessible, the physical barriers of the airport building walls can no longer keep other services out and prevent them from servicing airport passengers. The airport is no longer the sole conductor of the passenger's journey because mobile technology has enabled third parties to insert themselves into the journey and has given them access to the passenger at every point in it. Of course, there are still certain aspects of the journey (security and boarding) that, for now, can only be conducted by official entities and at certain places within the airport. Nonetheless, these instances are becoming more the exception and less the rule as organizations (airports, airlines, concessionaires, CBP, etc.) work to maximize business drivers (operational efficiencies, revenues, and customer experience) by using passenger mobile devices as a processing platform and work to provide more alternatives for the passenger regarding how to move through the journey. For the airport, the key to becoming a higher degree Stage 4 airport will be the ability to introduce new technology in an integrated and cohesive manner as advances occur and processes change. For the industry, the key to moving to a higher degree of Stage 4 will be the ability of airports and tenants to work together to share data in an integrated and cohesive manner.

Since technological advances in self-service are moving more and more passenger processes beyond the airport premises (e.g., ticketing, U.S. Customs passport and declaration submission, parking reservations, concessionaire food orders, checkpoint queue reservations, and airport wayfinding), a discussion of the Stage 4 airport requires a broader and slightly different view that includes areas that are off-airport. Figure 1-16 illustrates this broader view by including the off-airport area and representing a change in perspective. Airport areas have traditionally been thought of in terms of functions that are performed and specific locations, such as parking, curb-side, check-in, security, concessions, hold room, boarding area, and so forth. In Stage 4, this is no longer the case except for security and boarding. In Figure 1-16, security and boarding areas are represented as clearly defined square boxes to illustrate two points of specific boundaries.

In prior illustrations of stages, there was a straight line that signified the linear process of the journey with notation designating the functional steps along the journey. In Stage 4, it is not the process steps that need to be defined, but rather the areas where the passenger may pass through the various steps. In an effort to represent a simplified view of passenger process areas, the ACRP Project 10-17 research team came up with six passenger process areas that are likely to be a part of most commercial air travel:

- **Off-Airport.** This area covers all areas outside the airport campus. From an airport perspective, this includes homes, hotels, convention centers, off-airport train stations, shopping malls, and so forth. Due to mobile technologies, this area actually includes any place where a person could receive wired or wireless Internet connectivity.

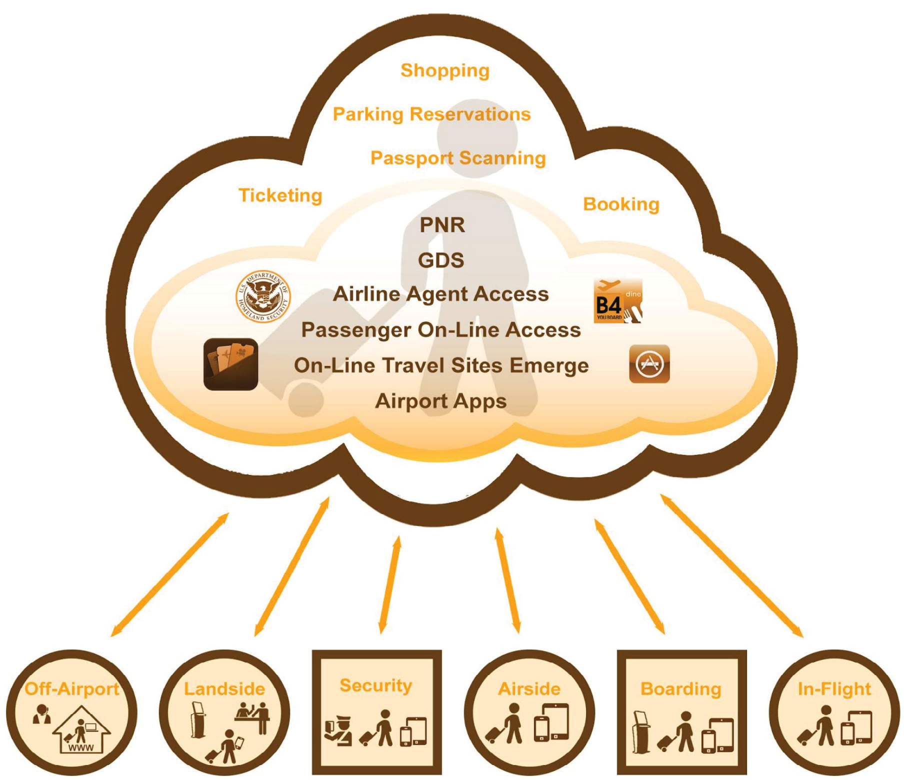


Figure 1-16. Stage 4 airport process.

- **Landside.** This area refers to the area covered by the airport campus boundaries prior to the security checkpoint. In essence, once the passenger enters airport property, he/she is considered to be landside, the non-secure side. Parking facilities, on-campus train stations, and the curbside terminal areas are part of landside. This area "ends" once the passenger reaches security.
- **Security.** This area is actually a checkpoint rather than an area. At this point, passengers' travel documents, including boarding passes and passports (or other identification documents), are checked and validated. Once passengers have completed the security screening process, airside "begins."
- **Airside.** This area, also called the secure side, covers the area from security to the boarding gates. It includes concessionaire areas, such as shops and restaurants, as well as gate holding/waiting areas and charging sections/stations for electronic devices.
- **Boarding.** Similar to security, this is a checkpoint that controls access to individual aircraft. It separates airside from the in-flight location. Typically, for domestic flights, only boarding passes are required to provide access to the aircraft. Passports are required for international travel.
- **In Flight.** This area is a physical location in the sense that it involves passengers inside the aircraft. It is also, however, a timeframe or duration as it designates the time between boarding and deplaning, at which time the passenger enters the airside location of the destination airport.

These descriptions of airport areas are generalized, so in a particular airport one of these areas may look different from the way it is described above. For instance, some overseas airports manage security at the gate, resulting in many small security and airside locations blended together at the boarding area. As these airports continue to experiment, modify layouts, and incorporate technology, the configuration of these areas may change and may be re-defined in the future. Some airports might not see a need to define six areas and might make adjustments leading to fewer areas such as merging existing ones.

In reality, the passenger may conduct his or her travel requirements throughout these defined areas, jumping in and out of many of these areas throughout his or her journey, with many passengers taking completely different paths. For example, a passenger may be on the secure side of the airport, waiting for his or her flight, and decide to check in for tomorrow's flight using the airline's mobile application. Figure 1-17, with the different arrows indicating a unique passenger and the nodes on each column representing a unique option for completing that column's process, illustrates the idea that passengers can take different "paths" to complete a journey.

With this understanding of the passenger journey, the airport operator must still manage the airport as a "common environment." In this case, the term "environment" refers to the facility, IT systems, policies and procedures, and all other elements needed in managing the cohesive asset known as the airport. By managing the airport as a common environment, the airport operator

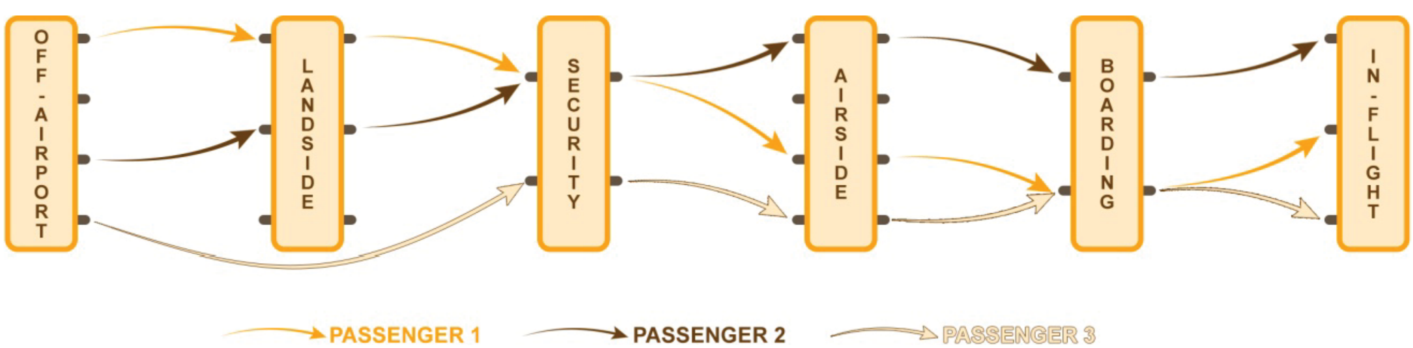


Figure 1-17. Multiple passengers' travel paths.

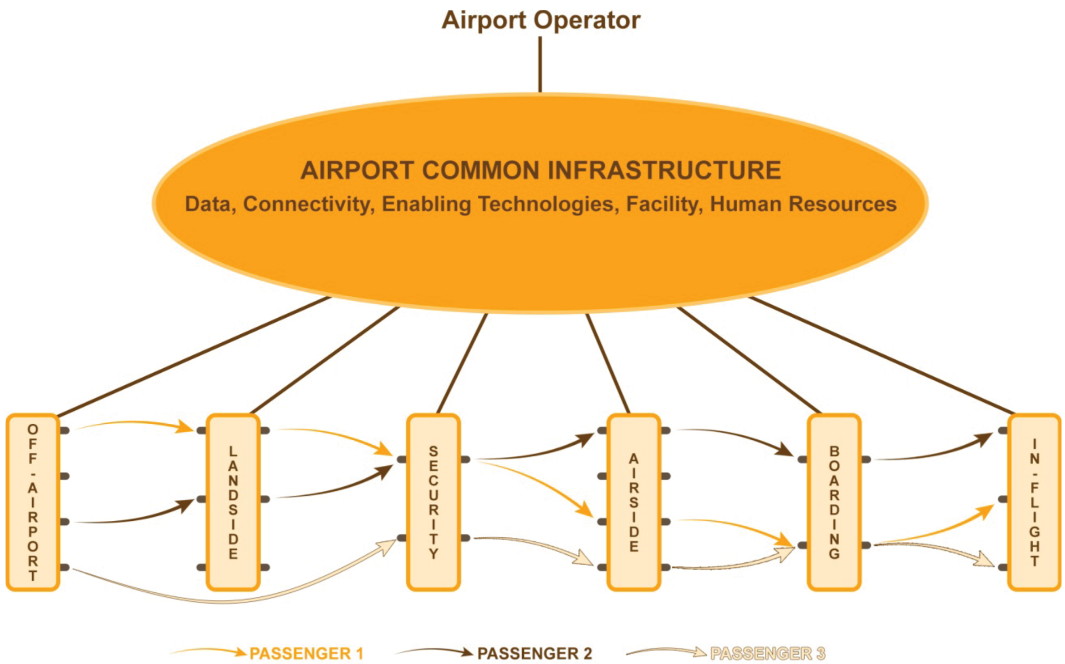


Figure 1-18. The need for an airport common infrastructure.

can facilitate the various paths taken by various passengers to meet their travel requirements. It is through this means that the airport operator works with its airlines and other tenants, managing and accommodating the variations within each operating model. Figure 1-18 illustrates this concept.

Figure 1-19 illustrates the omni-directional free flow of virtual passenger data throughout the cloud, among all parties, including airports, which will happen once Stage 4 is fully realized. Part of transitioning out of Stage 3 is moving from the old data flow model where the data flow in only one direction—from the passenger to the airline and then to the airport and regulatory agencies.

In Stage 4, data will flow back and forth among all parties to facilitate development of the virtual passenger profile and to provide the passenger with a highly customized and personalized experience. Anijo Mathew, an Associate Professor at the IIT Institute of Design in Chicago, is part of a multidisciplinary team working to "push the boundaries of design thinking and technology to connect passengers to the places they experience." As part of a panel discussion at the 2014 Fall Future Travel Experience Conference, Dr. Mathew said, "Industry thinks about travel as three distinct entities—city, airport, airline—because it is and the customer does not want it to be. The industry needs to bring them together. The user doesn't want to know when he or she is moving from one system to another, they just want a cohesive experience as a whole."

As well as illustrating changes in data flow and shifting the focus to the two physical locations, Figure 1-19 illustrates the concept that the increasing importance of the off-airport area means that airport operators must continue to expand their understanding of their "environment" to include not just the airport, but also the community in which the airport is located.

A fully realized Stage 4 airport of the future will require no human interaction, allowing the passenger to completely self-serve and experience the journey in a customized and personalized manner. However, for now, and as airports move toward that eventuality, the degree to which a Stage 4 airport is a Stage 4 airport is dependent first on the extent to which the airport operator assumes responsibility for establishing and implementing a comprehensive strategy and second on the number and level of options the airport and its tenants provide to passengers.

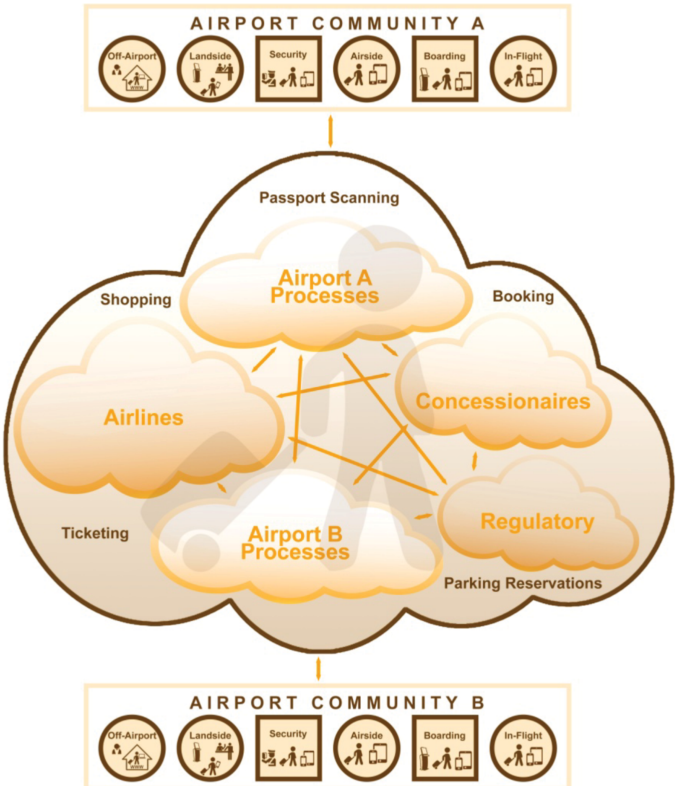


Figure 1-19. Stage 4—airports and communities.

So taking this vantage point, the industry is now considering a far more simplified view of the passenger journey and focusing on how to accommodate passengers as they travel through the processes. As the airport operator, airlines, and other major tenants consider how passengers travel through the six areas described above, planning across a common environment now takes on an integrated approach. Stage 4, therefore, introduces a true model for an integrated passenger self-service program (IPSSP). The Roadmap that follows is provided to describe the approach of introducing passenger self-services in an integrated fashion. Chapters 2 and 3 of the report provide further explanation of each of the steps in the Roadmap.

The "Applying the Passenger Self-Service Vision" Roadmap

The "Applying the Passenger Self-Service Vision" Roadmap (Roadmap), shown in Figure 1-20, depicts the process from beginning to end (Steps 1 through 9) of planning and implementing an IPSSP. The Roadmap provides the framework for the content included in this report. Steps 1 through 5 are discussed in Chapter 2, and Steps 6 through 9 are discussed in Chapter 3.

Step 1: Understand Airport Perspective

Every airport operator has a unique perspective through which its IPSSP should be designed. These perspectives are shaped by things such as management expectations, business drivers, airline operating models, passenger profiles, and industry involvement. Defining the perspective for a specific airport will lay the foundation for making a valid case to obtain the required level of management support.

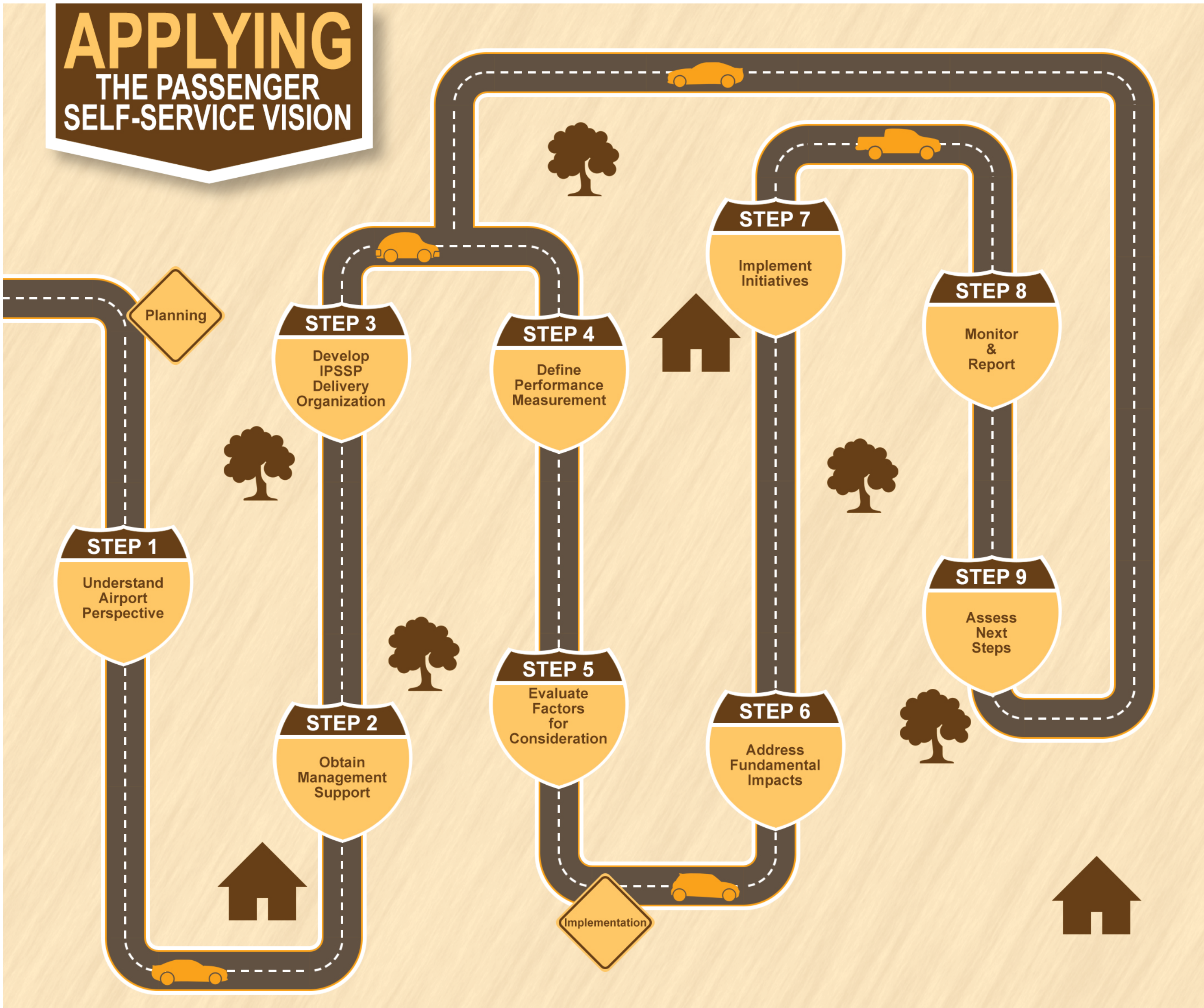


Figure 1-20. The "Applying the Passenger Self-Service Vision" Roadmap.

Step 2: Obtain Management Support

Executive management support for an IPSSP is absolutely critical for the long-term viability of a successful program. Operations, planning, and IT all play a fundamental role in the planning and implementation of IPSSP initiatives, and all must have active executive support from the beginning for the airport-wide process changes to be accepted.

Step 3: Develop IPSSP Delivery Organization/Steering Committee

A formal organization is needed to plan and govern an IPSSP. This organization serves as the hub for stakeholder engagement and performs and/or oversees the planning, implementation, and review for passenger self-services airport-wide to ensure a consistent approach toward achieving IPSSP objectives that are fully aligned with the airport business objectives.

Step 4: Define Performance Measurement

Without a means to measure performance, IPSSP initiatives and the program as a whole may function for years without ever producing the required outcomes necessary to achieve its objectives. In order to judge success or failure and make necessary adjustments, key performance indicators must be developed, monitored, and reported.

Step 5: Evaluate Factors for Consideration

Several key factors play a pivotal role in the design of passenger self-service initiatives that if not adequately considered can result in failure. Stakeholder consensus, regulatory and legal issues, access to passenger and flight data, and privacy concerns are a few. It is also imperative to evaluate the likelihood of achieving the expected benefits and of experiencing risks.

Step 6: Address Fundamental Impacts

There are a number of fundamental impacts within the airport environment that must be understood and addressed to support a successful implementation. These include the management of data, provision of connectivity, use of enabling technologies, changes to the facility, human resources, and communications with passengers. A proactive approach to addressing these items from a high-level strategy will greatly increase the probability of success.

Step 7: Implement Initiatives

A well-conceived and thoroughly justified IPSSP can quickly lose support as a result of a single poorly implemented initiative. After the significant investment of resources and time in strategy development and program planning, project implementation is not the time to start cutting corners. Each project must adhere to a structured implementation process that applies the appropriate amount of planning for the size and scope of the project.

Step 8: Monitor and Report

Monitoring and reporting on progress toward meeting the defined performance criteria for each and every initiative is necessary to ensure that adjustments can be made that further progress toward achieving the stated objectives or that initiatives can be halted before further resources are wasted. This is a critical component of the quality management process.

Step 9: Assess Next Steps

As passenger self-service projects are closed out and transitioned to steady-state operations, the focus cycles back to the planning stage, where data are analyzed, objectives are tweaked, key performance indicators (KPIs) are adjusted, and corrective actions are taken. Each and every component of the IPSSP will continually evolve under Stage 4 as fundamental impacts change, new factors for consideration emerge, and perspectives evolve.

CHAPTER 2

Applying the Vision—Planning

Understand Airport Perspective

- Self-Service Perspectives
- Evolution of Airport-Airline Relationship
- Business Drivers
- Case Studies
- Aviation Perspective on the Next Stage of Industrial Development

Step 1: Understand Airport Perspective

Self-Service Perspectives

The development of self-service processes is driven from different perspectives and motivations, giving consideration to multiple priorities and goals. The airport case studies conducted under ACRP Project 10-17 illustrate the different business drivers for airports and how these drivers have affected the choice of projects. Beyond issues and innovations directly related to the aviation industry, there are developments in broader areas, such as mobile technology, data sharing, and biometrics, which are beginning to have major impacts on decisions related to self-service.

Industry bodies, such as the Airports Council International (ACI), and IATA, are concentrating their efforts as much on the reasons for new processes and their social context as they are on the technical elements required for new systems and equipment. Major aviation industry players, including airlines, airports and suppliers, are looking outside the aviation world for new ideas on how people behave and what they value in order to drive design and development.

Evolution of the Airport-Airline Relationship

The airport-airline relationship is becoming increasingly interwoven and complex, as both entities share responsibility for more processes and data, and they seek to collaboratively improve efficiency and service levels. In addition, both airports and airlines must respond to a wide range of regulatory and security requirements. For example, Schiphol and KLM have open communication and regular meetings regarding how to collaboratively address topics about the airport and KLM in social media, security queue times, and passenger experience. The overall passenger process is no longer just the responsibility of one or the other. New technology and systems require infrastructure changes and other long-term design considerations to be successful.

An increasing number of airport operators are seeking to serve airlines as an integrated tenant, using airport-provided infrastructure, rather than permitting independent and proprietary operation. Evidence of this trend is the growing adoption of common use passenger processing operational models within the United States. Many airlines operating systems such as baggage handling and sortation, boarding bridges, networks, and agent workstations function on a transactional or pay-per-use model, as opposed to airlines investing in their own infrastructure and equipment. This model increases the need for airport operators to understand passenger processes and new technology. This model also requires airport operators to evaluate and update service and support models to accommodate the airlines' extended hours of operation.

Business Drivers

The fundamental drivers for the development and implementation of self-service are increasing efficiency and improving service levels. An early example was the shift to self-service booking, and later ticketing, using remote tools. As new Internet-based technology became available, airlines were able to deploy remote access to their reservations and ticketing systems initially to trusted third parties and later directly to passengers with tools such as CompuServe and early online travel sites. Now, virtually all passenger transactions—booking, payment, immigration and customs, and check-in—are available remotely through self-service tools.

The effect of these changes has been to extend the concept of airport landside operations beyond the terminal into the broader community. This has enabled airports to deploy their own passenger self-service processes, such as parking reservation, cell phone lots, wayfinding, and integration with intermodal facilities.

The foundational elements of virtually all passenger transactions are identification and payment, and the different processes and systems either validate or modify these elements. As the processes have moved outside of the airport terminal and more entities have a role in passenger processing, it is useful to look at self-service in terms of how identification and payment data are handled. Many transactions can also be seen as "confirmation of intent" by the passenger, such as bag registration, boarding access, and immigration procedures.

For passenger self-service, a coordinated strategic approach is required across the community, involving the airport, airline, regulator, and passenger. For all, the key drivers are costs, data, and predictability of service and outcome. The following section provides summaries on passenger self-service as gathered via the ACRP Project 10-17 case study effort.

Case Studies

The airports and airlines studied for this project include Tokyo Narita Airport (NRT) with Japan Airlines (JAL); Amsterdam Airport Schiphol (AMS) with KLM Airlines; Montréal–Pierre Elliott Trudeau International Airport (YUL); Seattle-Tacoma International Airport (SEA); Port Authority of New York/New Jersey (PANYNJ); and Genève Aéroport (GVA). The outreach also included working groups of both major industry organizations, IATA representing airlines and ACI representing airports. In support of the airport case studies, over 20 other airports and airlines were interviewed either by teleconference or in person. The airports interviewed spanned North America and Europe and ranged in size from 3 million passengers per year to over 50 million per year.

The key findings from the case studies, as provided below, show that each airport has its own perspective on self-service and the justifications for deploying new processes and systems. While these perspectives reflect individual airport priorities, there are common themes among the perspectives as well as the same fundamental business drivers.

Tokyo Narita Airport

Narita is one of the major airports serving Tokyo (the other is Haneda) and is the home base of Japan Airlines (JAL). Narita also serves as a major gateway for Asian traffic to North America and Europe. As a result, self-service and other process improvements are evaluated in the context of their contribution to the overall value of the airport compared to others.

- Primary Perspective: Competition
  - Narita Airport versus Haneda Airport for Tokyo passengers and other local traffic.
  - Narita Airport versus other Asian Airports for passengers from the United States.
  - JAL at Haneda Airport versus Bullet Train for passengers to Kyoto.

- Narita is seeking full compliance with IATA's Simplifying the Business (STB) objectives to further enhance the airport's ability to support airline process initiatives.
- JAL is a major stakeholder at Narita and has well-defined performance and operational goals which help define the airport's processes:
  – Allows at-airport check-in up to 15 minutes prior to departure for passengers without checked baggage.
  – Recognized as the "world's top performer for on-time arrival" in 2013

Amsterdam Airport Schiphol

Amsterdam Airport Schiphol is a major economic driver for the Netherlands and is very conscious of competition from other European hub airports. While Amsterdam is the home base for KLM, the airport is actively supporting transit opportunities and intermodal traffic to ensure growth. Self-service projects are used to differentiate the processes at Amsterdam.

- Primary Perspective: "Europe's Preferred Airport."
- Key Drivers:
  – Self-service enables the passenger/consumer to be in control.
  – Common use provides the airport with the means to lower costs to the airlines.
- Amsterdam maintains extensive cooperation with the airlines, particularly KLM, to ensure coordinated development.
- KLM E-Development Vision:
  – Deliver the right service, at the right touch point, at the right time.
  – Provide as much of the process as possible off-airport.
  – Give the customer as much choice as possible.

Montréal–Pierre Elliott Trudeau International Airport

Montreal Airport has a balanced mix of traffic across all market segments, domestic, United States, and international. In addition, the airport has a wide range of airlines and therefore has an important development and coordinating role in defining processes and services. The airport has taken a strong leadership role both in terms of its own initiatives and in providing support for airline products.

- Primary Perspective: Customer Service.
- Montreal believes that passengers want choices, and each service responds to a specific need so the airport actively encourages new process deployment.
- Dedicated to common use.
- It is the role of the airport to get involved with passenger flow and airline process issues.
- Airport should play a role in making changes to build what will be needed in the future, even though the airlines will be developing their own processes.

Seattle-Tacoma International Airport

Seattle-Tacoma International Airport (Sea-Tac) serves a community that is highly aware of technology in general and therefore evaluates the airport experience in terms of an ability to support new systems and tools. Self-service initiatives are part of this dynamic, and the alignment of technology to achieve strategic airport goals is a key part of the deployments.

- Primary Perspective: Strategic Focus.
- Airport's purpose is defined as strategic goals.
- Strategic goals drive technology strategies.
- Technology strategies are defined and drive specific technology objectives.
- Airport's investments support the initiatives from this alignment.

- Technology strategies support passenger self-services:
  - Anticipate and plan for innovation in consumer and aviation technology.
  - Encourage adoption of advances in customer service technology (ACI, Airport Service Quality [ASQ], and IATA).
  - Create a culture of technology enthusiasts and data-driven decision making.
- Emphasis on mobility and the extension of the airport beyond the terminal.

Port Authority of New York and New Jersey (PANYNJ)

PANYNJ is the authority managing multiple airports serving New York City and the surrounding area. These airports serve very diverse markets across various airports, terminals, and airlines. The operating models in the facilities are also different, with airlines, terminal operators, alliance, and the airport authority performing multiple roles. As a result, PANYNJ has a significant role in ensuring that its high standards of customer service are implemented across the community and in coordinating the deployment of new processes and systems from multiple stakeholders.

- Primary Perspective: Customer Service.
- Airlines drive passenger self-service within the PANYNJ airports.
- PANYNJ role is to support the airlines and drive improvements in customer service systemwide:
  - Customer surveys and feedback drive investments and provide performance measurement.
  - Reply to 100% of passenger feedback, including Twitter, within 10 days.
  - Provide customer service standards for all airport tenants/concessionaires.
  - Engage other port departments to improve support for passenger services.

Genève Aéroport

Genève Aéroport (Geneva Airport) is a busy facility in an urban environment, with significant space and infrastructure constraints. The airport serves multiple airlines for long- and short-haul traffic, as well as connecting and intermodal services. Overall growth is creating pressure on the facility, both in terms of throughput and service. The airport therefore looks at self-service in terms of the operational improvements it can deliver, both for airport processes and airline initiatives.

- Primary Perspective: Maximize Potential and Customer Service.
- Focus on a smooth flow of airport operations and the quality of services to customers:
  - Coordination and planning with partners for optimized flow and safety.
  - Monitor airport activities in order to improve service to customers, especially punctuality.
- Measure performance with ACI ASQ and internal KPIs

Aviation Perspective on the Next Stage of Industrial Development

As each airport operator seeks to understand its unique perspective, it must acknowledge that each passenger, airline, and regulatory agency has specific requirements that must be accommodated. The relative importance each stakeholder group places on enabling self-service options to address primary concerns must be considered. This will allow the airport operator to determine the overlap and devise a strategy that addresses the greatest overall need.

Although it may seem rather obvious, understanding one's unique airport perspective can be somewhat challenging. Especially since the dynamics of an airport may impact, or change over time, the elements of a once-understood perspective. Take for example, the Denver International Airport (DIA), which has traditionally been known as a primary origination and destination (O&D) airport. As one might expect, the Aviation Department had focused its passenger services primarily on the O&D market. However, connecting traffic has been on the rise at DIA for the past several years and has reached a level significant enough for the Aviation Department to

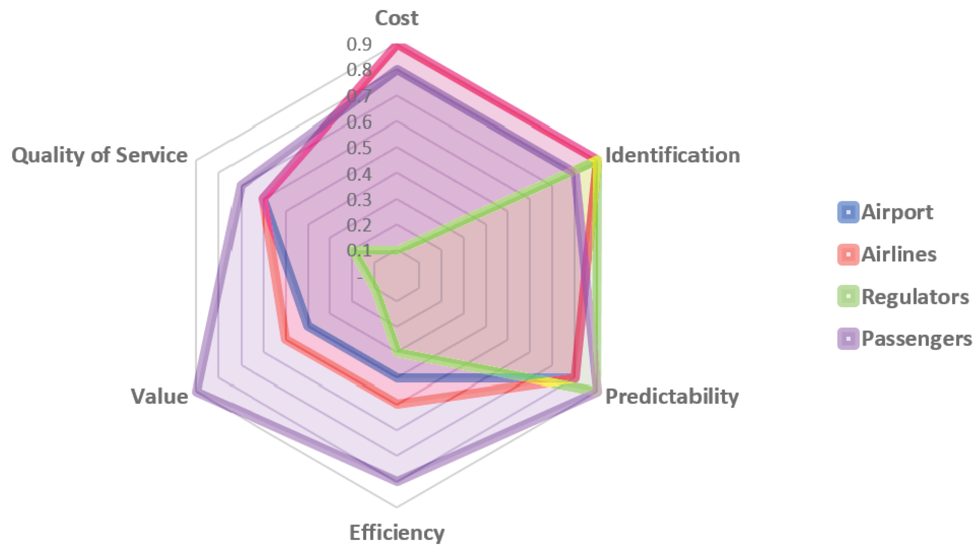


Figure 2-1. Identifying stakeholder priorities.

make an effort to understand how new passenger self-service initiatives could benefit the growing population of connecting passengers.

To illustrate the idea of defining a unique airport perspective based on differing stakeholder priorities, Figure 2-1 shows a hypothetical example of how each stakeholder group might prioritize the following criteria on a scale of 0 to 1: cost, identification, predictability, efficiency, value, and quality of service. The airport would gather information on and determine these priorities in different ways depending on the group. For passengers, this information could be obtained through surveys conducted by the airport and conducted by other industry associations. For airlines, the information could be obtained through association surveys and articles, as well as through interpretations of observed business practices. The areas with the greatest overlap and that are furthest out on the graph—in this case identification and predictability—represent the greatest opportunity for self-service solutions that will satisfy multiple stakeholder needs.

The pace at which passenger self-service processes are evolving continues to increase as technological advancements are made. Because of this, the initiatives envisioned today may be replaced with new concepts or improved technological solutions within just a few years. To ensure that the airport operator is establishing initiatives that will be relevant upon implementation, a thorough understanding of the industry direction is needed from both the airport and airline communities. Key industry associations/institutions are working to continually improve the aviation industry with programs that have a direct impact on the development of passenger self-service processes and initiatives.

Associations/Institutions

Several aviation-specific trade associations/institutions exist to promote improvements in the aviation industry. Those actively involved in promoting passenger self-service initiatives include ACI, ACI-NA, IATA, Airlines for America (A4A), and the ACRP.

ACI

ACI serves airports around the world and provides representation to governments and organizations internationally. ACI creates standards, policies, and recommended practices that enable consistent and continual improvement within airports globally.

As per their website (http://www.aci.aero), key objectives of ACI that are relevant to passenger self-service include the following:

- Achieve cooperation among all segments of the aviation industry and their stakeholders as well as with governments and international organizations.
- Influence international and national legislation, rules, policies, standards and practices based on established policies representing airports' interests and priorities.
- Maximize cooperation and mutual assistance among airports.
- Provide members with industry knowledge, advice, and assistance and foster professional excellence in airport management and operations.

ACI-NA

ACI-NA represents the governing bodies that operate commercial airports throughout the United States and Canada. ACI-NA is one of the five worldwide regions of ACI and serves as an airport advocate in government affairs, legal, environmental, safety, security, operations, and technical issues.

As per their website (http://aci-na.org/), key services of the ACI-NA relevant to passenger self-service include the following:

- Promot[ing] cooperation with all elements of the commercial civil aviation industry.
- Exchang[ing] ideas, information, and experiences on common airport issues.
- Identif[ying], interpret[ing], and disseminat[ing] information to its members on current industry trends and practices.
- Creat[ing] forums of common interest, build[ing] professional relationships, and interpret[ing] key airport policy and business issues to the ACI-NA membership.

IATA

IATA represents airlines globally among governments and regulatory agencies. IATA seeks to educate policy makers on the economic benefit of the airline industry and thereby minimize over-burdensome regulations. IATA also develops global standards for commercial operations that will simplify processes, increase passenger convenience, reduce costs, and improve efficiency.

A4A

A4A serves as an advocate for airlines based in the United States to the government as well as other groups to maximize the safety, security, and health of the U.S. airline industry.

ACRP

ACRP develops practical solutions for issues being experienced by airport operators throughout the United States. ACRP is one of the programs under the Transportation Research Board (TRB) of the National Academies. ACRP, through the financial support of the FAA, leads industry experts in the development of research products that provide guidance on addressing common challenges faced by U.S. airports.

Collaboration

Collaboration is the basis on which each of the aforementioned industry groups is able to successfully address industry-wide challenges. Whether it is airport-focused groups such as ACI, ACI-NA, and ACRP, or airline-focused groups such as IATA and A4A, the collaboration of airports, airlines, and industry experts has enabled continuous advancements through sharing of information and cooperative problem solving. It is within these associations that multidisciplinary working groups composed of airport, airline, and private industry representatives are developed to address issues from all aspects, including commercial, financial, facilities, regulatory, legal, operational, and technical. This collaboration results in the adoption of industry-wide policies, standards, and recommended practices.

Furthermore, this collaboration is an ongoing process that continually updates the industry knowledge base as new strategies are conceived, new technology is unveiled, or new regulations are imposed. Many airport operators, such as the Port of Seattle, closely monitor the progress of IATA. As noted during interviews with Port of Seattle staff, IATA Fast Travel has significant implications for facilities planning to enable "self-service everything." The Port of Seattle is a strong supporter of IATA Fast Travel and embraces it as a disruptive technology that is driving self-services. The Port of Seattle also closely tracks advances proposed by the IATA Passenger Experience Management Group (PEMG).

Major Passenger Self-Service Initiatives

Both ACI and IATA have been involved with passenger self-service process and system development for many years. As airports and airlines have deployed new tools such as kiosks, self-tagging, mobile devices, web access, and so forth, industry groups have worked to develop technical standards and recommended practices and create the framework for successful implementations.

While the standards continue to evolve and become more comprehensive, there are some significant themes emerging which will drive development. Both organizations are actively promoting concepts of flexibility and customization.

IATA

IATA manages self-service through the overall structure of Fast Travel and the PEMG. Multiple technical and other working groups are responsible for different topics and systems.

The PEMG is developing an overall theme which will drive and coordinate the other standards, based on the concept of the "customized passenger experience." This means that each passenger's experience—essentially the "batch process of one" concept previously presented—can be adapted to his/her needs, using different tools and accessing different processes.

ACI

ACI has several work groups concerned with self-service and technical best practices, including the Airport Community Recommended Information Services (ACRIS). This group is developing guidance for airports in deploying multiple technologies using service-oriented architecture (SOA) to facilitate and simplify the overall airport environment.

As part of this work, ACRIS is looking beyond the aviation industry to manufacturing in general, and the rapidly emerging concept of the "batch of one." This concept sees each product as an individual, with distinctive attributes and requirements. As discussed in Chapter 1, when applied to the airport environment, the passenger can be interpreted as a "batch of one," with a distinctive data profile and tools, accessing specific processes.

Integrated self-service builds very clearly on the concepts of flexibility and customization, which are well supported by the leading aviation industry groups and are at the forefront of industrial design thinking today. As these concepts develop and expand, the support of aviation managers and planners is critical to success.

Obtain Management Support

- Align IPSSP Vision with the Business Vision
- Build Awareness for Change
- Be Ready to Discuss Strategies for Awareness in Process Change
- Prepare to Discuss Roles and Responsibilities
- Present Next Steps
- Establish Trust by Effective Follow Through

Step 2: Obtain Management Support

This section discusses how to obtain executive management support for establishing an IPSSP. Along with executive management, key contributors to an IPSSP typically come from operations, planning, and IT. Each contributor has a fundamental role in ensuring success, and depending on the airport organization structure, any of these contributing areas may provide the champion for establishment of an IPSSP. Regardless of who becomes the champion for establishing an IPSSP, executive management support is needed from the onset of the program. An IPSSP is doomed to fail if executive management does not actively support the initiative.

For an IPSSP to be successful, executive management must be ready not only to provide financial support but also to provide resourcing support, perhaps in ways that are not already available. It is important that executive management be ready to also provide visible support to demonstrate the importance and necessity of integrating passenger self-services. Sustained, visible support can help the early success of this program, as the inevitable challenges occur. Although there will be immediate successes, the sustained success in moving to an IPSSP is a long-term effort.

This section discusses the following actions involved in successfully obtaining the initial support of executive management and establishing a means of keeping that support throughout the IPSSP:

- Align the vision of the IPSSP with the business vision.
- Build awareness for change.
- Be ready to discuss strategies for awareness in process change.
- Prepare to discuss roles and responsibilities.
- Present clear next steps.
- Establish trust with effective follow through.

Genève Aéroport

Passenger self-service has high management support from the top down.

Align the Vision of the IPSSP with the Business Vision

When presenting the need for an integrated approach to passenger self-services, the first step is to understand the airport's mission ("What we do" and "Why we do it") and vision ("What do we want to be in the future"). Regardless of how formalized the mission and vision are, executive management understands them. Through an airport's mission and vision, key objectives are defined, measured, and assessed. This topic is discussed further in the Business Case Development Guide (Part III, Chapter 4) of this report, but typical issues addressed in the mission and vision are the following:

- Customer Service
- Culture
- Community
- Competition
- Innovation

Sea-Tac

We take a top-down approach to initiatives. As such, there is alignment with the airport's goals and all technology objectives.

Understanding the business vision, then aligning project prioritizations is a fundamental method for the Narita Airport Authority (NAA). For the business, their top priority is providing better service than their competition. NAA's internal analysis focused on understanding its competition from a local/regional area and then globally. Through understanding their competition, the NAA could analyze how to improve its own internal processes—the key internal process being the amount of time it takes a passenger to arrive and go through the airport. The NAA has also started to assess how well the airport, along with its airline tenants, complies with IATA's STB objectives. Through this assessment, the NAA plans to improve the self-service process across all passenger journey points. Once the planning department has established the overall objectives in line with the business, the IT planning department, the IT development department, and the planning department (and some related departments) then establish IT projects and goals to help achieve the overall objectives.

Table 2-1. Aligning the IPSSP vision with the airport's vision/mission.

Customer Service	The IPSSP will provide self-service tools for the passenger throughout his/her journey, in a consistent manner, wherever these tools are needed.
Culture	The IPSSP will seek to evaluate the greatest benefit and assess the risks, understanding that the culture of this airport is to take risks when benefit is at its highest.
Community	The IPSSP will evaluate all projects against the community awareness program, knowing that the airport facility seeks to draw community involvement.
Competition	All IPSSP projects will be evaluated against their impact on shortening the total time it takes for a passenger to process through the airport, knowing that competition depends on this goal.
Innovation	The IPSSP will anticipate and plan for innovation in consumer and aviation technology.

Once the airport's mission and vision are understood, identifying an IPSSP vision that best matches the stated airport's mission and vision is the next course of action. Using the understanding of the airport's perspective, discussed in Step 1, an example of how to align the IPSSP vision with the airport's vision is shown in Table 2-1.

The effort to gain executive management support starts with aligning the specific vision and can be improved by understanding the perspectives discussed in Step 1. Specific stakeholder needs will differ from airport to airport, but having success stories from similar airports may prove extremely valuable. Knowing what other airports (maybe even competing airports) are doing in this regard can only help in the discussions.

Finally, it is necessary to be prepared with options in the vision statements when presenting the alignment of the IPSSP vision with the airport's mission and vision. Since the airport's mission and vision are developed over time, it stands to reason that executive management will have comments and perhaps differing opinions as to how well the initial alignment is presented. Expect that executive management buy-in will naturally result in value-added modifications to the initial plan.

Build Awareness for Change

How executive management supports change becomes the filter that all elements of the IPSSP will be run through. This is better understood when it is realized that an effective IPSSP impacts all stakeholders involved with the passenger, including airlines, concessionaires, federal agencies, and practically all airport operational divisions.

In considering change, there will be times when a change to improve passenger processing will be required by a federal agency, which may impact many of the airlines. In such cases, it may be much easier for the airport representative to talk to the airline regulators than for the regulators to talk with each airline.

Aéroports de Montréal

The airport should take the lead role in making changes—even if it is an airline "thing."

It is also very important for the airport operator to fully understand the business objectives and impacts behind the change. For example, a change to integrate passenger self-services may first appear to be a technology issue, because it includes data and IT infrastructure. However, further consideration shows that such a change may also impact how the passenger uses the airport facility or how a passenger is interacting with his or her preferred airline.

In a nutshell, the underlying theme for passenger self-services is change. Look out constantly for innovative solutions with the potential to improve performance and benefit, as this is relevant for a successful IPSSP. Executive management must be aware that a successful IPSSP will be ready to take advantage of and to manage such opportunities, while remaining open to change and new ideas. Obviously, the degree of openness to change is directly applicable to the culture of executive management in being undaunted by risk and adapting new trends and ideas to personal circumstances.

Chapter 1 of this report provides examples of the importance of this element of change. One way to help executive management understand the importance would be simply to show how the industry (e.g., IATA and ACI) is in the process of changing its outlook on passenger self-service and aligning more with the Stage 4 passenger.

Once understanding is achieved, present a change management process. Understanding change is necessary for achieving long-term success, but properly managing change will actually bring the success to fruition. Change management is discussed in detail in the following sub-section.

Be Ready to Discuss Strategies for Awareness of Process Change

At this point, prepare a clear process change strategy that includes objectives for awareness and eventually training needs. Many airports already have dedicated staff for the planning of passenger services, but few truly track the end-to-end passenger journey for the varied methods and approaches passengers take through the airport. Process change strategy will include changes in behavior in existing processes or creation of completely new processes as a result of the airports' potential lack of understanding of the end-to-end passenger journey. Further discussion on the process is provided in Section 3 of this chapter.

Until executive management realizes that something is broken, ideas addressing any changes will certainly fall on deaf ears. Come up with a convincing way to present the differences and the missed opportunities to executive management. This will help to ensure complete management buy-in. The following example of how a passenger self-service project may have been looked at with Stage 3 understanding, compared to how the same project would look with Stage 4 understanding as a part of the IPSSP can help to clarify the need for awareness of the changed or new processes. The example shows approaches to conducting a passenger self-tagging project.

Schiphol

Every passenger journey element is inspected and scrutinized for process improvements.

Stage 3—Approach to a Passenger Self-Service Project

A case is made that passengers traveling through the airport can benefit from installing passenger self-tagging. This case is brought to the attention of the airport operator through one of the airline tenants most interested in such an installation. Under the Stage 3 way of thinking, the following typical steps are taken:

1. A single use case is established, recognizing the passenger self-tagging impacts on the check-in process. The use case may consider functionality and features for a single airline, more than one airline, or common use.
2. Costs and benefits are discussed and evaluated. Consideration is given to the expected savings in time for the passenger and in staff resources for the airlines. These benefits are evaluated against the cost of deployment, including facility changes to accommodate the self-tagging area and perhaps the eventual bag drop area, as well as provisions for continued bag security. IT and facility infrastructure is assessed to ensure proper capacities are in place.
3. If benefits warrant moving forward with the project, deployment requirements are planned for, either for an immediate deployment or through a first-step pilot program.
4. Deployment commences with appropriate testing and training in place. If the project is conducted first through a pilot, an extended period is given for process evaluations.
5. Post-deployment assessment and reporting are conducted and evaluated against success measures.

Stage 4—Approach to a Passenger Self-Service Project as a Part of the IPSSP

A case is made that passengers traveling through the airport can benefit from installing passenger self-tagging. This case is brought to the attention of the airport operator through one of the airline tenants most interested in such an installation. Under the Stage 4 way of thinking, the following typical steps are taken:

1. Various use cases are established showing how passenger self-tagging would impact the end-to-end passenger journey. Rather than just considering how passenger self-tagging would impact the check-in process, passenger self-tagging is looked at as part of the overall airport passenger journey. From this vantage point, beneficial impacts across the entire journey can be evaluated. For example, a use case may show that biometric enrollment is needed for improvements in the security checkpoint process. Considering the passenger's end-to-end journey may show that it makes sense to perform the biometric enrollment at the same point that the passenger performs self-tagging, thus eliminating a step/point in the overall process where passenger information is requested. Another use case may show an increasing number of passengers are checking in through the remote train access. In this case, consideration is then given to potential use of passenger self-tagging at the remote site.
2. Goals are evaluated for each type of passenger through the end-to-end journeys. This allows the establishment of a "Heat Map" of problem or weak points within the passenger process that can then be evaluated and prioritized. Problem statements are established with business case justifications prepared that consider risks, benefits, and technology innovations.
3. The passenger self-tagging project is assessed against the integrated approach of the IPSSP, where at least the following issues are considered: data requirements and data sharing, key stakeholders, similar uses, other use case benefits, and related airport uses.
4. IT is engaged for potential solution sets, considering both existing technology and innovation opportunities.
5. Costs and benefits are discussed and evaluated. Consideration is given to the expected savings in time for the passenger and in staff resources for the airlines. These benefits are evaluated against the cost of deployment, including facility changes to accommodate the self-tagging area and perhaps the eventual bag drop area, as well as provisions for continued bag security. IT and facility infrastructure is assessed to ensure proper capacities are in place.
6. Solution sets are analyzed, and it is determined that the passenger self-tagging project should be performed as a pilot program, with the following integrated components:
   - Biometric enrollment at the kiosks.
   - Bag drop process deployed simultaneously to evaluate all baggage requirements.
   - One airline, using preferred flyer program and non-preferred flyer program tracked independently for use case evaluation.
   - Mobile bag tracking application provided by the airline in collaboration with the airport is provided for opt-in passengers.
7. Use cases are established, including KPIs, for post-deployment review. Measurement criteria and means of reporting are established, as a part of the IPSSP.
8. If benefits warrant moving forward with the project, deployment requirements are planned for, either for an immediate deployment or through a first-step pilot program. In this case, deployment requirements are set for a pilot program and milestones are established to measure the success of the pilot program. IT infrastructure is assessed to ensure proper capacities are in place.
9. Deployment commences with appropriate testing and training in place. If the project is conducted first through a pilot, an extended period is given for process evaluations.
10. Post-deployment assessment and reporting is conducted and evaluated against KPIs. This process requires continual reevaluation, with the expectation of a higher adoption rate and evolution of choices as the IPSSP matures. Expectations are that process definition will change over time.

Although the basic approach for conducting the project under either the Stage 3 or Stage 4 way of thinking may be similar, under Stage 3 the project is approached from a single focus (or use case), whereas under Stage 4 it is approached from an end-to-end focus (many use cases). The steps followed in Stage 3 are also followed in Stage 4; however, with the Stage 4, "batch process of one" way of thinking, the steps are expanded upon to achieve a truly integrated approach.

Once awareness of the change in processes is achieved, an education strategy is needed. Use the education strategy to help establish a shift to the Stage 4 way of thinking. Issues to consider in building an education strategy are the following:

- How to view the passenger as the "batch process of one": focusing on what the passenger does in particular areas of the airport rather than on the process steps (e.g., check-in).
- How to track and measure the passenger processes through the entire end-to-end journey.
- Understanding passenger choices through their own way of moving through an airport, and perhaps through airlines' preferences and other influences such as TSA's Pre✓™.
- Determining means and methods for measuring success.

Prepare to Discuss Roles and Responsibilities

This subject matter is discussed in detail in Step 3 of this chapter. When meeting with executive management, it will be important to be prepared to discuss at least roles and responsibilities for a steering committee, planning elements, project sponsors, and innovations.

Genève Aéroport

Our project organization facilitates project definition and priorities across all airport responsibilities.

Present Next Steps

Assuming that executive management accepts the concept of managing passenger self-services through an IPSSP and that change is needed, options for next steps should be ready at this time. Finding three or more options for the change plan can be helpful. Presenting only one option limits dialogue and collaboration from executive management: It becomes an all-or-nothing scenario.

Establish Trust with Effective Follow Through

A key to a collaborative relationship is following through on what was promised. During the initial meetings, set realistic milestones for follow up with executive management to report progress. It is important to stay organized and to keep executive management in the loop as progress is made.

Step 3: Develop IPSSP Delivery Organization/Steering Committee

An integrated approach to passenger self-services requires the airport operator to formalize its program delivery organization, with a focus on reviewing and planning for passenger self-services across all aspects of the airport. Although airport operators may have the basic management structure in place for planning of passenger services, they may not have the formalized emphasis toward passenger self-services. The established passenger self-services program delivery organization should facilitate the definition of projects and priorities across all operating divisions of the airport, starting from airport operations, and with close business relations with IT.

Develop IPSSP Delivery Organization/Steering Committee

- IPSSP Steering Committee
- IPSSP Planning

With regard to passenger self-services, three airport business functions typically take a lead role in the planning and execution of passenger self-service initiatives. These are the following:

- Operations—focuses on the efficiency, safety, and flow through of the passenger.
- Planning—focuses on the satisfaction of the passengers as they flow through the airport.
- IT—provides the communications infrastructure and IT solutions for meeting the passenger's needs.

The following program delivery organization recommendations are based on careful planning and cooperation of operations, planning, and IT to achieve a successful IPSSP.

IPSSP Program Steering Committee

Within the defined program delivery organization, establish certain criteria to provide effective program definition, prioritization, and approval. Establishing the IPSSP steering committee is a good first step. The IPSSP steering committee produces accountability needed for the success of the IPSSP through the life cycle of each defined project or initiative. Through the IPSSP steering committee a single point of accountability is set, which holds the decision-making authority.

For some airports, a similar steering committee already exists that may allow adoption of the IPSSP steering committee responsibilities. Whether the IPSSP steering committee is adopted into an existing committee or whether it is newly established, the IPSSP steering committee ultimately is responsible for defining stakeholder needs, establishing objectives, and authorizing projects for all passenger self-service initiatives across the defined process areas of the airport, which in this report includes off-airport, landside, security, airside, boarding, and in flight.

When properly organized and empowered, the IPSSP steering committee provides oversight, advocacy, support, and decision making across all aspects of planning and execution of passenger self-service projects, as a part of the overall IPSSP. The IPSSP steering committee provides the overall strategic direction for passenger self-services and, in effect, can be considered as an advisory body to executive management. In its advisory role, the IPSSP steering committee must monitor progress in such a way so as to ensure the success of the initiatives and ultimately the program in achieving its objectives and satisfying stakeholder needs. Keep in mind that the IPSSP steering committee is put in place to "steer," not to manage. Therefore, the IPSSP steering committee's success depends on its ability to execute governing responsibilities, while allowing the airport's project execution and management teams to perform their respective responsibilities.

Whether establishing a new IPSSP steering committee or merging with an existing steering committee, a good first step is to define the IPSSP steering committee charter (charter). The charter will help to set the bounds of the IPSSP steering committee, including its purpose, authority, structure, and governing guidelines. An airport organization most likely has set up guidelines on how to produce charters related to voting rules, procedures, and governance. If not, the IPSSP charter should address these basic IPSSP steering committee requirements. In addition, consider the following issues and questions in preparing the IPSSP steering committee charter:

- What is the IPSSP steering committee make-up regarding actual member positions and advocate support roles?
- Is there membership representation for all six process areas of the airport? If not, how will the IPSSP steering committee ensure that process area representation is achieved across all passenger self-service initiatives?

- What is the IPSSP steering committee scope with relation to the IPSSP vision? Does the scope of the IPSSP steering committee span all aspects of the project and program?
- What types of meetings will be required (regular, special, workshop, etc.), and how often will meetings occur?

Traditional Representation on the IPSSP Steering Committee

In considering the IPSSP steering committee make-up, keep in mind that steering committees operate efficiently and with less risk when the designated "mission" is executed under a formal organization structure. Such a structure provides a framework of accountability for how committee work gets done. The following list provides recommended representation for IPSSP steering committee membership:

- **Executive Representation.** Depending on the approach to a steering committee, executive representation may or may not be a part of formal membership. However, the role is needed to help the IPSSP steering committee stay focused on airport business objectives (marketing, competition, etc.). Executive representation has a level of understanding in regard to the airlines and local communities.
- **Operations.** Operations representation is required for understanding the operational functions and relevant strengths and weaknesses within each process area of the airport. To allow for a collective review of project requirements, representation should include at least one advocate from all six areas.
- **Airline Operations.** Representation from airlines should include airline advocacy as a priority. Airlines conduct many of the same passenger self-service initiatives as airports, and close coordination between the airport operator and airline is needed to establish a business and information sharing platform. When considering projects within the six process areas, the IPSSP steering committee must recognize that airline needs may provide additional complexity. How a passenger travels through the airport and each airline's needs in addressing its specific passengers must be assessed in the project. For example, one airline may require multiple check-in desk configurations (elite passenger, web check-in passenger, etc.) while another airline accommodates all passengers through one basic check-in approach.
- **Planning.** Planning representation is needed to help focus on understanding current passenger processing and the planning approach for capacity studies, satisfaction surveys, and community involvement. The planning representation provides understanding of current satisfaction levels, along with the statistical requirements for future initiatives. For the IPSSP, planning representation takes on the responsibility for considering end-to-end journeys and the complexities of managing the common infrastructure.
- **Facilities/Infrastructure.** Facilities/Infrastructure representation is needed to understand the facility impacts of passenger self-services initiatives, including architectural, power, and IT. This representation is important to ensuring the management of a common infrastructure.

> **Narita Airport**
>
> Executives' position is to focus on understanding competition, and to analyze how to improve its own internal processes.

> **Narita Airport**
>
> We have a complete time analysis for the passenger journey points. No area is safe from scrutiny, even elevator time.

Innovation Representation on the IPSSP Steering Committee

Innovations representation is needed on the IPSSP steering committee to maintain a consistent view of the ever-changing environment for passenger self-services. Innovation representation should consider technologies, aviation committees and standards, and social media. Airport executive participation in the IPSSP steering committee will be necessary to enable the establishment of a specific role for innovations. It will also require continual investigation of new technologies and close coordination with airport IT.

Genève Aéroport is an example of an airport owner considering innovation by ensuring its organization structure accommodates innovation. As with most airport owners, Genève Aéroport maintains an information and communications technologies (ICT) group. Project needs from operations are then passed down to ICT for operations planning and project definition. In addition to ICT and operations, Genève Aéroport also maintains an IT airport innovation group, separate from ICT. ICT therefore works in coordination with operations steering and the IT airport innovation group to help define the project. Depending on recommendations from IT airport innovation, Genève Aéroport may initiate project pilots to prove the project definition and need.

Innovation is an important part of the planning and definition of the project. For example, the following hypothetical business need could be provided by the IPSSP steering committee: "Passengers traveling through the airport should not have to identify themselves. Passengers will not have to deal with, or provide information to, the airline or the airport or a government agency or a third party. Information will be seamlessly shared between the airline, the airport operator, government agencies, and their contractors." Most likely, IT, project management, and others will scoff at such a vision, stating that this type of journey is not possible, at least not in the foreseeable future. However, it would be technology innovation that may present the fact that this type of travel is close to a reality in the Netherlands, between airports, and is known by the vendor and airlines as "touchless total tracking." The technology being applied is through a series of biometric identifiers and surveillance data systems. The collaboration, although difficult, is being achieved due to close coordination and planning with a major airline and airport operator. Technology innovation is achieved through constant research and participation in the committees and organizations that are driving airport and airline technology solutions. This constant contact requires at least one near-full-time staff member.

Figure 2-2 shows a typical organization chart of the primary members of an IPSSP steering committee. Listed directly below each member are the coordination responsibilities. The effort involved managing these coordination responsibilities has resulted in many airports establishing subcommittees (such as airline affairs) that then report to the IPSSP steering committee.

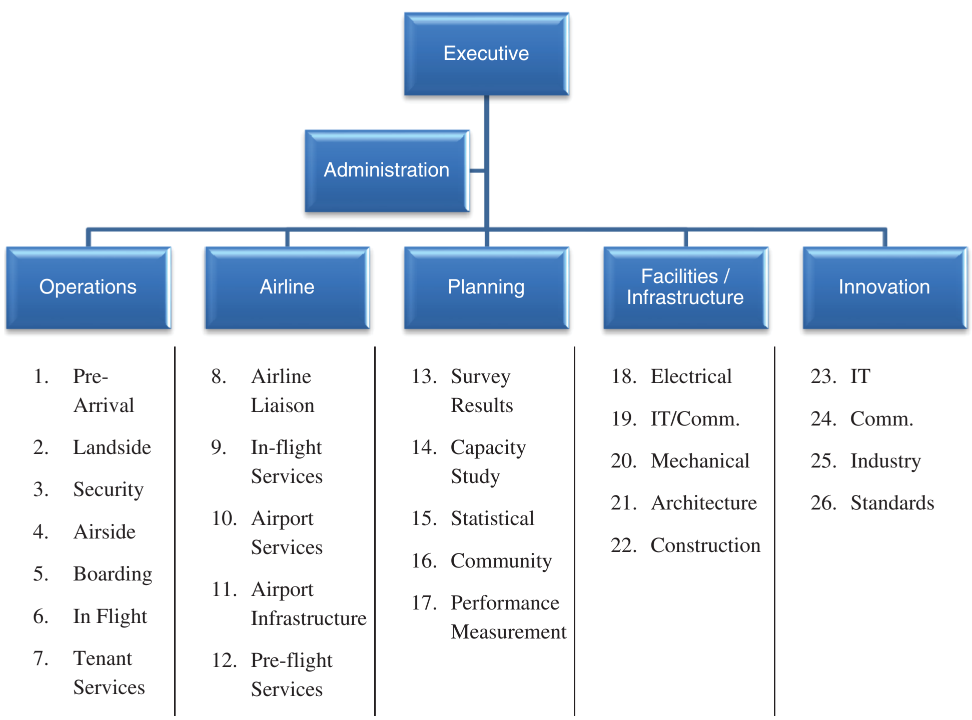


Figure 2-2. IPSSP steering committee and responsibilities.

IPSSP Planning

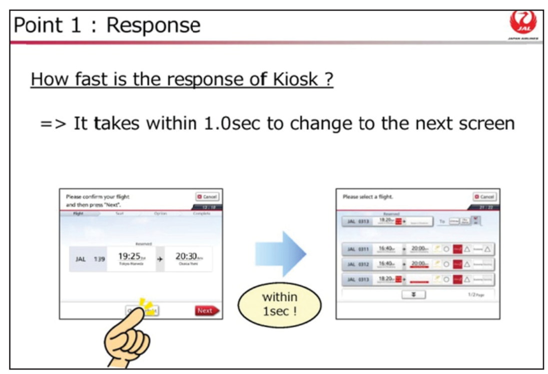
Stakeholder Needs for Passenger Self-Services

Since the IPSSP steering committee is ultimately responsible for defining the end-to-end journey of the passenger, it must consider passenger self-service impacts and benefits across all process areas relative to stakeholder needs. The IPSSP steering committee must recognize that within each of the six process areas, passengers have options as to how to travel through the airport (as discussed in Chapter 1). For instance, with the various airline frequent flyer programs passengers move and interact in completely different functional means, based on their selected airline and their status with the airline. Therefore, the IPSSP steering committee must understand how various passenger self-services are applied, while still considering the airport's needs for a common infrastructure.

For passenger self-services, the planning effort requires the application of collaborative statistical measurement. Consider, for example, that the airport operator has an objective to reduce the time it takes for passengers to travel through the process areas by 15%. This objective might be driven by (1) community interests, such as the local passenger who wants to arrive at the airport much closer to his/her departure time, and (2) commercial interests, such as the airport operator's desire to increase the amount of dwell time a passenger has to shop. Coincidently, a major airline at this airport may have a similar goal in mind.

The typical method for approaching such a project includes unique steps, conducted independently by the airport operator and by the airline. For the airport operator, the effort may be focused in reducing queue time at the security checkpoint. With this effort, the airport operator may have established new methods to allow passengers priority or scheduled travel time through the security checkpoint.

For the airline, a similar effort may have resulted in reducing the check-in time at the airport. For example Japan Airlines (JAL) had an objective of reducing the check-in time for passengers so that the airline could remain competitive with local trains. JAL had determined that the only way to remain competitive with the train was to get the total passenger journey time close to the amount of time it takes to board the train. In considering time constraints, JAL evaluated the check-in kiosk functions and determined that the transition between self-service check-in kiosk screens must be 1 second or less. By making this change to kiosk screens, JAL was able to reduce the overall time taken by the passenger to perform the key check-in functions—change flight (same destination), upgrade, stand-by, mile registration, receipt issue, ticketing with create new booking, and ticketing with existing PNRs.



In effect, the examples mentioned above proved to be successful. However, both could have resulted in far greater efficiencies, by considering a coordinated effort and fully understanding how the passenger travels through the six process areas. If the airport operator had evaluated how the JAL passenger traveled through the airport, an option could have been designed and installed on the JAL check-in kiosk for printing (or downloading) and an airport "security fast-track lane" coupon.

Understanding first the objective (such as reducing time) provides the opportunity of knowing what to measure within the passenger's journey. Planning now looks at the full passenger journey and how the passenger will travel through the airport. By doing this, passenger self-service begins to take on an integrated model of the Stage 4 concept. To better understand this, consider the different approaches to implementing a "fast-lane" program in the example case described below.

In the example case, the airport operator observes that the security checkpoint has significant wait times throughout the day. Although there is a priority lane, it is only available for those who have achieved elite status with the respective airlines. To improve passenger options and help reduce queue wait times, the airport operator implements a fast-lane program that allows the passenger to pay a nominal fee through the airport's website and download a token, which when scanned at the checkpoint will allow the passenger to go through the priority lane, thus saving the more than 20-minute wait time. An added benefit the airport operator has achieved is to also introduce a new stream of non-airline revenue. The flow chart in Figure 2-3 represents the evaluation taken to justify the adoption of this program. Observe that the evaluation considers only the passenger's flow to the checkpoint and does not consider any impact or benefit to the other process areas.

Although this approach to implementing a fast-lane program proves to provide a benefit, what it lacks is an integrated view of the entire passenger self-service journey, resulting in the following:

- It does not provide a way to measure how many passengers will use the new lane.
- It does not include a consideration of how many airline passengers will be prepared to take advantage of the lane.

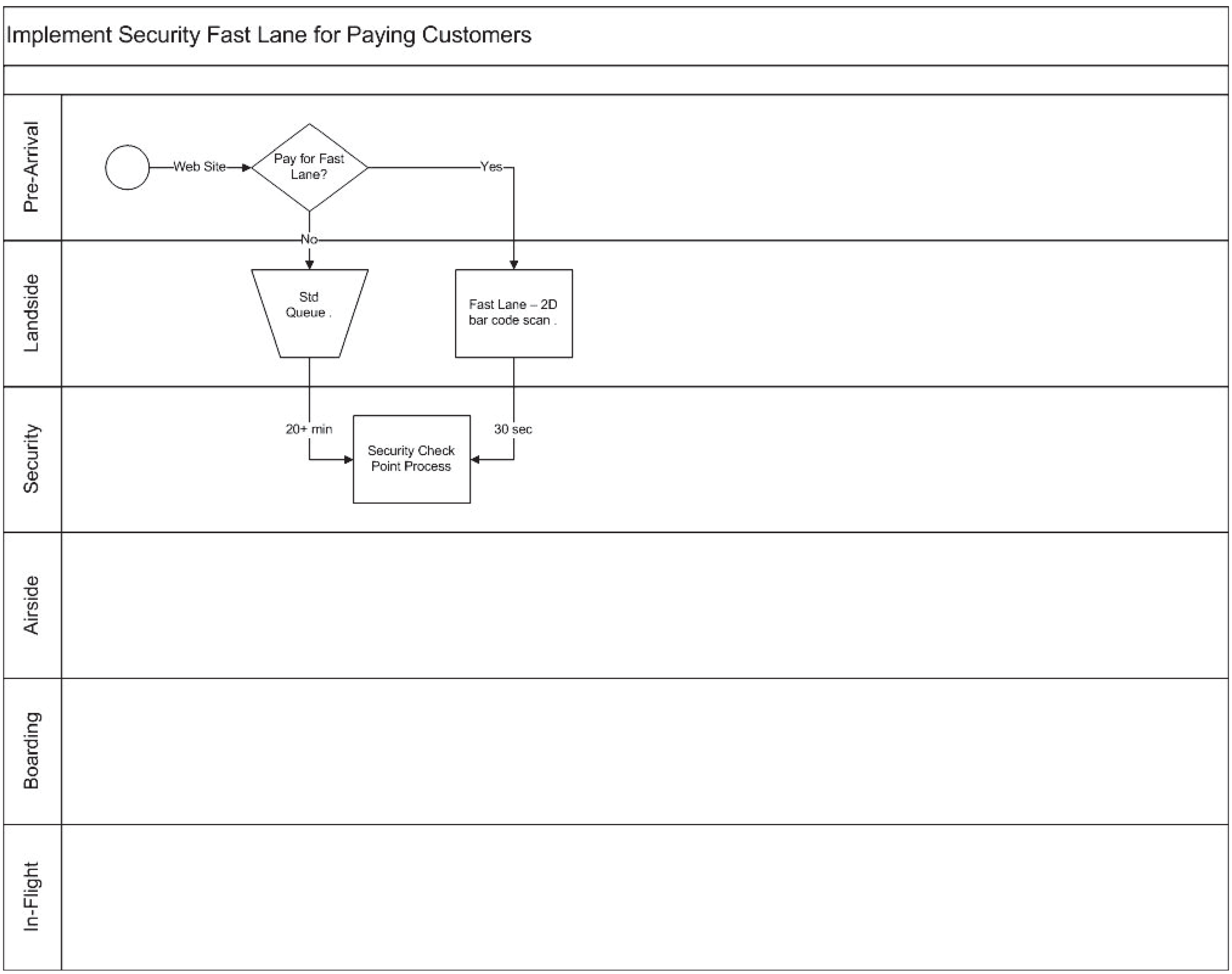


Figure 2-3. Justification for adoption of the fast-lane program.

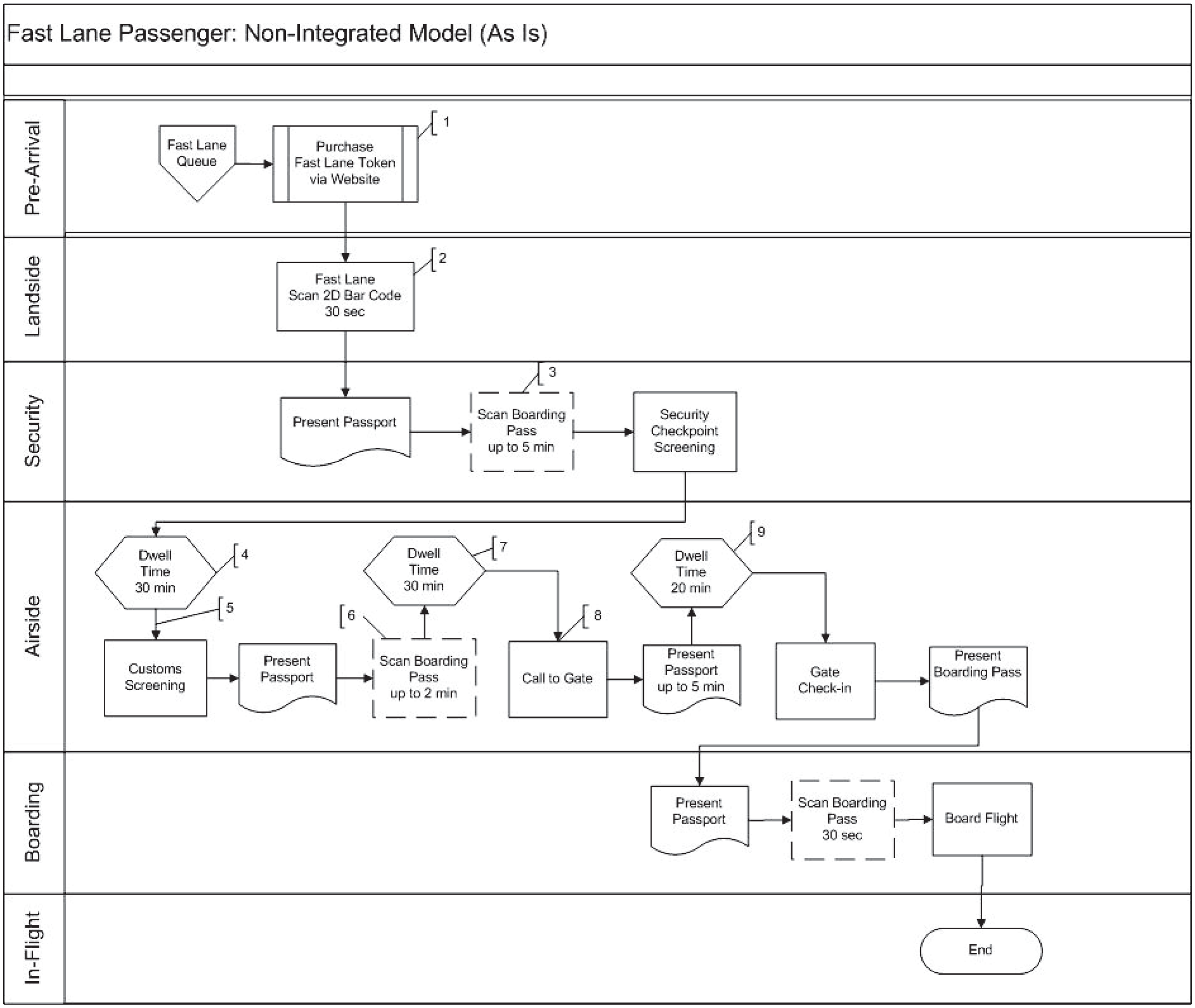


Figure 2-4. Fast lane—non-integrated approach.

- It does provide a downstream or upstream analysis of the process to determine other benefits.
- It fails to provide a qualitative analysis of the entire passenger journey from the integrated passenger self-service perspective (Stage 4).

To further understand the limitations of implementing passenger self-services under the Stage 3 approach, the flow chart shown in Figure 2-4 provides a snapshot of the impacts of the new fast-lane option on the passenger as he/she traveled through the airport. In Figure 2-4, there are nine journey points, each indicated with a bracket ([) and a number, 1–9. These numbers indicate points where there is a limitation in the fast-lane program as implemented under the Stage 3 approach. Explanations of the limitation encountered at each numbered point are the following:

1. The website requires that the purchase token be electronically scanned, thereby requiring the passenger to use his/her mobile phone at the fast-lane entrance point. Use of mobile

phone scanning will require wireless access at the airport. The passenger will either have to connect to the airport wireless or use his/her mobile phone roaming capabilities (expensive to passenger).

2. The passenger is presented with a request to scan the fast-lane token. It is at this point that the passenger realizes he/she is not connected to airport wireless. To save time, the passenger opts to use roaming to pull up the token and scan it. This process is fast.
3. The screening agent instructs the passenger on screening preparation. As the passenger loads his/her belongings (including cell phone) into screening bins, the screening agent asks for a passport and boarding pass. The passenger must first retrieve his/her mobile phone, and then pull up a boarding pass. The roaming signal is weak, and the process is delayed. It takes the passenger 2 to 5 minutes to complete this embarrassing process.
4. The passenger has arrived on airside with just under 2 hours before boarding. The passenger checks the flight information screen to confirm that his/her flight is on time. The passenger is pleased that enough time has been saved that there is time to shop and grab some breakfast.
5. Unsure of the boarding process, the passenger starts his/her journey toward the gate 1 hour prior to departure. The passenger plans to get a cup of coffee at the gate, plug into power, use the airport Wi-Fi, and check e-mails before boarding.
6. The passenger reaches the customs checkpoint for the selected gates. The agent checks passenger's passport, and instructs the passenger to scan his/her boarding pass. The passenger once again uses his/her roaming to pull up the boarding pass for scanning.
7. The passenger was unaware that the airport did not open the boarding gate holdroom area until 30 minutes prior to departure, thus he/she is forced to linger in a general hold area, with no access to power, uncertain as to when the gate would be opened.
8. The gate area is opened, and the airline agent requests that the passenger show a boarding pass and passport. The agent was not prepared to scan a mobile boarding pass and instructed the passenger to go to another line, where another agent would confirm the electronic boarding pass against a paper manifest. This took additional time.
9. Gate dwell time was minimal, and, as a result, the passenger did not have his/her cup of coffee as planned, nor was the passenger able to check e-mails before boarding.

A careful evaluation of the flow chart shown in Figure 2-4 and the actual passenger journey provides the following insights:

- The passenger had to interact with four agents; three of which were distinct (security, customs, and airline—twice). Each agent required the passenger to present his/her passport and boarding pass. Two of the three times resulted in delays because of handling an electronic boarding pass.
- Total wait time spent in queues is estimated at 13 minutes.
- Positive dwell time, where the passenger had the luxury of shopping and eating are measured at 30 minutes.
- Negative (or simply wasted) dwell time is measured at 50 minutes.
- The impacts of how a specific passenger travels through the entire process are now seen and understood, thus resulting in opportunities to collaborate with airlines and agencies.
- Although the passenger attempted to prepare his/her journey with as much automation as possible, there remained several steps involving personal interaction.

Considering the passenger journey from the security checkpoint through boarding, there remain opportunities for reducing wait times and improving positive dwell times. The flow chart shown in Figure 2-5 evaluates the passenger journey from an integrated perspective (Stage 4). In the Stage 4 evaluation, the airport operator can conduct a qualitative analysis of the journey, based on what the passenger chooses to do. As in Figure 2-4, in Figure 2-5 nine journey points are shown, each indicated with a bracket ([) and a number, 1–9. In Figure 2-5, these numbers

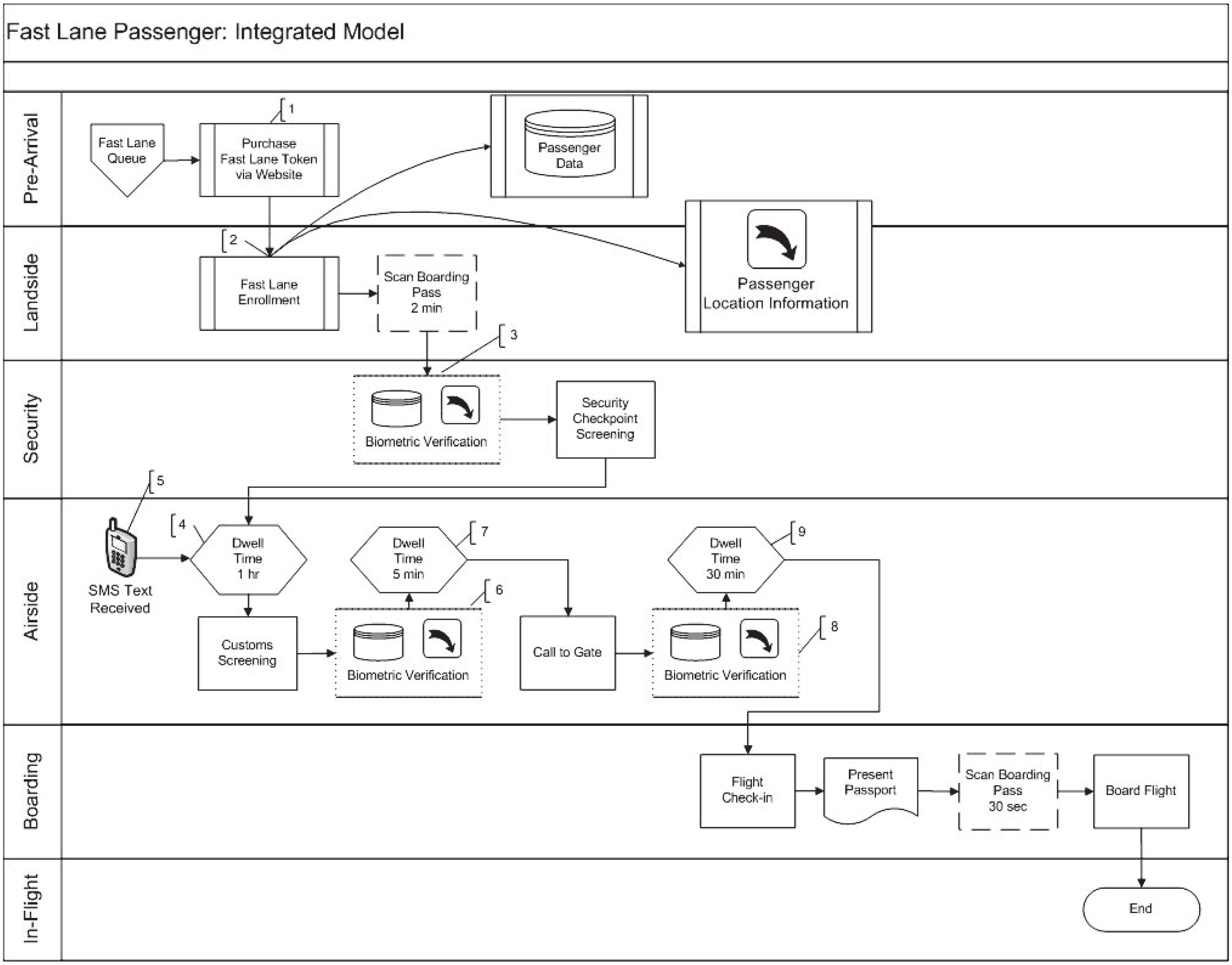


Figure 2-5. Fast lane—integrated approach.

indicate points in the journey when a benefit might be realized by implementing an integrated approach. Explanations of the potential benefit at each numbered point are the following:

1. The website associates purchase of fast-lane token with a boarding pass and the name, so the fast-lane electronic token is not required. The website also informs the passenger of free Wi-Fi services and provides easy-to-follow instructions as to how to connect, prior to the fast-lane entrance.
2. At the fast lane, a new biometric enrollment process is put in place to eliminate manual processes and redundant steps through the entire journey. Time studies show that this new process takes 2 minutes to perform. The passenger uses the airport's free Wi-Fi for the boarding pass scan.
3. The passenger performs security lane biometric verification and does not have to present a boarding pass or passport. The airport system is aware of the passenger's location and can provide that information to the airline. Biometric verification takes less than 30 seconds.
4. The passenger has arrived on airside with just under 2 hours before boarding. The passenger checks the flight information screen to confirm that his/her flight is on time. The passenger

is pleased that enough time has been saved that there is time to shop and then grab some breakfast.

5. The airport operator has installed a location awareness system in the dwell area. The airport sends the passenger a short message service (SMS) text to inform him/her that the flight is on time and that call to gate will not open until 30 minutes prior to boarding. The passenger is encouraged to take an additional 30 minutes for shopping.
6. The passenger performs customs biometric verification and does not have to present a boarding pass or passport. The airport system is aware of the passenger's location and can provide that information to the airline. Biometric verification takes less than 30 seconds.
7. Pre-gate dwell time is reduced to just 5 minutes.
8. The passenger performs call to gate airline biometric verification and does not have to present a boarding pass or passport. The airport system is aware of the passenger's location and can provide that information to the airline. Biometric verification takes less than 30 seconds.
9. Gate dwell time is an acceptable 30 minutes, giving the passenger ample time to enjoy coffee and check e-mails using airport's free Wi-Fi and power plug-in.

The flow chart shown in Figure 2-5 presents the full benefit and opportunity of planning passenger self-services through the Stage 4 methodology. As shown in Figure 2-5, the following advantages are seen:

- Solutions are developed based on how the passenger travels through the airport.
- Collaboration points between security agents and airline agents are identified.
- Collaboration points include data sharing, and resource allocation improvements are identified.
- Additional passenger self-service opportunities are identified.
- New innovations are identified with multiple points of potential success, including biometric enrollment and location awareness technology.
- Positive dwell time is improved to more than 1 hour.
- Negative dwell time is reduced to fewer than 20 minutes.

Although far more comprehensive than most passenger use cases, the example case discussed above presents only one of many passenger use cases that could be developed. When fully developed, the flow charts and subsequent use cases would not only show pre-arrival and in-flight activities, but also would include other information sharing interactions, such as with concessionaires, to provide additional non-airline revenue sharing opportunities. Nonetheless, the "fast-lane" example clearly shows the opportunities airport operators and airlines have in evaluating passenger self-services using the Stage 4 approach.

One final note, the flow charts presented in this section are simplified for presentation and descriptive purpose. Organizations, such as the IATA Biometric Group, have developed detailed flow charts related to the biometric enrollment process used throughout the passenger journey.

IPSSP Objectives

Once the stakeholder needs are understood, the IPSSP steering committee must define the specific objectives by which the IPSSP will be measured. The objectives are not based on any one specific initiative, but rather on a high-level set of specific outcomes to be achieved during a given timeframe that will bring the program closer to accomplishing the IPSSP vision. The objectives should be created based on the IPSSP steering committee's understanding of each of the previously discussed elements, linking all the way up to the airport's mission, vision, and objectives. To define effective IPSSP objectives, it is important to understand the latest industry developments and activities that are relevant to passenger self-services and define KPIs.

IPSSP Project Evaluation

With clearly defined IPSSP objectives in place, the IPSSP steering committee can begin the work of evaluating specific issues within the airport to determine the individual project initiatives that should be undertaken. This is accomplished through a business case evaluation process. This process will enable the IPSSP steering committee to make wise decisions that maximize the value of each project toward achieving specific IPSSP objectives.

Developing the business case is a step-by-step process of defining appropriate passenger self-service initiatives based on a strategic evaluation of their alignment with the IPSSP objectives and the overall airport ideology. The IPSSP steering committee needs to adequately assess the business case issue to be addressed to define the current financial, operational, stakeholder, and staffing conditions. In addition, the IPSSP steering committee should evaluate the opportunity parameters to determine the following:

- Implementation schedule demands
- Opportunity window for solution
- Supporting evidence that opportunity is real
- Positive impact on the business

The next step in the process is to thoroughly evaluate each option being considered against the status quo. This evaluation should first document the benefits and value of each option in terms of financial, operational, competition, stakeholder, and staff conditions. The second step is to define the qualitative and quantitative costs and value of each option relative to the people, assets, marketing, stakeholders, and organization. Also, the extent to which each of these costs has been budgeted for should be defined, and the funding source should be determined. The next step is to address the feasibility of new or changing components to determine the likelihood of success and assess the risks. Finally, the IPSSP steering committee should identify major issues that must be overcome along with the required resolution actions and stakeholder impacts.

Upon completion of the evaluation of each option, the IPSSP steering committee should have all of the necessary information to make the best decision on moving forward with a new project. A Business Case Development Guide is provided in Part III (Chapter 4) of this report.

IPSSP Project Definition

Project definition consists of the elements needed for effective project execution. During this phase, these project elements should be planned to an appropriate level of detail:

- Scope, schedule, and budget
- Project team make-up
- Risk and impact planning
- Benefits
- Communications
- Deliverables

> **Narita Airport**
>
> Once planning establishes overall objectives, then IT development establishes projects to achieve objectives.

It is important that through project definition, the IPSSP steering committee maintains a decision-making framework for conducting the business changes and managing expected project activities. Through the IPSSP steering committee, project ownership is established using any of the airport operational divisions or key tenants. Ultimately, project owners ensure that the project definition meets IPSSP steering committee requirements and report back to the IPSSP steering committee during pre-defined project milestones.

The project owner establishes and leads a project definition team consisting of the following representation:

- Project management for
  - Project governance planning
  - Benefits/risks
  - Scheduling
  - Budget
  - Regulatory
  - Operational impacts
- Information technology (to assess IT impact during project definition)
- Technology innovation (to assist with product definition and opportunity)
- Relevant tenant and stakeholder advocacy
- Architectural and facility (to assess facility impacts)
- Planning (to update passenger flow analysis throughout the project definition phase)

Depending on project size and other criteria, the project definition team will initiate project pilots to prove the project definition and need. If the project pilots prove successful, the project moves to full implementation for rollout on a larger scale.

Providing a detailed discussion on project definition is beyond the scope of this guidance. What is relevant, however, is ensuring that project governance has been established and is effectively followed through the course of project implementation to ensure that, when completed, the project has successfully improved the integration of passenger self-services. The following steps are provided to help with this process:

- The IPSSP steering committee has properly identified project accountability and put in place guiding principles. This determines who is empowered to make key project decisions through the course of the project life cycle. Project governance is fully established and put in place, including consideration for the following:
  - Change management
  - Stakeholder involvement and management
  - Problem escalation criteria
  - Staff resourcing
  - Project monitoring—back to the IPSSP steering committee
- Project testing criteria are established to ensure that progress toward achievement of the original goals of the project can be measured prior to project commissioning. Testing criteria and testing results provide important information for setting the KPIs (discussed further in Section 4).

Define Performance Measurement

- Key Performance Indicators
- Performance Measurement System
- Industry Benchmarks

Step 4: Define Performance Measurement

Measuring the performance of the individual passenger self-service initiatives and the IPSSP as a whole is a critical component of a successful program. Performance measurement is necessary to ensure that projects are producing the desired outcomes and that the governance system itself is functioning as required. Performance measurement is accomplished through a system of ongoing performance monitoring, evaluation of success criteria, and assessment of impacts. Before any level of performance measurement can occur, the IPSSP steering committee must develop the criteria that define success, i.e., the KPIs.

KPIs

KPIs are the criteria used by the IPSSP steering committee to evaluate the performance of the IPSSP and the individual passenger self-service initiatives. KPIs are the quantifiable measurements that indicate a level of progress toward achieving the IPSSP objectives. KPIs must be defined and linked to each objective. An airport operator may have KPIs for the "Check-in Counter Queue Time" (defined as the average amount of time a passenger stands in a queue at the check-in counter) or the "Biometric Security Validation" (defined as the daily percentage of passengers using biometric identity validation at the security checkpoint). KPIs that do not link to an objective are arbitrary and are a distraction from the agree-upon IPSSP objectives. Objectives that do not include sufficient KPIs may lack ongoing measurement of progress and thereby risk not being met.

In establishing KPIs, it is important to engage the airlines and key tenant stakeholders. For example, for KLM Airlines, metrics are highly valued for the purpose of understanding the passenger and for evaluating initiatives meant to improve engagement, service, and customer experience. Customer panels, usability testing, on-the-spot customer interviews, and website click behavior analyses are all methods used to understand customers and to evaluate the performance of new initiatives to improve passenger service and experience. Results of these studies and analyses are evaluated against KPIs to help determine the effectiveness and value of a given initiative.

It is through these methods that KLM was able to learn that 70% of its passengers at Schiphol Airport are transfer passengers. Using this information, KLM worked with the airport operator to establish ample KLM kiosks for transfer passengers and to build a business case for provision of a KLM lounge. Also through these studies, KLM learned that 70% of their passengers utilize mobile boarding passes and that there are still 30% of passengers that are not yet ready to use them.

KPIs must define specific, measurable criteria and define the means to evaluate them. "Increase the number of new passengers using a mobile boarding pass at the security checkpoint" is a useless KPI if the data are not available to distinguish between first-time users of mobile boarding passes and repeat users. "Become the preferred airport in the state" is not a measurable KPI even though the data exist to show the number of enplanements at all airports in the state. The data that are needed to validate this KPI are data that show the extent to which each passenger utilized the airport that they preferred as opposed to the airport that was most convenient or chosen for some reason other than preference. Finally, KPIs must have a target defined for a specific period of time.

Following is an example of a fully developed KPI:

IPSSP Objective. Reduce average security checkpoint processing time by 20% over the next 2 years by enabling biometric identity validation.

1. KPI—Biometric Security Validation
   - Definition—Daily percentage of passengers using biometric identity validation at the security checkpoint. This is calculated by dividing the total number of passengers successfully processing through security using biometric identity validation at all of the checkpoint lanes combined by the total number of passengers processing through security at all of the checkpoint lanes combined.
   - Target—Daily average of 8% during the fourth quarter of 2015.
   - Monitoring Method—Daily statistics of all identity validations accepted are logged into database titled "Security Validation Method."
   - Reporting Method—Monthly report "Security Validation Method" generated as an Excel pivot table, providing total number of accepted identity validations across all security checkpoint lanes, categorized by method used, and summarized by percentage of total. Report is submitted in electronic form and emailed to "IPSSP_Steering@Airport.net."

KPIs are generally set as measurements to be used over a long-term period; however, if shifting priorities or practicality issues mean that a change in the IPSSP objectives is needed, it is important to update the KPIs or the KPI targets accordingly.

Performance Measurement System

Establishing a performance measurement system begins with the development of a methodology for measuring performance. This methodology defines the objectives, scope, and process for measuring the IPSSP. The IPSSP steering committee should create this methodology, which then becomes the basis for the overall evaluation of the IPSSP. Identify and engage the relevant passenger self-service stakeholders throughout the airport, including management and process owners, and communicate the requirements and objectives for monitoring and reporting. It is a good idea to align the monitoring and evaluation approach with the airport's overall monitoring and evaluation system and business intelligence tools for data gathering and reporting if they are available. Use the following to develop the performance measurement methodology:

1. Gather input from the full stakeholders group; evaluate industry benchmarks; develop a set of KPIs that address performance, conformance, value, and risk; define the targets; and document the relationship of each target to the IPSSP objectives.
2. Develop processes for life cycle management and change control over the monitoring and reporting functions.
3. Define the resource requirements for the appropriate level of monitoring based on investment and reporting expectations.
4. Establish a review cycle for the IPSSP steering committee to evaluate the overall performance measurement system.
5. Communicate the KPIs and processes to the IPSSP stakeholders.
6. Conduct periodic reviews of the performance measurement system to
   - Assess the methodology used
   - Identify new or changed stakeholders
   - Identify changes to requirements and resources
   - Validate and update KPI targets for practicality
7. Communicate changes to the performance measurement system to the relevant IPSSP stakeholders.

Industry Benchmarks

There are currently three primary industry benchmarks being used by airports to define a baseline for performance measurement as it relates to passenger self-services. These include IATA's Fast Travel Program, ACI's Airport Service Quality (ASQ), and the Skytrax Airport Quality Service Audit (AQSA). Each of these has its own unique perspective based on the goals of the organization that manages it.

IATA Fast Travel Program

The IATA Fast Travel Program is based on data indicating that the majority of passengers worldwide would like to have additional self-service options. The vision of the Fast Travel Program is "By 2020, 80% of global passengers will be offered with a complete relevant Self-Service suite, throughout their journey to provide better convenience and reduce queues."

Narita Airport

We assess how well we comply with IATA's STB objectives. By doing so, we will improve the passenger self-service process across all passenger journey points.

Fast Travel is an effort to bring airports and airlines together to create more self-service opportunities for the passengers they serve. It is based on six projects for which uniform standards and recommended practices are being created to enable effective adoption. These projects include the following:

- Check-in: Self-service check-in being offered through automated kiosk, web, or mobile.
- Bags Ready-to-Go: Passenger self-tagging and dedicated baggage drop-off.

- Document Check: Passenger self-scanning of travel documents and automatic verification of compliance with transit requirements.
- Flight Rebooking: Passenger self-rebooking through kiosk, web, or mobile.
- Self-Boarding: Passenger self-scan of boarding token at the gate to gain access to aircraft.
- Bag Recovery: Passenger self-claim file for lost bag through kiosk, web, or mobile.

In 2011, Fast Travel compliance for an airline/airport pair was the following: the airline needed to have implemented Check-in, Bags Ready-to-Go, Flight Rebooking, and any one of the remaining three projects. This was viewed as encouraging the projects that provided the biggest impact on customer experience and cost savings while providing the flexibility for customization according to unique needs.

The Fast Travel Program objective is to enable 50% of passengers globally to have the capabilities defined above by 2016 and 80% by 2020.

ACI ASQ

The ACI ASQ Program is based on the belief that "Excellent customer service is one of the greatest assets for an airport in today's competitive environment" (www.ACI.aero). The ACI World Governing Board has defined customer service as one of ACI's six primary targets. The ASQ Program has four components, ASQ Survey, ASQ Performance, ASQ Assured Certification, and ASQ Retail.

ASQ Survey

ASQ Survey is a monthly passenger survey service that uses a standardized questionnaire and survey methodology for every airport. Each airport subscribing to the service is given the full results of all participating airports in order to assess itself against best practices.

> **Genève Aéroport**
>
> To evaluate performance and business needs, we start with setting a baseline using ACI ASQ, then add our own KPIs.

ASQ Performance

ASQ Performance provides a comparative assessment of the airport's service levels relative to other airports. The assessment is designed to measure the delivered service performance to identify areas of underperformance, bottlenecks, and over-performance. It uses 16 KPIs to define the passenger experience at the airport. Some of the KPIs include check-in wait time, security wait time, immigration wait time, and availability of baggage carts.

Measurements are conducted through observations during peak hours in order to identify key issues. Monthly feedback is provided with deliverables including management summaries and databases of recorded observations.

ASQ Assured Certification

ASQ Assured Certification provides a quality management certification indicating an effective process is in place to manage service quality. It includes an independent audit report on the airport's service quality management processes. The certification does not indicate that a particular level of service quality has been achieved, but rather that the airport is committed to the process of managing and improving service quality.

ASQ Assured Certification provides a framework for continual improvement through identification of priorities. It enables the airport operator to develop a strategy for service improvement, benchmarking the existing processes against industry best practices, and measuring annual progress.

ASQ Retail

ASQ Retail provides a measurement of passenger satisfaction with the commercial services provided at a particular airport in comparison to other airports. It is designed to enable a better understanding of the airport's retail experience.

Skytrax AQSA

The Skytrax AQSA applies methods and systems for improving and maintaining customer service standards using qualitative measures and analysis of the passenger travel experience. The AQSA provides a customized analysis for each airport based on its unique requirements relative to the standards experienced by passengers for service quality industry-wide. It assesses the single passenger experience throughout the airport, including the airline areas of responsibility.

AQSA includes a thorough evaluation of every aspect of the passenger experience from particular passenger perspectives, such as

- First-time or experienced passenger
- Leisure or business passenger
- Passengers with special needs

A service quality evaluation is performed based on each passenger profile with respect to

- Ease of terminal navigation
- Transportation facilities
- Immigration systems
- Leisure
- Business
- Restroom facilities
- Staff service and language skills
- Shopping malls

Fraport

Skytrax audit showed gaps in arrival and departing areas for passenger self-service.

Evaluate Factors for Consideration

- Stakeholder Collaboration and Consensus
- Regulatory Issues
- Privacy Concerns
- Payment Card Industry Security Standards
- Nondiscrimination Rules on the Basis of Disability
- Benefits
- Risks

STEP 5 Evaluate Factors for Consideration

Step 5: Evaluate Factors for Consideration

There are a number of factors that airports should consider when developing their IPSSP strategy. This section will discuss, at a high level, many of these factors. The discussion is not intended to provide a comprehensive list of factors, rather it is an illustration of the more common and significant factors that should be addressed in planning exercises. Airports will have unique characteristics, so each airport will need to determine which factors affect them and their community.

Stakeholder Collaboration and Consensus

It is important that all primary stakeholders at the airport are involved early on in the planning process. All stakeholders will have their own requirements and processes that must be considered to successfully implement an integrated passenger self-service environment. Often these requirements will appear to conflict; however, through structured dialogue among stakeholders, compromises may be found that lead to effective deployments.

Stakeholder collaboration with the airlines is of utmost importance. As discussed earlier, airlines are constantly assessing their passenger self-service programs. An example of this constant assessment at airlines can be seen at WestJet. A key business driver for WestJet is to continually improve the passenger experience. WestJet believes that it improves the passenger experience by allowing passengers to have increasing control over their journey, to obtain information when they need it, and to complete routine air travel tasks when/where it is most convenient for them. At WestJet, passengers continue to request additional self-service features, and the requests are evaluated and incorporated into WestJet's self-service road map.

WestJet believes that partnerships with airports are critical to the success of self-service products. Airport leadership needs to work closely with airline tenants to understand each individual tenant's self-service philosophy and desires. These may not always align among tenants or between tenants and the airport. Dialogue, debate, and compromise will be required in order to settle on a direction that best suits the needs of everyone. A simple example to illustrate the importance of collaboration is the compromise between the cost to deploy self-service check-in kiosks and the optimal layout to maximize user adoption rates. The layout with the lowest installation cost may not be the layout that maximizes adoption.

It is critical that stakeholder engagement include the proper representatives from each organization. A combination of local and corporate representation from the airlines and major tenants will provide the planners with both the corporate direction and local nuances necessary to develop a comprehensive understanding of stakeholder objectives, which in turn will result in a strong, integrated program.

A factor that will be important to any tenant operating at multiple airports, regardless of the type of business, is the ability to provide a consistent and often seamless experience to their customers or passengers. This is not to say that each storefront must be identical; however, the overall experience between locations will be considered by the stakeholders throughout the planning process.

Open and honest dialogue, shared planning, transparency, and collaboration are keys to building a successful long-term integrated strategy.

Regulatory Issues

The IPSSP will certainly be influenced and often controlled by existing (and future) regulations. Typically, regulatory agencies will be included in the early planning and stakeholder engagement meetings.

Regulations will, in some cases, provide very clear directions for the implementation of components of an IPSSP, such as defining the required quantity of accessible kiosks. However, the effect of regulations on a program or facility can be more subtle. Sometimes this effect is simply a result of new technologies or products being introduced before facilities are ready to fully support them or regulations are updated to include them. An example would be introducing products such as mobile passport control in immigration areas that prohibit the use of phones or mobile devices.

Ensuring that applicable regulations and their impacts are clearly understood as well as having an awareness of the future direction and trends of regulators is critical to the success of an IPSSP strategy.

Privacy Concerns

The ability to collect and utilize personal data to enhance the airport experience is a trend that will continue to evolve. Passenger self-service products are going to increasingly take advantage of personal data to offer real-time, tailored experiences to passengers throughout their journeys. The data will range from very personal biometric data to more general purchase predictions from age/gender analysis and anything in between. The implications for airport IPSSP strategies are far reaching.

Consent to Collect and Ability to Opt-Out

As personal data become increasingly available from multiple sources, there are two components that should be considered and that in some jurisdictions are regulated. First, it is important that individuals can decline to provide data. In order to make an informed decision, they need to understand what data are being collected, why the data are being collected, who is collecting the data, and how the data will be used. Second, individuals must have a mechanism available to them to opt-out of providing data, if they so desire. Ideally, everyone will be able to customize their airport experience based on their needs for each trip.

The best way to encourage data collection is to clearly define the value of providing the data. In some cases this is simple; if a person doesn't provide certain requested data, he/she may be ineligible to board a flight. Likewise, a passenger may be able to expedite processing through programs like Global Entry by submitting to a pre-approval process. In other cases, the benefits of providing data may be less clear cut, such as receiving an offer for a premium parking discount on the day of travel in exchange for the provision of requested data.

Data Sharing

It is clear that collaboration and data sharing across agencies and organizations at airports provides tremendous opportunities and efficiencies. The challenge is to ensure that there are clearly understood and implemented protocols defining the security, control, and use of the shared data. Industry associations, such as ACI and IATA, are working with their members and partners to develop industry standards to support data sharing. Airports are encouraged to follow industry standards wherever practical as a best practice. It is recommended that airports ensure that they are familiar with and understand current local, state, and federal regulations pertaining to the sharing of personal data.

Data Storage

As data become more personal, ubiquitous data security is increasingly important. An IPSSP must ensure that the storage of any data complies with all applicable regulations.

Payment Card Industry Security Standards

The payment card industry (PCI) has developed and published clearly defined security standards. IPSSP planning should include a review of the relevant PCI security standards to ensure that programs and infrastructure can comply with the current standards. The PCI Security Standards Council is a good source for information in this regard.

Nondiscrimination Rules on the Basis of Disability

IPSSP planning must consider local, state, and federal rules and laws with respect to nondiscrimination on the basis of disability. This can include facility design and accessibility, product placement, and application features among others.

Benefits

Passengers increasingly want the ability to take control of their journeys. Passenger self-service products allow passengers to complete transactions and processes on their own terms. The ability to create a unique experience for each journey results in a more convenient and efficient use of passenger, airport, and airline resources.

The introduction of passenger self-service products can result in cost savings through the optimization of staffing. Allowing passengers more independence and control through passenger self-service products can free up staff that traditionally supported the transactions so that they can be redeployed to take on new, higher value responsibilities. The successful integration of a coordinated passenger self-service program across multiple products and organizations can result in staffing efficiencies that are orders of magnitude better than individual or single product implementations.

A fully integrated passenger self-service program can result in significant improvements in facility utilization. The introduction of passenger self-service can effectively reduce terminal congestion and support growth within existing facility footprints. For instance, in the CBP area at Orlando International Airport, there was a tremendous facility utilization benefit when the Greater Orlando Airport Authority chose to implement passenger self-service CBP kiosks. Heavy congestion periods during peak hours were a normal event. In fact, during such periods, heavy congestion in the CBP area could result in incoming aircraft being parked on the runway for as long as 2 hours. This condition was extreme, but it can happen, especially with passengers from countries that participate in the Visa Waiver Program. In these cases, CBP can experience an influx of 5,000 to 6,000 passengers in a very short time span. The installation of the passenger self-service kiosks has greatly helped to reduce the congestion within the CBP area.

To fully realize maximum benefits, implementations designed to improve facility utilization will often require airport terminal modifications or tenant improvements. These are often necessary to support increased processing capacity and maximize passenger throughput. The result of this investment is the delay or elimination of extensive terminal expansion projects and the deferment of the associated capital costs.

The implementation of IPSSP across organizations may also provide new revenue opportunities. Data sharing across organizations or agencies may introduce advertising or other marketing avenues previously unavailable to tenants. It is possible that successful partnerships may generate substantial increases in non-aeronautical revenues. The successful implementation of these partnerships will require that stakeholder interests are aligned.

Additional benefits of an IPSSP implementation are likely, including improved quality of service for passengers, increased opportunities for service expansion for airlines, and competitive advantage over other airports. In addition, many of the investments made to support passenger self-service initiatives, such as data-management systems and network infrastructure, can be leveraged to provide ancillary benefits to the airport operator. As an example, the implementation of an enterprise service bus (ESB) and an operational Wi-Fi infrastructure to enable a robust mobile application can be leveraged to provide connectivity to the airport's maintenance management system. Such connectivity could enable work orders to be accessed and managed via mobile devices throughout the airport with minimal additional investment.

Risks

In order to maximize the potential for success of the IPSSP, a number of risks need to be fully assessed and, if necessary, mitigation plans need to be developed for them. Risks with the highest likelihood of impact are those associated with IT investments, changes, and labor agreements.

IT investments are the key enabler of passenger self-service; however, significant risks exist with these investments, including the following:

- Airport executives or senior managers who are not willing to engage with IT, resulting in a lack of committed sponsors for IT programs.
- Poor IT governance or management resulting in insufficient stakeholder engagement, low business value, unclear IT spending, inefficient use of resources, or inadequate IT staff.
- Poor IT quality or change control resulting in system failures, data loss, inadequate outsourced service delivery, or failed regulatory compliance.
- Poor IT project management resulting in failed initiatives, cost overruns, or ineffective solutions.

Changes in the internal or external environment may have significant impact on the IPSSP. These include the following:

- Changes in airport leadership and/or airport-wide projects or new marketing strategies resulting in shifting priorities of key internal stakeholders.
- Changes in regulatory compliance requirements or consultant assessments resulting in new issues to be resolved.
- Airline mergers or evolving IT service provider business models resulting in changing requirements and capabilities of third-party stakeholders.
- Economic downturn or technology advancements resulting in potential failure of, or lack of value in, initiatives that are already in progress.

Another associated risk with any passenger self-service implementation and particularly a fully integrated approach is the implications the program may have for labor agreements. With one of the key business drivers of an IPSSP being cost savings and one of the natural outcomes of passenger self-service being reduced reliance on staff support, the elimination of jobs is a likely result.

Each of the factors described in this section is an illustration of general issues that can have a significant impact on passenger self-service initiatives if not adequately addressed. A comprehensive identification and evaluation of limiting factors, benefits, and risks should be undertaken during the planning stages, with full stakeholder engagement and collaboration. Once this is complete, the IPSSP can move from planning to implementation and start addressing the fundamental impacts that will affect virtually all IPSSP initiatives.

CHAPTER 3

Applying the Vision—Implementation

Chapter 2 detailed the first five steps of the Roadmap; Chapter 3 will address Steps 6 through 9, covering fundamental impacts, implementation, monitoring and reporting, and next steps.

Step 6: Address Fundamental Impacts

Passenger self-services, whether deployed by the airport, the airline, a concessionaire, or some facet of the government will need to rely on the airport's infrastructure in some way. This infrastructure support may be a utility such as electrical or IT, staff support, building support, or something else. Whatever the case, for the airport to function as a Stage 4 airport and to allow its tenants to function in a Stage 4 capacity, the airport operator will have to provide this underlying infrastructure in such a way that its systems and organizational structures are adaptable to situations that constantly change.

This section discusses how each of the following areas is an important part of this infrastructure make-up and why it is imperative that the airport operator commit to providing this support.

Address Fundamental Impacts

- Data
- Connectivity
- Enabling Technologies
- Facility Changes
- Human Resources
- Passenger Outreach/ Communications

Data

The research conducted under ACRP Project 10-17 indicated that there is a growing awareness within the industry of the benefits of data collection and analysis. For some, the idea of "if we build it, they will come," is taking root, leading airport operators to begin collecting data from all projects, then analyze it from various perspectives to try to figure out how it can be used and integrated in other ways.

Interest in the sharing of passenger data between airport operators and airlines is also developing. One area where this is developing is in location-based services. Lufthansa Airlines, for example, is interested in the location of the passenger, at the very moment he or she enters the terminal. At Frankfurt Airport, Lufthansa is starting a program in which passengers scan their boarding passes at the security checkpoints in E-gates. Once scanned, these data are then shared by airport operator and airline.

Understanding this new significance of data collection and analysis changes the dynamics of project requirements:

- New project initiatives require a more clearly defined integration with the existing data, infrastructure, and applications.

- Proper data sharing reduces duplicate processes and sometimes project initiatives themselves.
- When projects are evaluated based on KPIs, data are needed to justify the performance.
- Collected data, such as on retail sales or allocation of gates, become a part of the business case.
- Collection and use of data drive changes to the IT infrastructure.
- Project requirements must consider impacts to the management of data.

Moving into the data collection, sharing, and analyzing business brings new challenges that an airport operator must plan for. These challenges can include

- Needing more airport resources for data maintenance, organization, assessment, and so forth.
- Assuring all stakeholders that their shared data are safe, secure, and private.
- Reaching an agreement on who owns the data, how to mask irrelevant data, and so forth.
- Adopting and adhering to industry data format and delivery standards.
- Providing a secure network infrastructure to protect the transmission of data among systems and stakeholders.
- Obtaining and sharing of data with external agencies and tenants.

Proper planning and persistence are required to overcome the political and procedural hurdles to data sharing. However, with proper education, awareness, and industry involvement, many of the hurdles can be overcome. For the airport operator, it is important to ensure that the technical portion will not be a roadblock as the politics are worked out.

An airport's IT organization should consider at least these questions as it takes on an expanded role in sharing the data that are vital to a successful IPSSP:

- What is the *architecture* for the secure transmission of data between systems?
- How will the data be *stored* and retrieved?
- What *standards and protocols* impact data sharing?
- What *tools* will be put in place for the analysis and reporting of the data?
- What are the *policies and procedures* for data sharing and storage?

Technical Architecture

A significant amount of data must be shared between systems to enable flight and passenger movements to occur according to plan. A multitude of applications across numerous systems must communicate in order to share these data. This communication has typically been accomplished through technical architectures that rely on point-to-point communication interfaces. When systems are replaced or data formats or processes change, however, reworking those single-purpose interfaces is time consuming and expensive.

Many airport operators are now investing in a different technical architecture within the airport enterprise to improve the sharing of data and the flexibility of system interconnectivity. These airports are implementing an ESB that facilitates an SOA.

> **Fraport**
>
> Our IT Infrastructure is based on the SOA. Bus technology is used where each stakeholder maintains its own ESB.

The Greater Toronto Airports Authority (GTAA) provides an example of investing in a different technical architecture. The GTAA recognized that change was required at Toronto Pearson International Airport to align with the global market and direction of technology. In order to improve the timely collection and use of information, the GTAA upgraded its existing IT infrastructure to one consisting of the following:

- Message broker/ESB
- SOA messaging
- Industry-based standards including XML schema objects and web services
- Enterprise-wide business intelligence (BI)

- Virtualized server environment
- Enterprise document management system

The GTAA recognized that such a system could also improve the general quality of service provided to its customers, passengers, and guests and open up many opportunities for new passenger services, based on improved demographics. The GTAA therefore set out to establish the new IT environment on the basis of information that would be "recorded once and used many times," relying on its ESB to simultaneously transfer information to the relevant applications and client interfaces. The GTAA is well on the path to seeing its IT environment vision completed.

When implemented correctly, an SOA allows different systems to exchange data with one another over this "bus" without requiring knowledge of how the other systems will use or, sometimes, even configure the data. This ability is the key differentiator between the ESB/SOA model (often referred to as a "loosely coupled" architectural model) and the more traditional fixed, "point-to-point" interfaces between systems (sometimes referred to as "tightly coupled"). This bus technology can be employed in a variety of ways including separately, in which each stakeholder maintains its own distinct ESB, or more jointly in a layered model in which various stakeholder groups maintain their own portion of a shared ESB.

The SOA presents a single interface for each data classification or "service." Any systems connected to this bus may be granted permission to access that "service" and send or receive data, depending on the functionality of the service. When designed correctly, this architecture reduces the number of data connection points exponentially.

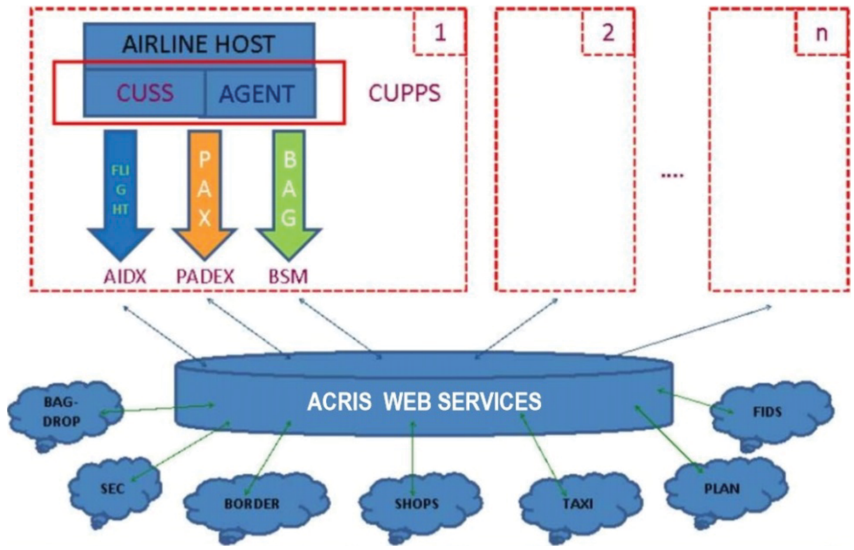
For the past several years, ACI has led an initiative to standardize the approach to managing data within the airport environment. The ACRIS has standardized process definitions and data descriptions and is working to standardize "interfaces" or "services" that show what data are available and how this data exchange can be used and reused in an efficient way (i.e., a loosely coupled model).

With the goal of enabling faster implementation, lower development and implementation costs, and more predictable results, ACRIS embraces the SOA as presented in ACRIS Recommended Practice, ACI_RP502A10_ACRIS. In this Recommended Practice, ACI specifically states: "It is RECOMMENDED that, when an airport, airline or associated service provider plans to exchange information between two or more IT solutions, the SOA principles and specifications described in this Recommended Practice (RP) should be applied."

Figure 3-1 was created by ACI to illustrate how multiple different services can access data from any of the data feeds across a multitude of applications. In Figure 3-1, the ESB that deploys the various services for use by "Bag Drop," "Security," "Border," and the other participating systems is contained in the "ACRIS Web Services" core. This ESB core allows each of these participating systems to "subscribe" to the data services they require to share data about the flight, passenger, bag, or other data services provided by the empty dotted-line rectangles labeled "2" and "n" and so forth.

The SOA supports a flexible configuration of business processes and enables dynamic discovery of services. It provides seamless integration of applications, business work units, and business partners. In comparison to single-purpose, point-to-point interfaces—which make systems more tightly coupled, inflexible, and expensive to change—the SOA reduces operation costs. The SOA provides improved data management, enables reusable services, adds flexibility, and facilitates alignment of organizational goals.

The initial investment to establish an SOA is often higher than the traditional alternative, and there is increased documentation, such as a requirement for use and test cases. Also, an SOA requires a clearly defined and strongly enforced governance model. However, the additional



Source: ACI, used with permission.

Figure 3-1. ACRIS service-oriented infrastructure.

investment will result in a long-term benefit through the contribution to a more flexible technical architecture and a resulting cost and time savings when replacing solutions and implementing changes.

Airports wanting to implement an SOA will need to evaluate such internal factors as initial investment costs, appetite for technological change, staff ability to deploy an SOA or a budget for consultants and developers, the ability of existing or intended systems to participate in a new, "loosely-coupled" environment, as well as system and storage capacity. Evaluation of these factors can then help an airport make an appropriate ESB/SOA investment from among several general alternatives:

- Including an ESB/SOA as part of a vendor's deployment such as a resource management system, airport management system, or some other broadly utilized airport system.
- Purchasing an ESB/SOA from a known vendor such as IBM, Oracle, or TIBCO and building it to fit the airport environment.
- Deploying an open-source ESB/SOA with minimal up-front software costs (such as WS02, Mule, JBoss, Open, and others) but perhaps greater risk than either of the other two options listed.

Data Storage

Most airports have invested in some level of business and operational data storage. However, not many airports have evaluated data storage needs with regard to the collection and analysis of passenger data. In keeping with the SOA principles discussed above, the IPSSP data requirements should also be evaluated as an integral part of the SOA. As such, IPSSP data should be accessed, stored, and retrieved through the ESB integration platform.

The IPSSP data storage can include such categories as passenger flight data, passenger demographics (perhaps), loyalty participation and concession aspects, baggage data, airport flight data, parking, and other airside-facility data. When considering a number of business partners are participating in such data-sharing systems, the volume and complexity of data can increase significantly. In fact, when moving into an IPSSP, determining accurate data storage requirements becomes an ongoing process and one where requirements are evaluated with every new project. Data storage evaluation will need to be repeated regularly throughout the life of the IPSSP.

With the analytic opportunities associated with passenger self-service, airport operators are expanding their understanding of and experience with BI systems, in which data are analyzed across a multitude of scenarios. Many such scenarios lead toward new commercial opportunities, such as predicting passenger buying behavior in relation to security wait times. Storage requirements for this level of data analysis are significantly greater given the number of data sources and data types, and careful consideration should be given to data storage means and methods. For example, large BI projects sometimes overwhelm the performance capabilities of even an enterprise-grade virtualized infrastructure. SAP's BizObjects BI tools generally perform better when running on physical servers with direct-attached local storage. If such BI concepts are not yet a part of an airport's data center, they may soon need to be, putting new demands on IT infrastructure and operations.

In considering an IPSSP and the true integration of data, the following other data storage considerations should be taken into account:

- How much integration is needed between passenger-related data and the operational data warehouse?
- What are the performance requirements for "live" data loads?
- What are the data archive requirements and how often should archived data be purged?
- What are the IPSSP data backup requirements related to disaster recovery?
- How should planning be conducted for growth of data storage related to virtual and physical server distributions?

Standards and Protocols

Implementing an IPSSP will require a review of data standards, especially when considering the interoperability between airlines and other business partners. New levels of data security are also introduced, resulting from the diverse requirements of airlines, airports, and government agencies.

The definition and implementation of data standards and interoperable IT solutions is an important step, especially when considering increased revenue opportunities and cost reductions. Data standardization will help develop a true business-to-business (B2B) integration of the airport operator's and partners' different IT solutions. Data standards help to eliminate duplicate or erroneous data in interoperability between systems. The airport operator who bases the SOA architecture on industry standard data exchanges is less likely to have to significantly rebuild or re-factor those services in the future. Vendor systems are also being upgraded on a regular basis to meet such industry standards because doing so lowers their long-term interface maintenance costs as well. Airports adhering to these standards will find it easier to add or replace vendor systems over time when they all utilize common service definitions.

Sea-Tac

Increased interoperability between business partners requires new data communications standards.

When considering data standards, airport operators should first educate themselves on the standards already established through industry-related organizations such as IATA, ACI World, and the International Civil Aviation Organization (ICAO). Second, since many of these standards are emerging, airport operators should also seek active involvement with these organizations. For example, IATA's STB program has renewed data exchange protocols to address seamless integration across the entire passenger journey.

Tools and Resources

As the IPSSP develops, it is important to consider an appropriate set of database tools that will help in the organization of data, particularly with data that may be compartmentalized in separate information silos. Such tools will help the airport operator integrate data from numerous sources, including from Excel spreadsheets and Access databases. The following is a general listing of the tool sets related to the collection and use of IPSSP data:

- BI solutions. BI tools vary in cost and complexity, starting with open-source tool sets and scaling up to BI suites as a part of the larger enterprise resource products.
- Data analytics, such as with the open-source Apache Hadoop tool set.
- Dashboards, which can be a part of the BI solution, or developed independently.
- Workflow tools for database management, database write-backs, and alerts.
- Middleware or adapters for communication with existing enterprise solutions, such as SAP.

The implementation performance of these tools is greatly improved when the airport operator has established a consistent data model. In doing so, the airport operator should carefully evaluate staffing requirements. Every new tool will require learning and new skill sets. Training of existing staff should be established, along with analysis of the need for new positions.

Policies and Procedures

An IPSSP requires new policies and procedures that govern at least the following:

- The production and use of data and data duplication.
- Management and upkeep of information dashboards.
- User authorizations, in accordance with security requirements.
- Data storage.
- Interoperability of identity management between airlines-owned and authority-owned processes and data.
- Legal aspects of data storage and sharing.

IATA is developing data standards and best practices related to the following areas, which may help provide guidance on the IPSSP data requirements:

- Enrollment and proper identity confirmation prior to biometric association.
- Pros and cons by types of biometrics used, ideally by application (access control, identity verification, and transactional interactions).
- Privacy and data protection best practices/challenges by geography and application.
- Regulations, laws, and requirements related to biometric and personal data management by geography.
- Interdependencies and applicability of existing standards and industry best practices from other industries or applications.

Most of these best practices will be in the adoption period for some time, like the regulations related to storage of passenger data. Best practices today require closely monitored time limits on the information stored, along with a careful washing of the passenger's personal information. With these best practices continually changing, airport operator should ensure close coordination with IATA.

Connectivity

Network Connectivity

The foundational IT systems within the airport play a significant role in enabling the implementation of passenger self-service initiatives. The most elemental form of this foundation is the fiber optic cabling infrastructure that enables data to flow among the primary network components of the airport, its tenants, and out to the Internet via a connection to the local service provider(s). The robustness and resiliency of an airport's network is directly related to the quality of the installation, the level of design redundancy, and the care taken in maintaining the fiber optic backbone cable. If properly designed and installed, a fiber optic cable plant can last 20 years or more. Additionally, single mode cable installed today is expected to be able to support anticipated advancements in electronics data throughput over the 20 or more years.

Primary network components such as switches, routers, and firewalls are as important as the fiber optic cable plant and for the same reasons. These components serve two major functions: they provide the intelligence of the network (such as address assignments, network protocols, address and network filters, network address translations, virtual networks, and so forth) as well as the bridge between the fiber optic cable plant and the end user. Robustness and resiliency are equally important for the network electronics. Robust network electronics as well as sound design, installation, and operations and maintenance support help to ensure that tenant service level agreements are maintained. The cable plant and the local area network (LAN) components together make up what is commonly referred to as "the network."

Given that Ethernet technology is the standard network architecture for consumers and enterprise organizations, it is safe to say that most airports use this proven network architecture as their foundational LAN or the network that supports the area (premises) of the airport. A passive optical network (PON) is an emerging network architecture for a large enterprise LAN such as airports. A PON provides opportunities for reduced capital expenditures, reduced IT room space, reduced power and heating loads, and reduced fiber needs compared with those of the traditional Ethernet LAN while supporting Ethernet connectivity.

Early enterprise installations of the PON architecture are showing impressive results and warrant consideration as part of a new network design or replacement effort. Whichever network architecture is chosen, the airport's LAN is the foundation upon which all other IT deployments rely, and the airport operator needs to ensure that it is well designed and appropriately flexible to support the changing and evolving needs of the IPSSP.

Bandwidth

The issues of bandwidth and throughput are key network aspects that must be addressed in order to accommodate the growth of data sharing and storage. This is especially true if the airport operator is depending on cloud-based technology. In such a case, it is important to evaluate whether the IT infrastructure can support the connectivity required to transfer large quantities of data that will need to be stored. Wide area network bandwidth will directly impact the performance of outsourced cloud storage and associated data transfer.

It is important that the airport understand and continually monitor its network bandwidth capacity and usage at several key points:

- The LAN's fiber backbone
- The core switch and router architecture
- The storage area network or network attached storage
- Shared tenant services agreements
- External links to the Internet and cloud-based services
- Projected network needs

Understanding and monitoring the key points listed above helps identify the airport's requirements and allows the airport to assess the current bandwidth factors, such as capacity, peak usage, and capability. Having this understanding enables the airport operator to identify gaps that need to be addressed to ensure that adequate bandwidth is provided.

> **Sea-Tac**
>
> We embrace the fact that mobile devices are rapidly evolving, and airlines are counting on them to revitalize the passenger experience.

Wireless Connectivity

Similar to the importance of wired network connectivity, wireless connectivity is particularly critical for enabling passenger self-service initiatives. The advancements of Stage 3 and the transition into Stage 4 would not be possible without the wireless connectivity to the Internet that mobile devices rely on. The ubiquitous nature of wireless connectivity has made it possible for the passenger and those service providers (airport, airline, etc.) involved in the passenger's journey to stay in constant contact and thereby separate passenger journey processes from the physical locations in the airport where they have traditionally taken place. Without this connectivity, there would be no advancement to Stage 4.

As it pertains to passenger self-services, mobile devices currently rely on two forms of wireless connectivity to the Internet. One is the long-range technology of cellular connectivity and the other is the relatively shorter range of Wi-Fi connectivity. Cellular data are provided by a cellular company (such as AT&T, Verizon, Sprint) network. Most of the time, connectivity between the passenger's mobile device and that provider's cellular network is via a direct connection to a cellular provider's outside antenna tower. However, in the case of large complexes such as airports, convention centers, stadiums, and so forth, the physical structure of the facilities can severely impede the quality of the signal between the mobile device and the cellular tower.

Also, the high user density of these locations can strain the ability of a single tower to adequately support the connectivity needs of the mobile users. In both instances, the quality of the connection can suffer and result in a subpar passenger experience at best and a complete loss of usable connectivity at worst. To address such a situation, a distributed antenna system (DAS) can be implemented to overcome both the physical obstacle of the building and the high-density issues possible through reliance on a single cellular tower. The DAS is made up of antennas that are located throughout the airport and connected to a head-end (primary) component that has cabled connectivity to the local cellular carrier(s). In some instances, the airport may be able to work out an agreement with the cellular carrier(s) that helps with the installation and/or purchase of the system.

Wi-Fi connectivity, because it is a shorter range, Ethernet-based, wireless technology, is deployed within the airport either by the airport with connectivity to the airport LAN or by a vendor. Wi-Fi connectivity in airports is deployed to provide untethered network and Internet access to mobile devices. Wi-Fi connectivity is important to passengers because it is generally faster and sometimes cheaper than cellular data connections. Airport Wi-Fi frees the mobile customer from cellular data usage caps and the typical bandwidth limitations. Airport Wi-Fi also gives users the freedom to connect to the Internet and the growing range of passenger self-service offerings at greater data speeds and without cellular data charges. This is especially true for foreigners that may be traveling in the United States and would suffer steep charges for even minimal cellular roaming data usage. Additionally, many computers, tablets, and devices such as gaming systems are only capable of connecting to the Internet using Wi-Fi.

From the perspective of the tenant and especially airlines, Wi-Fi connectivity is a part of what is being termed "flexible IT." It is flexible in that it, more than any other technology, allows a tenant to quickly, easily, and cost-effectively deploy passenger self-service in almost any location in the terminal. Wi-Fi connectivity allows an airline to quickly deploy operations in a new airport, and it allows the airline to stay in constant contact with its customers. Unlike cabled connectivity, Wi-Fi connectivity does not require the installation time and effort it takes to pull, terminate, and test cable. Wi-Fi connectivity can also help alleviate some need for cutting into and coring through floors.

For an airport aspiring to become a Stage 4 airport, it is imperative to provide a solid bandwidth of free Wi-Fi to passengers for several reasons. First, passenger self-service relies heavily on the passenger having constant Internet connectivity. Second, any costs associated with this connectivity will greatly impede the success of passenger self-service deployments. Third, customers have come to expect that public Wi-Fi will be provided for free.

Another increasing area of importance for a Stage 4 airport is ensuring that wireless connectivity is available in and around ramp areas. Many of the airlines are investigating the installation of wireless connectivity throughout their aircraft fleet. United Airlines has stated that it is in the process of upgrading its entire international fleet with wireless connectivity. For an airline, once wireless connectivity is installed in the aircraft, better services can be offered. Such services (whether maintenance related or commercial related) require download capabilities upon arrival and departure. Airport wireless infrastructure enables this download capability for the airline.

Network Security/PCI

Of paramount importance to the network is maintaining its integrity and protecting it from outside threats. Part of securing the network involves physically controlling access to network components; this is typically something that most airports have a good handle on. However, the network also has to be secured from virtual outside threats; virtual threats are more complicated and also the most likely kind of intrusion. Securing credit card transactions is a common and pressing concern for airport network security today. It used to be that monetary transactions with passengers took place in only a few locations. Today, credit card transactions can take place anywhere passengers have Internet connectivity for their mobile devices. As a result, managing compliance with PCI requirements has become more challenging. As passenger self-services are increasingly developed, adopted, and deployed, and the virtual passenger profile is populated with increasing amounts of sensitive personal data, the security of the network becomes more and more important. Regardless of the airport stage, network security is a priority for doing business.

Enabling Technologies

Another element in building the IPSSP foundation is the consideration of available "enabling technologies." Enabling technology is to be understood in the broadest sense and covers elements such as hardware, protocols, and applications. Often, these elements are combined into full-fledged systems to provide various functionalities for specific purposes. Due to the interdependencies between the different elements and the general need for some hardware to make it all work, it was challenging to structure the discussion of enabling technologies provided in this section. In accordance with the other sections in this report focusing on the higher, strategic level of the readership, the report authors have chosen to group the discussion of enabling technologies into the following broad categories:

- Wireless communications
- Close proximity storage and transmitters of information
- Biometrics
- Wearable technology
- Mapping
- Passenger counting
- Speech/voice processing

The discussion of each category provides a general description of a technology, standard, or function and its overall purpose and/or application; introduces specific enabling technologies; and, if applicable, discusses related requirements or dependencies.

For those readers interested in more details on each of the enabling technologies including actual implementations and usage at leading airports around the world and information on leading vendors, easy-to-use, printable one-page summary write-ups are provided on *CRP-CD-168* (which is bound into this report and also available as an .iso file on the TRB website at http://www.trb.org/Main/Blurbs/172418). In addition, the glossary in Appendix A presents concise definitions, and the annotated resource guide in Appendix B offers publicly available resources for further research.

For analytically cross-referencing these enabling technologies with all self-service inventory items, the reader should consult the Passenger Self-Service Inventory tool discussed in Chapter 5. The tool is a spreadsheet matrix provided on *CRP-CD-168*.

Wireless Communications

Wireless communication in essence refers to the transfer of information between two or more points that are not connected by an electrical conductor. This category discusses various wireless data communications technologies—which are an essential component of mobile computing—that can differ in terms of local availability, coverage range, and performance. Technologies discussed in this section include Global Positioning System (GPS), Wi-Fi, Global System for Mobile Communications (GSM), Bluetooth, Bluetooth Low Energy (BLE), Near-Field Communication (NFC), and TransferJet. For an airport or airline these technologies are of primary relevance as the passenger is moving throughout the facility.

GPS is a satellite-based navigation system that can pinpoint the location of a compatible receiver, such as a smartphone, tablet, or cell phone. Basic GPS can provide only a location, but most GPS units routinely also derive the direction in which a receiver is moving and its speed. Change in speed or direction of the receiver may cause the indication of direction to become somewhat inaccurate. A compass or inertial navigation system is used frequently in addition to GPS to get a more accurate position.

Wi-Fi is a wireless LAN technology that lets compatible electronic devices (e.g., smartphones, tablets, audio devices, smart watches, laptops, etc.) connect to the Internet using a wireless network access point (or hotspot) to upload/download information. The coverage of an access point is affected by the kind of architecture it operates in and how many access points are connected. Wi-Fi is less secure than a wired connection (such as Ethernet). This necessitates security encryptions, which differ in regard to the level of security required or desired by the user of the device. Sometimes, concessionaires and other airport stakeholders offer their own Wi-Fi, which in a sense "competes" with an existing airport-offered network.

GSM is a standard that was developed by the European Telecommunications Standards Institute and describes a protocol for 2G cellular networks. GSM is the default worldwide standard for mobile communication and is available in over 200 countries and territories. GSM offers the ability to send and receive data, voice calls, and SMS (or "text messages"). Voice over Internet protocol can also be utilized. Over time, GSM has evolved into 3G GSM and includes data such as General Packet Radio Services and Enhanced Data Rates for GSM Evolution. Although 4G and long-term evolution (LTE) technologies are emerging strongly around the world, GSM is still relevant as a global standard (covering approximately 80% of the world, including most of China and India) and will continue to grow alongside 4G/LTE.

Bluetooth is a wireless technology standard used to transfer data (including voice, text, music, photos, videos, etc.) over short distances—generally up to 100 meters or 328 feet. Connecting devices require a small computer chip containing the Bluetooth radio as well as software to connect, via Bluetooth technology. Connected devices do not have to maintain a line of sight because they use a radio communications system. Typically, Bluetooth applications are utilized indoors within a single room or limited space. Maximum and minimum range requirements per device are set based on specific use cases. This technology has been applied in many industries, consumer as well as commercial in nature. A myriad of devices use Bluetooth technology; however, some of the more common examples include smartphones, computers, and in-dashboard GPS in cars.

BLE is a wireless, personal area network designed and marketed by Bluetooth's Special Interest Group (SIG). BLE has been applied in the healthcare, home entertainment, and fitness industries. It is quickly becoming popular in the transportation industry with the breakout of its applicability in indoor positioning. BLE consumes significantly less power than Bluetooth while maintaining almost an equal range. Mobile operating systems, such as iOS, Android, Windows 8, Linux, and Blackberry, inherently support BLE. As with Bluetooth, BLE devices must meet SIG's standards and maintain specifications to ensure compatibility. It uses the same 2.4 GHz radio frequency as Bluetooth, but employs a simpler system of modulation. While Bluetooth has been fading in the technological landscape, the introduction and application of BLE has brought back its popularity, as functional applications have improved.

NFC is a form of short-range wireless communication that, while using antennas, does not use radio or electromagnetic waves; instead it uses a modulated electric or magnetic field. NFC allows for two-way communication while radio-frequency identification (RFID) is limited to one-way communication. Unpowered NFC "tags" are readable by NFC devices and could potentially rival RFID systems. Applications that are expected to successfully deploy NFC include transfer of data, communication (through an NFC "tag"), and contactless transactions. Many cellular phones use electric-field NFC due to its security for certain transactions. For contactless payments, for example, the encryption level is very desirable and implements tokenization of data in order to further guarantee privacy of information. In many arenas, NFC piggybacks on other technologies. For example, smartphones can be equipped and paired with an NFC "tag" or sticker, which can be programmed by an application to automate tasks such as creating text messages or executing commands. NFC is not bound to a specific company and can therefore be used by anyone who has the technology.

TransferJet is another emerging technology that deals with close proximity, wireless transfer of data. Instead of using radiation-field technology, it uses couplers based on electric induction fields. Developed by Sony, TransferJet permits quick data exchange by touching two electronics together. Its concept includes a touch interface which can be used in environments that need peer-to-peer transfer without external connectors. Although TransferJet is somewhat similar to NFC, TransferJet provides added functionality, especially for high-speed data transfers, including the capability to transmit larger files between coupled devices.

Close Proximity Storage and Transmitters of Information

This category is focused on information storage and data transmitters. These can be in the form of visual lines and patterns (such as barcodes, both one-dimensional [1-D] and two-dimensional [2-D]), in the form of RFID tags and receivers, and in the form of sensors/beacons, such as those utilizing close proximity protocols to transmit and receive data wirelessly.

1-D barcodes have a small series of stripes (parallel lines) varying in width and spacing that is used to represent data. This barcode can be optically scanned by a machine to withdraw the data enclosed in the barcode. When barcodes first originated, special machines were needed to scan them, but today barcodes can be read by smartphones, printers, and a wide variety of other more practical devices.

2-D barcodes are geometric patterns in two dimensions that use hexagons, rectangles, and other shapes to represent data. Like their predecessors, 2-D barcodes are also read by machines. A popular and widespread example of a 2-D barcode is the QR (quick response) code, a small square made up of other squares patterned differently. QR codes can be used in advertising and for identification of an individual. Both 1-D and 2-D barcodes are widely used at virtually all airports by all airlines, especially in boarding passes and bag tags, either on a printed document or electronically on smartphones or smartwatches.

RFID tags are small chips that contain specific information that can be modified, added to, or subtracted from. This capability differentiates RFID from barcodes, which only hold static information. RFID technology uses electromagnetic fields to wirelessly transmit data from transmitters to an antenna for the purpose of automatically identifying and tracking tags that can be attached to objects. While safeguards are put into place, there is not yet a way to guarantee that RFID data are 100% secure. Airports often use RFID technology to track the movement of baggage and locate lost luggage. RFID tags are also used by many airlines as a way for passengers to tag their own bags.

Close proximity systems primarily use **sensors** to transmit and receive data. These small sensors, sometimes called beacons, are a cost-effective way to transfer data. The sensors generally use BLE technology to transmit information to a receiver such as a smartphone or similar device. Indoor navigation, passenger tracking, social media, and advertising/promotion all have the potential to be successful applications of this kind of technology. Researchers estimate that these types of transmitters and receivers will be much more common in many environments, including airports. A limiting factor can be, however, the extent to which passengers perceive close proximity systems to involve an invasion of privacy because services using this technology—such as push notifications—will be based on personal information, including flight information and shopping or food/beverage preferences. Opt-in passenger programs have proven to be a good way to mediate this potential issue.

Biometrics

Biometrics is a form of analysis that uses metrics based on human physiological or behavioral characteristics and other unique qualities. Biometric identifiers are quantifiable characteristics used to identify people and can be processed using fingerprinting, face recognition, iris and retina scanning, hand geometry, vein matching, and voice biometrics technologies, among others, including DNA, which is considered at the time of this writing to be the most promising future biometric technology. There are a multitude of competing vendors for all of these technologies.

Application of a biometric process at an airport usually occurs at security, immigration, border control, and customs checkpoints. Biometrics has proven more reliable than traditional access control practices such as confirming identity using a passport or driver's license or relying on a password or personal identification number. Biometrics can also be added to chipped smart cards. A combination of more than one type of biometrics can improve effectiveness and accuracy, which is especially relevant for security purposes. All biometrics require sophisticated hardware and software utilizing codes and algorithms to build a unique identifying profile. These profiles are then measured against a database to determine an identity match.

Fingerprinting is the most often deployed form of biometrics at airports. Not only is fingerprint scanning the easiest and most traditional form of biometrics, it is also considered the most reliable. Facial recognition, iris scanning, and even voice analysis can change as a user ages; fingerprints endure.

Facial recognition utilizes a comprehensive three-dimensional scan of a person's face, which is also very accurate. Additional factors in facial recognition biometrics include texture of skin and the ability to incorporate algorithms to determine eye width and all other dimensions.

Iris and retina scanning both are highly accurate due to the uniqueness of the human eye. Iris scanning covers the pupil center and edge, the iris edge, eyelids, and eyelashes whereas retina scanning targets the blood vessel pattern on the retina. Eye safety is a concern and therefore an impediment to user adoption although these technologies continue to be improved.

Vein matching (vein pattern on the back of hand) is slightly less accurate, but it provides another viable biometric option, primarily due to it being less invasive to the user. However, it is often used in conjunction with other forms of biometrics or identification processes.

Voice biometrics, one of the primary emerging behavioral identifiers, analyzes acoustic patterns in speech based on a user's anatomy and takes into consideration pitch and speaking style.

Wearable Technology

Wearable technology refers to clothing and accessories that integrate computer and advanced electronic technologies along with useful functions and features. The first application of wearable technology came with the introduction of the calculator watch in the 1980s. At the time of this writing, smartclothing (based on e-textile technologies), smartjewelry (rings, necklaces, and key chains), as well as voice-activated wearable badges/clips were being researched and tested for possible applications. More established, however, are smartglasses and smartwatches. In general, all of these forms of wearable technology depend on complex software and hardware.

Smartglasses are wearable display technology units with built-in intelligence. They can range from devices offering only simple data displays to those using wireless connectivity (e.g., Wi-Fi, 4G, and Bluetooth) for application and data processing, or even incorporating complete systems comparable to Android or iOS systems. Smartglasses generally include cameras and high-definition video. The units are equipped with a heads-up display for the user using a projector to project images onto the eyeglass lens that equate to an approximately 25-inch display from 8 feet away. Applications of smartglasses in an airport environment include airport/airline staff wearing them to identify passengers using facial recognition technology at the entrance to security, at the gate, or at the aircraft door.

Smartwatches are wristwatches that use computerization for tasks far more complex than telling the time. Smartwatches have broad capabilities and can be as advanced as a smartphone. Some sample applications include GPS, calculator, thermometer, camera, and media-playing capabilities, as well as the capability to track heartbeat, steps taken, and miles traveled. Smartwatches use Bluetooth to connect with a user's phone and/or Wi-Fi and GPS. This technology could be quite beneficial to passengers by providing pop-up calendar or flight reminders, as well as displaying and scanning boarding passes.

Trials for both smartglasses and smartwatches revealed that passengers were supportive of this technology as it could simplify and personalize their airport experience. Airport staff also responded favorably as paperwork and the need for radio communication was reduced. The major issue, as with other technologies, is its reliance on wireless connectivity. Use of wearable technology was, at the time of this writing, in its early stages, but airports and airlines both consider it to be an enabler for a smoother travel process. Although the largest potential seems to be the applications on the enterprise side, if biometrics can be integrated successfully with wearable technologies, many new possibilities and opportunities would also be available to the passenger.

Mapping

This category covers technologies that

- Assist airports in developing indoor maps of their campus, facilities, and relevant spaces.
- Allow airports to position/locate as well as track objects and people.
- Allow passengers to use the maps to determine their location and navigate the airport.
- Allow an airport (and its tenants) to improve marketing efforts and create new business opportunities.

The primary technologies that address the functionalities listed above include indoor positioning/navigation technology (INPT), augmented reality (AR), and context-aware mobile applications (CMA). Depending on the vision of the airport, these technologies can be used and deployed either in isolation or in combination with each other. The different functionalities, features, and distinct advantages can be pooled to create an overall solution that meets the specific needs of an airport.

The foundational element of this category is an airport map, generally developed by third-party vendors. Airports can then use sensors (receivers and transmitters), software applications, wireless communication protocols, and so forth to create a virtual environment in which people (e.g., passengers, employees, and non-passengers) and objects (e.g., assets and baggage) can be located and tracked in real time, if in motion. The locating and tracking functions use different technologies, such as Wi-Fi, sensor networks, BLE, Active RFID, infrared, ultra-wideband, and magnetic positioning, among others.

The airport map can also be made available to users, such as passengers, either within an existing airport map or as a stand-alone map application. Running such an application on mobile devices, a passenger can find his/her location on the airport campus and can proceed to other locations using the map as a guide. The mobile devices themselves function as the trackers by which the airport can gather relevant data about locations and movements.

The functionality of such a map can also be greatly enhanced by using AR technology or by integrating it into a CMA application. AR refers to a real-time view of a physical location whose elements are amplified by GPS data, video, graphics, or audio sensory input generated by a computer. CMA is used to notice and respond to what is actively occurring in a user's environment based on specific user information stored in a mobile application. These advanced mapping solutions allow the airport to incorporate and make available additional information as the user navigates through the airport. This can be done actively by using the device's camera to scan the environment while running an AR application or passively by simply passing by sensors often located at travel touch points (such as security) or concessionaires (restaurants and shops). This way, the airport can provide push notifications if a device is close enough to a sensor/beacon or incorporate personal information previously stored in a CMA. This type of functionality can be leveraged for improved customer service, marketing purposes, and to create business opportunities for the airport and its tenants and thereby can become a vital component of an IPSSP strategy.

Passenger Counting

Passenger counting technologies refer to any kind of technology that determines how many passengers are passing through a queue or a certain area of an airport. There are four primary technologies in this category: beam counters, thermal imaging systems, synthetic or artificial intelligence, and video analytics. These technologies can manage passenger traffic as well as queue times at an airport. In addition, some are used for determining passenger flow and direction. Factors considered in the determination of the most appropriate counting solution include where an airport is trying to improve efficiency and what to do with the data captured.

Beam counter systems emit an infrared beam from a compact electronic device to an opposing receiver or sometimes without such an opposing receiver. The system registers each beam disruption as a passenger count and sends data either through a wireless link or cellular network. This is a fairly accurate technology, vertical beams being more accurate than horizontal ones, and is easily deployable to gather information about queue lines and help an airport identify areas of improvement in relation to peak passenger travel times and patterns.

Thermal imaging systems distinguish the heat emitted by a person's body to count both passenger flow and direction. These systems are more versatile than beam counters because they are mounted on the ceiling and have a lesser probability of being obstructed. However, weather conditions can affect the readings negatively. Due to the significant required training, it is a rather costly solution.

Synthetic or artificial intelligence uses several infrared transceivers positioned about a foot from the floor that emit a system of beams, creating a zone. This form of passenger counting, like thermal imaging, is able to evaluate a person's direction of travel. Unique to synthetic intelligence is the ability to determine whether or not an object traveling through the zone is a human. Like thermal imaging, it can count in the darkness. As is the case with beam counters, however, people and objects can block the zone. This technology also requires a substantial investment due to the number of transceivers needed.

Video analytics refers to technology used to acquire a three-dimensional image of a location using at least two cameras and an algorithm to accurately determine the number of people in a certain area. This technology is especially effective in helping to address the problem of overcrowded areas as well as in determining the direction of people in motion. Depending on which type of video analytic is used, the cameras can use emitted light to further pinpoint each person. Like thermal imaging, video analytics is widely used due to the ease of deployment and the high degree of accuracy. Video analytics was developed to address high-traffic environments.

Speech/Voice Processing

Speech/voice processing, as a categorical term, refers to interactions between humans and computers in the area of linguistics. In this report, speech/voice processing refers to speech recognition and voice translation technologies. These two primary technologies have been implemented in various industries and have found multiple applications, especially in the area of mobile technologies.

Speech-to-text—a speech recognition technology—is widely used in most smartphones as part of the search feature, as well as in text and e-mail applications. Another promising speech recognition technology for passenger self-services is voice command. This function is used in automated call-center applications as well as in smartphones. Both Apple and Android-based smartphones utilize voice-activated "personal assistants" to enable the user to perform tasks without having to type. This type of application can be of great benefit to an airport as part of an IPSSP strategy. Voice command could be a value-added feature to virtual assistants, which are increasing in popularity across the world.

Voice translation, on the other hand, involves translating spoken words, phrases, and sentences from one language to another. Speaking into a microphone, a person's speech is turned into a string of words, an application translates it (to the best of its ability placing it in context), and a speech synthesis module uses waveforms similar to the text, pronunciation, and intonation to produce audio output. This technology could obviously be helpful where international travel is a priority, such as in airports that function as international transfer hubs.

At the time of this writing, Skype, in conjunction with Microsoft Research, has developed a near real-time, instant messenger, language translation tool called Skype Translator. Using neural-network-based speech recognition technology, this tool enables users speaking different languages to communicate via video chat. Airports could potentially benefit from such technology by integrating it into information kiosks already offering live communication with airport customer service representatives.

Facility Changes

Airport facilities must be capable of evolving with changes in airline operations, security procedures, passenger processes, technology trends, and customer expectations. Flexibility should be a cornerstone of any airport design or renovation project and inherent in nearly all design disciplines—architectural, structural, mechanical, electrical, and IT. With forward-thinking planning and design, functional areas can be flexible enough to accommodate current and future passenger self-service technologies.

The ideal airport facility is designed to streamline the passenger's journey from the moment he/she enters the airport to the time he/she boards the aircraft. The savvy passenger realizes that as technology advances, his/her journey can be made faster and that bottlenecks are more likely to be avoided when he/she uses self-service devices provided by the airlines and airports. The airport and the airlines have a responsibility to monitor and adjust their facilities (reconfigure, expand, or replace) in response to changes to the passenger processes that occur as more self-service amenities are offered. While making adjustments to the facility in response to changes is often necessary, it does not always allow for the best configuration. To improve this process, the IPSSP steering committee needs to collaborate with the airport planning department and provide input on the IPSSP objectives to long-term construction planning efforts.

At Heathrow Airport, the idea of facility change to accommodate the passenger flow is always taken very seriously. The manager of Heathrow Airport has made a conscientious effort to reduce the number of times passengers have to change levels in the airport, primarily departing passengers. In many cases, the changes made at Heathrow to reach this objective have resulted in passenger flow maintained all on one level, with passengers needing to drop down a level only at the boarding gate. Understanding its passenger flow needs, Heathrow Airport also sought to reduce the number of times passengers had to change levels at the new Terminal 2. Passengers enter the building on the top floor; the security check and departure lounge are on the same level. For arriving passengers, baggage reclaim and immigration are on the same level.

A prime example of how passenger self-service has affected many airports can be seen in the impact that passenger check-in has had on security screening checkpoints. Before the advent of passenger self-service, passengers frequently experienced long queues to see an agent at the check-in counter during peak travel periods. This, in turn, metered the flow of passengers to the security checkpoint. The throughput capacity of the checkpoint was based on accommodating that flow of passengers and thus the checkpoint queues were relatively small compared to today. However, the metering effect of the check-in area has largely been removed in airports making increasing use of passenger self-service because of faster check-in using kiosks and Internet/mobile devices. The bottleneck has now been moved to the security screening checkpoint where long queues are frequently experienced during peak periods.

As discussed in Chapter 1 of this report, the shift from Stage 3 to Stage 4 is where a new level of integration is added to the automation of moving passengers through the airport terminal. Airports must build flexible facilities that are able to adapt to the inevitable changes that will occur. For example, a hypothetical airport of the future might accommodate passengers using biometrics instead of driver's licenses or passports for identification at check-in and the security checkpoint. Even the airline boarding pass could be replaced by a biometric check that matches a person with a flight database. The biometric check will confirm the person is flying that day and will permit the person through security all the way to passing through the boarding gate. No one knows for sure which technologies will be commonplace in the future, but changes will continue to drive the industry.

Passenger Check-in

Opportunities for a passenger to check in for his/her flight have expanded from the traditional ticket counter to the kiosk, the home computer, the smartphone, and recently to proximity ID cards and "smart" baggage tags. With this evolution has come a change to the way passengers utilize the check-in lobby. Lengthy queues to see an airline agent are less common, with passengers expecting walk-up availability for kiosks and baggage drop-off areas.

A structure-free check-in lobby provides the greatest opportunity to accommodate current and future self-service technologies. Given adequate space, the structure-free check-in lobby can be reconfigured to evolve with new passenger flows, airline services, and security procedures. Common use baggage drop-off stations staffed by third-party airline representatives could be provided along major circulation paths from the curb, parking, mass transit stations, or ground transportation drop-off areas so passengers who have already checked in can drop their luggage without visiting an airline counter.

When possible, check-in area floors should be designed to allow easy access from below to facilitate adding or removing electrical and data/network floor penetrations as the lobby configuration changes. In locations with no lower level below the check-in lobby, a computer floor system can be considered to allow for flexible redevelopment. Wireless data needs will continue to grow, requiring sufficient infrastructure to accommodate passengers and their devices as the check-in and baggage drop-off experience becomes a more seamless process.

Baggage Handling System Modifications

Designing flexibility into the baggage handling system (BHS) should be a priority for new and reconfigured facilities. Since the attacks of September 11, 2001, airports have worked with the TSA to reconfigure many BHS systems, providing inline checked baggage inspection. Prior to the attacks of September 11, 2001, most outbound baggage systems were proprietary, point-to-point systems serving only one or two airlines. One of the recognized advantages of many of the newer systems is that a bag may be inserted at one of many points (check-in counter, curbside, parking garages, etc.) and is routed through the TSA screening system before being distributed to its airline's baggage make-up area. In these systems, the point at which a bag is inserted into the system is unimportant as long as the bag has a bar code or RFID tag to identify the bag's destination to the system. If multiple BHSs are constructed due to size, complexity, or distance, providing interconnectivity among the systems makes them flexible enough for bags to be inserted at any location and still be delivered to the correct baggage make-up device in a timely manner.

Security Screening Checkpoint Modifications

Since the attacks of September 11, 2001, many airports have seen a tenfold increase in TSA lease areas. The security screening checkpoint (SSCP) is continuously evolving as new technologies and procedures are implemented. Like the check-in lobby, a flexible, column-free area with below-floor access provides the greatest opportunities for changes in queues, passenger identification, and surveillance, as well as for future screening equipment providing greater detecting capabilities and speed. Advances in biometrics are expected to bring another layer of security equipment. In the future, it is expected that passengers will have the option of providing the government with personal information and biometric data in exchange for a less intrusive security screening process, in a way similar to the Department of Homeland Security's (DHS's) Global Entry and the TSA's Pre✓™ programs. Flight information will be matched with previously collected biometric data at a self-service gateway allowing the "known passenger" to enter the screening area. This technology would replace the TSA travel document checker just as automated gates at a transit station have replaced the traditional ticket taker.

Other considerations for the SSCP include providing sufficient lighting and optimal ceiling heights to allow for advances in closed-circuit television (CCTV) camera systems that will compare faces with images stored in government databases searching for potential threats. High ceilings create attractive public spaces, but they do not work well with CCTV systems. If SSCP areas must be located in high-ceiling areas, then cameras must be placed on floor posts, or a substructure should be suspended over the checkpoint for CCTV mounting and support lighting.

Holdroom Area Modifications

Self-boarding gates are expected to relieve gate agents from scanning boarding passes so that they can concentrate on serving passengers who need assistance. In the automated boarding process, passengers self-scan their boarding pass; smart phone; tablet; smartwatch; or other form of identification, such as a biometric feature, a proximity ID card, or an identification chip in their handheld or wearable electronic device. In most airline holdrooms, the self-boarding gates are anticipated to fit into the areas currently occupied by the lift podium and walkway to the passenger boarding bridge. Therefore, minimal reconfiguration of the holdroom would be necessary. Data/network and power connections will be required.

Baggage Claim Area Modifications

Airlines have begun installing self-service kiosks in or outside of baggage service offices for passengers to use when their luggage is missing or damaged. Passengers use the kiosks to track their baggage, report missing or damaged bags, and provide personal information for baggage delivery or repair. Each kiosk requires a minimum of 14 square feet of floor area to accommodate passengers with their carry-on baggage while using the kiosk.

Concession Area Modifications

Static airport directories are being replaced by dynamic, touch-screen, multilingual, searchable directories that provide passengers with detailed information such as store hours, cuisine type, distance, and directions. Generally, these directories do not require additional space, but will likely require additional data/network and power connections. Passengers also may use airport- or concession-supplied applications on their smartphones and tablets to locate concessions, order items for pickup or delivery to their gate, and make payments.

Parking Area Modifications

Airports have made great improvements to the parking experience over the past decade, adding pay-on-foot kiosks, vehicle counters that direct cars to floors or aisles with available spaces, and parking space indicators that show whether a space is occupied or not with just a glance down a row of parked cars. Parking agent booths are being replaced by machines that accept credit cards and cash payments as well as receipt cards from the pay-on-foot kiosks. Some exit lanes use local highway toll passes to accept payment. Each of these elements requires power and data/network infrastructure to be provided at parking entrances, exits, and potentially within the parking areas themselves.

Future advances in parking technology may include making payment or reserving spaces using smartphones, locating parking spaces using airport or third-party applications on smartphones, and frequent or premium parker programs that may include coupons or other incentives to encourage parking on airport property.

Human Resources

Implementing an IPSSP requires extensive involvement of human resources with a full range of experience and capabilities from a variety of stakeholders. It may be assumed that increasing the passengers' role in processing through the required travel functions will result in a decrease in requirements for human resources to perform the traditional functions. This, however, may be truer for airlines and their staffing requirements than for airports. In fact, implementing an IPSSP will likely increase the human resource requirement for the airport operator. Those impacts will vary based on the functional need (executive, management, operational, and service) for planning and design, project implementation, and operations and support.

Planning and Design

Executive Level

Executive-level staff must be engaged in a leadership role, providing governance as well as direction on key planning issues, such as overall airport business objectives. The executive staff should provide insight on changes in airport culture, engaging airlines as business partners, and accommodating airline business models. Executive-level staff should also contribute to the establishment of roles and responsibilities within the IPSSP steering committee and the development of IPSSP objectives. Depending on the structure of the IPSSP steering committee, it may also play the role of project sponsor for significant design projects.

Management Level

Management-level staff will likely take on the most time-consuming role in the planning process, serving in governance roles and other leading specific tasks. Management staff will provide insight on impacts that will be experienced by their specific division and strategies for addressing key considerations. They will take an active role in defining IPSSP objectives, KPIs, KPI targets, and processes for monitoring and reporting. Management staff will also lead the business case evaluation effort and perform the project definition tasks.

After the planning phase, a management-level resource will be needed as a program manager to oversee the implementation of the IPSSP. In many cases, this role will be taken on by a full-time airport staff position, and, in other cases it will be filled through an outsourced agreement.

Operational Level

Operational-level staff will provide input into the planning process as needed by the IPSSP steering committee. Operational-level staff can assist in providing an understanding of the impacts that will be experienced by their specific division and strategies for addressing key considerations. These staff members can also provide a realistic perspective on KPI targets and the resource requirements for implementation, operations, and support. After the planning phase, key operational staff members will be needed to provide ongoing support to the design project by attending design review meetings.

Service Providers

Consulting and design support plays a significant role in the IPSSP planning and design effort due to the need for specialty services for which most airports do not employ staff. During the planning effort, consultants may be needed to help with business-level assessments, airport capacity planning, airport master planning, and other tasks so that the IPSSP steering committee has the information needed to create clear and attainable IPSSP objectives. Consultants can provide additional high-level services, including assistance in developing an IPSSP ideology, developing a business model, planning for and facilitating stakeholder engagement, and, in some cases, facilitating the development of the IPSSP itself when an IPSSP champion is not present within the airport staff. Consultants can also be used to perform feasibility studies, facility assessments, requirements definition, technical specifications, policy and procedure development, and program management.

Once the planning and initial requirements are developed, the airport operator may need to engage design consultants, architects, engineers, and other professional services to create a design that may be installed or constructed.

Project Implementation

Executive Level

Executive-level staff will continue to be involved throughout project implementation as a member of the IPSSP steering committee governance structure. The executive staff will provide oversight at the highest level to hold the program manager accountable for meeting the project objectives. Executive-level staff will also serve as an escalation point to address issues that arise that require engagement of stakeholders beyond the authority level of the program manager.

Management Level

Management-level staff members who are part of the IPSSP steering committee will continue to serve in a governance role to provide oversight of the program manager and engage stakeholders as needed to support the implementation efforts.

The program manager will play the largest role during implementation, overseeing all aspects of the implementation including project definition and planning, execution, control, and close-out. In most cases, the program manager will be responsible for managing multiple interrelated efforts by different groups, each of which will have a project manager responsible for its independent scope. In some cases, where the initiative may be small in scope, the program manager may serve as a project manager as well. The program manager will be accountable to the IPSSP steering committee for achieving the defined project objectives.

Operational Level

Operational staff members will provide project support by providing information and feedback to the project team and, in some cases, serving as project team members to accomplish specific tasks as part of the internal project scope.

Service Providers

Consultants and solution providers are needed in most projects to provide specialty services that are either not part of the internal resource pool or that the airport operator does not have sufficient resource availability to provide. Consultants are often used as an owner's representative to provide the program management role when a full-time internal resource is not available. Consultants also provide a subject matter expert (SME) role to give the airport operator the expertise needed to ensure that the solution being provided will meet the IPSSP objectives.

Solution providers, also referred to as vendors, provide specialty products and services related to the design and implementation of applications and systems. Multiple solution providers are often used to provide individual, but interrelated scope elements as part of the full solution.

Operations and Support

Executive Level

As projects transition to steady-state operations, executive-level staff, as part of the IPSSP steering committee governance structure will evaluate the performance and conformance of the new application, system, or process to ensure it is meeting the required KPI targets. Executive-level staff will lead the decision-making effort regarding changes to the program's KPI targets or IPSSP objectives.

Management Level

Management-level staff that are part of the IPSSP steering committee will continue to serve in a governance role to evaluate the performance and conformance of the new application, system, or process to ensure it is meeting the required KPI targets. Management-level staff will lead the decision-making effort regarding changes to specific passenger self-service elements as required to improve the performance or bring it into compliance.

The program manager will lead the effort to transition the initiative from a project to the steady-state operational environment and oversee the training of operations staff and the commissioning of the application or system. The program manager will oversee the performance monitoring and reporting responsibilities and will lead the effort to make changes to passenger self-service elements as directed by the IPSSP steering committee. The program manager will oversee the development and enforcement of new policies and procedures required for achieving the required performance and conformance metrics.

It is also the responsibility of the program manager to confirm whether or not the change has impacted existing policies and procedures. At Heathrow Airport, the impact of passenger self-service on policies and procedures is well understood. At Heathrow, all boarding pass checks are now automated. Recently, all gates have also been automated. With this change, Heathrow Airport has updated all procedures for boarding, including security procedures. For all projects related to passenger self-service, they will do a thorough review of all standard policies and procedures.

Finally, the program manager will lead the regular stakeholder engagement effort with the airlines and other stakeholders to accommodate business processes and support negotiation and contract management on behalf of the airport.

Operational Level

Operational staff members will provide the application, system, or process administration of the new passenger self-service element. Staff from the specific division that owns the element will perform the daily operations of new services, including processing functions, configuration changes, and asset maintenance. Technology staff will provide support for problem resolution and maintenance of the infrastructure and systems. The business units will provide support for legal counsel on liability and compliance issues, marketing program development and implementation, environmental impact assessment and support, and financial support for account management. Depending on the scope and scale of the new passenger self-service element, additional airport staff members may be required within the division that owns the element and within the technology division. An example of an operational change that will engage multiple groups is the addition of APC kiosks in the CBP area. The rollout of a passenger self-service initiative of this sort requires extensive collaboration between various stakeholders because the airport is providing a service in an area controlled by a regulatory agency. Beyond planning and implementation activities, ongoing maintenance and support requires engagement from operations, technology, and the business units to ensure successful operations within the confines of this restricted area and the policies and procedures of the governmental agency.

Service Providers

Service contracts are often used to provide the support and maintenance responsibilities for a new application or system. The vendor from which a specific product was procured is typically retained to provide at least level-three application support, which resolves major application problems over the course of the contract. The specific vendor or third-party service providers are often used to provide level-one and level-two support, which resolve basic hardware and software issues and general system administration when the airport operator chooses not to use internal staff.

Passenger Outreach/Communications

Communication and outreach to the customer have always been important elements of any business, including airports. Since passengers/customers are always online, even while at the airport, the airport has a unique means of insight into their customers. Continuous communication, including the effective use of e-mail, websites, and social media, can build customer loyalty. Using social media as an outreach tool is an emerging application, and airport staff are still finding out how best to do this. Social media, if deployed well, can serve to humanize the airport organization. If an e-mail is a virtual version of a written letter and an airport website is a virtual store front, social media can become a virtual conversation that interested people can join. It is through participation in a conversation with passengers that the airport becomes more "humanized." This is important because of people's preference for doing business with other people rather than with a non-personal organization. Additionally, the conversational aspect of social media provides a richer, more personal experience. Use of social media by the airport also underscores the airport's care for its customers. Of added benefit to the airport is that, unlike e-mail, social media conversations are publicly visible, which allows other potential airport customers to see "customer service in action."

Social media channels (e.g., Facebook, Twitter, Linked-In, Pinterest, g+, YouTube, etc.) offer airports a means for addressing a passenger's travel-related issues. Amsterdam Airport Schiphol's Twitter channel, for example, receives an average of 50 passenger questions per day. Retail- and parking-related questions are answered by airport retail staff between 6 a.m. and midnight. Amsterdam Airport Schiphol's current policy is to respond to media inquiries within an hour. There are also a number of people each day that post on social media that they have arrived at Amsterdam Airport Schiphol, to which the airport responds with a "Welcome" posting.

As has been discussed, Stage 4 passengers prefer to operate with minimal human interaction and rely as much on passenger self-service as possible. Airports that are active in conversations on social media sites provide an alternative means for obtaining airport assistance and in the preferred format of the Stage 4 passenger. Responsiveness and conversation are the keys to making social media a viable passenger self-service option. Amsterdam Airport Schiphol observed that while travel data, such as flight information, are important to users, "commercial," or advertising-centric messages, are *not* well received on social media. To be effective, social media messages need to combine information and "fun." Also, certain kinds of content can be more appropriate on one social media channel than on another. YouTube is a great example. As YouTube is a video-sharing platform, content posted to this site is strictly video content. Some airports have had great success on YouTube featuring behind-the-scenes videos of various airport operations, such as de-icing a plane.

Given that airports and airlines go hand-in-hand and that passengers do not always draw hard distinctions between the two, it is of great benefit for an airport to extend its airline relationships to assist with social media. This cooperation should go both ways. Airline-to-airport cooperation is taking place at Amsterdam Airport Schiphol and is highly valued. This occurs on a daily basis when passenger messages are received by Amsterdam Schiphol Airport and KLM through social media and passed on to the appropriate party for response. In addition, Amsterdam Airport Schiphol's E-business group meets with the airlines (e.g., meetings with KLM occur four times per year) to discuss social media specifically and to work together to improve coordination and response across all media channels.

Some airports have a dedicated staff member that manages and responds to the various social channels. Some airports utilize multiple staff members to support the various channels in addition to their other job duties. Some airports utilize vendor support for 100% coverage of social media or some combination of airport staff and vendor support.

Measuring an airport's return on investment with social media is difficult because it is hard to tie social media responsiveness to revenue generation. Instead, airports measure and track users' engagement with the airport's media channels. In social media, "engagement" is defined as the level to which other users "engage" or interact with the content/information "posted" (broadcasted) on the channel. The quality of social media posts is measured by user engagement with a particular post. Tracking can be done manually or with automated tools. Some combination of both is advised as fully automated tools cannot be trusted to understand the nuances of sarcasm and joking and may rate some responses as "good" when they really are not and vice versa. Some review of the tracking done by automated tools is necessary when measuring the "success" of a particular posting. Measurement of the level of user engagement on each social media channel can be used to help the airport to meet the needs of users of these channels. To improve upon electronic communications efforts, such as using social media channels, airports ought to consider investigating how other companies in other markets have succeeded in using electronic communications efforts.

Step 7: Implement Initiatives

Implementing the chosen set of passenger self-service initiatives should be based on a structured process and be the result of thoroughly developed business cases. The IPSSP steering committee should take a strategic approach to implementing the integrated solution so that benefit is maximized and risk and the impact on resources are minimized.

Implement Initiatives

- Project Definition and Planning
- Project Implementation
- Project Close-out

In most cases, the program manager will be responsible for managing multiple interrelated efforts by different groups, each of which will have a project manager responsible for its independent scope. These groups are likely to be composed of multiple vendors and internal resources, each of which will provide a portion of the total effort needed to enable the complete solution.

Project Definition and Planning

During the planning phase, each of the areas addressed by the business case will be further developed, and the specific plan that will guide the execution and control of the project will be created. The following areas are addressed during planning:

- **Scope:** Scope planning and scope definition
- **Time:** Activity definition, activity sequencing, activity duration estimation, and schedule development
- **Cost:** Resource planning, cost estimation, and cost budgeting
- **Quality:** Quality planning
- **Communications:** Communications planning
- **Human Resources:** Organizational planning and staff acquisition
- **Procurement:** Procurement planning and solicitation planning
- **Integration:** Project plan development
- **Risk:** Risk management planning, risk identification, qualitative risk analysis, quantitative risk analysis, and risk response planning

The planning phase lays the groundwork for efficient and effective execution and control of the project. The overall outcome of the project is highly dependent on the level of effort put into planning and its completeness.

Project Implementation

Once project approvals are achieved, the project moves into the implementation phase of work, where critical milestones are set up to measure project progress and success. It is important to note that project ownership is maintained by the IPSSP steering committee through the entire project implementation life cycle.

Project Execution

During the execution phase, the project moves forward according to the project plan defined in the planning phase. The following areas are addressed during execution:

- **Integration:** Project plan execution
- **Quality:** Quality assurance

- **Human Resources:** Team development
- **Communications:** Information distribution
- **Procurement:** Solicitation, source selection, and contract administration

During a typical airport system or infrastructure project, project execution includes design, development, testing, and implementation by a vendor or contractor. The extent to which design and development are necessary depends on the customized nature of the project.

Project Control

The control phase comprises a series of processes that overlap the execution. Project control ensures that the project is executed according to the project plan and facilitates adjustments where necessary. The following areas are addressed during project control:

- **Communications:** Performance reporting
- **Integration:** Integrated change control
- **Scope:** Scope verification and scope change control
- **Time:** Schedule control
- **Cost:** Cost control
- **Quality:** Quality assurance and control
- **Risk:** Risk monitoring and control

Control processes are often underutilized due to resource constraints or lack of understanding of the value they provide. During the course of a project, the effort associated with closely monitoring the performance and risk issues and the management of change control can be seen as unnecessary and too burdensome when everything appears to be running smoothly. Often it is not obvious when a project begins to veer off course and risks begin to materialize because the individuals in control of the problem areas believe they can recover and get back on track and take action to do so. In most cases, recovery is possible and the risks are mitigated. However, if for a particular problem area the risks cannot be mitigated and issues cannot be readily resolved, it may be too late to resolve them without a negative impact on the project. In this case, changes to scope, cost, time, or quality may be necessary.

Project Close-Out

The close-out phase involves the formal acceptance and closure of a project after all project activities have been completed to the satisfaction of the airport. The following areas are addressed during closing:

- **Procurement:** Contract close-out
- **Communications:** Administrative closure

The closing phase is another area in which significant value can be lost. By the time the project activities are complete, resources are quickly released and reassigned to the next project, particularly in cases where a project has gone over budget or beyond its schedule. Unfortunately, the quick release of resources can result in inadequate administrative closure. The closure process should include two key components: the preparation of project archives and documentation of lessons learned. Development of project archives is the creation of organized documentation of the project. When this is adequately done, these archives become a valuable reference resource for future projects. Documentation of lessons learned is a critical need, especially when a project experienced challenges. In addition, documentation of lessons learned enables the evaluation of circumstances that may have contributed to project challenges and can lead to changes in processes that will mitigate challenges in the future.

Step 8: Monitor and Report

Monitoring and reporting should be considered with regard to the benefit of the IPSSP and not just the project. With that in mind, as individual projects close-out, the IPSSP steering committee must engage to evaluate the project's performance against the IPSSP objectives as well as the individual project objectives. The IPSSP steering committee will also oversee the establishment of ongoing monitoring measures to support the KPI reviews.

Monitor and Report

- Performance Measurement
- Internal Control Measurement
- Monitor, Evaluate, and Assess Compliance with External Requirements

Performance Measurement

Performance measurement involves collecting, validating, and evaluating performance data on the passenger self-service process. Monitor each process to ensure that it is performing against agreed-on KPI targets and provide systematic and timely reporting to enable accountability.

Collect and Process Performance and Conformance Data

Collect and process timely and accurate data according to the IPSSP performance measurement methodology:

1. Collect data from defined processes (automate data collection where possible).
2. Assess efficiency (effort in relation to insight provided) and appropriateness (usefulness and meaning), as well as validate integrity (accuracy and completeness) of collected data.
3. Aggregate data to support measurement of agreed-on metrics.
4. Align aggregated data to the IPSSP reporting approach and objectives.
5. Use suitable tools and systems for the processing and format of data for analysis.

Analyze and Report Performance

Periodically review and report performance against targets, using a method that provides a succinct all-around view of IPSSP performance and fits within the IPSSP monitoring system. To analyze and report performance:

1. Design process performance reports that are concise, easy to understand, and tailored to various management needs and audiences.
2. Facilitate effective, timely decision making and ensure that the cause and effect between goals and metrics are communicated in an understandable manner.
3. Compare the performance values to KPI targets and benchmarks and, where possible, to external benchmarks (industry and key competitors).
4. Recommend changes to the KPI targets, where appropriate.
5. Distribute reports to the relevant stakeholders.
6. Analyze the cause of deviations from targets, initiate remedial actions, assign responsibilities for remediation, and follow up. At an appropriate time, review all deviations and search for root causes, where necessary. Document the issues for further guidance if the problem recurs. Document results.

Ensure the Implementation of Corrective Actions

Assist stakeholders in identifying, initiating, and tracking corrective actions to address anomalies by

1. Reviewing IPSSP steering committee responses, options, and recommendations to address issues and major deviations.

2. Ensuring that the assignment of responsibility for corrective action is maintained.
3. Tracking the results of actions committed.
4. Reporting the results to the stakeholders.

Internal Control Measurement

Internal control measurement involves continuously monitoring and evaluating the IPSSP control environment, including self-assessments and independent assurance reviews. Internal control measurement enables the IPSSP steering committee to identify control deficiencies and inefficiencies and to initiate improvement actions. It is necessary to plan, organize, and maintain standards for internal control assessment and assurance activities such as the following:

- **Monitor internal controls.** Continuously monitor, benchmark, and improve the IPSSP control environment and control framework to meet organizational objectives.
- **Review the effectiveness of IPSSP process controls.** Review the operation of controls, including a review of monitoring and test evidence, to ensure that controls within IPSSP processes operate effectively. Include activities to maintain evidence of the effective operation of controls through mechanisms such as periodic testing of controls, continuous controls monitoring, independent assessments, command and control centers, and network operations centers. Such activities provide the IPSSP steering committee with the assurance of control effectiveness in meeting requirements related to IPSSP and regulatory responsibilities.
- **Perform control self-assessments.** Encourage IPSSP steering committee and process owners to take positive ownership of control improvement through a continuing program of self-assessment to evaluate the completeness and effectiveness of the IPSSP steering committee's control over processes, policies, and contracts.
- **Identify and report control efficiencies.** Identify control deficiencies and analyze and determine their underlying root causes. Escalate control deficiencies and report to stakeholders.
- **Ensure that assurance providers are independent and qualified.** Ensure that the entities performing assurance are independent from the functions, groups, or organizations responsible for the work. The entities performing assurance should demonstrate an appropriate attitude and appearance, competence in the skills and knowledge necessary to perform assurance, and adherence to codes of ethics and professional standards.
- **Plan assurance initiatives.** Plan assurance initiatives based on IPSSP objectives and strategic priorities, inherent risk, resource constraints, and sufficient knowledge of the airport.
- **Scope assurance initiatives.** Define and come to agreement with the IPSSP steering committee on the scope of the assurance initiative, based on the assurance objectives.
- **Execute assurance initiatives.** Execute the planned assurance initiative. Report on identified findings. Provide positive assurance opinions, where appropriate, and recommendations for improvement relating to identified operational performance, external compliance, and internal control system residual risk.

Monitor, Evaluate, and Assess Compliance with External Requirements

The IPSSP steering committee needs to ensure that IPSSP processes and IT-supported IPSSP processes are compliant with laws, regulations, and contractual requirements. Obtain assurance that the requirements have been identified and complied with and integrate IPSSP compliance with overall airport compliance through the following:

- **Identifying external compliance requirements.** On a continuous basis, identify and monitor for changes in local, state, federal, and international laws; regulations; and other external requirements that must be complied with from an IPSSP perspective.

- **Optimizing response to external requirements.** Review and adjust policies, principles, standards, procedures, and methodologies to ensure that legal, regulatory, and contractual requirements are addressed and communicated. Consider industry standards, codes of good practice, and best practice guidance for adoption and adaptation.
- **Confirming external compliance.** Confirm compliance of policies, principles, standards, procedures, and methodologies with legal, regulatory, and contractual requirements.
- **Obtaining assurance of external compliance.** Obtain and report assurance of compliance and adherence with policies, principles, standards, procedures, and methodologies. Confirm that corrective actions are taken to address compliance gaps in a timely manner.

Step 9: Assess Next Steps

At this point, the process is in place to facilitate the evaluation of individual initiatives for achievement against the IPSSP objectives. However, it is necessary to go beyond assessing KPIs on a regular basis to ensure that the IPSSP is moving along according to the original plan. The ever-changing nature of the IPSSP environment necessitates an ongoing effort to assess the direction of the IPSSP itself.

Assess Next Steps

- Continually Reassess Direction of IPSSP
- Establish Schedule for Consistent IPSSP Reevaluation

Continually Reassess the Direction of the IPSSP

As each project is completed, the overall environment changes. For example, as queue times lessen and passenger flows shift on the landside, new bottlenecks at security and capacity issues in holdrooms could emerge. Some of the changes may have been adequately anticipated and mitigated, and others may not have been. In addition, as time passes, new technologies enable new services, and the industry associations continue to make process advancements. This continual change makes the passenger self-service vision a progressive movement, not an end result. The continually changing nature of an IPSSP means that the direction of the IPSSP must be continually reassessed.

Establish a Schedule of Consistent IPSSP Reevaluation

The IPSSP steering committee must establish a schedule for consistent reevaluation of the IPSSP itself. On a regular basis, at least annually, the IPSSP steering committee should go back to Step 3 and reassess the results of completed projects and changes in the overall environment that may impact the IPSSP objectives. After that, the IPSSP steering committee should move through the remainder of the Roadmap in preparation for the implementation of the next project. This includes the following:

- Reevaluation of the list of planned projects and redefining the projects as required.
- Assessment of KPIs and their targets for the value they provide in measuring the current IPSSP objectives.
- Evaluation of the performance measurement system for opportunities to improve.
- Review of industry benchmarks.
- Evaluation of key factors for consideration.
- Addressing fundamental impacts.

On a less frequent schedule, such as every 3 to 5 years or as significant changes in airport strategy or executive leadership occur, the IPSSP steering committee should start over at Step 1. The IPSSP steering committee should validate the airport perspective, confirm or attain management support, and redefine the IPSSP stakeholder involvement and program objectives. There may not be significant changes; however, if changes are needed, moving forward without addressing needed adjustments could result in wasted resources or failed projects and ultimately loss of support for the IPSSP. The risk of this kind of failure is not worth the time and effort saved by foregoing this process under the assumption that all is well. If executed thoroughly, consistently, and with transparency, this assessment will build the trust and support of the executive management team and other relevant stakeholders, as well as ensure that the IPSSP is constantly working in the best interests of the airport, airlines, regulators, and passengers.

PART III

Integrated Self-Service Tools

Three tools have been developed to supplement the Reference Guide presented in Part II of this report and are provided on *CRP-CD-168* (bound into this report and also available as an .iso image on the TRB website at http://www.trb.org/Main/Blurbs/172418.aspx). Each tool provides a unique purpose that will assist the user in developing an IPSSP.

The "Business Case Development Guide" (Chapter 4) provides a structured process through which an airport operator can strategically assess various self-service initiatives for applicability in addressing a specific issue.

The "Passenger Self-Service Inventory" (Chapter 5) provides a comprehensive listing of known passenger self-service applications, systems, and devices in operational environments and in development. Provision of this list will enable the user to gain a high-level understanding of the maturity level, locations within the passenger journey, benefits, and enabling technologies of each item.

The "Passenger Self-Service Environment Map" (Chapter 6) provides a graphical, interactive way of exploring the passenger self-service environment in which a passenger/traveler functions. This tool enables the user to explore the passenger self-service inventory information in a presentation-style format.

In addition, *CRP-CD-168* provides printable, one-page summary descriptions of the enabling technologies discussed in Chapter 2.

CHAPTER 4

Business Case Development Guide

Purpose

The primary intent of the Business Case Development Guide is to enable the airport operator to make wise decisions that will achieve strategic objectives and further its passenger self-service vision. The Business Case Development Guide is to be used to facilitate a key step within the "Applying the Vision Roadmap" (Figure 1-20). It will enable an end user to assess individual issues and evaluate options for implementation. It is comprised of a structured set of templates that guide the users through a step-by-step process of defining appropriate passenger self-service options based on alignment with their unique vision, perspective, and objectives. The Business Case Development Guide helps the user in seeking out the data needed to create a business case document that will define appropriate options with potential benefits and risks and the likely stakeholder impacts. This tool does not define the final strategy or solution for the user; however, it provides a framework for decision making that ties decisions related to passenger self-service to the airport's vision while maintaining a focus on creating optimal value. The Business Case Development Guide will walk the user through a step-by-step process for

- Defining the airport's IPSSP objectives relative to the airport's mission, vision, and objectives.
- Determining the applicability of differing options based on the unique perspective and stakeholder needs of the subject airport.
- Evaluating the value that differing options provide in meeting the objectives of the airport.
- Assessing the readiness level of the airport and airlines to implement the chosen option based on defined impacts and funding mechanisms.

How to Use the Business Case Development Guide

The Business Case Development Guide is a Microsoft Excel document that consists of three worksheets: Strategy Definition, Issue Analysis, and Opportunity Evaluation. The worksheets combine to create a basic business case document that can be used to record the data used in the decision-making process for a new initiative. The value of the overall business case is directly tied to the accuracy and completeness of the information that is put into these worksheets. Instructions for each worksheet are provided below.

Strategy Definition

The Strategy Definition worksheet documents the airport operator's overall ideology and that of the IPSSP as a basis for aligning the issues and opportunities being evaluated. The Strategy Definition worksheet provides areas for entering information on the following seven items:

1. **Airport Mission.** Enter the airport mission statement.
2. **Airport Vision.** Enter the airport vision statement.

3. **Airport Objectives.** List the airport objectives.
4. **Airport Perspective.** Describe the airport perspective as discussed in Chapter 2. Include any statements used by the airport business to define core values.
5. **Passenger Self-Service Vision.** Describe the passenger self-service vision as discussed in Chapter 2.
6. **Stakeholder Needs Relative to Passenger Self-Service.** List the stakeholder needs as discussed in Chapter 2.
7. **Passenger Self-Service Objectives.** List the IPSSP objectives as discussed in Chapter 2.

Issue Analysis

The Issue Analysis worksheet documents the issue or problem that the airport operator is seeking to address through a passenger self-service solution. Follow the instructions below for the various parts of the Issue Analysis worksheet:

1. **Issue Description.** Define the fundamental issue that will be addressed by the opportunity being evaluated. Address the reasons that the issue or problem exists, the elements which create it, the impact it is having on the business, and the timeframes within which it must be resolved.
2. **Current Conditions.** Describe the current condition. Clearly define the issues that are prompting changes as they relate to finance, operations, stakeholders, staff, or other elements.
3. **Analysis.** This category includes the following:
   - **Self-Service Objectives to be Addressed.** The IPSSP objectives entered in the Strategy Definition worksheet will be imported into this section. Select "Yes" from the drop down box next to each objective that will be addressed by the issue being evaluated.
   - **Airport Objectives to be Addressed.** The airport objectives entered in the Strategy Definition worksheet will be imported into this section. Select "Yes" from the drop down box next to each objective that will be addressed by the issue being evaluated.
   - **Stakeholder Needs to be Addressed.** The Stakeholder Needs entered in the Strategy Definition worksheet will be imported into this section. Select "Yes" from the drop down box next to each stakeholder need that will be addressed by the issue being evaluated.
4. **Opportunity Parameters.** Define the opportunity which has been identified, including implementation schedule demands, opportunity window for solution, any supporting evidence to prove that the opportunity is real, and the positive impact that realization of the opportunity will have on the airport.

Opportunity Evaluation

The Opportunity Evaluation worksheet should be populated for all solution options that are being considered. Instructions follow for the various parts of the Opportunity Evaluation worksheet:

1. **Opportunity Description.** Write a summarized description of the option identified. This will include the general approach to be taken and a summary of the core elements of the solution.
2. **Benefits, Goals, and Measurement Criteria.** Define the tangible and intangible benefits to the airport upon implementation of the solution. One of the obvious benefits described will be that the defined issue will be addressed. Define the benefits according to categories such as financial, operational, competition, stakeholders, staff, or others. For each benefit defined, associate a value in terms of a dollar value, percentage value, or descriptive value.
3. **Cost and Funding Plan.** Describe the tangible and intangible costs to the airport upon implementation of the solution. Include the costs of the actual project as well as any negative impact to the business resulting from the delivery of the project. Define the costs according to categories such as people, assets, marketing, stakeholders, organization, or others. For each

cost item defined, associate a value in terms of a dollar value, percentage value, or descriptive value. For each cost item listed select "Yes" or "No" from the dropdown list that will appear in cell in the "Budgeted" column where the cursor is placed. Define funding sources that will be used, with their associated amounts and any notes that are relevant.

4. **Feasibility.** Describe the feasibility of the solution. To adequately complete this section, a feasibility study may need to be initiated to quantify the likelihood of achieving the desired project result. To assess the overall feasibility of this option, break the solution down into components and rate the feasibility of each component such as technology, people, processes, assets, or some other component. Rate each component from 1 to 10 by going to the "Rating" column and selecting the appropriate rating from the dropdown list that will appear in the cell that the cursor is in. Describe the method used to determine feasibility for each component.
5. **Constraints.** Identify the major constraints associated with the adoption of this option. Define the category, such as technology, people, processes, assets, or some other component. Describe the constraint ("Description" column) and identify the severity by going to the "Selection" column and selecting the appropriate value from the dropdown list that will appear in the cell that the cursor is in.
6. **Risks.** Define the most apparent risks associated with the adoption of this solution. Risks are defined as "any event which may adversely affect the ability of the solution to produce the required results." Risks may be strategic, environmental, financial, operational, technical, industrial, competitive, or customer-related. For each risk, define the likelihood of occurrence by going to the "Likelihood" column and selecting the appropriate value from the dropdown list that will appear in the cell that the cursor is in. For each risk, define the impact of the occurrence by going to the "Impact" column and selecting the appropriate value from the dropdown list that will appear in the cell that the cursor is in. To complete this section thoroughly, it may be necessary to undertake a formal risk assessment (by documenting a risk management plan). To reduce the likelihood and impact of each risk's eventuating, clear mitigating actions should be defined.
7. **Issues.** Summarize the highest priority issues associated with the adoption of this option. Issues are defined as "any event which currently adversely affects the ability of the solution to produce the required deliverables." For each issue, define the priority by going to the "Priority" column and selecting the appropriate value from the dropdown list that will appear in the cell that the cursor is in.
8. **Stakeholder Impacts**. Identify the major stakeholder impacts associated with the adoption of this option. Define the stakeholders affected, define the impact, and identify the severity by going to the "Severity" column and selecting the appropriate value from the dropdown list that will appear in the cell that the cursor is in.

CHAPTER 5

Passenger Self-Service Inventory

This chapter introduces the Passenger Self-Service Inventory (Inventory), a comprehensive listing of known passenger self-service applications, systems, and devices in operational environments and in development. The Inventory is a spreadsheet matrix and is included on *CRP-CD-168,* bound into this report and available as an .iso file on the TRB website (search on *ACRP Report 136*).

As seen in the matrix, the various Inventory items are briefly described and grouped into the following areas:

- Information/Wayfinding
- Baggage
- Check-in
- Security/Immigration/Customs/Border Control
- Boarding/Gates
- Parking
- Service/Programs
- Mobile/Web Applications
- Others

Each of the individual Inventory items is then analyzed according these evaluation criteria:

- **Maturity.** Is the item emerging, mature, or sun-setting in regard to product life cycle considerations?
- **Locations.** At which of the six locations (Off-Airport, Landside, Security/Customs, Airside, Boarding, and In Flight) is, or could, this item be used or implemented?
- **Benefits.** Which of the 21 listed general, quantitative, and qualitative benefits (see the Inventory for the listing) can be achieved by each item? Evaluations are done using the designations high, medium, low, and n/a.
- **Enabling Technologies.** Which enabling technology (see the Inventory for the listing) can be (opportunity) or needs to be (required) integrated/considered, if the item is implemented?

The detailed analysis results presented in the Inventory will provide an airport with the commonalities between, and therefore potential for integrations of, various self-service items. The analysis will also indicate any dependencies. Both aspects are crucial components of an IPSSP effort.

High-level summary content, based on the detailed information included in the Inventory, is also presented in interactive graphical form in the Passenger Self-Service Environment Map, as discussed in Chapter 6.

CHAPTER 6

Passenger Self-Service Environment Map

Purpose

The purpose of the Passenger Self-Service Environment Map (Map) is to provide the reader with a graphical, interactive way of exploring the passenger self-service environment in which a passenger/traveler functions. The airport has a significant opportunity to provide information and options that may influence the passenger's decision on where and how individual travel steps are, or can be, accomplished. Information included is pulled and summarized from various sections of *ACRP Report 136,* especially Chapter 5 and covers:

- Passenger Self-Service Inventory items by location
- Enabling technologies
- Programs and services
- Web/mobile applications

Features and Functionalities

The Passenger Self-Service Environment Map offers a variety of features and functionalities including the following:

- Overview of what to expect and instructions on how to navigate through the material.
- Non-linear exploration so that a user can "zoom" into a specific content of interest anywhere on the Map.
- Layered content detail so that a user can choose how deeply to explore content by "drilling down" into desired details.
- Summary analysis results for all Passenger Self-Service Inventory items, providing the most important, high-level evaluation criteria.
- Introduction to the other tools (e.g., the Business Case Development Guide*)* and how they relate to and work in conjunction with the Map.

How to Use the Map

Navigating the Passenger Self-Service Environment Map is very intuitive and only requires a few simple guidelines.

The first few screens are set up in a linear order, as they guide the user through the introductory material and at the same time provide instruction on how to best navigate through the Map. Once on the main screen (shown in Figure 6-1), the user can freely explore any area of interest. It is easy to return to the introductory material if necessary; just click on the material at the upper left corner of the main screen.

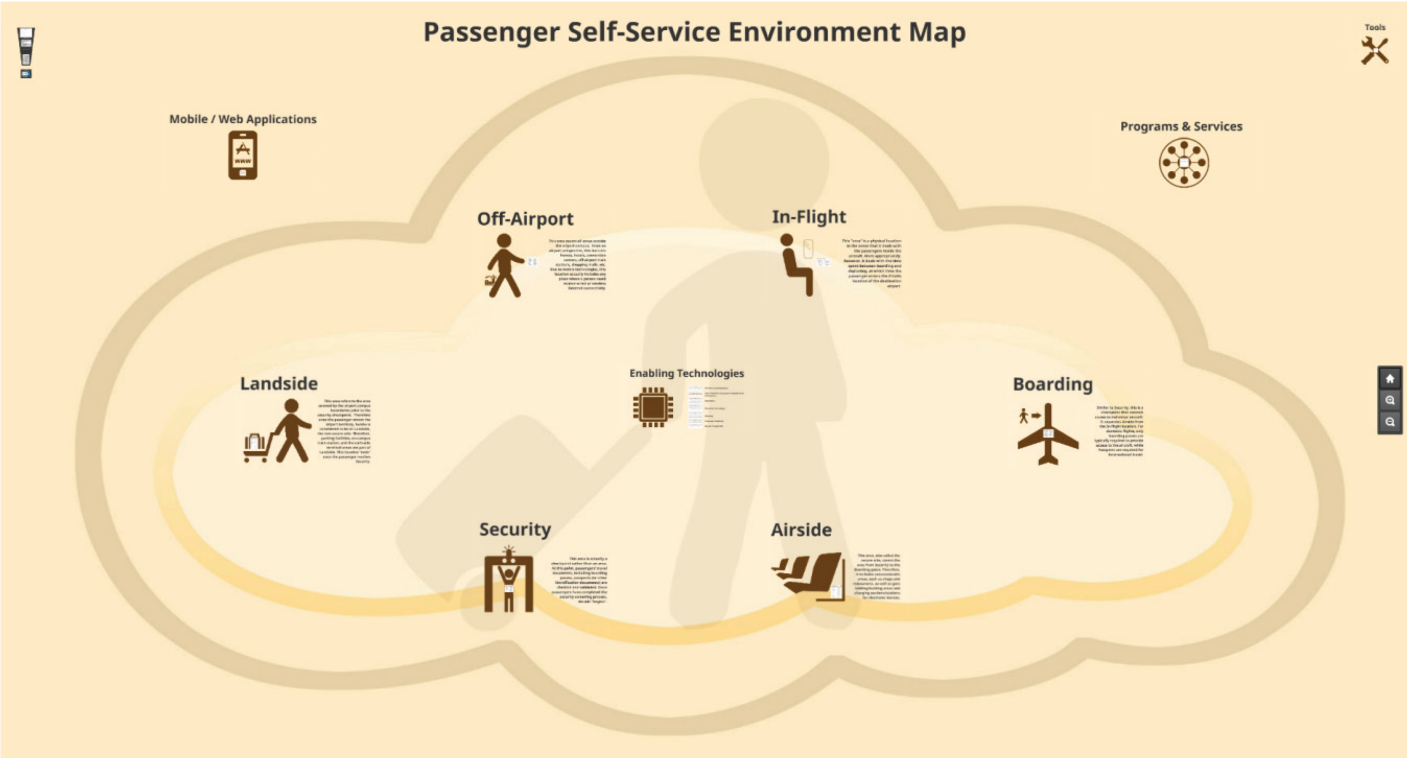


Figure 6-1. Main screen of passenger self-service environment map.

By clicking on hotspots, such as "Landside" (on the main screen), the Map will zoom in to show information in full screen; generally, additional content is available by clicking on newly revealed hotspots, which can be clicked on to zoom into more detail, as desired. Clicking close to the screen borders zooms the user out to the previous screen.

In addition, moving the cursor to the right side of the screen offers further options via small pop-ups:

- The "+" and "–" buttons allow the user to zoom a little bit more into (or out of) the current screen.
- The "home" button will get the user back to an overview of the main screen.

Other useful navigation features:

- The "click-hold-drag" feature (with the mouse) allows the user to move the viewing window freely.
- The mouse's scrolling wheel can be used for zooming in and out.

As mentioned earlier, these navigation guidelines are included in the Passenger Self-Service Environment Map itself, and can be accessed by clicking on the boxes on the top left of the main screen.

PART IV

Appendices

APPENDIX A

Glossary of Terms

1-D Bar Code—A group of parallel lines, differing in width and spacing, used to represent data. Designed to be scanned and read optically.

2-D Bar Code—Geometric patterns like dots and squares that are two dimensional that are used to represent data. Designed to be read and scanned optically.

Airports Council International (ACI)—The only trade representative of airports across the globe.

Airport Service Quality (ASQ)—An ACI initiative run on behalf of the airport industry worldwide.

Augmented Reality (AR)—A user's real-world, live environment that is supplemented (as an overlay) with computer-generated input such as audio and graphics.

Automated Passport Control (APC)—U.S. Customs and Border Protection (CBP) Program that expedites the entry process for U.S., Canadian, and other eligible travelers.

Baggage Handling System (BHS)—Type of conveyor system installed in airports that transports checked luggage from ticket counters to areas where the bags can be loaded onto airplanes.

Batch Processing—Automated transaction process requiring no human intervention.

Beam Counter—Infrared beam cast from one point to another that, when interrupted, counts passenger flow.

Benchmarking—Using best practices and industry standards to evaluate one's own company practices.

Best Practice—Method or technique that has consistently shown results superior to those achieved with other means and that is used as a benchmark.

Biometrics—Metrics related to human characteristics such as fingerprints, eye scans, etc.

Bluetooth—Wireless technology standard used to send data over short distances using short-wavelength UHF radio waves. Can be used in fixed and mobile locations.

Bluetooth Low Energy (BLE)—Designed by the Bluetooth Special Interest Group (SIG) as a lower energy alternative to Bluetooth that is aimed at personal use.

Business Case—Often a carefully written document or short verbal presentation that presents the reasoning behind deploying a new solution or technology.

Business Driver—A resource, process, or condition that is vital for the continued success and growth of a business.

Causal Link—Relation between a set of factors (causes) and a phenomenon (the effect).

Charter—Written grant by which an institution such as a company is created and its rights and privileges defined, similar to an Authority.

Closed-Circuit Television (CCTV)—The use of video cameras to transmit a signal to a specific place, on a limited set of monitors.

Common Infrastructure—When service providers or users of Information and Communications Technologies (ICT) share systems to distribute electronic communication signals and services in the terminal or around the Airport.

Common Use Working Group (CUWG)—Standards developed by IATA cover the following three specific areas of Common Use: Common Use Self-Service (CUSS), Common Use Passenger Processing Systems (CUPPS), and standardized data exchange through the use of web services technology.

Computerized Reservation System (CRS)—Computerized system used to store and retrieve information and conduct transactions related to air travel.

Context-Aware Mobile Applications (CMA)—Mobile device property that complements location awareness.

Data Flow—Software architecture based on the idea that changing the value of a variable should automatically force recalculation of the values of variables which depend on its value.

Department of Homeland Security (DHS)—The vision of homeland security is to ensure a United States homeland that is safe, secure, and resilient against terrorism and other hazards.

Distributed Antenna System (DAS)—Network of separated antenna nodes connected to a common source through a medium that provides wireless service within an area or structure.

Enterprise Service Bus (ESB)—Software architecture model used for designing and deploying communication between software applications in a service-oriented architecture (SOA).

Face Recognition—Automatic identification or verification of a person from a digital image or video frame of their face. Can be used against an existing database.

Fast Travel Program—Six areas of self-service options throughout a passenger's airport journey. Created by IATA and used as a standard for airports worldwide.

Fiber Optic Cable—Cable that has a much greater bandwidth than metal cables and therefore can carry more data.

Fingerprinting—Method that automatically matches two fingerprints, one of the many forms of biometrics used to verify identity of an individual.

Frequent Flyer Program—Loyalty program offered by many airlines.

Global Distribution System (GDS)—Network operated by an airport that enables automated transactions between third parties and booking agents to serve passengers.

Global Positioning System (GPS)—Satellite navigation system based in space that provides time and location information anywhere on earth, no matter the weather condition, where there is a clear line of sight between four or more GPS satellites.

Global System for Mobile Communications (GSM)—Standard to describe protocols for second generation (2G) digital cellular networks used by mobile phones developed by the European Telecommunications Standards Institute (ETSI).

Heat Map—Graphical representation of data where the individual values contained in a matrix are represented as colors.

Indoor Navigation/Proximity Technology (INPT)—A network of devices, magnetics, or other sensory data that can be utilized to locate people and objects in a building wirelessly.

Intermodal Facility—Combination of more than one mode of transportation and results in the interchange of equipment.

International Air Transport Association (IATA)—The global trade association for the airline industry.

Iris Scanning—Biometric that scans the eye of an individual and compares it using pattern-recognition to verify identity.

Key Performance Indicator (KPI)—Measure of performance that assesses the success of a particular activity in which a company engages or the company itself.

Local Area Network (LAN)—A computer network that interconnects computers within a limited area such as an airport.

Mobile Passport Control (MPC)—U.S. Customs and Border Protection (CBP) smartphone or tablet application that expedites the entry process for U.S. citizens and Canadian visitors.

Natural Language Processing (NLP)—A field of computer science, artificial intelligence, and linguistics concerned with the interactions between computers and human languages.

Near-Field Communication (NFC)—Form of short-range wireless communication where the antenna used is much smaller than the wavelength of the carrier signal.

Network Architecture—Layout of the network, consisting of the hardware, software, connectivity, communication protocols, and mode of transmission (such as wired or wireless).

Network Security—A specialized field in computer networking that involves securing a computer network infrastructure.

Passenger Experience Management Group (PEMG)—Created by IATA, addresses the end-to-end passenger journey from ticket purchase through to arrival at destination.

Passenger Name Record (PNR)—Record in the database of a computer reservation system (CRS) that contains the itinerary for a passenger, including when a group of passengers travel together.

Passenger Self-Service (PSS)—Passengers performing functions for themselves with no airport or employee intervention.

Passenger Self-Tag Bag Drop—Enabling the passenger to perform the steps of identifying and reconciling the baggage tag and boarding pass.

Passive Optical Network (PON)—Telecommunications network that uses point-to-multipoint fiber to the premises in which unpowered optical splitters enable one optical fiber to serve the premises.

Payment Card Industry (PCI)—Debit, credit, prepaid, e-purse, ATM, and point-of-sale cards and associated businesses.

Performance Measurement—Process of collecting, analyzing and/or reporting information regarding the performance of an organization or system.

Project Governance—Management framework within which project decisions are made.

Qualitative Analysis—Aim to gather an in-depth understanding of human behavior and the reasons that govern such behavior. Method which investigates the why and how of decision making, not just what, where, when.

Queue Time—Amount of time a person stands in line before being attended to.

Radio-frequency Identification (**RFID**)—The wireless use of electromagnetic fields to transfer data, for the purposes of automatically identifying and tracking tags attached to objects.

Regulation—A legal norm intended to shape conduct that is a byproduct of imperfection.

Retina Scanning—Biometric technique that identifies the unique patterns on retina blood vessels.

RFID Tag—Contains electronically stored information. Used for tracking people and objects and transferring data.

Security Screening Checkpoint (**SSCP**)**—**Area through which travelers must pass through the security process.

Self-Service Check-In Kiosks—A shared kiosk offering airport check-in to passengers without the need for ground staff.

Service-Oriented Architecture (**SOA**)**—**Pattern based on distinct pieces of software providing functionality as services to other applications using a protocol.

Signage—Signs collectively, especially commercial or public display signs.

Simplifying the Business (**STB**)**—**Industry initiative developed by IATA that aims to transform the entire journey experience through the implementation of innovative solutions.

Skytrax—A United Kingdom-based consultancy which runs an airline and airport review and ranking site.

Skytrax Airport Quality Service Audit (**AQSA**)**—**Applies methods and systems for improving and maintaining customer service standards.

Smartglasses—A wearable computer that can display information or transpose digital augments onto the user's environment.

Smartwatch—Wristwatch that is computerized and equipped to do more than keep time (e.g., answer phone calls).

Stakeholder—An entity that can be affected by the results of that in which they have an investment.

Steering Committee—Decides on the priorities or order of business of an organization and manages the general course of its operations.

Synthetic Intelligence—Passenger counting method that uses an array of infrared beams to count, even with varying direction.

Thermal Imaging System—Passenger counting method effective for large, crowded areas that uses heat detection and thermal imaging.

Tokenization—The process of substituting a sensitive data element with a non-sensitive equivalent, referred to as a token that has no exploitable value.

TransferJet—A new type of close proximity wireless transfer technology developed by Sony.

Transportation Security Administration (**TSA**)**—**Created to strengthen the security of the United States' transportation systems and ensure the freedom of movement for people and commerce.

U.S. Customs and Border Patrol (**CBP**)**—**Takes a comprehensive approach to border management and control.

Use Case—A list of steps, typically defining interactions between a user and a system, to achieve a goal.

Vein Analysis—Biometric technique that analyzes the patterns of blood vessels visible from the surface of the skin.

Video Analytics—Cameras are used with algorithms to calculate the number of people in a queue area with a high degree of accuracy. This system works even with crowds and when people are moving in two directions.

Voice Analysis—Study of speech sounds for purposes like speech recognition.

Voice Translation—Process through which a string of words is spoken in one language, translated into another, and spoken aloud by a computer in the second language.

Wayfinding—All of the ways in which people and animals orient themselves and navigate.

Wearable Technology—Clothing and accessories incorporating computer and advanced electronic technologies.

Wide Area Network—is created when linking networks at two or more sites extending beyond a single metropolitan area.

Wi-Fi—A wireless local area technology (WLAN) that allows an electronic device to exchange data or connect to the Internet using 2.4 GHz UHF and 5 GHz SHF radio waves.

APPENDIX B

Annotated Resource Guide

Aviation Industry Resources

Airport Cooperative Research Program (ACRP), Transportation Research Board (TRB)

TRB promotes innovation and progress in transportation through research. The ACRP is an industry-driven, applied research program that develops near-term, practical solutions to problems faced by airport operators. ACRP is managed by TRB of the National Academies and sponsored by the FAA. The research is conducted by contractors who are selected on the basis of competitive proposals.

International Air Transport Association (IATA)

IATA (www.iata.org) is a trade association of the world's airlines. IATA supports airline activity and helps formulate industry policy and standards. This association is responsible for the Common Use Self-Service (CUSS) Standard as well as the Fast Travel Program, both of which push airports to improve their efficiency and passenger satisfaction through implementation in six areas of passenger self-service.

- Passenger Facilitation Working Group (PFWG). The PFWG brings together airlines, airports, and governments to see how processes can be linked across stakeholder environments, with a focus on the crucial areas of security, border protection, immigration, and customs to provide an "end-to-end passenger experience that is secure, seamless, and efficient."
- Passenger Experience Management Group (PEMG). IATA's PEMG addresses the end-to-end passenger journey from ticket purchase through arrival at destination. It comprises a range of projects to improve the travel experience and help reduce unnecessary operational costs to the industry. One of the primary delivery channels is self-service options for passengers where it makes sense. In process areas controlled by government authorities, such as security, immigration, and customs, the PEMG will improve facilitation by harmonizing passenger data requirements and enhancing passenger preparedness to reduce queues and process times.
- Common Use Working Group (CUWG). IATA develops and maintains common use standards including recommended practices through the work of the CUWG, which is part of the IATA's PEMG. The standards cover the following three specific areas: CUSS, Common Use Passenger Processing Systems (CUPPS), and standardized data exchange through the use of web service technology.

Airports Council International (ACI)

The ACI (www.aci.aero, www.Airportservicequality.com) promotes excellence in airport management and operations and advances the interests of the airports and communities they serve. They developed the Airport Service Quality (ASQ) benchmarking system to improve airport standards and the quality of service to passengers, and it is currently in use by 280 airports worldwide.

- ACI–North America Business Information Technology (ACI–NA BIT). The Business Information Technologies Committee is the forum where members with airport-related IT responsibilities can network, communicate, share data, conduct research, and keep up-to-date with the latest technological developments. The committee examines new and emerging technologies for their applicability to airport systems and reviews how existing systems can be improved to better serve the airport system and passenger needs.
- Airport Community Recommended Information Services (ACRIS). An ACI-NA BIT project currently underway that will provide a service-oriented architecture allowing airports, airlines, and service providers to better communicate. In laymen's terms, it will help airports and airlines in real time, pass important flight operations data including block times, etc.

Airlines for America (A4A)

A4A (www.Airlines.org) advocates on behalf of the American airline industry as a model of safety, customer service, and environmental responsibility and as the indispensable network that drives our nation's economy and global competitiveness. The association works with the FAA to promote new policies beneficial to the economy and the environment and consistently monitors future technologies that may improve the passenger experience in American airports.

Federal Aviation Administration (FAA)

The FAA (www.faa.gov/Airports) is the national aviation authority of the United States. An agency of the United States Department of Transportation, it has the authority to regulate and oversee all aspects of American civil aviation. The FAA sets various construction, engineering, and design standards for American airports.

International Civil Aviation Organization (ICAO)

The ICAO (www.icao.int) is a specialized agency of the United Nations. It codifies the principles and techniques of international air navigation and fosters the planning and development of international air transport to ensure safe and orderly growth. The ICAO Council adopts standards and recommended practices concerning air navigation, its infrastructure, flight inspection, prevention of unlawful interference, and facilitation of border-crossing procedures for international civil aviation.

The Airport Association for Benchmarking (TAAB)

The Benchmarking Network, Inc., is an organization of experienced benchmarking specialists dedicated to using benchmarking to develop value-based performance improvement opportunities for corporations worldwide. These benchmarking specialists utilize proven processes and systems to streamline their efforts to achieve high impact results on a timely basis. They utilize their network of over 140,000 domestic and international contacts to provide the basis for successful global benchmarking solutions (www.taab.org).

Airport Operators Association (AOA)

The AOA (www.aoa.org.uk) is the national voice of UK airports. They are a trade association representing the interests of UK airports and the principal such body engaging with the UK government and regulatory authorities on airport matters. Working on behalf of these members, the AOA's mission is to influence governments, regulators, and opinion formers at the national and international levels in order to secure the policy outcomes that will deliver its vision.

Transportation Security Administration (TSA)

The TSA (www.tsa.gov/stakeholders) was created to strengthen the security of the United States' transportation systems and ensure the freedom of movement for people and commerce. TSA uses a risk-based strategy and works closely with transportation, law enforcement, and intelligence communities to set the standard for excellence in transportation security. The DHS of the United States provides security grants to mass transit and passenger rail systems.

Web Resources

Airport Technology

Airport Technology (www.Airport-technology.com) follows the latest trends and innovations in airports and the vendors that produce technology that can improve passenger experiences. A team of journalists objectively covers rules, regulations, construction projects, and groundbreaking deployment of new solutions to help airports make the right decision about what choices to make. Some of the tools and resources available include

- Free white papers
- Press releases
- Lists of current vendors by technology type
- Comprehensive coverage of industry innovation

Future Travel Experience

Future Travel Experience (www.futuretravelexperience.com) was first developed as response to interest in Common Use Check-In kiosks in airports, but as technology progressed, Future Travel Experience expanded to cover the entire passenger experience throughout the airport and the ways in which technology is developing to help improve air travel. Some of the tools and resources available include

- Information on three annual conventions (global, Asia, and Europe)
- Daily updates on new technologies implemented in airports
- Insight into airline deployment of technologies
- An objective view of ways to improve the passenger experience

EyeforTravel

EyeforTravel (www.eyefortravel.com) is a community where the world's top online travel brands—hotels, airlines, online travel agents, cruise and car-hire firms, and more—come to meet to drive forward growth and innovation in the industry. Eyefortravel publishes many free articles that follow airline and airport trends in adoption and deployment of new technologies and best practices that can improve the passenger airport journey. Some of the tools and resources available include

- Industry analysis and insights
- Webinars and research
- Conferences

airlinetrends

As an independent industry and consumer trends research agency, airlinetrends (www.Airlinetrends.com) is continuously monitoring the global aviation industry for commercial innovations launched by airlines in response to industry trends and changing consumer behavior. The latest breakthroughs and trends in commercial aviation are consistently covered. Some of the tools and resources available include

- Industry analysis
- Well-researched articles on innovation
- Airline-specific articles
- Area-specific articles (e.g., passenger experience, mobility, connected passengers, and consumer behavior)

Techopedia

Techopedia (www.techopedia.com) is a family venture providing insight and inspiration to IT professionals, technology decision-makers, and anyone else who is proud to be called a "geek." Techophedia's goal is to help users better understand technology and make better decisions as a result. Some of the tools and resources available include

- Comprehensive dictionary of technical jargon
- In-depth tutorials
- Examination of leading trends in articles

Wikipedia

Wikipedia (www.wikipedia.org) is written collaboratively, largely by anonymous Internet volunteers. Anyone with Internet access can write and make changes to Wikipedia articles, except in limited cases, where editing is restricted to prevent disruption or vandalism. Users can contribute anonymously, under a pseudonym, or, if they choose to, with their real identity. Some of the tools and resources available include

- Research into past and present airport technologies
- Information about passenger self-service
- Detailed technical information about technologies
- Virtually every airport and airline globally and their objectives
- Information on passenger statistics

Webopedia

Webopedia (www.webopedia.com) is an online technology dictionary for IT professionals and educators, providing definitions of words, phrases, and abbreviations related to computing and information technology. The goal is to provide easy-to-understand definitions and avoiding the use of heavy jargon, when possible, so that the site is accessible to users with a wide range of computer knowledge. Definitions are verified among multiple sources; definitions are never based on just one source. Some of the tools and resources available include

- Lexicon of specific terms
- Articles on how emerging technologies are used
- Studies and links to explore further

Other Resources

Bluetooth Special Interests Group (SIG)

The Bluetooth SIG (www.bluetooth.org) is the body that oversees the development of Bluetooth standards and the licensing of Bluetooth technologies and trademarks to manufacturers.

The Payment Card Industry Security Standards Council (PCI SSC)

The PCI SSC (www.pcisecuritystandards.org) is an open global forum for the ongoing development, enhancement, storage, dissemination, and implementation of security standards for account data protection. Its mission is to enhance payment account data security by driving education and awareness of PCI security standards.

APPENDIX C

Acronyms and Initialisms

A4A	Airlines for America
ACI–NA BIT	Airports Council International–North America Business Information Technology
ACRIS	Airport Community Recommended Information Services
AMR	Adaptive Multirate
AOA	Airport Operators Association
APC	Automated Passport Control
AR	Augmented Reality
AQSA	Airport Quality Service Audit (Skytrax)
ASQ	Airport Service Quality
ASR	Automatic Speech Recognition
BHS	Baggage Handling System
BI	Business Intelligence
BLE	Bluetooth Low Energy
CA	Context Awareness
CAP	Club Airport Premier
CBP	U.S. Customs and Border Patrol
CCTV	Closed-Circuit television
CMA	Context-Aware Mobile Applications
CRS	Computerized Reservation System
CUPPS	Common Use Passenger Processing Systems
CUSS	Common Use Self-Service
CUWG	Common Use Working Group
DAS	Distributed Antenna System
EAN	International Article Number
EDGE	Enhanced Data Rates for GSM Evolution
EFR	Enhanced Full Rate
ESB	Enterprise Service Bus
FR	Full Rate
GDS	Global Distribution System
GPRS	General Packet Radio Services
GPS	Global Positioning System
GSA	U.S. General Services Administration
GSM	Global System for Mobile Communications
GTAA	Greater Toronto Airports Authority
GTIN	Global Trade Item Number
HMM	Hidden Markov Model
HR	Half Rate
HRS	Human Recognition Systems

HUD	Heads-Up Display
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
ICT	Information and Communications Technologies
IFE	In-Flight Entertainment
INPT	Indoor Navigation/Proximity Technology
IPSSP	Integrated Passenger Self-Service Program
ISM	Industrial, Scientific, and Medical
IT	Information Technology
KPI	Key Performance Indicator
LAN	Local Area Network
LED	Light-Emitting Diode
LTE	Long-Term Evolution
MPC	Mobile Passport Control
MT	Machine Translation
NAA	Narita Airport Authority
NFC	Near-Field Communication
NIR	Near Infrared
O&D	Origin and Destination
PCI	Payment Card Industry
PEMG	Passenger Experience Management Group
PFWG	Passenger Facilitation Working Group
PNR	Passenger Name Record
PON	Passive Optical Network
PSS	Passenger Self-Service
QR	Quick Response
RFID	Radio-Frequency Identification
RP	Recommended Practice
SHF	Super High Frequency
SIG	Special Interest Group (Bluetooth)
SME	Subject Matter Expert
SMS	Short Message Service
SOA	Service-Oriented Architecture
SR	Speech Recognition
SSC	Security Standards Council
SSCP	Security Screening Checkpoint
STB	Simplifying the Business
STT	Speech-to-Text
TAAB	The Airport Association for Benchmarking
UHF	Ultra High Frequency
UPC	Universal Product Code
WAP	Wireless Access Point
WEP	Wired Equivalent Privacy
WLAN	Wireless Local Area Network

Abbreviations and acronyms used without definitions in TRB publications:

A4A	Airlines for America
AAAE	American Association of Airport Executives
AASHO	American Association of State Highway Officials
AASHTO	American Association of State Highway and Transportation Officials
ACI–NA	Airports Council International–North America
ACRP	Airport Cooperative Research Program
ADA	Americans with Disabilities Act
APTA	American Public Transportation Association
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
ATA	American Trucking Associations
CTAA	Community Transportation Association of America
CTBSSP	Commercial Truck and Bus Safety Synthesis Program
DHS	Department of Homeland Security
DOE	Department of Energy
EPA	Environmental Protection Agency
FAA	Federal Aviation Administration
FHWA	Federal Highway Administration
FMCSA	Federal Motor Carrier Safety Administration
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
HMCRP	Hazardous Materials Cooperative Research Program
IEEE	Institute of Electrical and Electronics Engineers
ISTEA	Intermodal Surface Transportation Efficiency Act of 1991
ITE	Institute of Transportation Engineers
MAP-21	Moving Ahead for Progress in the 21st Century Act (2012)
NASA	National Aeronautics and Space Administration
NASAO	National Association of State Aviation Officials
NCFRP	National Cooperative Freight Research Program
NCHRP	National Cooperative Highway Research Program
NHTSA	National Highway Traffic Safety Administration
NTSB	National Transportation Safety Board
PHMSA	Pipeline and Hazardous Materials Safety Administration
RITA	Research and Innovative Technology Administration
SAE	Society of Automotive Engineers
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (2005)
TCRP	Transit Cooperative Research Program
TEA-21	Transportation Equity Act for the 21st Century (1998)
TRB	Transportation Research Board
TSA	Transportation Security Administration
U.S.DOT	United States Department of Transportation

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