The Future Passenger Experience: A Shift from Physical to Virtual Design

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Abstract

The importance of passenger experience in aviation has become well understood in the last several years. It is now generally accepted that the provision of good passenger experience is not an option, but a necessity, from an aviation profitability perspective.

In this paper, we paint a picture of the future passenger experience by consolidating a number of industry and research perspectives. Using the future passenger experience as a starting point, we explore the components needed to enable this future vision. From this bottom-up approach, we identify the need to resolve data formatting and data ownership issues. The resolution of these data integration issues is necessary to enable the seamless future travel experience that is envisioned by the aviation industry.

By looking at the passenger experience from this bottom-up, data centric perspective, we identify a potential shift in the way that future passenger terminals will be designed. Whereas currently the design of terminals is largely an architectural practice, in the near future, the design of the terminal building may become more of a virtual technology practice. This of course will pose a new set of challenges to designers of airport terminal environments.

Keywords

Passenger Experience, Future, Vision, Travel, Design, Data, Airport

The “Airport Terminal of the Future” has been an important topic of discussion at aviation industry conferences in the last few years. In fact, the exploration of the future terminal and associated passenger experience are considered so paramount, that entire conferences have emerged dedicated to this topic alone. As an example, Future Travel Experience now hosts three conferences each year, namely FTE Global, FTE Asia and FTE Europe (Future Travel Experience, 2013a, 2013b, 2013c).

In the last year, there has been a convergence of ideas regarding what the future passenger experience will be like. The commonality across various stakeholder viewpoints can be attributed to several key trends, including: (a) the maturation and accessibility of technologies, (b) a shared need to reduce the cost and time associated with processing passengers through terminal buildings, and (c) a growth in the number of passengers travelling by air each year (IATA Corporate Communications, 2011).

In the first instance, technologies such as mobile devices, social media and the proliferation of wireless networks make the vision of a technology-centric airport technically feasible. Equally importantly however, the use of these technologies by the general public has reached a tipping point – a recent study by Lookout (2012) found that 58% of respondents check their mobile phone at least once an hour. It is now believed that the use of these devices has shifted from being conscious, to being habitual in nature (Carr, 2010). To an airport, this signals a customer base that is ready to embrace a more technology centric airport terminal experience (Grossman, 2006; IATA Corporate Communications, 2011; SITA, 2013).

The inevitable move to making the future passenger experience more technology focussed is partially driven by this increased adoption of technology in many aspects of our lives. Another key reason, however, driving the industry towards making the passenger experience increasingly automated is the global need to reduce passenger processing costs and increase processing speeds. The reduction of costs and processing speeds are vital in accommodating the projected growth on passenger traffic worldwide (IATA, 2012). As stated by Jager in his opening address at Passenger Terminal Conference in Vienna last year "…the creation of increasingly larger terminals is … economically, financially, operationally and environmentally unsustainable…" (Jager & Ofner, 2012). Creating a more technology focussed passenger experience is seen as a way to answer this industry dilemma.

In the remainder of this paper, we present an example of what the future passenger experience might look like. The example represents a consolidation of industry perspectives and research in the field. We then go on to de-construct the example into a set of components needed to make the vision of future travel a reality. We discuss the emerging challenges, and outline a potential approach to addressing them. Finally, we examine the impact that the vision of the future passenger experience will have on the design of future airport terminal environments.

Future Passenger Experience

It is generally accepted that the future passenger experience will be centred around interactions between passengers and various modes of technology (IATA Corporate Communications, 2011; Port Authority of New York and New Jersey, 2012; SITA, 2013). This scenario is inevitable due to the convergence of three critical factors, namely (1) the industry's need to reduce costs (IATA, 2013c), (2) a passenger preference for technology based solutions (SITA, 2013) and (3) the need to make passenger processing more efficient to accommodate projected global passenger traffic (IATA, 2012).

Although technology will unquestionably feature highly in the passenger experience of the future, the shape of what this future experience will look like remains largely unarticulated. In this section, we present an example of what the passenger experience might look like. The example, although fictitious, is based on a number of information sources, including:

1. The results of an industry workshop held in New York in 2012 (Port Authority of New York and New Jersey, 2012). Ninety-five invited industry participants brainstormed ideas for what the future travel experience would look like for each component of the trip: curbside, departure lobby, security checkpoint, concourse and gates. The group found that "…the largest leap will be in achieving an intuitive and seamless free flowing experience the customer can control, engage and enjoy in a manner and timeframe they control from the time they leave home to the time they arrive to their final destination".

2. The results of SITA's 2012 passenger survey and 2013 position paper "Flying into the Future" (SITA, 2012, 2013). In general, the reports present a very strong desire by passengers for a more seamless, personalised, technology intensive experience, not only in the terminal, but as part of the extended travel experience (researching and purchasing travel, notification of flight delays, personalisation of in-terminal retail, etc).

3. An analysis of the major programs currently underway at IATA (IATA, 2013a). These programs include the Checkpoint of the Future, Fast Travel, Passenger

Facilitation and One Stop Security initiatives (Copart, 2012; IATA, 2013b; IATA Press Release, 2011).

Consolidated Example: International Departures

In this section, we present an example of what the international departures segment of the future passenger experience may look like. The example is constructed from an analysis of the data sources described in the previous section. The example, illustrated in Figure 1, shows the experience of a fictitious passenger, “Anna” in her journey from the workplace to the boarding gate.

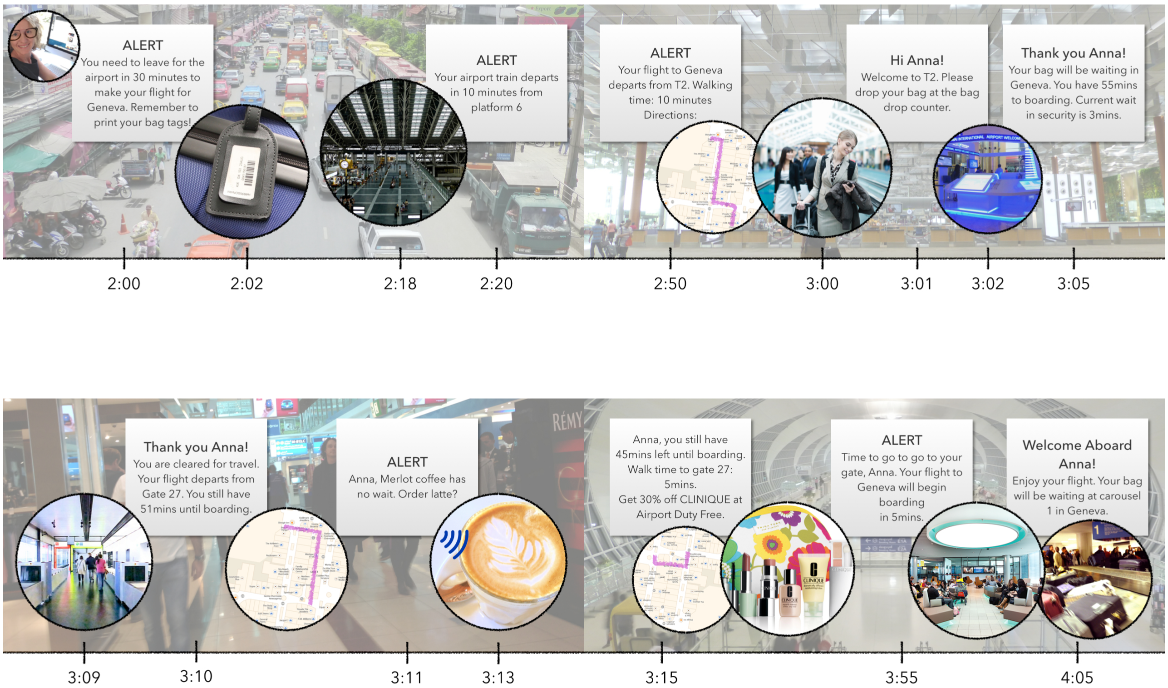

Figure 1: The future travel experience: International departures example

The example begins with passenger “Anna” receiving an alert while at work. The alert (2:00pm) informs Anna that she will need to leave work for the airport in 30 minutes, and reminds her to print her baggage tags. Clicking on the link, Anna prints her baggage tags and attaches them to her suitcase (2:02pm). Anna proceeds to the train station with her baggage (2:18pm). Shortly after arriving at the train station, Anna receives an alert telling her the platform and departure time of the next airport train (2:20pm).

Half an hour later, Anna alights from the train and is greeted by an alert informing her of the terminal her flight departs from and the walking time needed to get there. A map showing the fastest walking route is also provided (2:50pm). Upon entering the airport terminal building, an alert recognises Anna, welcomes her to the terminal and reminds her to drop her bags at the appropriate bag drop counter (3:00pm). After dropping off her bags (3:02pm), an alert informs Anna of the time she has left until boarding, directs her to the next step in the process, namely security, and informs her of the current wait in that processing zone (3:05pm).

Anna chooses to proceed straight through to the security zone, where she is identified and cleared for travel (3:09pm). Anna walks straight through the “green” pre-cleared security lane (3:10pm) and is greeted by a welcome alert informing her which of her favourite coffee vendors has the shortest wait (3:11pm). Anna clicks to order her coffee, proceeds to pick it up and pay for it using NFC technology embedded in her mobile phone (3:13pm).

After finishing her coffee, Anna is reminded that she still has ample time before boarding. Based on Anna's passenger profile, an appropriate retail lure appears, enticing Anna to spend some of her time and money in the airport retail outlets (3:15pm). At the appropriate time, Anna is reminded to head towards the boarding gate (3:55pm). After a short wait, Anna boards the plane. An alert greets her, and informs her which carousel her bag will be waiting at when she reaches her final destination (4:05pm).

Hurdles and Obstacles

The example presented in the previous section represents a significant departure from the current check-in, security/customs and boarding international departures sequence in use by most airports world-wide (Popovic, Kraal, & Kirk, 2009). Surprisingly however, the major obstacles to implementing this futuristic, seamless passenger journey through the terminal building are not the absence of underlying technologies. For the most part, the technology needed to enable each component in the above example has already been developed or is approaching readiness: secure Wi-Fi communications, mobile technologies, NFC technology, self-service bag-drop, check-in and boarding gates, one-stop security, the checkpoint of the future (Alliance, 2003; Harrison, 2012; IATA, 2013b; IATA Press Release, 2011; Madlmayr, Langer, Kantner, & Scharinger, 2008).

One of the key obstacles that prevents the above example from being realisable is the issue of data integration (Maurizio, 2002). In order to make the vision of future travel possible it is essential to resolve the issue of data integration and interoperability. This is critical, as the data required to enable each of the components shown in Figure 1 will necessarily come from multiple underlying sources, as illustrated in Figure 2. These data sources include airline reservation systems, airport mapping systems, passenger processing systems, flight information, government watch lists, passenger identification data, as well the numerous sources of "personalisation" information that can be sourced from "big data".

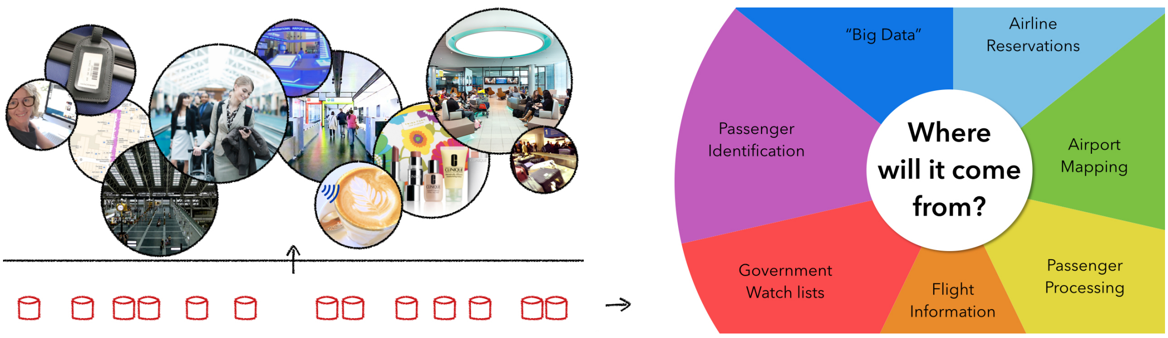

Figure 2: The vision of future travel is necessarily reliant upon the integration of data from multiple data sources, each one independently owned and operated

Integration of Data Sources

To illustrate the data integration issue, consider the following extract from the future travel example, as shown in Figure 3.

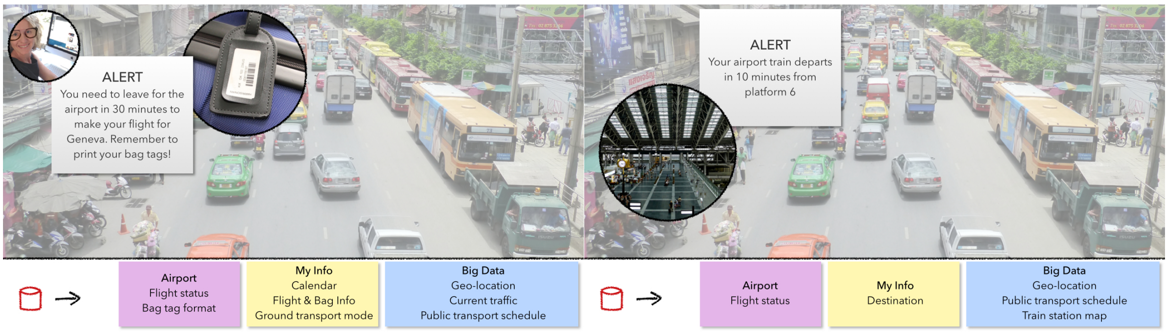

Figure 3: An extract from the future travel example, showing the various data sources that need to be integrated in order to create the two sample passenger alerts shown

In order for passenger Anna to receive the first alert reminding her of her upcoming flight, information will need to be assembled from, at least, the following data sources:

1. Airport databases: flight information (is the current flight scheduled to depart on time?), bag tag format.

2. Anna's information: calendar entry noting the flight details, existence of bags to be checked-in, preferred mode of travel to the airport.

3. "Big Data": Anna's current location, the travel time to the airport via the selected mode of transport, any issues in the selected mode of transport (such as train strikes, traffic jams, road closures, etc), a schedule of services for the selected mode of transport.

The second alert in the extracted example shown in Figure 3 will similarly require the assembly of information from various data sources, including:

1. Airport: a check of the flight status to ensure there have not been any changes.

2. Anna's info: the destination and desired time of arrival.

3. "Big Data": Anna's current location, schedule of services for the selected mode of transport, a map of the (train) station.

As is evident from this small extract of the future travel example, in order for each of the alerts and notifications to arrive "seamlessly" to the passenger's mobile device, data has to be integrated from a variety of different sources.

Formatting and Ownership

The data integration problem has been studied extensively in the fields of computer science and database design (Maurizio, 2002). Conceptually, the data integration problem can be broken down into two components, namely data formatting and data ownership.

To a large extent, the data formatting issues have been resolved. These solutions have progressed through various stages of development, and increasing complexity (Figure 4). The very early data integration problems revolved around reconciling physical differences in the storage format of data, for example, a person's name may be stored as a series of *characters* in a text file and a *string* in a database. In order for the text file to be imported into the database, the series of characters would need to be physically converted into a string data format.

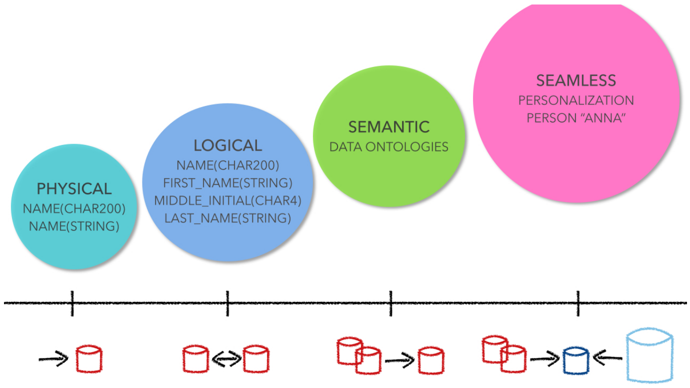

Figure 4: A historical perspective of the developments in data integration

The next development in data formatting was to reconcile logical differences between data stored in various databases. In the example in Figure 4, one database could store a person's name as a *name* field, while another database may store it as three separate fields, namely *first name*, *middle initial* and *last name*. In order for information about a person to be retrieved from the two data sources, the fields name and first, middle, last name would have to be logically mapped as being equivalent.

The next significant development in data integration occurred with the development of semantic ontologies and data dictionaries. This phase extended on the simple logical mappings defined in the previous phase by constructing taxonomies of concepts. In certain cases, these taxonomies have been developed to map out very complicated concepts – as in the example of the Snomed CT ontologies developed for the healthcare industry (Tun, Bird, & Goodchild, 2002). The development of semantic ontologies has allowed data to be shared globally between various stakeholders.

In contrast to the data formatting issues, the data ownership issues remain an open area of research. As shown in Figure 4, the next phase in data interoperability revolves around the integration of data sources needed to provide a "seamless" customer experience. The challenges in creating seamlessness, however, lie more in finding solutions to data sharing than data formatting.

In aviation, the data formatting issues have been addressed to a limited extent. There are numerous initiatives aimed at constructing industry standards or data communication formats. As an example, IATA has been developing a set of data formats under its Passenger Airport Data Interchange Standards (PADIS) initiative (IATA, 2011). The PADIS standards aim to define common industry data structures for passengers, flight information and boarding passes. Although these data standards need to be expanded into a comprehensive aviation data ontology, the key issue that IATA is facing, however, is not in the definition of common data formats, but rather in reaching an agreement between stakeholders about how data is to be shared once the standards are developed (IATA Fast Travel Working Group, 2012).

Approaches to Data Sharing

In order to overcome the data sharing problem, it is helpful to consider the reasons for why data sharing is not approached with favour. Traditionally, stakeholders have viewed their data as their competitive advantage (Smith, Grimm, Gannon, & Chen, 1991), and have therefore been reluctant to "share it". This is part of the reason why current attempts at resolving data integration issues in the industry are failing. Although data structures can be agreed on, the common (integrated) data source cannot be populated as the owners of the data do not want to share it. It is therefore necessary to think of alternate ways of approaching this problem.

One possible approach to overcome the issue of sharing data that is perceived as proprietary, or private, is to ask the owner of the data to “validate” the data, rather than to share the underlying data itself. As an example, a passenger already has all of their own details, such as name, flight information, in-flight preferences. A system could validate whether the passenger was a known traveller by matching the passenger’s data against what is stored in the proprietary database. Instead of sharing data, the system could just provide a YES/NO validation against the passenger details. If the information was of a sensitive nature, it could be encoded using one of numerous appropriate technologies, for example using a cryptographic one-way hash (Naor & Yung, 1989).

Example: Using Tokens

Returning to the example of the future passenger experience, let’s consider another extract, as shown in Figure 5. In the extract shown, in order for passenger “Anna” to receive a welcome alert when arriving at the airport terminal, a check needs to be made against the flight records to see whether Anna is an expected traveller for the given terminal. Passenger Anna’s information can encrypted and sent to the airline’s reservation system and the airport’s passenger flight information system. If the records match, a *registered passenger token* can be returned to Anna.

A similar process can be applied to pre-clear the passenger for security – the passenger details can be checked against various known traveller and government watch list databases. If Anna is allowed to travel, she can be issued with a *security clearance token*, giving her access to the pre-cleared security lane. Naturally, if passenger Anna was not issued with a security clearance token, she would need to be processed through security by a staff member (or other fall-back mechanism for handling exception cases).

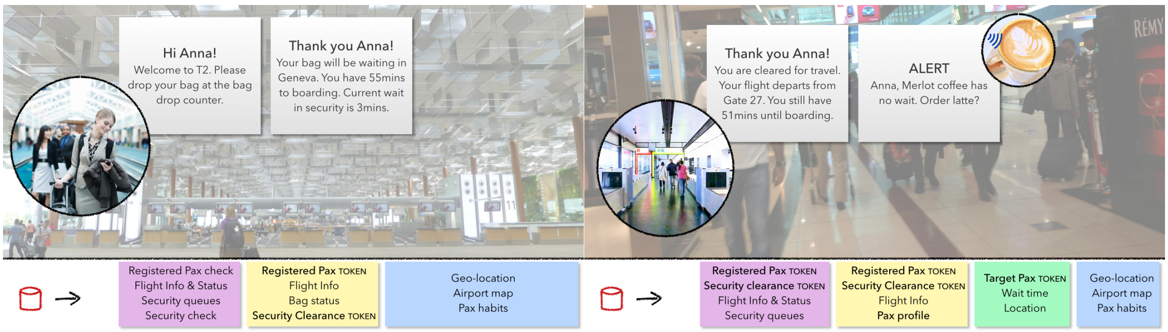

Figure 5: An extract from the future travel example illustrating an approach to data sharing which preserves data ownership and data privacy

Information can be exchanged in the same way between passengers and retailers. In the example in Figure 5, Anna’s preferences for coffee are already known to her, and thus stored as part of her own data, as are her demographics. A particular coffee retailer need not have access to Anna’s personal information – the only thing the coffee retailer is concerned about is that their message gets delivered to passengers who meet their target customer profile. Once again, Anna’s data can be hashed and compared with the retailer’s desired demographics. A token can be issued if there is a match.

It is important to note, that in the above example, the data sharing problem is avoided through the issuing and passing of tokens, rather than actual passenger data values. This element is important as it overcomes both data sharing and potential data privacy issues.

Looking Ahead: Opportunities

The approach to data sharing outlined in the previous section addresses one of the key obstacles that need to be overcome if the vision of the future passenger experience is to become a reality. By developing a comprehensive aviation data ontology, and making it available globally though a distributed virtual infrastructure, data can be integrated and leveraged to support a seamless passenger journey.

In addition to enabling seamless travel, an approach based on global data standards and data validation rather than data sharing would have two significant benefits to the aviation industry. Firstly, it would enable global passenger tracking – i.e. passenger Anna would be "known" to the arriving country's systems, instead of being treated as a new, unknown passenger. This of course would not only improve the passenger experience, but also improve world wide aviation security.

The second benefit would be the opportunity to realise global efficiencies though the use of standard data formats. Rather than each country solving the same problems individually from first principles, solutions could be developed and re-used worldwide. For example, instead of each airport developing their own "app", and each passenger needing a separate app for each airport they travel through, one global airport app could be deployed. This would make the passenger experience more simple (one app instead of many), and deliver savings to airports (one app is developed and maintained globally, rather than by each individual airport).

Design Implications: A Shift from Physical to Virtual

The future passenger experience example presented at the beginning of this paper is entrenched in technology (refer to Figure 1). The example, although fictitious, represents the convergence of thoughts and research outcomes from various industry and academic sources. As is evident, a significant part of this future passenger experience will involve interaction between passenger and some form of technology.

From a design perspective, this completely changes the nature of passenger terminal design from that of being a predominantly architectural practice, to that of being a virtual and technology practice. This of course raises an interesting question, namely, what will be the relative importance, or otherwise, of the passenger terminal building in the future passenger experience?

It will of course not be possible to research the answer to the above question until the passenger experience resembles the future vision more closely. However, based on the results of interviews conducted at an international terminal during 2011-2012 (Harrison, Popovic, & Kraal, 2013), there is suggestive evidence that the terminal building itself is not a significant factor in the passenger's overall experience.

According to the results reported by Harrison et al. (2013), passengers generally did not speak about the airport environment directly when recounting stories of their experience in the terminal building. In cases where the building environment was mentioned, it was always in the context of time perception – for example, a "light and airy" airport was equated with an absence of queues, and thus the prospect of faster processing, rather than an innate appreciation of architectural qualities or features. As stated by one participant, "…the airport is just a port to travel…". The airport is largely not considered as a destination, but an overhead that must be overcome in order to get to a desired destination.

In designing the terminal of the future, therefore, it is likely that problems of architecture will be superseded by problems associated with creating seamless virtual passenger experiences. Of course, the architecture of an airport may still be important in communicating a city's status, or importance, but its actual form may be disconnected from the passenger experience itself. This potential shift in importance from architectural to virtual design would dramatically change the way in which future terminals are designed and built.

Summary

In this paper, we presented an example of what the future passenger experience may look like. The fictitious example was consolidated from various data sources, including industry workshops, surveys into passenger preferences, an examination of key industry initiatives.

By looking at the problem of future travel from the perspective of a grounded example, we were able to highlight some of the key components that need to be addressed before the vision of seamless travel can become a reality. In addition to the development of comprehensive global data standards to address data formatting issues, a system for overcoming data ownership issues will need to be developed. Resolving both formatting and data sharing issues is necessary in order to integrate data from various underlying data sources. This in turn is critical to providing a seamless travel experience.

By looking at the passenger experience from a data centric perspective, we identified a potential shift in the way that future passenger terminals will be designed. Whereas currently the design of terminals is largely an architectural practice, in the near future, the design of the terminal building may become more of a virtual technology practice. This naturally has significant implications for the way in which the design of these environments is approached in the future

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