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Future airport terminals: New technologies promise capacity gains

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ABSTRACT

The changing dynamics of passenger processes in future airport terminals resulting from pressures from both the demand and supply side are analyzed in this paper. Short and long term (beyond 2020) developments are studied following technology advances and business plans of airlines and airports. Key technologies affecting the central passenger processing functions include identity management and biometrics, Near Field Communications, Big Data analytics and smartphone applications. A simulation model is developed and used to assess the impact of forthcoming changes on the airport's departure hall. Lisbon Portela airport is used as case study. It is shown that passenger process times at the check-in and security checkpoints are significantly reduced, due to the introduction of passenger facilitation processes, under a range of behavioral, technological and policy uncertainties. The most salient implication of these reductions is the quantified capacity gains in the building which question the need for terminal expansion.

1. Introduction

Transport planners are called upon to manage the present and plan for future transport systems under prevailing conditions, large-scale complexities and considerable future uncertainties on the demand and supply side. This is especially relevant in the aviation sector where significant technological developments and travelers' behavioral changes force airlines, airports and other stakeholders to continuously adapt their business plans. In this context, serious barriers have to be overcome due to the international dimension of air travel: slow application of worldwide regulations, different development levels and distinct cultural practices. It seems though that nowadays, almost 100 years after the birth of modern aviation, technology is invading more than ever in air transport and is urgently calling for rethinking airport planning. Airports are increasingly announcing plans for creating a radically new environment for conducting business. Novel concepts related to facility management and operations are being introduced, aiming to provide a faster, less stressful, more secure and efficient travel experience.

Airport terminals serve a wide variety of users and functions. They process passenger and baggage check-in, board passengers and baggage to aircraft, transfer passengers between flights, accommodate aircraft movements and provide space for commercial areas that help finance the airport. This multifaceted operation demands them to operate effectively so as to ensure benefits for all the stakeholders involved: passengers, airlines, airport owners and operators of airport services such as the security and border control agencies. However, current practice in many airports worldwide indicates that terminal services fall short in meeting the expectations of stakeholders.

Passengers often find air travel time-consuming, uncomfortable (Greghi et al., 2013), stressful and expensive. Considering the estimated 5.8% annual increase of worldwide traffic and the projected 7.2 billion passengers in 2015 (IATA, 2012a), conditions will only get worse. Changes in the perception and expectations for service offerings resulting from the wide penetration of smartphone applications also require the attention of airlines and airports. 76% of travelers are already carrying a smartphone (SITA, 2013) and this generates opportunities for personalized choices. A growing number of passengers expect travel services that would integrate all the transportation steps from origin to destination, fast and secure experience at check-in, security and immigration checkpoints, continuous information regarding closest services and special offers at restaurants, bars and hotels (Amadeus, 2012). Rapid consumer adoption of smartphones can transform travel habits all the way from trip planning, getting to the airport, shopping and navigating at the airport, in flight and upon arrival at the destination airport.

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Low profit margins remain a characteristic of the airline industry (Tretheway and Markhvida, 2014). This persisting trend, in conjunction with the increase of fuel prices, more passenger taxes and the EU emissions trading scheme, may lead to higher fares. Airlines are, hence, forced to further reduce costs. At the airport environment, as traffic increases, the quality of service is expected to deteriorate due to capacity and expansion limitations (Eurocontrol, 2013). Security check-in often creates passenger discomfort and long waiting lines. Industry costs exceeded $7.3 billion in 2012, while 1% of baggage worldwide was mishandled costing the airlines $2.58 billion (IATA, 2013a). In addition, especially for medium-distance trips, air transport faces increased competition from rail (Adler et al., 2010; Dobruszkes, 2011; Albalate et al., 2014), which attracts significant investments worldwide, fueled by favorable regulation promoting train against other transport modes as it is more environmentally friendly (European Commission, 2001; Ginovi and Banister, 2007; Borken-Kleefeld et al., 2010). Although passenger air traffic growth is estimated to double by 2030 (European Commission, 2014), high speed rail is expected to gain higher market shares in the future (Eurocontrol, 2013). As a combined consequence of the above developments, airlines and airports need to continuously refresh their business model. In particular, pressure will be exercised to airports to confine all non-travel activities and enhance the travel features (Wang et al., 2014), reinforcing self-service options (Linz, 2012), context aware information and personalized services as is currently happening in retail (Moon et al., 2008).

In the context outlined above a number of issues have been studied in the literature including: time-savings (IATA, 2006) and passenger satisfaction gained by self service (Wittmer, 2011), new baggage handling methods (Rijsenbrij and Ottjes, 2008), optimized check-in (Hsu et al., 2012) and security operations (Lee and Jacobson, 2011), efficiency using passenger segmentation (Babu et al., 2006; Nie, 2011; Majeske and Lauer, 2012; Nie et al., 2012) and shared use of facilities (de Neufville and Odoni, 2002; ACRP, 2008).

On the supply side several key enabling technologies are already in various stages of development and hold excellent promise to radically change facilities and operations in passenger buildings so that they can meet future challenges. Biometric systems automatically verify that the traveler and the document owner are the same and thus considerably accelerate passenger end-to-end processing (e.g. e-passports (Schouten and Jacobs, 2009)). Near Field Communications (NFC) allow transfer and storage of data between enabled devices. Transactions such as mobile payments, ticketing, access control and information exchange can be done by NFC-enabled smartphones in a simple movement in full respect of people's data privacy. Big Data analytics can handle massive volumes of data from a wide array of data sources simultaneously and at great speed allowing for context-aware personalized services. Smartphone applications will continuously, and at every location, collect data and provide recommendations and context-aware personalized services.

Theses technologies enable passengers to control all segments of their journey minimizing both the number of interactions with agents and the time consumed by each interaction. Based on this potential, IATA set out the so called Passenger Experience Program aiming to provide passengers a full range of self-service options and an end-to-end journey (IATA, 2014a).

Therefore the objective of this paper is to analyze the profound changes that will materialize in the passenger buildings over the next years as a result of technology innovation, passenger and airline traits, and to assess the consequences for airport operations and facilities. Simulation modeling is used to study the operation of the building under a short term (before 2020) and longer term horizon (beyond 2020). The model covers the passenger activities from their arrival time at the airport until they pass security control and computes total process times and space requirements considering inherent uncertainties. Lisbon Portela airport is used as case study. It is shown that process time savings as well as capacity gains in the building are achieved under a range of behavioral, technological and policy uncertainties. At the expense of only a minor increase in biometric machines, behavioral changes such as shorter arrivals of passengers at the airport before flight departure are accommodated.

The rest of the paper is organized as follows. Section 2 provides an overview of current operations in the terminal as practiced by the majority of airports worldwide. Section 3 describes technological and airport developments over the short and long terms. In Section 4, the effects of these developments on passenger processes are studied. Finally, conclusions are given in Section 5.

2. Travel processes in the current passenger building

The functions served by passenger buildings are physically or logically separated into three main categories: departure, transfer and arrival, each placing different constraints on passenger flows. Some are under the direct control of the airlines while others are conducted by government agencies. The processes studied in this paper are briefly described below.

2.1. Check-in

Traditionally, check-in was handled by airline employees who checked the air ticket, passenger and travel documents and then issued the boarding pass and the baggage tag. Following the introduction of the electronic ticket by United Airlines in 1994, several self-service options nowadays are offered through one of the following channels: dedicated or common-use automated machines at the airport (commonly referred to as kiosk) or online (personal computer, portable or mobile device). The common-use kiosk is a notable example of the recently developed “Common Use Passenger Processing System” (CUPPS). Online check-in was launched in mid 00s and since then it has greatly alleviated passenger queues at the airport check-in desks. Today almost 70% of passengers check-in using a self-service channel (SITA, 2012).

Passengers carrying baggage deliver it to check-in counters where passenger and baggage identification takes place. Self-service options for baggage check-in are also available and are continuously being offered by the majority of airlines. The passengers may scan their passport, store or print baggage tags, apply them on their luggage without any personnel assistance and deliver their bags fast (20–30 s) (Future Travel Experience, 2013) at automated drop-off areas. Passenger and baggage check-in can also be offered at offsite facilities (Goswami et al., 2011). As a consequence of the above developments, large spaces previously dedicated to check-in functions are currently underutilized in many airports.

2.2. Security control

The increasing risks from terrorist threats after 9/11/2001 have led to extensive security screening whose primary focus is the identification of prohibited items. Passengers are screened by metal detectors at a rate of 149 pax/hour/lane (IATA, 2012b). If an alarm occurs, they are further subject to a physical search, or body scanning. Separate X-ray screening is applied to passengers' personal belongings. Items rejected by the x-rays operator are physically searched.

Information sharing between airports and airlines enables risk-based screening which has already been introduced at some