Next-generation airport check-in process development from a market requirement perspective

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ABSTRACT:

Over the past two decades the check-in process went through a number of major changes, driven by the introduction of self-service technology that enabled to separate the various elements of the complete check-in and optimise each of these individual processes. However for airports to develop their check-in product, it is important to have a clear understanding of the market requirements, which is seen as a key driver for airport process development. Both passengers and airlines are increasingly in favour of self-service processes, however this largely depends on a number of factors including personal technological readiness, and the (perceived) ease of use and usefulness.

1. Introduction

The check-in process already exists since the early days of commercial air transport and for several decades limited changes took place in terms of this fairly traditional airport process. Until the introduction of the first self-service alternatives in the 1990's, which started to transform the way passengers check-in for a flight. Self-service technology and automation have significantly changed the process over the last two decades.

Traditionally 'check-in' was seen as a single process, however it is a combination of various smaller processes: the check-in itself (confirming a ticket, assigning a confirmed place on board the flight and providing a boarding pass to the passenger), the process of checking-in hold baggage (which is carried in the aircraft cargo hold) and travel document checks.

By the introduction of automation and self-service alternatives for each of these separate steps, the overall check-in process has become increasingly separated and increasingly efficient. This also means that airports have to adapt to these changes to comply with changing market requirements in terms of airport check-in.

Research Methodology

This research, which is based on both qualitative and quantitative data, focusses on identifying the influence of changing market requirements on the long term development of the check-in process and the resulting implications for airport operators. This research includes developing a clear understanding of the different aspects of the process, the past and current developments and the different elements that are involved in the development of an airport check-in product. This is translated in a concept development framework, which can act as a guideline for airport planners and operators for (check-in) process planning and development. This research paper is partly based on a case study of Brussels Airport.

A literature review is performed to establish a detailed understanding of the check-in process, identifying past, current and expected future developments and identifying customer requirements in relation to the airport check-in product. An important element of the literature review focusses on understanding how passengers experience alternatives for the traditional check-in process. Their willingness to use, and trust in self-service technology and automation is important to consider.

Furthermore the outcomes of qualitative market research (passenger research in focus groups and airline questionnaires) conducted at Brussels Airport is used as input. This helps to understand how both passengers and airlines experience the check-in process and what their current or future requirements are. In addition, industry experts in airport operations and (master) planning development are consulted both within Brussels Airport Company (BAC)

and externally. Also data and statistics of Brussels Airport (BRU) on check-in behaviour, baggage and the arrival profile of passengers (time of arrival at the airport before the planned departure time) is used as input.

2. Check-in Process

The check-in process is well known as one of the main passenger airport processes and usually the first process air travellers go through after booking a ticket (**figure 1**). Already since the earliest days of commercial air transport, a check-in process has been taking place. Especially until the 1950's, when advance payments started to be introduced, it had an important financial role for airlines. Reservations were made in advance with payments only taking place at check-in. This also meant that it was important for airlines to enable sales until the very last minute to make up for potential lost revenue of passengers not showing up (ACRP, 2015). This role has largely disappeared, but the role of check-in as a step of confirmation and separating the passenger and its hold baggage still exists as of today.

The first element of the overall process is the actual check-in. Having a (confirmed) ticket reservation is not sufficient to be allowed on board the aircraft. At check-in, the ticket (which can be for more than one person) is exchanged for a unique boarding pass for each individual passenger, provided through the Departure Control System (DCS) of the respective airline. The DCS is linked to the CRS (Computer Reservation System) of the airline and updates the PNR (Passenger Name Record) of each passenger at various 'touchpoints' in the air traveller journey. Since 2010 all boarding passes worldwide are based on the BCBP (2D Bar Coded Boarding Pass) standard of IATA defined in Resolution 792 (IATA, 2010). The replacement of boarding passes with magnetic strips, which was the previous standard in in some regions used up until 2010, also enabled the development of self-printed and digital boarding passes as a simple printed 2D barcode is sufficient for airport processing.

The second main process that is seen as part of check-in, is separating passengers and hold baggage which follows a separate process of screening, transport and loading into the aircraft via the BHS (baggage handling system). Each piece of hold baggage has to be linked to a specific passenger due to baggage reconciliation regulation, which is also done via the DCS, which subsequently provides a baggage tag that has to be attached for further processing.

In addition, the check-in process can also include an important role in checking travel documents and authorizing passengers to travel and check-in baggage, depending on locally applicable regulation. For example in the United Kingdom 'Triple A'-regulation (Accounting And Authorizing) requires a visual identity match of each passenger before he or she is allowed to check-in baggage for international flights. Also when specific passport requirements apply (such as specific visas) to be allowed entry at the destination, the airline (or ground handler) that executes the check-in process, will check the passports for compliance (and if necessary also insert specific passport information in the DCS). Airlines face heavy fines for transporting passengers that do not have the right travel documents. In addition, about 30 countries worldwide require API (Advance Passenger Information) to be sent to their immigration services in advance of the departure of the flight, allowing an initial 'advance screening' of passengers that will arrive at a certain destination.

Figure 1 shows all air traveller processes as defined by IATA (2015), including the 4 elements of the overall check-in process.

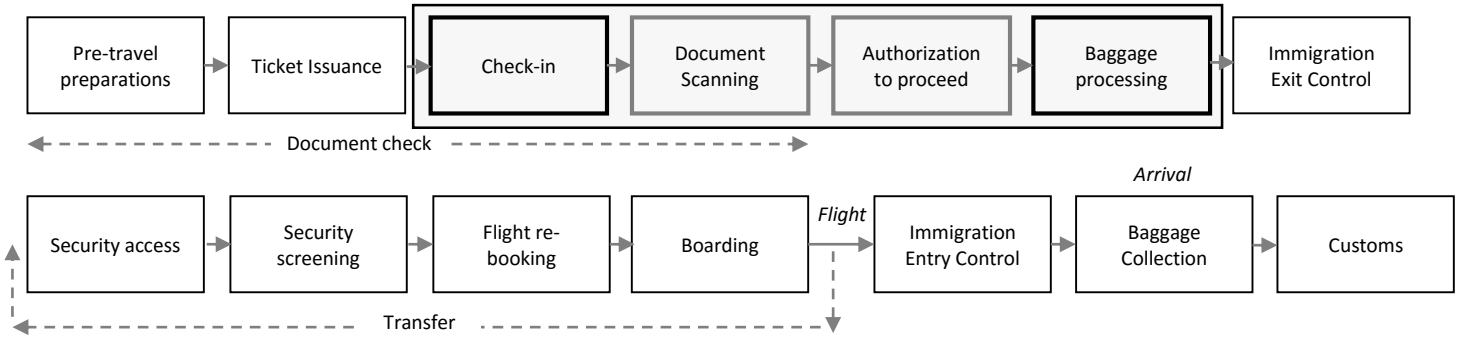

Figure 1: Air passenger travel processes defined by IATA (2015)

Check-in and baggage drop-off methods

The process steps as described above is traditionally performed as one single process at an airport check-in counter. In 1995, Continental Airlines first introduced an alternative in the form of a self-service check-in kiosk (Continental Airlines, 2004). Currently more than 90% of (medium-sized and large) commercial airports worldwide have self-service kiosks (SITA, 2015). These allow travellers to complete check-in and print their boarding pass themselves. In 1999, Alaska Airlines first introduced internet check-in, allowing passengers to check-in themselves via the internet. Since the introduction of barcode boarding passes, passengers can also print these themselves and more recently digital boarding passes on smartphones or smartwatches have been introduced. Airlines such as SAS (2012) and Air France have trialled NFC (Near Field Communication) technology to use smartphones to check-in (by holding the smartphone near a NFC reader) and as a boarding pass throughout the airport. Qantas has introduced frequent flyer cards that can be used to check-in and as a boarding pass on domestic flights in Australia (ICM, 2016). However large scale NFC deployment in air transport processes has not yet materialised.

According to airline surveys of aviation IT provider SITA, about 9% of the passengers in 2015 used a smartphone or tablet to check-in (online process), while 23% used internet check-in via a pc or laptop. By 2018, SITA expects mobile check-in to grow to 24%, while regular internet check-in is expected to slightly decrease to 20% (SITA, 2015b). However, this highly differs per market and per airport. At airports dominated by low-cost carriers (LCC), a majority of passengers use internet or mobile check-in as LCC's charge a fee for a traditional airport check-in process. While at other airports sill close to 100% uses a traditional process. This depends on a number of factors such as the type of airline (some airlines stimulate or force customers to use self-service alternatives (Chang & Yang, 2008; Liljander et al., 2006; Meuter et al., 2003), while others do not offer it at all) and cultural and demographic factors such as age and origin (Castillo-Manzano & Lopez-Valpuesta, 2013).

These innovations have decoupled the process of check-in and baggage drop-off, mainly benefitting passengers that only travel with carry-on luggage. Therefore check-in is currently often referred to as a two- or three-step process: check-in, baggage drop-off and in some cases document checks and authorization to proceed.

It took until the mid-2000's before the first self-service options appeared on the market for baggage drop-off. Amsterdam Airport Schiphol was one of the first worldwide to trial so-called 'automated bag drops' (ABD's) (Schiphol Group, 2008). As of 2016 less than 20% of large and medium-sized commercial airports offer self-service bag drops, however SITA expects this to increase to 75% by 2018 based on global airport surveys (SITA, 2016). It has to be noted that SITA itself is a provider of both soft-and hardware used for self-service check-in and baggage drop-off. It is therefore possible that their surveys are biased towards a selection of airports and airlines that are not necessarily a correct representation of the complete market. It is however used a global industry reference, and therefore also likely to influence airport planners and operators themselves. More independent global research would be required to confirm this.

Two important different types of ABD's can be identified. A popular choice for airports that want to trial the technology and/or are not able or willing make major infrastructural changes, are the plug-in ABD's that can be installed on existing check-in counters. This is also the system used at the case study example of Brussels Airport. Alternatively ABD's can be installed as completely new units, fully replacing counters.

Relevance of check-in process

While the need to be able to drop-off baggage is obvious, the relevance of the check-in itself is less clear. The process involves a number of elements such as confirming a ticket and assigning a seat, delivering a dangerous goods notification and issuing a boarding pass. However most of these roles can be integrated in other processes such as booking and boarding.

In 2012, Air France was the first airline to offer automated check-in, currently being offered by a range of airlines such as Qatar Airways, Iberia, Qantas and JetBlue (Future Travel Experience, 2014). This effectively means that, when the passenger selects this option, the airline automatically checks-in the passenger for its flight and sends the boarding pass via e-mail or sms (being a mobile or pdf boarding pass).

The phenomenon is not well-known yet by passengers and not extensively used by airlines as of 2016. This likely has a number of reasons. It requires extensive IT investments by airlines to enable their systems to perform such process and

especially on a large scale. Furthermore it reduces opportunities for airlines to perform 'upselling' or 'add-on sales' which can range from seat upgrades, special meals, lounge access to hotel bookings and car rentals (often referred to by (mainly LCC) websites during the online check-in procedure). Finally it also makes it more difficult for airlines to control the process of overbooking, which is still done based on historic data of no-shows. It will only become apparent at the gate which passengers effectively show up.

Yet it proves to be an attractive choice for passengers, who benefit the most from an automated check-in process. The IATA Global Passenger Survey indicated that automated check-in is the preferred option of 38% of the passengers globally, compared to 40% preferring online/mobile options. In Europe even 42% indicated to prefer automated check-in, compared to 38% for online and mobile check-in (IATA, 2015b). These are very high numbers, considering that in 2014 only a few percent of all global air travellers already experienced automated check-in themselves. SITA expects that 10% of global passengers will be using automated check-in by 2018 (SITA, 2015b).

With an increasing amount of passengers opting for internet-based or even fully automated check-in processes, the airport process increasingly focusses on the element of baggage drop-off. This changing focus of this process means that airports should rethink the way they facilitate check-in and baggage drop-off at the airport.

3. Planning and development framework

Based on the various aspects of the check-in process and required airport infrastructure, as well as the factors that determine how the process should look like and how it should be facilitated, a concept development and planning framework has been developed (**figure 2**). This framework helps to assess the input at stakeholder level, to the actual process and infrastructural planning, down to the expected output (which as to be crosschecked with the requirements identified at the beginning of the framework).

The model starts with identifying the three main factors that influence the check-in process and product: the market requirements, the airport strategy (itself driven by the need to create shareholder value and the role of internal stakeholders) and the external stakeholder vision and requirements (in particular airlines, ground handlers and regulatory institutions). Combining the input from these three main 'input levels' results in defining the primary design principles and requirements. This can include basic requirements such as the need to facilitate a certain amount of traffic, to the aim to include flexibility or resilience in the process.

Based on these principles and requirements the 'processor' can be developed. This level is mainly influenced by decisions taken on the level of process design and technology. The airport operator has to decide how the process should be designed and what type of technology is the best suited for this type of process. In some cases the

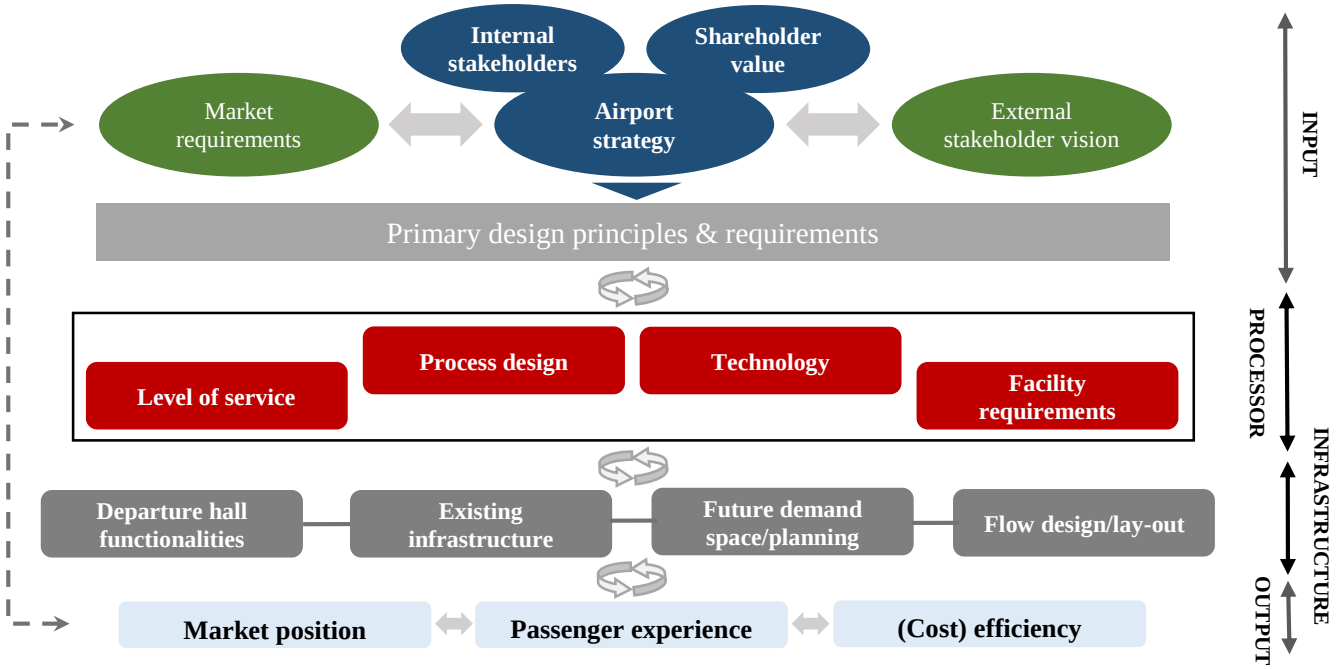

Figure 2: Concept airport process planning and development framework

development of new technology drives a change in the process itself, and therefore both factors are shown on the same level. Add-on criteria are the aimed level of service (in particular in terms of spatial requirements, processing times and maximum waiting times) and the facility requirements which result from the process design, technological decisions and level of service, based on the expected traffic demand.

When the process has been defined, as well as the required amount of units needed to facilitate demand, this can be translated in infrastructural planning. This also requires to include other functionalities that have to be facilitated in/near the check-in area (such as airline ticket counters and food & beverage outlets), potentially the already existing infrastructure, required 'new' infrastructure to facilitate future demand and the flow design and lay-out of the area.

The output is assessed on three levels: market position, passenger experience and (cost) efficiency. Each airport has a different focus and mix of these three factors (a large low-cost airport is likely to aim for high cost efficiency and a leading market position in terms of passenger throughput, while a regional business-oriented airport is likely to aim for a very high passenger experience and efficiency in terms of total throughput time). Each airport has to assess whether the output fulfils the design requirements as defined at the beginning of the model.

This paper further focusses on the market requirements and stakeholder vision in terms of passengers and airlines in relation to the check-in process.

4. Market requirements

For airport operators to (re)develop their check-in operations, it is crucial to understand the needs and requirements of their customers. From an airport perspective, both airlines and passengers are customers. While overall trends can be identified on a global scale, the specific mix of passenger and airline types at a specific airport can influence customer requirements. These findings are based on the outcomes of market research conducted by Brussels Airport Company in cooperation with Airbiz and Why5 Research specifically for Brussels Airport.

Qualitative market research of passengers at Brussels Airport (4 focus groups of 6 participants discussing their experiences and requirements based on a predefined discussion guide) showed that passengers are generally not dissatisfied with the check-in process. It is however also associated with stress, nuisance and insecurities, especially by occasional travellers and when travelling with a lot of baggage and/or small children. These passengers are in need of support and affirmation, highly appreciating human assistance. In case of frequent flyers and premium passengers, there are two distinctive groups. Notably younger generations of frequent flyers and business travellers, as well as those originating from more technology-accustomed regions (such as Northern and Western Europe) highly value efficiency and do not mind doing processes themselves if that proves to be more convenient. Older generations of premium travellers expect a human service. Also when premium travellers have the choice with no queuing at the regular counters, they still opt for a traditional process. This also confirms research findings of Castillo-Manzano and Lopez-Valpuesta (2013).

Self-service processes were generally welcomed by all persons questioned during the market research. Mainly because travellers see the efficiency benefits of it, rather than that they actually prefer to executive processes such as baggage drop-off themselves. Notably occasional travellers clearly express the need to have sufficient staff available for assistance, lacking the trust to do it fully independently. Most passengers also say they would not object a common use product (whereby customers of any airline can use any processing unit), as long as there is the ability to ask airline- or flight-specific questions. Furthermore also remote check-in as well as a door-to-door product is seen as very convenient, being able to get rid of baggage before arriving at the airport terminal. Particularly train stations (busy train stations in Belgium and the Brussels Airport train station) and parking locations (at the airport site) were seen as convenient locations. However as trust proves to be crucial in terms of hold baggage, many respondents expressed their wish to see that the airport is in control of this service and not for example a train operating company.

Furthermore passengers expressed the need of clear wayfinding and sufficient flight information. Dedicated digital information (such as via smartphone) was welcomed, but as an addition to the 'regular' provision of information rather than a replacement, especially as not all passengers are accustomed to such technology.

The look and feel of the departures hall, where check-in is situated, was also raised as an

important element to make an air travel journey more pleasant. The feeling of being cramped in a crowded area, while having to endure long queues and waiting times, is generally not seen as an enjoyable beginning of the journey. This is an important factor as passenger satisfaction has a big impact on commercial (non-aeronautical) spending by passengers. According to ACI World, which bases its analysis on the ACI ASQ surveys (conducted at 300 airports worldwide, with 550,000 participating passengers) and the ACI Airport Economics Survey, a 1% increase in passenger satisfaction results in 1.5% higher non-aeronautical revenue (compared to 0.7 to 1% in case of 1% more traffic, or 0.2% in case of a 1% expansion in commercial space) (Airports Council International, 2016).

From an airline perspective, check-in is still often seen as an important element of the complete ground product. However major differences exist in terms of priorities. Dominant home carriers and global airline alliances (such as Star Alliance) usually want their brand to be clearly identifiable in the check-in area used by them. A fully common use operation enables the highest efficiency, but lacks the ability to really brand a check-in zone except for digital branding on the displays during the process. For other carriers, notably LCC's, the cost efficiency is more important. As paying a fee per passenger using self-service units proved to be more expensive in the past than having a few regular staffed counters (often with a lower level of service, such as longer waiting times), LCC's were relatively slow in adopting self-service technology especially at smaller bases and outstations. However these airlines are usually more willing to use fully common, mixed-use facilities, contributing to lower costs per passenger and making them more attractive for LCC's to use. Airlines from the Middle East, Asia and Africa have, in many cases, also been slower in adopting self-service technology from a both a cost and service perspective (personnel costs are significantly lower in those regions compared to other regions), while African carriers are often slower in deploying the necessary IT systems and have other investment priorities. However also this is changing, with an increasing number of Asian and Middle Eastern carriers deploying self-service technology at their home bases (and in some cases at outstations), mainly for economy class passengers. A small-scale study in Egypt also indicated that passengers were usually positive about using self-service kiosks and largely understood the process even though they never used it before (Abdelaziz, Hegazy & Elabassy, 2010). This shows a relatively general global trend of introducing more self-service options for the largest group of passengers (Economy class), while a traditional check-in process (in that case with much shorter queues) becomes a premium product (as well as for exceptions such as passengers that need special assistance or travel with out of gauge baggage). Certain airlines force (a part of) their passengers to use self-service processes, while others offer the choice.

These findings are also confirmed by global industry surveys such as those of IATA and SITA (in cooperation with Air Transport World and Airline Business industry magazines). The IATA 2014 Global Passenger Survey shows that in Europe 80% of the passengers express automated, mobile or internet check-in as their preferred option (IATA, 2015b). However only 5% mentions kiosks as their preference. This is likely the result of internet-based and fully automated services being more convenient and when using kiosks in combination with hold baggage, it automatically means the passenger needs to complete two airport processes for check-in. This is especially inconvenient when the bag drop is done at counters that still have reasonably long queues. Currently most passengers still use a regular check-in counter to drop-off baggage, but according to SITA (2016) 52% of the passengers express that they would prefer an automated bag drop process. However two thirds of this group wants it to be an 'assisted bag drop', showing the uncertainty that travellers still have with using this relatively new type of technology. SITA does not elaborate on the reasons for passengers to choose a self-service process, but it likely has to do with the efficiency benefits rather than being a more enjoyable process. However also the element of 'doing it yourself' is likely to be an influencing factor, as increasingly more people are used to do things themselves and like to be in control. These two assumptions can however not be confirmed by existing research.

Overall it can be concluded that both airlines and passengers prefer a self-service process if this clearly proves to be more efficient (in terms of throughput time, but also in terms of costs). For many passengers it remains important to have assistance available when required and to have the opportunity to ask (airline or flight-)specific questions. While for many airlines the aspect of

branding and offering check-in as a product remains important, especially for the premium segment of the market.

5. Self-service technology usage

Market research generally seems to show a preference of passengers for self-service processes. It is however more difficult to determine exactly why passengers prefer this type of process. The respondents of the market research at Brussels Airport clearly expressed the benefit of efficiency of common-use self-service processes. While a complete self-service process is not necessarily shorter in terms of processing time, splitting up the process and passengers per step of the process (check-in, bag tagging and bag drop) enables more passengers to be processed at once, and for those arriving already checked-in at the airport, they can complete a rapid bag drop process at any available processing unit (independent of airline) instead of queuing at a bag drop counter of their specific airline. as other research shows

Over the last decade several studies have been conducted on how passengers experience processes and technology such as online check-in and self-service kiosks and the factors that determine the success or failure from a customer experience perspective. Having knowledge on the factors that are important in the decision making process of customers to opt for a certain process can help in the development of a more optimal process, by targeting those factors that have the most influence on passengers.

Many studies are based on the Technology Acceptance Model (TAM), such as a recent study of Lin and Filieri (2015) on how perceived usefulness and perceived ease of use influence the continuance intention of people towards the use of online (internet or mobile) check-in. They did this by integrating the TAM and the psychological factors of personal innovativeness and subjective knowledge (**figure 3**).

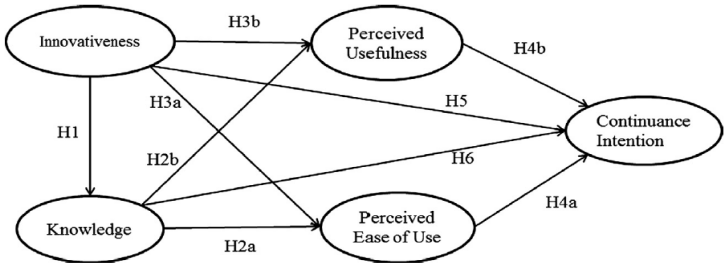

Figure 23: Simplified Technology Acceptance Model (TAM) in combination with the factors of personal innovativeness and subjective knowledge (Lin & Filieri, 2015)

This research shows that in particular perceived usefulness (how useful do travellers think the technology/process is) is an important predictor of continuance intention (the willingness to continue using it voluntarily in the future), in line with earlier TAM-based research (Davis, 1989; Davis et al., 1989; Lu et al., 2005). Both personal innovativeness and subjective knowledge were found to have a direct influence on the continuance intention , as well as an indirect effect by influencing the perceived ease of use and perceived usefulness (Davis, 1989; Lin & Filieri, 2015). This shows that especially in an early stage of adoption, it is important to target customers who are comfortable with using technology in their daily lives and think they are able to use it and believe in the usefulness of it (subjective knowledge has a much stronger influence on consumption behaviour than objective knowledge (Packard & Wooten, 2013)).

An earlier study of Lu et al. (2009) however indicated a relatively weak relation between the use of self-service kiosks and the perceived ease of use and usefulness. Rather the conception of technology of being convenient, time-saving and 'smart' positively influenced passengers' decision to use kiosk technology. However according the IATA Global Passenger Survey, check-in kiosks are the least favourite option for check-in (IATA, 2015b). Research by SITA shows that the ease of use can increase kiosk adoption by 86% and mobile check-in by 59% (SITA, 2016). In terms of ease of use and usefulness there are a number of factors to be considered: the actual check-in application (highly influencing the transaction times), the use of the machine (such as location and visibility of practical units such as scanners and printers), the location of the kiosks and waiting times. Furthermore it is preferential if a kiosk process can be followed by a rapid bag drop-off process with limited queueing as otherwise much of the efficiency benefit for the customer is lost.

A study of Lin and Hseih (2007) used the factor of technological readiness of passengers, to investigate the relation with self-service technology satisfaction. People who are more used to using technology on a regular basis, are also more like to be satisfied with the use of self-service technology. People with a high level of technology readiness are also more likely to give positive advice to other people on using technology, positively impacting behavioural intentions.

Important to take into account is the influence on customer behaviour when they face a failure in the use of self-service technology (for example a technical malfunction). A study of Zhu et al. (2013) showed that 56% of the participants in the study would rather opt to 'fix' the problem rather than switching to a different type of process or technology (if possible). This indicates the opportunity to recover from a failure by offering sufficient processors, so that passengers can quickly switch to another unit. For the 44% that would opt to switch to another process type, it is important to foresee staff for assistance that can possibly solve the problem. Especially for remote locations, the use of a direct telephone line or online connection is proposed as possible alternative for staff (Green, 2009).

Finally also the demographic factors of origin and age can influence the intention to use self-service technology. A study of American, Australian, Korean and Taiwanese passengers by Lu et al. (2011) indicated that there is a strong correlation between passenger nationalities and the choice of check-in services. Western travellers were found to be more inclined to use self-service check-in. However also more than one-third of the Korean respondents in the research indicated a preference for web check-in. This however does indicate that passenger nationalities also have to be considered when determining the expected usage of self-service processes and technology. The influence of age is not extensively researched as an individual factor. A study of passengers at Zurich Airport however did not show a very clear correlation between age groups and the use of self-service or traditional check-in processes (Wittmer, 2011). This might however be very different in regions where the population is less used to technology, in which case the difference between younger and older generation is significantly larger.

Overall passenger experience in case of self-service process is mainly positive when customers are used to technology. With increasingly more self-service technology being used for check-in globally, younger generations being more familiar with using technology and a generally positive experience after first usage, it can be considered that self-service technology will continue to transform the traditional check-in process for a majority of the market. Airports should therefore consider this when developing their check-in product, however local differences should not be ignored, requiring specific research to identify the market requirements of the respective airport.

6. Conclusion

This research paper aimed at identifying check-in process developments, in particular from a market requirement perspective. Market requirements and stakeholder vision are seen as main determining factors that have to be considered by airport planners and operators when developing a process. Based on market research conducted at Brussels Airport, as well as global surveys, indicate that passengers are increasingly in favour of self-service processes. The traditional check-in process is associated with long waiting times and long queues, causing stress and nuisance. Self-service processes are often more efficient and also seen like that by passengers. Also common use is seen as a beneficial element, as it further improves efficiency. Airline requirements are more differing, but in general the industry moves to more self-service. Traditional check-in at a counter increasingly becomes a premium product. However this does not mean that all passengers are satisfied with more self-service. Research studies show that in particular technological readiness and factors such as the (perceived) ease of use and usefulness are very important. Demographic factors also play an important role, with Western travellers more easily opting for self-service when they have the option.

However existing research studies do not provide sufficient knowledge on the customer experience related to newer technologies such as automated bag drops. Also the influence of age is not clearly demonstrable using existing studies. Furthermore the exact reason for passengers to prefer self-service processes is not widely researched, especially in terms of baggage drop-off. The assumption of efficiency being the primary driver, can therefore not be confirmed. This offers opportunities for further research. Having a more detailed understanding of why passengers choose a certain process, can help in the product development to stimulate passengers.

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