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Challenges in passenger terminal design: A conceptual model of passenger experience

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In recent years, de-regulation in the airline industry and the introduction of low-cost carriers have conspired to produce significant changes in the airport landscape. From an airport operator's perspective, one of the most notable has been the shift of capital revenue from traditional airline sources (through exclusive use, long term lease arrangements) to passengers (by way of fees collected from ticket sales). As a result of these developments, passengers have become recognized as major stakeholders who have the power to influence airport profitability. This link between passenger satisfaction and profitability has generated industry wide interest in the "passenger experience".

In this paper, we define the factors which influence passenger experience, namely (a) artifacts, (b) services and (c) the terminal building, and explore the challenges that exist in the current approaches to terminal design. On the basis of these insights, we propose a conceptual model of passenger experience, and motivate its use as a framework for further research into improving terminal design from a passenger oriented perspective.

Keywords: Airport passenger experience; terminal design; experience; conceptual model; experience typology; level of service

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Introduction

In recent years, de-regulation in the airline industry and the introduction of low-cost carriers have conspired to produce significant changes in the airport landscape (de Neufville, 2008). From an airport operator's perspective, one of the most notable has been the shift of capital revenue from traditional airline sources (through exclusive use, long term lease arrangements) to passengers (by way of fees collected from ticket sales) (Causon, 2011; Peterson, 2011). As a result of these developments, passengers have become recognized as major stakeholders who have the power to influence airport profitability. Not surprisingly, this direct link between profits and passengers has placed "Passenger Experience" as a key item on the airline industry's agenda. This is evidenced by the recent surge in industry conferences specifically dedicated to the passenger experience, for example, Passenger Terminal Expo, Future Travel Experience and the IATA World Passenger Symposium.

Despite the industry focus and energy being channeled into the airport passenger experience, very little is actually known about passenger needs (Popovic, Kraal, & Kirk, 2010). In fields outside of aviation, the link between customer experience and great design is clearly understood and exploited. The late Steve Jobs left as his legacy this lesson: in order to provide "insanely great" customer experience (Gallo, 2010), it is essential to understand the goals, needs and wants of the customer, *from their perspective*. According to Jobs, the design process should begin with the customer experience, not with the ultimate product or technology.

The Apple story reflects the transition that has been quietly taking place in the marketplace. In the words of Pine and Gilmore (1999), society has entered the age of the "experience economy", a new economic offering which has surpassed the provision of goods and services. They argue that in order to succeed, companies must transition their focus from the provision of superior services, to the provision of memorable experiences.

The transition from service design (Shostack, 1982) to *experience design* necessitates an understanding of the customer's needs, from their perspective (Klingmann, 2007; Norman, 2009; Parasuraman, Zeithaml, & Berry, 1985). As we will show, this has not yet been achieved in the field of passenger terminal design. Through an analysis of the existing approaches, we will examine the factors that inhibit the inclusion of passenger experience in terminal design, and propose a conceptual framework to address these limitations.

Terminal design in the experience economy

In addition to providing the setting for the passenger experience, an airport terminal is the context for interactions that occur between numerous other stakeholders within the larger airport system. As an entity, the airport must satisfy the needs and requirements of these divergent stakeholders (Gourdin, 1988; Popovic, et al., 2010), including:

- Government bodies, who must uphold laws and regulations
- Airport staff, who are mainly concerned with wages and their work environment
- Retailers, who are primarily focused on profits
- Airport shareholders, who are also focused on profits
- Airlines, whose main concern is minimization of aircraft ground time (which affects their profits)
- Airport passengers, who are mostly concerned about their own experiences

The complexity underlying terminal design stems, in part, from the inability to simultaneously satisfy the conflicting goals of all the stakeholders. As an example, the overheads introduced by the security screening process mandated by various laws and regulations conflict with the goals of passengers (added inconvenience), retailers (non-ticketed passengers unable to access some retail areas), airport operators (need to provide physical space and staff for security screening) and airlines (introduction of possible passenger delays).

Traditionally, the design of an airport terminal building has been carried out as a process between the airport owners, the selected architectural firm(s), and occasionally, individual airlines. The design process has "typically ignored [other] major stakeholders in the airport" (de Neufville & Odoni, 2003, p. 563). Passenger experience, although of interest to passengers, has not been a direct goal of any stakeholders involved in terminal design. With the changes in aviation, however, the role of passengers has changed from a non-involved party to that of an involved stakeholder (Causon, 2011; Peterson, 2011).

Airport passenger experience

Passenger experience, like all human experience, is subjective and influenced by the context in which it takes place: the place, time, and interactions with others (Ciolfi, Deshpande, & Bannon, 2005; Healy, Beverland, Oppewal, & Sands, 2007).

Popovic et al. describe airport passenger experience as the "activities and interactions that passengers undergo in an airport (terminal building)" (2010). They categorize passenger experience into two broad categories, namely (a) necessary activities and (b) discretionary activities. Necessary activities are those that must be completed by a passenger in a set order, for example check-in, security, customs, boarding. Discretionary activities, on the other hand, are optional and unordered, for example, a passenger may exchange currency and/or have a cup of coffee, or choose to do neither.

Pine and Gilmore (1999) allude to a temporal quality that distinguishes experiences. They argue that experiences linger with the customer past the event date, much like the memories of a great vacation become part of the fabric of family history. From this perspective, a customer experience is a relationship with the experience provider, rather than an interaction.

In the context of terminal design therefore, the passenger experience is a relationship between passengers and the airport (operators) which is formed over time through a series of activities or interactions between the passenger and the airport. The activities consist of a set of ordered, necessary activities, optionally interspersed with discretionary activities. Each activity represents an interaction between a passenger and/or a service, and/or an artifact, and/or the terminal building (Figure 1).

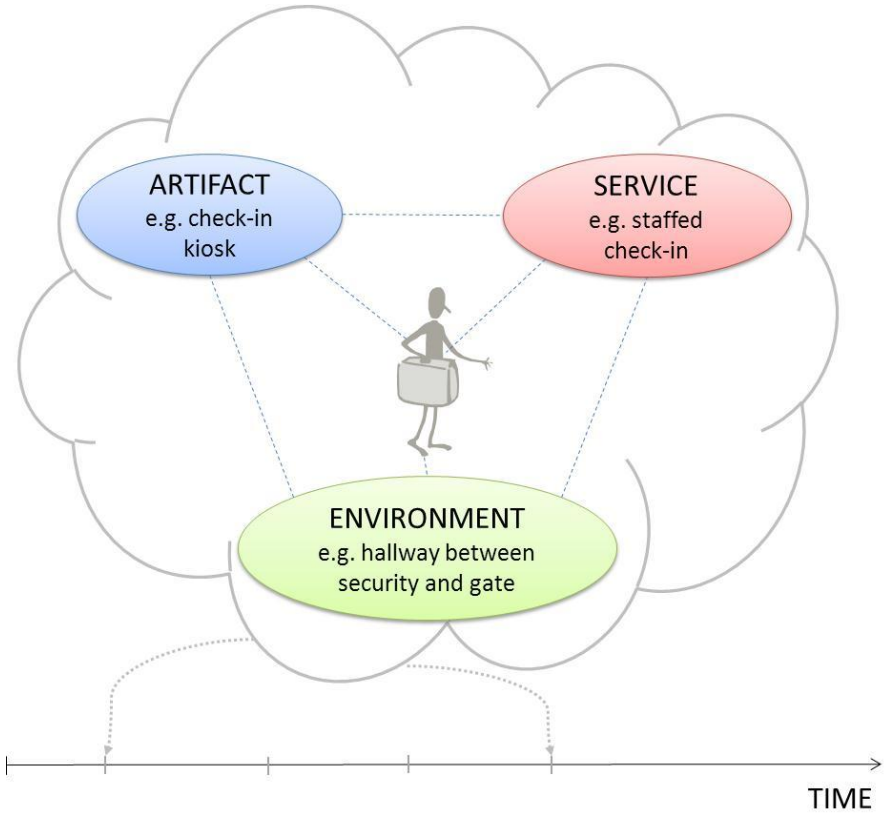

Figure 1: Factors Influencing the Passenger Experience

Challenges in terminal design

Experience has been identified as an influential factor in terminal design (Popovic, et al., 2010) yet is not currently utilized in the design process (Klingmann, 2007; Zidarova & Zografos, 2011). This chasm between the recognition of the importance of experience, and its limited use in practice is influenced by a number of factors, including:

- Ambiguities inherent in the industry level of service (LOS) metrics. These misdirect the prevailing industry view that adherence to LOS standards results in the provision of superior service to passengers.
- The subjectivity of passenger experience. Objectively computed LOS metrics may not accurately represent passenger experience, which is subjective and not necessarily reflective of actual events.
- External constraints, which often conflict with the passenger experience and serve as a roadblock to creating designs which are passenger focused.

Disambiguating LOS

Level of Service (LOS) is a metric used in the terminal design process. The LOS metrics represent industry benchmarks of the amount of space (square meters) that should be allocated to accommodate future passenger traffic at various stages of the airport process (IATA, 2004). The metrics provide both a guideline for architectural design and inform planning decisions for airport operators (de Neufville & Odoni, 2003).

The terms "level of service" and "quality of service" have been used almost interchangeably in the aviation literature (Zidarova & Zografos, 2011). Most importantly, neither phrase uses the conventional meaning of the term "service", i.e. an act or helpful activity. In this context, *service* refers to the range of acceptable area per passenger (in square meters), as defined by a six point scale (ranging from A-*best*, to F-*worst*) (IATA, 2004).

The inclusion of the word "service" in the LOS standards reveals a hidden assumption in the metrics, namely, that more area per passenger equates to better service. Table 1 shows an excerpt from the standards for the check-in area of the terminal building (de Neufville & Odoni, 2003). The data clearly illustrates this implicit linkage between space and service: the levels of service (A to F) are associated with both space (per passenger) *and* a qualitative description. Accordingly, it is assumed that the provision of 1.8m^2 per passenger in a check in area will also result in "excellent quality and comfort", "free flow" and "no delays" in the check-in area of the terminal.

Table 1: LOS Standards for Check-In Areas

Adapted from "Airport systems: Planning, design and management" by R. de Neufville and A. Odoni, 2003, p. 637.

LOS	SPACE PER PASSENGER (m^2)	DESCRIPTION OF STANDARD		
		QUALITY AND COMFORT	FLOW CONDITION	DELAYS
A	1.8	Excellent	Free flow	None
B	1.6	High	Stable, steady	Very Few
C	1.4	Good	Stable, steady	Acceptable
D	1.2	Adequate	Unstable, stop and go	Barely acceptable
E	1.0	Inadequate	Unstable, stop and go	Unacceptable
F	< 1.0	Unacceptable	Cross flows	Service breakdown

Although there is unarguably a minimum amount of space required for humans to function (Hall, 1966), there is no evidence that the more space allowed per passenger, (a) the better the terminal design, or (b) the better the "service" experienced by the passenger (Passenger Level of Service and spatial planning for airport terminals., 2011). This inherent (flawed) relationship between service quality and provision of space misdirects the prevailing industry view that adherence to the LOS standards results in the provision of superior service to passengers (Zidarova & Zografos, 2011) .

The subjectivity of passenger experience

The standard IATA LOS metrics (2004) have been augmented in various ways in an effort to capture passenger preferences (Zidarova & Zografos, 2011). Zidarova and Zografos classify the existing work in this field into three broad categories, namely:

1. Objective measures of LOS from analytic and simulation models
2. Subjective measures based on studies of passenger perception, and
3. Subjective feedback from passenger responses to surveys and questionnaires.

In this section we examine the approaches in each of the above categories, and explore their limitations in capturing subjective passenger experience information.

Limitations of LOS based on objective metrics

The first category of works are based on approaches which utilize analytic and simulation models for the evaluation of terminal performance (Zidarova & Zografos, 2011). Although the approaches differ, the commonality between them is the inclusion of time and space as an objectively measured metric.

This perspective of LOS accurately reflects the goals of airport owners and airlines, and hence represents an assessment of terminal performance *from their perspective*. These metrics may not accurately represent terminal performance from the passengers' point of view. In part, this can be explained through the observation that space and time are experienced subjectively (Csikszentmihalyi & LeFevre, 1989; Hale, 1993; Hall, 1983). Thus, a check-in process completed in the LOS recommended timeframe may still be very unsatisfactory to a passenger who is greeted by a rude check-in clerk.

In addition to using objective measures for the evaluation of subjective experiences, the approaches in this category rely upon estimates of future passenger traffic. As demonstrated by Odoni and de Neufville (1992), estimates of future passenger flows tend to be reasonably inaccurate. Thus, the general value of terminal design based on this category of LOS metrics is questionable. This observation is supported by recent figures which indicate that less than 15% of the responding airports actually use these metrics in practice (Passenger Level of Service and spatial planning for airport terminals., 2011).

Limitations of LOS based on passenger perceptions

The second category of work recognizes that quality of service is related to perceptions of service. For example, Correia et al (2008a) note the limitations of LOS based on purely objective measures and extend the basic metrics with four additional variables, namely walking distance, orientation, total time and a secure environment. The identification of variables which contribute to the passenger experience is a major contribution of this category of work.

The main limitation of this category of work lies in the representation of subjective experience factors (such as total time) through objective metrics (such as seconds). As observed by Yen et al. (Yen, Teng, & Chen, 2001), and again by Yen and Teng (Yen & Teng, 2003), a*irport* time and space are not the same as p*assenger* time and space, yet they are treated as one.

The recent industry review of LOS metrics (Passenger Level of Service and spatial planning for airport terminals., 2011) supports the notion that objective metrics do not adequately represent passenger preferences. For example, an excerpt of data from the report is shown in Figure 2. The results highlighted illustrate the disconnect between the objective measure (elapsed time) and the perceived passenger satisfaction (measured on a scale of 1-*excellent* to 5-*very bad*): why do passengers consider a baggage wait time of 45-50 minutes *excellent* (1.0), whereas a shorter wait time of 35-40 minutes is perceived as *bad* (4.0)?

Irrespective of the underlying reasons for these discrepancies, the data supports that objective measures of space and time are not the same as their subjective interpretation by passengers. It follows therefore that approaches utilizing objective measures will be limited in their ability to capture passenger experience.

Table 2: Average perception ratings by function, based on wait times spent in process

Adapted from "Passenger Level of Service and spatial planning for airport terminals", *Airport Cooperative Research Program (Report 55),* ed. D. English, p. 16

TIME IN QUEUE (MINS)	KIOSK	CHECK-IN	SECURITY SCREENING	BAGGAGE CLAIM
0-5	1.9	1.8	1.8	1.6
>5-10	2.2	2.2	2.4	1.8
>10-15	2.5	2.6	2.6	2.3
>15-20	2.7	3.2	1.0	2.9
>20-25	3.3	3.4	-	2.9
>25-30	-	3.1	2.0	2.9
>30-35	-	4.1	3.6	4.0
>35-40	-	4.3	3.5	4.0
>40-45	-	4.0	-	2.8
>45-50	-	5.0	-	1.0
>50-55	-	5.0	-	4.0
>55-60	2.0	4.3	2.0	4.0

Limitations of LOS based on surveys and questionnaires

The final category of LOS metrics is based on passenger satisfaction surveys. Terminal assessment based on this methodology boasts the reliability of data collected across very large sample sets. Although surveys such as SKYTRAX survey millions of passengers annually, care must be taken when interpreting the actual data that is collected.

As an example, although Hartsfield-Jackson International Airport (ATL) is rated as a 3-star airport by SKYTRAX (2011b), 62% of respondents make very negative comments about the arrivals process (2011a). Inspection of other airports in SKYTRAX supports the general discrepancy between the ratings assigned, and the comments posted by passengers. A similar phenomenon has been noted in a review of the Passenger Facilitation data collected by Australian Customs (2008-2009). A possible explanation for these discrepancies lies in the psychology of answering questionnaires: most people do not want to give the *wrong* answer, and tend not to choose *bad* scores for fear that it will reflect negatively on them, and/or those conducting the survey and/or those being surveyed (International Sociological Association, 1998).

Correia et al (2008b) note that approaches based on survey and questionnaire administration often ask respondents to recall past events or predict future events. Recall has been shown to be a process which is often inaccurate and not necessarily reflective of the actual experience (Mori, 2008; Norman, 2009). In general, according to Csikszentmihalyi and LeFevre (1989), surveys and questionnaires are not a reliable method for measuring the quality of a person's experience.

Thus, although information gathered through surveys is useful for indicating trends or making broad comparisons, the results should not be taken to be reflective of actual passenger experience.

External constraints

There are a number of external forces which can conflict with, and thus inhibit the process of creating a terminal design optimized for passenger experience. The first external, and largely immovable, constraint is the presence of laws and regulations. Although designed for the public good, it is often the case that various restrictions imposed by laws and regulations conflict with passenger goals. For example, the overheads imposed through heightened security following 9/11 are an inconvenience to passengers (Parks, 2007), yet cannot be removed from the terminal design.

The second class is associated with the economic realities of terminal building projects: the ultimate need to adhere to both budgetary and scheduling constraints. Although budgets can, and often are, increased, and time goalposts shifted, there are boundaries on both time and money which can ultimately impact the optimality of the ensuing terminal design (de Neufville & Odoni, 2003).

A third and also largely non-negotiable factor in terminal design are the physical constraints imposed by the site. Although there are various ways to address these constraints, solutions usually involve major infrastructural expenditure. As an example,

the lack of space for the expansion of Hong Kong's old international terminal led to a project involving the reclamation of land to accommodate the new terminal (Evans, 2011). In the absence of sufficient resources and support (from local governments), site conditions can influence the ability to optimize terminal design from a passenger's perspective.

The sources of revenue, as manifested through the goals of relevant stakeholders, can also affect the degree to which a terminal will be optimized from a passenger perspective (de Neufville & Odoni, 2003). Until recently, as these stakeholders have not included passengers, it follows that design decisions have often been made by parties without a vested interest in the passenger experience.

Although little can be done to eliminate these external constraints, the passenger experience can nonetheless be improved through awareness and consideration of these factors.

A conceptual model of passenger experience

In the preceding sections we identified challenges in terminal design which affect the creation of terminal buildings optimized from a passenger experience perspective. We also observed that passenger experience is subjective, and varies depending on the viewpoint from which it is considered. These observations form the foundation for the conceptual model we present in this section (Figure 2).

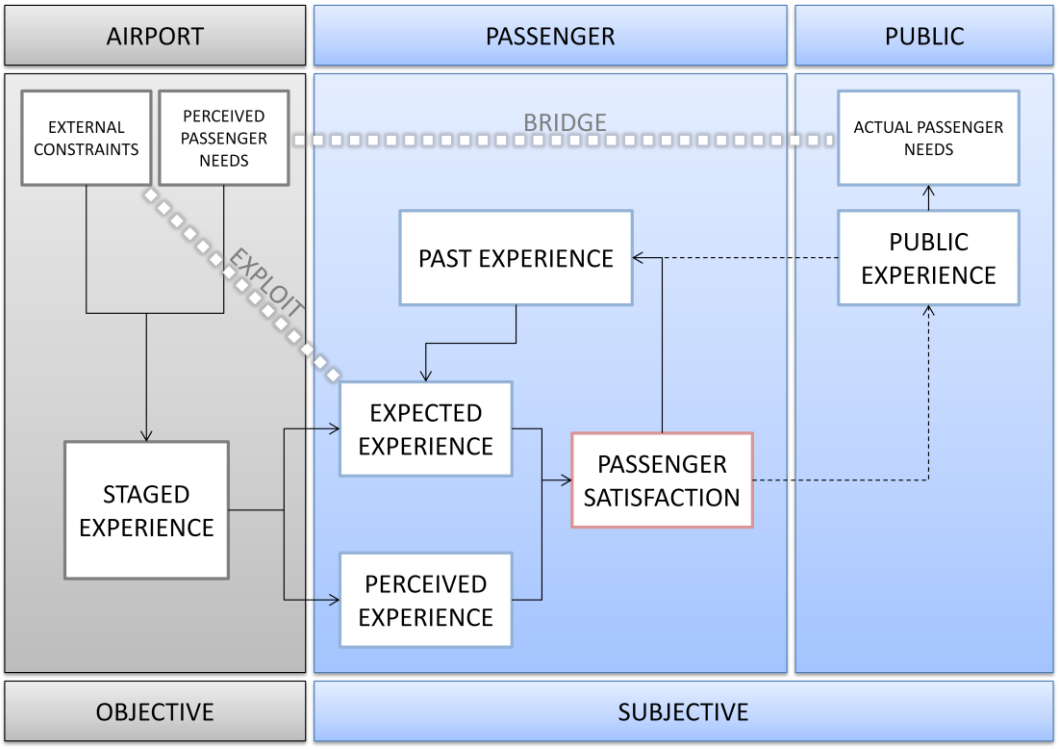

Figure 2: Conceptual Model of Passenger Experience

The proposed model deconstructs passenger experience into five distinct types, namely: (i) staged, (ii) past, (iii) expected, (iv) perceived and (v) public experience. The model categorizes the experience types according to the perspective of the experience, namely airport, passenger or the public, and shows how these experience types are inter-related. The nature (objective or subjective) of each experience type is also explicitly noted and should be considered when determining appropriate metrics by which to evaluate experience of a particular type.

Airport Perspective

In the proposed model, the passenger experience from the airport's perspective is represented by the "*staged experience*" (Pine & Gilmore, 1999). The staged experience (Figure 2) is objective from the airport's perspective and forms the basis for employee performance benchmarks, for example, average time to check-in a passenger. These

benchmarks are measured largely though the industry LOS metrics, and provide an objective view of the time, space, and satisfaction of passengers in an airport.

The objective nature of the staged experience provides a useful base point for airport planning and evaluation of airport performance from a managerial perspective (i.e. *does the terminal adequately handle the passenger traffic now, and in the future?*). However, as this experience category provides an objective reflection on the passenger experience, it does not communicate information about the experience of passengers, from their perspective. This distinction is important to consider, especially when interpreting the results of studies based on current LOS metrics.

Passenger Perspective

As discussed in previous sections, airports and passengers do not have the same perspective. From the passenger's perspective, experience is subjective, and hence necessarily distinct from the airport's perspective (Figure 2). For each passenger, their experience is a culmination of prior experience (both first hand, and as learned from others), expectations and actual perceptions at the time of the experience.

The past experience of the passenger is the value proposition of the passenger experience (Pine & Gilmore, 1999). It represents the relationship that the airport has established with the passenger through repeat interactions (direct) and the "word of mouth" opinions of others (indirect) (Parasuraman, et al., 1985). A passenger's past experience is subjective, informs personal expectations and thus has a direct impact on satisfaction. Through transitive closure, past experience of a passenger influences the choices of other travelers.

A passenger's expected experience represents the expectations that the passenger has of a particular experience. Importantly, expected experience is subjective and not necessarily reflective of the staged experience (as perceived by the airport). This category of experience is influenced by a passenger's past experience and the dynamics of the experience offering itself. For example, a passenger's expectations about the duration of the check-in process will be formed by what they have experienced in the past (*check in usually takes 45 minutes*) and by what they can ascertain about the current situation (*the queue looks short but has not moved in the last 30 minutes*).

Perceived experience represents the interpretation of a particular experience by a passenger at a given time. It is both subjective and dynamic in nature. Perceived experience is influenced by artifacts, services and the terminal building itself (i.e. the staged experience). For example, a flight delay is likely to be perceived as longer in the presence of poor service than in the presence of good service (Norman, 2009).

Passenger satisfaction represents the difference between a passenger's perceived and expected experience. Regardless of the objective measures of the staged experience (e.g. minutes in check-in queue), if a passenger's expectations are met, he/she will be satisfied with the experience (Norman, 2009). For example, an anxious passenger in an unfamiliar terminal will have few expectations of finding their way to their departure gate. Upon finding the desired gate (expectations met) the passenger is likely to be satisfied. As shown by Norman, the degree of the passenger's satisfaction will be influenced by factors such as service (finding a staff person willing to help with directions).

Public Perspective

Public experience represents the collective subset of passenger experience that is recalled after the event (Figure 2). Research in other contexts has shown that people tend to remember the start, the end and the most memorable (good or bad) events from the middle (Mori, 2008; Norman, 2009).

Public passenger experience is recorded formally by aviation surveying firms and informally through a variety of social-media channels (SKYTRAX, 2011b; Soule, 2010). These less formal social networking channels should not be overlooked in terms of their power to influence public experience. As an example, the now famous case of Dave Carroll's guitar damaged by United Airlines in 2008 heavily influenced public opinion about the airline (Carroll, 2009; The Daily Telegraph, 2009).

Future Work

The development of the conceptual model presented in Figure 2 has identified an opportunity to exploit the external constraints that underpin most terminal design projects. Through our investigations, we observed that modern consumers, including passengers, value information (Norman, 2009; Passenger Level of Service and spatial planning for airport terminals., 2011; Pine & Gilmore, 1999). In fact, Norman has demonstrated that even in the face of service breakdown, customers' expectations can be re-set through transparency of information: alerting passengers to the reasons for a flight delay can result in positive customer satisfaction, in spite of their original expectations not being met.

Although the presence of external constraints set by laws, regulations, budgets, site conditions or stakeholder's goals may be in conflict with passenger goals, their existence need not have an adverse effect on passenger satisfaction. The negative effects of these constraints can be mitigated through the provision of information which will adjust the expected passenger experience. These observations are confirmed by our preliminary field studies which show that passengers' expectations are very resilient in the face of courteous and open communication. Further work is underway to identify the nature and thresholds which characterize the relationship between the staged experience and ultimate passenger satisfaction.

Conclusions

Recent changes in aviation have led to an increased focus on the passenger experience. As a result, the process of terminal design has been challenged to produce outcomes beyond the purely functional and aesthetically spectacular. In order to increase revenue, airports of the future need to look for opportunities to create memorable experiences and forge positive relationships between airport and passenger.

Although there are many cases of successful terminal designs, particularly from a passenger experience perspective, the current design processes is "guided by intuition" (Palmer & Fentress Bradburn Architects, 2006, p. 7). This lack of systematic approach has resulted in many multi-million dollar cases of design "trial and error" (Great Buildings, 2011). Our exploratory research suggests that in order to achieve terminals which enhance the passenger experience, it is necessary to understand the requirements of the passenger, *from their perspective*. In particular, we have motivated that an understanding of the distinctions between objective and subjective views of experience is a step towards overcoming these obstacles.

On the basis of these insights, we proposed a conceptual model for the integration of passenger experience in terminal design. The model is based on the identification of five distinct types of experience. We intend to use the conceptual model as a framework for further empirical research in the aviation domain.

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Anna Harrison is a PhD student within the People and Systems Lab at Queensland University of Technology in Brisbane, Australia. Following a career in product design in London, New York and San Francisco, Anna has shifted gears into the architectural and service design spaces. Her research on the Airports of the Future project draws on this rich background, and aims to explore the relationships between perceptions of service quality and perceptions of space and time by passengers in an airport terminal building (anna.harrison@qut.edu.au).

Vesna Popovic

Vesna Popovic is a Professor in Industrial Design at Queensland University of Technology, Brisbane, Australia. She has made an international contribution to product design research where she has integrated knowledge from other related areas and applied to the artifact design (e.g. human factors/ergonomics, product usability, design and cognition, expertise and experience, design computing or applied design research) in order to support and construct design applications. She has successfully integrated the industrial (product) design research agenda with diverse disciplines such as medicine, science, engineering, humanities and information technologies in order to enhance or change their practices. In particular, she has been a founder of People and Systems Lab research at QUT. The impacts of Vesna's research lies in the cross-fertilisation of knowledge across humanities and technologies to design humanised artifacts/ systems by facilitating the understanding of diverse expertise and experience. Vesna is a Fellow of the Design Research Society (UK). She is recipient of three Australia Research Council grants (v.popovic@qut.edu.au).

Dr Ben Kraal

Ben Kraal is a Research Fellow with the People and Systems Lab at QUT. During the last six years he has made significant contributions to design research. Dr Kraal's approach adapts rich sociological techniques to investigate the complex interplay between people, the tools they use and the environment in which they work, allowing the identification of the essential elements of the work practice in question, making it clear where technology and design interventions are able to achieve the greatest positive impact. His ongoing research looks at how people use airports and how doctors and nurses collaborate with digital telehealth stethoscopes (ben.kraal@qut.edu.au).

Dr Tristan Kleinschmidt

Following the completion of a PhD focusing on speech processing in 2010, Tristan changed tracks to focus on the study of airport modeling and simulation. His interests lie in changing the way passenger simulation is used for assessing the effectiveness of airport systems.