Passenger Experience in an Airport
An Activity-centred Approach

Vesna Popovic, Ben Kraal and Philip Kirk

People and Systems Lab, Faculty of the Built Environment, Queensland University of Technology
{v.popovic; b.kraal; philip.kirk} @qut.edu.au

Abstract: An airport is one of the largest and most complex systems in modern society. Observational field studies have been conducted to investigate passenger experiences in, and interactions within, an international airport. Based on these studies, this paper discusses how activities mediate people's experiences in the airport. For example, moving through the security screening process is discussed from both passenger and staff perspectives. The applied coding scheme ensured research rigor. The findings illustrate that passenger activities are complex and shared, and only partially supported by current terminal design. Thus, this research has the potential to impact on airport design to facilitate passenger flow through airport precincts.

Key words: Experience, activity-centred approach, human-centred design, airport design, observational analysis.

1. Introduction

An airport is one of the largest and most complex systems in modern society. It is an assemblage of people, processes, technology, government agencies, private companies, space, artefacts and information. Design has often been concerned with artefacts, and systems can be considered as artefacts of human society; as ways of organising people and technology through a set of processes that monitor the flow of people, activities, artefacts and information in an effective way.

The International Air Transport Association's (IATA) Simplifying Passenger Travel (SPT) [11] initiative "aims to improve the passenger travel experience by replacing repetitive checks of passengers and their documents with a new streamlined system that will collect the information once and then share it electronically with subsequent service providers" [10]. It is a technology-focused program that aims to integrate the currently segmented activities involved in entering an airport in order to board an aeroplane. However, the SPT program does not have a passenger-centered perspective. It is focused on technologies, particularly biometrics, that are thought to potentially reduce the time it takes to process passengers through the required checks. It is not based on an adequate analysis of the current situation in airports and does not arrive at a systems-oriented, integrated and – above all – human and activity-centered approach.

This project aims to address this shortfall, and is but one stage of a larger project that investigates passenger experiences and interactions with information, services, processes, equipment and technology at the airport. Its overall goal is to construct qualitative models of the experiences, activities and interactions that passengers

undergo in an airport. These models will then be integrated in an airport process model to provide a predictive capacity that will inform the design, or redesign, of better airports for passengers. The Brisbane International Airport passenger terminal has been a living laboratory for the field studies conducted and the findings described below.

2. People and Activities at the Airport

There is much written on how passengers and visitors use airports [2, 4-7, 9, 12, 17, 18, 20, 21] and while some work addresses the passenger experience of flight related services [22], retail services [19] and general passenger satisfaction [1, 8], a gap exists in qualitatively addressing passenger experience in a way that includes flight and and non-flight services. This is a significant shortcoming as, in addition to the essential flight related tasks of navigating the terminal in order to check in and board their flight, passengers make many decisions about how to spend their time on non-flight related services provided at the terminal.

Wales et al [22] looked at passenger interaction with flight related services with a view to improving technologies used to process passengers. In their study, they treated airline passengers as "intelligent actors negotiating their way through the system" of the airport, with a particular focus on passenger-service interactions. This is an important perspective to take because it shows that passengers are active participants in their interaction with airlines and this active participation can both help and hinder airline processes as new situations arise. Breakdowns in optimal procedures, from getting lost in the terminal to missing a plane, require negotiation at every turn. This, in turn, suggests that technologies to support interaction at the airport must allow for this active negotiation, rather than following a fixed path.

Caves and Pickard [2] review the "physical and psychological needs" of people in airports. Their concern is primarily with airport customers, with a specific focus on the physically disabled. Taking a view primarily from ergonomics, they identify three main problems with passenger acceptance of the airport terminal: the space provided for passenger movement and down-time, the time required for movement from point to point, and the ability to navigate the terminal building itself. Caves and Pickard critique standard methods for allocating space in terminal buildings, noting that the formulas for space allocation are easy to misinterpret. They recommend that such formulas "should be improved by a realistic appreciation of the dynamics and behaviour of sequences of queues, the psychology of crowds in such situations, and the ways airport users truly allocate the time they spend in passenger terminals – their slack time is often much greater than their processing time" [2] (p10). They conclude that human-centered design can improve the airport experience for both airline workers and customers; however, this conclusion is not well supported by their research.

Rowley and Slack [19] describe how airports should be designed to enhance feelings of timelessness and placelessness. This contrasts with the view of Ciolfi et al [3] who had begun research to enhance a feeling of place in an airport. While both Rowley and Slack and Ciolfi et al are advocates for passenger comfort, Rowley and Slack argue that timelessless and placelessness are relaxing states, while Ciolfi et al argue that a feeling of place is desirable.

However, to improve passengers' experience one needs to understand what passengers do in airports during their 'in-between' or 'down' times cannot be considered without understanding what passengers do when they are being processed. Therefore, this research is broken down into the following questions: (i) How do people allocate their time in the airport, and in what ways is it allocated for them? (ii) What decisions do people make while at the airport? (iii) What things do people do at the airport? and (iv) Who do people interact with at the airport?

There are two levels of interaction in people's airport activities: (i) the macro-global level and (ii) the micro-domain level. The macro level encompasses the overall passenger flow at departure, including entering the terminal, check-in, security, customs, and boarding – activities that are integral to the process of being a departing passenger in an airport. The micro level addresses passenger interactions at the domain level, such as the check-in counter, currency exchange and security check. It also includes passenger discretionary experiences such as their activities in the departure lounge.

There are many different approaches that have been used to assist in understanding human interaction and experience. Within the context of this study, *interaction* is very broadly defined and refers to *various levels of human engagement.* Furthermore, the inclusion of activity within the design process has lead to the notion of "activity-based" or "activity-centred" interaction [15]. This, in turn, aims to challenge designers to design artefacts or systems within the context of a specific activity. However, within any activity – be it at work or leisure – people have social engagement where they are linked on a social and individual level [13]. The activities are in constant change, and this change influences artefact and system transformation. Any developmental process in an activity can generate a new activity [13] and is achieved through different actions. The design of the dynamic structures of artefacts and systems supports exploration, flexibility and adaptability during interaction. It has been a common approach that design of artefacts and systems provides organisations of interfaces and controls based on logical organisation, following task analysis patterns. However, these controls fail to support activity patterns [16]. Designers think about the "correct" order in which the activities are undertaken; they rarely think about unusual circumstances and new situations, or consider that people's engagement with complex systems generates new activities. In order to assist designers' understanding of this phenomenon, this paper will explore micro-level passenger interaction within the selected airport contexts.

3. Passenger Interactions

There are two main categories of activity identified: process activities and discretionary activities. Process activities are part of passenger flow from check-in, security screening, passport control to boarding a plane. Discretionary activities are activities that occur while passengers are moving between processing points; for example, getting a coffee, shopping, or exchanging money.

The research is based on the analyses of observational data collected from footage already available and video recording of activities at the airport terminal. The coding scheme has been developed and supported by the Observer [14] software. It was dependant on the context observed and the activities undertaken within that particular situation – for example, check-in, security (Table 1 and Figure 3) or activity within the departure lounge area – and each different activity observed had a unique coding scheme. This paper shows four

representative examples of activity analysis: (1) tracking a passenger's bag from check-in to security (Section 3.1); (2) analysing the activities undertaken at the security checking station over a period of time [that is, analysing the activities of passengers as they arrive at the security checkpoint (Section 3.2), and the activities of the security staff who are working at the checkpoint (Section 3.3)]; and (3) describing the activity of passengers from the time they enter the airport to approximately one hour before their departure (Section 3.4).

3.1 A Person-and-Bag

An airport system, from check-in to security, is concerned with many things. However, these can be classified into two broad categories: (1) the passengers themselves and (2) the things that passengers carry. Once check-in is complete, passengers are left with their hand luggage which becomes the focus of the security scanning point as they negotiate their way to an aircraft. A bag's location and its owners were observed and tracked while moving through the airport in order to understand how the artefact (bag) mediated the interaction of the passengers with the airport infrastructure.

Figure 1 shows an orange and white bag that stood out prominently. The bag belonged to an older couple, apparently traveling with a tourist group. The observation of the bag begins at 00:01:39 minutes in the check-in line (Figure 2). The woman is holding the bag. At 00:03:03 she gives the bag to the man who carries it until 00:08:37 when he places it on the security scanner conveyor belt. At 00:09:26 the bag is removed from the conveyor by a security staff member who passes it to a second security staff member. The second security person motions to the couple to come with him to a small space at the end of the security screening area so he can examine its contents. From 00:09:49 to 00:11:35 the bag is examined by the security staff member who then carries it back to the conveyor (from 00:11:35 to 00:11:50). The bag travels along the conveyor and through the scanner again, from 00:11:50 to 00:12:29. This time the scan is satisfactory. The security staff member brings the bag back to the couple (from 00:12:29 to 00:12:40) who then spend a brief period of time re-packing it before moving off (00:13:04 minutes).

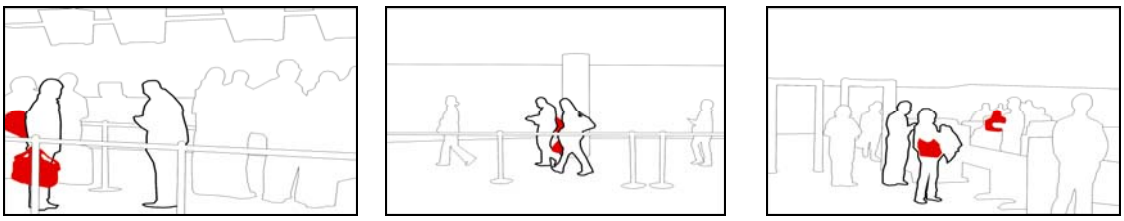

Figure 1 Person-and-a bag interaction sequences: In line at check-in; walking to security; security screener takes bag for detailed examination

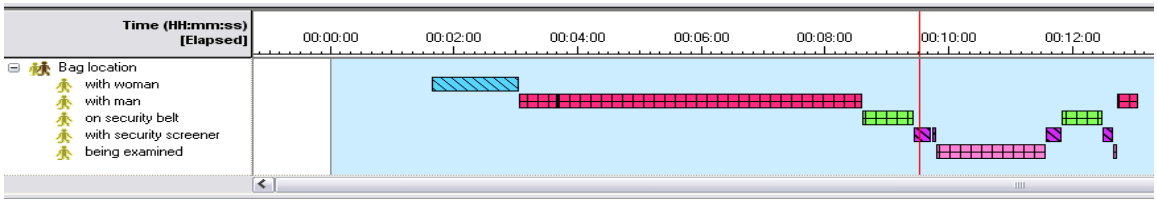

Figure 2: The location of the bag as it moved through the airport from check-in to security

This interaction is notable for several reasons. First, it brings into question who the owner of the bag is. The woman carried it first, but the man carried it the longest. It could be hers, his or theirs. Whether the security personnel would see it that way is something we will examine in future research. Second, it was observed that the bags, and its contents, are very important mediators of interaction in the airport. As people carry the bag, they become a person-and-bag from the airport's point of view. A bag without a person is a security risk. A person who carries a bag is responsible for that bag's contents at the time the examination of the contents takes place. However, when the bag is taken to the examination point, both the man and woman go with the bag.

3.2 Security: Passengers (group)

This section describes the interactions of nine passengers as they passed through the security screening point. Figure 3 shows the average times for these nine passengers to pass through security. Not all passengers participated in all activities; for example, only Passengers 5 and 6 were taken aside to have Passenger 6's bag examined by a security staff member (Passengers 5 and 6 are the couple from Section 3.1 and Figures 1 and 2. Figure 3 shows the average security activity times for these nine passengers and reveals some interesting patterns. The long manual examination time for Passengers 5 and 6 obscures the differences between the other activities.

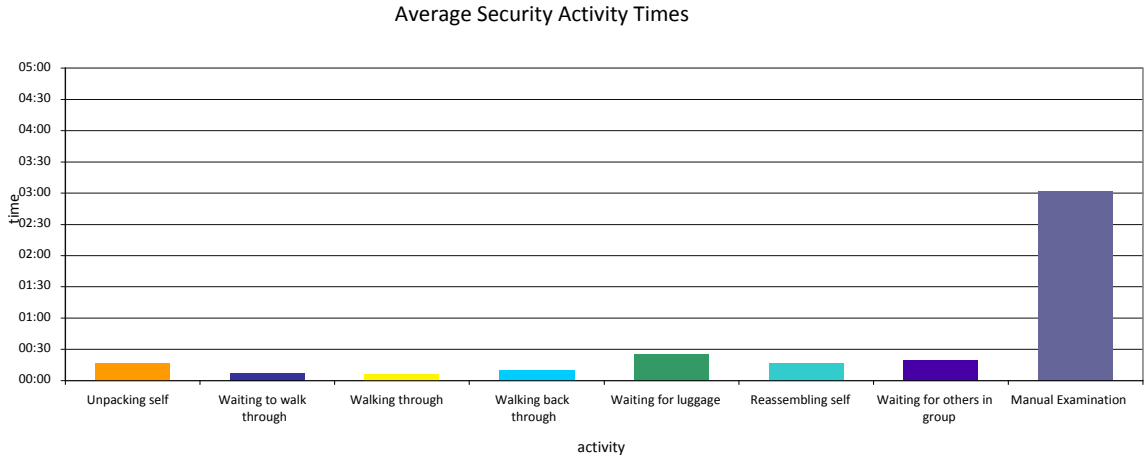

Figure 3: Average security activity times in seconds

The average time for the activity of walking through the scanner is very short (6 seconds), as is the average time for the related activity of "waiting to walk through" (7 seconds). As only Passenger 8 had to walk back through the scanner the average for that activity is an average of one and cannot be considered representative. The activities that passengers perform before and after being scanned take much longer. On average, the nine people took 17 seconds to unpack themselves and the same time (17 seconds) to re-assemble themselves before they walked away from the scanning output conveyor. They spent an average of 26 seconds waiting for their luggage to move through the x-ray scanning equipment before they could retrieve it.

The activity that was interesting was waiting for others in the group to complete the scanning process (20 seconds). In this set of nine observations, three people waited for others in their self-selected group to complete the scanning process so they were able to move as a group to the passport control point. People waiting for others in their group stopped in the middle of the walkway to passport control as there were no obvious places

for groups to re-form. It is also noticeable that passengers spent more time waiting for their luggage and then re-arranging themselves than they did waiting for others, yet there are no obvious and well defined spaces for luggage collection and personal reassembly. Thus, people clustered around the luggage conveyor and then had to re-pack their bags or get into their coats in the middle of the pathway from security to passport control.

3.3 Security: Personnel

This section describes the activities of the 18 security personnel who were working at the outgoing passenger scanning point.

A security person's task begins when a passenger's bags and other personal items are placed in a tray and they assist with "sorting bags pre scan". The tray then goes through an x-ray machine, and a security person will be "watching the monitor" of the x-ray machine to identify any disallowed items. While this is happening, the passenger walks through a metal detector, and here a security person will be "watching detector". If the detector does not react, the passenger has completed the security check and is able to collect their bags. A security person may be here to "sort bags post scan". If there appears to be anything that needs clarification in the bag it will be carried ("carrying bag") by the security person and then checked ("checking bag and contents"). Once it is checked it will be rescanned ("re-scanning bag") and returned to the passenger ("returning bag to passenger"). Other behaviours that were observed by security personnel included "collecting trays", "talking to passengers" and "interacting with another security person".

Following coding, total time and the average time for each activity were calculated. Table 1 shows the total and average times for all observations as percentages.

Table 1: Total and average time as per activity

Activity	% Total time	% Average time
Sorting bags pre scan	30.56%	30.00%
Watching monitor	23.83%	19.50%
Watching detector	9.91%	16.22%
Sorting bags post scan	7.06%	4.34%
Carrying bag	3.74%	2.62%
Checking bag and contents	4.80%	11.78%
Re scanning bag	2.23%	2.74%
Return bag to customer	0.34%	0.84%
Collecting trays	4.08%	5.01%
Talking to customer	2.88%	1.77%
Interacting with another security person	10.56%	5.19%

The largest time allocation of the security personnel was to sorting bags pre-scan (30%). During this time the security staff member would assist passengers in organising their personal possessions into the x-ray machine in an orderly and timely fashion. Watching the monitors and detectors (average of 19.50% and 16.22% respectively) accounted for the second and third largest time allocations. Checking bag and contents required the fourth largest, and collecting trays, the fifth. Sorting bags post scan was the second least time consuming activity (4. 34%), while the least time consuming was talking with the passengers (1.77%). These figures show that

passengers have little assistance with repacking after passing through security even though, as shown in Section 3.2, this is a time consuming activity and one that can obstruct the general passenger flow.

3.4 Passengers

Figure 4 shows an example of an older couple's activities from entering the airport to approximately an hour before departure. The observation of the couple begins at 0:00:06 seconds when they walk to check-in. They both start the check-in at 0:01:21 minutes and finish at 0:09:18 minutes. During queuing for check-in they are handed exit cards which need to be completed to get through customs. After check-in both passengers walk to the desk which is allocated for filling in the customs card. They arrive at 0:10:42 minutes and begin the process of filling out the information. At 0:11:30 minutes the man walks away to join the queue at the currency exchange. For 6 minutes the couple is involved in different activities – the woman filling in their departure cards, and the man getting foreign currency. After the departure cards are finished the woman joins the man (0:18:44 minutes). They spend another 10 minutes at the currency exchange, with the man spending a total time of 17 minutes 7 seconds. They leave together at 0:28:46 minutes to walk to security and then go through passport control. This takes approximately 15 minutes (However, due to security reasons, it was not possible to record at passport control). When they arrive airside they go to a currency exchange again and spend a further 2 minutes 13 seconds there. They then both walk to a café, where they order a coffee each. After paying for the coffees at 0:45:46 minutes, the man sits at a table while the woman waits for the coffee to be made.

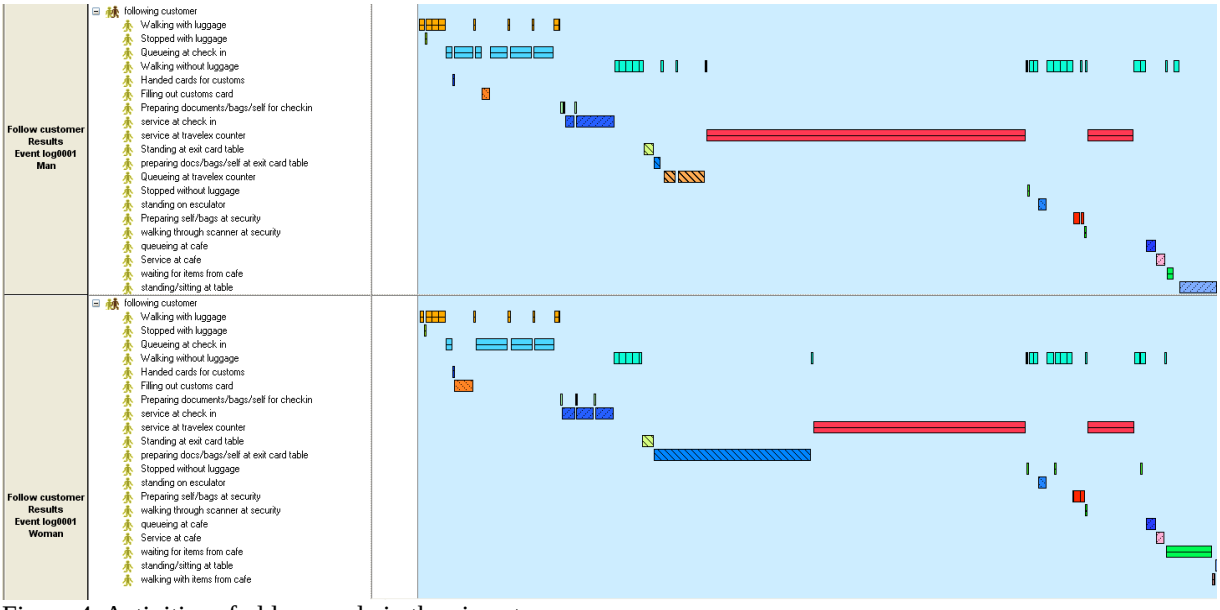

Figure 4: Activities of older couple in the airport

4. Discussion

The focus of this research is the study of airport departure activities in order to understand the processes and interactions that occur. The research is based on the analysis of observational data collected from fieldwork. The coding scheme developed is domain specific in relation to the situation coded. Following the coding, The Observer [14] is used to generate the maps of interaction. These maps are instrumental in the analysis and understanding of activities and the way in which these activities and artefacts mediate interaction. By examining the maps of interaction, it is possible to draw conclusions about activities and passenger interaction. This has

been illustrated through representative examples: (i) mapping ownership of things passengers carry with them after check-in, (ii) mapping passenger (group) activities at the security checking point, (iii) mapping activities of the security personnel at the security checking point, and (iv) mapping of passenger activities from entering the terminal to boarding (specifically, the activities of a couple traveling with a tourist group). The following section details the interactions that are worth noting.

4.1 Ownership

An interaction might have an impact on the perceived ownership of an artefact (in this case, a bag; Section 3.1). From the airport point of view, the bag might be seen as an artefact that needs screening. However, this artefact was mediating an interaction between a man and a woman. The responsibility of the bag was passed from a woman to a man. During the inspection process they both went with the bag and the bag became 'theirs'. This interaction might have an influence when looking for a bag ownership and planning to design domain interface at the screening point, taking into consideration a person-and-bag instead of considering them separately.

4.2 Waiting for Others

At the security checking point, passenger and personnel activities were separately analysed. It has been noted that, within the process chain, most of the passenger time (Section 3.2) is devoted to (i) waiting for luggage (26 seconds), assembling/re-assembling themselves (17 seconds each), and waiting for the others in the group to go through the process (20 seconds). This indicates that people will wait for the group members to complete screening which might, in turn, have implications for passengers flow (as waiting passengers might obstruct it and extend the processing time). The other implication is that the design process should consider the provision of space to facilitate this level of interaction. This scenario also illustrates the impact of social interaction on space design and on the passenger flow chain.

4.3 Security Activity Discrepancy

Analysis of the interaction of security personnel to facilitate the screening process is illustrated in Section 3.3, and the range of coded activities is presented in Table 2. Sorting of the bags before screening (30%) and the watching of monitors (20%) were the most time consuming activities. However, sorting and re-packing the bags after the screening involved very little time (4.34%).

When analysing the security checking point activities, it is noticeable that there is no compatibility between passenger and personnel interactions and mediating artefacts. Passengers spent most of the time after the screening waiting for the luggage and re-assembling themselves, while security personnel spent most of the time on 'before screening' and 'screening' processes. This also illustrates goal differences of these two categories of users and interrelations between interactions.

During the screening process, facilitation is provided. However, after the screening is done, passengers wait for luggage but assistance in sorting bags after screening is minimal. Facilitation for passengers to re-assemble themselves was not provided. This, in turn, might impact on/ obstruct the passengers flow. Additionally, the process of waiting for group members was not considered and facilitated. It can be argued that screening is an

ultimate goal here, but passenger experiences during this process count equally. In this particular case, design did not incorporate or support passenger needs and activity patterns; rather, it focused on technology and process alone.

Table 2: Security screening activities comparison

Activity	Passengers	Security personnel
Assembling	5.93% of the time	
Waiting for luggage	9.10% of the time	
Re-assembling	5.93% of the time	
Sorting bags before the screening		30% of the time
Screening (monitor and detectors)		36% (20%+16%)of the time
Sorting bags after the screening		4.34% of the time

4.4 Sharing Activities

People are linked on a social and individual level: they interact by sharing activity sets among the group or doing them together (as illustrated in Figure 4). The passengers started their activities together, split up to share activities in parallel, and joined together afterwards. This behaviour is worth noting as shared activities have the potential to speed up the passenger flow process by making queuing shorter for experienced passengers. The passengers observed were experienced travelers who knew what needed to be done and planned their set of activities. They also demonstrated interrelations between activities such as obtaining foreign currency and completing the necessary departure cards.

5. Knowledge Transfer to Other Domains

Despite that this research is about the study of different activities its findings are transferable to other domains including design. Their applicability is within the process modeling and planning of the airports, scenarios development as well as designing better services and systems (Table 3).

Table 3: Transfer of findings

Activities	Interaction	Implications
Activities and artefacts	Artefact mediation	Artefact ownership, planning and design of domain interfaces at the screening points considering social interaction impact.
Waiting for others	Group and individuals	Passengers flow modeling; design to provide space for social interaction while waiting for group members to assembly
Security checking	Screening	Design to support passengers needs and activity patterns; passengers flow modeling
Discretionary activities	Sharing	Planning and design to facilitate sharing of trip-related activities; passenger flow facilitation and modeling

Table 3 illustrates summary of findings reported in this paper and their potential implications to the process modelling, design of interfaces, designing for user experiences and an activity focused scenario. This research has opened another opportunity, that is this the potentials of this research approach transfer to various domains.

6. Conclusions

This research is significant as it provides new knowledge about passengers and airport personnel experiences at the airport and how these experiences are affected by the overall operation of the system. It provides a detailed understanding of passenger/staff experiences and expectations during the security check process, and thus has the potential to improve passenger facilitation and flow in future airports.

The purpose of larger research has been to investigate broad activities and interactions at airports. This paper, on the other hand, has reported on research that is dependent on situation and domain. The research methodology and analysis techniques are novel, particularly with regard to the area of investigation. The developed maps illustrate relationships between activities, people processes and technologies, and the subsequent **observations** demonstrate the complex interplay and interrelations at the micro-domain level of interaction. This demonstrates the emergence of interactive models among activities, passengers, staff and artifacts.

The significance of this research is in its potential application to airport terminal design as it advances existing knowledge of user experiences and engagement. The most significant findings presented concern the differences in interactions at the security checking domain (before and after). This has implications for the consideration of passenger facilitation in the design of future airports. Future research will test the findings demonstrated in this paper within the process model and apply the findings to specific domain planning and design.

7. Acknowledgements

The authors would like to recognize Brisbane Airport Corporation for supporting this research

8. References and Citations

[1] Australian Competition and Consumer Commission. Quality of service: price-monitored airports : 2005-06, Canberra, Australia, 2006.

[2] Caves, R.E. and Pickard, C.D. The satisfaction of human needs in airport passenger terminals. *Transport, 147* (1), 9-15.

[3] Ciolfi, L., Deshpande, P. and Bannon, L.J. Understanding Place as Experience: Augmenting Human Activities in Context. in Wright, P., McCarthy, J., Blythe, M., Coyne, R. and Boehner, K. eds. *Workshop on Place and Experience in Human-Computer Interaction*, INTERACT, Rome, 2005.

[4] de Neufville, R. Designing Airport Passenger Buildings for the 21st. Century. *Transport Journal, UK Institution of Civil Engineers, 111* (May), 83-96.

[5] de Neufville, R., de Barros, A.G. and Belin, S. Optimal Configuration of Airport Passenger Buildings for Travelers. *ASCE Journal of Transportation Engineering, 128* (3), 211-217.

[6] de Neufville, R. and Odoni, A.R. *Airport Systems: Planning, Design and Management*. McGraw-Hill, 2003.

[7] de Neufville, R. and Weinberg, R. Rethinking Retail Relationships in a Volatile World. *International Airport Review, 7* (1), 26-34.

[8] Folkes, V.S., Koletsky, S. and Graham, J.L. A field study of causal interences and consumer reaction: the view from the airport. *The Journal of Consumer Research, 13* (4), 534-539.

[9] Gatersleben, M.R. and Weij, S.W.v.d. Analysis and simulation of passenger flows in an airport terminal. in Farrington, P.A., Nembhard, H.B., Sturrock, D.T. and Evans, G.W. eds. *Proceedings of the 1999 Winter Simulation Conference*, 1999, 1226-1231.

[10] International Air Transport Association. SPT General Frequently Asked Questions, 2005.

[11] International Air Transport Association. SPT: Ideal Process Flow V2.0, 2006.

[12] Kazda, A. and Caves, R.E. Passenger Terminals. in Kazda, A. and Caves, R.E. eds. *Airport Design and Operation*, Pergamon, Amsterdam, 2000.

[13] Nardi, B. Studying Context: A Comparison of Activity Theory, Situated Action Models and Distributed Cognition. in Nardi, B. ed. *Context and Consciousness, Activity Theory and Human – Computer Interaction*, MIT Press, Cambridge, Masss., 1996, 69-102.

[14] Noldus. The Observer, Noldus, 2008.

[15] Norman, D. *The Invisible Computer*. MIT Press, Cambridge, Mass., 1998.

[16] Norman, D.A. Logic versus usage: the case for activity-centered design. *Interactions, 13* (6), 45-ff.

[17] Odoni, A.R. and de Neufville, R. Passenger Terminal Design. *Transportation Research, 26A* (1), 27-35.

[18] Pitt, M., Wai, F.K. and Teck, P.C. Strategic optimisation of airport passenger terminal buildings. *Facilties, 19* (11/12), 413-418.

[19] Rowley, J. and Slack, F. The retail experience in airport departure lounges: reaching for timelessness and placelessness. *International Marketing Review, 16* (4/5), 363-376.

[20] Snowdon, J.L., El-Taji, S., Montevecchi, M., MacNair, E., Callery, C.A. and Miller, S. Avoiding the blues for airline travellers. in Medeiros, D.J., Watson, E.F., Carson, J.S. and Manivannan, M.S. eds. *Proceedings of the 1998 Winter Simulation Conference*, 1998, 1105-1112.

[21] Takakuwa, S. and Oyama, T. Modeling people flow: simulation analysis of international-departure passenger flows in an airport terminal *35th conference on Winter simulation*, ACM, New Orleans, Louisiana, 2003, 1627-2634.

[22] Wales, R., O'Neill, J. and Mirmalek, Z. Ethnography, Customers and Negotiated Interactions at the Airport. *IEEE Intelligent Systems, 17* (5), 15-23.