
**Institute of Technology Management and Entrepreneurship**

# A NEW HUMAN-CENTRIC MODEL OF AIRPORT SMART SECURITY SYSTEM TO ENHANCE THE PASSENGER EXPERIENCE



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# A NEW HUMAN-CENTRIC MODEL OF AIRPORT SMART SECURITY SYSTEM TO ENHANCE THE PASSENGER EXPERIENCE

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**DECLARATION**

I declare that this thesis entitled “A New Human-Centric Model of Airport Smart Security System to Enhance the Passenger Experience” is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature : ……...

Name : Ghalib Abdulla Almarri

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**APPROVAL**

I hereby declare that I have read this thesis and in my opinion this thesis is sufficient in terms of scope and quality for the award of Doctor of Philosophy.

Signature : ……

Supervisor Name : Prof. Dr. Massila binti Kamalrudin

Date : ……

**DEDICATION**

I would like to dedicate my highest acknowledgement to my beloved family for always being with me through all the hardship of my study by giving consistently support and encouragement.

## ABSTRACT

Airports are becoming one of the dominant and preferred transport sectors that intensely improving their services and facilities to attract passengers as well as to improve their travel comfort and experience. In aviation industry, improving the passenger experience is often the primary objective of the airport business to increase satisfaction and loyalty among passengers. There is a shortage of literature on the study of human centric design for passenger experience in airport industry order to replicate the findings in other industries. On top of that security has become the main concern as it involves in every phase of the passenger's travel life-cycle from departure to arrival. However, the airport security process and services often impinge on the passenger experience. It is necessary to consider human perspective to model security infrastructure of airport in order to meet the physical and emotional expectation of the passenger. Up to this date, many studies have overlooked the aspect of human when it comes to the security system integration in an airport. Hence, the aim of this study is to develop a human-centric smart security system at the Dubai International Airport, the overall experience of the passengers can be improved as well as their satisfaction level can be increased. There are three objectives of this study. First, is to analyse the factors that influence passenger experience in using smart security system of airport. Second, is to design a new human-centric model that able to enhance the experience of passenger in using the smart security system of airport. Third, is to validate the human-centric model in enhancing the passenger experience. This study adopts a process base design consisting of three phases, which the first is analysis, second is the design and development while the third phase is evaluation and testing. The statistical data obtained are based on statistical package (SPSS) software. A survey was conducted with 400 respondents who experienced using the airport security system at the Dubai International Airport. To develop the human-centric model, data were analysed based on regression model to test the seven hypotheses. The results derived show that there are only six significant factors which are: 1) emotional/feeling ($p < 0.05$, 0.009), 2) behaviour ($p<0.005$, 0.000), 3) needs and requirements ($p<0.05$, 0.004), 4) usability ($p<0.05$,0.00), 5) trust ($p<0.05$,0.00) and 6) ergonomic ($p<0.05$, 0.050) that affect the passenger experiences toward airport security system that focus on smart gate. There is one insignificant factor, which is cognitive ($p > 0.05$, 0.819) towards passenger experiences. We then realised that the model with prototype of smart security gate. Finally, we evaluated the usability of the model through passenger who experience the prototype. The results show a strong agreement among the participants on the usefulness of the tool (65.58%), ease of use (57.70%), ease of learning (65.04%) and satisfaction (56.91%). In summary, the findings of the study will assist airport industry and authorities in UAE airport to better position their security system and the human-centric model is able to enhance the passenger experience.

***MODEL BAHARU BERPAKSIKAN-MANUSIA TERHADAP SISTEM KESELAMATAN PINTAR LAPANGAN TERBANG BAGI MENAMBAHBAIK PENGALAMAN PENUMPANG***

## *ABSTRAK*

*Lapangan terbang menjadi salah satu sektor pengangkutan yang dominan dan menjadi pilihan yang sentiasa menyediakan penambaikan yang baik terhadap servis dan fasilitinya bagi menarik lebih ramai penumpang-penumpang selain turut menambahbaik keselesaan pelancongan dan pengalaman para penumpang. Dalam industri penerbangan, penambahbaikan pengalaman penumpang selalu menjadi objektif utama bagi perkhidmatan lapangan terbang untuk meningkatkan kepuasan dan kesetiaan dalam kalangan penumpang. Selain itu, keselamatan sudah menjadi faktor utama kerana ia melibatkan setiap fasa bagi seseorang penumpang pesawat bermula dari urusan perlepasan hinggalah urusan ketibaan. Walaupun begitu, perkhidmatan dan proses keselamatan di lapangan terbang selalu memberi kesan yang negatif terhadap pengalaman penumpang. Ianya sangat menjadi keperluan untuk mengambil kira faktor perspektif manusia dalam mereka infrustruktur keselamatan di lapangan terbang bagi memenuhi jangkaan para penumpang. Sehingga hari ini, banyak kajian terlepas pandang aspek faktor perspektif manusia apabila melaksanakan integrasi sistem keselamatan dalam lapangan terbang. Oleh itu, tujuan kajian ini adalah untuk mengembangkan sistem keselamatan pintar yang berpaksikan manusia di Lapangan Terbang Antarabangsa Dubai, selain menambahbaik pengalaman penumpang secara menyeluruh dan meningkatkan tahap kepuasan mereka.Terdapat tiga objektif kajian ini. Pertama, adalah menganalisis faktor-faktor yang mempengaruhi pengalaman penumpang dalam menggunakan sistem keselamatan pintar di lapangan terbang. Kedua, adalah merancang model berpaksikan-manusia yang mampu meningkatkan pengalaman penumpang dalam menggunakan sistem keselamatan pintar di lapangan terbang. Ketiga, adalah mengesahkan model berpaksikan-manusia dalam meningkatkan pengalaman penumpang. Kajian ini menggunakan proses-reka bentuk asas kajian yang terdiri dari tiga fasa, yang pertama adalah analisis, yang kedua adalah reka bentuk dan pembangunan manakala fasa ketiga adalah penilaian dan pengujian. Data statistik diperolehi melalui perisian pakej statistik (SPSS). Tinjauan dilaksanakan melibatkan 400 responden yang menggunakan sistem tersebut di Lapangan Terbang Antarabangsa Dubai. Untuk membangunkan model berpaksikan-manusia, data yang diperolehi perlu dianalisis berdasarkan model regresi untuk menguji tujuh hipotesis yang telah dicadangkan. Ringkasan hasil kajian mendapati, terdapat enam faktor yang berpaksikan-manusia di mana ianya mempunyai hubungan yang signifikan dengan pengalaman penumpang terhadap keselamatan sistem lapangan terbang melalui pagar pintar iaitu 1) emosi/perasaan ($p < 0.05$, 0.009), 2) tingkah laku ($p<0.005$, 0.000), 3) keperluan (($p<0.05$, 0.004), 4) kebolehgunaan ($p<0.05$,0.00), 5) kepercayaan ($p<0.05$,0.00) dan 6) ergonomik ($p<0.05$, 0.050). Terdapat hanya satu faktor, iaitu faktor kognitif ($p >0.05$,0.819) tidak mempunyai hubungan yang signifikan dengan pengalaman penumpang. Seterusnya kami merealisasikan melalui model prototaip terhadap pagar keselamatan pintar. Hasil kajian menunjukkan kesepakatan yang kuat di antara para peserta mengenai kegunaan alat (65.58 %), kemudahan penggunaan (57.70%), kemudahan belajar (65.04%) dan kepuasan (56.91%). Ringkasnya, penemuan kajian ini akan membantu industri lapangan terbang dan pihak berkuasa di lapangan terbang UAE*

*untuk meletakkan sistem keselamatan mereka dengan lebih baik dan model manusia berpusat mampu meningkatkan pengalaman penumpang.*

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## LIST OF ABBREVIATIONS

| | | |
|---|---|---|
| ACI | - | Airport International Council |
| ACC | - | Adaptive Cruise Control |
| BMS | - | Biometric Verification System |
| BGMS | - | Border Guard Maintenance System |
| CCTV | - | Closed Circuit Television |
| CMD | - | Cooperative Method Development |
| CPU | - | Central Processing Unit |
| CSI | - | Central Interface System |
| DAS | - | Document Authentication System |
| FUI | - | Facilitate User Interaction |
| HSR | - | High Speed Rail |
| HCD | - | Human Centric Design |
| IATA | - | International Air Transport Association |
| IOT | - | Internet of Things |
| SST | - | Self Service Technology |
| SSKs | - | Self Service Kiosks |
| SCP | - | Security Control Point |
| SPSS | - | Statistical Package for Social Science |
| TOPA | - | Taxonomy of Passenger Experience |

## LIST OF APPENDICES

## LIST OF PUBLICATIONS

1. Ghallib Abdulla Almarri, Massila Kamalrudin 2019. A Study on Passenger Experience using Smart Security System in Dubai Airport. *International Journal of Recent Technology and Engineering (IJRTE)*, 8 (1C2), pp. 851-856.

2. Ghallib Abdulla Almarri, Massila Kamalrudin, Halimaton Hakimi, Safiah Sidek; 2021. Factors Influencing Human-centric model for Better Passenger Experiences Using Smart Security System in Dubai Airport. *Journal of Theoretical and Apllied Information Technology (JTAIT)*, 99 (4), pp. 2697-2709.

# CHAPTER 1

# INTRODUCTION

## 1.1 Introduction

Airports are becoming one of the dominant and preferred transport sectors that are intensely improving their services and facilities to attract passengers by improving the comfort and experience of travelling. Consistent with this focus, security has become the main concern as it involves in every phase of the passenger's travel life-cycle, from departure to arrival. This study aimed to propose a new human-centric model of smart security system airport to improve passengers' experience. In this chapter, we provide a detailed background of the study, followed by the motivation of the study, which is drawn from a review of previous studies within the context of security in airports and passengers' experience at the airports. The problem statement and the research aim, objectives and questions are also presented. The subsequent section presents the significance and scope of the research along with the proposed methodology that will be considered to accomplish the aim and objectives of the research.



## 1.2 Research background

Airport, known as one of the most complex systems in transportation sector has become one of the dominant and preferred travelling options by most travellers. Statistic shows that there are 420,870 planes registered in 2016, in which these planes can accommodate around 250 or more passengers. This is an increment from around 373,534 in 2013, when aviation is relatively new (Mahutga et al., 2010). This development has

necessitated the existence of more than one airport in many world cities, including the United Arab Emirates (UAE).

The UAE airline has become one of the most preferred forms of transportation because it is faster and more comfortable than other modes of transportation. Moreover, in recent years, due to the competition in the aviation sector, the fact that air transportation has become more economical has also led to a serious effect on the preference of air transportation (Alameeri et al., 2017). The number of passengers in domestic and foreign airlines in 2017 was approximately 88,242,099 in comparison to approximately 83,654,250 in 2016, 78,014,838 in 2015 and 70,473,893 in 2014 respectively. This shows that there has been a significant increment at approximately 25% until 2017 (Alameeri et al., 2017). This increment increase of passengers has brought significant improvement in the airport and their current situation. Along with this, it has also triggered the need to design a new airport or extend the existing airports. Like other Emirates in the UAE, the Dubai International Airport has been built and expended several times to fulfill the needs and increasing number of international passengers (Kasarda, 2010).

Along with the development, the security infrastructure of the airport has become the other center of interest. This is because the security processes and services involved in every phases of passenger's travel life-cycle. However, these security processes and services often impinge on the passengers' experience. For instance, the airport screening often caused long waiting lines at the screening points, leading to unpleasant experience. A recent survey found that there is a need to improve and shorten the screening process. However, it may increase the security problems at the airport. As improving the passengers' experiences become the utmost important, there is a necessity to model and develop the security infrastructure of the airport, focusing on the needs, contexts, behaviors, and emotions of the passengers.

Therefore, in this study, the international passenger will be evaluated in terms of the current smart security system experience. The experience of the passengers will be measured from their perception, when using the smart security system.

## 1.3 Problem statement

Airport needs to provide effective security infrastructure and environment for better passengers' experience. Positive and negative passengers' experience in the airport process life-cycle will impact the entire travel experience. Negative experiences will impact the reputation of the airport, which will lead to numerous losses to the airport business. Airport industry has to enhance the passengers' experience in achieving the aims to be the most memorable airport that passengers enjoy their experience of traveling (Wiredja et al., 2015).

Many studies have been reported in human centric design mention on the enhancing passenger satisfaction such as Airport Nepal (Tiwari and Thapa, 2017), Melbourne Airport (Jiang and Zhang, 2016), China's High Speed Rail (HSR) service (Wu, 2018), Jordan airport (Al-Refaie et al., 2014) and Air Asia purchasing online ticket (Budi Kurniawan, 2010). There is a shortage of literature on the study of human centric design for passenger experience in airport industry order to replicate the findings in other industries such as manufacturing (Kluge and Termer, 2017), military equipment (Kuo et al., 2012), healthcare (Mullaney et al., 2012; Vechakul et al., 2015) and product design (Zoltowski et al., 2012).

Therefore, improving the passengers' experience is often the primary objective of the airport business to increase satisfaction and loyalty among passengers. Human centric design (HCD) is a model that adopted from human-computer interaction technology is adopted in this study as a method to enhance the passengers' experience. It is because HCD is an approach that focuses on the user, their needs and requirements to ensure the

developed system is usable and useful from the perspective of users. As airport has high end technology infrastructure especially at the security unit. From 9/11 onwards, security has become a crucial part and leads to prolonged security processing times to airport service (Kirk, 2016). Further, the additional screening of user belonging such as laptops and shoes has added anxiety for passengers (Jones, 2012). It needs to be properly managed to meet passengers' expectations when they experience the security measures at the airport. It is necessary to consider human perspective to model the airport security infrastructure in order to meet the physical and emotional expectation of the passenger.

However, many studies have overlooked the aspect of human when it comes to the security system integration in an airport. In this study, the existing factor for human-centric model from other industries are adopted such as cognitive (Oviat, 2006), behaviour (Oviatt, 2006), emotional (Farsimadan, 2016), and need and requirements (Kluge and Termer, 2017). Trust, usability and ergonomic are emerging variables in the literature and considering them as new factors to human-centric model can help better understanding the passenger's experience at airport (Kluge and Termer, 2017).



It implies that there is a need for an improvement in the existing smart security system at the Dubai International Airport by developing a more human-centric design of the airport. Thus, in the light of the identified challenges, it is argued that the development of a human-centric smart security system at the Dubai International Airport has the ability to improve the overall experience of the passengers, which subsequently provide the competitive advantage to the airport.

## 1.4 Research questions

The present study have formulated the following research questions for this study: