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# Industry 4.0 Elements in Enhancing Future Customer Expectations in KLIA

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**Abstract**

*The rise of new digital technologies is driving the change of various industries around the world. Henceforth, the fourth industrial revolution has opened a new era to the aviation industry through higher levels of automation and digitalization implementations. The digital transformation of airports is expected to bring seamless experiences to passengers through the implementation of industry 4.0 pillars. Customer expectations have elevated as the aviation industry in Malaysia transforms into Airport 4.0 for the future. The objective of this study was to evaluate the nine industry 4.0 elements in enhancing the customer expectations in Kuala Lumpur International Airport by focusing on the diffusion of innovation theory. Additionally, the study was conducted among the millennials to further enhance the significance between Airport 4.0 and its cohesion to this group. Quantitative research using simple random sampling technique was conducted by distributing questionnaires using the online platform. Results obtained from 204 respondents indicated significant relationships between the nine elements of industry 4.0 and expected enhancement toward customer expectations in Kuala Lumpur International Airport. Henceforth, airport management should further focus and divert resources toward enhancing the experience of industry 4.0 elements in consideration of customer needs and wants. This would create a heightened customer experience and at the same time elevate the competitiveness of the airport.*

*Keywords: Aviation industry; Customer expectations; Millennials; Diffusion of innovation*

## 1. Introduction

Aviation industry plays an important role which contributes to the efficient and rapid movement of people, local economy and employment in the world nowadays (Nwaogbe et al., 2013). With the rising of passengers and cargoes demand, the aviation industry is expected to be developed further. Nowadays, customers are expecting and demanding for a more efficient service. Therefore, enhancing the airport performance is necessary to increase customer satisfaction and the competitiveness of the airport. Declining of Kuala Lumpur International Airport (KLIA) performance can be seen through the decreasing KLIA's ranking since 2001. As a consequence, KLIA loses its competitive advantage to other airports that possess higher level of service performance to the customers through digitization.

With the increasing customer expectations towards the services and experience of airports these days, the development of technologies has led the aviation industry towards smart airports. Digital maturity of an airport indicates its level of technology adaptation (Rajapaksh and Jayasuriya, 2020). Even though KLIA has been partly transforming into Airport 4.0, however, to transform completely into Airport 4.0 by implementing all the nine elements of Industry 4.0, certain challenges might be faced as the acceptance level of new technologies might vary among each individual. Therefore, airport authority should

prioritize the implementation of industry 4.0 elements in the aviation industry taking the ranking of industry 4.0 pillars on customer expectations as reference.

## 1.1 Objectives

The objective of the research is to compare the ranking of industry 4.0 elements based on customer preferences in enhancing the performance of KLIA. Moreover, the research aims to recommend the types of measures to improve future performance of KLIA through implementation of industry 4.0.

## 2. Research Framework

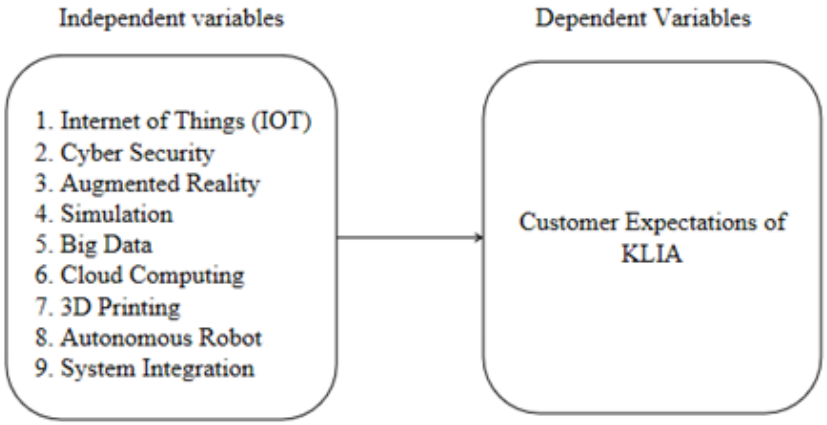


**Figure 1:** The conceptual framework

The independent variables of the study are the nine pillars of industry 4.0 which include Internet of Things (IoT), cyber security, augmented reality, simulation, big data, cloud computing, 3D printing, autonomous robots and system integration. IoT is a system of interrelated computing devices, machines, animals, people or objects that has the ability to transfer data over the internet. It changes the operation of airports through smart sensors, connected devices and analytics (Jamkatelsh, 2018). Cyber security is the protection of computer systems from cyber-attacks. It prevents the information of passengers from losing or leaking in aviation industry (Gulbahar, 2017). On top of that, augmented reality (AR) is one of the most important industry 4.0 pillars at airports. AR application eases the passenger journey in the airport terminal by providing important information and directions to the users (Alodhaibi et al., 2019).

Simulation tools are mathematical modelling or algorithms that optimize the process to achieve the design of production systems while the concept of big data applies to large, diverse and complex datasets that affect the organizational decision making of airports (Erboz, 2017). Cloud computing enables the sharing of platforms that serve to the multiple users. It can store, manage, process and access data online (Lim et al., 2015). In aviation industry, 3D printing drives the airport operations through producing customized goods for the requirements of customers (Erboz, 2017). Autonomous robots are used to solve complex tasks with little or no human intervention (Cheng, 2019). The last pillar of industry 4.0 is

horizontal and vertical system integration. According to Erboz (2017), vertical integration refers to the flexible and reconfigurable systems of factory and the extent to which they are fully integrated with each in achieving agility whilst horizontal integration deals with the integration of partners within the supply chains.

The customer expectations in KLIA are the dependable variable of the study. The airport authorities should understand passengers' needs and expectations in order to deliver a better service that satisfy the customers. Passenger expectation is a key performance indicator for the airport operations (Chow et al., 2014). The people are travelling more frequently compared to previous due to different purposes. According to the AARP's 2019 Travel Trends report, the average millennial plans to take roughly five trips throughout the year (Chow et al., 2014). The generation is highly dependent on complex technologies as they are more exposed to advanced technologies (Lim et al., 2015).

## 3. Methodology

Quantitative research was the chosen method for this research. The main international airport in Malaysia, KLIA was selected as the target area for this study. With a large population size of KLIA, the accuracy of the research outcome might be affected. Therefore, the researchers narrowed down the target population to the millennials that travel internationally. Simple random sampling method was used to select the participants to better reflect diversity and generalization of findings.

The sample size was determined using Krejcie and Morgan as the reference in which the estimated sample size for this research was 384 passengers in KLIA. The sample obtained for this research was 204 respondents due to certain restrictions. Among the difficulties encountered were the inabilities to be directly involved in distribution of questionnaires as the airport was closed, and particularly time restrictions in accumulating the data. As such, questionnaires were distributed to the target respondents through online platforms due to the covid-19 restrictions. The Statistical Package for Social Science Program (SPSS) was used to perform the statistical analysis which is reflected at the next section.

## 4. Results

**Table 1:** Summary of findings

| Hypothesis | Pearson Correlation | Sig. | Sig. | Findings |
|---|---|---|---|---|
| There is a significant relationship between Internet of Things (IoT) and customer expectations in KLIA. | 0.575 | 0.000 (<0.05) | 0.005 | Accepted |
| There is a significant relationship between cyber security and customer expectations in KLIA. | 0.154 | 0.028 (<0.05) | 0.018 | Accepted |
| There is a significant relationship between augmented reality (AR) and customer expectations in KLIA. | 0.473 | 0.000 (<0.05) | 0.047 | Accepted |
| There is a significant relationship between simulation and customer expectations in KLIA. | 0.472 | 0.000 (<0.05) | 0.021 | Accepted |

| | | | | |
|---|---|---|---|---|
| There is a significant relationship between big data and customer expectations in KLIA. | 0.274 | 0.000 (<0.05) | 0.019 | Accepted |
| There is a significant relationship between cloud computing and customer expectations in KLIA. | 0.488 | 0.000 (<0.05) | 0.005 | Accepted |
| There is a significant relationship between additive manufacturing and customer expectations in KLIA. | 0.561 | 0.000 (<0.05) | 0.012 | Accepted |
| There is a significant relationship between autonomous robots and customer expectations in KLIA. | 0.139 | 0.047 (<0.05) | 0.038 | Accepted |
| There is a significant relationship between system integration and customer expectations in KLIA. | 0.564 | 0.000 (<0.05) | 0.004 | Accepted |

## 5. Discussion

Nine independent variables were examined and analysed to rank the effect of each variable on the customer expectations of KLIA. Table 1 above depicts the results obtained from the survey method. The factors were from the elements of the industry 4.0 which include, IoT, cyber security, augmented reality, simulation, big data, cloud computing, additive manufacturing, autonomous robots and system integration. Based on the results, all the factors provide significant effects on customer expectations of KLIA.

IoT is the most important element in driving the customer expectations of KLIA. 89 percent of the early movers insisted that customer engagement would be significantly influenced by IoT (Yenida et al., 2018). Customers have high expectations on the full implementation of biometrics (Yaru et al., 2018). IoT technology connects the airport to off-airport assets and door-to-gate experience in order to leverage the future travel expectations of customers (Yau et al., 2015).

System integration ranked as the second most important element in enhancing future customer expectations in KLIA. System integration involves the combination of various computing systems and software applications to produce a larger system. The integration of systems driving industry 4.0 to work at its optimum. Therefore, system integration is acting as one of the fundamental aspects in adoption of industry 4.0.

Moreover, additive manufacturing or 3D printing ranked third among all the independent variables. It is believed that additive manufacturing would bring greater customer satisfaction. Malaysia, Thailand and Singapore are the biggest adopters of 3D printing in ASEAN region (Yaru et al., 2018). Consumers want customized products as they always have high expectations on the products and services. This certainly bodes well for airports to pursue this method.

Furthermore, cloud computing ranked fourth out of all industry 4.0 elements. Cloud computing facilitates real time tracking of air bodies in the aviation industry. With the assistance of cloud computing systems, customers are also well informed with respect to the weather conditions as well as ticket reservation prior to the airplane departure (Vagdevi and Guruprasad, 2015). Customers often expect all the information they need to be easy and accessible within their fingertips (Tran et al., 2016).

Aside from that, augmented reality is placed in the middle rank. 74% of the consumers would prefer to receive information on their phones with the application of augmented reality (Yenida et al., 2018). The system enables the passengers to get directions in the camera view of their mobile devices and locate the check-in areas easily at airports (Dou, 2020). The passengers expect to get more seamless travels with the enhancement of augmented reality (Yaru et al., 2018). In order to provide top-notch travel experience, the authority needs to leverage the customer expectations and customer satisfaction level through AR technology adoption (Tran et al., 2016).

From the perspective of the airport authority, a simulation model allows more efficient and adaptable resources allocation to respond to peak times as well as optimization of runway usage for a foreseeable impact of flight delays (Lim et al., 2015). The adoption of simulation models is extremely beneficial for airport operations management (Alodhaibi et al., 2019). However, customers may not be able to understand the entire operation process of the airport and the benefits brought by the simulation model.

Big data is less important than simulation and is considered as the seventh important factor that influences the customer expectations of KLIA. Although big data analytics is facilitating the airport efficiency, the customer expectations on the performance of the airport is personalised as it is based on individual preference (Dou, 2020). Due to the complexity and complication of the aviation industry, the data platform involves different technical and layer of networks (Mahmoud et al., 2019). Consequently, big data is less significant to the users as compared to the previous factors.

Cyber security is considered as the second least important factor among all of the other elements. Cyber security is undoubtedly important to prevent breaches of data (Sundareswaran, 2018). However, even if cyber security is important in reducing the risk of data spilling, there are still 53% of customers who may abandon their transactions when too many security steps are required to set up an account (Cheng, 2019). Thus, the need to impose such changes may vary between airports of different regions which have threats that vary in nature.

Autonomous robots are the least significant factor that affects the customer expectations of KLIA. There was a survey conducted regarding the effectiveness of measures to streamline the airport experience. The results showed that robotics is one of the options that was not selected by respondents. This is because the travellers prefer human customer service rather than robotics (Lukes et al., 2017). Therefore, the customers do not have high expectations on the autonomous robot service.

## 6. Recommendations

There are several recommendations after taking into consideration the outcome of the questionnaires. Airport security can be further strengthened through the adoption of new screening technologies and intense digitisation of security processes (Lukes et al., 2017). The airport authorities should implement a fully autonomous system with automated processes especially for check-in and bag drop. Computed Tomography (CT) should be implemented at all security lanes in order to check and screen carry-on luggage at the passenger security checkpoint (Mahmoud et al., 2019). It provides better outcomes for operations through generating 3D images.

Moreover, computer simulation models can help airport authorities to minimize the airport congestion. The models are able to simulate and understand passenger flows to estimate future capacity constraints and service level. Apart from that, KLIA should embrace 5G networks to enhance the communication between machines and development of autonomous vehicles (Cheng, 2019). This is due to the fact that transitioning to 5G network can help KLIA to enhance operations efficiency and attract more passengers by offering high-speed wireless connectivity networks.

Furthermore, KLIA would be able to increase the level of comfort and convenience that meets customer expectations through the implementation of Computerized Maintenance Management System (CMMS). Planning served as an important element for maximum efficiency by allowing proper allocation of resources, equipment, inventory and time, CMMS enables airport facility operators to arrange a proper schedule for advanced preventive maintenance (Marks et al., 2015).

## 7. Conclusions

This research provides a better insight and comprehension on how the industry 4.0 elements enhance the customer expectations of airport and an overview for the airport authorities in enhancing the airport performance. The results highlight that the nine variables derived from the components of industry 4.0 elements have significant relationships with dependent variable, which is on customer satisfaction. Airports are clearly becoming more digitalized that create higher levels of customer expectations. Nevertheless, the need to constantly evolve and invoke higher customer experience is a must to edge toward higher competitive advantages for airports serving mass markets. KLIA is no different, and the ability to focus on industry 4.0 elements in providing a better customer experience would certainly elevate its status as the chosen airport in the region.

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