

Development of an Airport Service Quality and Efficiency Tool: A Comparison Based on Passenger Perceptions During Pre-pandemic and Pandemic Operations

Richard C. Li

Faculty of Industrial and Systems Engineering
Department of Industrial and Systems Engineering
De La Salle University - Manila
Manila, Philippines
richard.li@dlsu.edu.ph

Justin Christopher Javelosa, Endrei Clyne Mercullo, Julian Clement Tan and Trisha

Lauren To Chip

Undergraduate Student – Industrial Engineering
Department of Industrial and Systems Engineering
De La Salle University - Manila
Manila, Philippines

justin_javelosa@dlsu.edu.ph, endrei_mercullo@dlsu.edu.ph, julian_clement_tan@dlsu.edu.ph,
trisha_tochip@dlsu.edu.ph

Abstract

This paper aims to develop an instrument based on passenger perception to measure and assess airport service quality (ASQ) and efficiency in the pre-pandemic and pandemic operations. First, the researchers analyzed literature to identify the dimensions incorporated into the survey instruments. Many authors emphasized the importance of considering quality and efficiency in measuring airport service performance. Thus, the dimensions of Responsiveness, Tangibles, Reliability, and Empathy were critical in passengers' perception of the quality and efficiency of airport services. Then, a 56-item pre-pandemic and 32-item pandemic questionnaire was developed and was administered electronically to 100 respondents through convenience sampling. Results were analyzed using descriptive statistics, clustering, and Principal Component Analysis, proving that every dimension is essential for both operations. Additionally, findings suggest that Empathy and Responsiveness are significant concerning passengers' perception of high service quality. This implies that passengers are keen on the quality-of-service delivery and their safety and well-being while availing of such services in the pre-pandemic and pandemic operations, respectively. Thus, it is recommended for airport managers to focus on the mentioned dimensions to increase passenger satisfaction, quality, and efficiency of service delivery, even in post-pandemic operations.

Keywords

Responsiveness, Empathy, SERVQUAL, ASQ

1. Introduction

The aviation industry is one of the fastest-growing industries with an accounted revenue growth rate of 13.2% yearly, with Europe having a higher growth rate at 6.6% (ICAO 2019; IBISWorld 2021). The industry created and supported more than 65.5 million jobs (ATAG 2019), including direct and indirect jobs in aviation and tourism, respectively. The sector has carried more than 4.3 billion passengers in 2019 (ATAG 2019) and generated economic prosperity with its contribution to increasing the world's GDP by 3.6% (ATAG 2019). However, when the COVID-19 pandemic struck the world in 2020, it seized almost all business operations due to forced lockdowns. The aviation industry lost revenue due to mobility restrictions and the closing of borders by most countries to safeguard its nation against the crippling effects of the virus. As a result, the industry just earned \$328 billion in revenue, which is just 40% of the industry's total revenue in the previous year and just the same as the 2000 revenue (Bouwer et al. 2021). Alongside

revenue losses, the workforce also declined globally following the pandemic's economic recession. The International Labour Organization reports that 114 million people globally became unemployed, increasing by 1.1%, which places the industry in a difficult position. Thus, the industry is challenged to devise creative plans attached to their rendering of services to come back strong in the coming years as the pandemic plateaus, and that normalcy is quite likely.

The industry's shift to the desired and optimal normalcy in the pre-pandemic times will be challenging. For the industry to recover fully and thrive in a post-COVID environment, collaboration and partnership with health agencies are essential regarding health and safety protocols to deliver the services intended without sacrificing the health and safety of the customers (de Cotret 2020). Bouwer et al. (2021) stated that the aviation industry is only likely to recover 80% of its normal levels by 2024, with remote and flexible work arrangements still at hand. Nonetheless, restructuring airlines for greater efficiency and increased aircraft availability will help the industry bounce back and regain its profitability in the succeeding years of recovery, with customer safety at the forefront of service of each airport and airline company globally. Moreover, service quality must also improve to achieve high customer satisfaction, which is a significant challenge for airports in a post-COVID world as inefficiencies might arise, such as terminal congestions and diverse perceptions of customers (Mwesiumo and Halpern 2021). This challenge implies that airports are complex due to their inclusion of different aspects ranging from in-house services to several value chain businesses (Baker and Freestone 2010) that render service towards customers driven by service quality and efficiency. Thus, this paper aims to develop a survey instrument that will assess and measure the quality and efficiency of airport services in conjunction with airport service quality dimensions and other factors affecting service quality that determines passenger perception in the pre-pandemic and pandemic operations.

1.1 Objectives

The study's primary objective is to develop a survey instrument to assess an airport's overall service quality and operational efficiency during pre-pandemic and pandemic scenarios. Concerning the main objective, the following sub-objectives will also be addressed and achieved for further enhancement and contribution:

1. to identify statistically significant dimensions in determining ASQ and overall efficiency of an airport from a customer's perspective;
2. to develop a valid survey questionnaire based on the SERVQUAL instrument;
3. to establish a comparison regarding the findings observed between the pre-pandemic and pandemic survey instruments.

2. Literature Review

Service quality has been of research interest and one of the most debated topics in the service marketing literature (Lee and Yu 2017; Bezerra and Gomes 2016). It rose into popularity in the 1980s, with the primary goal of assessing airport service quality from the passenger's perspective (Mumayiz and Ashford 1986; Omer and Khan 1988). As a result, it aided airports and airport employees to fully understand customer behavior, needs, and perceptions, especially on as to what degree they will be identifying it as an exemplary service or not. After all, the primary goal of airport services is to improve and enhance passenger experience and satisfaction before their flight. Thus, airports see this area as directly related to its profitability and efficiency. Therefore, they seek to operate efficiently to reduce costs while improving the quality of services for passengers (Oum et al. 2003). However, understanding service quality requires a deeper understanding of different views and dimensions of customers' perceptions, dimensions of service offerings, business trends, and so much more. For example, airport service quality is a multidimensional construct and approach encompassing a broad range of customer perceptions and experiences that vary per customer (Lee and Yu 2017; Fodness and Murray 2007). Thus, the airline sector's challenge is correctly identifying the correct perception and expectations on airport service quality (Pakdil and Aydin 2007). In addition, studies should integrate customers' voices in their identification process. Thus, having a good understanding of the customer needs and wants and having the proper methodologies and tools can guide organizations and companies in providing such services (Cronin et al. 2000; Falk et al. 2010) and aid them in their measurement of service quality. Consequently, it will also help airports identify the primary service quality determinants, factors, and dimensions to maintain overall operational efficiency.

Several studies have utilized different methodologies to measure airport service quality. However, most studies are similar to the SERVQUAL methodology, developed by Parasuraman et al. (1998), that focuses on five dimensions of service: tangibility, reliability, assurance, responsiveness, and empathy. The SERVQUAL methodology is proven reliable and valid as it produces accurate and dependable results. For example, Jakupovic et al. (2018) analyzed the methods and found a Cronbach's alpha value of $\alpha=0.908$, which denotes high reliability. Thus, it captures most of the

passenger expectations and perceptions. However, some studies suggest that SERVQUAL does not measure all types of industries (Yuan and Gao 2019). In addition, several issues such as the dynamic nature of customers' expectations and perceptions, capturing customer satisfaction rather than the quality of service itself, and the vagueness of expectations (Jain and Gupta 2004; Mishra 2020) were identified through empirical studies.

Baharum et al. (2020) benchmarked their airport terminal level of satisfaction (ATLOS) model on SERVQUAL to provide the best solution for the air transportation and mobility industry, alongside the criteria of LOS and SERVPERF, which enables the development of an ASQ model that considers particular dimensions. Integrating dimensions from previous evaluation methods to modern standards ensures that all the valuable criteria are considered even as early as the conceptual model development. With the incorporation of the concept of ASQ, passengers will realize drastic improvements in terms of services, which will lead to an increased expectation (Bogicevic et al. 2013) in the long run and will affect the reputation of the airports and airline companies. Chou et al. (2011) aimed to eliminate the vagueness and uncertainty in evaluating service quality using numerical values, filling that gap by utilizing the fuzzy weighted SERVQUAL method where values are expressed in linguistic terms. The findings reveal that the most critical service dimensions are reliability and assurance, responsiveness, empathy, tangibles, then flight pattern. In terms of the service items, safety came first, followed by customer complaint handling, crew courtesy, on-time departure and arrival, and comfort and cleanliness of the seat. Furthermore, within the airline industry, it has been found that ASQ, including the airport's terminal qualities, have a direct effect on the satisfaction of the travelers (Farooq et al. 2018) and that amongst passengers, only airport facilities and servicescape made significant contributions to the customer's satisfaction (Prentice and Kadan 2018). However, Chang and Liao (2009) stated that passengers view reliability and safety-related concerns as their top priority in determining the quality of the airport services. These findings were obtained from utilizing a multiple criteria-decision-making (MCDM) methodology in determining a set of criteria that is highly important in ASQ. He further explains that each standard should have different weights, making the SERVQUAL method quite disadvantageous since it assumes the same importance for each dimension. Measuring and assessing ASQ need not be made on a modular setup but can also be done online. On the other hand, Lee and Yu (2017) applied sentiment analysis using Google reviews. Findings suggest that online reviews were suitable alternative parameters for judging the airport's ASQ and could also be used as a gauge to cross-validate the industry's traditional surveys. These findings can also describe a two-way advantage for passengers, airports, and airline companies. The passengers get to capture the attention of airports and airline companies for them to be able to adjust their services in terms of quality and efficiency that the customers expect and perceive, which consequently can increase customer satisfaction, company reputation, and higher sales.

As for the efficiency of airports, most studies considered complex methodologies by incorporating service units solely inside the airport terminals using fundamental Data Envelopment Analysis (DEA). However, others utilized its variants, such as the two-stage DEA efficiency approach. For example, Assaf and Merkert (2015) employed the two-stage method to solve individual airport efficiency scores and determine the determinants of airport efficiency by basing it on passengers' perceptions. Olariaga and Moreno (2019) similarly utilized DEA that is more basic for determining airport efficiencies in Colombia where conveniences such as availability of seats in the waiting area, bank/ ATM exchange, or flight information display affected airport operational efficiency.

In lieu of the literature and studies examined, assessing quality services combined with overall operational efficiency is essential for airports to focus. Today, the industry has begun to devise recovery plans to stimulate the airline industry by offering various unique and creative product offerings. It may range from flexible flight bookings and cancellations to customer loyalty programs while considering the economic effects of the pandemic that produced a net loss of \$134 billion (IATA 2020). Bouwer et al. (2021) note that for the airline industry to recover, airline companies must stimulate once again by offering leisure travel at the very least, even though a slow recovery for 2024 is expected. As a result, airports will need support in maintaining and ensuring that service quality and efficiency will be held at the highest level of standards to ensure customer satisfaction as if it were in the pre-pandemic years. However, based on the literature examined, studies created no instrument or framework for airports in the light of the COVID-19 pandemic, specifically a system measuring airport service quality and efficiency based on the passengers' perspective. Thus, the authors focused on this niche and aimed to develop a survey instrument that measures the efficiency and quality of airport services while encompassing both pandemic and pre-pandemic situations. This study would benefit airport employees, managers, and top management in regulating and maintaining their service standards towards the passengers in light of the pandemic challenges. Lastly, this would be beneficial by comparing the perceived pre-pandemic service quality and efficiency with the pandemic situation, thereby creating an opportunity to improve their services towards the passengers further.

3. Methods

3.1 Questionnaire Design

Two survey questionnaires were formulated in several steps based on findings of existing literature and through focus group discussions. Firstly, critical demographic variables were determined, such as sex, age, the scope of travel, highest educational attainment, occupation, frequency of trips in the last five years, and trip purpose. Next, several dimensions such as SERVQUAL and ASQ (airport service quality) dimensions were taken into consideration, inspired by the findings of the previous studies for the pre-pandemic survey instrument and focus group discussion for the pandemic survey instrument. Unlike the generality of the dimensions, the author aimed for crafting a survey questionnaire that is catered specifically to the airport setting where the researchers established the following dimensions for both pandemic and pre-pandemic statements: 1) Tangibles, 2) Reliability, 3) Responsiveness, 4) Competence, 5) Empathy, and 6) Efficiency. The statements under each dimension were also crafted based on the literature examined and via focused group discussion among ten respondents through convenience sampling. In addition, the statements were also inspired by the airport service branches that were classified into the following domains by Popovic et al. (2010) (i) check-in, (ii) immigration (iii) security screening, (iv) discretionary activities, and (v) boarding. Thus, two new survey instruments were formulated, specifically a 56-item pre-pandemic survey instrument and a 32-item pandemic survey instrument. The questions are explicitly addressed to passengers' perceptions and were rated using a 5-point Likert scale, with 1 being the strongly disagree and 5 strongly agreeing. Lastly, the questionnaire was statistically analyzed to validate its reliability through Cronbach's alpha and validity through Discriminant and Convergent Analysis and clustering for its usage among airports. The formulated statements are represented in Table 1 and are grouped based on the established dimensions and for the variables for pre pandemic statements for service dimensions are shown in Table 2

Table 1. Pandemic Statements per Service Dimension

Tangibles	Reliability	Responsiveness	Competence	Empathy	Efficiency
Availability of thermal scanners	Airport employees are well trained on the new protocols and requirements added into the system due to the pandemic	Airport staff are able to answer passengers' queries on essential information needed before the flight	Protocols and rules assure the safety of the passengers	Airport staff are proactive with regards to passenger problems and conflicts	Additional safety measures do not hinder or slow down the processes
Availability of alcohol dispensers in check-in counters, immigration area, lounge areas, amenities, and boarding gates	Employees are adamant to make sure minimum health protocols are being observed	The necessary flight information are easily accessible in the airport's website and other social media platforms	Constant sanitation of seats in waiting areas and counters are evident	Staff are calm and collected in performing their services to passengers despite the difficulty of the pandemic situation	Contact tracing mobile applications are fully utilized by the airport management and staff to accelerate the process
There are adequate social distancing markings and health protocol reminders present	Airport employees constantly remind passengers of adhering to the health protocols	There is an automated messaging AI to respond directly to customer queries	Airport employees know and strictly comply with the standard health protocols	The staff are more sensitive to the needs of the passengers	The whole airport processing time (check-in to boarding) is within 60 minutes
Airport elevators have markings for distancing as well as visual signs that the buttons are regularly sanitized	Requirement of vaccination cards and RT-PCR test	The staff are responsive towards reminding passengers to observe health protocols strictly		The staff caters to the needs of other passengers without causing delays on others	Adequate amount of check-in kiosks and security check equipment are present
There are visual signs that airport escalator handles are regularly sanitized	Presence of acrylic dividers in check-in counters				Boarding queues are adequate and organized
Presence of personnel that regulates and checks on passengers who do not follow the protocols	Protocols and rules are reliable, reasonable and valid				Employees ensure swift transactions to avoid the spread of the virus
There are waiting area signages present for passengers who arrived early before the flight	Amount of people present in the airport are regulated				
All airport airport and airline employees wear PPEs					

Table 2. Pre-pandemic Statements per Service Dimension

Tangibles	Reliability	Responsiveness	Competence	Empathy	Efficiency
Counters and kiosks are well-organized	Staff provide the required service	Check-in staff are able to address concerns	Staff have the ability to answer all queries	Staff shows customer importance	There is an adequate amount of check-in counters
Important information regarding check in are clearly stated and organized	Check-in staff addresses the concerns right the first time	Shop clerks and employees are willing to assist customers	Staff demeanor and behavior instill confidence in the customers	Check-in staff give individual attention to customers	Check- in queues must be efficient and delivered quickly
Queue guides are visually present per booth	Technology used in immigration security systems are updated and accurate	Information desk employees are approachable	Immigration officers do not project intimidating authority	Immigration officers are consistently polite in asking the questions	Number of booths are adequate for optimal queues
X-ray machines and countertops must be clean	Immigration and security officers must be adept and thorough in taking security measures	Information desk employees responds to the needs of the passengers	Booth setups give passengers a space for privacy and security	There is an area to allow passengers to remove / consume prohibited items before entering the boarding area	Availability of security personnel to guide passengers
Shops are visually appealing to passengers	The security system thoroughly checks the luggages to ensure safety of the passengers	Gate employees and managers accommodate passengers' queries with boarding passes and flight concerns	Screening process makes you feel safe	The system gives consideration to the needs of elderly, pregnant women, and infants without compromising security.	Number of security equipment and personnel are adequate to ensure smooth flow of the process
Wheelchairs and motorized carts are available for persons with disabilities and the elderly	Completeness of necessary shops to the customers for leisure time while waiting for boarding		Shop clerks and employees are knowledgeable of customer product queries	Shop clerks and employees give personal attention to customers	Screening process is quick to detect any problems/issues/danger
Availability of enough chairs for passengers waiting at the gate	There is a presence of quality food and necessity shops while waiting for flight		Information desk employees are courteous and truthful in providing requested information to passengers	Elder disability assistance is evident within airport facilities	The availability of adequate personnel to serve customers and help them find items as quickly as possible
Currency Exchange booths and ATMs are present in the airport facility	The internet speed of the airport is capable for moderate to high-speed use		Information desk employees are able to resolve passenger queries and concerns	Information desk employees give personal attention to passengers	The availability of adequate cashier lanes for peak times of the day
There is a presence of accessible cellphone and laptop charging stations	Charging stations are in good working condition		Gate employees are able to resolve passengers' flight and boarding concerns.	Gate employees give their personal time and attention to address passengers' flight and boarding concerns	Boarding queues should be adequate and organized
Conducive work spaces are available within the airport facility	Gate employees give accurate time estimates during flight delays				
Presence of adequate number of airport carts for lengthy walkways	Gate employees provide clear and audible announcements of				

5. Results and Discussion

5.1 Related and Important Dimensions

Part of the data analysis is the relatability of each dimension and the dimensions that would best describe the service dimensions passengers perceive for each of the two scenarios. Firstly, the average rating was computed per dimension per respondent for each of the two instruments (Table 3). After which, the researchers used Minitab to conduct a Principal Component Analysis (PCA) to consider the dimensions' variances and common variances (Bastos 2021) and to identify a smaller number of highly correlated dimensions, which would represent the data gathered from the two surveys (Table 4 and 5). Responsiveness, followed by Empathy and Competence, rendered the highest average rating for the pre-pandemic survey. On the other hand, Empathy, Reliability, and Tangibles represent passengers' perception of quality service for the pandemic survey. Findings were parallel to that of the previous studies were reliability, responsiveness, and assurance in the form of competence were found to be necessary to passengers' perception of high

quality and efficient airport services (Pabedinskaitė and Akstinaitė 2014; Pakdil and Aynib 2007; Kratudnak and Tippiyawong 2018; Otieno and Govendor 2016; Chonsalasin et al. 2020).

Additionally, the results of the formulation of the pandemic survey instrument are similar to the findings of other surveys. For example, Elliott (2021) noted that 74% of customer service leaders observed that customers are now empathetic and the services that customers expect to receive. Moreover, Moon et al. (2021) suggest promoting response-efficacy through reliable customer services and tangibles to protect passengers from the virus is essential to maintain customers' patronization of such services. Thus, this will lead to passengers' loyalty and trust towards airports and airlines.

As for the principal component analysis which values are shown in Table 5, for the pre-pandemic survey, all dimensions correlate with one another. It explains 80.1% of the variation in the data obtained from the respondents and exhibits the highest eigenvalue. As a result, PC1 is considered for measuring airport quality service in the typical environment. Similarly, all dimensions correlate for the pandemic scenario where PC1 explains 82.4% of the passengers' perception of services in the pandemic scenario, where adjustments and attention to detail are perceived to be necessary. This translates to offering services that still bear the highest quality standards and promotes safety in terms of the health and well-being of the passengers.

Table 3. Average Dimension Rating

Dimensions	Pre-pandemic	Pandemic
Tangibles	3.95	3.88
Reliability	3.97	3.97
Responsiveness	4.29	3.80
Competence	4.03	3.79
Empathy	4.08	4.05
Efficiency	3.98	3.53

Table 4. Principal Component Analysis Eigen Analysis for Pre-pandemic Survey

	PC1	PC2	PC3	PC4	PC5	PC6
Tangibles	0.414	-0.354	0.440	-0.376	0.083	-0.601
Reliability	0.403	-0.505	0.266	0.530	-0.260	0.402
Responsiveness	0.399	0.564	0.288	0.358	0.558	0.006
Competence	0.409	0.490	-0.122	0.014	-0.731	-0.206
Empathy	0.423	0.051	-0.087	-0.648	0.100	0.617
Efficiency	0.400	-0.242	-0.793	0.169	0.263	-0.233
Eigen Values	4.807	0.416	0.289	0.226	0.160	0.102
% of Variance	0.801	0.069	0.048	0.038	0.027	0.017
Cumulative	0.801	0.871	0.919	0.956	0.983	1.000

Table 5. Principal Component Analysis for Pandemic Survey

	PC1	PC2	PC3	PC4	PC5	PC6
Tangibles	0.408	-0.023	0.629	-0.240	-0.593	0.167
Reliability	0.427	0.298	-0.040	0.052	-0.020	-0.851

Responsiveness	0.402	0.203	-0.652	-0.528	-0.132	0.274
Competence	0.407	0.465	0.004	0.665	0.111	0.405
Empathy	0.389	-0.782	-0.282	0.361	-0.158	-0.040
Efficiency	0.416	-0.203	0.313	-0.295	0.770	0.086
Eigen Values	4.946	0.325	0.279	0.212	0.144	0.094
% of Variance	0.824	0.054	0.046	0.035	0.024	0.016
Cumulative	0.824	0.879	0.925	0.960	0.984	1.000

5.2 K-means Clustering

K-means clustering is used to cluster items into groups in a nonhierarchical method. First, items are grouped into units based on their distance from the group centroid. Then, each item is assigned to a cluster by computing the sum of the squared distance between the data points and the cluster's centroid at the minimum. This technique ensures that each item will only be part of one group (Dabbura 2018). The results of the conducted K-means clustering are summarized in Figure 1 for both pre-pandemic and pandemic scenarios. The figure illustrates the final partitioning of statements per survey instrument. Each cluster represents each dimension, with each dimension having a maximum number of observations that it can accommodate, which will be based on the maximum distance from its centroid to the statements when graphed. Most statements overlap with the given partitioning conditions, meaning that a statement can belong to one or more clusters. Thus, the reclassification of statements was done based on the limits of several observations per dimension, maximum distance from the centroid, and the statement thought concerning the perceived definition of each dimension from reviewed literature.

Final Partition					Final Partition				
	Number of observations	cluster sum of squares	Average Maximum			Number of observations	cluster sum of squares	Average Maximum	
			Within distance from centroid	Maximum distance from centroid				Within distance from centroid	Maximum distance from centroid
Cluster1	18	913.167	6.699	11.925	Cluster1	4	23.750	2.420	2.704
Cluster2	12	390.333	5.535	8.163	Cluster2	19	441.579	4.657	6.827
Cluster3	14	371.429	5.016	7.534	Cluster3	1	0.000	0.000	0.000
Cluster4	29	495.793	4.035	7.108	Cluster4	10	240.500	4.710	7.131
Cluster5	4	90.250	4.698	5.449	Cluster5	17	173.765	3.083	4.441
Cluster6	23	855.217	6.008	9.040	Cluster6	3	58.667	4.300	5.754

Figure 1. Final Partition for Pre-pandemic (left) and Pandemic (Right) Survey Instrument

5.3 Validation

The data gathered from the survey will be used to verify the reliability of the study by utilizing Cronbach's alpha and the validity by using Discriminant Validity to identify whether the factors used are consistently related. The overall Cronbach value of the survey will be compared with the Cronbach value of 0.92 of the SERVQUAL questionnaire, which is a determinant of the reliability of the formulated survey instrument (Parasuraman et al. 1988). The Cronbach alphas for both survey instruments are 0.97 and 0.98 for the pandemic and pre-pandemic research instruments, respectively, which are greater than the minimum threshold value of 0.92 as established by Parasuraman et al. (1988). Therefore, both survey instruments are reliable for organizational use and support reliability. In lieu of the reliability analysis, discriminant and convergent validity were conducted to the two research instruments developed. The basis of the study is the correlation values of the average rating per dimension per respondent due to numerous statements per research instrument. From the results obtained, convergent validity is evident due to the high correlational values that each dimension has with the other dimensions. This means that all dimensions under the construct of airport service quality present relative importance based on the passengers' perspective.

5.4 Proposed Improvements

Future studies can utilize the service quality dimensions identified and compare their validity and reliability with other established instruments. Moreover, the analysis can increase the number of respondents to ensure more excellent reliability of results and might consider a more randomized sampling. Since the paper only presents a reclassification

of statements per dimension, a second run may also be conducted to reevaluate and verify the new classifications of the statements in the service quality questionnaire. Future studies can also determine if the reformulated questionnaire will improve the reliability and validity of the survey instrument. Future studies should also consider a deeper and more comprehensive analysis about the clustering of each variable, and statements presented during the study should also be conducted for better understanding as to which variables influence one another.

Given the results, several factors have shown great significance to customers when they are present in the airport. These factors have been found significant by the customers; therefore, these will help enhance customer satisfaction and help airports increase the quality of their facilities. The most critical dimensions, which gave the highest importance rating, were responsiveness and empathy for pre-pandemic and pandemic operations. Thus, it can be concluded that these two dimensions should be the first dimension that must be given focus. Sustainable improvements applicable to both pandemic and pre-pandemic circumstances that can be made are the following:

1. screening and skill-matching of staff so that they are empowered to perform services to the customers;
2. technological equipment, such as security checks and immigration counters, must be updated and reliable;
3. develop a company handbook for employees to refer to so that they are reminded of the job fundamentals, company values, and the standards of service that they must observe;
4. incentivize employees who exceeded the minimum expectations of their service rendering to customers.

6. Conclusion

In this pandemic, one of the industries that have been greatly affected is the airline industry due to several travel restrictions. However, there is still an inevitable interaction between people from different regions, which risks catching the virus and spreading it to other passengers. Consequently, supply chains in the industry saw a decrease in sales due to fewer people availing such services. Therefore, there is a need to ensure high airport service quality to enhance customer satisfaction even in pandemic operations. Also, ensuring the health and safety of the passenger's present should be a priority of the airline industry, specifically airports. Nonetheless, this study will be beneficial for airports when air travel goes back to normalcy soon, where customer perceptions and critical dimensions are to be considered by airports to stimulate sales growth. As a result, this study aims to identify significant service quality dimensions, determinants, and the overall efficiency of an airport from a customer's perspective and to create a survey that will be reliable and valid. In addition, practical implications for improving airport efficiency for both pandemic and pre-pandemic situations were recommended.

The study formulated two survey questionnaires. The first survey was a 56-item survey instrument containing pre-pandemic items and the second survey was a 32-item questionnaire, which consisted of pandemic statements. Both questionnaires are administered to respondents who had experiences in availing of airport services before and during the pandemic. Additionally, both are tested on their reliability and validity. A Cronbach alpha of 0.97 and 0.98 was obtained for the pandemic and pre-pandemic survey instruments, respectively, more significant than the minimum threshold of 0.92. It implies that both questionnaires are reliable and can be used by different industries or organizations. Moreover, a validity test was also conducted on the average rating per dimension. The results suggest that the data has convergent validity. Finally, it means that all the dimensions identified to measure airport service quality are relatively significant from passengers' perspectives.

The results show that the top three (3) dimensions with the highest average rating during the pre-pandemic operations are tangibles and competence, responsiveness, and empathy. On the other hand, empathy, reliability, and tangibles were genuine for pandemic operations. Thus, in the pre-pandemic operations, passengers are after the quality-of-service delivery matched with well-versed employees and undivided attention to passengers' needs. On the other hand, passengers are more after their health and safety than the pandemic operations. Thus, employees are perceived to be more empathetic towards the passengers' needs and have reliable services that promote health and well-being matched by tangibles such as sanitation areas, alcohol dispensers, and markings throughout the facility while maintaining the highest quality standards of service delivery.

Complementary to the dimensions that should be focused more on by airport employees and customer service leaders, the complementary of each dimension as proven by the PCA done should not be disregarded. Aside from the invaluable insights produced, the researchers considered this, and reclassified statements were also presented in Table 6 and Table 7 by considering the cluster centroids of the questions and the dimensions. The proposed reformulated

questionnaire then contains 51-dimensional statements for the pre-pandemic and 28-dimensional statements for the pandemic.

Table 6. Reclassified Statements per Dimension for Pandemic Scenarios

Tangibles	Reliability	Responsiveness	Competence	Empathy	Efficiency
Availability of thermal scanners	Airport employees are well trained on the new protocols and requirements added into the system due to the pandemic	The necessary flight information are easily accessible in the airport's website and other social media platforms	Protocols and rules assure the safety of the passengers	Airport staff are proactive with regards to passenger problems and conflicts	Additional safety measures do not hinder or slow down the processes
Availability of alcohol dispensers in check-in counters, immigration area, lounge areas, amenities, and boarding gates	Employees are adamant to make sure minimum health protocols are being observed		Constant sanitation of seats in waiting areas and counters are evident	Staff are calm and collected in performing their services to passengers despite the difficulty of the pandemic situation	Contact tracing mobile applications are fully utilized by the airport management and staff to accelerate the process
There are adequate social distancing markings and health protocol reminders present	Airport employees constantly remind passengers of adhering to the health protocols		Airport employees know and strictly comply with the standard health protocols	The staff are more sensitive to the needs of the passengers	Employees ensure swift transactions to avoid the spread of the virus
There are waiting area signages present for passengers who arrived early before the flight	Requirement of vaccination cards and RT-PCR test		Airport staff are able to answer passengers' queries on essential information needed before the flight	The staff caters to the needs of other passengers without causing delays on others	
	Presence of acrylic dividers in check-in counters		The staff are responsive towards reminding passengers to observe health protocols strictly		
	Protocols and rules are reliable, reasonable and valid		Adequate amount of check-in kiosks and security check equipment are present		Employees ensure swift transactions to avoid the spread of the virus
	Amount of people present in the airport are regulated		Boarding queues are adequate and organized		
	Presence of personnel that regulate and checks on passengers who do not follow the protocols				
	All airport and airline employees wear PPEs				

Table 7. Reclassified Statements per Dimension for Pre-pandemic Scenarios

Tangibles	Reliability	Responsiveness	Competence	Empathy	Efficiency
Counters and kiosks are well-organized	Staff provide the required service	Shop clerks and employees are willing to assist customers	Staff have the ability to answer all queries	Staff shows consideration to the needs of passengers especially to the elderly, pregnant women, and infants without compromising security	There is an adequate amount of check-in counters
Important information regarding check in are clearly stated and organized	Check-in staff addresses the concerns right the first time	Information desk employees are approachable	Staff demeanor and behavior instill confidence in the customers	Immigration officers are consistently polite in asking the questions	Check- in queues must be efficient and delivered quickly
Queue guides are visually present per booth	Technology used in immigration security systems are updated and accurate	Information desk employees responds to the needs of the passengers	Immigration officers do not project intimidating authority	There is an area to allow passengers to remove / consume prohibited items before entering the boarding area	Number of booths are adequate for optimal queues
X-ray machines and countertops must be clean	Immigration and security officers must be adept and thorough in taking security measures	Gate employees and managers accommodate passengers' queries with boarding passes and flight concerns	Booth setups give passengers a space for privacy and security	Staff give their personal time and attention to address passengers' flight and boarding concerns	Availability of security personnel to guide passengers

Shops are visually appealing to passengers	The security system thoroughly checks the luggages to ensure safety of the passengers	Screening process makes you feel safe	Number of security equipment and personnel are adequate to ensure smooth flow of the process
Wheelchairs and motorized carts are available for persons with disabilities and the elderly	Completeness of necessary shops to the customers for leisure time while waiting for boarding	Shop clerks and employees are knowledgeable of customer product queries	Screening process is quick to detect any problems/issues/danger
Availability of enough chairs for passengers waiting at the gate	There is a presence of quality food and necessity shops while waiting for flight	Information desk employees are courteous and truthful in providing requested information to passengers	The availability of adequate personnel to serve customers and help them find items as quickly as possible
Currency Exchange booths and ATMs are present in the airport facility	The internet speed of the airport is capable for moderate to high-speed use	Information desk employees are able to resolve passenger queries and concerns	The availability of adequate cashier lanes for peak times of the day
There is a presence of accessible cellphone and laptop charging stations	Charging stations are in good working condition	Gate employees are able to resolve passengers' flight and boarding concerns.	
Conducive work spaces are available within the airport facility	Gate employees give accurate time estimates during flight delays	Check-in staff are able to address concerns	
Presence of an adequate number of airport carts for lengthy walkways	Gate employees provide clear and audible announcements of boarding or changes in boarding time		
Visual signs (i.e. gate number, amenity facilities, etc.) and flight information display are present	Boarding queues should be adequate and organized		
Queues are organized and well-coordinated			

References

- Assaf, G. and Merkert, R., Using DEA models to jointly estimate service quality perception and profitability – Evidence from international airports, *Transportation Research Part A*, vol. 75, pp. 42–50, 2015.
- ATAG, Aviation Benefits Report, Available: <https://www.icao.int/sustainability/Documents/AVIATION-BENEFITS-2019-web.pdf>, 2019.
- Baharum, Z., Yacob, A., Hamid, S. F. Z. A., and Rahman, F. A., An Integrated Model on Airport Terminal Level of Satisfaction for Service Quality Evaluation: A Proposal, *International Journal of Advanced Trends in Computer Science and Engineering*, vol. 9, no. 1.3, pp. 247-250, 2020.
- Baker, D.C., and Freestone, R., *The airport city: a new business model for airport development*, Routledge/Taylor and Francis, Oxon, UK, 2010.
- Bastos, R., Exploratory Factor Analysis vs Principal Components: from concept to application. Available: <https://towardsdatascience.com/exploratory-factor-analysis-vs-principal-components-from-concept-to-application-b67bbdb82c4>, January 21, 2021.
- Bezerra, G.C.L. and Gomes, C.F., Measuring airport service quality: A multidimensional approach, *Journal of Air Transport Management*, vol. 53, pp. 85-93, 2016.
- Bogicevic, V., Yang, W., Bilgihan, A., and Bujisic, M., Airport service quality drivers of passenger satisfaction, *Tourism Review*, vol. 68, pp. 3-18, 2013.
- Bouwer, J., Saxon, S., and Wittkamp, N., Back to the future? Airline sector poised for change post-COVID-19, Available: https://www.mckinsey.com/~media/mckinsey/industries/travel%20logistics%20and%20infrastructure/our%20insights/back%20to%20the%20future%20airline%20sector%20poised%20for%20change%20post%20covid%2019/back-to-the-future-airline-sector-poised-for-change-post-covid-19_vf.pdf?shouldIndex=false, April, 2021.

- Chang, Y. and Liao, M., The effect of aviation safety education on passenger cabin safety awareness, *Safety Science*, vol. 47, no. 10, pp. 1337-1345, 2009.
- Chou, C., Liu, L., Huang, S., Yih, J., and Han, T., An evaluation of airline service quality using the fuzzy weighted SERVQUAL method, *Applied Soft Computing*, vol. 11, pp. 2117-2128, 2011.
- Chonsalasin, D., Jomnonkwo, S., and Ratanavaraha, V., Measurement model of passengers' expectations of airport service quality, *International Journal of Transportation Science and Technology*, pp. 1-11, 2020.
- Cronin, J.J.J., Brady, M.K., and Hult, T.M., Assessing the effects of quality, value, customer satisfaction on consumer behavioral intentions in service environment, *J. Retail.*, vol. 76, no. 2, pp. 193-218, 2000.
- de Cotret, Y., Gadsden, T., Markovic, D., and Terry, B., COVID-19 Aviation's recovery flight plan, Available: <https://www2.deloitte.com/content/dam/Deloitte/ca/Documents/public-sector/ca-en-aviation%27s-recovery-flight-plan-aoda.pdf>, 2020.
- Dabbura, I., K-means Clustering: Algorithm, Applications, Evaluation Methods, and Drawbacks, Available: <https://towardsdatascience.com/k-means-clustering-algorithm-applications-evaluation-methods-and-drawbacks-aa03e644b48a>, September 18, 2018.
- Elliott, C., This Is How The Pandemic Improved Customer Service, Available: <https://www.forbes.com/sites/christopherelliott/2021/01/28/this-is-how-the-pandemic-improved-customer-service/?sh=c3e8a48dd7>, January 28, 2021.
- Falk, T., Hammerschmidt, M., and Schepers, J.J.L., The service quality-satisfaction link revisited: exploring asymmetries and dynamics, *J. Acad. Mark. Sci.*, vol. 38, pp. 288-302, 2010.
- Farooq, M.S., Salam, M., Fayolle, A., Jafaar, N., and Ayupp, K., Impact of Service Quality on Customer Satisfaction in MALAYSIA Airlines: A PLS-SEM Approach, *Journal of Air Transport Management*, vol. 67, pp. 169-180., 2018.
- Fodness, D. and Murray, B., Passengers' expectations of airport service quality. *Journal of Services Marketing, J SERV MARK.*, vol. 21., pp. 492-506, 2007.
- IBISWorld, Global Fastest Growing Industries by Revenue Growth (%) in 2021, Available: <https://www.ibisworld.com/global/industry-trends/fastest-growing-industries/>, 2021.
- IATA, COVID-19 Updated Impact Assessment, Available: <https://www.iata.org/en/iata-repository/publications/economic-reports/covid-fourth-impact-assessment/>, April 14, 2020.
- ICAO, The World of Air Transport in 2019, Available: <https://www.icao.int/annual-report-2019/Pages/the-world-of-air-transport-in-2019.aspx>, 2019.
- Jain, S. and Gupta, G., Measuring Service Quality: SERVQUAL vs. SERVPERF Scales, *VIKALPA*, vol. 29, no. 2, pp. 25-37, 2004.
- Jakupovic, V., Solakovic, S., Celebic, N., and Kulovic, D., Reliability and Validity of Modified Service Quality Instrument (SERVQUAL) in Patients' Motivation to Adhere to Insulin Therapy, *Material socio-medica*, vol. 30, no. 1, pp. 53-57, 2018.
- Kratudnak, S. and Tipayawong, K.Y., Analysis of Key Factors for Airport Service Quality: A Case Study of Three Regional Airports in Thailand, *Proceedings of the International Conference on Industrial Engineering and Operations Management*, Bandung, Indonesia, March 6-8, 2018.
- Lee, K. and Yu, C., Monitoring Airport Service Quality: A Complementary Approach to Measure Perceived Service Quality Using Online Reviews, Available: <https://commons.erau.edu/publication/1162>, 2017.
- Mishra, A., Servqual Questionnaire with FREE template, Available: <https://managementweekly.org/servqual-questionnaire/>, Accessed on October 11, 2020.
- Moon, J., Choe, Y., and Song, H., Determinants of Consumers' Online/Offline Shopping Behaviours during the COVID-19 Pandemic, *Int. J. Environ. Res. Public Health*, vol. 18, no. 1593, pp. 1-15, 2021.
- Mumayiz, S.A., and Ashford, N., Methodology for planning and operations management of airport terminal facilities, *Transp. Res. Rec.*, vol. 1094, 1986.
- Mwesiumo, D., and Halpern, N., Airport service quality and passenger satisfaction: The impact of service failure on the likelihood of promoting an airport online, *Research in Transportation Business & Management*, pp. 1-15, 2021.
- Olariaga, O.D., and Moreno, L.P., Measurement of Airport Efficiency: The Case of Colombia, *Transport and Telecommunication*, vol. 20, no. 1, pp. 40-51, 2019.
- Omer, K.F., and Khan, A.M., Airport landside level of service estimation: utility theoretic approach. *Transp. Res. Rec.*, no. 1199, pp. 33-40, 1988.
- Otieno, P.S. and Govender, K., Managing airport service quality – the impact of self-service technologies, *Investment Management and Financial Innovations*, vol. 13, no. 3, pp. 387-393, 2016.

- Oum, T. H., Yu, C., and Fu, X., A comparative analysis of productivity performance of the world's major airports: summary report of the ATRS global airport benchmarking research report 2002. *Journal of Air Transport Management*, vol. 9, pp. 285–297, 2003.
- Pabedinskaite, A. and Akstinaitė, V., Evaluation of the airport service quality. *Procedia - Social and Behavioral Sciences*, vol. 110, pp. 398 – 409, 2014.
- Pakdil, F. and Aydin, O., Expectations and perceptions in airline services: An analysis using weighted SERVQUAL scores. *Elsevier*, vol. 13, no. 4, pp. 229-237, 2007.
- Parasuraman, A., Zeithaml, V.A., and Berry, L.L., SERVQUAL: a multiple item scale for measuring consumer perceptions of service quality. *Journal of Retailing*, vol. 64, pp. 12–40, 1988.
- Popovic, V., Kraal, B., and Kirk, P.J., Towards airport passenger experience models, *Proceedings of 7th International Conference on Design and Emotion*, Chicago, United States, October 2-7, 2010.
- Prentice, C. and Kadan, M., The role of airport service quality in airport and destination choice, *Journal of Retailing and Consumer Services*, vol. 47, pp. 40-48, 2018.
- Yuan Q., and Gao Q., Is SERVQUAL Reliable and Valid? A Review from the Perspective of Dimensions in Different Typical Service Industries. *Lecture Notes in Computer Science*, vol. 11576, 2019.

Biographies

Richard Li is an ASEAN Engineer and a Professional Industrial Engineer. He obtained his MSIE degree from De La Salle University (DLSU) in 1993 and is currently a PhD IE degree candidate from the same university where he is an Assistant Professor in the Department of Industrial Engineering. He was the Department chairperson from 2007-2009 and from 2012-2016. He is also the appointed University Solar Car Project Manager from 2012 to the present time. He was a Board Member of the Operations Research Society of the Philippines (ORSP) from 2002-2006 and remains a member of the ORSP to this day. He also represented DLSU Solar Car Project team as an active member in the regular board meetings of the Sikat Solar Challenge Foundation Inc. His specialization is in operations research, specifically in mathematical programming (linear and mixed integer linear programming) that involves decisions and optimization in inventory management, inventory planning and inventory cost control, material/process selection and distribution/logistics/warehousing in a product supply chain context, value chain analysis, among others. Research interest also includes performance measurement in service industries or service-intensive activities using variations of the SERVQUAL instrument and Data Envelopment Analysis. His industry projects and training engagements involve both the public and private sectors and have revolved around the areas of Systems Modeling and Optimization, Systems Evaluation and Improvement, Business Process Management, Design and Streamlining, Process Mapping and Documentation, Total Quality Management and Continuous Process Improvement, Service Quality Improvement, Warehouse and Inventory Management, Financial Analysis and Industry and Market Research.

Justin Christopher Javelosa is a fourth-year Industrial Engineering student from De La Salle University and is currently taking up Industrial Management Engineering with a minor in Service Management. For 2 years, he headed projects as an Associate Vice President in the Industrial Management Engineering Society of the same university.

Endrei Clyne Mercullo is a fourth-year Industrial Engineering student, with a minor in Service Management at De La Salle University Manila of Industrial and Systems Engineering Department. He is a current member of Industrial Management Engineering Society (IMES) of the same university. His research interest includes Ergonomics and Human Factors, Service Management, and Operations Management.

Julian Clement Tan is an undergraduate student currently taking up Industrial Engineering minor in Service Management in De La Salle University. He has been a member of the Industrial Management Engineering Society (IMES), the local school organization for Industrial Engineering students at the same university and has actively participated with their different conferences and seminars. During his formative years he has already involved himself in various organizations within and outside his academic institution. He has already spearheaded conducting various activities that benefit his immediate local community as well as serving within the premises of the school organizations he was involved in.

Trisha Lauren To Chip is a fourth-year Industrial Engineering student, with a minor in Service Management at De La Salle University Manila of Industrial and Systems Engineering Department. Her research interests include Service Management and Operations Management. She aspires to pursue a career in a multinational corporation.

