Post COVID-19 Precautions Management in Small-scale Airports:
Evaluation of Check-in Process in Erkilet Airport by Simulation

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Abstract

Purpose: The number of passengers, luggage, and cargo served at the airports increases at certain times due to flight density (peak hours). Due to the long queues at check-in desk during peak hours, there may be delays in flight operation processes. In addition, it is estimated that check-in queue times will increase even more in accordance with Covid-19 social distance rules. The aim of the study is to calculate the possible effects of Covid-19 measures on check-in queues at small-scale airports. For this purpose, the number of check-in desks that should be opened at peak hours was evaluated by simulation method at Erkilet airport.

Design/methodology: In the first part of the study, the effects of Covid-19 measures on the aviation industry and airport management issues are presented with the literature research. Information about Erkilet airport was collected by using qualitative research method and the intensity experienced during peak hours was simulated in the ARENA-TRIAL simulation program. Two 3D scenarios were prepared, including the pre and post COVID-19 social distance constraints.

Findings: In the analysis section of the research, check-in queue times and staff productivity were calculated for both scenarios. In the calculations, comments were made regarding the problems that may occur during the peak hours of the airport within the scope of the check-in desk and COVID-19 social distance constraints. Based on the analysis outputs of the simulation program, recommendations were made for small-scale airports.

Originality/value: The effect of COVID-19 on the check-in process in small-scale airports was examined for the first time with simulation method.

Keywords: Check-in, airport, Covid-19, simulation
1. Introduction

Aviation operations are dynamic and non-flexible. Avoiding failures in operations is a priority and fundamental for the safety of passengers and people who work in air transport. Moreover, almost all operational processes in aviation bring high direct and operational costs. Therefore, the use of simulation methods is important for the industry. Airport simulation applications are used to calculate conditions that affect the aircraft landing, take-off, ground movements, wind and weather. Besides all these calculations, simulation methods can be used in the demand & capacity analysis of the airport. The simulation technologies that can be used in the airport management for security, education, planning, and etc. to minimize risk and cost (Durak et al., 2018).

Airports are a system that continues flights actively for 24 hours. During the day, especially at certain times, due to the high number of flights, high numbers of passengers, freight and cargo arrive, and there are hours of intensive. In aviation literature, these intensive hours are called peak-rush hours. Meeting the Passenger demand during peak hours is one of the important criteria in airport design and planning. Demand must be met at airports under peak hours. Thus, the services needed for the passengers are guaranteed.

In this research, the peak days and hours of flight density which cause the long queues in the check-in process at the airports are examined. It is observed that the total travel times due to increasing of waiting times of the passengers are prolonged and thus have negative effects on the service quality. In the research, the problems that may occur during the peak hours of the airport were analyzed within the scope of COVID-19 social distance constraints by using simulation method.

2. Literature Review

2.1. Airport measures post Covid-19

Many epidemics have emerged throughout the history of humanity, causing mass deaths. Covid-19, which emerged in Wuhan, China, is a virus that causes mass deaths at the global level. According to recent research, Covid-19 virus has been found to be linked to a family of viruses with Severe Acute Respiratory Syndrome (SARS) and some common cold types (WHO et al., 2020).

According to the data of World Health Organization (WHO), the appearance of the new virus, which first appeared in China on December 31, 2019, took place on January 13, 2019. Covid-19 was considered a pandemic (epidemic) by WHO due to the high rate of transmission from person to person and the disease process occurring at an alarming level of violence (WHO, 2020).

Aviation is caused as one of the most important reasons the spread of the virus to rapidly toward the world countries. Flights to countries with Covid-19 were reduced by the end of 2019. Ultimately, with the transformation of the epidemic into a pandemic, the passenger flights around the world were completely stopped. With the cessation of flights, a major impact has occurred in the aviation companies as airlines, airports and ground handling, and etc. In addition, report of International Airport Council (ACI), the airport revenues will exceed 45 billion by the end of 2020 (ACI, 2020).

With Covid-19, which creates deep traces on aviation by covering the whole world, it is anticipated that there will be differences in the operations carried out at the airports. Along with the outbreak, many precautions have been specified by WHO. Some of these precautions are: social distance, the necessity of using a mask, frequent cleaning of the contacted objects and frequent washing of the hands (WHO et al., 2020). All of these have also
reflected as precautions in the aviation operations. A kind of Mandatory Certification in Turkey was announced according to the precautions of pandemic by Directorate of Civil Aviation General. The effect of "Airport Pandemic Measures and Certification Circular" in the check-in process pre-post Covid-19 are shown in Table 1.

Precautions taken at the check-in desks at the airports, where passengers are waiting in line, gain importance post-Covid-19. In this study, the current check-in process of the airport and the social distancing brought to precautions along with Covid-19 were simulated.

| Process Time                  | Pre-Covid-19                                      | Post-Covid-19                                      |
|-------------------------------|---------------------------------------------------|---------------------------------------------------|
| Online check-in               | Informing the passengers                          |                                                   |
| Check-in baggage drop-off     | Printing and handing over the boarding pass       | Health and safety information                      |
|                               | Performing identity check                         | Mask control                                      |
|                               |                                                   | Cabin baggage not accepted                         |
|                               |                                                   | Passenger guidance screens not in contact          |
|                               |                                                   | Contactless identity check                         |
|                               |                                                   | E-boarding pass application                        |

Table 1. The process of the check-in pre-post Covid-19 (SHGM, 2020)

2.2. Simulation model of airport passenger services

Simulations have application areas such as communication, production, military and transportation. The use of simulations can be analysis and training in the airport. The simulation models are different types as intermittent event, continuous, discrete-continuous in Airport Passenger Services. Simulations can have different programming languages and environments (Goldsman et al., 2009).

Airport terminals are a facility used by passengers to change the mode of transportation. In order to get on the aircraft, the passenger must go through different processes. The first of these processes ground access of the arrival passenger to the terminal by highway or railway. After entering the terminal, passengers apply to the check-in desk to receive their boarding passes and deliver their luggage. Check-in procedures are provided by airport personnel or airline personnel, depending on the agreements of the airport. The supply, conditions and performance measurements of the facilities and resources required to check-in are provided by the airport.

Inefficient management of resources (ground services, personnel, table etc.) causes density and congestion at the terminals (Mota, 2015).

Table 2 lists the check-in studies carried out with the simulation method in the literature.

Bevilacqua and Ciarapica (2010) conducted a simulation application to improve performance by analyzing the current status of check-in operations at an airport. Check-in desk and personnel planning were among the most influential issues in this process. (Bevilacqua & Ciarapica, 2010).

In the study conducted by Marintseva (2014), simulations were applied on the queues that occurred during the check-in processes at Boryspil Airport in Kiev, Ukraine. It has been demonstrated that the waiting times can be reduced by applying a dynamic approach to opening and closing check-in desk (Marintseva, 2014).

In a study conducted by Mota (2015), a new methodology was presented by combining evolutionary algorithm and simulation to eliminate the perception of excessive waiting times in check-in areas and the resulting decrease in service quality (Mota, 2015).

Félix and Reis (2016) carried out work at Lisbon Airport Terminal 1. According to the model results, it has been observed that the problem will be eliminated with the encouragement of the passengers to be directed towards self check-in procedures and the introduction of bagdrop applications (Félix & Reis, 2016).
| Author, Year   | Purpose of the study                                      | Result                                                                 |
|---------------|----------------------------------------------------------|------------------------------------------------------------------------|
| Bevilacqua & Ciarapica, 2010 | Performance improvement                                  | Reduction of the queuing time                                          |
| Mariutseva, 2014   | Reduction of check-in queues                             | Decrease of the passenger waiting times                                |
| Mota, 2015         | Reducing passenger waiting time, improving service quality | Reducing passenger waiting time, improving service quality             |
| Félix & Reis, 2016 | Examination of passenger behavior and performance in the check-in area | Individual applications such as self check-in and bagdrop will have a positive effect on performance. |
| Al-Sultan, 2018    | To minimize operational costs and maximize passenger service level | Optimization at passenger service level with 15 different scenarios    |
| Chen et al., 2014  | Increasing customer satisfaction and customer value at airport | The waiting time of the customer decreased and customer satisfaction increases |
| Gonçalves & Caetano, 2017 | Determined service level assessment for small-scale airports | Airport characteristics, passenger processing, and prices are significant impact on the overall service level of the small-scale airport |

Table 2. Check-in studies in the literature

In the study of Al-Sultan (2018) developed fifteen different scenarios on the check-in procedure to minimize operational costs and maximize passenger service level at Kuwait International Airport. These scenarios were implemented on ARENA simulation software. In the study, the number of passengers and arrival models for each flight were examined, allowing for predictions and optimization decisions for important decisions at the passenger service level (Al-Sultan, 2018).

Chen et al. (2014) conducted a study on service innovations aimed at increasing customer satisfaction and customer value at airports. As a result of the study, the presence of self check-in kiosk devices has an important place among the necessary service innovations at the airport. In this way, while the waiting time of the customer and the total travel time are shortened, customer satisfaction also increases (Chen et al., 2014).

Gonçalves and Caetano (2017), conducted a study including service level assessment for small-scale airports. According to the study, it is stated that the service level at airports consists of three dimensions. These dimensions; airport characteristics, passenger processing, and prices. It has been concluded that the dimensions including the check-in process have a significant impact on the overall service level of the small-scale airport (Gonçalves & Caetano, 2017).

When the studies in the literature are examined, it is seen that the airport service quality perception of the airport customers is related to the check-in queues. Customer satisfaction can be achieved by reducing check-in queues. Thanks to customer satisfaction, it is predicted that the satisfaction rates with the services received will increase. Decreasing the waiting times of the customers may increase the service quality and consequently the customer satisfaction.

3. Methodology

The interview technique used in the qualitative research method was used to collect data on the airport. Validity and reliability concepts, which are stated as important criteria in scientific research, are considered as credibility within the framework of qualitative research (Yıldırım & Şimşek, 2018). Accordingly, quotations from the interview were included in order to ensure the credibility of the study.

The research is based on at Erkilet Airport and the company name will not be given due to ethical rules. In the scope of the research an employee at Erkilet Airport for many years received data on the airport's peak hours, the types of aircraft served and the number of passengers, and the flows of passengers at the airport. The data were obtained from the qualitative research methods by interview technique. According to the airport
information received from the participant, the airport model was established using ARENA-TRIAL. Passengers’ check-in procedures are stochastic and variance according to the seasons.

In this study, the intensity experienced at the airport at the peak hours was simulated in the ARENA-TRIAL simulation program with 2 scenarios as pre-post Covid-19.

The increase in the check-in queues and the increase of the waiting times of the passengers are simulated during the peak hours when the number of flights is high at the airports. In this study, discrete event simulation was applied. Because the arrival time of the passenger’s check-in desk values vary at certain times, it was defined as a discrete event. The assets (passengers), activities and events (arrival time and service time), resources (staff) and variables, which are the structural components of the check-in simulation, are modeled using a random number generator.

4. Analysis and Findings

4.1. Erkilet airport

Airport Kayseri Erkilet cities in Turkey and is operated by the State Airports Enterprises. According to DHMI (State Airports Authority) data, Erkilet Airport serves 2,325,863 passenger, that are 1,980,252 domestic and 345,611 international in 2019. Aircraft traffic data is a total of 15,060 aircraft, including 12,605 domestic and 2,455 international flights in 2019 (DHMI, 2020). According to these data, the airport is considered a small airport by aviation authorities in Turkey. In the study, the model was run with peak data occurring at certain periods of the year at Erkilet Airport. In the study, the breaks and shifts of the employees are ignored and it is assumed that they are constantly working.

The participant interviewed gives the following statements about the business periods of the airport; “In winter, Erciyes is a high level of ski tourism, and in summer there is a concentration of our citizens living abroad (expatriates).”

According to the data, it can be said that the airport has a flow of passengers for different reasons both in summer and winter.

The number of check-in desk at the airport, which is included in the scope of the study, is expressed as 12 on international flights and 13 on domestic flights. However, it is stated that not all of these check-in desks are actively used. It was stated that there are more flights in the summer, and there is a shortage of resources due to the fact that there are more flights in the international flights and there are airlines operating at the same hours.

The information given within the scope of the participant’s peak period of the year and the airlines served by the company are as follows;

“We can consider the busiest month in July. It is possible to say the first week of July as a week.

Boeing 737-800, Boeing 737-8K5. To give an example in the peak period, a company always reserves 180 seats of the plane's capacity (189 seats). Plane number occupancy ratio is 95%, with 180 passengers.”

Simulation was carried out using the data of July and the number of passengers given in this scope, in the study.

Kiosk devices are considered as a factor that reduces waiting times in check-in procedures. However, there is no check-in kiosk at Erkilet airport. In this context, it can be said that all check-in procedures are carried out at the check-in desk.

It is stated that the arrival time of the passengers to the desks varies in domestic and international lines. The information received from the interviewer is as follows;

“We open our desks 2.30 hours before international flights and 2 hours before domestic flights. We close our desks with an average of 20 minutes remaining. For the normal time, it is too late for the desk closing, but unfortunately passengers apply to the desk too late, the operations officer closes our desks late to avoid calculating again and asks the captains to close late. Passengers are often admitted to the flight when they arrive late. Assuming that the departure is at 14.00, there are times when we accept passengers at
VIP and CIP passengers are usually different check-in desks at the airports. However, there is no separate check-in for VIP and CIP passengers due to the fact that Erkilet Airport is an airport that can be described as small in nature. It is stated that the transactions of VIP and CIP passengers are also carried out from the same check-in desks.

Due to the importance of the area to be simulated within the distance of airport, the walking times of the passengers were also specified. Data on walking distance could not be measured in real environment. The reason is that the airport does not serve due to the Covid-19 pandemic that has been going on for a while. Therefore, data on walking times are considered as average values.

4.2. Simulation scenario

The peak hours of the check-in desk at the Erkilet Airport international area is simulated by the data obtained in the interview were taken into consideration. Within the scope of current data, the check-in process has been simulated in the ARENA-TRIAL (Figure 1).

The check-in process has been simulated within the scope of changes such as the social distance that may occur in the process of the airport pre-post Covid-19 increasing the controls.

Currently, the pre-Covid-19 check-in times are given as 130 minutes, and in the case of the post Covid-19 process, 200 minutes, considering the measures. There has been no change in the number of employees working at the desk and other issues. In this context, the results obtained and the comparison of the results will be evaluated in the findings section.

4.3. Analysis

In the study, the number of passengers was determined as 540 for both scenarios. Changes that may occur in the number of passengers are ignored, and the processing times of passengers at the desk due to the reduced of the number of employees have been shortened. The data obtained with ARENA-TRIAL are given.

Figure 2 shows the processing times of the passengers in the current situation. The average processing time for each passenger was 0.23 minutes, and the most waiting passenger completed the transaction in 0.31 minutes. The waiting times of the passengers averaged 0.034 minutes, and the most waiting passengers waited 0.37 minutes. When we look at the total times, it is seen that each passenger has an average waiting time of 1.14 minutes and maximum of 6.82 minutes.

Figure 3 shows the check-in process times of passengers in case of post COVID-19 precautions. The average processing time for each passenger was 0.37 minutes, and the most waiting passenger completed the transaction in 0.41 minutes. The waiting times of the passengers averaged 0.071 minutes, and the most waiting passengers...
waited 0.78 minutes. When we look at the total times, it is seen that each passenger has an average waiting time of 1.37 minutes and a maximum of 6.89 minutes.

| VA Time       | Average | Half Width |Minimum Value | Maximum Value |
|---------------|---------|------------|---------------|---------------|
| Entity 1      | 0.2392  | 0.002359896  | 0.1723        | 0.3114        |

| NVA Time      | Average | Half Width |Minimum Value | Maximum Value |
|---------------|---------|------------|---------------|---------------|
| Entity 1      | 0.00    | 0.000000000 | 0.00          | 0.00          |

| Wait Time     | Average | Half Width |Minimum Value | Maximum Value |
|---------------|---------|------------|---------------|---------------|
| Entity 1      | 0.03427514 | 0.0089069324 | 0.00          | 0.3718        |

| Transfer Time | Average | Half Width |Minimum Value | Maximum Value |
|---------------|---------|------------|---------------|---------------|
| Entity 1      | 0.8738  | 0.067051573 | 0.00096772   | 6.8147        |

| Other Time    | Average | Half Width |Minimum Value | Maximum Value |
|---------------|---------|------------|---------------|---------------|
| Entity 1      | 0.00    | 0.000000000 | 0.00          | 0.00          |

| Total Time    | Average | Half Width |Minimum Value | Maximum Value |
|---------------|---------|------------|---------------|---------------|
| Entity 1      | 1.1483  | 0.068375338 | 0.1870        | 6.8246        |

Figure 2. Passenger Processing Times for pre-Covid-19 (minutes)

Considering the differences between Pre-Post Covid-19 situations, it is seen that the waiting times of the passengers increased in all processes. When we compare all the data, the result can be listed as follows;

- Compared to passenger processing times, there was a 60% increase in each passenger processing time.
- The duration of most waiting passenger ratio increased 32%
- The average waiting times of the total passengers increased 108%
- The maximum waiting time of the passengers was 110%
- It is observed that the average waiting time of each passenger increased by 20% and the duration of the most waiting passengers increased by 1% in total times.

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According to simulation the data, Post Covid-19 the check-in process times of the passengers increased in each variable. Moreover, there was elongation in the check-in desk queues. It is anticipated that satisfaction and service quality will decrease with the increase of waiting times of the passengers.

Figure 4 shows the efficiency of the staff according to the data in Pre-Covid-19. This coverage makes it possible for two staff to show an efficiency of 49%.

Figure 5 shows the efficiency of the staff during the simulation in the case of Post-Covid-19. It is stated that 1st Personnel performed 50% and 2nd Personnel performed 49%.

According to the personnel simulation data, the total working time of the system was extended by 80 minutes due to the constant number of passengers.

5. Result and Discussion

Two scenarios were prepared, including the pre-post COVID-19 precautions. The social distance constraints were considered to create the scenarios. In the analysis of the research, check-in queue times and staff productivity were calculated for both scenarios.

In the calculations, comments were made regarding the problems that may occur during the peak hours of the airport within the scope of the check-in desk and post COVID-19 precautions as social distance constraints. However real life

Since the real-life scope and scale could not be simulated, some assumptions were accepter for comparison pre-post Covid-19 scenarios.

An increase in passenger processing times was observed between the two cases. The high rate of increase in waiting time can be resolved by increasing the number of check-in desks. In this way, a reduction in total waiting times can also be achieved.

Because of Erkilet airport scale, the social distance rule can be violated. In addition, it is anticipated that the aircraft may not close the door on time during the check-in period.

Opening of the check-in desk should be start earlier than pre Covid-19. Because of the passengers should arrive at the airport early to extend the working time of the check-in desk. Also, the rules of the International and National Aviation authority should be changed the opening of the check-in desk time.

The study on the impacts of the pandemic on air transport is relevant, mainly, due to the need for adjustments in operations, aiming to ensure the health of passengers, employees and society as a whole. Unfortunately, air transport was (and may be) one of the main means of transporting contaminated people, which led to a significant expansion of the geographical area with cases of Covid-19.
It is thought that there may be researches that can be done later. One of these studies is to take the sample data (via observation) from the airport as the data collection method. Another simulation study may be modeled about the impact of the passenger services process on the entire airport process post Covid19 precautions. In addition, due to COVID-19, the effects of passenger service queues of the aircraft delays probability can be investigated and contributed to the literature.

6. Conclusion

In this study, has been examined the check-in process at Erkilet Airport, a small-scale airport. Check-in queue lengths that may occur at the airport with the pandemic. Two scenario; pre Covid-19 and post Covid-19 were examined. According to the research results, the maximum waiting time of 6.82 minutes in the usual operating process pre Covid-19 can be interpreted as acceptable. The maximum waiting time in the process post Covid-19 was found to be 6.89. In this situation, there was no major difference compared to pre Covid-19. It should not be unforgettable that this situation involves small scale airports.

It has been observed that the passenger processing times, waiting times of the passengers, and the duration of the waiting passengers, which are the other examined issues, have been increased. Although the open time of the counter was extended within the scope of the post Covid-19 period, the increase in the waiting period shows that the process is still insufficient. Due to the increase in the waiting time of the passengers, it is predicted that the satisfaction rates will decrease. The most important reason for this is that there is not enough space for waiting queues at small airports. It is anticipated that a 60% increase in passenger transactions will affect the capacity negatively.

Another issue examined was staff productivity. It is stated that there are 2 employees in total in the data collected within the scope of the research. Accordingly, when the pre covid-19 and the post-Covid-19 are compared, there is no high change in personnel productivity. It is thought that this situation is due to the increase in counter times. It is expected that the number of personnel will increase in the post-Covid-19 period.

All of the findings, appears that the necessary care and guidance regarding health, both for passengers and employees, led to increased times. With this increase, it is natural and expected that the lines at the check-in counters will be stretched. One of the ways to solve and/or work around the problem is the use of tools and technological resources that are already widely used in other airports and well accepted by passengers, such as internet check-in and self-service kiosks at airports.

Declaration of Conflicting Interests

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