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Yer Hizmetlerinde Kaynak Yönetimi: Uçak Çevrim Süresi Verimliliğinin Dijital Simülasyonu[1]

Resource Management in Ground Services: Digital Simulation of Aircraft Turnaround Time Efficiency

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ÖZET

Havacılık sektöründe yer hizmetleri, uçakların havalimanlarındaki operasyonlarının verimli bir şekilde yönetilmesi açısından kritik bir rol oynamaktadır. Yer hizmetleri, uçakların yerde geçirdiği süreyi minimuma indirmek amacıyla çeşitli alt hizmetler sunarak uçak çevrim süresini etkiler. Yer hizmetleri kaynak yönetiminin uçak çevrim süresi verimliliğine etkisinin incelendiği bu çalışmada, yer hizmetleri ve uçak çevrim süresi kavramları ele alınmış, ardından kaynak yönetimi ve yer hizmetleri kavramlarının önemi üzerinde durulmuştur. Kaynak yönetiminin çevrim süresi verimliliğine etkisi Arena yazılımı ile simülasyon modellemesi yapılarak incelenmiştir. Covid-19 salgını öncesinde ortalama 44.29 dakika olan uçak çevrim süresi, salgın sonrasında 66.03 dakikaya çıkmıştır. Uçak çevrim süresini en çok etkileyen faktörler ise personel çalışması oranlarıyla belirlenmiştir; yükleme ve boşaltma %66,78, temizlik %34,68 ve yakıt ikmali %21,84 zaman almaktadır. Yer hizmetlerindeki verimliliği artırmak için kaynak yönetimi kavramı ve kurumsal kaynak planlama (ERP) sistemleri kullanılmaktadır. ISO 55000 standartlarına göre tanımlanan kaynak yönetimi, kuruluşların stratejik planlarını gerçekleştirmek amacıyla kaynaklarını ve performanslarını yaşam döngüleri boyunca en iyi ve güvenilir şekilde yönetmelerini sağlar. Havacılık sektöründe ERP sistemleri, maliyet tasarrufu, kalite artışı, insan faaliyetlerinin geliştirilmesi ve verimlilik artışı gibi nedenlerle tercih edilmektedir.

Anahtar Kelimeler:

Yer Hizmetleri Verimliliği,

Uçak Çevrim Süresi,

Kaynak Yönetimi,

ERP Sistemleri,

ABSTRACT

In this study, which examines the effect of resource management in ground handling services on the efficiency of aircraft cycle time, the concepts of ground handling services and aircraft cycle time will be discussed, followed by an emphasis on the importance of resource management and ground handling services. The effect of resource management on cycle time efficiency will be analyzed through simulation modeling using Arena software. In the aviation sector, ground handling services play a critical role in the efficient management of aircraft operations at airports. Ground handling services impact aircraft cycle time by offering various sub-services aimed at minimizing the time aircraft spend on the ground. Before the COVID-19 pandemic, the average aircraft cycle time was 44.29 minutes, which increased to 66.03 minutes after the pandemic. The primary factors affecting aircraft cycle time have been determined based on staff work ratios: loading and unloading take 66.78%, cleaning 34.68%, and refueling 21.84% of the total time. To enhance efficiency in ground handling services, the concept of resource management and enterprise resource planning (ERP) systems are utilized. Defined according to ISO 55000 standards, resource management enables organizations to manage their resources and performance in the most optimal and reliable way throughout their life cycle to achieve their strategic plans. In the aviation industry, ERP systems are preferred for reasons such as cost savings, quality improvement, enhancement of human activities, and increased efficiency.

Keywords:

Ground Services Efficiency,

Aircraft Turn Around Time,

Resource Management,

ERP Systems,

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1. INTRODUCTION

The concept that meets the services provided to aircraft at the airport is the concept of ground handling services in aviation literature. Airline companies conduct ground operations at airports through specialized ground handling service providers. In the aviation sector—characterized by intense time pressure and increasing competition—the time an aircraft spends on the ground is critically important. This leads us to the concept of aircraft cycle time. Aircraft cycle time is the whole of the sub-services provided to the aircraft by different providers such as catering and fuelling, and good management of aircraft cycle processes plays an important role in the efficiency and success of airline companies. Ateş et al. (2018) emphasize that ground handling services are critical to ensuring airline (Ateş et al., 2018).

The time allocated for aircraft cycle time for airline operators varies depending on the aircraft type but generally ranges between 35 minutes and 100 minutes. According to the study conducted by Öztürk and Ateş (2021), the average aircraft cycle time of an aircraft was 44.29 minutes before the Covid-19 outbreak, while it was 66.03 minutes on average after Covid-19 measures and measures taken. In the same study, the sources affecting the aircraft cycle time are also indicated with their percentages. According to the results of the study, for the post-Covid-19 period, the ratio of personnel working during loading and unloading is 66.78%, the ratio of cleaning personnel working is 34.68%, and the ratio of fuel workers working is 21.84%, which are the most time-consuming services (Öztürk and Ateş, 2021).

According to Wu and Caves (2004), operations at the airport cause a significant portion of the delays in the air transport system (Wu and Caves, 2004:26). Delays constitute a cost for airline companies. Due to delays, the costs of airline businesses cause significant increases in the short and long term (Uslu, 2009). According to a study conducted in the USA in 2019, the average cost of aircraft cycle time is $74.24 per minute. Due to delays, airline operators incur various costs such as productivity costs and gate costs. FAA/Nextor estimates that the annual cost of airline delays to airlines in 2018 was approximately $28 billion (U.S. Passenger Carrier Delay Costs, 2020).

The costs in aviation, the necessity to make decisions by considering safety and passenger comfort make decision-making processes complex. The concept of Resource Management (Asset Management) appears at this point. As defined in ISO 55000 standards, resource management is the systematic activity by which an organisation manages its resources and resource systems, their associated performances, risks and expenditures in the best and most reliable way throughout their life cycle in order to achieve its strategic plans (ACRP, 2012). Enterprise resource planning (ERP) systems are among the popular systems preferred in many organisations. Although there are many reasons for using ERP systems in the aviation industry, the main reasons are summarised as saving costs, improving quality, managing resources, improving human activities and increasing productivity (Ramadhan and Koutaini, 2019).

In this study, in which the effect of the use of resource management in ground handling services on the efficiency of aircraft cycle time is examined, the concepts of ground handling services and aircraft cycle time will be discussed, followed by the importance of resource management and ground handling services. The effect of resource management on the efficiency of the cycle time will be examined by simulation modelling through Arena software.

2. MATERIAL AND METHOD OF RESEARCH

2.1. Literature Review

In aviation literature, ground handling services is a concept that defines the services provided to an aircraft while it is in motion and parked on the ground at the airport. Ground handling operations involve many processes. Some of these processes are the provision and operation of the equipment required for ground

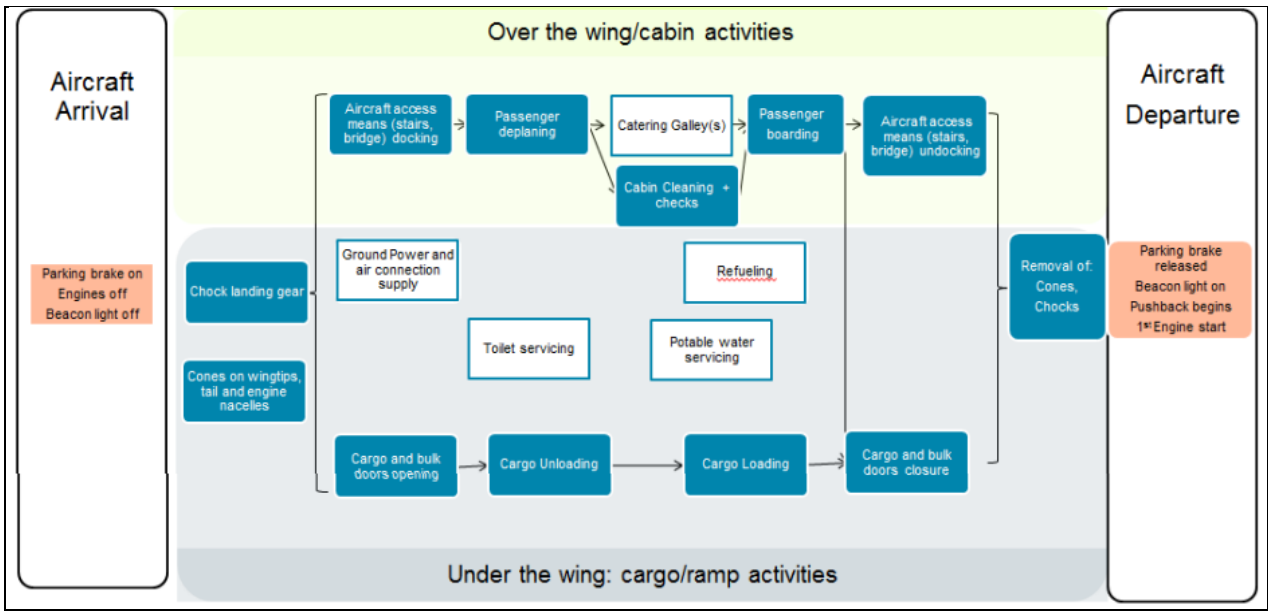
handling, loading and unloading of the aircraft, as well as the transport of crew, passengers and baggage between the aircraft and the terminal, and catering services. Kwasiborska (2010), describes and models the overall operation in the ground handling processes performed on the apron (Kwasiborska, 2010).

Schmidberger et al. (2009) conducted a study on the development of a performance measurement system after the liberalisation of ground handling services at European airports. In this study, they emphasised that the work steps carried out in ground handling processes play an important role in increasing competition and cost pressure in the airline sector. They defined ground handling processes as one of the basic functions of airports, covering all handling activities carried out on the apron. Loading and unloading operations of aircraft, transport of passengers, cargo and cargo between the airport and the aircraft are within the scope of ground handling activities. Due to the increasing competitive pressure in the sector, businesses have to redesign their business scopes and strategies in ground handling services (Schmidberger et al., 2009:104-105). In their paper, Wu and Caves (2004) conducted a performance study of the turn around processes carried out at airports within the scope of ground handling services using simulation and modelling. They mentioned that the operations carried out at airports are important in air transport delays. They also pointed out that ground handling processes affect the punctuality performance of airline companies and the change in passenger airline preference.

This is where the management of aircraft turnaround time comes into play. Wu and Caves argue that good management of aircraft turnaround processes plays an important role in the efficiency and success of airlines. There are multiple activities that affect this process. The aircraft turnaround process can be considered as the whole of the sub-services provided to the aircraft by different providers such as catering and fuel purchase. One of the unique and important points of the aircraft turnaround process is that many different services are provided to the aircraft at the same time (Wu and Caves, 2004).

In the study conducted by Tabares and Camino in 2017, it is seen that the aircraft turnaround time is divided into two in the processes after the arrival of the aircraft. The services provided to the aircraft above the wing start with the staircase / bellows docking and then end with the disembarkation of the arriving passenger from the aircraft, the docking of the catering vehicle and the catering, the cleaning of the cabin, the boarding of the departing passenger and the staircase / bellows towing. The services provided to the aircraft under the wing include independent processes such as receiving support from external tactics and ventilation etc., opening the cargo and loading door, receiving toilet services, loading clean water, loading fuel. The end of the service is achieved by pulling the cargo equipment and closing the door. The process of aircraft cycle time is shown in detail in Figure 1.

Figure 1. Aircraft Cycle Time Process



Kaynak: Tabares ve Camino, 2017.

Horstmeier (2001), investigated the effect of new and large aircraft on aircraft turn around time. Horstmeier and Haan define the turn around time as the time between the arrival and departure of the aircraft at the gate or ground handling point. They emphasised that this process has become very important in terms of ensuring passenger comfort and safety as well as ensuring that airlines are punctual. In their study, they drew attention to

the point that there may be differences in service times according to the size differences of the aircraft served. When the services provided during the aircraft turnaround process are considered in terms of time, it is noticeable that not all services are provided at the same time. For example, while passengers are disembarking (de-boarding) and boarding (boarding), services such as cleaning and catering loading are not provided to the aircraft due to the comfort of the passengers. Likewise, refuelling while passengers are on board is not preferred according to safety rules. When the processes affecting the aircraft turnaround time are examined in general terms, it is observed that there are six basic processes affecting this process. These processes are; (1) passenger loading and unloading, (2) baggage handling, (3) cargo handling, (4) refuelling, (5) catering and (6) waste water service (Horstmeier and Haan, 2001:266-267).

The study by Nugroho et al. provides performance improvement recommendations for ground handling services. The ground handling processes specifically mentioned in the study are baggage, passenger services and in-flight cleaning activities. The reason for the selection of these activities is that they affect the turnaround process and these activities have a direct impact on passenger satisfaction. In this study conducted at PT Garuda Indonesia, the three services mentioned above were analysed, almost all the existing activities were observed, and the existing activities were analysed in terms of added value. In the study, various suggestions have been made that are thought to improve the process. Some of these suggestions are; creating reminder boards about the documents that passengers need to prepare before arriving at the security checkpoint, creating information boards about passenger boarding priorities during boarding, saving time in services by creating boards prepared with the help of visuals to facilitate x-ray operations, redesigning in-flight cleaning processes prepared with motion study principles. At this point, in this research conducted by Nugroho et al., it was concluded that as a result of appropriate studies, various measures can be applied to increase the efficiency of the process in the aircraft cycle time and thus improve the process (Nugroho et al., 2012).

In their research, Szabo et al. (2022) focused on increasing the efficiency of ground handling services provided to aircraft. The measurement of the whole standard airport, which is a part of the handling process, is considered within the subject of the research. In the study, airport was analysed in a certain season. Looking at the results of the research, an interesting result was obtained, such as time savings can be achieved if improvements are made in the food/catering trucks related to the catering service (Szabo et al., 2022). The study conducted by Öztürk and Ateş (2021) covers simulation analysis of the aircraft turnaround process. In this study, the periods determined for narrow-body aircraft were taken into consideration and the process before and after Covid-19 was taken into consideration. According to the results, Covid-19 has significantly affected the aircraft turnaround process, but despite this, it is stated that the airline company used in the study is successful according to the standards. Another important point noted in the study is that the cleaning process has increased due to the measures taken during the Covid-19 process, which increases the workload of the cleaning team. It is mentioned that this situation can be overcome by reinforcing the staff and increasing the resources of the cleaning team (Öztürk and Ateş, 2021:1637).

Fei and Shu'an (2016) investigated ground handling scheduling problems in their study. In the study, the problem of decreasing service quality due to shorter turn around times at airports was addressed. In this study, which is based on real flight data and supports effective operation planning, cleaning processes are also addressed while modelling. In this respect, this study by Fei and Shu'an reveals the possibility of encountering negative situations as a result of the turn around process improvement activities to be carried out in ground handling services and the possibility of encountering an undesirable result such as decreased service quality (Fei and Shu'an, 2016).

Resource management is a management approach that aims to manage the physical assets of the enterprises in the most favourable way by considering all the economic-environmental-political conditions and the processes of occupational health practices together. It can be realised by combining business processes such as resource management, maintenance management, quality management and integrity management (Ercan, 2009). Asset Management, i.e. resource management, is defined based on ISO 55000 standards. It is the systematic activities by which an organisation manages its resources and resource systems, their associated performances, risks and expenditures in the best and most reliable way throughout their life cycle to achieve its strategic plans. In airline transport, while providing ground handling services to landing and take-off aircraft, safety should be prioritised, passenger comfort should be taken into consideration and work should be carried out quickly. The aircraft cycle time should also be carried out as efficiently as possible, considering these principles. Taking all of these factors into consideration, decision-making processes in ground handling services are becoming increasingly complex. According to Ramadhan and Koutaini (2019), the importance of information systems increases with the complexity of decision-making processes.

Enterprise resource planning (ERP) is one of the popular information systems preferred by many organisations. ERP is a system that integrates many software that centralises business functions. Organisations that effectively implement these systems see the unlimited benefits of the system (Ramadhan and Koutaini, 2019). These systems, which aim to integrate, synchronise and centralise corporate data, are generally accepted as a vital tool for businesses to succeed in the rapidly changing global market. The selection of systems is a strategically important decision for businesses as well as a difficult decision. Because ERP systems have high costs in terms of purchasing, installation and implementation (Kılıç et al., 2014). The use of enterprise resource planning (ERP) software in aviation enables businesses to do business more efficiently. ERP software organises processes in many parts of the business. Examples of these processes include sales, accounting, supply chain, inventory management. Airline companies use various ERP systems to manage their processes efficiently. These systems include SAP, ramco, Trax, Amos, Oracle e-business suite, Microsoft Syspro, Quantum, Pentagon, Corridor, Quickbooks (Frank, 2020).

2.2. Methodology of Research

The purpose of this study is to determine the effect of the use of resource management on the efficiency of aircraft turnaround time in the ramp services provided to the aircraft at the parking position. In order to make this determination, simulation method with Arena programme was used. Arena is a successful simulation programme developed by Systems Modeling Corporation. In the simulation, input and output data can be analysed in detail (Büyüksaatçı et al., 2008:8). Antalya Airport was selected as the application area because it is busy during the summer season and handles ground services for a large number of aircraft. The study was shaped by considering the services provided to a private airline in 2021-2022.

This study primarily examined aircraft turnaround time. Turn around time is defined by Wu and Caves as the time it takes to serve an aircraft from the time it parks in the parking position until the aircraft closes the door and chocks are removed (Wu and Caves, 2004:49). Resource management is the systematic activities in which businesses manage their resources, associated performances, risks and expenditures in the best and most reliable way throughout their life cycles (Ramadhan and Koutaini, 2019). From this point of view, the main problem of the research is the effect of resource management usage on the efficiency of aircraft cycle time in ground handling operations, and this effect is examined by means of Arena simulation programme.

Table 1. Data on Operation Processes and Distributed Times in Over the Wing Processes

Operation Time in Over the Wing Processes	Distributed Duration
Passengers leaving the aircraft	TRIA (5,15,20)
Cabin crew controls	TRIA (10,15,20)
In-flight cleaning	TRIA (30,35,40)
Catering unloading	TRIA (5,6,8)
Loading catering	TRIA (5,6,8)

The method used in the research is the interview method. Face-to-face interview technique, one of the qualitative research methods, was used. The interviewee works as a ramp supervisor in a private ground handling company. As a result of the interviews, all durations used in the research were determined by taking expert opinion and applied in simulation with triangular distribution. According to the answers given by the participant, the durations of the activities affecting the aircraft turnaround process in the ground operation were tried to be determined and the distributed durations are expressed in the tables below.

Table 2. Data on Operation Processes and Distributed Times in Under the Wing Processes

Operation time in Under the Wing Processes	Distributed Duration
Sewage water extraction	TRIA (20,25,30)
Clean water intake	TRIA (15,20,30)
Luggage emptying	TRIA (13,15,17)
Luggage loading	TRIA (15,17,20)
Fuel purchase	TRIA (8,10,12)

As for the assumptions and limitations of the study, the data of a private airline serving as a traditional carrier are used in the study. Since the airline flies to Antalya Airport with only one type of aircraft, a narrow-body aircraft with Expo 1 distribution is considered operationally in the study. It is assumed that the equipment

serving the aircraft during the aircraft turnaround time operates continuously, the equipment arrives at the aircraft immediately as soon as the aircraft arrives, and the equipment subject to the research serves only the private airline served.

Table 3. Resources and Number of Resources Used in the Aircraft Turnaround Process

Resources Used in the Aircraft Turnaround Process	Number of Resources
Airbridge	21
Stairs	30
Cobus	30
Transfer vehicle for the cleaning team	3
Catering vehicle	1
Sewage truck	2
Clean water vehicle	2
Fuel vehicle	1
Conveyor	40

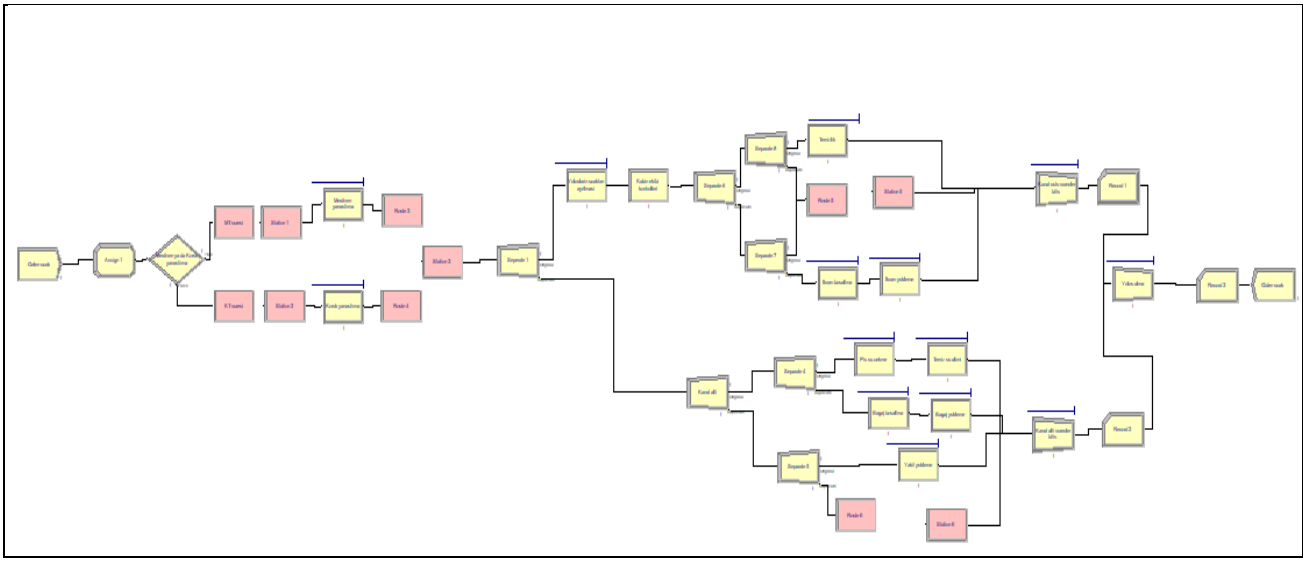
The reason why the catering and fuel vehicles specified in the tables in the study is 1 is that these services are outsourced and one is allocated for each aircraft served. In addition, the break times of the personnel working in the study, the periods when the equipment is under maintenance and the procedures applied for passengers requiring special service are ignored.

3. ANALYSIS AND FINDINGS OF RESEARCH

This research simulates, using the Arena simulation program, how the use of resource management in ground handling services affects the turnaround time efficiency of a narrow-body aircraft operated by a traditional private airline at Antalya Airport, taking into account the services provided during the aircraft cycle time.

According to the data received, among the aircraft arriving at Antalya Airport in a day, the number of aircraft that the private ground handling company deals with is 111, while the number of aircraft transferred to the departing aircraft section after the services provided during the aircraft cycle time is 108 (*these data were obtained by running the simulation in a 24-hour period*). Different results can be displayed by increasing or decreasing the number of ground equipment serving the aircraft on the simulation. In this way, in different possibilities, data such as whether the number of aircraft served has increased or not, in which scenario we can get which result can be displayed. In the figure below, the simulation image of the aircraft turnaround time in which all processes are taken into account separately on the wing and under the wing is given.

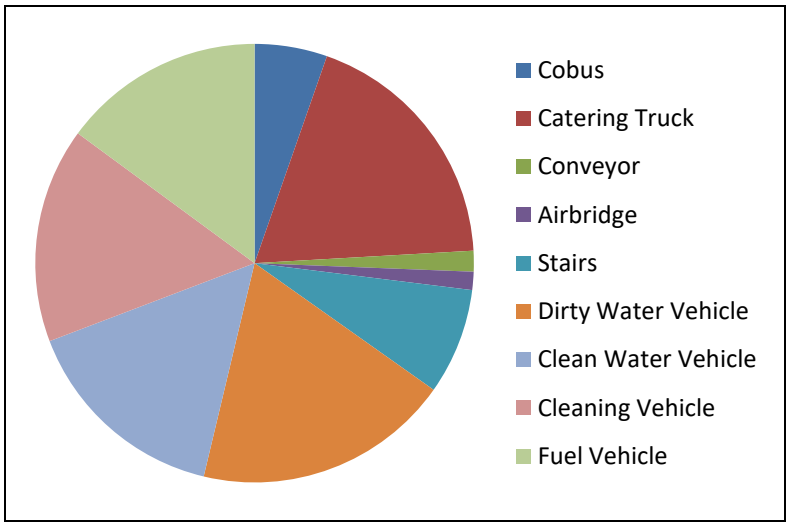
Figure 2. Simulation Image of Aircraft Turnaround Time Process



Source: This figure was created by the authors of the study in the simulation programme according to the data obtained.

The utilisation intensities of the resources owned by the ground handling company are given in Figure 3 below;

Figure 3. Utilisation Intensity of the Resources Owned by the Ground Handling Company



Based on the resource utilization intensities presented in the graphs from the Arena simulation results;

- It is concluded that the use of catering trucks, dirty water vehicles, clean water vehicles, cleaning vehicles and fuel vehicles is quite intensive.
- In addition, it is seen that the number of cobus, conveyors, airbridges and stairs are more than the number of aircraft we serve.

In the application named Pan Analyser within the simulation, possibilities can be tested. Here, it is checked whether there is an increase or decrease in the number of aircraft served during the day in case of resource increase. Figure 4 below shows the pan analyser results.

Figure 4. Pan Analyzer Results

	Scenario Properties				Controls									Response
	S	Name	Program File	Reps	Cobus	Ikram Araci	Konveyor	Korukler	Merdiven	Pis Su Araci	Temiz Su Araci	Temizlik Araci	Yakit Araci	System.NumberOut
1		Scenario 1	8 : 30.05.202	1	30.0000	1.0000	40.0000	21.0000	30.0000	2.0000	2.0000	3.0000	1.0000	108.000
2		Scenario 2	8 : 30.05.202	1	40.0000	1.0000	40.0000	21.0000	30.0000	2.0000	2.0000	3.0000	1.0000	108.000
3		Scenario 3	8 : 30.05.202	1	30.0000	2.0000	40.0000	21.0000	30.0000	2.0000	2.0000	3.0000	1.0000	113.000
4		Scenario 4	8 : 30.05.202	1	30.0000	1.0000	50.0000	21.0000	30.0000	2.0000	2.0000	3.0000	1.0000	108.000
5		Scenario 5	8 : 30.05.202	1	30.0000	1.0000	40.0000	31.0000	30.0000	2.0000	2.0000	3.0000	1.0000	108.000
6		Scenario 6	8 : 30.05.202	1	30.0000	1.0000	40.0000	21.0000	40.0000	2.0000	2.0000	3.0000	1.0000	108.000
7		Scenario 7	8 : 30.05.202	1	30.0000	1.0000	40.0000	21.0000	30.0000	3.0000	2.0000	3.0000	1.0000	108.000
8		Scenario 8	8 : 30.05.202	1	30.0000	1.0000	40.0000	21.0000	30.0000	2.0000	3.0000	3.0000	1.0000	107.000
9		Scenario 9	8 : 30.05.202	1	30.0000	1.0000	40.0000	21.0000	30.0000	2.0000	2.0000	4.0000	1.0000	109.000
10		Scenario 10	8 : 30.05.202	1	30.0000	1.0000	40.0000	21.0000	30.0000	2.0000	2.0000	3.0000	2.0000	109.000

As can be seen in the figure 4, in each scenario, by increasing the number of equipment, it was analysed whether the number of aircraft served by the system per day increased or not. In Scenario 1, all available equipment was included and the number of aircraft served by ground handling services within 24 hours with the available equipment was displayed. The evaluation of the possibilities started as of scenario 2. In Scenario 2, the number of cobuses increased from 30 to 40 and the number of aircraft served remained the same, while in Scenario 3, the number of catering vehicles increased from 1 to 2 and the number of aircraft served per day increased to 113. Similar changes are observed in scenario 9 with the increase in the number of cleaning vehicles to 4 and in scenario 10 with the increase in the number of fuel vehicles to 2, and the total number of aircraft served per day increases from 108 to 109. As a result of the experiments, according to the pan analyzer data, if the number of cleaning vehicles, catering vehicles and refuelling vehicles are increased, the number of aircraft served can be increased in the same period.

4. CONCLUSION

In the study, an application was made by evaluating the services received by a traditional airline from a private ground handling service during the aircraft cycle time. In the application, ground handling services provided to a narrow-body aircraft of the company at Antalya Airport during the 2021-2022 summer season. The times during the aircraft cycle were obtained by interview method. Trial simulation was also used to examine whether the resource utilisation leads to a change in the number of aircraft served per day with the scenarios prepared.

According to the information obtained at Antalya Airport, the operation of 108 aircraft per day can be successfully completed within 24 hours as a result of the services provided to narrow-body aircraft. When the resources of a private ground handling company that provides service during the aircraft cycle process are reviewed, it is concluded that the use of catering vehicles, dirty water vehicles, clean water vehicles, cleaning vehicles and fuel vehicles is quite intensive.

On the other hand, it is seen that the number of cobus, conveyors, bellows and stairs are also high compared to the number of aircraft served. In the trials where the number of resources is increased, if the number of cleaning vehicles, catering vehicles and refuelling vehicles are increased, the number of aircraft served can be increased in the same period.

This shows that the number of available resources, the duration of their use and the speed at which they serve the aircraft affects the aircraft cycle time efficiency. In future studies, the scope of the study can be improved by choosing a ground handling company serving different airlines and different aircraft types. Conducting similar studies at different times will be very important to reveal that the use of resource management in ground handling services affects aircraft cycle time efficiency. Topics such as profitability that will arise from the correction of such processes can also be addressed.

YAZAR BEYANI / AUTHORS' DECLARATION:

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YAZAR KATKILARI / AUTHORS' CONTRIBUTIONS:

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