MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
NATIONAL AVIATION UNIVERSITY

Air Transportation Management Department

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Head of the Department
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"_____"_____2022

QUALIFICATION PAPER
(EXPLANATORY NOTES)

Theme: «Methods for assessing the quality of the organization of air passenger transportation»

Done by: Mostafa Ashraf Mostafa Mohamed Elshikh

Supervisor: Phd in economic Katerna Olga

Standards Inspector: Phd in economic Shevchenko Julia

Kyiv 2022

Міністерство освіти і науки України
НАЦІОНАЛЬНИЙ АВІАЦІЙНИЙ УНІВЕРСИТЕТ

Кафедра організації авіаційних перевезень

ДОПУСТИТИ ДО ЗАХИСТУ
Ззавідувача кафедри
Шевчук Д.О._____
«_____»_____2022 р.

КВАЛІФІКАЦІЙНА РОБОТА
(ПОЯСНЮВАЛЬНА ЗАПИСКА)

ВИПУСКНИКА ОСВІТНЬОГО СТУПЕНЯ «БАКАЛАВР»

Тема: «Методи оцінки якості організації пасажирських авіаперевезень»

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Київ 2022

NATIONAL AVIATION UNIVERSITY

Faculty of Transport, management and logistics

Air Transportation Management Department

Major (Specialty): 275 “Transport technologies”

APPROVED BY
Head of the Department
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“_____”_____2022

TASK

of completion the qualification paper

Mostafa Ashraf Mostafa Mohamed Elshikh

The topic of The Bachelor ‘s thesis entitled “Methods for assessing the quality of the organization of air passenger transportation” was approved by decree of the Rector order №436/ст. of April 27, 2022.

1. Productivity dissertation term: 18.05.2022 to 16.06.2020.

2. Initial data required to write a dissertation for a Bachelor’s degree: methods for assessing the quality of the air transportation, analysis of production and financial activities of “Cairo” Airport; SWOT-analysis of the enterprise; Formation of the concept of quality of air transportation for Cairo International Airport.

3. Content of the Note: to identify the viewpoint of arriving and departing passengers through Cairo International Airport through: Determining the ground services provided by Cairo International Airport to passengers and their most important elements. And evaluation of the most important ground services provided at Cairo International Airport for passengers.

4. Content of the explanatory notes: to create a conceptual model that can be used to measure the quality of airport services.

5. List of mandatory graphic matters: graphs of passenger turnover of Cairo International Airport, SWOT-analisys, efficiency of Passengers facilities system implementation at Cairo international airport.

6. PLANNING CALENDAR

№	Assignment	Deadline for completion	Mark on completion
1.	Collection and processing of statistical data	16.05.22-22.05.22	done
2.	Writing of the analytical part	23.05.22-29.05.22	done
3.	Writing of the design part	30.05.22-2.05.22	done
4.	Writing of the introduction and summary	3.06.22-4.06.22	done
5.	Execution of the explanatory note, graphic matters and the presentation	5.06.22-10.06.22	done

7. Given date of the task: May 16, 2022.

Supervisor of the bachelor thesis: Olga Katerna

Task was accepted for completion: Mostafa Ashraf
Mostafa Mohamed Elshikh

ABSTRACT

Explanatory note to the master thesis « Methods for assessing the quality of the organization of air passenger transportation»: 56 pages, 10 figures, 5 tables, 20 references.

KEYWORDS: AIRPORT, AIRPORT INFRASTRUCTURE, AIR PASSENGER TRANSPORTATION, GROUND SERVICES, SERVICE

The object of the study is to study the Methods for assessing the quality of the organization of air passenger transportation

The subject of research : to set of methods aims to analyze the quality of air passenger transportation. It includes a theoretical and practical framework for carrying out this assessment.

The aim of the research to analyze the quality of air passenger transportation in the Caipiro air port.

Research methods of this study was to establish a framework for carrying out research that was based on the principles of economic theory.

The analytical part of this report focuses on the statistics of passengers and airlines. It also includes information about the operations of airports and airlines.

Bachelor thesis materials are usually used in the study of tour operator in order to consider various types of cooperation between the company and an airline. One of these is the establishment of a subsidiary airline. Data collected from the websites of both airlines will be used to evaluate the performance of the partnership.The main objective of this study is to analyze the performance of the partnership between Cairo International Airport and Singapore's Changi Airport. The report shows that the former has a significant gap in the services provided to the passengers and businessmen.

ABREVIATIONS

ACHP - air cargo handling process

AQS - Airport Quality Improvement Program

BPI – Business Process Improvement

TFP - total operational revenue

CONTENTS

INTRODUCTION

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Head of the Department	Shevchuk Dmytro								

The aviation sector has become one of the most important components of the country's economic development. It is responsible for moving various products and people from one place to another. Due to the increasing number of air transport activities, the demand for airport services has also increased. As airports look to maximize their revenues, they are also exploring new ways to provide non-aviation services. These include commercial facilities that are commonly used by the airport. The objective of this study is to identify and assess the various non-aviation services that are offered at the airport to improve the passenger experience.

The objective of this study was to analyze the perceptions of the passengers of Cairo International Airport-T3 using a mixed approach. The quantitative approach was used to collect information on the passengers. The qualitative approach was used to conduct interviews with 12 individuals. The study was conducted through various methods, such as face-to-face interviews and indirect interviews.

The study was conducted on a sample of 12 individuals, which included airport officials, shopkeepers, and public relations personnel. The main findings of the study revealed that the airport is capable of optimizing the dwell time of its passengers, but it needs to add more services to improve the passenger experience.

The study revealed that the passenger spending and the dwell time are directly related to the airport's revenues. It also suggested that the airport should introduce new services to improve the passenger experience.Due to the increasing number of airports, they are also exploring the possibility of developing other commercial activities. These activities are aimed at increasing the airport's revenues.

The study compared the non-aviation activities of the Cairo International Airport with those of the Singapore International Airport. A checklist was created based on the various services that are offered by the airport in Singapore. Data collected from the two airports were analyzed using the airport's website and the navigation of its website.The study revealed that the passenger experience at Cairo International Airport-T3 is significantly different from that of Singapore's Changi airport. It was also noted that the airport has a significant gap in the services that are offered to the VIPs and businessmen.

The goal of this study was to create a conceptual model that can be used to measure the quality of airport services. Through an in-depth analysis of the data collected by over a thousand passengers, the authors were able to come up with a set of recommendations for improving the airport's operations. Most of the studies that focus on the quality of passenger services are focused on the assessment of the operations and services of airports. According to the authors of these studies, the main objective of the study is to analyze the expectations of the passengers.

The study focused on two functional areas: the passenger experience and the efficiency of the airport. One of these included the various factors that contribute to the effectiveness of an airport's operations, such as the exterior signs, the layout, and the availability of various means of transport. The other one included the time it takes to register and get off the aircraft.

The third area of the study was the assessment of the operations and services of airports. It focused on the various factors that contribute to the effectiveness of an airport's operations, such as the supply of restaurants and stores that cater to local culture, the establishment of business centers, and the presence of silence zones.

The results of the study revealed that leisure and corporate travelers have different expectations regarding the quality of airport services. The differences were also identified by the way both groups viewed the airport's operational efficiency. The study revealed that the interaction dimension was the most important factor that the passengers considered when it came to assessing the quality of airport services.

The study aims to identify the viewpoint of arriving and departing passengers through Cairo International Airport through: Determining the ground services provided by Cairo International Airport to passengers and their most important elements. And evaluation of the most important ground services provided at Cairo International Airport for passengers.

1. ANALYTICAL PART

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1.1. Main characteristic of Cairo international airport

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The Cairo Airport is regarded as the main gate of the Capital's airport and its destination to all Aviation activities in the world. This is very important for the country's economic development as it allows the authorities to monitor and control the activities of various airlines and businesses. The airport is also regulated by a set of laws and regulations which are aimed at enhancing the performance integrity of Egyptian Civil Aviation[1].

The Cairo Airport is also striving to maximize the use of its resources in order to develop its sustainable development. The airport's history started in the 1940s when an air-force base was established near the airport to serve the Allied forces during the Second World War. After the war, the American forces left the base and it was handed over to the International Civil Aviation Organization in 1945. The airport was then referred to as King Farouk 1st Airport. In the following years, the airport was also dedicated to domestic flights[2].

During that period, the airport handled over 200,000 passengers a year. During the peak hour, it reached around 200 passengers per hour. In 1955, a new terminal was planned to be built near the two runways of the Cairo Airport. The location of the new facility was chosen between the runways. The passenger traffic increased during the 1970s as air transport rates went up. In 1980, a third hall was added to the airport. A second terminal was also needed due to the increasing passenger traffic during the 1980s. The new facility, which was called Terminal 2, was constructed to accommodate over 3.5 million passengers a year[1].

Due to the increasing number of air traffic and the need for more facilities, the airport's management decided to develop the facility's transit hall. This project was completed by the end of 2003. It cost about $12 million. The design and construction of the new facility was handled by a company known as Engineering Consultants Group, S.A., Cairo. The building's structure consists of a ground floor, a first floor,

and a mezzanine. The first phase of the project was completed in March 2002. During this period, the airport was able to operate smoothly as the work was carried out[3].

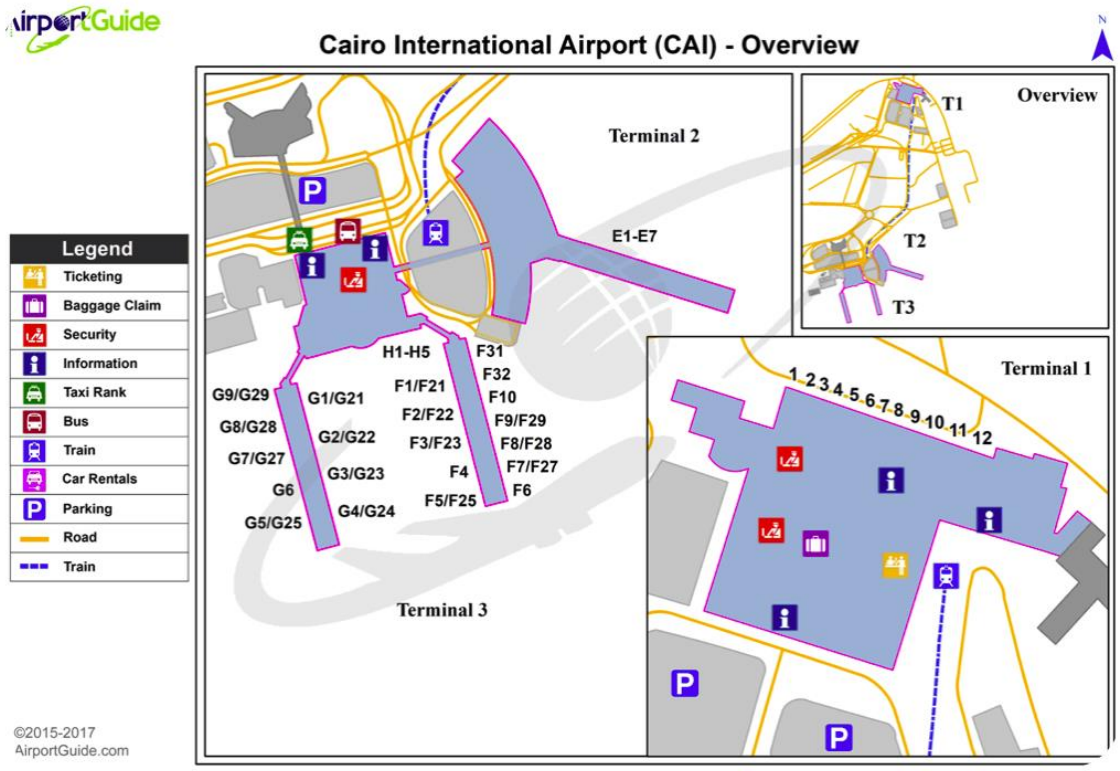

Fig.1.1. - Cairo airport overview

The new terminal was designed to provide a variety of services to accommodate the varying needs of its passengers. It also features a wide selection of restaurants and bars, as well as a 1960s cafe overlooking the runway. The third phase of the project, which was completed in 2003, also included the establishment of a duty free shop and a cafe overlooking the runway[4].

The facility features various facilities for passengers. Some of these include a variety of telephones, screens, and monitors that allow passengers to monitor their flight status and provide detailed information. Other facilities include a pharmacy, a post office, a bank, and a variety of other services[5].

According to a statement released by the Ministry of Civil Aviation on November 11, 2019, the Cairo International Airport was ranked as the first airport in Africa in terms of the air freight traffic during 2019. It was able to maintain its

position as one of the top airports in the continent for the third consecutive year. The statement noted that the facility's cargo operations grew by 11.6% during the year[6].

1.2. Main characteristics of the air cargo market

The characteristics of the air cargo market are various factors that affect the choice of transportation mode and the cost of doing business. Some of these include the value of the goods, the location of the manufacturing facility, the vulnerability of the goods, and the availability of transportation.

The price of cargo is computed by taking into account the various factors that affect its movement, such as the cargo's weight, volume, and surface modes of transport. Based on the type of goods that are transported, the air cargo market can be categorized into different categories such as high technology goods, capital equipment, textiles, footwear, and consumer products. Air cargo is considered to be the fastest mode of transportation in the world, with a speed of up to 30 times faster than the average sea. It is also faster than using a train. The increasing value of time due to the new normal life of people has also increased the need for flying[7].

Table 1.1

Total cargo in the period of 2019-2020

Total Cargo Carried 2019/2020			
	Freighter	**Bellies**	**TOTAL**
Export/ton.	30,590	32,228	62,819
Import/ton.	16,436	15,931	32,367
Transit/ton.	19,195	24,570	43,765

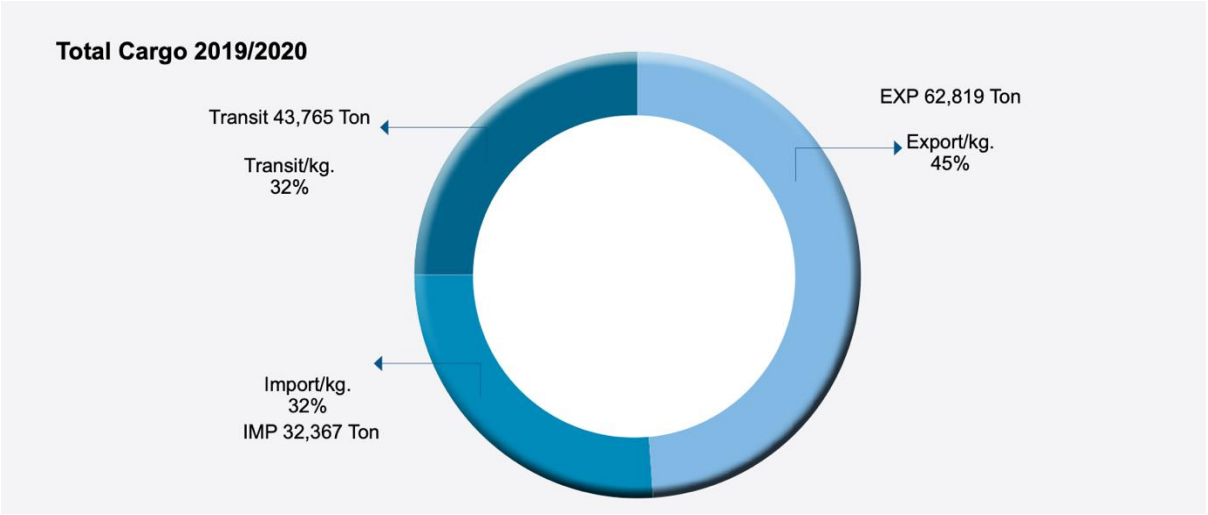

Fig.1.2. - Total cargo per 2019-2020

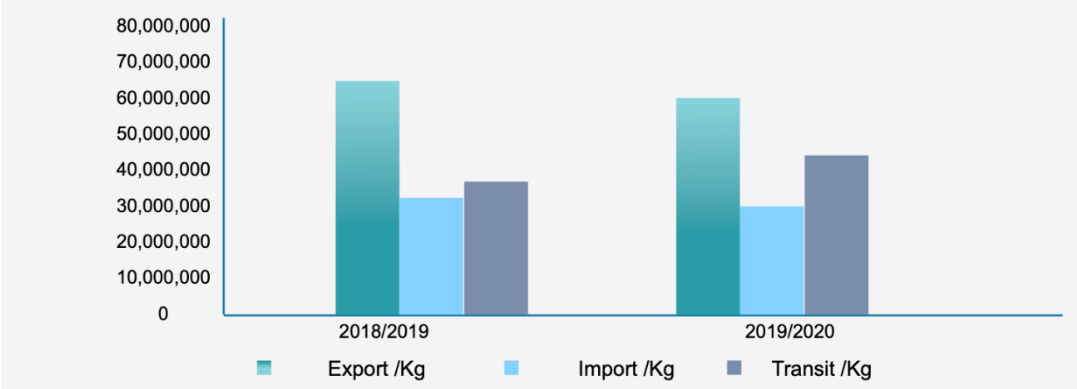

Fig. 1.3. Total Cargo comparison turnover during 2018-2020

Air cargo is considered to be safer than other transportation modes such as road and railways. This is because it offers better safety and comfort. A demand-based pricing concept is used to set a price that is based on the perception of the consumers' value. Despite the advantages of air cargo, it is still important for the companies to have a fair price. This is because the customers are usually the ones who demand the lowest possible price. Most airlines also provide their customers with tools that allow them to customize their prices[8].

1.3. Analysis of air cargo handling process in airport

The complexity of the air cargo handling process is due to the various sub-processes that are involved in its operation. One of these is the arrival and departure of cargo, which are carried out simultaneously. This process is also complex because it involves the various steps involved in the physical and documentary handling of the cargo. This process is also performed at the same time as the other two processes, such as the handling of passengers and aircraft. Before implementing a comprehensive pricing strategy, it is important to thoroughly analyze the various activities involved in the aircraft handling process. the complexity of the ACHP is also a factor that can affect the performance of the hotel industry[9].

The various subprocesses that are part of this process are organized into a sequence of actions that are required to complete the tasks and activities within the given process step. This ensures that the prerequisites for the next step are created and the output from the previous step is also included in the calculation.The start of a process step must coincide with the completion of the previous steps. The ACHP is a series of activities that are carried out through a written procedure. This procedure determines the activities that are performed during the course of the process[7].

The various activities that are involved in the air cargo handling process are defined in procedures that are designed to describe their sequence of execution. Control points are also defined that are used to evaluate the effectiveness of the activity.If the answer is yes, the process can continue, while if the no, it will be repeated until the desired quality level is achieved. This ensures that the final results do not fall short of the expectations of the users. A control point is also created to ensure that the process is managed properly[5].

If the ACHP is not followed properly, then it can lead to the failure of the service provider to provide a quality service. This could cause various consequences such as the loss of reputation and the cost of doing business. The owner of the cargo or his agent is the one who should determine the effectiveness of the ACHP.The

profitability of a handling agent is also linked to the quality of the service that it provides. In order to maintain its reputation as a reliable and profitable service provider, the owner of the cargo must ensure that the various activities that are involved in the transportation of his goods are carried out properly. Aside from ensuring that the cargo is properly packed and labeled, the shipper is also responsible for ensuring that the information about the product is disseminated to the carrier and the logistics operator[4].

The next step is to ensure that the requirements of the cargo owner are met. This process involves planning and implementing the necessary resources to ensure that the ACHP is carried out according to the customer's requirements. This step also involves preparing the documents that are required to accompany the shipment. These include the manifest, airwaybill, and other documents related to the cargo. Some of these include the notification to the captain, as well as other documents related to the different types of cargo.The next step is to prepare the cargo for transport. This process, which is referred to as the cargo handling process, involves both documentary and physical handling. It is performed on the airside and on the landside, and it is usually carried out simultaneously. This step is complex and needs to be decomposed properly.

Table 1.2

Total cargo in Cairo international airport in the last five years

year	DOMESTIC	INTERNATIONAL	TOTAL
2017	10,030,606	1,262,824	11,293,430
2018	10,305,353	1,318,472	11,623,825
2019	10,212,587	1,308,289	11,520,876
2020	3,014,282	272,450	3,286,732
2021	6,462,146	42,489	5,778,255

The growth of the airport market in North America and Europe was slower than that of other regions such as Asia, Latin America, and the Middle East. The impressive growth of the international traffic was also linked to the development of a more stable and prosperous market. The aviation services industry has changed

significantly since the start of the economic crisis in 2008, and it is still growing in different regions. In some areas, the growth of the industry slowed down, while in others, it remained stable. According to the European Commission's 2010 Annual Analyses of the Air Transport Market, the main indicator of the market's growth was the country's gross domestic product.In 2010, the airports and airlines experienced a recovery in their profitability. Both the passenger and cargo traffic indicators showed signs of growth.

According to a study conducted by the ACI, the number of airports has increased due to the increasing number of air travelers. This has led to the need for airports to provide their passengers with better services and compete with their competitors.The Council of International Airport Authorities (CIA) conducts quarterly surveys to evaluate the level of services provided by the airports. These surveys are used to determine the position of the airport in a group of airports.

A study conducted on the quality of airport services revealed that the most frequent assessments of the facility's operations are carried out by conducting passenger surveys. However, these surveys are not focused on the airlines, which are the most important customers of the airport. If the airlines stop flying to a certain airport, it could affect the market share of the airport and the passengers.The airport's success in attracting new airlines has increased its competitive advantage and contributed to the improvement of its operations. Air carriers also rate the airport's efficiency in order to improve their services. Due to the increasing number of airlines, the number of routes that are served by the airport has also changed.

The increasing number of air travelers has a significant impact on the behavior and attitude of the passengers. This is why it is important that the authorities conduct regular surveys to evaluate the operations of the airport.The airport provides various services to both the airlines and the passengers. These include the maintenance and operation of the facilities needed for the aircraft, as well as the provision of safety and security measures. Other services that are offered by airports include ground handling, passenger transport, and the establishment of information technology

systems. Non-aviation services offered by airports include commercial activities such as car parking, commercial leasing, and business lounges.

According to Kasarda (2006), the various activities that are carried out by airports are considered to be the core services and commercial facilities offered to passengers.

A study conducted by the Air Transport Research Society revealed that the non-aeronautical activities of airports in Europe have resulted in a significant increase in their revenues. These activities are mainly carried out at airports such as Frankfurt and Munich.

These activities are mainly used by airport employees and other individuals who are connected to the airport, such as local residents and business visitors. These activities are considered to be very profitable and have lower operational costs than the aeronautical ones.

Due to the increasing number of airports that are operating, the need for additional sources of income for the airport has become more prevalent. These activities are mainly aimed at improving the passenger experience and reducing the cost of operations.

In 2011, Fuerst and colleagues noted that modern airports have become more than just functional facilities. They also feature various other non-traditional services such as restaurants, museums, and conference centers.

Over the years, the non-aeronautical activities of airports have been able to significantly increase their revenue. These activities are estimated to have contributed to the total revenues of the airports.

According to a study conducted by Baron & Wass in 1996, most passengers browse through duty-free stores first to fill their time and then to find a specific product.

The time spent in the airport's retail area has a significant impact on the likelihood of a consumer making a purchase. This is because the number of products that are offered to consumers has increased.

The presence of retail outlets at airports has been instrumental in the growth of the airport's operations. It has been estimated that the retail industry has contributed to the airport's total revenues. Due to the increasing number of products and the establishment of new facilities, many airports have started to expand their commercial offerings.

In addition, the time that travelers spend in the airport's retail area can help them kill time. It can also be postponed in case of a lack of time.

The time spent waiting in line at an airport is often associated with frustration and boredom. Due to the increasing number of air passengers, airports are looking for new ways to improve the experience of their passengers. One of the most common factors that can affect the passengers' experience is the length of the wait time. This is why a research project was conducted to analyze the various non-aviation services that airports can provide to improve the dwell time of their passengers.

This study aims to analyze the various non-aviation services offered by airports and determine how they can improve the passenger experience. The project's sub-goals are focused on analyzing the passenger dwell time and identifying areas where improvements can be made.

The study was conducted to determine the various non-aviation activities that are carried out at Cairo International Airport. These activities could have contributed to the airport's total revenues and were considered to be the core services and commercial facilities of the airport.

Non-aeronautical operations are commonly carried out through franchise agreements and self-operation. These activities are considered to be core services and commercial facilities of airports.

In addition to the passenger experience, the study also analyzed the various non-aviation activities that are carried out at Cairo International Airport. These include the establishment of retail shops, the leasing of space for advertising, the provision of goods warehousing and cargo handling services, and the establishment of information processing facilities.

The establishment of a new organizational framework that enables airports to effectively manage their various operations has shown the evolution of their operations from a simple aeronautical infrastructure to a complex multi-functional one. This new approach is aimed at providing both commercial and aeronautical services.

The objective of this section's study was to analyze the various non-aeronautical activities that are carried out at Cairo International Airport and determine how they can contribute to the airport's total revenues. In order to maximize the profits that are generated by these activities, the value of these activities can be split between the airport and its customers. Some of these activities are used by the airport's staff and other local residents, while other activities are only restricted to ticket holders.

Non-aviation activities are considered to be profitable as they have lower operating costs compared to the aeronautical operations.

The study revealed that the non-aeronautical activities that are carried out at Cairo International Airport contribute significantly to the airport's total revenues. In 1997, Zhang & Kratzsch noted that the total revenues of the airport have increased due to the growth of commercial and non-aeronautical activities.

The various services that are offered by airports over the years have shown the evolution of their operations from a simple aeronautical infrastructure to a complex multi-functional one. Some of these include the establishment of commercial facilities, the leasing of space for advertising, and the provision of goods warehousing and cargo handling services. In order to minimize the costs and improve the passenger experience, many airports are trying to expand the scope and number of non-aeronautical activities.

According to Kasarda, in 2006, the increasing number of non-aeronautical activities at airports has shown the evolution of their operational management. As a result, many airports have started to develop property or real estate divisions in order to expand their commercial activities. Some of these include the British Airport Authority and the Singapore Airport Authority.

One of the factors that has been identified as contributing to the growth of the non-aeronautical activities at airports is the improving of the land surrounding the airport. This has led to the establishment of various commercial facilities and office parks.

1.4. Definition of ground services at Cairo International Airport

Ground services are represented according to the divisions of the Ministry of Civil Aviation into five types, which are ground services provided for (airplanes - passengers - catering - goods, mail and luggage - fuel).

Passengers start and end their flights at the main passenger terminal. From the sales department of the various airlines, departing passengers can purchase their tickets or show the tickets they have to the specialized staff at the airline offices located inside the building. The passengers' luggage is inspected and then weighed in the places designated for this purpose. Passengers board the plane and then upon their arrival at the airport where the flight ends. In the passenger halls there are loudspeakers, television screens and illuminated panels that announce the times of arrivals and departures. There are also seats in the waiting rooms for the convenience of passengers and their depositors. Passengers from these halls go to and return to planes from planes through gates. In most large airports, there is a covered corridor called the air body that connects the gate to the plane while passengers are heading to it.

Passenger satisfaction is a measure of how satisfied a customer is with a service encounter following a purchase or consumption. This is typically done by analyzing the total experience of a customer over a period of time. In the low-cost carrier industry, this concept was used to describe the passenger response to a service experience.

One of the most influential factors in a consumer's purchase and loyalty is satisfaction. This concept has been used to describe the overall evaluation of a product or service's performance. It is a measurement that takes into account the multiple experiences that a consumer has with a product or service over time

When it comes to buying low-cost carriers, passenger satisfaction with them is often different from the dissatisfaction with other low-cost carriers. According to researchers, it's important for customers to perceive superior service quality in order to improve their satisfaction. This concept is typically used to describe the antecedent of customer satisfaction.

In the low-cost carrier industry, the first step in satisfying a passenger is to determine the quality of the service provided. This process can be carried out through a service quality assessment.

According to Oliver (1997), customer satisfaction can be used to predict a consumer's behavior. It can help them increase their willingness to purchase and improve their consumption habits. For instance, if a customer is satisfied with the service provided by a low-cost carrier, they are more likely to recommend the company to their friends.

Studies have shown that customer satisfaction can influence the likelihood of a consumer making a purchase decision after a service experience. This concept should be added to the long-term goals of a company to improve its performance.

For organizations that are looking to improve their customer satisfaction, it is very important that they have a well-defined and consistent strategy. Various studies conducted by researchers in the low-cost carrier industry have shown that customer satisfaction can be influenced by various factors.

In 2000, Gronroos noted that the passenger experience with low-cost carriers can influence a consumer's decision to purchase. However, little research on the subject has been conducted. For instance, the effects of passenger satisfaction on a company's performance may vary depending on the type of service provided.

Various service quality models have been created to measure the various factors that can influence a consumer's satisfaction. One of these is the SERVQUAL model,

which was introduced in 1988. It has five dimensions: reliability, responsiveness, empathy, assurance, and tangibles. In a follow-up study, Parasuraman and colleagues introduced a three-factor model.

The factors that can influence a passenger's decision to purchase a company are the quality of the service provided and the presence of competent personnel. The latter refers to the ability to perform the service correctly and efficiently. Customer satisfaction is also linked to the various features of the service, such as the environment and the facilities.

Although the SERVQUAL model can be used to measure the various factors that can influence a consumer's satisfaction, it cannot be used to analyze the service quality of other service industries. For instance, the perceptions of low-cost carriers' customers do not seem to fit with the model's overall design.

The factors that can improve the reliability of low-cost carriers' services are expected to affect the satisfaction of their passengers. For instance, if a passenger is satisfied with the quality of the service provided by the company, this will lead to higher levels of loyalty.

The quality of personnel of low-cost carriers is also linked to the satisfaction of their passengers. According to Theingi and Saha, the level of qualified personnel that the company has is determined by the responsiveness, assurance, and empathy dimensions.

The perceptions of passengers about the quality of the service provided by low-cost carriers are also linked to the training and development of their employees. This is because these factors can help improve the efficiency and effectiveness of the company's operations.

Studies also suggest that the skills and knowledge of employees can affect the quality of service provided by low-cost carriers. For instance, in 2006, Park and colleagues noted that the ability of an airline to respond quickly to meet the needs of its passengers is regarded as an antecedent of passenger satisfaction.

Studies also suggest that improving the quality of the service provided by low-cost carriers can also be carried out through the training and development of their

employees. This can be done through the establishment of well-qualified and experienced personnel.

One of the most important factors that passengers consider when it comes to choosing a low-cost carrier is the availability of a convenient flight schedule. This factor can help improve the quality of the service provided by the company. In addition to having a good flight schedule, other factors such as the time interval between the flights and the availability of adequate parking spaces can also affect the passenger experience.

In 2009, Ishii and colleagues noted that improving the quality of the service provided by low-cost carriers can be carried out through the establishment of better scheduling alternatives and the availability of more flight frequencies. In 2009, Theingi and Saha also noted that the flight schedule is the most important factor that affects the quality of the service provided by low-cost carriers.

Several studies also suggest that the availability of a good flight schedule can help boost the performance of low-cost carriers. It can also help them compete against full-service airlines. According to Williams and O'Connell, the increasing number of passengers who choose to travel with low-cost carriers can help improve their strategy for increasing their market share.

The following hypothesis was proposed as a possible solution to the issue of low-cost carriers' passenger satisfaction.

One of the most effective ways that low-cost carriers can improve the quality of their services is through the establishment of an online ticketing service. This can help them reduce the ticket processing charges and provide their passengers with a convenient and faster way to purchase their tickets.

In a study conducted in 2008, Chen and colleagues noted that the availability of online ticketing services can help low-cost carriers improve their passenger satisfaction. They noted that the company should provide a variety of tools and features that can help its passengers easily access their online transactions.

Studies also suggest that the availability of an online ticket reservation and ticketing service can help improve the passenger experience when it comes to

choosing a low-cost carrier. In 2012, a survey conducted by Sarker and colleagues revealed that many passengers prefer to travel with low-cost carriers when it comes to choosing their flights.

The importance of customer satisfaction is also regarded as the main factor that influences the post-purchase intentions of passengers. According to a study conducted by Zeithaml and colleagues in 1996, dissatisfied customers are more likely to switch to a different service or product provider, while those who are satisfied with their current experience are more likely to repurchase their products or services in the future.

The future purchase intention is a type of behavior that describes a customer's future decisions regarding a product or service. It has been regarded as a crucial factor that can help retain a customer. Researchers have also considered it as a multidimensional construct. For instance, the most common type of post-purchase intention is the repurchase or recommendation.

The study focused on the two dimensions of post-purchase intentions: the repurchase and the recommendation intention. The former refers to the passenger's willingness to return to the low-cost carrier for a second time, while the latter refers to the customer's willingness to recommend the company to others.

According to researchers, the importance of passenger satisfaction is a critical factor that can help low-cost carriers retain their customers. In 2011, Lee and Kim noted that if the passengers are satisfied with the company's services, they are more likely to make a purchase or recommend the company to others.

In 2013, Han noted that high levels of passenger satisfaction can help boost the positive publicity about low-cost carriers. He also noted that this positive feedback can help encourage more people to buy and recommend the company. A study conducted in 2017 by Saleem and colleagues revealed that the passenger satisfaction and willingness to repurchase are related to the level of experience that the airline industry has.

1.5. SWOT analysis of Cairo airport

The rapid evolution of the aviation industry and the increasing number of airlines have resulted in a more competitive environment for travelers. With a wide variety of airline services and low-cost fares, recent travelers can benefit from this environment.

Price has been regarded as the most important competitive advantage that airlines can offer their customers. In addition to being able to provide the best possible service, airlines have also started adopting a dynamic pricing model.

The increasing number of airlines has resulted in a more competitive environment for travelers. This is because the price alone can no longer provide the sustainable advantages that customers expect. In order to maintain its competitive advantage, an airline should focus on providing the best possible service.

Studies have shown that the quality of service is a key factor that influences the choice of an airline. It can also help retain existing customers and acquire new ones. In addition to being able to provide the best possible service, airlines can also generate strong loyalty by attracting new customers.

Studies have shown that the quality of service is a key factor that influences the choice of an airline. Some of the studies that have examined the issue include the drivers of airline choice and the passenger expectation. Others include the factors that influence the service recovery and the brand positioning of an airline.

Previous studies have shown that the quality of service is related to the various attributes of an airline. If an airline's performance is good, then its overall satisfaction and quality of service can increase.

Although airline services are not as complex as high-tech products, they still have an intricate structure. They are composed of various interactions between the various service providers and their customers. Some of these include the check-in and boarding services, in-flight entertainment, and catering.

The quality attributes of a service are also related to the interactions that passengers have with flight attendants. For instance, passengers' perceptions of authenticity and the extra attention they receive when interacting with flight attendants are important factors that influence the performance of in-flight services.

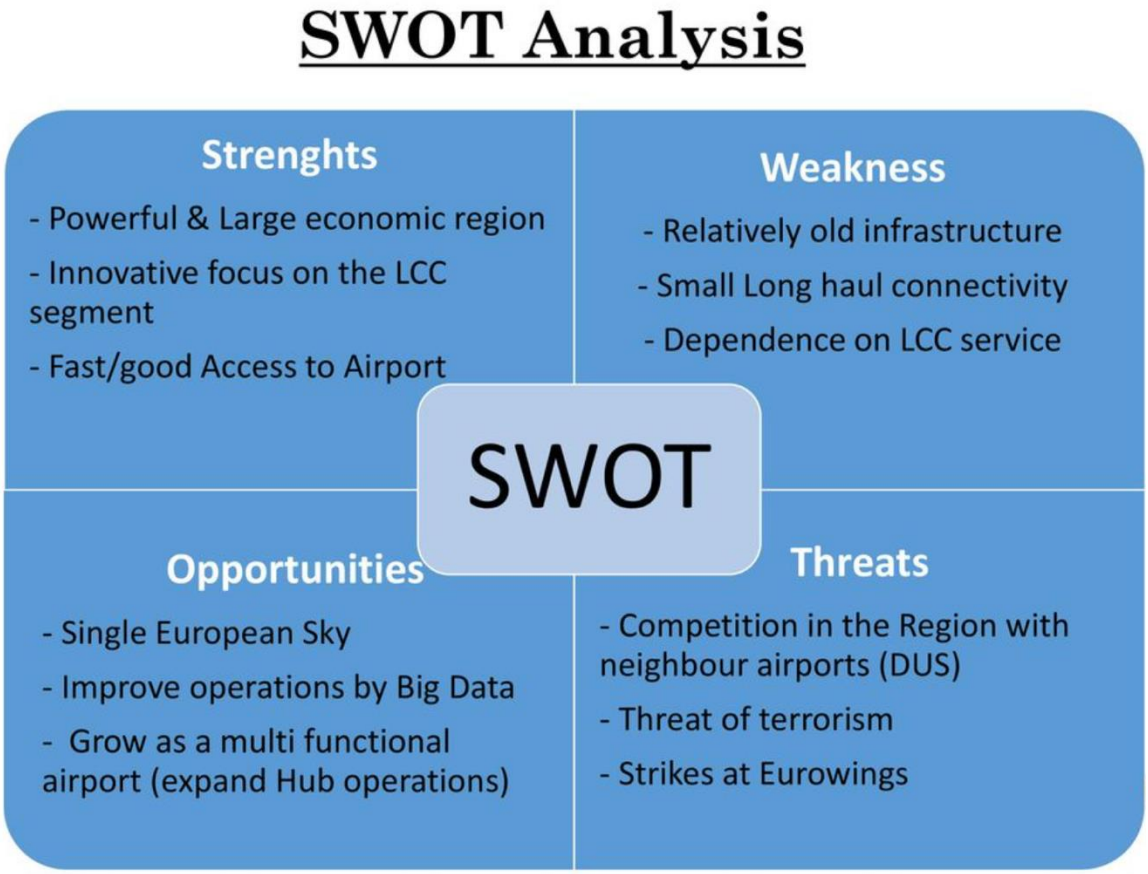

Fig. 1.4. SWOT- analysis of Cairo airport

The physical environment can be considered as an intangible factor that affects the quality of a service. Aside from the various factors that affect the service encounter, the in-flight experience can also be influenced by the intangible attributes of the service. For instance, the temperature and the quality of the air are some of the factors that can be considered critical for an airline's F&B service.

For instance, Korean Air serves a variety of Korean cuisines to attract its target market. Other airlines from Muslim countries also provide Halal food to their Muslim passengers. Malaysia Airline is regarded as one of the best airlines that offer genuine Halal meals.

According to Sean and Han, in-flight service performance is significantly affected by the quality of food and beverage provided by an airline. Having a clear understanding of the various factors that affect the service's performance can help improve the efficiency of an organization.

The various attributes of a service can be categorized into two categories: sensory and nutrition, and service delivery. These include the variety of food that the restaurant serves, the temperature of the air, and the cleanliness of the service delivery area.

Due to the increasing competition in the airline industry, customers are more likely to select a low-cost carrier when it comes to choosing a flight. To gain a competitive advantage, airlines should consider the various quality attributes of their services in a way that they can be considered as value for money.

According to Anderson and Mittal, in 2000, the quality of a service can greatly affect the satisfaction of a customer. In the tourism and hospitality literature, the relationship between satisfaction and quality attributes is generally studied in a linear manner. The high level of satisfaction that customers experience with a service can help generate loyalty.

Despite the importance of linear and symmetric effects, the effects of various quality attributes on satisfaction can be limited by the degree to which they are perceived as sensitive to dissatisfaction or satisfaction. For instance, if the temperature of the air is agreeable, then the satisfaction of passengers might not be as high as it is due to how they take for granted this attribute.

While it's important to consider the various quality attributes of a service, it's also important to note that dissatisfaction can be triggered by a particular attribute. For instance, if the air-conditioning system fails during a flight, then the passenger becomes extremely dissatisfied.

The effects of various quality attributes on the satisfaction of customers are explained as the differential effects of these factors on the overall satisfaction of a customer. For instance, the quality attributes of a service can affect the satisfaction of passengers differently depending on the type of attributes they are dealing with.

2. DESIGN PART

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2.1. Ground Handling Improvement Suggestions at Cairo Airport

The Cairo International Airport has a floor area of 37 square kilometers, and it serves about 14,711,500 passengers annually. It is the second-busiest airport in Africa after the Tambo International Airport in South Africa. It has a retail space of 1,300 square meters in the first terminal of Egypt Air. The main building of the Cairo International Airport Terminal 2 has a limited commercial space. There are only 5000 square meters of retail space in terminal 3, which is mainly used by Egypt Air and duty-free shops.

Duty-free shops are one of the main sources of profit for airports. They are located in the areas where passengers wait for their flights, and they provide them with the necessary supplies to take advantage of this time. There are also various small shops in the area that offer basic goods.These stores sell various types of goods and services at a higher price than supermarkets. The National Association of Convenience Stores classifies these types of establishments into six categories.These stores can sell various types of food and beverages, such as frozen food, beverages, tobacco, and newspapers. They are also located in areas where passengers are waiting for their flights. These establishments are able to provide their customers with fast and convenient access to their goods and services.

There are two types of stores in the airport: the newsstand and the bookstore. The former is an outdoor area that sells newspapers and periodicals, while the latter is a place where you can buy books.

These stores are also known as retail stores that sell baked goods, such as cakes, cookies, and pies. They also sometimes sell beverages such as coffee and tea. These establishments usually make their own soft drinks and serve them while the customer is eating.

These stores are also known as retail establishments that sell various types of goods and services that are designed to remind people of their trips. Some of these

include clothes, jewelry, and hats that are adorned with the names and logos of the places they visited.

Outside of airports, there is a huge parking area that includes the car rental companies, city shuttles, and various other facilities. This area allows passengers to easily access the various areas of the airport. It also gives employees and visitors a great flexibility in parking their cars at airports. Car rental companies are also known to operate in this area. They provide a variety of cars to their customers for short-term rental. This is more than just using private cars. City Shuttle is also a vital part of connecting the city.

The car parking area in Singapore features various types of vehicles, such as motorbikes, vans, and scooters. The Cairo International Airport's car parking area has a total area of 86,395 square meters. It can handle over 300 cars for short and long parking. The city shuttle service at the nearby airport of Singapore provides passengers with a convenient and cost-effective way to reach downtown hotels.Although there is no city shuttle service at the Cairo international airport, there are several car rental companies that operate there. They are located in all the terminals of the airport. In addition, there is also a limousine service that can transport passengers from the airport to their destination.

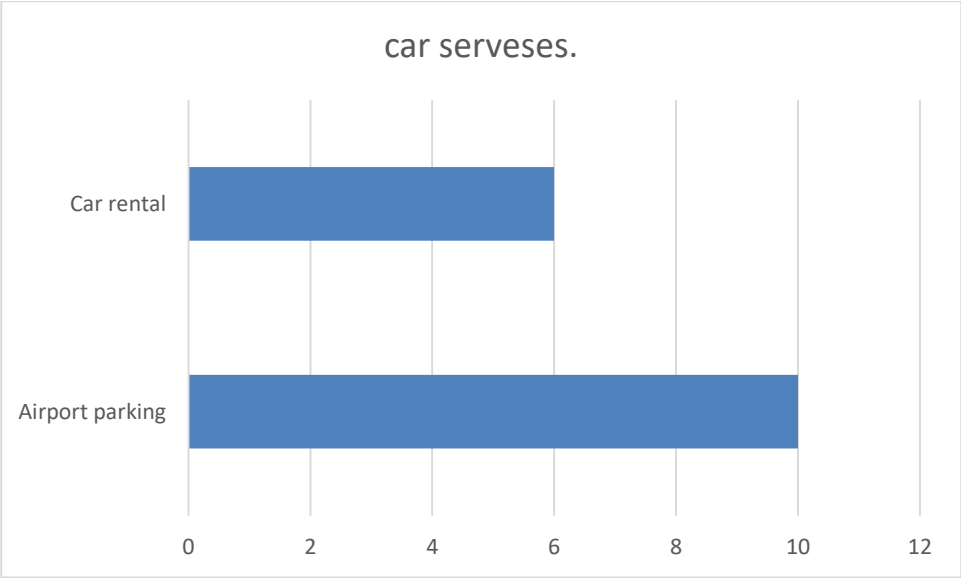

Fig. 2.1. Car serveries in airport

Nowadays, banks are very important to the customers as they provide a wide range of financial services. One of these is the use of automated teller machines, which are commonly used for various transactions. In the past, these machines only handled cash transactions.In 2017, Bogicevic and colleagues explained that moneychangers are establishments that allow customers to exchange money from one to another.

The Aerotel transit hotel, which is located inside the terminal, has a swimming pool and a bar. This facility is ideal for the passengers who are waiting for their next flight. They can also enjoy the other leisure services offered by the hotel on a complementary basis.In addition to these, the airport in Singapore also has a variety of play areas and movie theaters. In contrast, the Cairo international airport has no leisure facilities. Some of the play areas in the airport are located in the departure terminal and feature plastic seesaws and playhouses.

Fig. 2.2. Airport museum in Cairo airport

These services are offered to customers who require various types of assistance such as medical services, family services, and baggage storage. Family services also include the provision of strollers, baby care rooms, and playground equipment at the

airport. In addition, the airport has a wide variety of these in its terminals to provide children with an enjoyable experience.At the Singapore airport, there are four baby care rooms that provide a variety of services such as hot water dispensers and cots. They also have private areas where parents can bathe and sleep with their babies. Unfortunately, Cairo international airport does not have these family services. These are considered to be very important for families with young children.

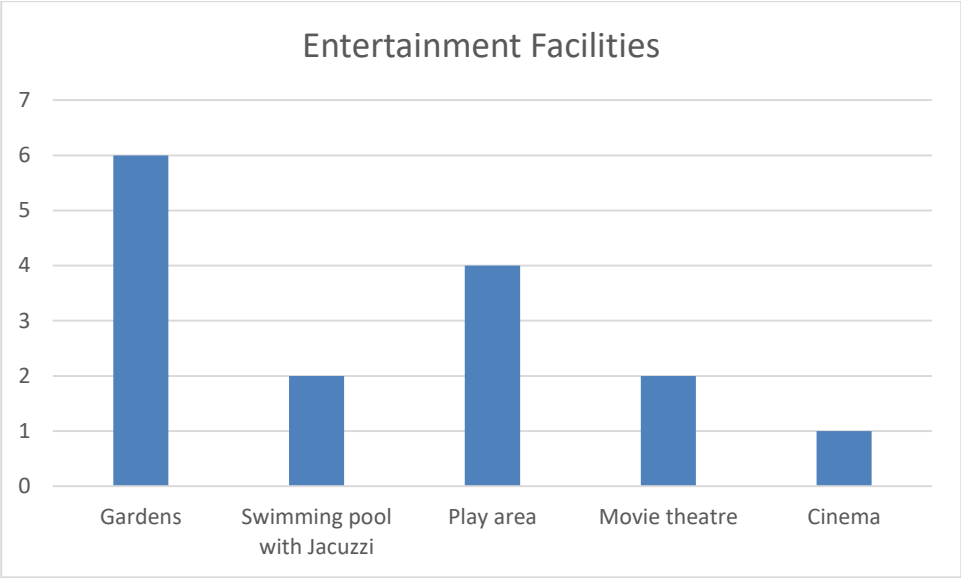

Fig. 2.3. Entertainment Facilities proposed in the design

Today, disabled passengers can easily travel by air. Due to the availability of various equipment and services, such as wheelchairs, airports have become more accommodating for their needs. In addition, the onboard toilets and the terminals have been equipped with door expansion to allow passengers to travel more comfortably. Cairo international airport and Singapore's Changi airport provide these services to passengers with special needs. They have trained staff members who can handle emergency situations and provide sign language for those with visual and hearing impairments.

In addition, the customer service counters of the airports in Singapore and Cairo provide free wheelchairs to the elderly and those with less mobility. They can also rent them from the medical centers for $15 an hour. These services are also complemented by the installation of ramps and elevators, which allow the passengers

to easily access the various levels of the building. Restaurants, baby lounges, and restrooms can also be accessed by travelers in wheelchairs. Cairo international airport also provides a variety of special services for those with special needs, such as the provision of ramps and wheelchair-accessible toilets. These facilities should only be notified to airlines in advance.

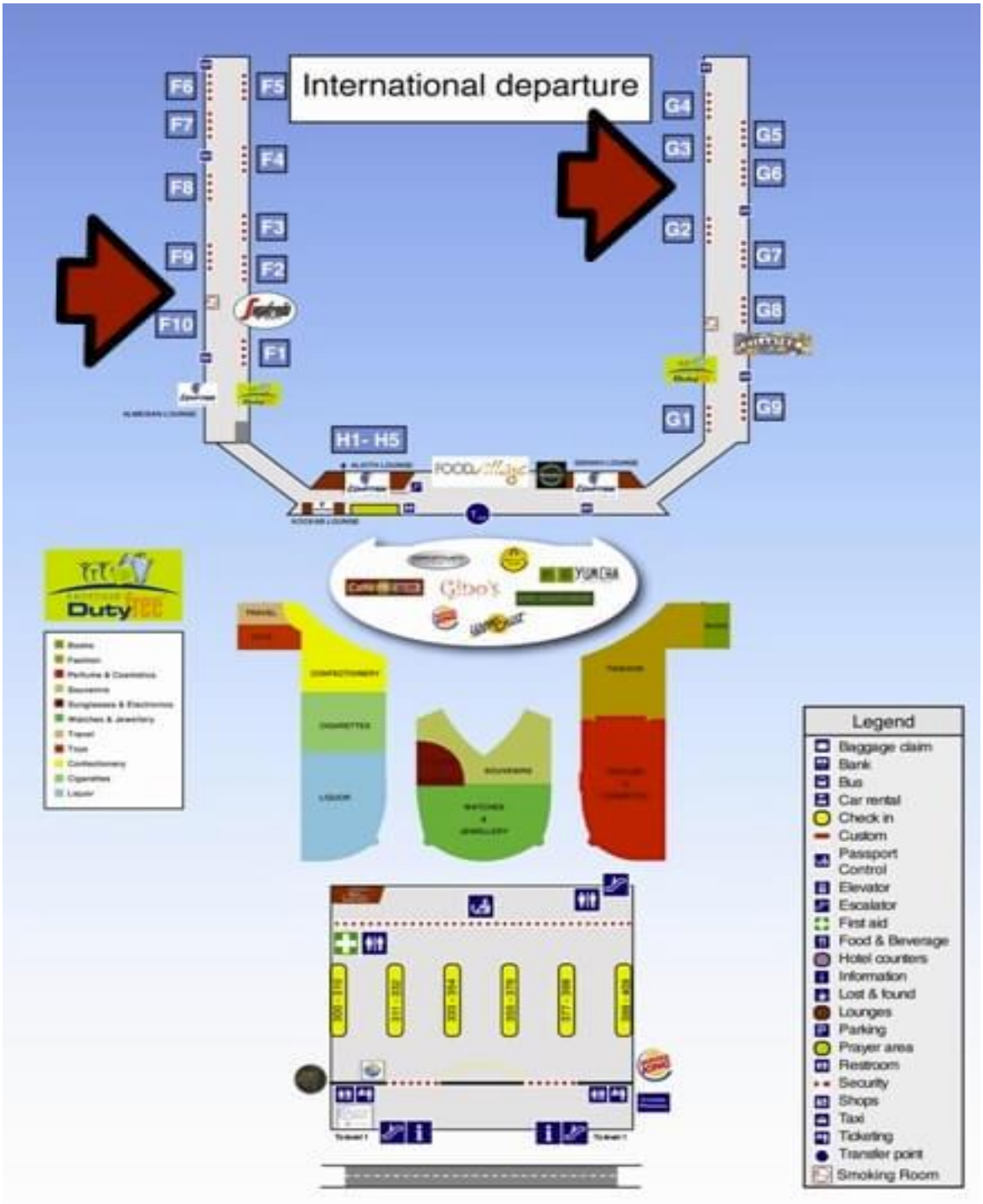

Fig. 2.4. Showing different passengers facilities in Cairo airport

Both Cairo international airport and Singapore's Changi airport provide medical services to passengers who don't feel well and need assistance. These facilities are available in the public areas, including the transit lounge, restaurants, and restrooms.Aside from these, Singapore's Changi airport also has a variety of medical facilities that provide a wide range of services, such as vaccinations and advice on health matters. It has 6 clinics that are part of the Raffles Medical Group, and 10 pharmacies. On the other hand, Cairo international airport only has two pharmacies, which are owned by El-Ezaby.

The Cairo international airport has a special service that's called "Ahlan", which is a dedicated and professional service that's offered to all its distinguished guests. This includes making all the necessary arrangements for the arrival and departure of passengers.The airport's medical services are divided into two categories: VIP and meet and assist. The former provides a variety of services, such as claiming luggage and providing access to the airport's VIP lounges. On the other hand, meet and assist services only cater to the passengers in normal lounge areas.

In addition, the airport has porter services, which allow passengers to store their luggage in the airport's facilities. These services are available 24 hours a day.Cairo international airport and Singapore's Changi airport also have porter services that are designed to help passengers carry and move their bags. These services can be booked in advance by making a reservation with a minimum of 4 hours before the flight's departure.

2.2. Proposition for complementary services

These business centers provide various services such as mail, faxing, and typing. They can also help businessmen and passengers work more efficiently. Lounge facilities are also known as pay-per-use facilities. These are areas where guests can

gather and relax while waiting for their transportation. They can also provide various services such as massage and beauty services, gym, and reservation counters.

The meeting rooms are also equipped with all the necessary equipment for meetings. They can also provide video conferencing capabilities to meet the needs of both VIP and business passengers. Usually, these rooms are used by passengers due to the presence of other people from different countries who are coming for meetings. Businessmen also use these facilities to prepare for their meetings. One-bedroom nap rooms are also known as single occupancy rooms. They have a variety of entertainment options such as flat-screen televisions and a business area with computers and newspapers.

Airport management training courses are also available to help managers improve their skills and knowledge regarding the service quality of the airport. They can also learn about the leading airports in the industry. Aside from these, there are also travel agencies and transit hotels that can be found in both airports. Business centers are also available in both airports. There are 3 business centers in Singapore's Changi airport, while no such facilities are found in Cairo's international airport. When it comes to pay-per-use lounge facilities, the airport in Singapore offers special features such as free Wi-Fi and a gym.

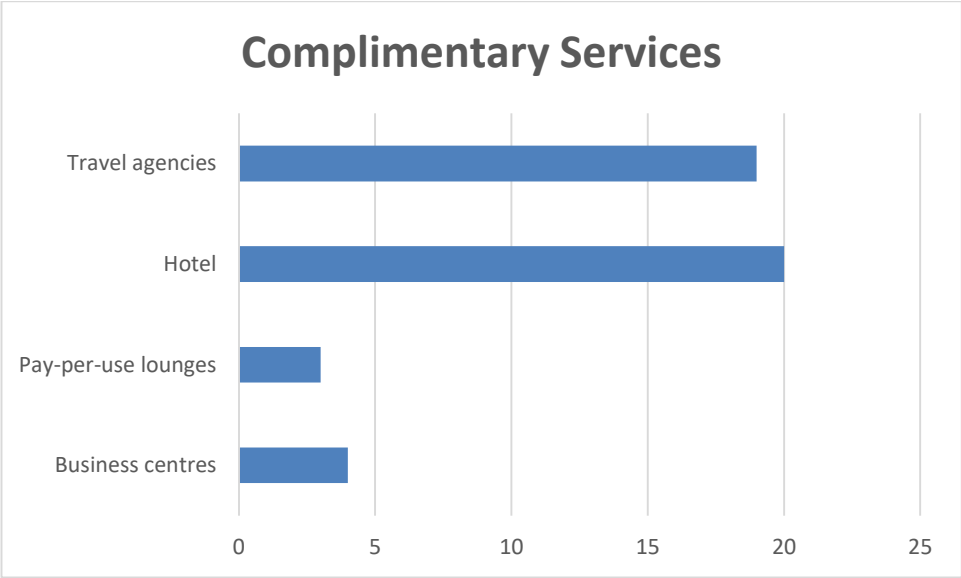

Fig. 2.5. Showing number of Complimentary Services in Cairo international airport

The Cairo International Airport has a VIP lounge that's designed to provide exclusive privacy for those traveling as well as business passengers. It has three main lounge areas, a stereo restaurant, and a transit hall. These areas are located at the center of the airport and allow passengers to enjoy drinks while watching the transit hall. Besides these, airport lounge facilities also provide various services such as food and beverages. There are several Egypt Air facilities that offer these services. These include a variety of food and beverages, a toilet facility, and a workstation area that has multiple computers and printers.

All of these hotels have the necessary facilities and services to meet the needs of the passengers. In addition, there are no meeting rooms in the Cairo airport. Also, single occupancy nap rooms are only available in Singapore's Changi airport. These are only available through the training facility of the ACI GTH. Airport management training courses are also available to help managers improve their skills and knowledge regarding the service quality of the airport. There are also 19 travel agents at the Cairo airport that provide various services such as ticket issuing and reservation.

Several travel agencies that can be contacted through websites such as Misr Travel, Paradise, and Fast Tours operate out of the airport. Transit hotels at the airport provide well-equipped rooms with a variety of amenities such as a power shower and a swimming pool. The transit hotel at the Cairo airport provides a variety of rooms for those who are waiting for their next flight. These rooms are located inside the airport and allow passengers to stay their nights.

2.3. Calculation of proposed model

The finalization of attributes is carried out through the review of literature and expert opinion. These are referred to as c1, c2, or n number of attributes. Through the

review of literature and expert opinion, various attributes can be obtained. These are referred to as c1, c2, c3, and c6.

The finalization of these attributes is carried out through the determination of the best and worst attributes.

Step 3: After the selection of the best attribute, the preference ranking is performed on a scale of 1e9. This method will help you determine the best attribute over the other one.

Experts then perform the finalization of the other attributes over the worst one. The comparison of the two attributes can be shown in vector form.

The a1W, a2W, and a3W represent the ratings of any attribute with the worst-rated attribute. In this case, aWW 1 represents the rating of the attribute with the worst-rated attribute.

The objective of this method is to minimize the absolute differences between the different attributes. Using the minimax model, the weights of the various attributes can be calculated.

Another parameter that needs to be considered is the consistency xL of the comparisons. A value closer to 0 will ensure that the results are consistent.

$$\text{wj} \geq 0; \text{ for all j,} \tag{2.1}$$

The average decision matrix is then computed using the equation. This method ensures that the results are consistent.

$$F = \frac{1}{k}\sum_{k=1}^{k} Fk \ , \tag{2.2}$$

The management of Cairo Airport is considered to be an international hub for Egypt. This means that it must be improved to achieve a good reputation.The land around the airport should be used for various projects in order to create more job opportunities and improve the area around it.

Table 2.1

Input date for modeling

		Current **FINANCIAL POSITION** 2022		After the model applied expected per year
Fixed Assets (Net)		18,347,298,881		22,545,619,588
Projects In Progress		1,182,471,769		725,192,124
Long - Term Investments		3,773,749,569		3,861,483,737
Long - Term Loans And Debit Balances		205,602,590		164,809,470
Total of Non-Current Assets		23,509,122,809		27,297,104,919
Current Assets				
Stock		34,110,812		36,073,901
Customers , Notes Receivables And Debit Accounts		4,538,620,966		4,808,118,808
Cash in banks and in hand		131,326,780		595,433,728
Total Current Assets		4,704,058,558		5,439,626,437
Total Assets		28,213,181,367		32,736,731,356
Equity				
Paid Up Capital		4,078,806,000		4,128,806,000
Reserves		2,233,222,766		2,335,609,093
Total Equity		6,312,028,766		6,464,415,093
Total of Non - Current Liabilities		12,613,349,699		14,407,758,773
Total Equity & Non - Current Liabilities		18,925,378,465		20,872,173,866
Current Liabilities				
Provisions		2,547,171,281		2,691,404,993
Creditor banks		3,877,399,934		4,037,645,855
Suppliers , Notes Payable And Credit Accounts		2,863,231,687		5,135,506,642
Total of Current Liabilities		9,287,802,902		11,864,557,490
Total Equity & Liabilities		28,213,181,367		32,736,731,356
	REVENUES			
PARTICULARS				
Activity Revenues .		4,082,995,096		2,795,191,617
Grants & Donations.		60,837,408		93,375,504
Investments Revenues & Interests.		72,125,230		32,853,169
Other Revenues & Profits.		188,285,636		386,615,863
Total Revenues		4,404,243,370		3,308,036,153
COSTS & EXPENDITURES				
Raw Material , Requisites, Fuel & Spare Parts.		59,268,994		60,651,782
Wages.		437,759,173		530,507,803
Expenditures.		2,611,886,947		2,223,977,669
Purchases of goods for sale purposes .		95,706		40,836
Burdens & Losses.		1,005,342,445		445,732,223
Total Cost & Expenditures.		4,114,353,265		3,260,910,313
Profit (Loss)		289,890,105		47,125,840

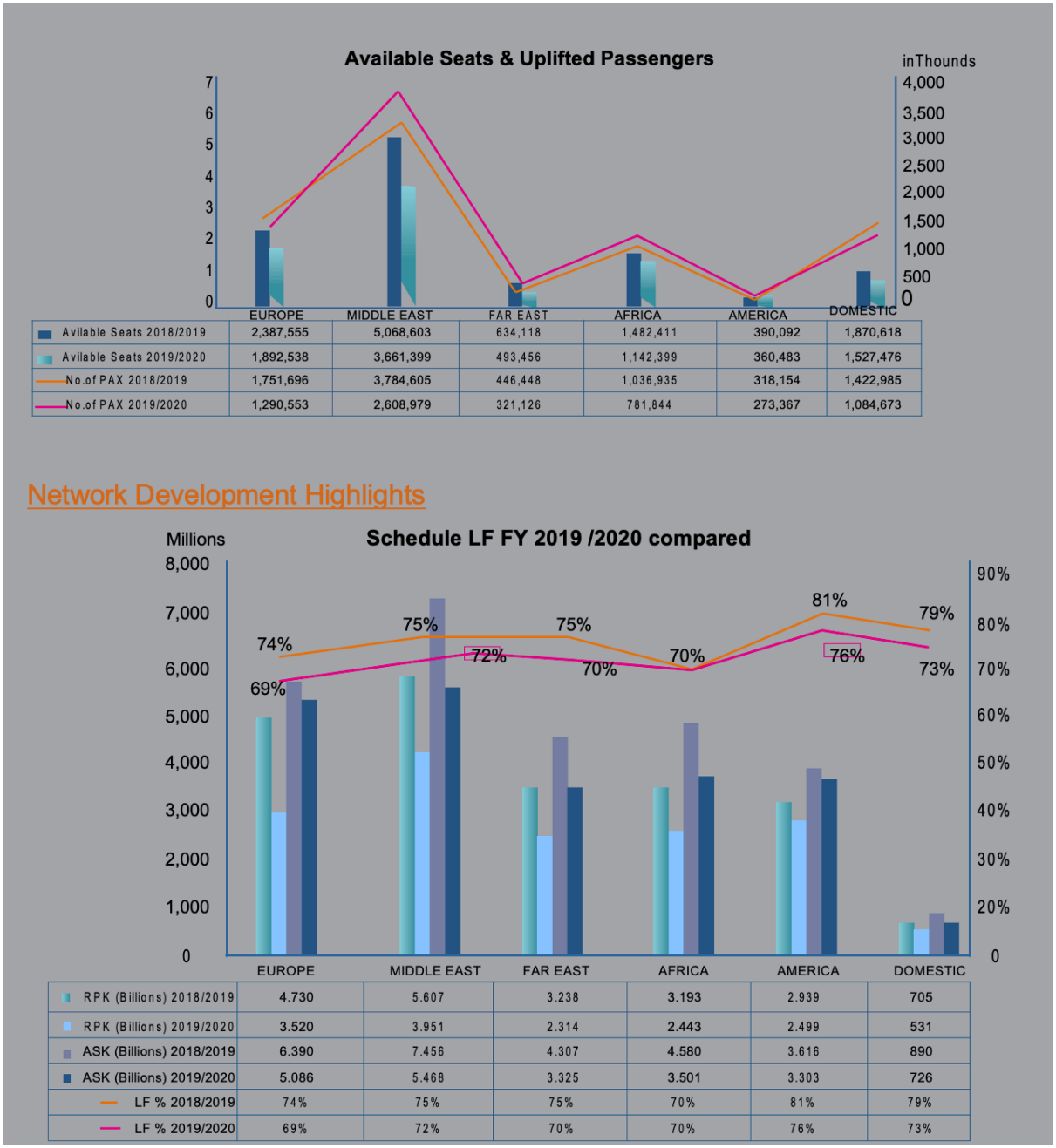

Fig. 2.6. Network development highlights

The location of Cairo Airport has a significant impact on the environment and its commercial and cultural activities.If the airport is turned into an Airport city, it will become an independent and self-sustaining entity that will be able to provide various services such as commercial, administrative, and residential facilities. This will allow the airport to increase its revenues.

The design of the airport's terminals can also affect the flow of passengers. This is because the locations of the buildings and their connections to each other can

create a lot of problems for people.The lack of parking spaces can also affect the flow of passengers. This issue can create a crisis during the official seasons.

Considering that, on average, 900 applications are received per day. The average duration of the airport formalities is 10 minutes, the queue length should not exceed 10 passengers.

Therefore, it is necessary to determine:

- the probability of downtime of the facilities ;
- the probability of failure;
- service probability;
- the average number of busy facilities ;
- the average number of applications in the queue (line);
- the average number of applications in the system;
- absolute carrying capacity;
- relative carrying capacity;
- the average time of the application in the queue;
- average time of a request in the system;
- average service request time.

Consider a queuing system with 5 passport control booths with waiting and a limited queue of 10 passengers.

We get the parameters:

n = 5 (number of facilities);

m = 10 (number of places in the queue);

The intensity of the incoming flow, $\lambda = \frac{900}{60 \cdot 24} = 0{,}6$ (applications per minute).

Intensity of the flow of service, $\mu = \frac{1}{5} = 0{,}2$ (1 application per 5 minutes).

Let's define the characteristics of this queuing system in the limit mode. Enter the parameter:

$$\psi = \frac{\lambda}{n \cdot \mu}, \qquad (2.3)$$

where, ψ is the load on 1 booth.

Thus, substituting values into the formula, we obtain: $\psi = \frac{0,6}{5 \cdot 0,2} = 0,6$.

Limit probabilities are determined by the following formulas:

$$\rho_0 = \frac{1}{\sum_{k=0}^{n} \frac{n^k}{k!}\psi^k + \frac{n^n}{n!} \times \frac{\psi^{(n+1)}(1-\psi^m)}{1-\psi}}, \quad (2.4)$$

Channel downtime probability: $\rho_0 \approx 0,04668723$.

Denial of service probability: $\rho_r = \rho_1 = \frac{5^5}{5!} \times 0,6^{10} \times 0,04668723 \approx 0,007351558$.

Relative carrying capacity (service probability):

$$Q = 1 - \rho_r, \quad (2.5)$$

Q = 1-0,007351558 = 0,992648442.

Absolute carrying capacity calculate by the formula:

$$A = \lambda \times Q, \quad (2.6)$$

A = 0,6×0,992648442 = 0,5955890652.

The average number of busy facilities is calculated by following formula:

$$N_{s=} \frac{A}{\mu}, \quad (2.7)$$

$$N_{s=} \frac{o,5955890652}{0,2} = 2,977945326.$$

The average number of applications in the queue (line):

$$N_{line} = \frac{n^n}{n!}\psi^{(n+1)} \times \frac{1-\psi^m(m+1-m\psi)}{(1-\psi)^2}\rho_0, \quad (2.8)$$

$$N_{line} = \frac{5^{5n}}{5!} 0{,}6^6 \times \frac{1 - 0{,}6^{10}(10 + 1 - 10 \times 0{,}6)}{(1 - 0{,}6)^2} \times 0{,}04668723 = 0{,}343812579.$$

The average number of applications in the system:

$$N = N_s + N_{line}, \tag{2.9}$$

N = 2,977945326 + 0,343812579 = 3,321757905.

Average request time under service:

$$T_s = \frac{N_s}{\lambda}, \tag{2.10}$$

$T_s = \frac{2{,}977945326}{0{,}„6} = 4{,}96324221$ min.

Average application time in the queue:

$$T_{line} = \frac{N_{line}}{\lambda}, \tag{2.11}$$

$T_{line} = \frac{0{,}343812579}{0{,}6} = 0{,}573020965$ min.

Average application time in the system:

$$T = T_s + T_{line}, \tag{2.12}$$

T = 4,96324221 + 0,573020965 = 5,536263175 min.

The concept of smart airports is about optimizing various processes in order to reduce the time it takes to get to your destination. With the help of technology, passengers can now enjoy faster and more convenient travel.Through a biometric facilities , which is designed as a virtual aquarium, passengers can check in with their passports at Dubai International Airport. In order to get a better look at them, the system will allow users to peer into the virtual fish.In order to enhance the experience of travelers, the facilities has been equipped with an automatic facial recognition

system. This feature will allow airport security personnel to check a person's face whenever they enter the facilities . If the check is successful, the floor will turn green, and the passenger will be contacted for an additional passport check.

After validating the data received by the kiosk, the system will allow the passenger to leave the airport. It will also check the passenger's permission to leave if the data does not match the submitted.The biometric facilities is designed to allow passengers to complete their passport control procedures in just seconds. It features an automatic facial recognition system.

The passengers were impressed by the facilities 's design and technology. They only had to show their faces to complete the passport control procedures. The passenger facilities and gates are also a part of the smart airport concept.The number of smart facilities s that will be built based on the queuing system will be calculated using the data collected by the system. For instance, through passport control at Cairo International Airport, the passengers can enjoy a multi-channel experience.

The concept of queue discipline is also a vital part of the smart airport's operations. In systems with waiting, applications are called for service in a first-come, first-served manner.There are various types of queuing systems that are designed to accommodate different types of claims. For instance, some of these are designed to accommodate passengers with disabilities and those with small children.

Then the average time of a request for service will be reduced by:

$$T_z = T_s - T_{SG}, \tag{2.13}$$

$T_z = 4{,}96324221 - 0{,}3 = 4{,}66324221$ min.

Average application time in the queue:

$$T_L = T_{line} - T_{SG}, \tag{2.14}$$

$T_L = 0{,}573020965 - 0{,}3 = 0{,}273020965$ min.

Average application time in the system:

$$T_2 = T - T_{SG}, \quad (2.15)$$

$T_2 = 5{,}536263175 - 0{,}3 = 5{,}236263175$ min.

The goal of the queuing theory is to develop recommendations that will help improve the efficiency of the system by rationalizing the various steps involved in the construction and operation of it.The goal of the queuing theory is to develop a method that will provide the best possible passenger service. It will reduce the waiting time and provide high-quality service.The advantages of the queuing theory are its ability to improve the efficiency of the system by reducing the time it takes to process a passport.

The results of the study revealed that the time spent in the queue by the passenger decreased significantly. This positive effect on the quality of airport services is also evidenced by the reduction in the number of people waiting in line.The implementation of the queuing theory has confirmed the need for a biometric system for the passing of passports at the control facilities.

In order to automate the process of issuing and validating passenger data, the Cairo International Airport will be able to install electronic passenger facilities that are based on facial recognition. These facilities can be operated in the airport's arrival and departure halls without the involvement of border guards.The use of a biometric system for the passport control process is a computer technology that is commonly used in the control facilities.

The implementation of the biometric system for the passport control process is expected to improve the reliability of the system. Through the use of exercises, the system can be able to control the characteristics of the data collected from the users.The system's technical result is achieved through the various blocks that it features. These include the collection of data from the visual scanning of the passport, the identification of the data from the database of individuals at risk, and the formation of addresses for the database. The system also receives fingerprint data and other biological parameters of the individual.

The use of biometric system for the passport control process is expected to reduce the time it takes to process a passport. This will allow the airport to save space and improve the passenger service. In addition to reducing the time it takes to process a passport, the system will also help the airport avoid experiencing excessive traffic.The number of personnel required to inspect and process the passengers will decrease after the introduction of the automated passport control system. Through the use of biometric technology, the system will be able to identify the passengers using their passports in real time.

According to the study, the satisfaction of the passengers regarding the services provided by the control facilities is 99%.The use of biometric system for the passport control process does not require the involvement of the airport's personnel. This will allow the facility to save money on the hiring and training of employees.

The study also indicated that the number of personnel required to process the passengers will decrease by 7. The costs associated with the training of these employees will also decrease.The number of people using the self-checkin system at the airport has increased significantly, which means that the use of biometric technology can be utilized by 30% of the total passenger traffic.

In this section, we discuss the various types of capital expenditures that can be made. These expenditures are the financial expressions of the costs of new construction, renovation, and reconstruction.An autonomous investment is a type of government investment that's mainly concerned with the stabilization of the economy. Unlike other forms of investment, such as commercialization, this type of investment is not influenced by microeconomic factors.

An indirect capital investment is made through the activities of a public institution or company. It can be related to the production or social infrastructure of the country.Direct capital investments are made through various economic entities. These investments are aimed at the reproduction of fixed capital.

Net investment is the total gross capital investment excluding depreciation charges.

$$C = n \times P_{dev}, \quad (2.16)$$

where n - is the number of devices;

P_{dev} - the price of the device, EGP.

K = 10 × 18 000 = 180 000 (EGP).

Calculation of annual operating costs:

$$C_{oper} = C_w + C_{maint} + C_{STr} + C_{rep}, \quad (2.17)$$

where C_w - wage costs, EGP;

C_{maint} - maintenance costs, EGP;

C_{STr}- staff training costs, EGP;

C_{rep}- repair costs, EGP.

Annual wage costs are:

$$C_w = (1 + C_{SC}) \times 12 \times \sum_i^n P_i \times C_{S\,aver}, \quad (2.18)$$

where C_{SC} - contributions to the social insurance fund (22%);

$\sum_i^n P_i$ - - number of employees of the i-category;

$C_{S\,aver}$ - average monthly salary, UAH

Annual maintenance costs are:

$$C_{maint} = P_{dev} \times \beta_{schare\ of\ maint}, \quad (2.19)$$

P_{dev} - the price of the device, EGP.

$\beta_{schare\ of\ maint}$ - share of maintenance costs, (15%).

Annual staff training costs are:

$$C_{STr} = C_{courses} \times H, \quad (2.20)$$

where $C_{courses}$- the cost of courses, EGP;

H - number of staff.

The cost structure and significance of implementing the Passengers facilities system for Cairo International Airport

Table 2.2

Structure and value of annual operating costs depending on the use of passenger identification

Passport control booths (classic system)	**passengers facilities System biometric control**
Annual salary costs, EGP:	
C_w = (1+0,22) × 12× 11900 =174 216	C_w = (1+0,22) × 12× 6400 =93 696
Annual staff training costs, EGP:	
C_{STr} = 400× 17 = 6800	C_{STr} = 400× 10= 4000
Annual maintenance and repair costs, EGP:	
C_{maint} = 3 000 × 0,15 = 450	C_{maint}= 180 000 × 0,15 = 27000
Total annual operating costs, EGP:	
C_{oper} = 174216+6800+450=181466	C_{oper}= 93696+4000+22500=124696

The annual difference in operating costs due to the introduction of new technology compared to the existing system is:

$$An_{diff} = C_{exist} - C_{oper}, \quad (2.21)$$

where C_{exist} - operating costs of the existing system, EGP;

C_{oper} - operating costs for the new technology, EGP.

An_{diff} = 181466 - 124696 = 56770 (EGP).

Payback period is the time required to cover the costs of a particular project or to recoup the money invested in it. Payback period will be:

$$PP = \frac{Inv}{An_{diff}}, \quad (2.22)$$

where Inv – investment in project, EGP;

An_{diff} - the difference in operating costs.

$PP = \frac{180000}{56770} = 3{,}1\ years,$

The results of calculations of the economic effect of the implementation of the activities of the airport Cairo international Passengers facilities system are collected in the next table

If the Passengers facilities system is implemented, Cairo International Airport will be able to pay for itself within three years. The installation of these facilities will reduce the time that international passengers spend at the customs and border control area.

Table 2.3

Efficiency of Passengers facilities system implementation at Cairo international airport

Indicators	*Value*
Average time of using passenger facilities	5
Reduction of time for passenger registration in the passengers facilities system, min.	3.5
The cost of the Passengers facilities system , EGP	14666
Annual operating costs of the existing system, EGP	19888
Annual operating costs for the Passengers facilities , EGP	11988
Annual reduction of costs for passport control of passengers at Cairo international Airport, EGP	38764
Payback period of the Passengers facilities system, years	11988/38764 = 3,09

From the previous analysis In terms of retail and duty-free areas, the area in Singapore's Changi airport is about 7% bigger than that of Cairo's international

airport. This is very accepted by the passengers in Cairo due to the variety of shopping and entertainment that the airport provides.

Both airports have a huge selection of retail stores that can be used for leisure shopping. This provides a great opportunity for people to shop.

Food and beverage products are commonly available in both airports, which provides passengers with a variety of options when it comes to their needs.

Although both airports have a variety of car parking and rental services, there is a shortage in Cairo's international airport due to the lack of a city shuttle. This is very important for Cairo as its transportation system is severely affected by the lack of proper transportation.

In addition, both airports have ATMs that can be used for multiple transactions. These facilities are spread across multiple locations in the airports.

There is a noticeable gap between the various services and facilities offered by both airports when it comes to the travel experience. For instance, while Cairo's international airport provides a variety of free services, Singapore's airport offers a more magical experience.

VIPs and businessmen traveling to Singapore or Cairo will be able to experience the great difference in both airports' facilities and services.

The website of Cairo's international airport is also lacking compared to that of Singapore's airport. This is because the website of the airport doesn't focus on the various aspects of the interaction with its passengers.

SUMMARY

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Following the recommendations of the literature review and the field study, Cairo International Airport could be upgraded to a modern international facility.

A comprehensive plan for the development of the Cairo International Airport is required to be established before the project's completion. It should explain the various features of the airport and its operations, and it should be implemented within scheduled time frames.

Despite the numerous obstacles that have been identified in the development ofx the airport, the authorities still need to resolve these issues.

The planning process should also consider the relationship between the cities and the airport when it comes to choosing a site for the facility.

In addition to the physical characteristics of the site, the design of the facility should also be taken into account the principles of sustainable construction.

The quality of the services and facilities offered by the airport should also be taken into account when it comes to choosing a site for the facility. These factors are related to the state's strategic location and the overall operation of the facility.

To ensure that the project is carried out according to the necessary standards, international offices should be used to study the airport's modernization and development.

The airport should also be designed to maximize the revenue from the non-aeronautical sources that it serves. This can be done through the use of the airport's dwell time.

The design of the facility should also be geared toward meeting the needs of a large segment of the population that are looking for leisure and affluence.

Diversifying the facility's offerings and increasing its passenger numbers to meet the needs of both the local and international communities are also important steps to improve the airport's revenue.

The website of the Singapore airport, which is regarded as a state-of-the-art model, should also be designed to provide a conducive environment for effective communication with the public.

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