UAB

Universitat Autònoma de Barcelona

CONTRIBUTION OF THE AIR TRANSPORT CONNECTIVITY TO THE ADVANCEMENT OF AFRICAN REGIONAL DEVELOPMENT

Bachelor's Degree Final Project in Aeronautical Management

made by

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Sabadell, June of 2024

The undersigned, **Laura Calvet Liñán**, director of the Final Degree Project, professor at the UAB School of Engineering,

CERTIFIES:

That the work to which this report corresponds has been conducted under her direction by

Marc González Cayuela

And for the record, signs this.

Sabadell, June 2024

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SUMMARY TABLE – SCHOOL OF ENGINEERING BACHELOR'S DEGREE FINAL PROJECT

<table>
<tr><td colspan="2">Title of the Bachelor's Degree Final Project:
Contribució de la connectivitat del transport aeri a l'avenç del desenvolupament regional africà
Contribución de la conectividad del transporte aéreo al avance del desarrollo regional africano
Contribution of the air transport connectivity to the advancement of African regional development</td></tr>
<tr><td>Autor: Marc González Cayuela</td><td>Date: June 2024</td></tr>
<tr><td colspan="2">Tutor: Laura Calvet Liñán</td></tr>
<tr><td colspan="2">Degree: Aeronautical Management</td></tr>
<tr><td colspan="2">Keywords:
Català: Aviació, Àfrica, desenvolupament, connectivitat
Castellano: Aviación, África, desarrollo, conectividad
English: Aviation, Africa, development, connectivity</td></tr>
<tr><td colspan="2">Bachelor's Degree Final Project Summary:
Català: El present treball de fi de grau té com a objectiu la investigació de la contribució de l'aviació al desenvolupament del continent africà. Tenint en compte el seu estat actual, els serveis oferts i la evolució del sector. Tot això amb la finalitat de determinar en quina mesura ha contribuït al desenvolupament general del continent.
Castellano: El presente trabajo de fin de grado tiene como objetivo la investigación de la contribución de la aviación al desarrollo del continente africano. Teniendo en cuenta su estado actual, los servicios ofrecidos y la evolución del sector. Todo esto con el fin de determinar en qué medida ha contribuido al desarrollo general del continente.
English: The objective of this bachelor's final degree project is to investigate the contribution of aviation to the development of the African continent. Taking into consideration its current state, the services offered and the evolution of the sector. All this to determine to what extent it has contributed to the general development of the continent.</td></tr>
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1. Introduction

In the present times, aviation is a sector that has taken over the entirety of the world, as it is what connects us as the fastest means of transportation at an affordable price. It is present in all continents, basically anywhere, from the north of Alaska to the south of Australia. Yet most studies of the sector are focused in the known as Western Countries, the European and American continent. Henceforth, there's not such a deep analysis towards the African market as there is with other regions.

Relating to the development, it is known that such a big continent as Africa, with some natural barriers such as the Sahara Desert, needs air connection as it is the fastest and safest way of connecting regions. Air transport connects touristic destinations such as Egypt or Morocco at the same time it connects small communities living in isolated towns with difficult road access. Providing the entirety of the continent with both passenger and cargo connectivity.

Not only air transportation in Africa is used to transport tourists, locals or cargo; but also to transport humanitarian aid. The United Nations has got the World Food Programme [1], which is based on transporting both humanitarian passengers and cargo, moving them throughout regions or countries for their own good.

A point to discuss is the extent of the air sector and its development in the region, and how is it related to economic growth. As expected, countries having better infrastructure (complying to higher standards), more companies operating, and a higher number of passengers will be mirroring their better economic state while counting on a higher GDP per capita. This is something to look forward to and determine the degree of correlation between those aspects in a continent such as Africa.

1.1. Motivation

The motivation behind this project comes from the desire to study about the aeronautical sector in Africa, especially due to how forgotten this continent is in that sector and generally in studies, while having a great potential due to the plurality of cultures and countries in there. To sum up, the motivation found to elaborate this project is to contribute to the sector and the African region by giving a realistic and meticulous analysis of the situation, its initiatives and growth and pointing out some changes that can be done to improve it all. In conclusion, to discuss about a forgotten region in the aviation world.

1.2. Objectives

The general objective of this project is to study the relation between the air sector development in different African countries and their economic situation and evolution and its indicators.

Specific objectives:

1. To describe the actual situation in Africa, such as the air traffic fluxes between countries in the region and outside of Africa.
2. To study existing regional and international initiatives to develop the aviation sector in Africa.
3. To analyze related data, carry out correlation studies, and discuss results. Comparing them to Europe and formulating a discussion regarding the lack of databases.
4. To explore the relation between GDP and development. Such as the number of flights or how the infrastructure is developed in a specific region, comparing it to the number of inhabitants per region and their economic data.

1.3. Methodology

This project will count on the use of an extensive number of resources to develop it.

The Literature Review done in this project will come from various sources:

- Research Papers from the online deposits and libraries, primarily from UAB.
- International Reports taken from diverse sources of the sector such as IATA or ICAO.
- African Regional Reports, these ones will be taken from different organizations or governments from African countries.
- News Outlets, mainly from Africa, depicting situations and context on the issue, also events happening on the sector.

We will also research through different Databases such as IEEE Xplore Digital Library or SABI [2] and conduct analysis on that data to reach relevant information and elaborate conclusions.

1.4. Scheduling

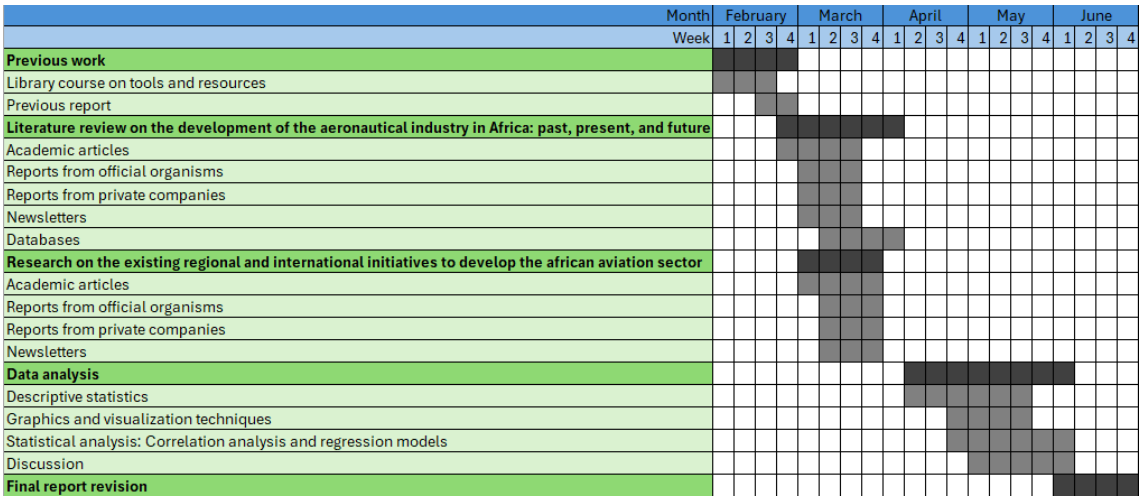

Figure 1. Scheduling plan for this project.

Source: Primary.

1.5. Risks

The project has some risks to point out, and the solutions to avoid them at the same time. The first risk is having some complexity in execution due to the plurality of countries in Africa; that will be solved by focusing on what is being talked about in each moment. The second one is pretty related to the first one, and it is the political instability of African countries. This will make some information found and written easy to be outdated soon, that is a risk that should be taken into consideration.

The third risk taken into consideration is establishing unrealistic initiatives while executing a discussion on improvements for the sector, this one is solved by bringing up realistic ideas taking into consideration the situation, while executing proper research on them. The fourth and last risk might be the most relevant one as it is the possible lack of information on research; this can be solved by doing an extensive research and getting different sources.

2. Past, Present and Future

To start analyzing the contribution of aviation towards the African continent, it is necessary to embark on determining how the situation is nowadays while mentioning at the same time a bit of its history. A task that is going to be performed in this chapter. This means, the state of infrastructure will be explored and how it changes between regions; the air connections in the continent, both intracontinental and intercontinental, including cargo.

This chapter is key to analyze the changes that this region has experienced as a measure to posteriorly use it to compare how the situation was in the past, not only a few years but also to an extent such as the late seventies, when Africa had ended the colonization period of most of its countries [3]. The study and depiction of the current situation in this project will appear as a pretty useful resource in this comparison task, resulting in an impeccable starting point to the project.

2.1. Infrastructure

In this point, the state of the air related infrastructure in Africa will be discussed as how it is nowadays and its future plans. To start, the focus will be on current airports that are hubs in the continent and, after going through it, the future will be discussed, and some comparisons will be done.

2.1.1. Current State

The current state of infrastructure will be depicted by specific regions from which different African airports are going to be pointed out. The airports that are going to be looked at will be those that have a significant impact in their respective regions, looking forward to those that are well known and have experienced either an increase in passengers or a high stable number.

As of today, the African continent is divided into five subregions by the UN: Northern Africa, Eastern Africa, Middle Africa, Southern Africa and Western Africa [4]. These are the regions that are going to be used in this chapter to discuss the existing infrastructure and the main airports, taking into consideration both traffic and quality, this last characteristic will be taken from Skytrax, a company that every year does a global ranking of worldwide airports by surveying customers since 1999 [5].

Northern Africa

Cairo International Airport

The gateway to Egypt is among the main airports in the continent as it is the busiest airport in number of passengers and the second one in number of operations, these numbers respectively being 20 million passengers and 163,579 operations in the year 2022 [6].
The airport was founded in the forties and since then, three terminals have been built to make the airport the big complex it is nowadays [7]. The oldest terminal being Terminal 2, built in the eighties, and the newest being Terminal 3 which was finished in 2009. Terminal 1 is used for national flights, Terminal 2 for international carriers and Terminal 3 for those carriers being part of Star Alliance [8], having a big number of companies operating in this airport.

Figure 2. Cairo International Airport Terminal 1.

Source: [9].

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Casablanca Mohammed V International Airport

Casablanca's Mohammed V International Airport is the main airport in Morocco, in terms of traffic. It handled 7.6 million passengers in 2022 [6], a number constantly increasing. Since air traffic is going up worldwide, the airport needs an expansion, which is going to be happening soon by the Spanish engineering company Ineco, whose job will also be to expect the airport traffic by 2040 [10].

The airport not only exceeds in the number of passengers that go through its installations, being the main air entry port of Morocco, but also in the quality of itself and its services. The airport was considered the fourth best airport in Africa in 2023 by the worldwide renown Skytrax World Airport Awards [11], setting up a situation of advantage over other airports as it is considered from the top airports in the continent. This difference puts Mohammed V in the spotlight as an airport to look forward to.

Western Africa

Lagos Murtala Muhammed International Airport

Lagos has one of the top airports in Africa traffic wise, being the eighth in the continent by passenger number and the fifth with more operations [6]. Despite not being the capital of Nigeria, which is Abuja, its airport is the main one as Lagos is the biggest city in the country and former capital under British colonial rule [12].

The airport nowadays is formed by two terminals, Domestic and International. The international terminal was finished in 1979 and expanded in 2014 [13], since it needed to be able to manage more operations in the current times, as aviation is exponentially growing.

Dakar Blaise Diagne International Airport

Dakar's Blaise Diagne serves as the main airport in Senegal, located in its capital city of Dakar it serves as the HUB for Air Senegal [14], Senegal's flag carrier. The airport opened some years ago, in 2017, after being in construction and delayed for years in works that cost more than 570 million US dollars [15].

The airport was built as a substitute to former Léopold Sédar Senghor International Airport, which stopped its passenger operations after Blaise Diagne opening [16]. After its closure, this airport has been operating as a military airport, with plans to restore its passenger operations with Let L-410 aircraft on national flights [17].

Central Africa

Luanda Quatro de Fevereiro International Airport

Angola's capital, Luanda, has got one of the most important airports in Central Africa, as it is the HUB for Luanda's flag carrier TAAG Linhas Aéreas de Angola,

an airline that connects some European countries with Central and Southern Africa [18]. The airport opened in 1954 by Portuguese president Craveiro Lopes, whose name was used to name the airport and changed once Angola got its independence from Portugal [19].

This airport is going to be closed soon, as it is planned that in this current year 2024 it will be replaced by the new Dr. Antonio Agostinho Nieto International Airport, a new and modern airport which will be able to handle up to 15 million passengers per year, with an immense number of facilities to serve travelers [20].

Eastern Africa

Addis Ababa Bole International Airport

The sixth airport in Africa by number of passengers is Bole International Airport in Addis Ababa, the capital of Ethiopia [6]. Not only exceeds in traffic being as well the third with more aircraft operations in the continent, but it's also considered by Skytrax as the seventh best airport in Africa [11]. This amount of traffic is understandable taking into consideration that the airport is the HUB for Ethiopian Airlines, the country's flag carrier [21].

All of these numbers are this high because the airport has been in constant expansion since its beginnings. Lastly, it expanded in 2019, just after becoming the main transfer hub for flights in the sub-Saharan region of Africa [22].

Southern Africa

Johannesburg O.R. Tambo International Airport

Being the second African airport on passenger numbers, with 14.8 million passengers in 2022, and the first with more aircraft operations [6], Johannesburg's O.R. Tambo International Airport is widely known in the aviation sector for its quality and services, being considered the third best airport in Africa by Skytrax [11].

This airport is named after the former politician Oliver Reginald Kaizana Tambo [23], a politician who fought against the apartheid regime in South Africa, it is also the main hub for South African Airways [24]. Both naming of the airport, in memory of a famous politician who was against apartheid and being the hub of one of the main African airlines, make this airport an iconic landmark of African aviation well known around the globe.

Cape Town International Airport

The best airport in Africa, regarding its level of quality, is considered by Skytrax to be Cape Town's [11]. Not only it excels in its services and beauty but also is widely used by millions of passengers yearly, 7.9 in 2022 [6], making it the third busiest airport in the continent.

The airport is well known in the aviation sector for being the departure and arrival airport on flights to a famous Norwegian Antarctic Station, Troll Airfield [25].

2.1.2. Recent Development

As most countries in Africa fall into a category named “Developing Countries”, this development being performed there is extended to all the areas, especially infrastructure. All countries developing their infrastructure will include airports in their plans, as an increase in movement between countries makes a country develop (due to exports, imports, etc.).

For this reason, it is comprehensible to have a considerable amount of airport projects in the continent. Some of them might work out while others might not, in this section of the project a specific case of the development of an airport in Africa which did not work out as planned is going to be analyzed. Specifically, the airport of the South African city of Durban.

The Case of Durban’s Airport

In the South African city of Durban, the new airport, used nowadays, King Shaka International Airport opened in 2010 as a measure of development facing the FIFA 2010 Football World Cup in the country [26].

Regarding this airport, there is a chapter written by Meghan Crosby and Brij Maharaj about the development of this airport and its impact [27], which is going to be used to discuss the airport in this section. All the information and data given in these next paragraphs comes from their work.

To start on, it was a new airport which had been planned to be built for such a long time, since the 1970s. Due to different political reasons (such as opposition to Apartheid in South Africa) and how they have been developed, the project went around for a long time until the plans came back in the 2000s, taking into consideration that South Africa was hosting the 2010 FIFA World Cup. Thanks to this, the airport opened just in time for the competition, and has since then been serving the city of Durban.

On the one hand, the new airport results in an advanced infrastructure development in the region, as the previous airport did not even have airbridges. King Shaka’s Airport does not only count as an infrastructural improvement to the airports in the region but also a service providing improvement to its passengers as way more shops and areas can be found in comparison to those that previously were in the former airport. All these developments do not only come as an aesthetic improvement but also the ability to connect way more people than before, also considering the increase in cargo operations.
On the other hand, this airport, as a lot of infrastructural developments built in countries where there’s a big gap in the economic power of its citizens, has not resulted in the infrastructural marvel it was promised. Firstly, its construction

promised development to the region as way more people would be employed, but at the end of the day this project has just affected positively to those who were already more economically powerful than the lower income population and already had resources.

All of these happenings are due to a poorly executed economic plan to create jobs with the finality of enhancing the region's economy and of its locals, henceforth, ending up in being just one of the bunch of airports built to increase traffic flow and provide a basic service despite of its beauty or quality in structural terms. It must be added that the initial plan, which was making it an aviation hub, has not ended up working out. Originally, the previous airport had basically operations at a regional level, mainly connecting the city to Johannesburg, the actual hub in South Africa. That was meant to not be happening in this airport, but in the end it did. The actual airport operations consist in flights throughout South Africa, specially to Johannesburg, and some international minor operations to worldwide hubs such as Dubai or Doha, but not acting as a hub, just as an origin or destination airport.

2.1.3. Brief Conclusion About Airport Infrastructure

After listing the main airports in the African continent, taking into consideration the different regions, and discussing the state of it and getting a more profound examination of one of them, some conclusions about the development of infrastructure in the African continent can be reached. It must be added that this is going to be a brief explanation looking over it, as the airports listed are from different places and they are not the same as it can be seen in the next map.

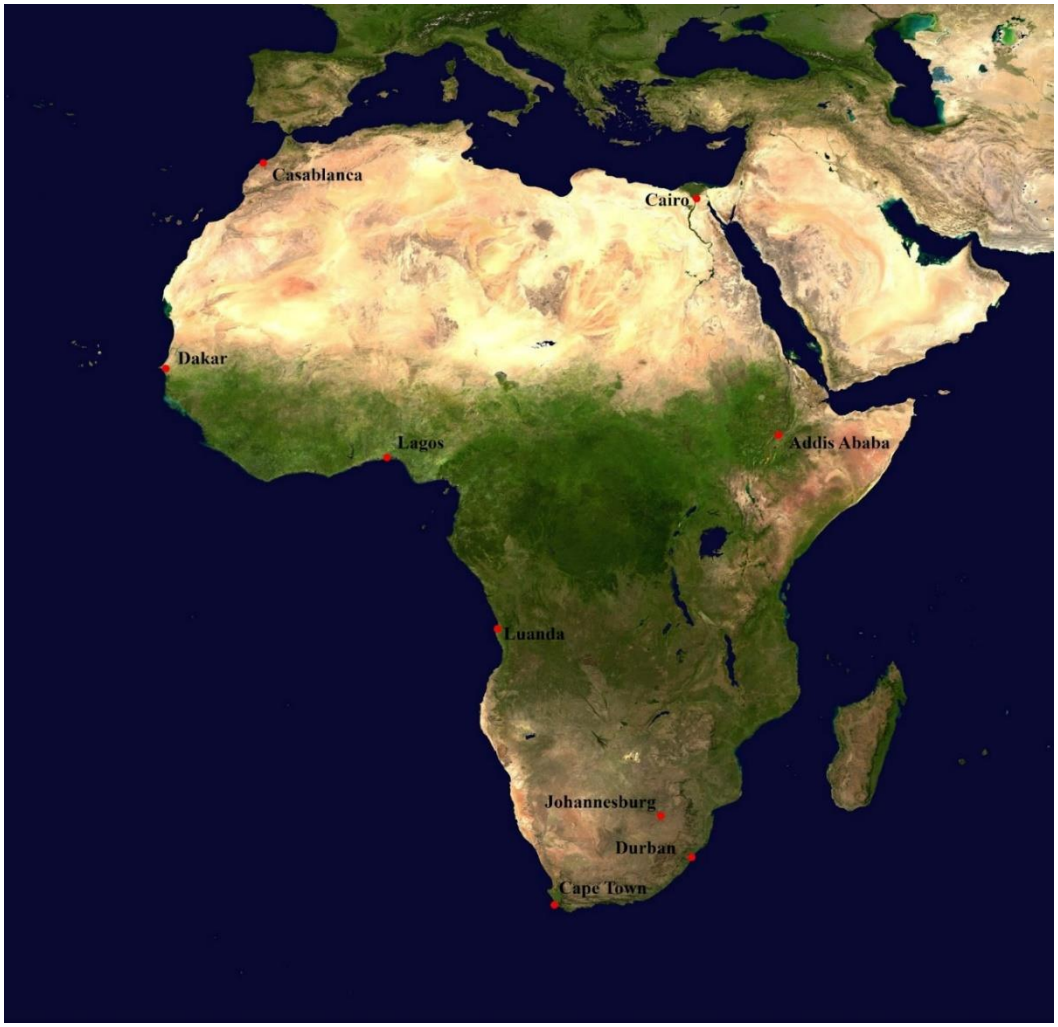

Figure 3. Map of airports listed in the infrastructure section.

Source: Adapted from [28].

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The conclusions that can be reached about the state of infrastructure in Africa are that out of the approximately 3000 airports in the continent [29, pp. 2], whereas in Europe there are around 3700 [30], just some of them are considered hubs and have a really big impact on the region and its image. This is due to different factors, such as political instability of the region and those countries being considered developing countries, which does not make at all those projects

be able to reach their objectives. These reasons add up to other ones such as how affected that country is by its history or corruption.

2.2. Connections

A vital point to serve a continent air wise are its connections, both in between different points inside of it and towards the exterior. In this section it is going to be displayed an examination of the connections that the African continent has with its development and its evolution throughout the course of time.

2.2.1. Intracontinental

One factor to consider as key in the air connection in Africa has got to be flights between regions in the continent, not only between the countries being part of it but also between airports in the same country. Intracontinental air connections result in an optimum way to connect communities, towns, cities and regions. Africa is wide, distances are massive, and the areas that are not properly considered cities or even villages tend to be pretty empty of infrastructure such as roads or a rail network, making a generalization as it may change between countries or even communities.

Due to the lack of developed ground transport related infrastructure, air connections result in an easy way of connecting points whose distances in between are massive. This is where airports and airlines come into matter, when they result in a practical way of covering the travel needs of citizens from different African countries. Taking all of this into consideration, several factors need to be kept in mind, such as the demand of travelers and the offer companies can afford to provide them.

In Western countries, most airlines have a hub routing strategy, where an airline has a hub and serves from there to different destinations. In Africa, this strategy is also used but results in a less practical way of connecting cities, as most countries have a high demand of traffic within the region (including different countries), but this demand is not as high between different regions, for example between Morocco and Zambia [31].

One remarkable difference between travelers in Europe and Africa can be remarked in this point, as shown in Eyden Samuneru's book "African Air Transport Management [32, pp. 130] through a survey, it is shown that most travelers in Eastern Africa fall into the "business" category. This fact shows a difference with Europe as we, as travelers, mostly do it for leisure and vacation.

How Does South Africa Set Up an Example on Regional Routes

When talking about the operation of regional routes within Africa, both international and national, South Africa is a clear example of it. This is due to the multiple airlines operating in the country on a national level, not only

internationally, as stated by Jacques Charlier and Frédéric Dobruszkes [33]. This country has an extensive and developed number of airlines covering regional routes between national airports; some of these companies are the South African Airways group and its airlines, Safair, Mango, etc.

The previously mentioned airlines serve the main hubs in the country (Johannesburg and Cape Town), connecting them to the growing number of smaller airfields located in different towns throughout the region, such as Durban or Port Elizabeth. Not only connecting these cities, but some of them also even have external operations to other countries, especially the neighboring ones such as Namibia or Zimbabwe.

This development in aviation in the country is considered as an example towards what different African nations can achieve, the hyper connection of the cities distributed throughout their country by plane. Making these airlines a basic service which connects everybody, from inhabitants of a capital city to locals in an isolated village, between themselves with the opportunity of having access to the world outside of the region.

Conclusions About the Intracontinental Connections

In terms of connecting a region at an internal level, a conclusion can be reached, determining that Africa is not a continent whose countries are properly connected between themselves air wise, especially in a national level more than an international one. This is something that is changing, as South Africa proves to be leading this development, but there's still a lot of work to do. Hopefully in the future, the continent will see a massive advancement in connecting its people and not only limited to a few countries where tourism levels are above the rest.

The development of air connections will not only make traveling easier for everybody but also will connect those who are in need of it, instead of just limiting it to take a less regulated or less reliable means of transport. The improvement in air connections will not only improve people's lives by making everywhere more accessible to them but also will develop air infrastructure, which can also lead into the developing of other kinds of infrastructure built towards citizens' commodities.

2.2.2. Intercontinental

Intercontinental routing in the air sector results in a critical point on which to decide if the air service sector is developed in a specific region. As an extensive regional connection eases movement inside of a specific area but does not always grant the benefit of being well connected towards the rest of the world. This is due to some cases where the region itself is not open to the outside world or there's not enough intercontinental connections. To ensure the sector is fully developed, a good relation between an advanced regional network and an intercontinental one must be present, which leads to attracting business and travelers towards the region. The development of the sector is not the main factor that plays a role in making the region attractive as political, economic and safety factors also play a key role, but the air sector development makes the region stand above the rest in any case.

This type of connections can happen in different ways, such as having a worldwide hub within the region or being connected to another one. Not only airlines play a key role in this but also airports and how developed is its infrastructure, as better infrastructure attracts more foreign airlines and promotes the creation of own international airlines offering long haul services. Enhancing an airport and its services will result in attracting more foreign airlines ending in an increase of connections for the region, making it more accessible from everywhere in the planet.

Nowadays there's a couple of big airlines in the African continent offering a wide range of flights throughout the world, with their main hub airports being the place where passengers coming from around the continent go on different aircraft to reach their final destination. These airlines, such as Ethiopian, Royal Air Maroc or Egyptair [34], operate from their main hubs primarily in the capital cities of their respective countries. Nevertheless, this does not apply to Royal Air Maroc, as its hub is the airport of Casablanca, rather than being the airport of Rabat, Morocco's capital [35]. These airlines previously mentioned offer their services to their respective country, but at the same time, to the entire African region as they got flights all throughout the continent due to being companies that operate a hub model.

Some major airlines in Africa could also be considered as companies whose operations are based in flying around the continent from their respective hubs. Counting with a wide international route expansion but not on an intercontinental level, as the case of South African Airlines which recently came back to operate intercontinental routes [36]. These cases can primarily be solved by the operation of foreign carriers to the country whilst having codeshare agreements with local airlines, enabling more passengers to access a specific airport in the world from another one located within the region they are from.

As of today, as Nicole Adler and Eric Tchouamou Njoya portray in their work [34], there are a few differences regarding the range of whether operations in African airports are in between the continent or at an intercontinental level. Most hubs in Northern Africa, such as Cairo or Casablanca, serve predominantly intercontinental routes rather than having a majority of routes connecting the African region. Enabling the connection of Northern Africa to the rest of the world, specifically Europe. On the other hand, Sub-Saharan Africa has a wider offer in intracontinental routes, such as Johannesburg or Cape Town's case. These airports have a wide range of routes throughout the continent as its airlines operate on a continental level, leaving most of the connections towards other continents to foreign airlines.

Relating to the same source of information, there is a third type of airport operations. Not being in any extreme in terms of serving predominantly either intercontinental or intracontinental routes there are the Central African hub airports. These are cases such as Lagos or Nairobi, which count with a balanced number of intercontinental and intracontinental operations. This leaves the airports in the region as a measure of contribution to the connection of the entirety of the continent to all the different regions in this planet, from America to Asia.

Traffic Trends Between Europe and Africa

In a world summoned to constant changes, those changes do translate into the manifestation of variations in the traffic patterns by passengers flying between continents. In this point, the variations of traffic patterns between European and African countries are planned to be discussed. Not only recurring to data but as well leading to a more subjective critical thinking.

These changes are studied by Eric Tchouamou Njoya, Panayiotis Christidis and Alexandros Nikitas in one of their articles in the Journal of Transport Geography [37]. As they describe, these traffic patterns are submitted through constant changes as time goes by. While passengers flying directly between European and Northern and Western African countries increase every year, this is due to the proximity and the constant development these countries are subject to.

On the other side, the traffic patterns of passengers flying directly between Europe and Southern Africa is decreasing. These passengers travel through the middle east by hubs such as Doha or Dubai. This happening occurs due to the rapid growth of popularity in middle eastern airlines which offer services connecting the farthest part of the African continent whereas national airlines in Africa, (in this case South African Airways), stop operating long haul routes to Europe at the same time Middle Eastern airlines are preferred by passengers

over European companies. All of these conditions result in a decrease of passengers on direct flights between the two continents.

This is not the case in Northern Africa, as there's a growth in traffic due to the emergence of new airlines and new routes by previously existing companies which offer direct services without passengers having to take a detour to the Middle East hubs. It must be added that the distance plays a key role as it makes those operations more affordable in comparison.

Conclusions About the Intercontinental Connections

As seen in this section, it is of extreme importance to take a look at the way a country is able to serve air connections to other continents as it is a key to becoming global. Maintaining a good infrastructure to attract customers is perhaps the most adequate contribution that can be made by people working in the air sector to increase the number of foreign airlines starting to operate flights to the country.

Adding to this last point, it is also of vital importance to work on the beginning of long-haul operations performed by national airlines if there's enough demand to cover it. The purpose of creation of long-haul routes by national carriers is to reduce the dependency on foreign carriers as well as the chances of them being canceled leading to an increase in isolation as a region. This is clearly seen in the case of South Africa, where passengers flying to Europe will mostly fly through the Middle East instead of flying directly.

2.2.3. Contribution to the Growth of Connections

To achieve a higher level of services, in this case on connections, it is necessary to perform some development in the area that it is being worked in. It is true that the African continent is considered to be a region where most countries are considered in developing status, which leads to categorize the air sector as another one in development, but in any case, it is at different levels relating to its development.

To get into this development, it is compulsory to coordinate between different strategies performed both by private companies and national governments, this is the way to get to a higher status and to prove the region can do better. These different strategies that have been used to contribute to this growth in aviation are going to be discussed in this section.

Low-Cost Airlines in Africa

In our current times, low-cost airlines are a recurring means of transport to most people who travel. This is not the exception to Africa, where its incursion and development has been present as well, either by low-cost companies based in the African countries and international ones.

Big low-cost carriers from Europe, such as Ryanair or Transavia, and from Asia, such as Pegasus or Flynas, are present in the continent. Adding them to the African ones, like Air Cairo or Air Arabia, represent an important number of air companies operating in the African continent, being mostly used for leisure. These airlines add to the traditional carriers, making the region possess a variety of companies with different purposes operating in them, mainly between Northern African countries and towards Europe [38].

The previous data has been centered towards Northern Africa, but there are a lot of cases of low-cost companies being beneficial for other regions in the continent as described by Charles E. Schlumberger and Nora Weisskopf in their book “Ready for Takeoff?: The Potential for Low-Cost Carriers in Developing Countries” [39]. On the first side it is Southern Africa, specifically the country of South Africa, which has been discussed about before in this project. The liberalization of the market in the country has doubled the number of citizens of the country traveling by plane, from a rough 4% to almost an 8%. This might not seem like a high number, but taking into consideration the state of the country and the continent itself it is a really surprising number, proving the change to day-to-day life of South Africans by opening them an enormous number of opportunities.

Related to this same book, its stated clear the difference that there is present with the region of Eastern Africa. The air transport in this region is currently under development, which means that low-cost companies are minimum. Whereas nowadays traveling within Eastern Africa is more limited to ground transport or traditional non-low-cost companies, the future development of them is in there and it will surely bring a lot of hyperconnectivity to the region.

Other Contributions to the Growth on Connections

Aside from the coming out of low-cost companies, several other policies can be developed by companies and governments to promote connectivity and the use of air transport. One of them is pricing and fares accorded, taking into consideration the economic power of citizens altogether with the costs the airline faces. Recent studies have proved that when fares are planned accordingly under a liberalized market rather than under restrictive prices, frequencies have risen up to 40% [40].

Another measure related to the aviation liberalization in the country is the widely adopted Yamoussoukro Decision. This is a cooperation agreement between African states to liberalize the market and increase the air traffic by making it more profitable than how it would be in cases where the state is in charge of it. This agreement has led to an increase in traffic since it was adopted and a rapid evolution of the sector in the continent [41].

Together with the previously mentioned measures there are as well Airline Alliances. These are a union of companies that together serve its passengers, offering connections between them and frequent flier programs which are interconnected between themselves. In Africa, these alliances play a key role in connecting as they offer flights from one hub (either outside or inside of the continent) and operate around the entire region. African companies in alliances have taken profit from it, increasing its traffic due to the need by passengers flying other airlines from outside of the continent from their same alliances. It must be pointed out that one of these alliances is exclusively African, the so-called Vanilla Alliance [42].

2.3. Situation of Cargo

Another sector worth looking forward to are the air cargo companies. These kinds of airlines have experienced a rise since they began operating as the way freight is shipped has been constantly dividing between means of transport. And air freight is not excluded from this. This increase that air cargo has experienced since its introduction is because of its speed, being a very reliable mean of transport which at the same time lasts no longer than two days to reach the other side of the world.

The continent, as it is in constant development of its industry and other sectors, has experienced a rise as well in the air cargo operations, either by cargo airlines or regular airlines offering cargo services. In the countries of Nigeria, South Africa, Kenya and Egypt; four of the most well-known and powerful African countries, this type of shipping method has been in increase since the 80s [43]. All the growth experienced by this sector in the previously mentioned specific countries is mainly attributed to the development in technology. These technological advancements have enhanced logistic processes to be taken a step up by becoming more reliable and faster. However, development also came with costs related to the implementation of new technologies and transport, making it less profitable than expected.

The advancements in logistics technologies have proven to be successful for companies with a high interest in exporting goods. In Kenya, the floricultural market supply chain relies on aviation, as it is a fast method to do so while ensuring the transport under the correct conditions such as humidity or temperature. This national market has been exporting flowers towards the exterior, especially Europe [44]. These exports are mainly directed towards the world's most well-known country for its flower commerce, The Netherlands, meaning a good amount of its flowers actually come from Kenya; making the African nation a key supplier of them, ensuring its freshness and quality.

Not only air transport has contributed to the exportation of flowers but as well on some other goods such as textile. In the country of Ethiopia, which predominantly lives of agriculture, textile has had a significant increase in recent years. This type of industry is now considered a priority and it is now competing with the leader of its region, Kenya [45]. This happening has been helped by the development of logistics and air transport. Complying with the rapidity required in nowadays textile commerce, manufacturers from the country have been able to offer a fast and reliable service internationally. Bringing a relevant contribution to its value chain, creating numerous jobs and establishing it as a sector to exploit by an economic development plan, relying less on agriculture.

3. Study of the Evolution

In this section, different studies and observations are going to be done to determine the impact of aviation on the inhabitants of African countries and its economy. All of this, with the purpose of finding a correlation between different characteristics of the air travel sector and economic inputs in the African region. Moreover, some countries taken into consideration are going to be analyzed to determine if its actual economy has grown since the development of the sector as a cause or this development has been a consequence of economic advances.

The objective of this part is to determine how the aviation industry and airlines have contributed to the economy and life of African people. This is being looked over while detecting if this specific sector has taken part of it or just has been developed in periods of economic prosperity. It must be taken into consideration busy routes, hubs and the number of airports in the continent whilst observing different economic inputs such as the Gross Domestic Product (GDP) or population.

3.1. Busiest Routes Operating in the Continent

Some cities experience big amounts of traffic between themselves. These cases, especially in cities that are considerably far away from each other, come with the growth of flights between their respective airports. In this section it is going to be studied the main air routes departing from airports within the African continent, its number of weekly flights and the percent of GDP from each country coming from tourism to seek some information about the economic benefits that each of these countries experience.

The goal is to determine how beneficial those routes and the number of passengers traveling to the studied countries are, at the same time research for these specific routes is done. The way this information is going to be treated is by studying the 15 busiest weekly air routes in Africa, analyzing the countries they serve and classifying their percent of GDP coming from tourism.

The number of flights departing or arriving African airports will be extracted from the airport database on the website Flightradar24 [46]. This website has an extensive database on flights between all airports in the world, having its own statistics and showing the real-life traffic between different airports.

Rank	Departing Airport	Arrival Airport	Flights per Week
1	ZNZ (Zanzibar, Tanzania)	DAR (Dar-es-Salaam, Tanzania)	358
2	JNB (Johannesburg, South Africa)	CPT (Cape Town, South Africa)	315
3	CAI (Cairo, Egypt)	JED (Jeddah, Saudi Arabia)	283
4	JNB (Johannesburg, South Africa)	DUR (Durban, South Africa)	218
5	ZNZ (Zanzibar, Tanzania)	ARK (Arusha, Tanzania)	182
6	LOS (Lagos, Nigeria)	ABV (Abuja, Nigeria)	180
7	CAI (Cairo, Egypt)	RUH (Riyadh, Saudi Arabia)	163
8	NBO (Nairobi, Kenya)	MBA (Mombasa, Kenya)	139
9	CAI (Cairo, Egypt)	MED (Medina, Saudi Arabia)	99
10	CAI (Cairo, Egypt)	KWI (Kuwait City, Kuwait)	92
11	JNB (Johannesburg, South Africa)	HRE (Harare, Zimbabwe)	91
12	ADD (Addis Ababa, Ethiopia)	BJR (Bahir Dar, Ethiopia)	88
13	CPT (Cape Town, South Africa)	DUR (Durban, South Africa)	87
14	ZNZ (Zanzibar, Tanzania)	PMA (Pemba, Tanzania)	81
15	JNB (Johannesburg, South Africa)	PLZ (Port Elizabeth, South Africa)	76

Table 1. Top 15 routes in Africa by number of weekly flights.

Source: Adapted from [46].

As seen in the table, most of the busiest routes in Africa are national flights. This is due to commuting because, as stated before, the continent itself is made up of vastly sized countries where people actually need to travel between cities that are pretty far away in distance. It is worth mentioning that only some of them are routes in which one of the airports is outside of Africa, which shows that the aviation sector in the continent is continentally oriented rather than just being based on flights connecting the continent with the outside. This point proves that there's a strong presence and development of own national airlines from its respective African countries, clarifying one of the main doubts people have about the aviation in Africa development.

Figure 4. Top fifteen routes in Africa by number of weekly flights.

Source: Adapted from [47].

Attribution: Karl L. Swartz.

The previous map results in a helpful tool to understand the routing itself. Most of them are short flights, as stated before, used for commuting by the citizens of their own country rather than exclusively for tourism. Yet this kind of travelers fall into the tourism and travel category of each country's Gross Domestic Product (GDP).

Country	% of GDP from Travel and Tourism (2019)
Tanzania	10,6% [48]
Egypt	8,5% [49]
Kenya	7,9% [50,51]
Zimbabwe	6,5% [52]
South Africa	6,4% [53]
Ethiopia	6,4% [54]
Nigeria	4,5% [55]

Table 2. GDP coming from travel and tourism from countries within the top fifteen of busiest routes in Africa.

The extracted data in the previous table corresponds to the values of 2019; this is due to the fact that recent data is based on projections and numbers coming from 2020-2022 are lower than they would ideally be due to the COVID-19 pandemic. In relation to the busiest routes in Africa, the countries they affect tend to be centered towards tourism at the same level as they share almost the same percent of GDP coming from it. There are a few noticeable exceptions relating to that. Tanzania and Egypt are pretty touristic countries due to being strongly focused on it, that's the reason this percentage is higher than in the rest. Whereas on the other side, Nigeria does not experience the same, actually the contrary, and does not revolve its economy around tourism and traveling as much as the rest. Henceforth, making its percent of the GDP remarkably lower than the previous.

3.2. Economic Impact of Aviation Hubs in Africa

Aviation hubs are a key component when connecting areas, not only the region they are located but cities connected to them through different airlines acting just as a bridge between different airports. The economic impact performed by this kind of airports categorize them as a figure of prosperity, as it creates jobs and improves connectivity while it indirectly contributes to the local economy by its needs of supplies and services provided by local businesses.

Some of the previously mentioned airports in the infrastructure section are hubs, the purpose of this subsection is to analyze some of these hubs, together with their evolution, and determine if their construction and expansion was out of a need due to a growing economy or if they actually enhanced the economy of their respective country.

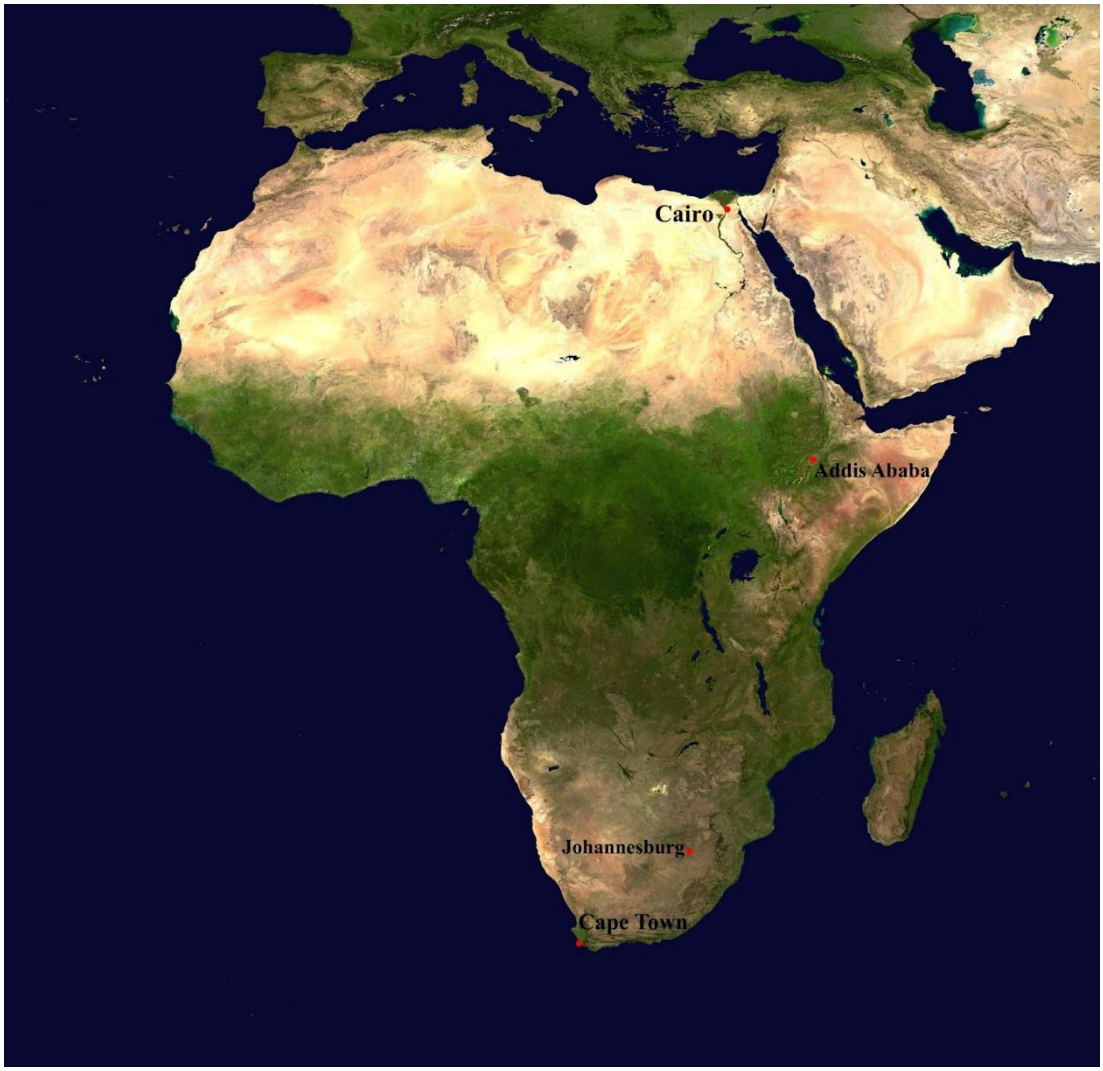

Figure 5. Map of airports looked over in section 3.2.

Source: Adapted from [28].

Attribution: NASA, Public domain, via Wikimedia Commons.

The Impact of Cairo Airport in the Egyptian Economy

The city of Cairo holds one of the biggest hubs in the continent. As Egypt is a big touristic destination due to its history and monuments, the airport of its capital results in a massive hub where a lot of airlines operate. Opened in 1945 and expanded in different phases in 1963, 1979, 1980 and 2003 [7], this airport is the clear image of a worldwide hub for its region.

Figure 6. Egypt's GDP compared to Cairo Airport expansions from 1965.

Source: Adapted from [56].

The previous graphic depicts the growth of Egypt's GDP since the 60s. In red the vertical lines represent a year in which the airport of Cairo was expanded. As it can be seen, the airport development has just been performed throughout the years to give a basic service to the city and the region's growing economy. Except for the last expansion in 2003, which comes before a period of economic growth mainly due to tourism from the 2000s, bringing travelers interested in visiting the country.

A point to highlight is that the last expansion seems to be a cause of the economic growth to make an impulse on tourism in the country hand, rather than just causing the growth. Henceforth, making the economy of the country improve by being more open to the outside world through this hub.

The Airport of Addis Ababa and the Growth of Ethiopia

The airport of Addis Ababa in Ethiopia, the airport of its capital and main hub in the country, was opened in the beginning of the 60s, expanded in 1992, 2003, 2006 [57] and afterwards the last expansion was done in 2019 [21]. This airport was not originally a hub but rather turned into the relevant airport that it is nowadays with the expansion of Ethiopian Airlines, the main company operating there.

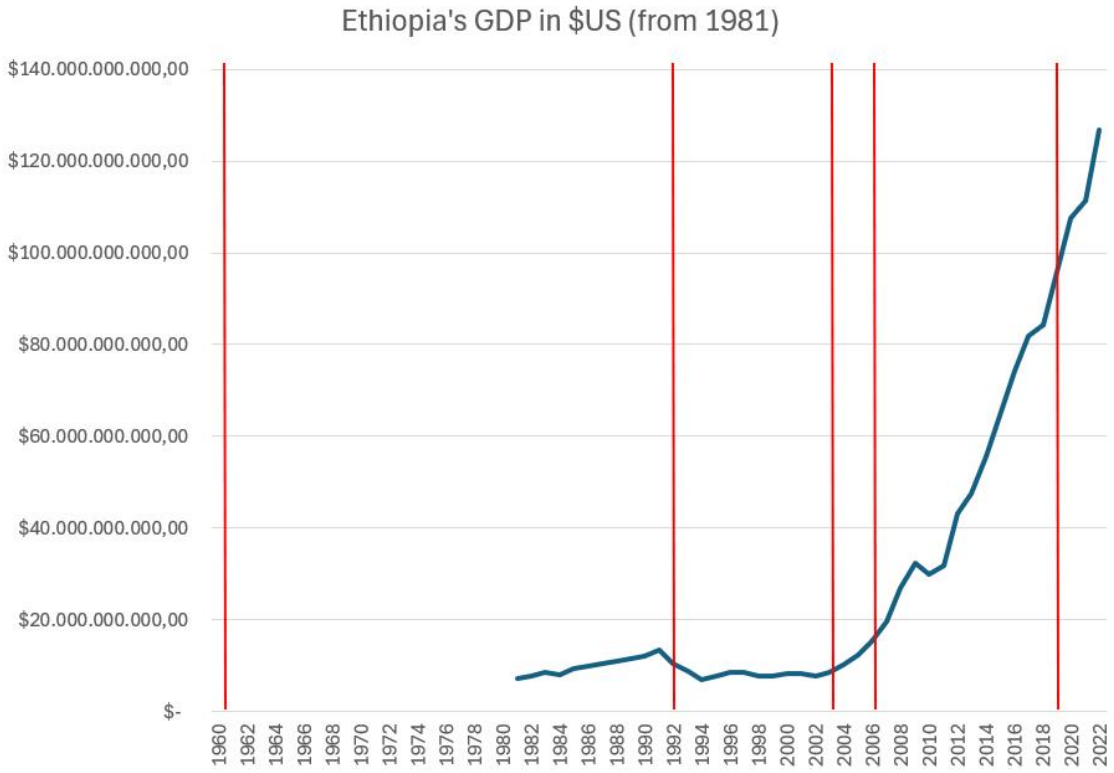

Figure 7. Ethiopia's GDP compared to Addis Ababa Airport expansions from 1981.

Source: Adapted from [56].

In the graphic regarding the GDP of Ethiopia, it's stated that after any of the expansions of Addis Ababa's Bole International Airport there's been economic growth in the country. The second line showing the expansion of 1992 comes just after a little peak on the country's GDP, but before the beginning of a growing economy, mainly, after the renovations from 2003 and 2006 making the country more connected than before and being done as a cause of the predicted growth. Lastly, it's seen how the GDP has been increasing constantly but, this increase led to the expansion of Ethiopian Airlines, the reason why the airport was renovated recently in 2019 in order to be able to handle its flights.

The Two Marvel Airports of South Africa

The case of South Africa varies significantly from these last two countries. The nation has not only one main hub but two, in Johannesburg and Cape Town. To examine the economic changes where the airport openings and expansions have been present, it is better to analyze both hubs at the same time rather than just one.

Johannesburg Airport opened in 1952 and was recently renewed before the COVID-19 pandemic [58] and in 1993 [59]. This infrastructural marvel serves the entire country as it is one of the most important airports to connect it, as well as the Southern Africa region, to the rest of the globe.

On the other side of the country Cape Town airport is found. This one, being opened in 1954, underwent renovations in 2005 for the 2010 FIFA World Cup and in 2022 [60], making it the important hub that it is nowadays. This airport, being the other option in the country, has some similar traffic to Johannesburg's airport, with lots of regional and intercontinental flights creating a sparse network and unifying the entirety of Southern Africa.

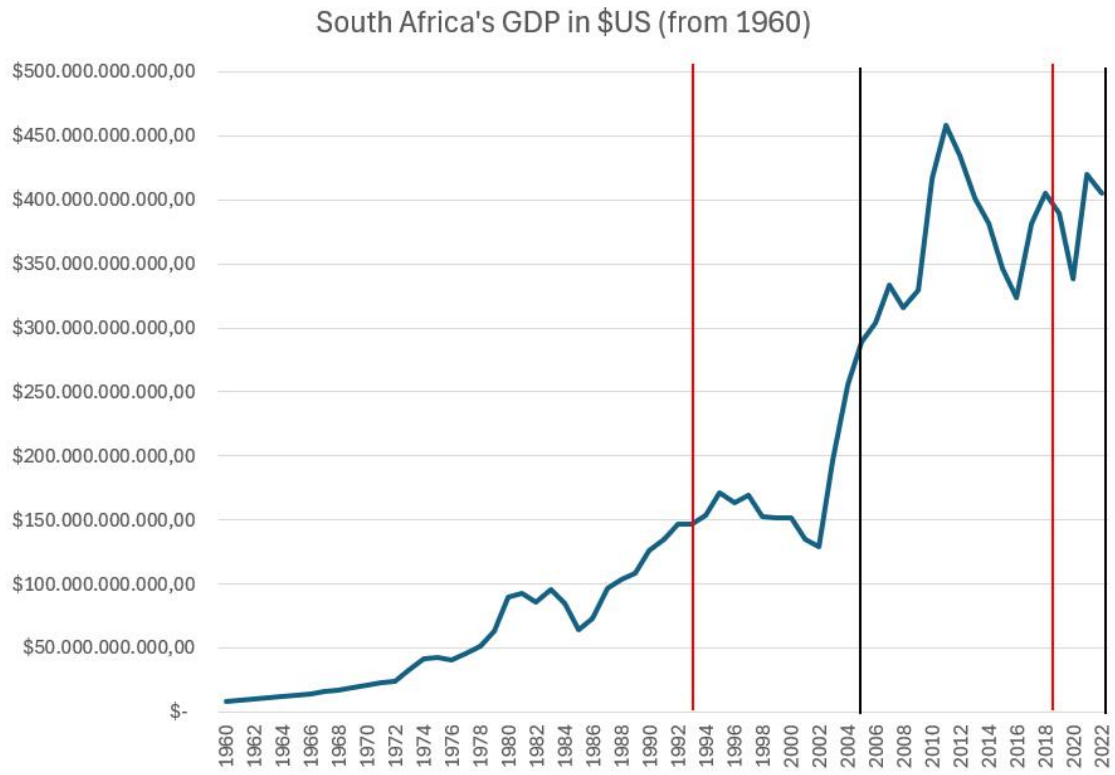

Figure 8. South Africa's GDP compared to Johannesburg and Cape Town Airports expansions from 1960.

Source: Adapted from [56].

South Africa's economic situation differs a bit from Ethiopia and Egypt, this country had its economic growth before the other two so recently its GDP is not going up constantly. In the graphic, the expansions in Johannesburg Airport are marked in red while Cape Town's in black. The airport of Johannesburg had its first renovation and expansion in an after-apartheid period when the economy was starting to improve, causing the country to improve its connections to the outside and contributing to it, while Cape Town's had to wait until the World Cup when the country was already growing in GDP.

Whereas the first expansions were allocated in times where the economy was proving to be growing rapidly, the last ones for these two airports have been done in periods of more struggle. These renovations in those periods of lower GDP are to be considered as a measure of a plan to boost the economy just as it happened with the improvement of Durban's Airport [27] as mentioned before in the infrastructure section.

3.3. Relation between Number of Airports, Population and Economy

Previously, it has been discussed the difference in numbers of airports between Africa and Europe, concluding there is a notable dissimilarity. Even though, it is true that there has not been a closer look into the data relating to the airports in the African continent and determined if the number of them is actually an indicator of development or a stronger economy in a particular country or region.

The main purpose of this section is to analyze the relation between the number of airports in each African country and its population and the country's GDP. To start on, the relation with the number of citizens of every country, excluding overseas territories of countries that are not in Africa, is going to be studied and found to be a correlation if there is. In the second half of this section the relation of the same number of airports with the GDP of the country is going to be explored.

It is also of importance to determine not only correlations in the numbers but also ratios. These ones, displaying the difference between countries in the continent on how many citizens there are per airport or how the level of wealth of the country is spent on building a major quantity of air infrastructure. The data used in this section is the number of airports in African countries in 2020, the population of 2023 and the GDP of 2022, unless specified the number is from another year.

Relation between Airports and Population

The analysis of a country comparing its number of airports with its population outcomes in a profoundly useful ratio. This one can be used to compare the level of service national governments offer their citizens in terms of connecting regions and towns to the rest of the country and the globe. When referring to aviation in the continent, this ratio (population per airport) is definitely a useful tool to compare the different countries in the area.

Country	Airports	Population	Population per Airport
Algeria	149	45.606.480	306.083,76
Angola	102	36.684.202	359.649,04
Benin	6	13.712.828	2.285.471,33
Botswana	74	2.675.352	36.153,41

Burkina Faso	23	23.251.485	1.010.934,13
Burundi	7	13.238.559	1.891.222,71
Cabo Verde	9	598.682	66.520,22
Cameroon	33	28.647.293	868.099,79
Central African Republic	39	5.742.315	147.238,85
Chad	59	18.278.568	309.806,24
Comoros	4	852.075	213.018,75
Congo	27	6.106.869	226.180,33
Cote d'Ivoire	27	28.873.034	1.069.371,63
DR of the Congo	198	102.262.808	516.478,83
Djibouti	13	1.136.455	87.419,62
Egypt	83	112.716.598	1.358.031,30
Equatorial Guinea	7	1.714.671	244.953,00
Eritrea	13	3.748.901	288.377,00
Eswatini	14	1.210.822	86.487,29
Ethiopia	57	126.527.060	2.219.772,98
Gabon	44	2.436.566	55.376,50
Gambia	1	2.773.168	2.773.168,00
Ghana	10	34.121.985	3.412.198,50
Guinea	16	14.190.612	886.913,25
Guinea-Bissau	8	2.150.842	268.855,25

Kenya	197	55.100.586	279.698,41
Lesotho	24	2.330.318	97.096,58
Liberia	29	5.418.377	186.840,59
Libya	146	6.888.388	47.180,74
Madagascar	83	30.325.732	365.370,27
Malawi	32	20.931.751	654.117,22
Mali	25	23.293.698	931.747,92
Mauritania	30	4.862.989	162.099,63
Mauritius	5	1.300.557	260.111,40
Morocco	62	37.840.044	610.323,29
Mozambique	98	33.897.354	345.891,37
Namibia	112	2.604.172	23.251,54
Niger	30	27.202.843	906.761,43
Nigeria	54	223.804.632	4.144.530,22
Rwanda	7	14.094.683	2.013.526,14
São Tomé and Príncipe	2	231.856	115.928,00
Senegal	20	17.763.163	888.158,15
Seychelles	14	107.660	7.690,00
Sierra Leone	8	8.791.092	1.098.886,50
Somalia	52	18.443.378	354.680,35
South Africa	407	60.414.495	148.438,56

South Sudan	89	11.088.796	124.593,21
Sudan	67	48.109.006	718.044,87
Tanzania	166	67.438.106	406.253,65
Togo	8	9.053.799	1.131.724,88
Tunisia	29	12.458.223	429.593,90
Uganda	47	48.582.334	1.033.666,68
Zambia	88	20.569.737	233.747,01
Zimbabwe	196	16.665.409	85.027,60

Table 3. Comparison between the number of airports and population of every African country.

Source: Adapted from [61,62].

In the table it is seen that the ratio of population in the country per airport varies wildly depending on the country, this can be due to economic reasons or its geography. A clear example of it is the case of Seychelles, being a country formed by islands means it will need some sort of connection which can't be by road, in this case it is air and sea connections. Adding to the fact that small islands can't be widely populated, and they need a large number of airports, this leaves the ratio in such a low value, making it 7690 inhabitants per airport.

Then there is the case of Nigeria, a country which is big in size and counts with the larger number of citizens in the continent. The point here is that it is a country really centered in big urban areas, leaving a wide number of population depending on one airport, making the ratio of approximately 4.15 million inhabitants per airport.

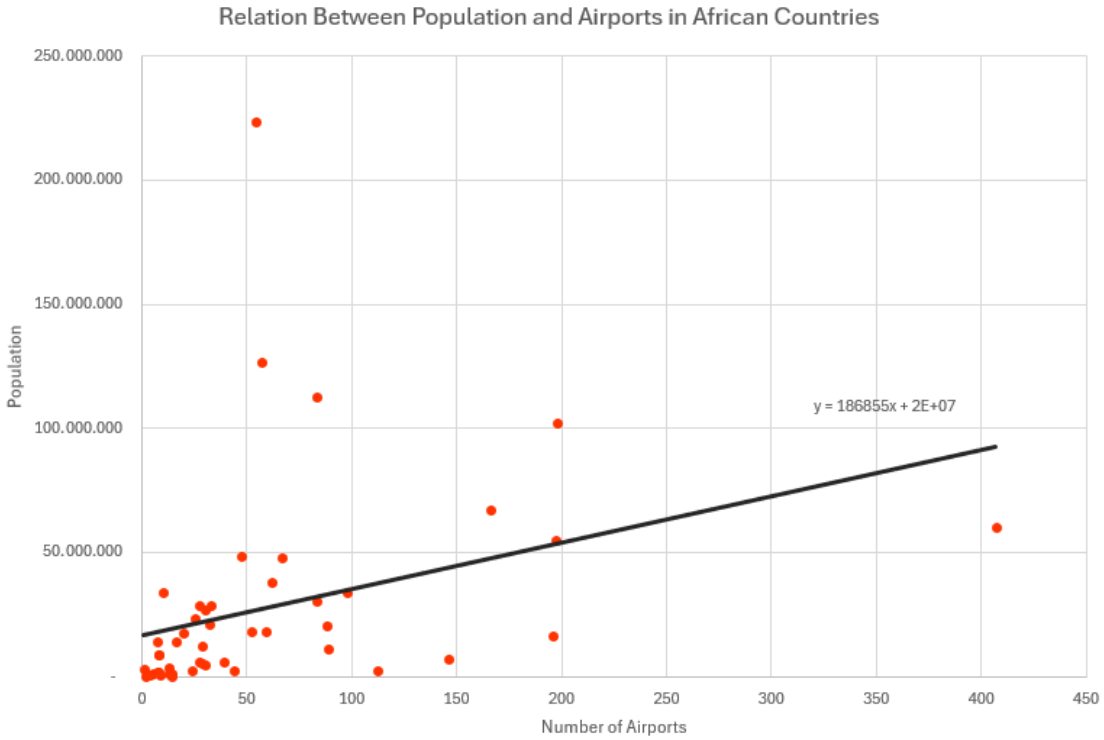

Figure 9. Scatter chart of the relation between population and airports in African countries and its correlation line.

Source: Primary.

The previous scatter chart shows where do countries fall in terms of comparing the number of airports to the population of the respective country. It can be seen that most countries stick together with some examples being found far away from the correlation line. The furthest country is Nigeria, as it is the most populous country in the graphic, whereas the most separate one is South Africa as it counts with the higher number of airports in the continent. The result of the Pearson correlation coefficient of this chart is *0,12*. This number means that the correlation between population and airports is low, but still when a variable increases the other one does the same.

Relation Between Airports and GDP

In order to compare the different countries in the region, other ratios regarding the number of airports rather than comparing them to population can be explored. One of them being the ratio comparing the GDP and the number of aerodromes. Leading to know which countries do invest more on airport infrastructure quantity out of their GDP value, portraying which of them are the ones with more airports regarding its economic status and which ones do invest the least.

Country	Airports	GDP ($ US)	GDP per Airport
Algeria	149	$ 191.913.000.000	$ 1.288.006.711
Angola	102	$ 106.714.000.000	$ 1.046.215.686
Benin	6	$ 17.401.746.309	$ 2.900.291.052
Botswana	74	$ 20.352.322.157	$ 275.031.381
Burkina Faso	23	$ 18.884.619.613	$ 821.070.418
Burundi	7	$ 3.073.414.678	$ 439.059.240
Cabo Verde	9	$ 2.314.816.792	$ 257.201.866
Cameroon	33	$ 44.341.646.509	$ 1.343.686.258
Central African Republic	39	$ 2.382.618.615	$ 61.092.785
Chad	59	$ 12.704.149.842	$ 215.324.574
Comoros	4	$ 1.242.519.407	$ 310.629.852
Congo	27	$ 14.615.532.210	$ 541.316.008
Cote d'Ivoire	27	$ 70.018.715.017	$ 2.593.285.741
DR of the Congo	198	$ 58.065.953.573	$ 293.262.392
Djibouti	13	$ 3.390.000.000 (2021)	$ 260.769.231

Egypt	83	$ 476.748.000.000	$ 5.743.951.807
Equatorial Guinea	7	$ 11.813.908.448	$ 1.687.701.207
Eritrea	13	$ 1.980.000.000 (2019)	$ 152.307.692
Eswatini	14	$ 4.854.167.638	$ 346.726.260
Ethiopia	57	$ 126.783.000.000	$ 2.224.263.158
Gabon	44	$ 21.071.739.228	$ 478.903.164
Gambia	1	$ 2.273.060.863	$ 2.273.060.863
Ghana	10	$ 72.838.798.788	$ 7.283.879.879
Guinea	16	$ 21.227.749.389	$ 1.326.734.337
Guinea-Bissau	8	$ 1.633.559.092	$ 204.194.887
Kenya	197	$ 113.420.000.000	$ 575.736.041
Lesotho	24	$ 2.553.459.763	$ 106.394.157
Liberia	29	$ 4.001.047.150	$ 137.967.143
Libya	146	$ 45.752.336.036	$ 313.372.165
Madagascar	83	$ 14.954.967.604	$ 180.180.333
Malawi	32	$ 13.164.667.627	$ 411.395.863
Mali	25	$ 18.827.176.532	$ 753.087.061
Mauritania	30	$ 10.375.460.680	$ 345.848.689
Mauritius	5	$ 12.898.307.089	$ 2.579.661.418
Morocco	62	$ 134.182.000.000	$ 2.164.225.806
Mozambique	98	$ 17.851.491.428	$ 182.158.076

Namibia	112	$ 12.607.436.976	$ 112.566.402
Niger	30	$ 13.969.605.583	$ 465.653.519
Nigeria	54	$ 477.386.000.000	$ 8.840.481.481
Rwanda	7	$ 13.312.796.765	$ 1.901.828.109
São Tomé and Príncipe	2	$ 546.680.342	$ 273.340.171
Senegal	20	$ 27.684.430.244	$ 1.384.221.512
Seychelles	14	$ 1.588.406.479	$ 113.457.606
Sierra Leone	8	$ 3.970.343.852	$ 496.292.982
Somalia	52	$ 10.420.000.000	$ 200.384.615
South Africa	407	$ 405.870.000.000	$ 997.223.587
South Sudan	89	$ 12.000.000.000 (2015)	$ 134.831.461
Sudan	67	$ 51.662.241.775	$ 771.078.235
Tanzania	166	$ 75.709.289.056	$ 456.080.055
Togo	8	$ 8.126.439.481	$ 1.015.804.935
Tunisia	29	$ 46.664.948.952	$ 1.609.136.171
Uganda	47	$ 45.559.202.049	$ 969.344.724
Zambia	88	$ 29.784.454.056	$ 338.459.705
Zimbabwe	196	$ 20.678.055.598	$ 105.500.284

Table 4. Comparison between the number of airports and GDP of every African country.

Source: Adapted from [61,63-67].

Whereas the table in the previous section compares the number of airports with its population, this one does it with its GDP and determines a ratio. This ratio is a

partition of the GDP into equal parts, one for each airport, which will make less rich countries with a high number of aerodromes have a lower ratio than those which are richer and have fewer airports. In this case it is found that the Central African Republic is the country with a lower ratio, meaning the nation invests more in relation to its GDP when comparing it to the other countries in the continent. This is due to the country being pretty sparse, as it is formed by a big number of towns found far away from each other and leading to the need of air connection.

On the other side, relating to the previous section, there is Nigeria as the country that invests less on airports compared to its GDP. Just as discussed before, the case of this country is that its citizens are distributed majorly in urban areas with just one airport. This is a remarkable difference with the Central African Republic, which is formed by sparse small towns. In the case of Nigeria, it is one of the richest countries in the continent so this division of GDP by number of airports ends up getting a high result rather than a low one.

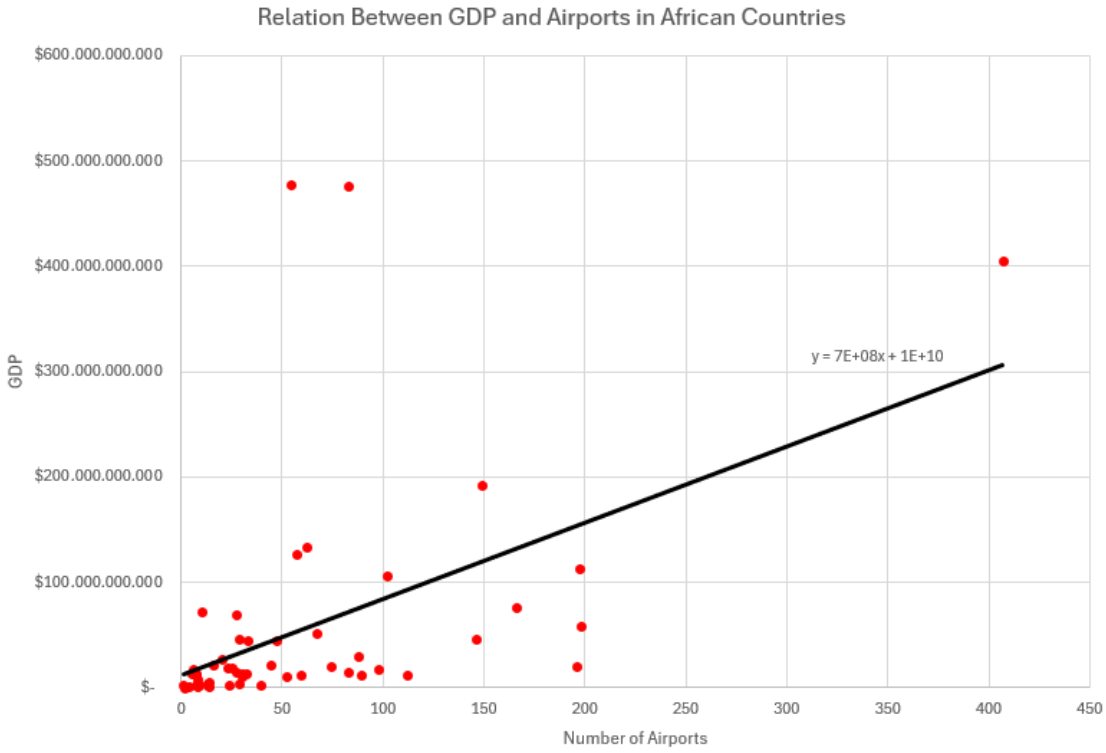

Figure 10. Scatter chart of the relation between GDP and airports in African countries and its correlation line.

Source: Primary.

In the previous chart it can be appreciated that the correlation in this specific case, comparing the GDP and the number of airports, is less sparse. Some cases such as Nigeria or Egypt differ widely from the correlation line as they result in powerful economies but generally all the dots are more centered in this case. This

information is showing that in the African continent, generally, the construction of airports is more related to the economic status of the country rather than the objective of being able to service its citizens and connecting them to the rest of the world. This point is proved by the result of the Pearson correlation coefficient which is *0,24*. Meaning the correlation is still low as in the case studied before but yet it has more relation to it.

4. Initiatives

On the task of improving the connections in the African continent, several initiatives have been proposed by governments and organizations. These ones, with the objective of developing the air transport and connectivity in the continent with the purpose of reaching a superior status to the one previous of their application. In this section some of them are going to be explored and discussed and, after this, some are going to be proposed.

One of the main measures taken is what is known as the Yamoussoukro Decision, previously discussed in the connections section. This is a policy developed by African leaders of 44 countries in a conference in the city of Yamoussoukro, capital of Cote d'Ivoire [41]. This measure was starting to be implemented in the early 2000s. Its objective was to liberalize the aviation market in Africa on the application of the Five Freedoms of the Air, granting the rights to operate in and overfly countries that are not the one of origin of the airline.

Another measure to promote air travel in the continents is the creation of the Single African Air Transport Market (SAATM); this is a project of the African Union, which is being developed nowadays, to liberalize the air transport market in the region [68]. This is signed by 80% of the African aviation market as of today, 34 countries in total. The purpose is to open the African skies and promote the full application of the Yamoussoukro Decision.

Regarding the previously mentioned resolution, which is fully supported by IATA, there is the Africa-Europe Alliance. This alliance promoted by the European Commission is working on a transport and connectivity task force in Africa to develop its infrastructure and level of service. Aviation wise, it is stated that to develop the aviation market the Single African Air Transport Market must be applied [69].

4.1. Proposal of New Initiatives

In this part of the section regarding the initiatives to improve and develop air transport in Africa several actions will be mentioned and given a reason of why they would be beneficial. These actions are thought to be taken by governments and institutions.

- The first measure is the liberalization of the market, this one is actually in progress as mentioned in the previous section. The purpose is to create a market where there is rivalry between companies, having to improve their services and lower their prices to stand out one ahead of the others. Its finality is to be more attractive to customers and easier to economically reach for citizens.

- Another action to consider is the strengthening of the applied safety and security measures, adapting them to the international IATA standards. This application would not only make the transport safer but would also give a positive image of it, working as a strong campaign in favor of air transport in Africa.

- Incentives and subsidies of national governments towards airlines operating in each region and performing different routes of interest for the citizens of a specific area, connecting them to the world, is also something to consider. These incentives promote the operations of these routes and at the same time lead to lower ticket prices, increasing the number of passengers and the number of tourists getting around.

- Research by organisms, organizations and universities is also a must when considering actions to make significant developments and advances in the sector. This research is a powerful tool to acknowledge the needs of passengers and citizens and the improvements that companies and governments must embark upon to be more appealing. Another type of research that must be performed is the investigation of technologies of all ranges, from improving safety or reducing costs to being more ecologically friendly regarding aircraft operations.

5. Conclusions

In this project several points regarding the aviation sector in Africa have been investigated and discussed. These ones being the development of the sector itself and the current state of it, from infrastructure to air connections. Moreover, the impact that the air transport market has on countries in the continent has also been discussed and studied together with the initiatives taken by organisms to make the sector grow.

This elaboration leads to several conclusions respecting the state and development of the sector in the African region in general terms:

1. The continent has proven to have an interesting correct development of infrastructure servicing aircraft. But there is still a lot of work to do in order to improve it and to make it worthy of a name on the globe. This last point is considered especially after seeing cases where there has been a development which turned out to not have the satisfactory results that were expected in the beginning.

2. There is a lot of importance given to air transport in the continent due to different reasons such as its geography and the long distances or safety in aviation which is proven to be higher than in other means of transport. Aircraft can connect remote and far away areas to a specific place or just to the entirety of the world, making every town more accessible at the same time it leads to economic growth in these regions.

3. As the years have gone by, the air connections in the continent have increased rapidly, both inside of the region and intercontinental. This increase has proven the growth of tourism in the area, mainly due to different reasons such as the attractiveness of the actual developed air services in the continent. To this one, it can also be added the appearance of low-cost companies flying in and to the region as well as the liberalization of the market.

4. Relating to the connections in the region, the continent has a strong demand for transport, especially regional. Aviation plays a key role in it, as it is a fast method to connect different areas in the African region whose demand of travel is above the average at the same time it results in a safer way to go around rather than by other means of transport. The African regional market sums up to the intercontinental demand that there is

present, which is lower, but it still is in there, expressing the relevance it has and that it acquired throughout the years.

5. There is a considerable presence of initiatives taken to develop the sector. These initiatives adopted by organisms, governments and organizations are based on the liberalization of the market and the opening of the skies to make air transport an easier way of connecting Africa. This is planned to lead to a big growth in air traffic in the continent, which is nowadays exponentially increasing, with the objective of connecting each other and helping the local economy improve.

6. The economic state of the country takes a lot of importance in the development of infrastructure and services. Those countries with a lower GDP are proven to invest way less on it due to lower traffic demand expected in comparison with other countries in the region. This applies mainly to those countries that are not touristy themselves and aviation is just a sector that is in there but does not have as much relevance as in other cases.

7. Research on the region's development of aviation has proven to be insufficient in comparison to other continents after the making of this project. This absence of information in comparison to other places such as Europe or America comes mainly due to the lack of infrastructure related to aviation and airlines themselves. The region, as seen in the progress of the project itself, is in development, which means it is not fully established even if it is growing. This is the main reason why the research results are limited when comparing it to the data that can be obtained from other regions.

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