DEVELOPING AIR LOGISTICS HUB IN AFRICA: A CASE STUDY OF CAIRO AIRPORT

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ABSTRACT

Africa and Europe have the best air connections, thus it's feasible that some volumes going to industrial sites, which are often in Asia, may have to pass through Europe first due to poor air connections or for consolidation reasons. As a result, this paper seeks to establish Egypt as an air logistics hub in Africa. Egypt has been selected as the African hub in this study because of its geographical location in the middle of Europe, Asia, and northern Africa, making it a desirable and advantageous place for the hub. The study's findings demonstrated that African hubs had significantly higher levels of connection and temporal coordination than European hubs. International courier firms would be best to engage in Africa as there are several obstacles owing to the difficulty in accessing information for development and the region's poor infrastructure. Additionally, as no African airport appears to have a clear advantage according to the literature analysis and reports, this article will analyze the best way to establish an aviation hub in Africa. As a conclusion, it will be simple to compare the competitive advantages of international airport hubs with those of African hubs and have a clearer understanding of the challenges that Africa faces.

Keywords: *Africa, Air Hub, Air Transport, Airport, Egypt, Logistics*

บทคัดย่อ

ทวีปแอฟริกาและทวีปยุโรปมีการเชื่อมต่อทางอากาศที่ดีที่สุด จึงเป็นไปได้ว่าปริมาณขนส่งบางส่วนที่ไปยังแหล่งอุตสาหกรรมในเอเชียอาจต้องผ่านทางยุโรปก่อน เนื่องจากปัญหาการเชื่อมต่อหรือเพื่อรวมสินค้า บทความนี้พยายามเสนอให้อียิปต์เป็นศูนย์กลางลอจิสติกส์ทางอากาศในแอฟริกา เพราะอียิปต์มีข้อได้เปรียบจากที่ตั้งทางภูมิศาสตร์ซึ่งอยู่กึ่งกลางระหว่างทวีปยุโรป เอเชีย และแอฟริกาเหนือ ผลการศึกษาแสดงให้เห็นว่าศูนย์กลางการบินในแอฟริกามีระดับการเชื่อมต่อและความร่วมมือสูงกว่าศูนย์กลางการบินในยุโรป จึงเสนอให้บริษัทขนส่งระหว่างประเทศเข้าไปจัดการทำงานในแอฟริกา เพราะมีอุปสรรคหลายข้อ อาทิเช่น ความยุ่งยากในการเข้าถึงข้อมูลเพื่อการพัฒนาและโครงสร้างพื้นฐานอันย่ำแย่ในภูมิภาค จากการวิเคราะห์บทความหรือรายงานที่ผ่านมา พบว่ายังไม่มีสนามบินใดในแอฟริกาที่มีความได้เปรียบอย่างเด่นชัด บทความนี้จะวิเคราะห์หนทางที่ดีที่สุดเพื่อจัดตั้งศูนย์กลางการบินในแอฟริกา กล่าวสรุป คือ การเปรียบเทียบความได้เปรียบทางการแข่งขันระหว่างศูนย์กลางการบินนานาชาติกับศูนย์กลางการบินในแอฟริกา เพื่อให้เข้าใจอย่างถ่องแท้ถึงความท้าทายที่แอฟริกาเผชิญอยู่

คำสำคัญ: ทวีปแอฟริกา ศูนย์กลางการบิน การขนส่งทางอากาศ สนามบิน อียิปต์ ลอจิสติกส์

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INTRODUCTION

The effects of sudden and significant changes in the environment, as well as in the economy and society, are what define the air transportation sector. An airport hub serves as a hub that connects everyone and everything. Because they protect the financial interests of airlines and satisfy the connectivity requirements of both passengers and cargo, hubs continue to play a significant role in aviation. An efficient hub airport with enough extra space will increase passenger options and encourage airline competition, opening the door for new competitors, routes, and frequencies. Airport Council International (ACI) asserts that the best airport can be determined based on the volume of travelers and its superiority and accomplishment in terms of facilities, customer services, operations, retail, environmental awareness, and community relations. In order to achieve the best results, airport networks must also implement developed management and make use of their resources, including: (geographical, capital, multi-model transport capability, future technology application readiness, readiness to accept firms like FedEx and DHL, application of e-airport with e-airline, e-freight, and e-AWB). This aids in achieving the greatest growth possible and preparing for quick expansion. Future airport networks should use a variety of transmission technologies in order to reach all areas. As a result, this study will compare it to the busiest hub in Asia, Hong Kong Airport (HKIA), as well as the busiest hub in Europe, Frankfurt Airport (Fraport), and the busiest hub in the Middle East, Dubai Airport (DXB).

There is a doubt that the air transportation industry has been badly impacted by a number of events, including wars, terrorist attacks, rising fuel prices, epidemics, and pandemics like the Covid-19 virus. These acts necessitated an immediate response from the field and the need to act. With an air hub and other supporting modes, Egypt has the potential to be one of the largest logistics transit centers, but in order to meet the needs of both passengers and airlines, it must develop each criterion and feature separately.

RESEARCH PROBLEM

This paper has addressed the following research problem:

> Studying the main criteria required to transfer the Cairo international airport into an effective air hub in Africa.

A set of criteria is used in this paper, including:

- Number of passengers and cargo in each hub,
- The geographical flight duration between the main hubs internationally
- And the number of populations comparing to number of passengers.

LITERATURE REVIEW

In their study of the global air transport networks during a 12-year period, Sun *et al*, (2015) analyzed the evolution of the world's air transport networks at the country level and identified countries and flight connections that were topologically critical in an unweighted network and functionally critical in a weighted network. (Sun *et al*., 2017).

The "A Global Airport Connectivity Index (GACI)" developed by Cheung et al. (2020) combines degree, closeness, and eigenvector topological indicators with two new volumetric indicators. For larger airports that have made progress in GACI, we observe a greater rate of passenger increase. While West Europe, South East Asia, and the Middle East concentrated on expanding their main airports into global hubs, America and North Asia concentrated on regional hub developments, serving short- to medium-haul routes. Our analysis shows that

increasing GACI improves an airport's competitive position and gives rise to increased influence over other airports. (Cheung *et al*., 2020)
Nobody is certain how economic development would have changed if there had been no access to air transportation services, according to Fung et al. (2006). Many other aspects must be taken into consideration because the comparison of changes in tourism revenue and airline spending may not accurately reflect the actual economic impact of air transportation services. These include the businesses that sprung up around the airport as a result of the airport's existence, and other industries have prospered as well. To get a more comprehensive quantification (Fung *et al*., 2006).

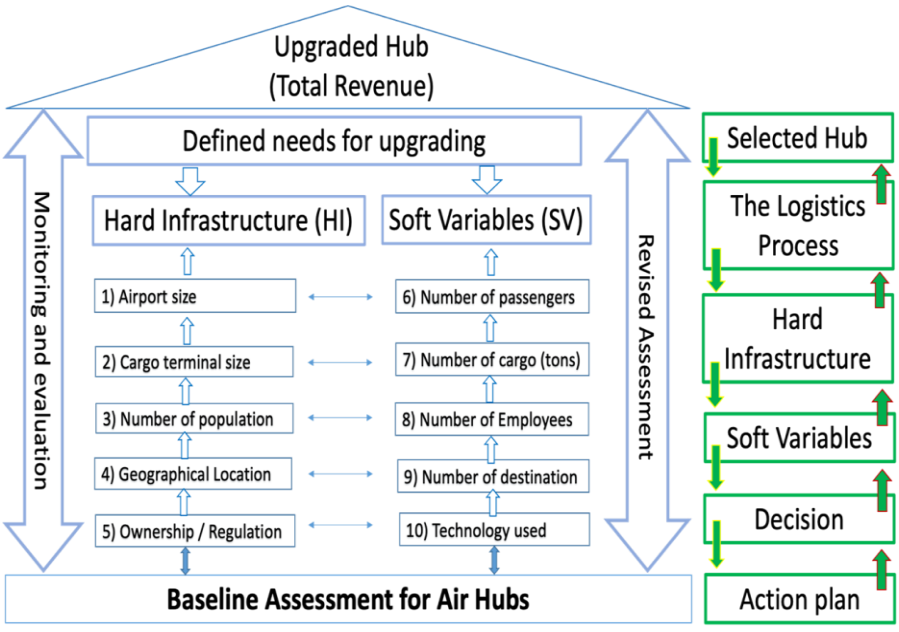
ANALYSIS AND DISCUSSION

1.1 Conceptual Framework

In response to the necessary evaluation of airport logistics capabilities, particularly in Africa, the framework was conceptualised. The FW's overarching goal is to identify and improve hubs. To get to the upgraded hub (UH), three parallel actions have been identified. Beginning with the assessment's baseline (BLA), all activities are undertaken. The study's existing air hubs' relative location, size, hard infrastructure, population density, and current processes for cargo and passenger travel all have a role in determining the BLA of this FW. The framework is divided into three primary pillars after the baseline data has been gathered. The first two pillars define the requirements for improving the chosen hub or hubs, while the third pillar focuses on assessing the particular hub. The assessment may be revised as a result of the ongoing monitoring and evaluation of these pillars.

In order to improve the best hub after defining and assessing the three pillars in Figure 1, the study's goal was to find the ideal African air cargo hub based on a number of characteristics and understand the challenges it faces. After examining the five air hubs (Hong Kong, Frankfurt, Dubai, Addis Abeba, and Cairo), it has been determined that Cairo International Airport is the best African hub that can be constructed using the framework and the characteristics listed there.

Figure 1: The Proposed Framework for the Air Hub



1.1.1 Hard Infrastructure (HI)

The first pillar of the FW is the HI needs, which are defined for Airport size, including the cargo terminal size, Number of populations, which can indicate the average salary of the employees and whether they are available or not, Geographic location for calculating the best transit by calculating the time spent in each journey from/to airport, Ownership of the airport, including whether it is controlled by the army or if it is private sector or a mix between both, and how it can affect The prerequisites needed for the UH might be determined from the stated HI.

1.1.2 Soft Variables (SV)

The SV demands are determined by the number of passengers, tonnes of cargo, destinations, check-in technology, amount of time spent in security, use of the e-AWB, and overall amount of e-freight. This is the second pillar of the FW. This results in the e-system's defined targets, which are utilised to demonstrate the air hub plan for the following years and the number of airport personnel.

1.1.3 Upgraded Hub (UH)

While the third pillar is employed to evaluate the chosen HUB against a developed reference hub in the main global air transport. This is accomplished by taking into account the data that has been collected for the (HI) and (SV) during the past ten years. By analysing this data, we can determine whether the hub needs to be upgraded and in what area.

1.2 Passengers Air Traffic in the Airports

The finalized civil international air traffic statistics for the past ten years at the international airports of Hong Kong, Frankfurt, Dubai, Addis Abeba, and Cairo are shown in Figure 2, along with the situation in 2020 during the COVID-19 pandemic, which shows a dramatic decline in the rate percentage of passengers with 77% fewer for just two months (April and May).

Figure 2: Passengers Air-traffic

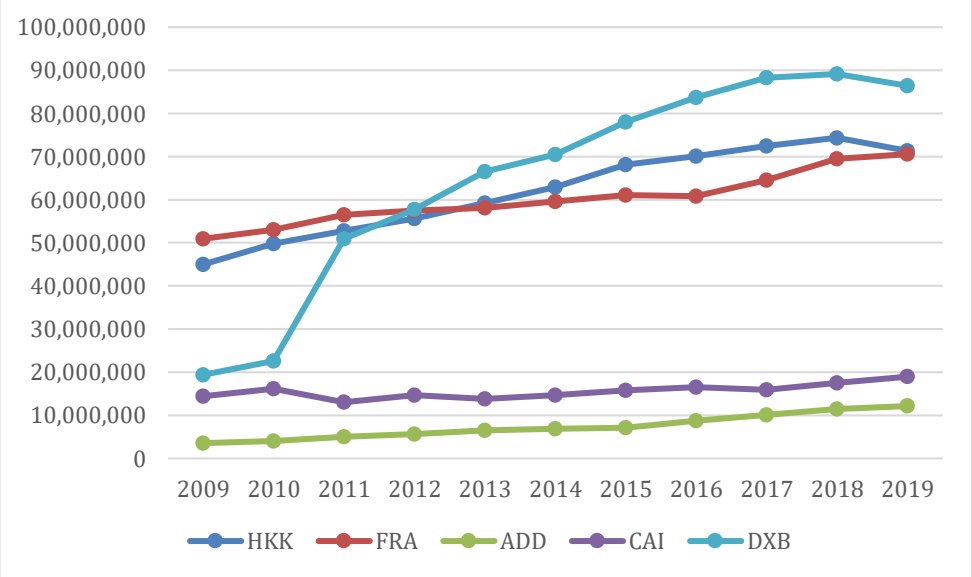


Figure (2) showed all the data for the passenger traffic in the five study hubs (HKK, FRA, ADD, CAI, and DXB) over a ten-year period from 2009 to 2019. The highest number of passengers was recorded at Dubai Airport in 2018 with 89 million, followed by Hong Kong

Airport with 74 million and Frankfurt Airport with 70 million. There is a significant disparity between airports in Africa, where Cairo Airport recorded 18.9 million passengers in 2018.

1.3 Cargo Air Traffic in the Airports

For the past ten years, the finalised cargo international air traffic data for the international airports of Hong Kong, Frankfurt, Dubai, Addis Abeba, and Cairo are shown in Figure 3.

Figure 3: Cargo Air-traffic

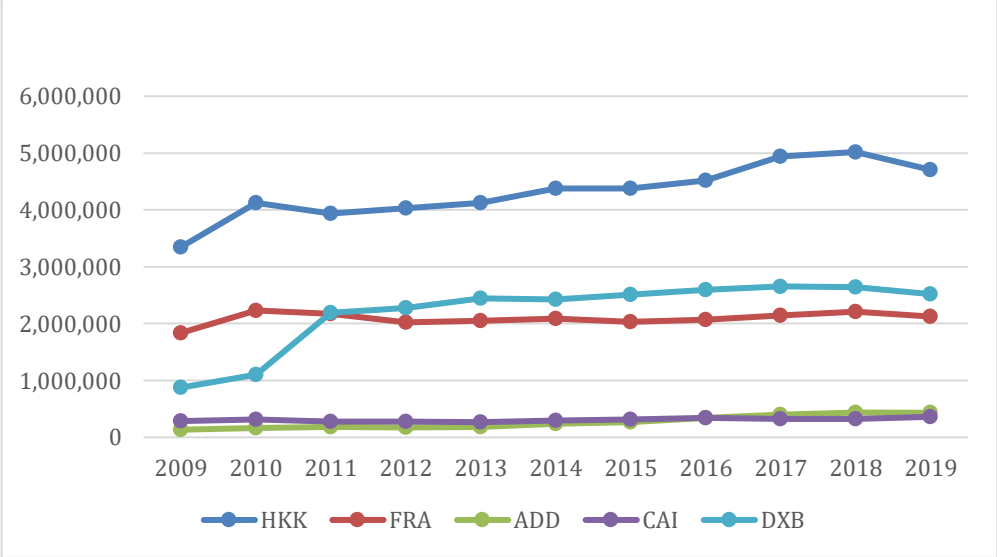


Figure (3) depicts the amount of cargo transported via Hong Kong Airport over the course of the last ten years, from 2009 to 2019, from where it climbed by 45% since 2009 to reach its highest level of 5 million tonnes in 2018. While the amount of cargo handled at Frankfurt Airport climbed by only 25%, reaching a maximum of 2.2 million tonnes in 2010 and 2018. The number of passengers at Cairo Airport did not expand at the same rate as those at Frankfurt Airport; instead, it only rose by 13% to reach its peak of 323 thousand tonnes in 2018.

1.4 Geographical Flight Duration between the hubs

Geographically speaking, the airport is well-positioned to develop into a hub. Because of its location, it can accommodate many airlines that require transit or technical stops. The length of long-haul flights increases as aircraft performance increases over time, and the likelihood of operating long-haul direct flights also increases (Bardai et al., 2017).

Table (1) illustrates the significance of the airports' geographic locations. Addis Abeba, the farthest country from the busiest hub in the world, is not the ideal location for an air cargo hub because the majority of the cargo being transported by air is high value or perishable, requiring very quick transportation.

While Cairo Airport and Frankfurt Airport are roughly the same in terms of time, the amenities and technology at the Frankfurt hub are vastly different. The study is focusing on several hubs in various regions with the same capabilities in order to provide the society of air transport what they are due. While they are comparable in terms of time value, they are not equivalent in terms of quality value. Despite being a moderate distance, Hong Kong Hub is neither the shortest nor the longest. Dubai Airport, a commercial city with a focus on international air

travel, has strived to be the world's favourite air travel centre while having the shortest summations of time.

Table 1: Flight Duration to the World's Busiest Airport in a Different Region

	Tokyo Haneda (Asia)	**London Heathrow** (Europe)	**Doha** (Middle East)	**Atlanta** (America)	**Sydney** (Oceania)	**Johannes-burg** (Africa)	**Total**
Rank	1st (70+m)	3rd (70+m)	5th (70+m)	7th (70+m)	5th (40-50m)	8th (20-30m)	
HKG	4hrs 40min	12hrs 55min	9hrs	20hrs 13min	9hrs 5min	12hrs 55min	**67hrs 35min**
FRA	13hrs 32min	1hr 25min	6hrs 15min	10hrs 20min	21hrs 55min	10hrs 25min	**63hrs 52min**
ADD	15hrs 36min	7hrs 40min	3hrs 35min	18hrs 32min	20hrs 35min	5hrs 25min	**71hrs 23min**
CAI	14hrs 6min	5hrs 10min	3hrs 5min	15hrs 20min	18hrs 10min	8hrs 10min	**64hrs 1min**
DXB	9 hrs 55 min	7 hrs 50 min	1 hrs 10 min	18 hrs 25 min	13 hrs 50 min	8 hrs 15 min	**59hrs 15min**

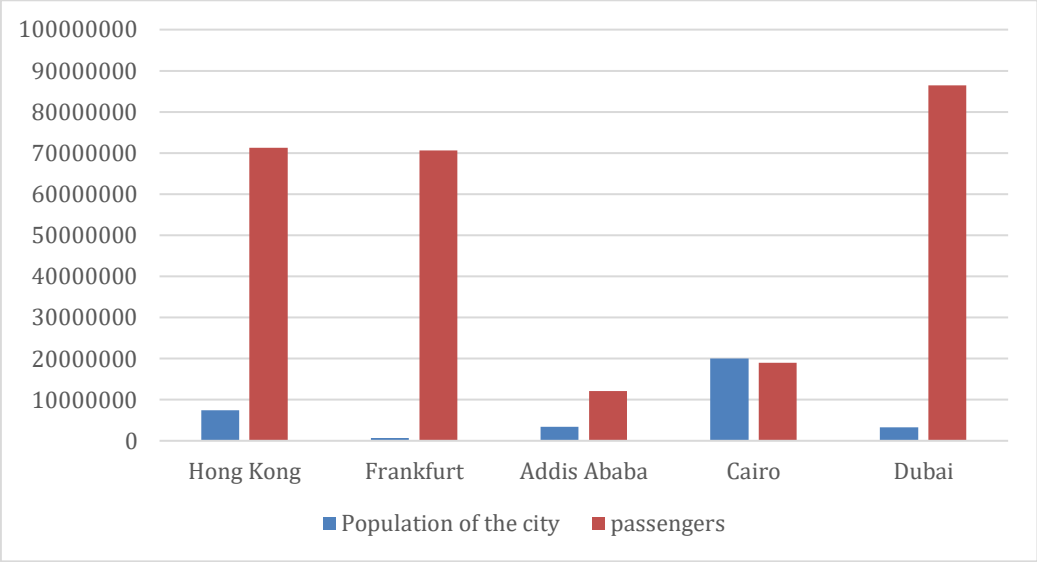
1.5 Population vs. Number of passengers

The comparison of the population and passengers handled at the airports in Hong Kong, Frankfurt, Addis Ababa, Cairo, and Dubai may be seen by comparing the number of passengers with the population in Figure (4). In Hong Kong, Frankfurt, Dubai, and Addis Ababa, more passengers were handled than there were people living there. This demonstrates that travelers have greater mobility than before. Passengers can now easily travel to any location thanks to the airport hub's connectivity, and any airport can be reached via a hub's direct or indirect link. Cairo is the only hub, but there are more people than travelers there.

Figure (4) compares the number of passengers handled at the airports in Hong Kong, Frankfurt, Dubai, Addis Ababa, and Cairo. In Dubai, Hong Kong, and Frankfurt, the number of passengers handled has exceeded the local population. This demonstrates that travelers have greater mobility than before. Passengers can now easily travel to any location thanks to the airport hub's connectivity, and any airport can be reached via a hub's direct or indirect link. Cairo is the only hub where the population outnumbers the number of travelers. Enhancing connection is one way to boost an airport's efficiency, as was previously mentioned.

The more options an airport can offer, the more likely it is that people will choose it. In other words, an airport's effectiveness is influenced by how convenient it is. The level of convenience that an airport hub offers travellers extends beyond the availability of several flights and also includes the hub's amenities and services. The airport operator should focus on each traveller's objective because the local population contrasts with the passenger flow.

Figure 4: The Ratio between the Passengers in One Year and the Population



Different types of passengers have different needs. The operator must therefore determine which types of passengers constitute the majority of the total passenger flow in order to develop appropriate solutions. Airport revenues are influenced by both aviation and other activities. Therefore, to increase revenues, it is essential to segment the target market (passengers).

1.6 The Revenue of the air hubs

Improving connectivity is one approach to increase an airport's effectiveness. The more options an airport has, the more likely it is that travellers will select it. In other words, the convenience of an airport affects its effectiveness. Beyond the availability of several routes, an airport hub also provides travellers with a high level of convenience through its amenities and services. The local population contrasts with the passenger flow, so the airport operator should concentrate on each traveler's goals.

Table 2: Number of Passengers, Cargo, and Revenue

Year 2019	Cairo Airport	Dubai Airport	Hong Kong Airport	Frankfurt Airport	Addis Ababa Airport
Number of passengers	18,955,450	86,396,757	71,287,552	70,560,987	9,660,129
analysis	18,955,450	355.5% ↑	276% ↑	272% ↑	49% ↓
Number of cargo (mt)	361,260	2,514,918	4,703,590	2,128,476	432,000
analysis	361,260	600% ↑	1,202% ↑	490% ↑	20% ↑
Total Revenue ($)	2,240,242 (million)	28,314.5 (billion)	2,179.2 (billion)	3,967.1 (billion)	260.0 (million)
analysis	2,240,242m	1,265,000% ↑	97,000% ↑	175,000% ↑	11,550% ↑

The airport's revenue is influenced by both aviation and non-aviation. Therefore, in order to increase income, it is essential to segment the target market (passengers). And although though they have less area, as indicated in Table (2), they generate significantly more money than the airports in Cairo and Addis Abeba. Of course, the volume of people and cargo traffic is to

blame for this. Dubai has 355.5% more passengers than Cairo does, Hong Kong has 1,202% more cargo, and Dubai Airport has 600% more passengers than Cairo does.

1.7 Descriptive statistics of variables

The descriptive statistics of variables included in the model are illustrated. Subject to the scarcity of data related to airports, data for the period 2009-2019 are used. Data sources include the World Bank, World Development Data for Population and, GDP data. And for the variables all from the official website of Hong Kong Airport, Frankfurt Airport, Cairo Airport, and Dubai Airport, and some statistics from IATA annual reports to collect the five airports of the study which are Hong Kong Airport, Frankfurt Airport, Addis Ababa Airport, Cairo Airport, and Dubai Airport are selected for testing the determinants of airport efficiency due to the availability of data. And the variables which are included are the time-variant variables which include the number of passengers, number of cargo in tons, and population in addition to total revenue.

As shown in Figure (5) the statistical analysis of available data for the selected airports can be indicated by the One-Way ANOVA Test for time-variant variables included. One Way ANOVA Test for the number of passengers according to airport illustrated the statistically significant differences among studied airports during the period of the study at a confidence level of 99%. Dubai Airport comes first then Hong Kong Airport followed by Frankfurt Airport then Cairo Airport and Addis Ababa Airport.

Figure 5: Means of Numbers of Passengers regarded to Airport Group

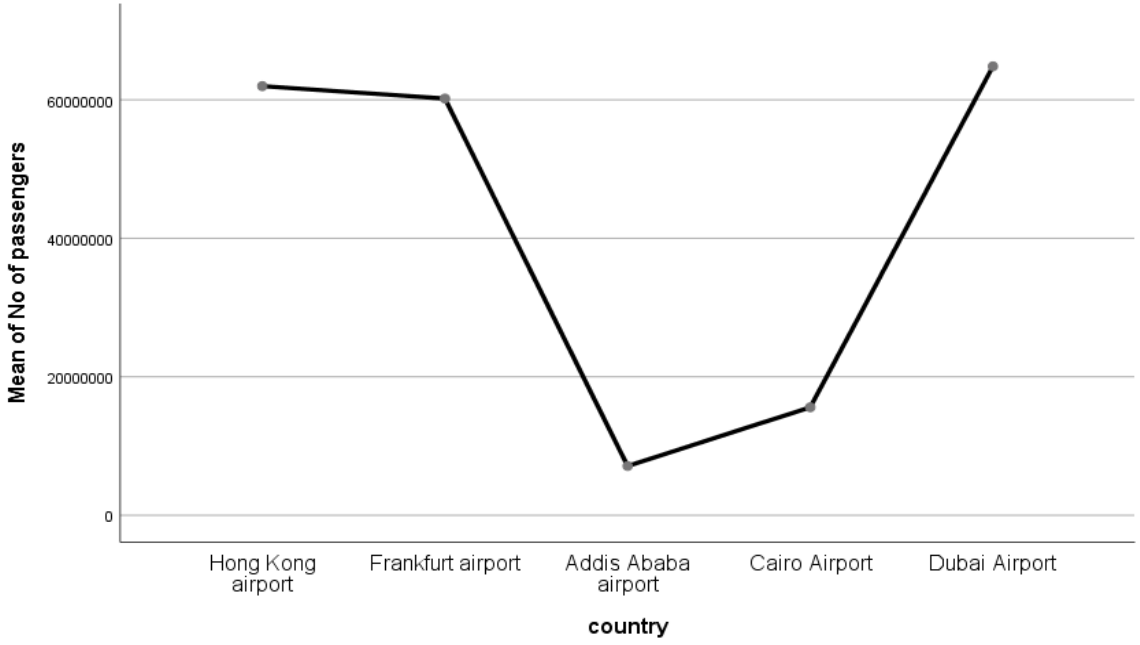


Figure (6) confirmed the statistically significant differences according to the airport for the number of Cargos in tons at a confidence level of 99%. This difference is in favor of Hong Kong Airport followed by Dubai Airport then Frankfurt Airport, Cairo Airport, and Addis Ababa Airport. And the results of Figure (7) shows that there are statistically significant differences according to the airport Group at a confidence level of 99% for Total revenue, this difference is in favor of the Dubai airport with a mean of 22991.61, then Frankfurt airport with a mean 2831.20, then Hong Kong airport, then Addis Ababa airport and Cairo Airport.

As one Way ANOVA Test illustrated the statistically significant differences among studied airports during the period in Total revenue, number of Cargo in tons, and the number of passengers, the correlation coefficients between the three mentioned above variables are measured for each airport of the five selected airports in separate.

Figure 6: Means of Number of Cargo regarded to Airport Group

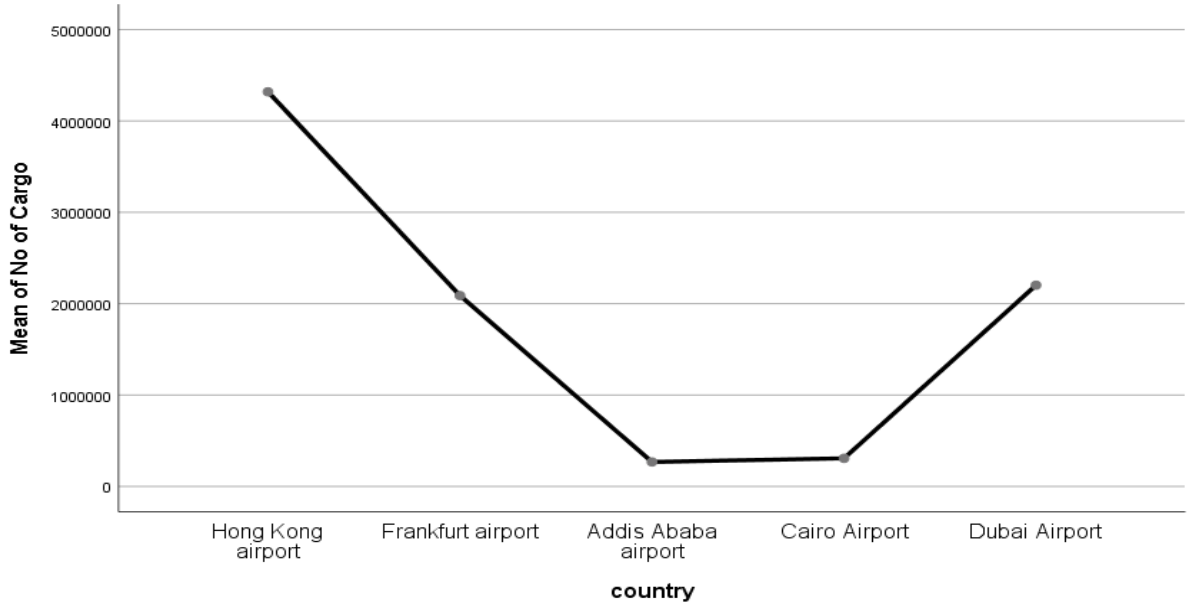


Figure 7: Means of Total Revenue regarded to Airport Group

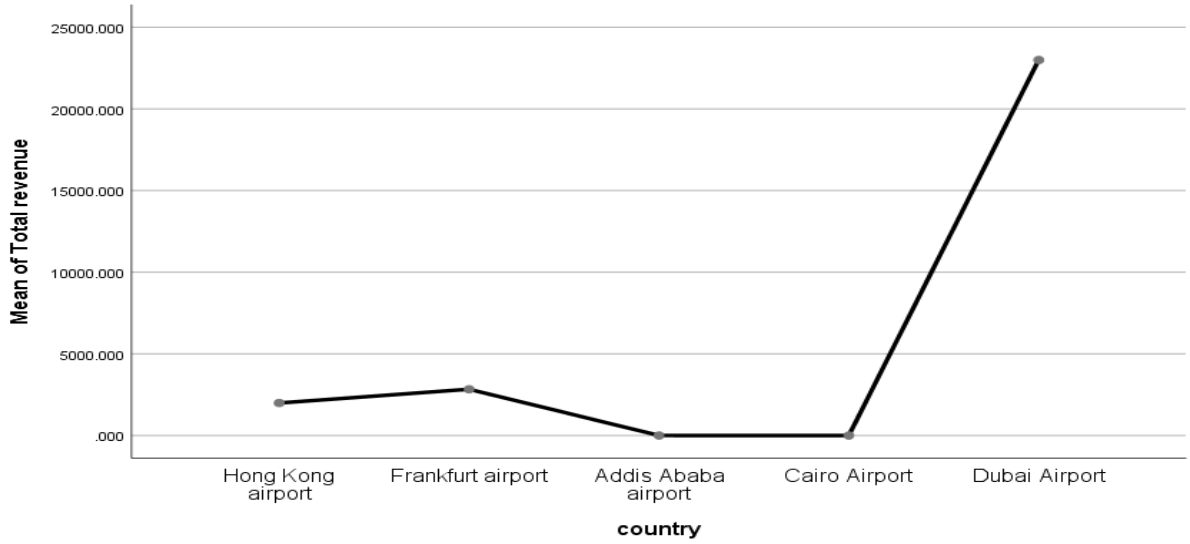


Table (3) illustrated that there is a statistically significant positive correlation between the number of passengers and number of the Cargo in tons at the level of confidence of 99% in all selected airports with an exception of Frankfurt airport. The statistically significant positive correlation between the number of passengers and Total revenue at a level of confidence of 99% is proven in all selected airports referring to the number of passengers as one of the main determinants of airport Total revenues. Also, there is a statistically significant positive correlation between the number of Cargo in tons and the Total revenue at a level of confidence of 99% in all selected airports with an exception of Frankfurt airport.

Table 3: The Correlation Matrix between Number of Passengers, Number of Cargo and Total Revenue

	Number of passengers	Number of Cargo	Total revenue
No of passengers	1	.824**	.594**
No of Cargo	.824**	1	0.247
Total revenue	.594**	0.247	1
**. Correlation is significant at the 0.01 level (2-tailed).			

** Correlation is significant at 1% level

CONCLUSION

After highlighting the significance of connectivity through the five hubs, we can discuss the advantages and disadvantages, threats, and opportunities of each of them, while keeping in mind that shifting investments to developed countries may have an international impact where more jobs may be available for them, thereby lowering the proportion of developed country citizens who travel to developing countries. However, if developed nations like Germany or China came and invested in the developed country, it would have a significant impact and fall under their control.

In conclusion, Hong Kong is leading the world in cargo transportation with over 4 million tons transported in 2019 that's makes its revenue exceed 2 billion, while Cairo is transporting 361,260 tons only, and it is supposed to be the leading country for fruits and vegetables worldwide.

The Revenues from the air transport sector in the African countries are too low (Cairo 2.2 million and Addis Ababa 260 million), and that's why the technology and administration policy need to be updated in such countries; Dubai is exceeding the 25 billion and Hong Kong and Frankfurt more than 2 billion.

Cairo has the same advantage in its geographical location as Dubai and Frankfurt within an average of 10 hours of the world. But with a smaller number of destinations that make Cairo the last choice to the agents, it has only 73 destinations, while Dubai, Hong Kong, and Frankfurt are more than 200.

Egypt has the potential to be one of the biggest logistics transit centers with an air-transport hub and other modes supporting this center but needs to develop each criterion and each feature individually to serve the customer's needs, either passengers or airlines.

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