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THE MOST IMPORTANT CRITERIA IN CONTROLLING THE SELECTION OF AIRPORT PLACES: A REVIEW ARTICLE

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ABSTRACT. Airports are one of the facilities that are subject to international standards established by the International Organization Cities related to the International Civil Aviation Organization (ICAO). Some of these parameters include terrain, and human and environmental obstacles, where navigational operations are affected. terrain and human obstacles, while noise and greenhouse gas emissions affect the environment in Airports' surroundings. Then the research deals with some of the standards set by ICAO, and in Egypt, the delta region was chosen to study its compatibility with these criteria, where they are suffering from the absence of an international airport, as the distance from the nearest airport 145Km and the population of the Delta region is 15.8 million people. Therefore, it was necessary to establish an international airport, especially a coastal one, to serve this region, stimulate the movement of tourism, facilitate transportation, as well as to revitalize the commercial movement. The science of ArcGIS has recently developed so that through advanced programs it can produce results in many applications. This paper is a solid understanding of how integrated by using GIS to construct A mega-project such as a delta Egypt international airport. This is to assess the importance of establishing an international airport in the delta region of Egypt and to identify the best places to set up such a huge project. This is done by presenting the literature on the topic and a summary of the methodology used in this paper, discussing the results and conclusions, and making recommendations.

KEYWORDS: Selection Criteria, Data Collections, Airport Places, ArcGIS, and GIS Programs.

1. INTRODUCTION

There are international criteria when picking an airport site for a building, according to Merkisz-Guranowska et al. [1] , and Erkan & Elsharida. [2]. The airport's location is a critical aspect in fulfilling the purpose of its construction; many previous studies were conducted by many researchers to determine the best location for the construction of airports. Researchers differed in looking at this problem, understanding who used geographic information systems to assess the choice of passengers and using different approaches to compare programs with each other, and some of them chose the location of the airport based on different indicators. According to Choi. [3] and Sandhyavitri & Fansyuri. [4] the International Civil Aviation Organization's international standards (ICAO).

Terrain, human, and environmental impediments are some of the variables that affect navigational operations. The environment in the vicinity of airports is affected by terrain and human impediments, as well as noise and greenhouse gas emissions. The research then moves on to some of the ICAO standards, such as operational standards in the areas of endeavor of the ICAO Specifications for design civil aviation, which have been published in a large number of documents and appendices, such as establishing, operating, and maintaining airports and their surroundings. For instance, I've listed the following organization:

- Around airports, there is a standard for obstruction height limits.
- Installation guidelines for navigation aids.
- The boundary between the flight path and the maximum altitude is defined by a set of standards.

- Natural impediments and people in the vicinity of the airport are at different heights.
- Noise and greenhouse gas emission control and management standards.

Wildlife in the area of airports should be organized and managed according to certain guidelines. Wildlife regulations and management in the vicinity of airports are governed by these standards.

The International Civil Aviation Organization (ICAO) Airport Planning Manual (ICAO 1987) explains the whole development of master planning as it takes place in five steps as shown in Table 1 and includes the correlation between the number of passengers at the airport and the acreage necessary at the airport for easy management.

At the end of a study, Amri & Pagarsukma. [5]. It was discovered that one of the most crucial factors for the project's success is the establishment of an airport. The dangers that come with airport building, as well as how to deal with them, must be addressed. Risk management comprises making a decision that aids in the attainment of one of the project's goals, and it's an important tool in deciding whether to build an airport and where to build it. According to the conclusions of the research, Mishra et al. [6],The hazards that come with the construction of airports must be addressed, as well as how to cope with them. Risk management entails making a decision that aids in the achievement of one of the construction's goals, and it's a vital tool in making decisions about building an airport and selecting the ideal location to develop it. Based on the study's findings Younes et al. [7]. The type of airport to be built is an important consideration in the planning process. Commercial Service, Primary, Cargo Service, Reliever, and General Aviation Airports were classed by the Federal Aviation Administration as Commercial Service, Primary, Cargo Service, Reliever, and General Aviation Airports, as indicated in Figure (1). Based on existing activity levels, The Federal Aviation Administration (FAA) created five new categories for airports offering general aviation (including non-primary commercial service, relievers, and general aviation). The five new airport categories.
Based on his study Mishra et al. [6], and Baghdadi & Kishk. [8]. There's a lot of information about the difficulties that come with establishing an airport. Depending on the type of airport, there are a variety of obstacles to overcome, including:

- Security
- Economic Returns from the Sectors
- A lot of Activities and Functions Involved
- Tied Time Schedule Requirement
- Special Systems and Specification
- ongoing or expected expansions
- the religious significance of the country
- variance of stakeholders
- Studies needed to choose an airport site

Conclude Ray et al. [9], and Al-Khashman & Shawabkeh. [10]. One of the problems in establishing an airport in a given place is the need to do some investigations. It was discovered that conducting some studies on the locations that will be picked as a site for the construction of an airport is preferred.

1. Study of the soil
2. Study of the climate
3. Study of the wind
4. Transportation system
5. Sources of water and electricity

During studies Sze-Wei Chang. [11], and Suyono et al. [12], A GIS program was inferred to have contributed to the achievement and development of these standards, as well as updated ways of planning for the creation of airports and how to cope with their dangers.

Table 1. Summary of the ICAO airport planning manual

STEP	DESCRIPTION
1	Inventory of existing conditions
2	Forecast future demand
3	Facility requirements (infrastructure and systems)
4	Analyze different alternatives according to the requirements
5	Select the most appropriate alternative followed by a detailed plan

2. OBJECTIVES AND APPROACH METHOD

1. Presentation of the international standards stipulated by the International Civil Aviation Organization (ICAO), which must be taken into consideration when constructing airports.
2. Correct many of the misconceptions agreed upon by non-specialists about aviation the cities.
3. Follow international standards to choose the best place to establish an airport in the delta region

The study relied on the descriptive-analytical

method, through which some attempts were analyzed and evaluated. The already existing ones to get to the best picture to build new airports, avoiding the above mistakes. In the cartographic method, it was used in drawing, classifying, and analyzing maps all through Geographical information systems programs such as GIS Arc and Base Database building A geography of Egyptian airports, and thus the production of automatically derived maps. In addition to programs, and finally, remote sensing's such as Map Global and Google Earth.

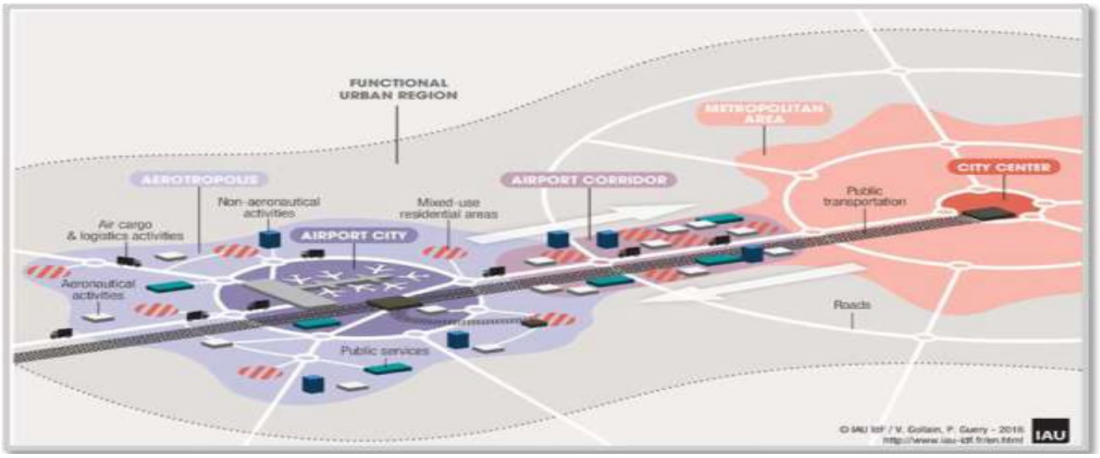


Fig. 1. Airport-centered urban development special forms. Source: Institute d's management Et' Urbanism)

3. Study Area Location

The study area is the delta region of Egypt. Where the criteria will be studied which established by the ICAO relating to terrain and human and environmental barriers and then applied to the Delta region, and then applying those criteria with GIS a program to choose the best places to establish an airport in this area.

4. Airports Standards

4.1. ICAO Standards:

By publishing a significant number of documents and appendices, the International Civil Aviation Organization (ICAO) has sought Specifications for designing civil aviation, including Establishing, operating, and maintaining airports and their environment.

4.1.1. Terrain factors and human barriers are used to set standards.

Topography and human barriers are major factors in determining where airports are located and thus activating them.

A. Surfaces are limited by the height of obstacles.

When the obstruction height boundary surfaces around the airfield are displayed, Natural impediments have an impact on airports, which are not just related to the ground spaces in front of the runway. In a radius of more than 15 kilometers around the airports.

B. The runway:

The runway length and width will be selected based on the types of aircraft that will be receiving the airport reference code. As a result of the terrain's height along the runway, the runway's length must be expanded by 9%. Although the runway must be oriented every 311 meters above sea level. Except that its axis can be changed to avoid natural and human barriers or environmentally sensitive locations, it must follow the direction of the wind.

C. Locations of the navigational aids:

Like a lighthouse, navigational aids are one of the most significant means of securing air traffic. They emit signals that are received and guided by aircraft. Agustini et al. [13].

i. Saline Aid from Very high frequency Omni-directional range (VOR):

It is desirable to put the (Range Omnidirectional VHF) VOR in the highest positions. To gain the best coverage with a direct line of sight, the earth is in a circumference at the center of a circle free of topography and human impediments, with a radius of 611 AD, and it is recommended that the auxiliary installation be positioned there. The navigator is as far away from power lines and fences as possible. If it is put in difficult terrain and near an easily accessible location, it will be more effective. If it is built in a rough terrain area near an

easily accessible mountain summit in the center of an obstacle-free circle, it will be more effective.

ii. The instrument landing system (ILS):

If the Navigational Auxiliary System (ILS) is built in a rough terrain area near an easily accessible mountain summit in the center of an obstacle-free circle, it will be more effective.

iii. A non-directional (radio) beacon (NDB) Navigation Assistant:

The ICAO suggested that the auxiliary be removed from operation as soon as feasible by the end of 2016 (ICAO, NDB (beacon directional-Non) It's Hot), MIDANPIRG Meeting, Cairo, Egypt, Model with VOR Navigational Assistant that does the same and more). Kuzmenko et al. [14].

D. SECURING FLIGHT PATHS:

The impact of terrain and human barriers extends to the phases of approaching aircraft to land and the phases of landing take off for departure, and automated landing process designers must follow the instructions obstacles) the stages of the landing procedure. Bird path protection areas (and adding vertical distance) are estimated to be 1111 feet high. 264 feet for the Approach Intermediate stage, 472 feet for the Approach Initial and Holding stages, and 472 feet for the Approach Intermediate stage. Last-Ditch Attempt Following on from the preceding presentation of ICAO standards related to terrain characteristics, ICAO It turns out that the organization has developed requirements and solutions for all obstacles (natural and human) that may be encountered during the selection of locations and operation of airports, and the following is a presentation of the reality of some airports, as well as a statement of the impact of terrain characteristics on airport operation. Fellah & Guiatni. [15]. In the case of establishing an airport, the Egyptian Civil Aviation Authority is committed to the international civil aviation Organization ICAO, which is one of the most important international institutions concerned with the process of aviation and its development, and thus the specifications of these two organizations' airports were used. The implementation of ICAO standards to St. Catherine and Borg Elgin is shown in the table below.

From the dining table due to the impossibility to install navigation systems that serve the airport, the influence of the high terrain around St. Catherine Airport. Due to the presence of the two restricted areas, Burg Al Arab Airport's freedom of navigation has been obstructed at P18/HE and P19/HE.

4.1.2. STANDARDS BASED ON ENVIRONMENTAL CHARACTERISTICS

A. NOISE AND GREENHOUSE GAS EMISSIONS

The International Civil Aviation Organization (ICAO) has published noise level standards to assist countries in determining what is appropriate for their environmental conditions and laws. Consider the following scenario:

Countries may impose suitable restrictions. Take into mind the populated and peaceful places, as well as the school locations. Hospitals, tourist and recreational destinations, and ecologically or historically significant locations are all examples. Coastal and private places.

- For operational consequences like noise, air quality, fuel consumption, and greenhouse gas emissions, the International Civil Aviation Organization (ICAO) has specified a variety of environmental criteria and assessment techniques.
- The International Civil Aviation Organization (ICAO) has urged countries to develop strategies to monitor and mitigate air and noise pollution.

In the neighborhood of airports, these plans include a statistical number of people affected by pollution, as well as the quality of air and any other factors Any restrictions on land use and the detection of any negative environmental indicators within a certain range

- The International Civil Aviation Organization (ICAO) was interested in investigating countries to activate the role of Plan Masters.

Avoid the construction of residential complexes, schools, and hospitals to make the best use of the land.

Limit the airport noise field and install environmental sensors near existing airports to investigate the impact of airport noise. Schreckenberg et al. [17].

The magnitude of its impact on the ecosystem, as well as an assessment of the viability of re-purposing the land Noise, was investigated at Borg El Arab Airport to assess and identify the airport's damaged regions, and measurements were taken. There were around 44 sites in the project area where there was noise. Using the noise integrated model, anticipated values for the years 2015, 2021, 2025, and 2030 were retrieved, according to. 2014. Furthermore, in 2014, the projected noise level in nearby communities around the airport is within noise regulations. By 2024, the noise level from nearby agricultural areas may increase to a limited

range of 61 dB, which is an appropriate level that does not annoy people in charge of agricultural activities. (Lawton & Fujiwara. [18], Azzam & Basha. [19], and [20] .)

- Greenhouse Gas Emissions: During peak hours,

An assessment of air quality and pollution emissions from various sources was undertaken at the airport, data was gathered and a database was created, and pollution levels were assessed.

Air including carbon monoxide (CO) and carbon dioxide (CO2), as well as Sulphur dioxide (SO2) and nitrogen (NO2), is created by aircraft and ground equipment.

These figures were compared and examined. per national and international regulations, the entire amount of pollution emitted by the airport terminal building was discovered to be little.

There will be no negative health impacts, and concentrations will be much below the allowed level in Environmental Laws Nos. 4 and 7 as well as the World Health Organization's principles and guidelines Expected dispersion values for the aforementioned gases at Borg El Arab Airport in 2015, 2020, 2030, and 2025.

When this criterion was used for Burg al Arab Airport, it was discovered that it is environmentally friendly, hence the airport will generate the necessary electricity using solar plants. There are no negative effects on the animals surrounding the airport, in addition to building a transfer station and processing solid waste at the source for recycling. There will be no adverse consequences on threatened or endangered species as a result of the project. Sarbassov et al. [21].

B. BIRDS/WILDLIFE:

In terms of wildlife, pay attention to endemic and migratory bird assemblages and migration routes.

The ICAO has included it under the heading "reduction risk strike wildlife," provided that national procedures are established to record the attack of elements of wildlife on aircraft, collect this data through authority-specific forms, analyses it, and send it to ICAO as reports to be stored in a special database, the ICAO Bird Strike Information System (IBIS) database. Dolbeer, [22]. Hesitant flocks of birds near Tuba Airport pose a threat since they fly at the same altitude. At 3,000 feet above the surface, the final approach to landing and the vital initial stage of takeoff are underway.

The airport has reached a point where it is impossible to navigate the planes around the swarms.

When these environmental requirements were applied, it was discovered that Burg Al Arab Airport serves as an example of an environmentally friendly airport, and Tuba Airport serves as an example of a wildlife-friendly airport. Usman et al. [23].

Table 2. In the following table, the application of ICAO standards to St. Catherine and Borg El Arab airports will be presented(Sayad et al., 2021)

Airport	Obstacle height limits surfaces	Runway	Saline Aid Positions	Securing flight paths
Saint Catherine Airport	34° J at coordinates 22 ° 41'19'A, the height of its surface level, the airport is not in the center of a harsh hilly environment. East Aerodrome 12265 m above normal elevation Where the topography pierced many surfaces, limiting the heights of the barriers, while only one obstacle, with a height of about 1366 m, affected the surface of the northern approach to the runway.	The runway at St. Catherine Airport is approximately 2,115 meters long and 36 meters wide, and it only handles Class A and B aircraft, therefore the dimensions of the runway match the class of aircraft it gets according to the regulations.	A suitable choice of location for the navigation aid installation leads to the spread of its signal in the form of a circle order, which was not achieved at St. Catherine Airport, where the surrounding high mountain peaks impeded the navigator signal's propagation	Circling was the name of the automated landing process employed before 1919. Because of the terrain and the lack of modern navigational aids, the planes had to approach the airport and follow them. At an elevation of 11,000 feet (above sea level)

Airport	Obstacle height limits surfaces	Runway	Saline Aid Positions	Securing flight paths
Borg El Arab Airport	The airport is located at 15 55 31 East 27 41 45 North, and the airport area is characterized by a height of 199 meters above the average surface, a plain area almost devoid of terrain, and a height of its surface that touches the sea. As a result, there are no penetrations to the surfaces of the barriers' height limits.	The runway's length and width meet ICAO requirements for receiving all aircraft of classes B, A, D, and C.	Nothing penetrates the Propagation surfaces of navigation aid signals from physical or human obstacles at Borg El Arab Airport, which features an ILS Precision Landing System and a radar station.	Due to the damage, it is not possible to equip the airport with navigational aids such as VOR or ILS. It was determined in the region, and following the ICAO's suggestion, to replace the existing circle landing procedure. The NDB is supported by satellites.

4.2. STANDARDS FOR AIRPORT EMERGENCY PLANNING

The United Nations' International Civil Aviation Organization (ICAO) is a specialized agency. The International Civil Aviation Organization (ICAO) creates international air transport rules and regulations and serves as a forum for cooperation among its 190 member states in all areas of civil aviation. The Convention on ICAO, Volume I, and Airport Service Manual Airport Emergency Plan, Volume I, are the primary sources for airport emergency planning. Airport event planning is defined as the process of preparing an airport to deal with an emergency that occurs at the airport or in its surroundings. The goal of airport emergency preparedness is to minimize the effects of a disaster, especially in terms of saving lives and keeping planes flying. The protocols for coordinating the responses of various airports are outlined in the Airport Emergency Planes emergencies, sabotage, including bomb threats, unlawfully seized aircraft, dangerous products incidents, building fires, natural disasters, and public health situations are examples of emergencies. Traffic control units, rescue and firefighting services, and airport security are examples of agencies in the airport Baučić et al. [24].

4.3. STANDARD MATERIALS FOR RIGID

Building a Pavement

- The surface courses of Portland cement concrete must meet Item P-501.
- Jointed plain concrete pavement is the standard material (JPCP).
  - It is possible to employ embedded steel-concrete or continuous reinforced concrete pavement (CRCP).
  - The thickness requirement is the same as that of JPCP.
- Item P-209 is a standard unsterilized subbase.
- A stabilized subbase (needed for aircraft weighing more than 100,000 lbs. / 45,360 kg) can correspond to the following specifications:
  - Item P-304 (cement-treated base) – Item P-306 (cement-treated base) (concrete base)
  - P-403 item (plant mix bituminous, base & leveling course).

5. AIRPORT PLANNING AND DESIGN

Because of the enormous growth in the number of passengers over the years, airport planning and design have become even more important. A lot of research on airport problems and design is available. The process of choosing an airport location takes a long time since trade-offs between a variety of criteria, including environmental implications, must be evaluated. According to the literature, the key factors to consider in airport planning are accessibility, the cost of right-of-way acquisition, the complex nature of airport planning and management, the need for a methodology to support the decision-making process, and the need for a methodology to support

the decision-making process. Savrasovs et al. [25]. The figure shows the number of passengers in millions during the period from 2014 to 2019.

From that statistic, the average number of passengers from2014 to2019 was 31millions, it was found that the number of passengers traveling through Egyptian airports is constantly increasing with the increase in the population and the increase in the resemblance to travelers through Egyptian territory and the presence of the large area new airports must be established.

5.1. CHALLENGES FACING AIRPORT CONSTRUCTION PROJECTS

The obstacles experienced by Saudi Arabia and many other nations that utilize the same code to build international airports are compared in the table below. Mishra et al. [6].

- Security
- Economic Returns from the Sectors
- A lot of Activities and Functions Involved
- Tied Time Schedule Requirement
- Special Systems and Specification
- ongoing or expected expansions
- the religious significance of the country
- variance of stakeholders
- Studies needed to choose an airport site

5.2. STUDIES AND CRITERIA NEEDED TO CHOOSE AN AIRPORT SITE

1. Study of the soil

   The soil is investigated to assess its ability to handle traffic loads on the flexible pavement, as well as the pavement thickness, access to the soil, and the necessary foundation layer.

2. The climate is investigated to determine the magnitude of changes and fluctuations that occur, as well as the existence of fog or other situations that obstruct eyesight.

3. Investigation of the soil

It analyses the wind and determines its direction, as well as the landing and takeoff directions and the number of lanes.

4. transportation system

   With a decent and great transportation check, the airport must be connected to all adjacent locations.

5. Sources of water and electricity

   to investigate the water and electrical supply at the airport Before proposing an airport site, one must first identify and study these characteristics

Urban planning around airports and sustainable development is one of the most important of these studies. Although general urban planning around airports may not be able to eliminate all negative effects caused by airport activities, it can assist in finding a balance and determining the means to implement specific urban initiatives. Depending on the geographical location, economic growth, and business orientation of airport operators, airport-centered urban development takes on several spatial forms. Airport City, Aero Airport Corridor, and Airport Region are the three basic models or concepts for any airport-related growth. To achieve this linkage, integrate the development of airport area international/regional strategic planning. Xiong et al. [26]. Many people and corporations now use airplanes as their primary source of transportation. Through the flow of people and commodities, the promotion of tourism and trade, the stimulation of business development, and the possibility for a wide variety of jobs, airports bring considerable employment and economic benefits to communities. Abdullahi. [27].

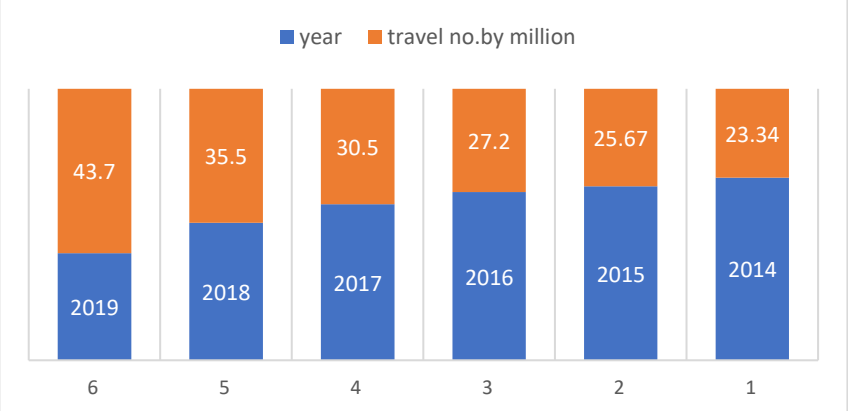


Fig. 2. the number of passengers in millions during six-year

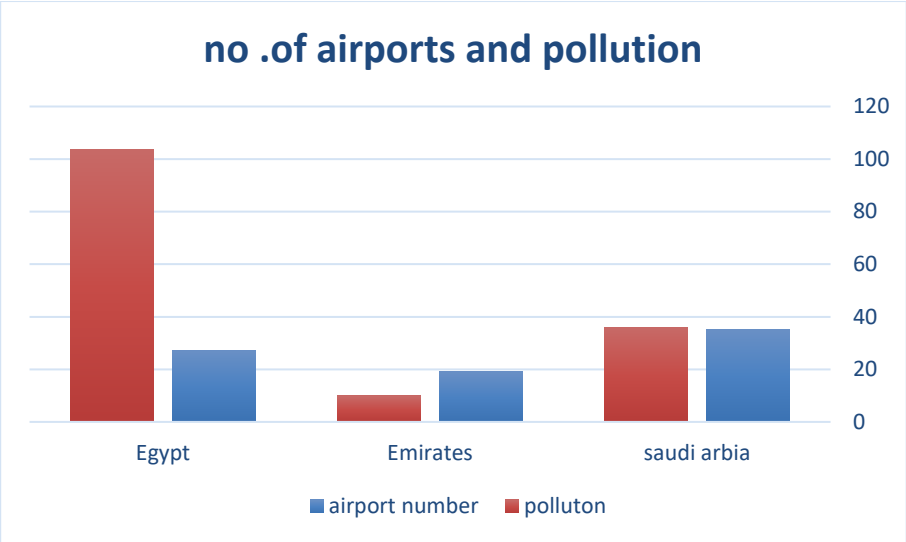


Fig. 3. No. of airports and pollution

Fig. 4. Challenges facing airport construction projects

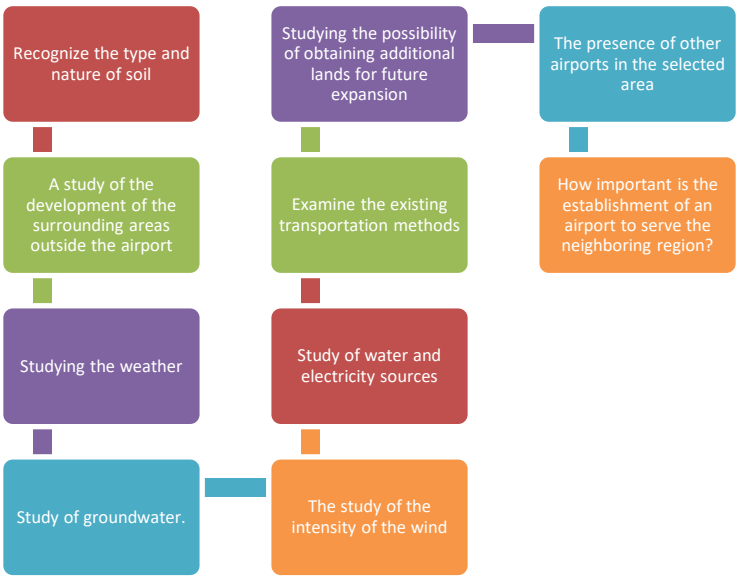


Fig. 5. Necessary studies for choosing an airport site

Table 3. criteria According the International Civil Aviation Organization's international standards (ICAO)

Main criteria	Sub-criteria
Operational conditions	Proximity to cities centers
	Distance from Lines of oil and gas
	Distance from Refineries
	Distance from wetland and wildlife
	Distance from Oil wells and fields
	Land use
Environment considerations	Noise and pollution
	Land cover
Climatic factors	Atmospheric
	Wind speed (m/s)
	Relative humidity %
	Clearness index
	Precipitation
	Temperature (◦C)
Topographical	Slopes (%)
	Elevation (m)
	Soil propertied
	Distance from faults
	Distance from water stream
Infrastructure	Proximity to major
	Proximity to water resources
	Proximity to power lines
	proximity to communications stations

5.3. LAND USE PLANNING FOR SUSTAINABLE DEVELOPMENT

The notion of sustainable development in terms of planning land uses around airports is a broad concept of planning that considers the local community's economic, social, commercial, and environmental planning. It's also not confined to urban planning. Noise compatibility, safety compatibility, airspace protection, and overflight are examples of compatibility concerns that affect land use planning around airports. Safety zones: These are the ones that are used to assess the safety compatibility of planned land uses in the vicinity of each airport. Chourasia et al. [28]. The Airport Land Use Compatibility Plan (ALUCP) is a guidance document for the regulation of land uses around civil airports. It is prepared for the areas surrounding airports and includes a division of regions and the types of uses that do not conflict with the airport or affect its operational efficiency. It must be approved by the appropriate authorities and updated regularly. AIA (Airport Influence Area): It is an essential component of ALUCP. AIA refers to the area in which airport-related noise, overflight, safety, and/or airspace present or will exist in the future. Alba & Manana. [29].

5.4. THE IMPACT OF AIRPORTS ON THEIR SURROUNDINGS

The presence of international airports has a significant impact on the surrounding area. Economically and in terms of urbanization, the area is changing. Within their metropolitan areas, these airports frequently develop into full-fledged commercial and urban hubs. Airport regions are those whose fate is tied to the presence of an international airport, and the long-term growth of these airports faces four major obstacles. As a result, all areas surrounding airports have many interactions with their airports. Some of these encounters are beneficial: For example, airport activity provides economic advantages to the surrounding areas in the form of jobs, local taxes, and, most notably, a transportation network.

6. AIRPORTS RISK MANAGEMENT

6.1. RISK MANAGEMENT

Risk management is the art and science of addressing risks posed by unplanned developments (uncertainties), which may necessitate departures from the intended method, jeopardizing the project's goals. It entails methodically identifying,

assessing, planning, and controlling risk before beginning the building of an airport. It is vital to address the risks associated with the formation of airports and know how to deal with them before beginning the construction of an airport. Risk management revolves around making a decision that aids in the achievement of one of the construction's objectives, and it's a vital tool in making decisions about building an airport and selecting the ideal location to develop it. Risk management provides a lot of advantages when it comes to deciding where to go. Invest time and money, invest time and money by the owner's or financing agency's needs Fig. 7 Mishra et al. [6].

6.1.1. IDENTIFICATION OF THE AIRPORT AIRSIDE RISKS

Risk is defined differently in different studies, but the expected value of combining likelihood and severity is consistently emphasized. Risk detection aids in the prevention of airport dangers during operations. This study defines risk as an expected value integrating likelihood, severity, and detectability, and brings the detectable notion to airport risk management. There are two types of airport systems: airside and landside. The apron-gate area, taxiway system, holding pad, runway, and terminal airspace are all part of the airside. The terminal buildings and the airport ground access system are located on the landside. Incidents on the ground can generate confusion at the airport or in the surrounding area, but accidents in the air can result in not only aircraft damage and staff injury, but also flight schedule delays and indirect disorder. Feng & Chung. [31].

6.1.1. RISK-BASED DECISION-MAKING PRINCIPLES

The assessment of hazards along a quantifiable scale—typically stated quantitatively like a credit report score—is a key feature of risk-based decision-making (which is, itself, a risk-based decision-making tool). After risk levels are determined, resources are allocated in proportion to the risk level, such as law enforcement action, investigation, or further passenger screening. Poole & Passantino. [32].

6.2. A CONCEPTUAL APPROACH FOR ASSESSING AIRPORT RISK IN MEDITERRANEAN REGIONS

Risk, and risk assessment, are increasingly widely used in a variety of disciplines, ranging from technical applications to project management, finance, and civil protection. The most widely recognized and broadest definition of risk in the scientific literature is that provided by the International Organization for Standardization (ISO) Norm 31,000, which defines risk as "the potential occurrence of events and consequences (impacts) or a combination of these adaptive capacity, on the other hand, refers to one's ability to adapt to or cope with the effects of climate change. In general, indications that describe a specific occurrence and its progression are widely used to characterize the components of risk. These indicators could have a direct or indirect association with the phenomenon being measured. In reality, in the absence of direct measurements, the indicator serves as a proxy for the Phenom eon. Marignani et al. [33].Climate indices define the climate and how it changes over time as a result of anthropogenic sources, whereas effects and vulnerability indicators can be used to measure the implications of climate change as well as the capacity of mental and socio-economic systems to cope with it. The risk assessment framework was created based on these concepts. To begin, we specified the climatic dangers that affect airports in Mediterranean regions, which are classified into three categories: severe temperatures, extreme rainfall, and sea-level rise. For each danger. De Vivo et al. [34].

6.2.1. RISK MEASUREMENT METHODOLOGY

This study uses fuzzy logic and a risk assessment matrix, which are presented in this section, to detect measure, and priorities the risk categories. In this order: "system," "terminal airspace," "holding pad," and "apron-gate area." Fig. 8 shows that operations on a taxi way (TXI) are the most dangerous step of the flight operation method, accounting for 37 percent of total risk, followed by procedures on landing. These two flight operation techniques account for 71% of the overall risk. Other flight operation procedures with the highest risk are takeoff, standing, approach, and pushback/towing. We decide that "RI-A" is the biggest single risk item, "runway" is the riskiest region, and "flight operations procedures" is the riskiest area based on the above analysis by risk category, occurrence area, and flight operations procedures The most hazardous are the taxi and landing. The overall conclusion of the investigation is that the highest risk is "runway incursion–animal on the runway during the landing procedure." Feng & Chung. [31].

7. STATISTICS OF THE NUMBER AND TYPES OF EGYPT'S AIRPORTS AND THE NUMBER OF PASSENGERS THROUGH THEM DURING SIX YEARS

According to international organizations responsible for airports, the following Tables from 4 to 7 detail statistics on the number and types of airports in Egypt.

In the event of the establishment of an airport, the Egyptian Civil Aviation Authority is committed to the international civil aviation organizations ICAO and IATA, which are two of the most important international institutions concerned with the process of aviation and its development, and thus the specifications of these two organizations' airports were used.

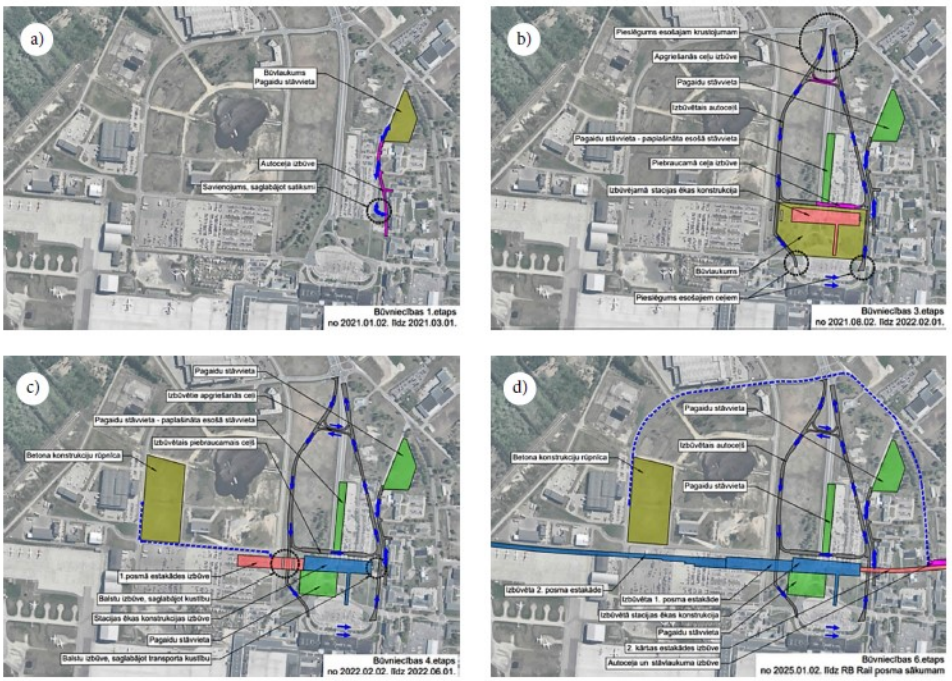


Fig. 6. Stages of airport development: a – 1st stage of development; b – 3rd stage of development; c – 4th stage of development; d – 6th stage of development Riga international airport case study Savrasovs et al. [25].

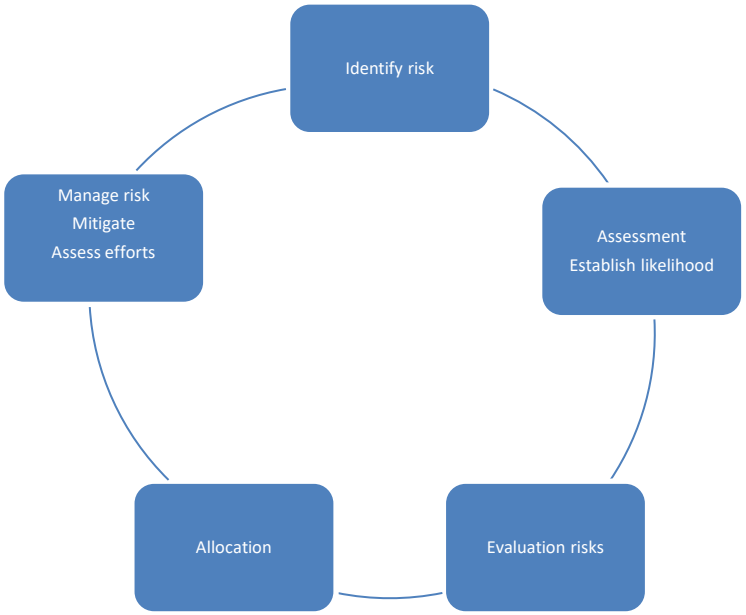


Fig. 7. Risk management process.

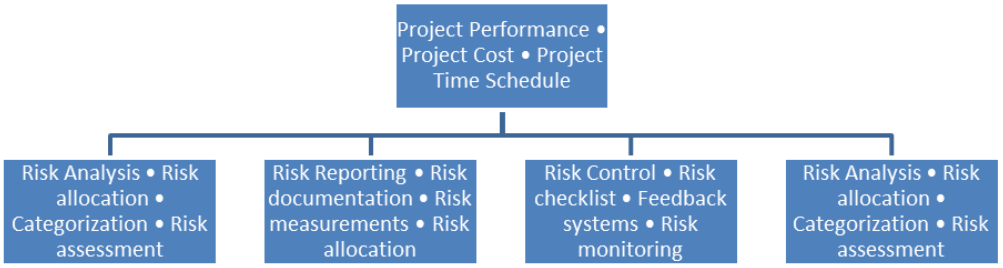


Fig. 8. Conceptual Framework. (Risk Management Practices and Project Performance at Kenya Airports for example

Table 4. Statistics of the number of Egypt's international airports

Airport location	the International Civil Aviation Organization ICAO	The International Air Transport Association (IATA)	Airport name
Cairo	HE	CAI	Cairo International Airport
Giza	NEW	SPX	Sphinx International Airport
Alexandria	HEX	ALY	Alexandria International Airport
Alexandria / Burg Al Arab	HEBA	HE	Borg el Arab International Airport
Maras Matrious	HEMM	MUCH	Maras Mature International Airport
Sharma El-Shaikh	HESH	SSH	Sharma El Sheikh International Airport
Tuba	HELP	TCP	Tuba International Airport
Hardhat	HEGN	HRG	Hardhat International Airport
About	HEAT	ATZ	Asyut International Airport
Luxor	HELIX	LXR	Luxor International Airport
Aswan	HESS	AS	Aswan International Airport

Table 5. Statistics of the number of Egypt's domestic airports

Airport location	ICAO	IATA	Airport name
Arish	HEAR	AAC	Arish International Airport
Saint Catherine	HESS	SKI	Catherine International Airport
East Ow anta	HOW	GSQ	East Ow anta Airport
Abu Simbel	HELL	ABS	Abu Simbel Airport
Suhag		HMB	Suhag International Airport
Port Said	HEPS	PSD	Port Said Airport
El-Tor	HER	ELT	El-Tor Airport
Dahlia Oasis	HECK	DAK	Dahlia Oasis Airport
Charge	HIKING	URL	Charge Airport
Jorah	HER	EDGE	Jorah Airport
Giza	HOME		Imbibe Airport
the new Valley	HENV	UVL	New Valley Airport

Rags Negev	RAF	Negev Airport
Rags Garibay		Rags Garbed Airport
Rags Shirk		Rags shirk Airport
Abu Rudi's	AUE	Abu Reid's Airport
Valley of the Melisa	AUE	Melisa Airport
Administrative Capital		Administrative Capital Airport

Table 6. Statistics of the number of Egypt's Training airports

Airport location	**ICAO**	**IATA**	**Airport name**
Sixth of October	**HE**		**6th of October Airport**

Table 7. Statistics of the number of Egypt's Airports(BOT)

Airport location	**ICAO**	**IATA**	**Airport name**
Maras Alma	**HEMA**	**RMF**	**Maras Alma International Airport**
Maras Matrious			**El Alamein International Airport**

8. DATA COLLECTIONS AND PROGRAMS

8.1. DATA COLLECTIONS

The research area includes the delta region, and this drawing includes the research region, which includes five governorates as attest areas, namely: Kafr Al-Sheikh, DAKHELIA, MONOFIA, DAMITA, and GARIBAY. The following Figs. 9 to 11 describe the geographical area of each governorate and its population.

The study area is represented by 5 governorates. It was found that the largest area is a governorate Kafr Al-Sheikh and the least area is DAMITA It is the most populous DAKHELIA and the least populous is DAMITA and the average of population is 4444642 million and the ratio of the population of the region to the population of Egypt is 42.7%

8.2. GIS PROGRAMMING

A geographic information system (GIS) is a computer-based system for collecting, maintaining, storing, analyzing, producing, and disseminating spatial data and information.

These are systems that gather, enter, process, analyze, display, and produce spatial and descriptive information for specific aims, such as agriculture, urban planning, and housing expansion, as well as reading the infrastructure of any city by constructing so-called layers (LAYERS). This system allows us to enter geographic (maps, aerial photographs, satellite visuals) and descriptive (names, tables) data, process it (correct errors), store, retrieve, query, analyze spatial and statistical data, and display it on a computer screen or paper in the form of maps, reports, and graphs, or via the website. Abujayyab & Karaş. [35]. Geographical Information Systems (GIS) and remote sensing are effective techniques for obtaining accurate results. GIS is a software environment that allows you to collect, store, present, and analyze digital data for environmental management. Remote sensing imaging plays a critical role in both quantitative and qualitative research, minimizing the need for human data manipulation and transformation to combine the various datasets required for a particular analysis. When it comes to open geospatial data, Rowland et al. [36].

8.2.1. AIRPORT GEOGRAPHIC INFORMATION SYSTEM (AGIS)

The rapid development of web technology has revolutionized traditional Google Earth, in particular, the online mapping application Web GIS, which leverages web technologies to generate online maps. Google Maps has embraced the graphics renderer Web GL in its new edition.

Airport operators are increasingly implementing Geographic Information Systems (GIS). Some of the applications can be divided into two categories:

i. In the Air

GIS is used for airspace planning and routing applications, integrated flight monitoring, and real-time flight tracking by commercial airlines and air traffic control authorities. These applications help to improve airspace efficiency and support a variety of security and public information activities, such as noise monitoring and real-time aero plane arrival data.

ii. On the Ground

Modern airports are among the most heavily used infrastructures, and they must work at a high level at all times of the year, sometimes in difficult conditions. To solve these issues, airport managers are turning to GIS technology to help them plan, operate, maintain, and secure their facilities by integrating spatial data and modeling capabilities. They can get unique information and analytical capability from GIS that they can't get from other information systems. Above all, a comprehensive GIS can help with a variety of airport missions. Anwer & Sc. [37]. Airports are among the most frequently utilized facilities on the planet. Control regulators use GIS for airspace planning and routing applications, as well as for facilities management applications, due to the delicate nature of flights, particularly takeoffs and landings. Hammodat et al. [38]. Fig. 12 indicate what is available. GIS delivers information and analytical capabilities that are not available in any other system.

8.2.2. USES GEOGRAPHICAL INFORMATION SYSTEMS

For a variety of fields, GIS can be excellent planning and decision-making tool. GIS is used in a variety of fields. For example, GIS is used in environmental and earth sciences, as well as various economic and census-related investigations. It assists various disciplines and businesses in incorporating geographic data into their work processes so that they may more easily plan, optimize, maintain, and verify other activities. Fig. 12 depicts instances of many types of GIS applications and uses**.** Ağaçsapan & Çabuk. [39].

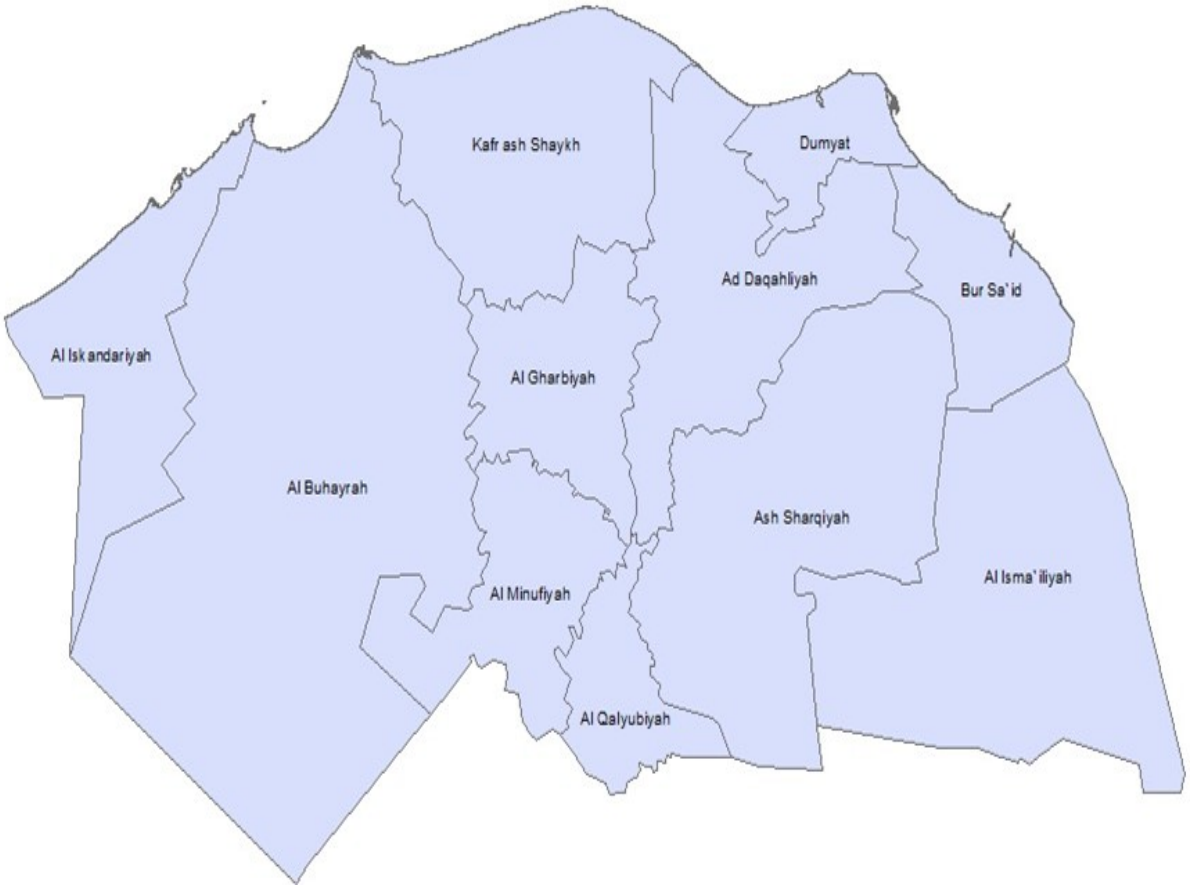


Fig. 9. Test area region

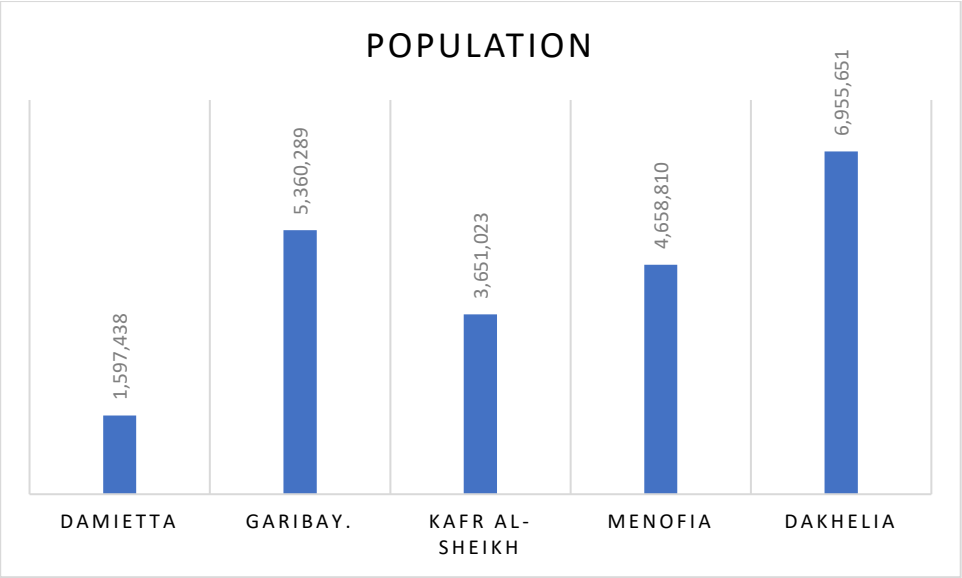


Fig. 10.Area and population of the Delta region

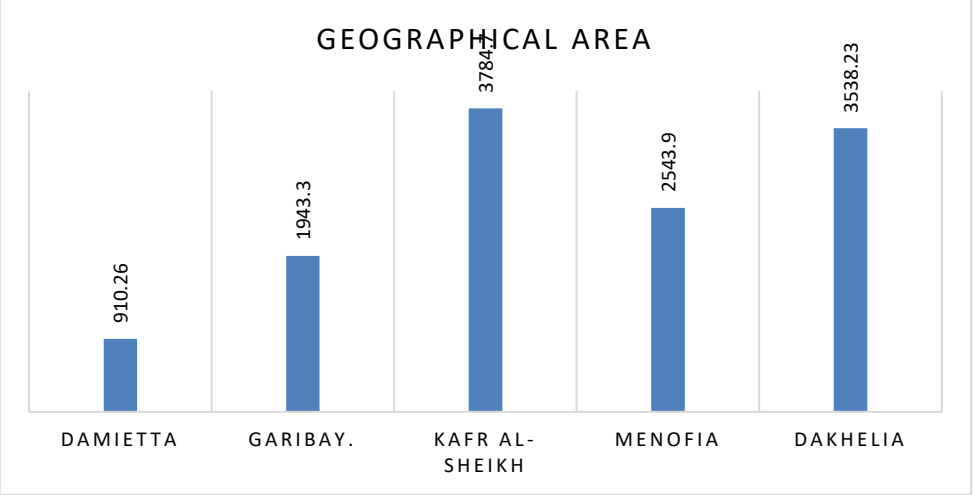


Fig. 11. Area and Geographical area of the Delta region

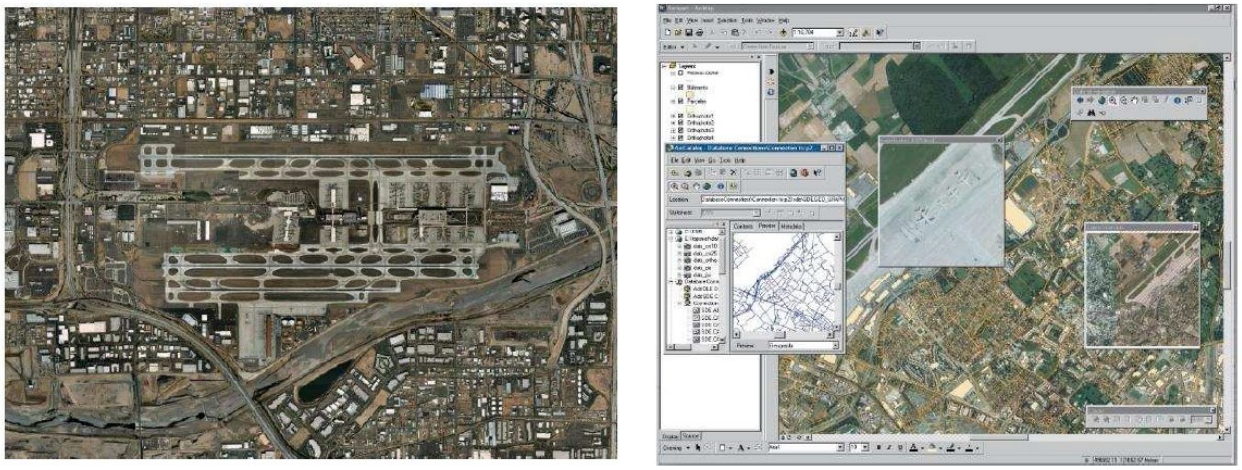


Fig. 12. The imagery of Phoenix Sky Harbor Airport, AZ

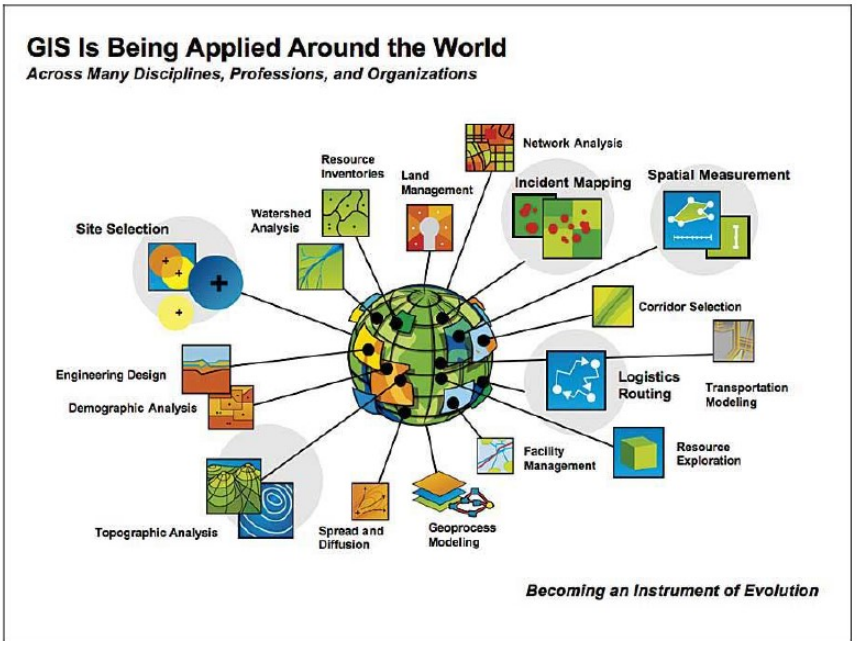


Fig. 13. Examples of different kinds of GIS applications and uses

8.2.3. TECHNIQUES FOR COMPLETING THE PROJECT VIA THE ARC GIS PROGRAM

A sequence of steps will be followed to complete this project, as stated below. A sequence of fundamental steps can be used to summarize the completed workflow. These include data collecting, the development of geo-database tools, and the establishment of a geo-database. Delineation of three coverage areas. The first phase in the endeavor was to gather data. - Flight solution learning data was used as a file for the majority of the flight data. A scenario for a prototype application's test case. This data set contains a wide range of flight information, including airspace maps and runway layouts. Robinson. [40]. The regional orientation of cloud GIS can be used in a wide range of geographic research domains, including terrain mapping and plans, weather analysis, biological species spatial distribution, and socio-ecological research. The information needed for GIS study can be gathered by literary, cartographic, and statistical methods, as well as direct observations made during local area studies, tours, and excursions. Kholoshyn et al. [41].

8.2.4. THE DEVELOPMENT OF THE AIRPORT PAVEMENT MANAGEMENT WEB GIS APPLICATION CONSISTED

Fig. 14 depicts the breakdown of two key periods into six stages. Phase one, data evaluation and geodatabase development, included the following stages: evaluation of current data, development of a GIS data model for airport pavements, and establishment of an airport pavement geodatabase The application development phase, which followed, consisted of the following stages: developing an online map for the Airport Pavement Management Web GIS application, and uploading the geodatabase to ArcGIS Online. For airport managers, the optimal management of pavement infrastructure planned for aircraft movement is a critical goal. Consideration of pavement as an asset with an infinite lifespan is a misconception that could endanger circulation. Di Graziano et al. [42].

All of these studies demonstrate the benefits of using GIS data sets to determine specific components and attributes of a city's or country's building stock. Some of them mention the difficulties of merging multiple GIS data sets, and others mention the difficulty of combining different GIS data types. Kleemann et al. [43].

The benefits and drawbacks of a variety of GIS programs are contrasted and described in the Table 8 below.

It is considered a powerful, easy-to-use, and interoperable GV GIS system used by thousands of users all over the world and is the most widely used globally, ArcGIS is a powerful single desktop GIS application, a feature-packed program developed with improvements and ideas drawn from its user community and is the most widely used in Egypt and the Middle East.

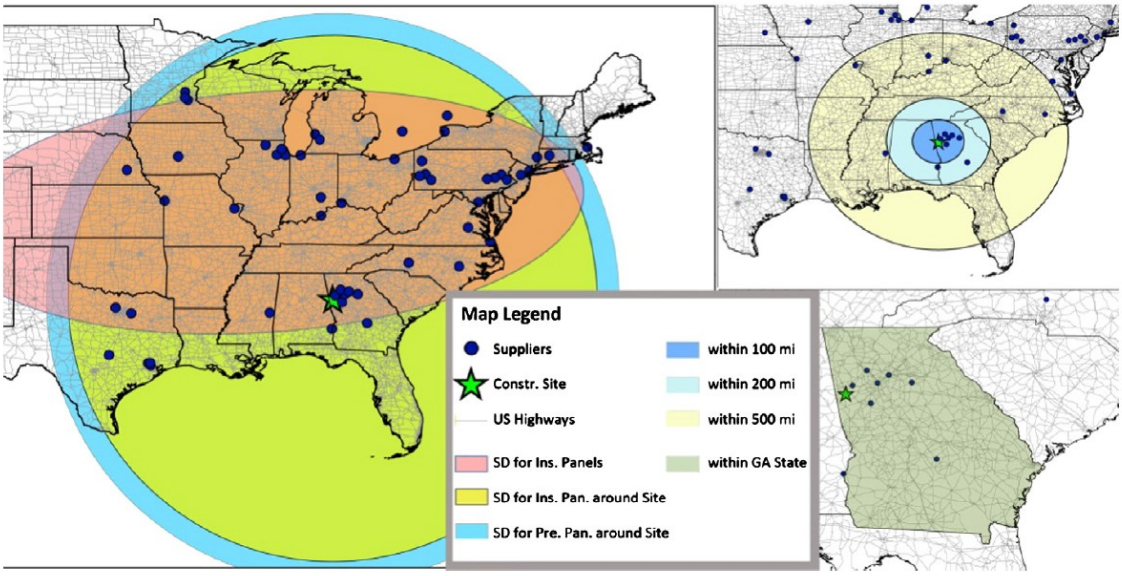
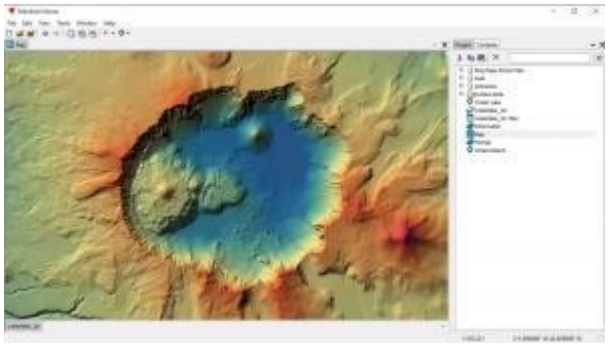
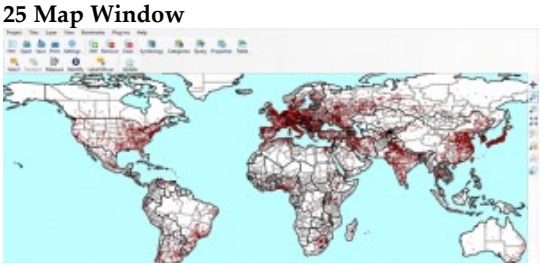


Fig. 14. GIS maps represent the availability of materials. (Irizarry et al. [44].)

Table 8. comparing GIS programs

Program	definition	pros	cons
G v SIG 	g v SIG is free and open source GIS software if you eat, sleep, and breathe GIS. You might be surprised by its features. It has a field app, 3D capabilities, and a desktop version, for example. However, it is lacking in documentation.	Mobile application for the field with a simple interface and well-documented documentation Extremely powerful CAD tools Open-source software with support and an intuitive interface	Support from a smaller community Zymology and archaic cartography NASA World Wind's 3D rendering is out of date, and metadata standards are lacking.
ArcGIS Desktop 	ArcGIS Desktop is a cutting-edge GIS application. It raises the standard by accomplishing what other GIS tools cannot. Its success is since it is.	The reprocessing framework that works Beautiful semiology possibilities for cartography A complete suite of editing and topological tools is available.	Framework for reprocessing that works For cartography, there are some lovely semiology options. There is a full set of editing and topological tools accessible.
9 Cad crop	The reprocessing framework that works There are some wonderful	Build Cad c ad SIS online maps with an intuitive ribbon interface for Desktop GIS	a lack of community support forum Miniature remote sensing devices

Program	definition	pros	cons
	semiology possibilities for cartography. A complete suite of editing and topological tools is available.	Data can be stored and served on the cloud. Web applications can be deployed via a server.	A CAD/GIS specialist but lacking in other aspects, a new product with little background information
Manifold GIS 	The Manifold System is a simple system to learn and adapt to. Its easy interface, programmability, and 64-bit processing are its features.	Processes and displays at the speed of light Parallel processing on the CPU and GPU User interface that is both stable and intuitive Natively 64-bit processing Product documentation and support are excellent.	Map design tools are limited to a few cartographical tools and a few specialist tools. Light engagement in the user community due to a lack of advanced web mapping Although it has a low price tag, it less cost
25 Map Window 	Map Window is a free and open-source application. While it fulfills roughly 90% of the needs of GIS users,	Map Window is a completely free and open-source program. While it meets around 90% of GIS users' demands, it is not without flaws.	Users and the community are lacking. Not as well-supported as others Other aspects of GIS and remote sensing are lacking.

9. . CONCLUSIONS

1. The International Civil Aviation Organization (ICAO) has developed standards and specifications for the construction of airports and required states to abide by them.
2. There is an important role of terrain characteristics and human barriers in determining the locations of airports. And therefore, its operation and the relationship do not depend only on the ground spaces in front of the runway and the extent to of It affects the take-off and landing movements but extends over distances of more than 15 km. As the ground level rises along the runway, the terrain also enters into the criteria of Choosing the locations of the navigation aids.
3. The effect of the high terrain around St. Catherine Airport due to the inability to install navigation devices that serves
4. The airport. The presence of the two restricted areas P18/HE and P19/HE impedes freedom of

navigation at Burg Al Arab Airport.

5. The International Civil Aviation Organization (ICAO) has taken great care of the surrounding environment.
6. Noise and greenhouse gases did not exceed the permissible limits at Borg El Arab Airport.
7. The conflict of the migration paths of birds with the navigation paths at Tuba Airport led to the taking of several Measures to protect wildlife and air navigation.
8. For aircraft heavier than required (100,000 lbs. / 45,360 kg) can conform to:
   – Item P-304 (cement-treated base)
   – Item P-306 (concrete base)
   – Item P-403 (plant mix bituminous, base & leveling course)
9. The goal of airport emergency planning is to reduce the effects of an emergency to save lives.
10. The decision is taken in the planning of airports based on the challenges facing the establishment of this project, Among the most important of these challenges are the studies needed by specialists such as (soil study, wind study, climate study, study of water and electricity sources, study of the road network around the airport site).
11. TAXI is the most dangerous stage, representing 37% of the total risks, followed by landing procedures, and together they represent 71% When conducting some studies on countries, it was found that China is the most exposed to risks, and Kuwait is the least exposed to risks during the construction of airports
12. The climatic risks that affect Mediterranean airports are represented in extreme temperatures, precipitation, and sea-level rise.
13. To complete a GIS project, basic steps include collecting data, creating a geographic database, developing tools to create it, and three delineations of the coverage area.
14. GV GIS is the most widely used globally, ArcGIS is a powerful single desktop GIS application that is the most widely used in Egypt and the Middle East.

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