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A resilience-based urban mobility strategy to climatic threats in smart Egyptian cities (case study: The New Administrative Capital, Egypt)

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ABSTRACT
Smart cities are designed to deal with a variety of urban issues. With the spread of the concept of smart cities on a large scale, planners began to include the concept of resilience as one of the most important factors in their planning, especially when communication and information technology was integrated to provide a huge database that accelerates and develops interaction in times of crisis, and while mobility is concerned with meeting needs, transportation (including vehicles, infrastructure and traffic rules) is the tool required to achieve tangible mobility. According to the literature review, there is a significant research gap as most studies focus on definitions, theory studies, and stochastic plans to respond to sudden crises, with little effort put into developing resilience indicators and measurement strategies. The research aims to access resilience in the urban mobility sector, and also to develop an indicator-based strategy for implementing and evaluating mobility resilience through smart solutions, while keeping in mind the expected climatic local threats Where the flash floods fall at the top of the list of risks affecting the local community. Working on the proposed strategy for the new administrative capital as an implementation area, since it is the most important new smart Egyptian city and its significance as a new smart capital.

Keywords: smart Egyptian Cities, Crisis Resilient, Resilience Strategies, Resilient Mobility Indicators, local threats, flash floods.

1. Introduction

The resilience of mobility is an important part of urban resilience. The "micro-geographies of everyday life". It is located at the crossroads of numerous metropolitan systems in order to develop and amass wealth, promote commerce, and sustain engineering and social infrastructures. Maintaining mobility resilience during man-made and natural disasters can be the difference between life and death, allowing city people to "stay resilient in the face of tragedy" and survive and recover quickly. This significant shift highlights the necessity of transportation authorities, operators, and developers considering global challenges in their local contexts. Maintaining a steady flow of people and goods in the face of threats would necessitate a thorough grasp of how these issues influence cities and regions.

The most common global risks, according to The 100 Resilient Cities (100RC), are natural stressors like earthquakes, flash floods, storms, hurricanes, and other natural disasters, there are also technological stressors like failure and error in complex technical network systems (Heeks & Ospina, 2013), finally human pressures like

terrorism, war, crime, and violent protests were incorporated into this model, as shown in "Fig. 1" This study's major objective will be on natural stressors (climatic threats).

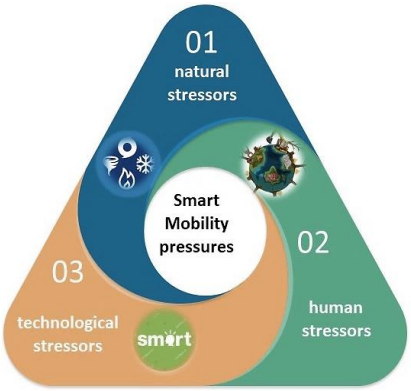


Figure 1: pressures on smart resilient mobility, source: the author

2. local climatic challenges for smart urban mobility

According to IPCC (Intergovernmental Panel on Climate Change) Egypt is one of the most vulnerable countries to climate change impacts, Country is affected by direct/indirect impacts of climate change (Kawasaki & Rhyner, 2018), "Fig. 1".

Each defined environmental threat or crisis in Egypt has a number of roots, along with serious effects and consequences for the urban environment. As an example, the study will focus on extreme weather events that have impacted Egypt's mobility sector:

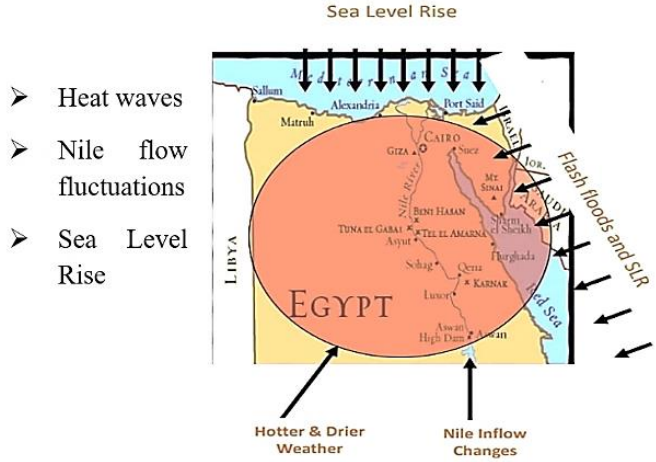


Figure 2: direct/indirect impacts of climate change on Egypt (IDSC, 2011)

2.1. flash Floods

Floods occur as a result of relatively short periods of heavy rain in the Red Sea and South Sinai, in addition to floods in another new city (5th settlement - New Cairo), which faced flooding in 2018. Many of these flash floods have caused damage on people and transport networks. This made it critical to conduct supplemental researches in order to discover appropriate risk mitigation techniques, particularly in the context of urban mobility, which has been completely crippled by the flash floods.

2.2 Dust and Sand Storms

In Egypt, they are common during the spring and late winter seasons. Dust storms can generate large amounts of particulate matter, which impairs vision, increases the risk of traffic accidents, and disrupts traffic.

Hence, there are many other natural disasters that directly and indirectly affect urban mobility locally, TABLE.١ The top 10 natural disasters with a local impact on the mobility sector were calculated until 2010.

Table 1
direct Egypt Disaster Statistics - human losses from disasters between 1980 and 2010 (Eiza, Cao, & Xu, 2020)

Top 10 Natural Disasters Reported

Affected People

Disaster	Date	Affected	(no. of people)
Flood	1994	160,660	
Earthquake*	1992	92,649	
Flood	2010	3,500	
Flood	1995	3,000	
Flood	2002	800	
Mass Movement Dry	2008	697	
Mass mov. dry	1993	300	
Flood	1996	260	
Earthquake*	2002	250	
Flood	1991	208	

Killed People

Disaster	Date	Killed	(no. of people)
Flood	1994	600	
Earthquake*	1992	552	
Mass Movement Dry	2008	98	
Mass mov. dry	1993	34	
Extreme temp.	1995	32	
Storm	2010	31	
Storm	1987	30	
Extreme temp.	1996	22	
Storm	1997	18	
Epidemic	2006	15	

However, based on the number of infections and deaths caused by the Covid-19 virus, it is clear that the situation in Egypt has changed, as it has around the world, and the injuries and deaths caused by the pandemic have risen to the top of the list of Egypt's most significant natural hazards affecting urban mobility, alongside floods and earthquakes and on that the outlook, ranking, and risks of global risks have shifted. The World Economic Forum 2021 Global Risk Perception Questionnaire is depicted in "Fig. 3".

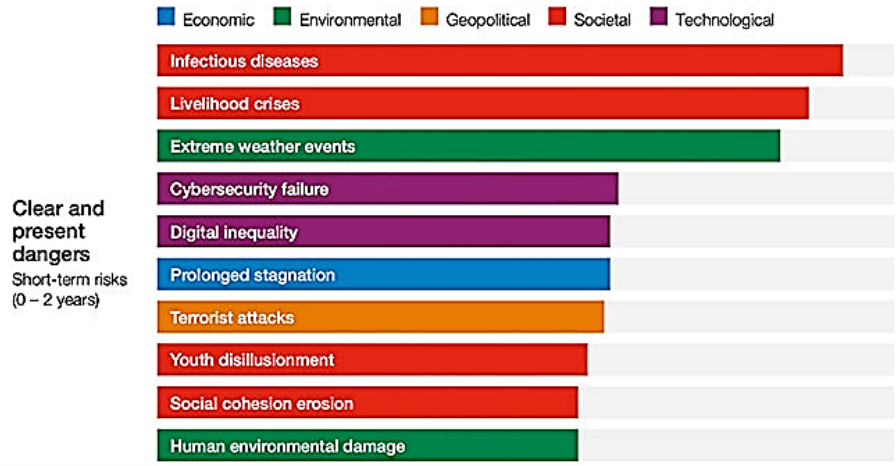


Figure 3: Global Risks Horizon (McLennan, 2021).

Whether the research will focus on sudden floods, which occur on a yearly basis, as contrasted to the epidemic, where it is uncertain how frequently the recurrence can last for decades or more.

3. Appropriate resilient mobility procedures and indicators

"Fig. 4" depicts the relationship between vulnerability and resilience, or an overview of a resilient system's performance over time. The system's performance degrades due to its susceptibility to incident from the start of normal operations. In the context of mobility systems, performance refers to a road network's ability to support better traffic logistics. As the interference spreads, it starts to affect the entire system, causing further degradation and, in some cases, performance failure. The performance levels achieved during the recovery process must exceed a factor that ensures in order to achieve the minimum acceptable performance. As a result, resilience is determined by interruption time and performance changes.

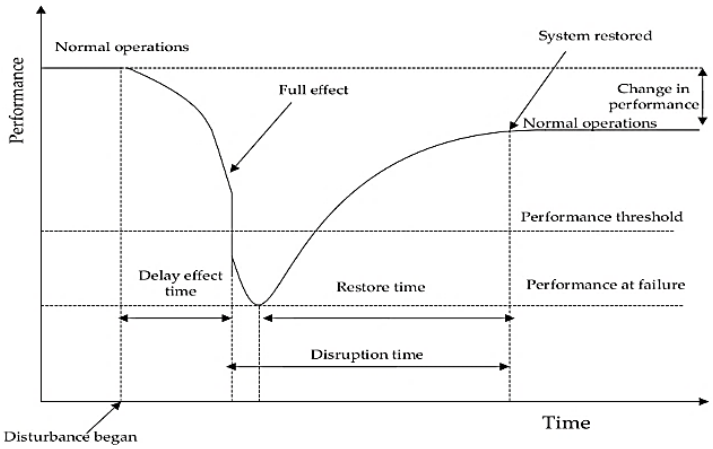


Figure 4: Impact of disturbances on a resilient system (Buma & Wessman, 2011).

3.1. Review of previous studies

Measuring the resilience of mobility and networks to external pressures is a complex systemic problem, so the rationality of various system factors and their designs must be examined. Several organizations and researchers have developed frameworks and index systems to assess mobility resilience from various perspectives

By reviewing of the various examples and the strategies that were analyzed with regard to resilient mobility in the face of rain and floods, a set of Procedures was deduced that could be followed to reach the appropriate indicators for the proposed strategy.

These procedures can be summarized as follows:

- Step1: (Choosing a smart Study area)
- Step 2 :(Issues)
- Step 3: (Dimensions)
- Step 4: (Phases)
- Step 5: (Principles)
- Step 6: (indicators)
- Step 7: (Scenarios)

3.2. Constructing the national strategy

Based on a review of several measurement strategies, the steps involved in developing the strategy and the sources of its measurement will be as follows:

1) Step :١ (Choosing a Specific Smart study area)

the study focuses on smart Egyptian cities, but it should be noted that it can be applied to traditional cities as well, but it will be less efficient because the information and communications technology integrated in smart cities works on the speed of prediction, as well as accelerating the reaction in facing unexpected event.

In Africa, there are a few national and commercial smart city initiatives in various scales and levels. Egypt's New Administrative Capital City, acts as a model for the building of the smart city concept, with the country's various other smart city efforts (Papa, Fistola, & Gargiulo, 2018) (Union, 2020).

Egypt is establishing a number of new smart locations around the country, in addition to the stunning advances in The New Capital “New Alamin”, is a large expansion on Egypt's Northwestern Coast along the Mediterranean Sea, with comprehensive governmental, healthcare, educational, and transportation infrastructure, the new capital will be able to accommodate a couple of million people in the future. Galala City, New Mansoura, and substantial improvements in other Upper Egyptian cities are just a few of the many other projects (Omar Al-Sayed Radwan, Ashour Ahmed Abu Al-Ela, & Abdullah Aliwa, 2021).

Fourth generation cities succeed in meeting citizens' needs in all aspects of life through technologies that save time and effort and seek to provide an environmentally friendly digital environment that stimulates learning and creativity, attributing to a sustainable environment that enhances a feeling of happiness and wellbeing as Egypt prepares to have new smart cities by establishing cities with world-class technology.

It is the definition that the researcher will adopt in creating the strategy by making indicators of smartness, sustainability and quality of life are the main indicators in new smart Egyptian cities. Understanding smart city components and their application to multiple sectors is absent in traditional cities, which is why 4thG cities "Fig. 5" like New Administrative Capital, New Alamein, and New Mansoura are needed to strengthen the foundations of new smart cities in Egypt (Ministry of Housing & Communities, 2019).

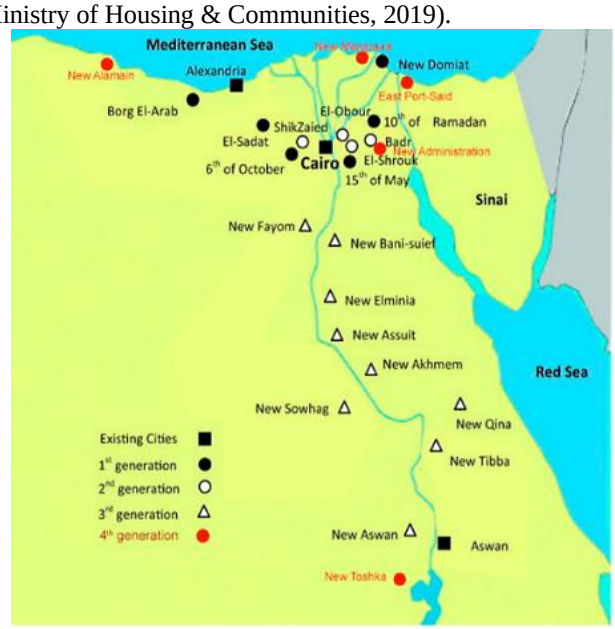


Figure 5: smart Egyptian cities (Fahmy, Mahmoud, Elwy, & Mahmoud, 2020).

2) Step 2 :(Issues)

Natural, technological, and man-made threats all pose serious risks. The general pressures that Egypt may face were previously considered, but the research will focus on dealing with the risks of heavy rains and flash floods.

3) Step 3: (Dimensions)

The number of dimensions varied across strategies, which can be classified into five categories as follows:

a) System/physical
b) Information/smartness
c) Organization/Business
d) Society/political
e) Decision-making/ cognitive, as specific and effective dimensions.

4) Step 4: (Phases)

The main purpose of resilience phases is to provide an understanding of how a disruptive crisis affects the mobility sector. Assessment is performed by measuring so-called macro indicators like robustness, disruption time, absorption time, downtime, recovery time, recovery rate, improvement/adaptation/transformation, and functionality level "Fig. 6" show the resilience phases a basic approach in developing the proposed strategy:

a) Understand risks
b) Anticipate / prepare
c) Absorb/withstand
d) Respond / recover
e) Adapt / transform

Figure 6: Illustration of resilience phases

5) Step 5: (Principles)

the seven resilience principles were selected from the 100RC, whereas joining the organization is one of Egypt's objectives being the organization that dedicated to helping cities around the world become more resilience to the physical, social and economic challenges that are a growing part of the 21st Century, Selected principles for the proposed resilience strategy are:

- Reflective,
- Robustness,
- Redundancy,
- Flexibility,
- Resourceful,
- Inclusive,
- Integrated

6) Step 6: (indicators)

Stakeholders and municipal officials face a difficult task in selecting relevant performance indicators because it requires experience and knowledge. The selection of a variety of criteria that have been studied and selected before by planners, experts and major institutions will provide more accurate indicators where the objective of the evaluation requires a great deal of knowledge and experience (Marijuán, Etminan, & Möller, 2017).

In the criteria for construct the strategy, there are three types of indicators:

a) KPI INDICATORS
b) VERIFICATION INDICATORS
c) PROPOSED INDICATORS

- KPI INDICATORS:

Where smart urban mobility indicators are among the basic indicators that will be integrated with urban resilience Procedures to conclude the strategy. ASCIMER (Assessment of Smart Cities in the Mediterranean)“ Fig. 7” These indicators were chosen as best selection because they are the most appropriate to Mediterranean countries, one of which is Egypt.

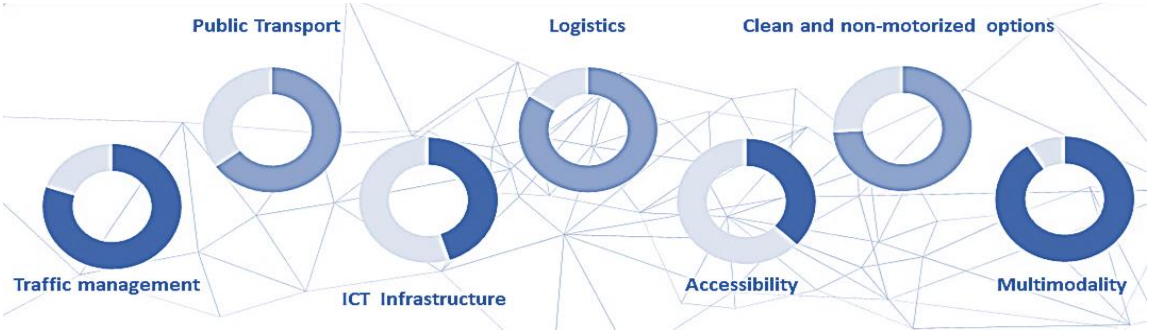


Figure 7: the smart mobility indicators from ASCIMER (Assessment of Smart Cities in the Mediterranean), source: the author.

- VERIFICATION INDICATORS:

According to the definition of the smart city, in the Egyptian context, which states “the employment of information and communication technology to build, disseminate and enhance urban development in order to meet urban

challenges and build sustainable and technically enabled infrastructure" the best quality of life for citizens in this context. So, the strategy will be verified using two types of indicators: (sustainability and quality of life in the urban mobility sector), where many strategies were reviewed and the most appropriate ones were chosen for use as assessing the extent to which the proposed strategy for sustainability and quality of life was achieved. " Fig. 8". represents the reviewed and selected indicators.

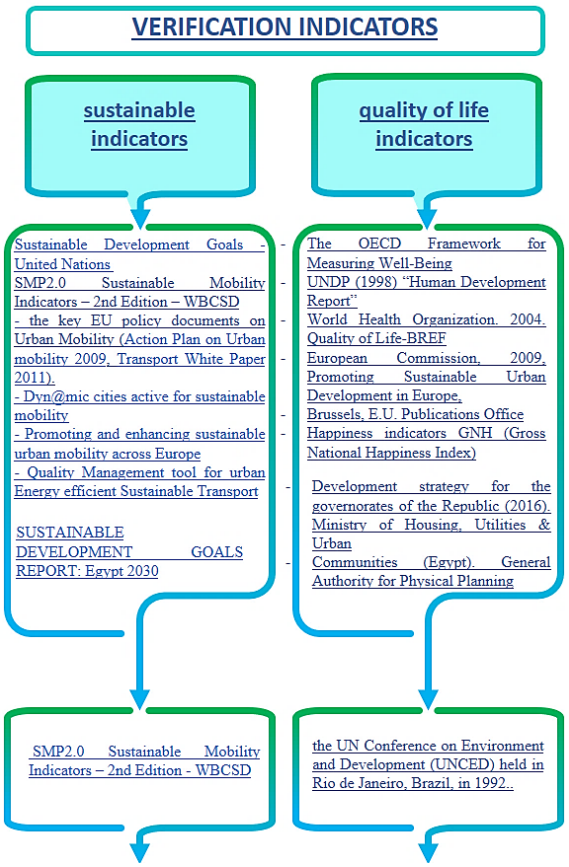


Figure 8: sustainability and quality of life reviewed and selected indicators, source: the author.

- PROPOSED INDICATORS:

In order to obtain the proposed indicators for the mobility resilience strategy in smart cities at the local level, the smart city indicators were integrated with the trends of resilience, attached to its sectoral objectives, and reviewed to achieve sustainability and quality of life standards as they are essential dimensions in Egypt

Vision 2030, through selective tables based on the previous literature review. The researcher created the criteria of the strategy to enable in the concluding process and to assess the strengths of each indicator in the following manner " Fig 9".

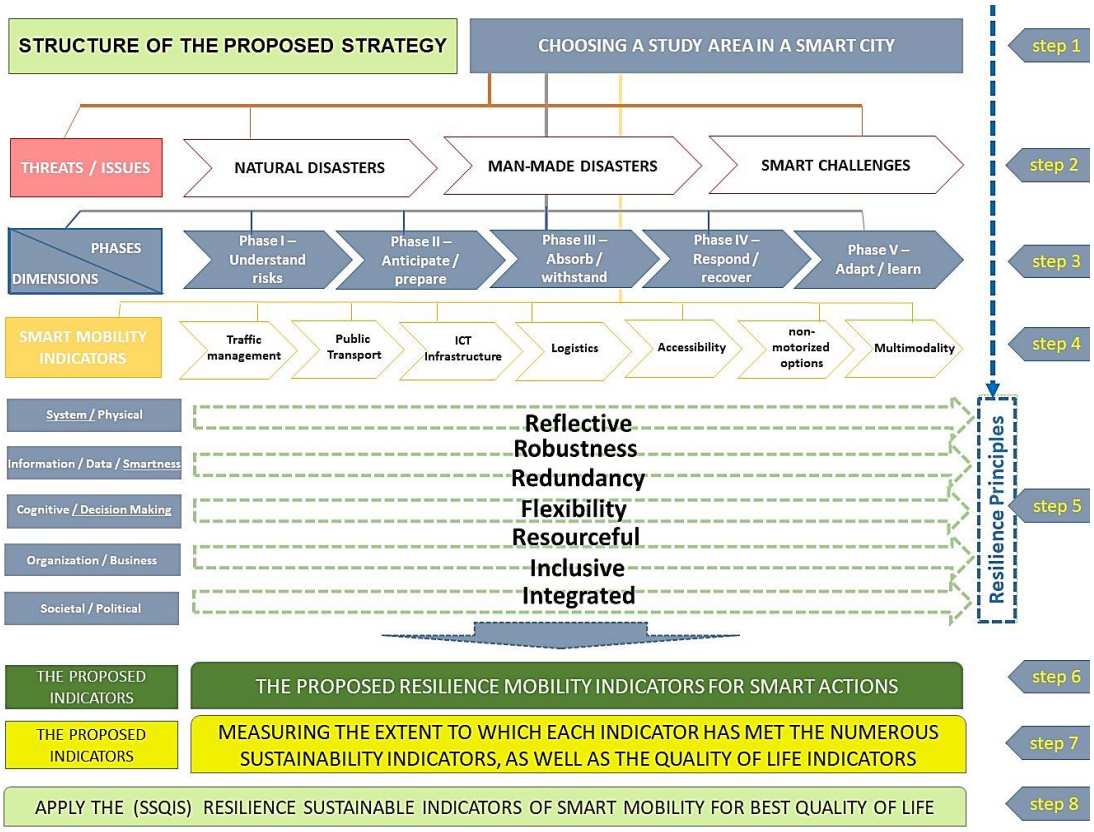


Figure 9: the proposed strategy's criteria, source: the author.

7) Step 7 :(Scenarios)

From analyzing the alternative case studies, Common actions used in relevant scenarios to achieve the resilient mobility, some of them can be summarized as follow:

Upgrading public transportation - Reducing the use of private cars - Increasing active movement - Digitizing transportation networks - Taking advantage of smarter and more convenient multimodal mobility solutions and other scenarios that can be followed, but they differ according to the risks to which mobility is exposed and the possibilities of solutions.

4. A strategy based on resilient mobility indicators for smart Egyptian cities

After studying the definitions and significance of indicators for measuring cities, it was discovered that in order to measure the extent of resilience in the mobility sector, it requires different and unique updated indicators to suit its modernity and Egypt's desire to join global institutions supporting resistance. 17 indicators were designed within seven main objectives between traffic control and traffic management, TABLE 2.

Table 2

The proposed goals and its indicators, source: the author

Dimensions	Goals	The proposed indicators
RESILIENCE TECHNICAL / SYSTEM	1. VEHICULAR TRAFFIC CONTROL	INDICATOR – 1.1 : TRAFFIC VOLUME RULE
		INDICATOR – 1.2 : DEMAND MANAGEMENT FOR TRANSPORTATION
		INDICATOR – 1.3 : ON-STREET PARKING MANAGEMENT
	2. ATTENTION TO TURN TOWARDS PUBLIC TRANSPORT	INDICATOR – 2.1 : RAISE THE VARIETY OF TRANSPORTATION CHOICES
		INDICATOR – 2.2 : OVERCOME WEAKNESS OF TRANSPORT FREQUENCY DURING THE CRISIS
		INDICATOR – 2.3 : EASE ACCESS TO PUBLIC TRANSPORT TRANSIT FACILITIES
		INDICATOR – 2.4 : SAFETY AND SECURITY ENHANCEMENT IN PUBLIC TRANSPORTATION
	3.IMPROVISING ACCESSIBILITY (REDUCE THE NEED TO TRAVEL)	INDICATOR – 3.1 : PEDESTRIAN ACCESSING TO BASIC AND SECONDARY FACILITIES
		INDICATOR – 3.2 : ENHANCING INTERCONNECTEDNESS (INTERNAL AND EXTERNAL)
	4. DEVELOP ALTERNATIVES TO MOTORIZED OPTIONS	INDICATOR – 4.1 : PEP TALK AND ACTIVATION OPTIONS OF CYCLING MOVEMENT
		INDICATOR – 4.2 : ENHANCING WALKABILITY NETWORK FOR PEDESTRIAN MOVEMENT
	5. RESILIENT MULTIMODALITY	INDICATOR – 5.1 : PASSENGER AND FREIGHT MULTIMODALITY

INFORMATION / SMARTNESS	6. ICT-SUPPORTED RESILIENT INFRASTRUCTURE	INDICATOR – 6.1 : DATA GATHERING SYSTEMS (MONITORING AND POSITIONING SYSTEMS)
		INDICATOR – 6.2 : COMMUNICATION AND QUALITY OF DATA
		INDICATOR – 6.3 : ICT PAYMENT SYSTEMS &TICKETING
ORGANIZATIONAL/- DECISION MAKING	7. LOGISTICS FOR INTEGRAL RESILIENCE	INDICATOR – 7.1 : TRACKING MANAGEMENT
		INDICATOR – 7.2 : STOCK MANAGEMENT

4.1. Constructing Assessment Criteria for RSSIs Strategy

Weighting and aggregating the variables/indicators The essential methods for developing smart and resilient city assessment include selecting relevant variables, weighting those variables, and aggregating data into a composite index (Juwana, Muttil, & Perera, 2012). The weighting and aggregation of index components are critical measures in any smart and resilience evaluation. Assigning weights to indicators is critical because it allows the user to determine which one are more important than others. However, selecting a weighting method can be incredibly hard because it is highly dependent on the variations and circumstances. There are three major classes of methods for weighting indicators (Li, Chang, Cheng, Yang, & Póczos, 2017) (1) fair weighting, (2) statistic-based weighting, and (3) public/expert opinion based weighting. When all the metrics are deemed equally relevant, or where no statistical or empirical evidence supports a unique system, Equal Weighting (EW) may be used (Munda & Nardo, 2005).

- **Equal Weighting (EW) method for calculating smart resilience index.**

If the goal receives 7 points, it is considered completely successful. Whereas, according to the equal Weighting, a point will be added for each of the resilience principles achieved (7 goals), Keeping in mind that achieving smart and sustainable mobility that corresponds to the highest quality of life standards are reference point.

As a result, we can assess the index's success in achieving mobility resilience as follows:

- 1:3: validation level is insufficient.
- 4:5: The average validation level is
- 6:7: Outstanding validation level

Since there are 17 indicators, the results of the study on which the indicators strategy will be implemented will be evaluated as follows:

- 7:21 points: Insufficient validation for the application area.
- 28:35 Points: The application area has a medium validation level.

42:49 Points: A high level of validation for the application area

5. VALIDATION OF THE PROPOSED STRATEGY

the indicators list presented is used to assess and evaluate the selected application area (The Residential Valley Three and The Central Business District in The Adjacent Area), New Administrative Capital, Egypt as an example of new smart cities.

5.1. Determine and analyze the application area

The residential valley three and the central business district in the Adjacent area, New Administrative Capital, Egypt. "The New Administration Capital" in Egypt is a large-scale program launched by The Housing, Utilities and Urban Communities Minister Mustafa Madbouly on March 13th, 2015, (Serag, 2017). As a Smart City located 45 kilometers east and just outside the Second Greater Cairo Ring Road, Between The Regional Ring Road, The Cairo-Suez Road, and The Cairo-El Ain El Sokhna Road, “Fig. 10”.

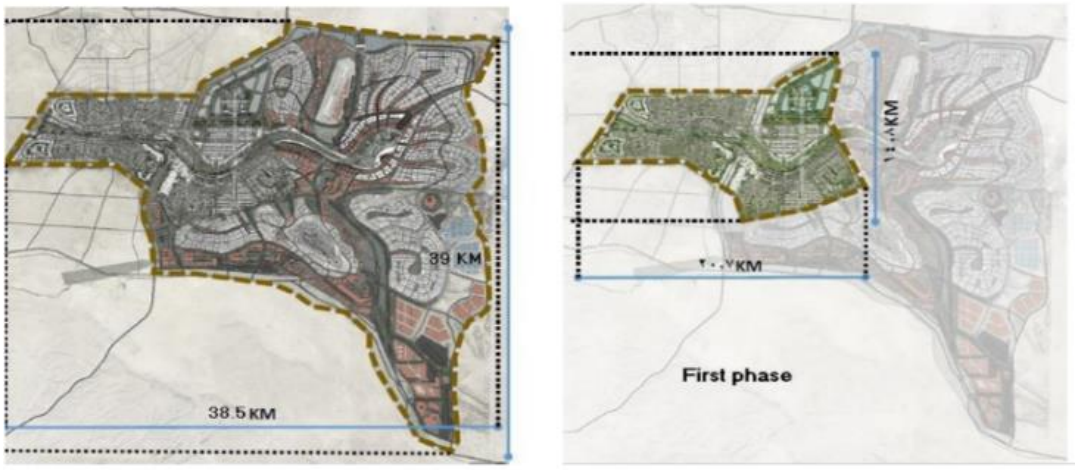


Figure 10: first phase of the new capital (Loewert & Steiner, 2019)

The application area chosen to be a part of the New Administrative Capital's first phase, figure (5.2) - 40000 acres, eight residential districts, a central commercial area, the presidential palace, a diplomatic district, investor zones, a green river, and a governmental district are all included in the first phase, it consists of three main areas of the New Administrative Capital, the diagram depicts the location of the study area: R3 (The Residential Valley 3) and the Adjacent rea the central business district, "Fig. 11", shows the land use of the three main parts of the application area.

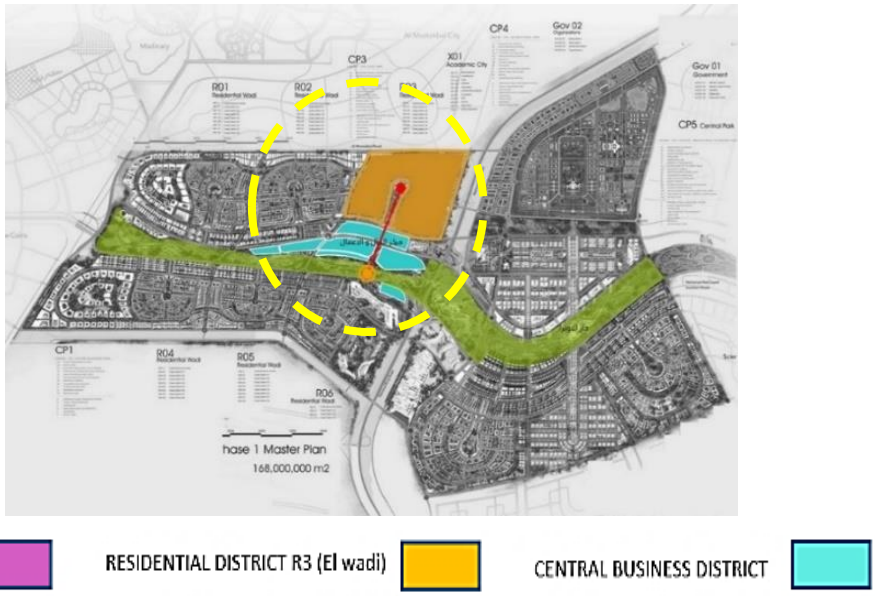


Figure 11: the land use of the three main parts of the application area, in the New Administrative Capital Scheme, processed by the author.

5.2. Identify relevant threats in the urban mobility sector of the application area (flash flood)

The location of this application area in the new capital city lies in the same region, as another new city (5th settlement - New Cairo). which had faced a flooding issue in 2018, because the city's masterplan was not shaped and formed using flood analysis/simulation. According to the paper Assessing the capability of the urban structure to meet various levels of flood risk (Walid S. Abdeldayem; Tamer El-Kholy), The flood analysis for the NAC (New Administrative Capital) utilize weighted criteria and the danger degree associated with each flood basin, "Fig. 12", The damaged zones are largely in the city's south and center, but some areas in the north are also affected, as shown on the map (focus in the study area).

A cross-section of the various topography of the application area due to the terrain and slope of the area, “Fig. 13”, this contouring section has taken in the masterplan's application area to assess the slope in all directions, as well as to consider different land-use alternatives.

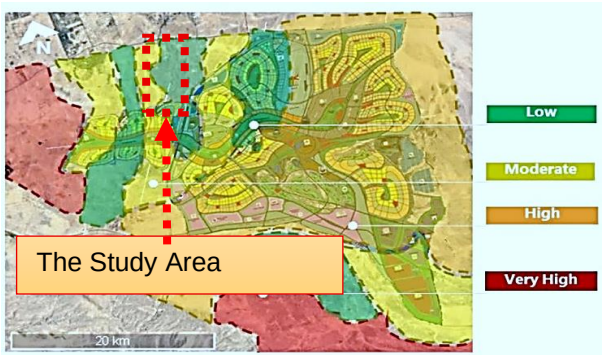


Figure 12: . Score related with flood threats in the application area updated based on the flood simulation report. Processed by the author from(Agarwal et al., 2016)

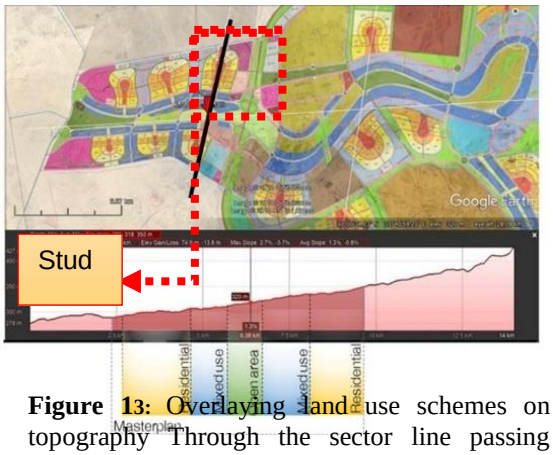


Figure 13: Overlaying land use schemes on topography Through the sector line passing through the study area, processed by the author from: (Abdeldayem & El-Khouly, 2019)

When the segment map for the application area was paired with the resulting danger degree for basins, which cannot be ignored, and the analysis was repeated, it was clear that the application area's urban structure and mobility network would not be able to withstand the flood torrents. Some areas have turned to dark blue in “Fig. 15”, suggesting that the loss of the principal link to the city street network resulted in the formation of a number of isolated islands as part of the study area. This highlights the consequences of ignoring the natural flood stream when designing and building urban structures of the selected application area.

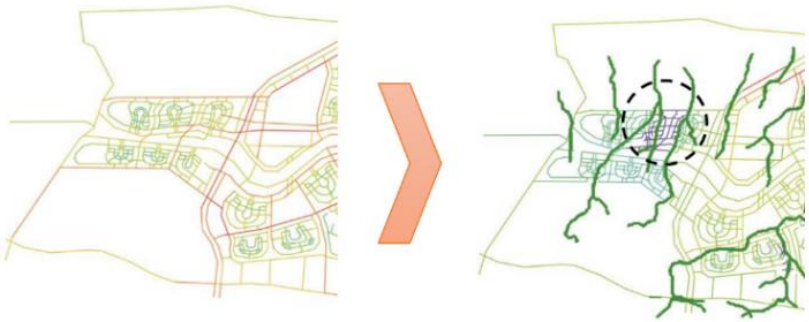


Figure 14: Integration map for the application area overlaid with the main flood basins. Processed by author from (Abdeldayem & El-Khouly, 2019)

5.3. implementing the indicators through the application area

GOAL #1 (1. vehicular traffic control)

- The current traffic volume in the application area

Due to the city's urban structure– the street network, and the network system does not have optimum forms of connectedness, “Fig. 16”, wide variety of roads (segments) by a low connective indication since the street network is connected by ring and arterial roads and by extension in the application area, it's worth noting that regional highway that travels through the city generates separation in the application area and also the entire city. Unlike local planning and urban needs, these sorts of roadways have fewer connections (as requirements for a walking city).

Figure 15: the city's urban structure the street network relies on the ring and arterial roads, with an analysis of the study area, Processed by author from https://archplan-eg.com/project/new-cairo-capital/

Oasis in Residential District R3 is a cultural, sports and entertainment complex located in Residential Valley 1 in Residential District R3. In the heart of the oasis there is a central garden and service area for the residential complex. Residents can walk safely from their homes to the banks of the Green River because the central park accesses the banks of the river without crossing any streets or vehicles as pedestrian traffic has been separated from vehicle traffic to ease traffic congestion, "Fig. 16".

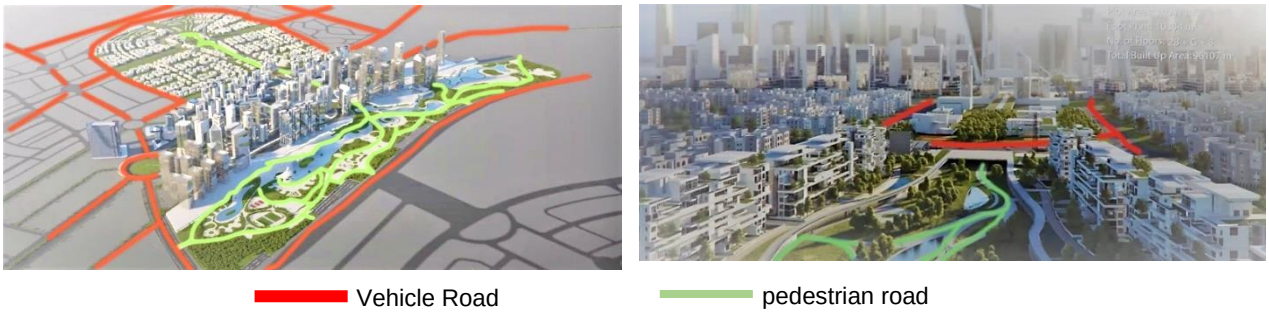


Figure 16: Separation of pedestrian traffic by vehicle using different levels in the application area, Processed by author from https://www.youtube.com/watch?v=3o1Oo0xSq7s

Indicator – 1.1: TRAFFIC VOLUME RULE

Interventions Suggestions Based on Indicator – 1.1 Since the city's master plan did not account for flood risk, some strategic actions must be taken below. A specific location inside Residential district 3 was identified as being under risk of the existing flood basins, While The central business district zone is located in the low zone, which places it in the safe zone. Several culverts and cisterns should be built to the study area's infrastructure and drainage system, and the roadway should be planned so that wastewater can be dumped through natural flood channels, "Fig. 17", , shows the affected part. Fig. 17. Proposed locations for reservoirs and catchments in the application area. Processed by: The Authors. The affected part from the application area, Source the author Because the water depths are shallow, speed limits will be imposed on flooded paths, and movement will continue in a normal and regular manner in vertical roads such as the axis and parallel roads because the roads are parallel to the path of water movement and do not intersect with it, while movement on horizontal roads flooded with water in front of traffic will calm down, "Fig. 18". narrow sub-roads will be closed, due to the likelihood of being considerably impacted, automobiles

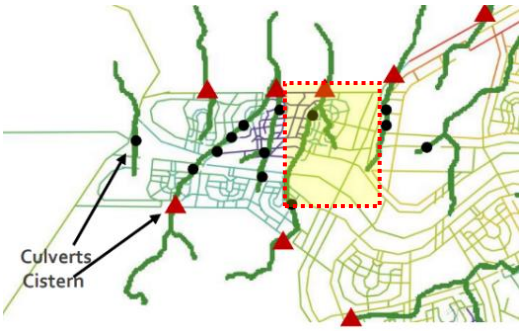


Figure 17: Proposed locations for reservoirs and catchments in the application area. Processed by: The Authors

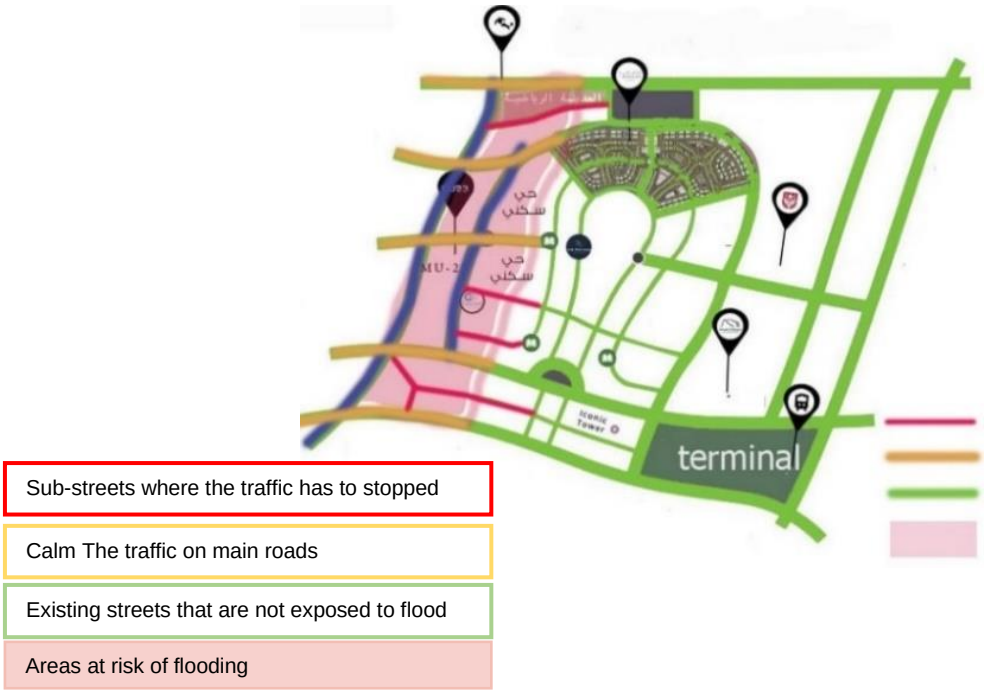


Figure 18: Suggested solutions to control the volume of traffic in the application area to resist flash flood in the study area, source: The Author.

Routes flooded to a shallow depth will have speed limitations imposed, while those flooded to a considerable depth will be closed to traffic. Both speed limits and road closures reduce network capacity, but road closures also shift traffic allocations. Due to the road restrictions, vehicles travelling through a flooded road with a deep water level must seek an alternate way to reach their destinations.

Indicator – 1.2 : DEMAND MANAGEMENT FOR TRANSPORTATION

Interventions Suggestions Based on Indicator – 1.2

When the road is closed due to flooding, each vehicle will be diverted individually based on its destination. As a result, during flood conditions, an algorithm must be included to comprehensively redirect the traffic situation. This is especially critical if there are many flooded streets across the entire network. Since it includes a comprehensive description of each trip, the micro-simulation approach is more reliable for estimating the losses associated with canceled flights that may occur due to flooding which is not difficult as the study area includes smart infrastructure integrated in The New Administrative Capital.

By generating a digital clone of real-world items, “Fig 19”, services, or equipment, or a set of other entities, digital twins enable enterprises to validate many sorts of services in a virtual realm. If connected automobiles become commonplace, they will be filled with sensors that create a lot of large data. Digital twins can use this information to build a virtual environment that mirrors the actual world in which the linked automobile exists.

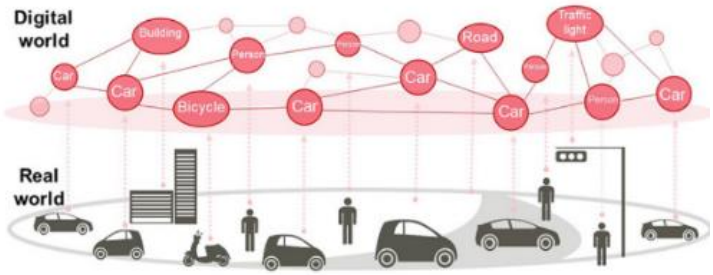


Figure 19: huge volumes of data are reflected in real-time onto the digital world (Zhou, Zhang, & Yang, 2010)

Indicator – 1.٣ : ON-STREET PARKING MANAGEMENT

Interventions Suggestions Based on Indicator – 1.3

It is clear, that the most afflicted to flooding in the study area is a residential area overlooking the oasis and surrounded by a commercial area on the other side. The flood study field will be focused on two things in the event of a flood:

First, prevent cars from entering the flood-prone area and have residents of the threatened residential area park their cars in the public garages available on the main road overlooking the oasis, as this will allow emergency vehicles to move and reduce the distance between the public garages and the threatened housing units. A stroll of no more than ten minutes is recommended, “Fig. 20”.

Most significantly, given the risks in the region, traffic directives must be established to prevent automobiles from entering the residential area for people using the business sector's services, “Fig. 21”.

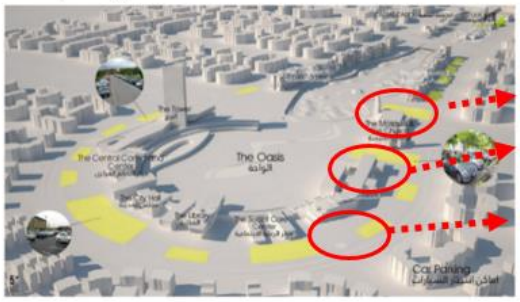


Figure 20: public garages available on the main road overlooking the oasis instead of parking in the affected area, source: Author

Figure 21: Establishing instructions not to park in the residential area prone to flooding and to prevent entry of cars in the most hazardous commercial area in the study area, Source: Author

GOAL #2 (2. attention to turn towards public transport)

- The current public transport situation in the application area

In application area district, “Fig. 22”. The major terminal project is already completed. Internal and external transportation in The New Administrative Capital, which is located near Knowledge City and runs parallel to the regional route. On 105 acres, it is a major project.

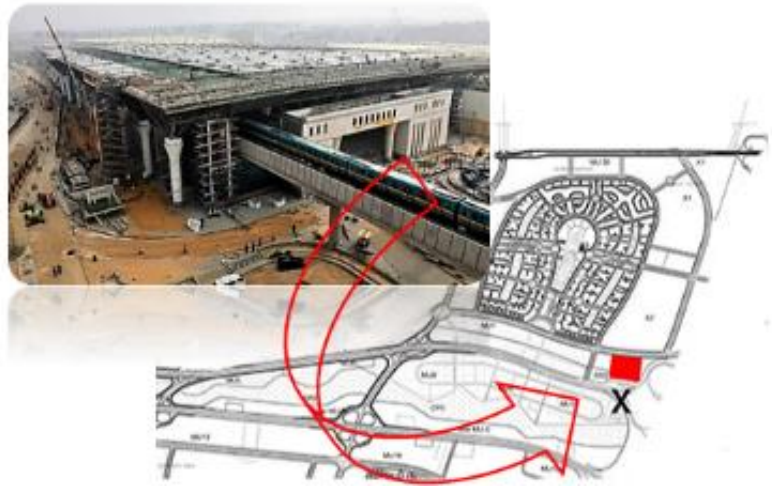


Figure 22: The New Administrative Capital terminal location and master plan, source: the author.

And here is a review of the forms of public transport methods in the application area, “Fig. 23” The main roadways travel horizontally through the residential area R3 on its fringes. The state has proposed that the monorail be built. It runs horizontally through the south of the future and the south of the region. The train also passes through the Bin Zayed gathering, a circle road, and three light metro lines that run horizontally through the financial and business district, as indicated. The Ministry of Transport also recommended a new scheme for train and metro lines, as well as public transportation buses

Figure 23: forms of public transport methods in the new capital.

Indicator – 2.1: RAISE THE VARIETY OF TRANSPORTATION CHOICES

Interventions Suggestions Based on Indicator – 2.1

Because of the prior plan to ban cars from accessing flood-prone residential zones, public transportation will be the primary mode of mobility in the impacted area of the R3 quiet district, which residents will depend on owing to its enormous size. efficient. While other modes of transportation may not offer the ideal travel experience. The availability of public transportation in the study area “Fig. 24”.

Figure 24: public transport ways in the application area, source: the author.

Because public transportation is available throughout the financial and commercial district, , the focus will be on that district R3. The proposed public transportation bus route in R3 circles around the major road that wraps around the oasis, while the other runs parallel to the axis of El Amal and the oasis. “Fig. 25”.shows how to improve the public transportation during floods.

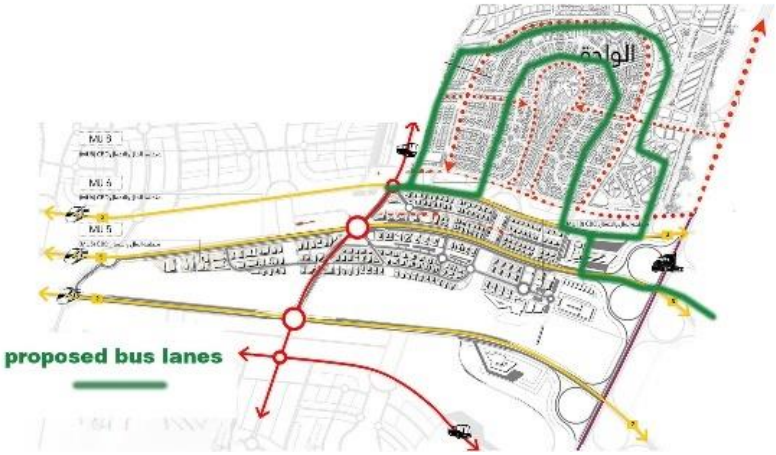


Figure 25: Proposed bus lanes in flood time, source the author.

Indicator – 2.2 : OVERCOME WEAKNESS OF TRANSPORT FREQUENCY DURING THE CRISIS

Interventions Suggestions Based on Indicator – ٢.2

the new default situation will be concerned with increasing transit stations and its sphere of influence. The frequency should be increased.

This indicator also recommends considering the increase in passenger transit stations, especially in the area affected by the flood, as this shallow flood will allow the continuation of public transport buses without other means of transport due to their size.

Increasing the frequency of public transport, as it is the most appropriate means at the time of the flood, will reduce the waiting time for passengers on the street and the risks they are exposed to at this critical time, Buses will not be late for passengers if the frequency of public transportation buses is increased, because in the event of floods, buses will slow their speed to control their movement in the water .

Indicator – 2.3 : EASE OF ACCESS TO PUBLIC TRANSPORT TRANSIT FACILITIES

Interventions Suggestions Based on Indicator – ٢.2

Despite the multiplicity of public transportation options in the study area, the plan shows that there are only two transit stations, "Fig. 26".which is inconvenient in case of flooding, as it is only possible to use public transportation and private transportation is suspended in some locations.

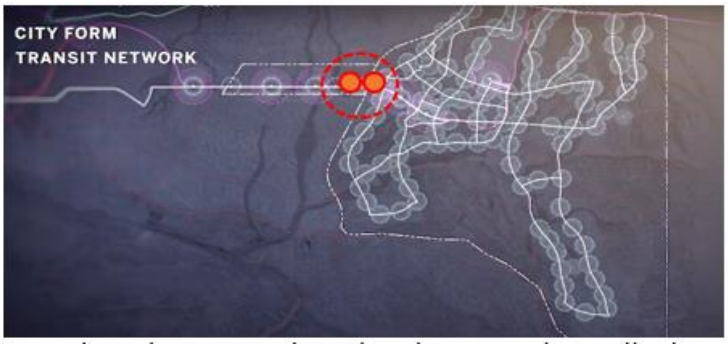


Figure 26: The existence transit station that serve the application area, processed by author.

The trend will be to reduce the distances between passenger stations with an increase in trips to encourage residents to go to public transportation and leave their private cars. The presence of the proposed stations will encourage the use of public transport due to the small distance traveled by foot to reach their destination.

This principle's single implementation goal is to locate urban development within a short walking distance of high-quality transit: ideally, 500 meters (m) or less, and no more than 1,000 meters (about a 20-minute walk),

including all detours, from rapid, frequent, and well-connected BRT, rail, and accordingly the bus stations were distributed as follows in the residential area R3, which previously assumed a bus route, as well as in the business area A hypothesis has been made for passenger transit with sufficient bus routes north and south of the central business district, "Fig. 27".

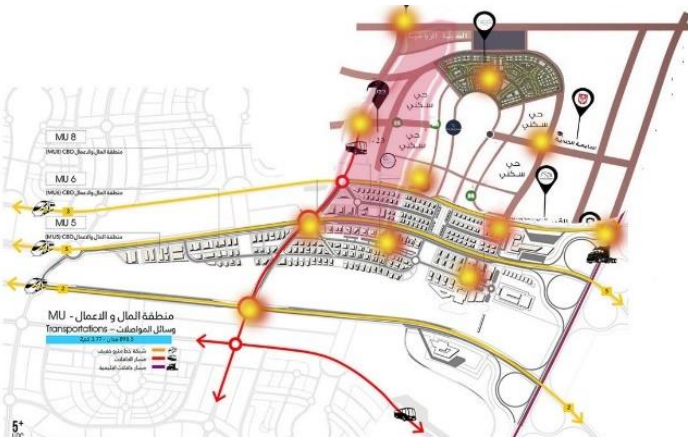


Figure 27: The existence and proposed transit station and the extent of their impact that serve the application area, whether during normal times or during flood times, source: author.

Indicator – 2.4 : SAFETY AND SECURITY ENHANCEMENT IN PUBLIC TRANSPORTATION

Interventions Suggestions Based on Indicator – ٢.4

During floods, for example, new techniques have been developed, "Fig. 28" to aid urban transit from afar. Companies have cooperated with water conservancy colleges and universities to develop Fengqi joint portable flood control barrier, which owns a number of national patents and breaks the long-term monopoly status of European and American companies in the domestic market by introducing advanced technologies where traditional flood control equipment is ineffective and dangerous.

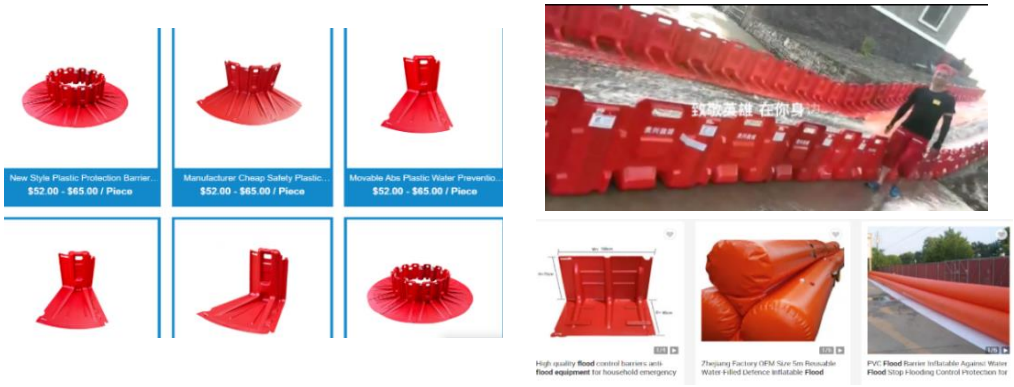


Figure 28: The New technologies used to provide security and safety during flash floods https://floodcontrolinternational.com/temporary-flood-wall-barriers/

Figure 29: Well-equipped public transportation and road safety signs that make safe mobility during flood https://floodcontrolinternational.com/temporary-flood-wall-barriers/

Figure 30: temporary equipment to prevent floodwater https://floodcontrolinternational.com/temporary-flood-wall-barriers/

It is also possible to use well-equipped public transportation that can deal with flood situations, “Fig 30” and the government has imported such kind of public transportation. It is also recommended to use all traffic lights or road safety signs “Fig 31” in order to preserve the safety of road users

GOAL#3 (3. IMPROVISING ACCESSIBILITY (REDUCE THE NEED TO TRAVEL)

- THE CURRENT ACCESSIBILITY IN THE APPLICATION AREA

The study area is characterized by a mixed design of a commercial, residential, and entertainment axis around the oasis that links the entire project, which includes shopping areas, parks, schools, social and cultural areas, and the central area was chosen to provide the closest distance to each residential area to serve all residents in all The districts that are categorized by the diversity of their levels, from high-density to medium-low housing, and the study area was chosen to provide the closest distance to each residential area to serve all residents in all. The financial and commercial hub, which acts as a primary business center, is visible and immediately accessible from the R3 district, “Fig 31” Analytical analysis illustrating the variety of uses in the research area.

Due to the mentioned diversity, we find that the study area has numerous alternatives, allowing easily accessible within the study area and access to important service “Fig 32” show the land use of the Application area.

Figure 31: Diversity of services in the oasis to serve in The application area https://www.youtube.com/watch?v=3o1Oo0xSq7s&t=130s

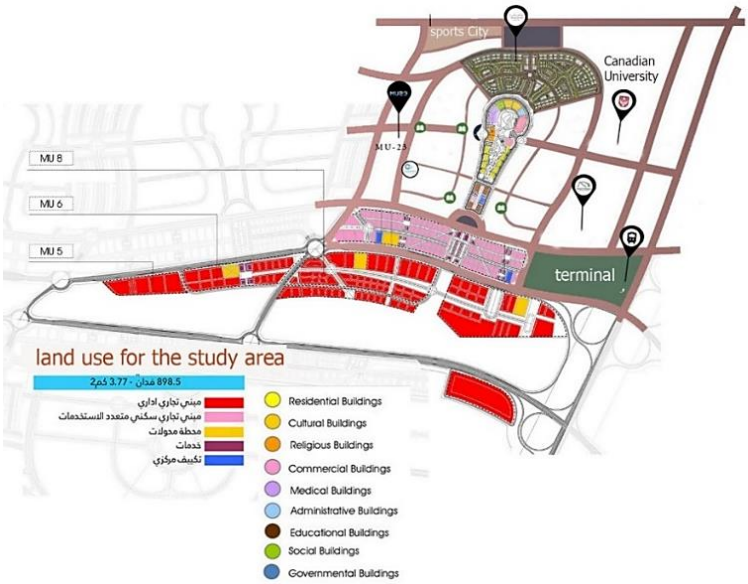


Figure 32: the land use of the Application area, Source: the author.

Indicator – 3.1: PEDESTRIAN ACCESSING TO BASIC AND SECONDARY

Interventions Suggestions Based on Indicator – 3.1

Since one part of the study area is within the danger zone, it is assumed that private vehicles are prevented, only public transportation, and pedestrians are permitted to enter during floods, based on previous criteria. Services are within walking distance of the risk zone, as depicted in the diagrams “Fig 33” Primary school A, a hospital or pharmacy, and a source of fresh food are all within 800 meters of the park or playground, and a 500-meter walk will take you to another park or playground. It's also worth mentioning that public transit can get you to the company and service facility in under 30 minutes, “Fig 34”, which shows how services will be dispersed on both sides of the residential areas, on the right (towards the Oasis and its services) and on the left (towards the Mu23 commercial district), reducing walking distances and bringing them within the allowable limit.

Figure 33: The basic services are in short supply in the oasis https://www.youtube.com/watch?v=3o1Oo0xSq7s&t=130s

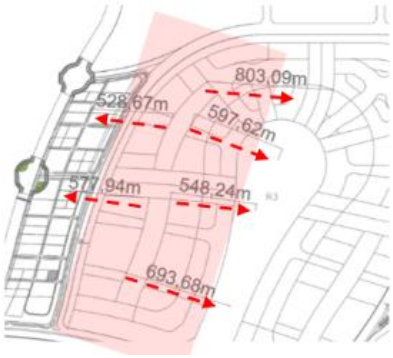


Figure 34: The distribution of basic and secondary services in the study area meets the needs of the population in the flood affected area by foot in case of flood source: author.

Indicator – 3.2: ENHANCING INTERCONNECTEDNESS (INTERNAL AND EXTERNAL)

Interventions Suggestions Based on Indicator – 3.2

The Superblock model anticipates ease of mobility for Passengers within large blocks, where it works to put pedestrians and cyclists (active mobility) as a priority

About the most severely impacted part of the application area from the flash flood, “Fig 35”, the superblock model will also support mobility and easy access to service vehicles and emergency cars in the event of flash floods

to provide resilient mobility during that crisis, while providing a more connected and interconnected environment in normal situations. “Fig 36”, The application area is being developed as a new mobility model "super-block

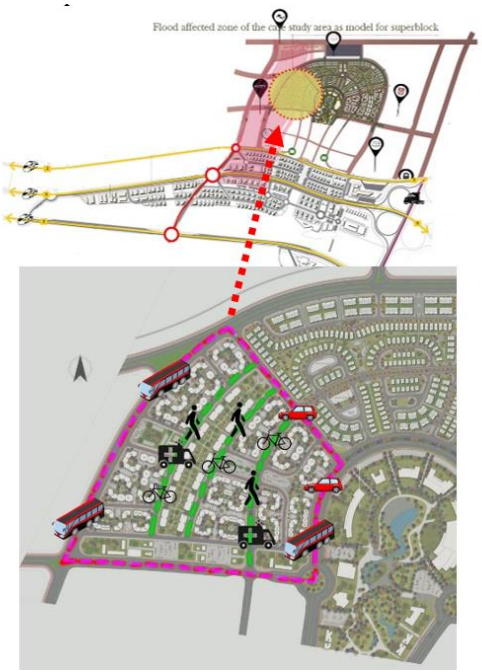


Figure 35: the super block model in one of the flooded area, processed by author

Figure 36: The application area is being developed as a new mobility model "super-block,", source: the author.

GOAL#4 (4. Develop Alternatives to Motorized Options)

- THE CURRENT ALTERNATIVES TO MOTORIZED OPTIONS IN THE APPLICATION AREA

The study area is planned with a human scale in mind, encouraging walking and cycling while limiting automotive traffic as a mode of transportation, “Fig 37”, as well as a focus on the existence of parks and green areas for cross-border social communication. Where those places within the neighborhood are classified, from public to semi-private to apartment building spaces, which are a collection of shared backyard flats that are not accessible by automobile. As illustrated in the diagram, a children's play area served by the outer boundary while leaving the inner boundary free for picnics and meeting places might have varied degrees of green space .

Figure 37: , pedestrian walkways and bicycle lanes in the application area (Serag, 2017)

Indicator – 4.1: PEP TALK AND ACTIVATION OPTIONS OF CYCLING MOVEMENT

Interventions Suggestions Based on Indicator – 4.1

According to the analysis of the study area, it becomes clear that there is a bike path in the residential neighborhood R3 around the oasis only.

But due to the importance of the role of bicycle paths as mentioned in this indicator and previous indicators, the study assumed a connected and integrated path for the study area, “Fig 38”,

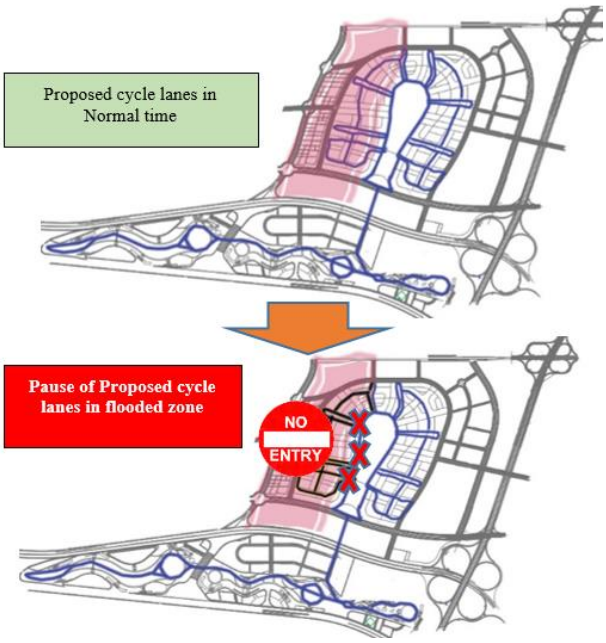


Figure 38: , closure of bicycle roads during the flash flood, source: the author.

Indicator – 4.2: ENHANCING WALKABILITY NETWORK FOR PEDESTRIAN MOVEMENT

Interventions Suggestions Based on Indicator – 4.2

Permeable pavement, on the other hand, is excellent for a pedestrian plaza or park. This design strategy's principle, “Fig 39”,Some of these solutions have been implemented in one of the capital’s regions, “Fig 40”, but they can be generalized, especially in the area at risk of flooding .

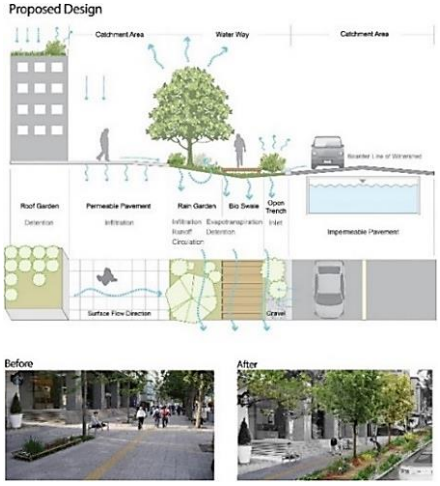


Figure 39: proposed design for flooded study area pavement

Figure 40: The status of the city.

And since the city is smart and built on a network of smart service tunnels, , “Fig 41”, smart systems can be used in the area at risk of flooding. These smart systems alert pedestrians to the high water level and direct them to another road or the other, linked to additional openings connected to waterways, which increase the absorption of flood water.

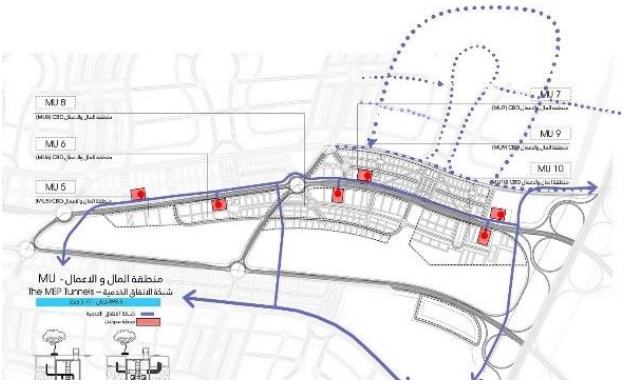


Figure 41: network of smart service tunnels in the application area source: the author.

GOAL#5 (5. RESILIENT MULTIMODALITY)

- THE CURRENT MULTIMODALITY OPTIONS IN THE APPLICATION AREA

The study area is characterized by the diversity of means of mobility that can be easily moved between them. The monorail has been proposed by the state. It passes through the south of the residential area R3,

which is bounded on the west by the future road through which the local bus passes and the south of the area horizontally. , the train travels via the Bin Zayed Cluster, a ring road, and three light metro lines that pass horizontally through the financial and commercial center, “Fig 42”, network of mobility in the application area . In addition to the availability of taxis, as well as pedestrian paths .

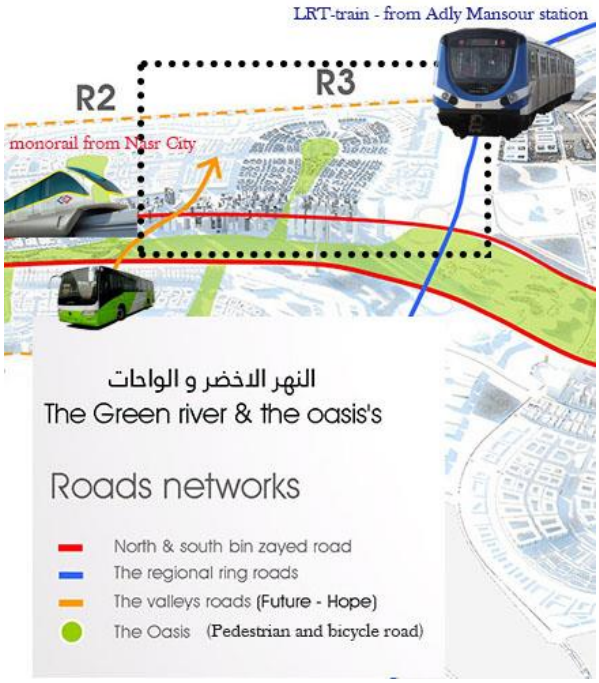


Figure 42: network of mobility in the application area, source: the author.

Indicator – 5.1: PASSENGER AND FREIGHT MULTIMODALITY

Interventions Suggestions Based on Indicator – 5.1

In accordance with previous standards and the decision to close roads in the face of vehicles in the event of flooding within the affected area, in which the road is closed to private cars and allowed to roam within the adjacent area on foot, because the area has commercial areas to serve the residential area, and as the depth of water in the

affected area does not exceed 0.25 feet, which also allows entry of service vehicles and emergency vehicles, public transportation buses, “Fig 43”, Goods transport vehicles, on the other hand, can enter the area during a sudden flood as service vehicles and then be carried to homes on foot. Despite the shortage of multimodiodality urban mobility choices in the affected areas, the safety element is the most influential concern here.

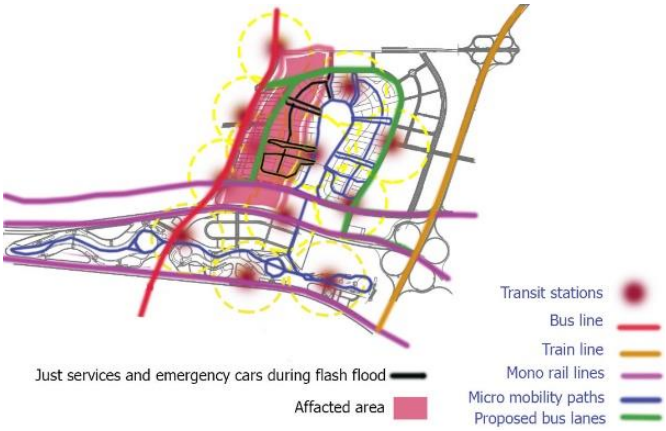


Figure 43: multimodality Mobility Model Supporting the flash Flooded Affected Area, source: the author

GOAL#6 (6.ICT-SUPPORTED RESILIENT INFRASTRUCTURE)

- THE CURRENT ICT INFRASTRUCTURE IN THE APPLICATION AREA

Provided Services MSI in The New Administrative Capital will be in responsible of analyzing user requests, establishing system requirements, designing, implementing, testing, measuring, and validating the intelligent traffic system, as well as maintaining it (together with its consortium partners). The MSI's work will entail the development of a Smart City system that follows the following tracks:

- Bus Stations (The scope of work for the bidder must only include bus station design and how it interacts with traffic signals.) The scope also includes determining the locations of the stations).
- Garages for parking
- Signals operated by pedestrians and bicycles, as well as traffic lights
- Infrastructure for non-motorized transportation (NMT) and bicycle pods
- Using public transportation as an integration approach
- How to Recharge an Electric Vehicle (The bidder's scope is limited to the design of the EV Charging units and the placement of the units
- Detection and enforcement of traffic violations
- Managing fleets using the national RFID program
- Traffic analysis
- Control room setup
- IT resources

Indicator – 6.1: DATA GATHERING SYSTEMS (MONITORING AND POSITIONING SYSTEMS)

Interventions Suggestions Based on Indicator – 6.1

With these technological abilities in the city, it is possible to utilize the flood detection system, which is a group of sensors and alarms that detect and warn of rising water levels in the streets, in the study area's most vulnerable area. Flood level monitoring can be conducted regularly, but it is not required .

• A sensor is a sensor that is set at the monitored location and sends out a signal when water is detected.

• An alert is a visible and audio signal that warns of a critical condition that requires quick attention.

• Flood warnings (water zero sensor) are sent to the chosen group, along with photographs, “Fig 44”,

• Flood notifications based on water level (level sensor) are sent to the selected group, along with photographs.

• The system's straightforward maintenance can be combined with ordinary track maintenance, Upon flood warning and flood alarm, a CCTV camera transmits photographs of poles/area.

Figure 44: early warning systems for flood, http://www.pr4gdm.org:8080/casestudy/technology_view?idx=60

Indicator – 6.2 : COMMUNICATION AND QUALITY OF DATA

Interventions Suggestions Based on Indicator – 6.2

Recent technological advancements in new sensors, data transfer, and computer algorithms can significantly aid urban flood modelling and, as a result, flood risk management. new technologies such as unmanned aerial vehicles photogrammetry may be used for frequent capture of sub-meter urban topography and land-use maps. This could have a significant impact on how urban drainage systems and floods are managed in the future. The Internet of Things is also making it easier to connect a large number of traditional flow sensors to data transmission and storage technologies that can provide real-time data on the flow, "Fig 45",

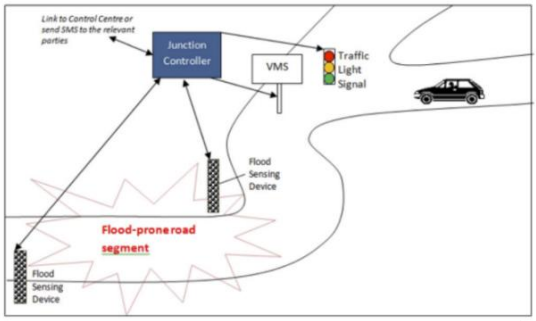


Figure 45: . Techniques clearly offer new opportunities for more accurate urban flood modelling.

Indicator –6.٣ : ICT PAYMENT SYSTEMS &TICKETING

Interventions Suggestions Based on Indicator – 6.3

As a result of the flood, services at waiting stations are disrupted or halted, making remote ticketing services a preferable option.

The city must activate its smart services for remote ticketing in order to preserve the safety and security of customers at station platforms, reduce the risks they may be exposed to, and create a safe and secure station environment in order to improve the experience of travelling by public transportation during floods.

Improving customer service, boosting public transit use, and minimizing fare evasion are all goals

GOAL#7 (7. LOGISTICS FOR INTEGRAL RESILIENCE)

- THE CURRENT LOGISTICS IN THE APPLICATION AREA

The Administrative Capital is a logistics project that focuses on a number of initiatives, including the deployment of environmentally friendly means of transport, the creation of traffic zones, logistics/charging stations, and innovative information systems. Systems for transporting cargo underground, “Fig 46”.

The Development of The New Administrative Capital will allow for greater integration with world trade. Increased export competitiveness, reduced costs, increased employment, and increased import levels of motivation from improved supply networks and more efficient use of national transportation assets.

In The New Administrative Capital, a customs complex will be created, which will help in the efficient flow of goods across the state's borders as well as the security of people.

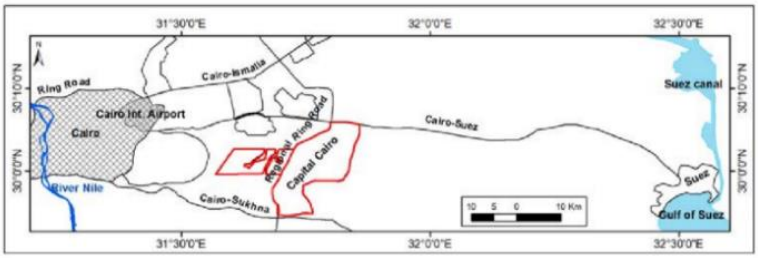


Figure 46: . The logistic location of The New Administrative Capital (ACUD, 2020)

Indicator – ٧.1: TRACKING MANAGEMENT

Interventions Suggestions Based on Indicator – ٧.1

In the study area it is suggested to locate the temporary reservoir problem with respect to the time period of the flood. Temporary warehouse locations can be identified and vehicle routing plans developed Of all the relief supplies to be transported optimally. The temporary repository is in this problem Is a facility different from typical warehouses on the fact that temporary warehouses were not created to provide storage, but Instead to facilitate the transfer of relief supplies from one type of conveyor to another type of conveyor in a flood where the most common means of transport used in a real flood problem are large buses and emergency and service vehicles, “Fig 47”,

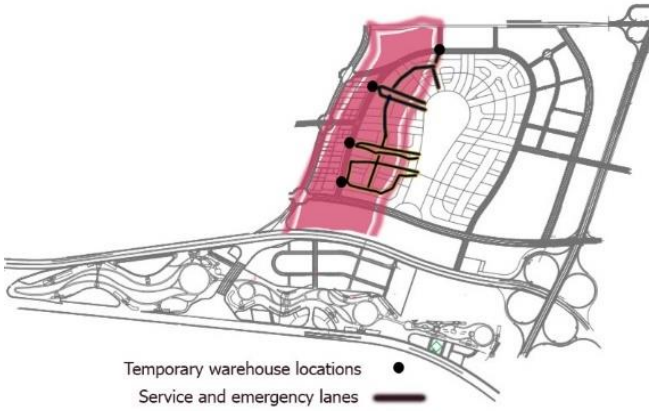


Figure 47: Temporary warehouse locations in flash flood times, source: the author

Indicator – ٧.2: STOCK MANAGEMENT

Interventions Suggestions Based on Indicator – ٧.2

Inventory management is the process of determining which things to keep in stock, where to store them, and in what amounts. Some items are in such great demand that distribution centers must pre-stock them. Procurement, storage, and distribution of products are crucial because disaster management strategy rely on catastrophe inventories.

The Administrative Capital government must distinguish between items that are required in every disaster (response-generated requirements), such as drinking water and medication, and items that are only required for a certain sort of disaster (agent-generated needs). Response-related needs can be saved because they are required for all emergency operations (floods). It's tough to determine what to keep in stock, in what amounts, and where for orders placed by the agent.

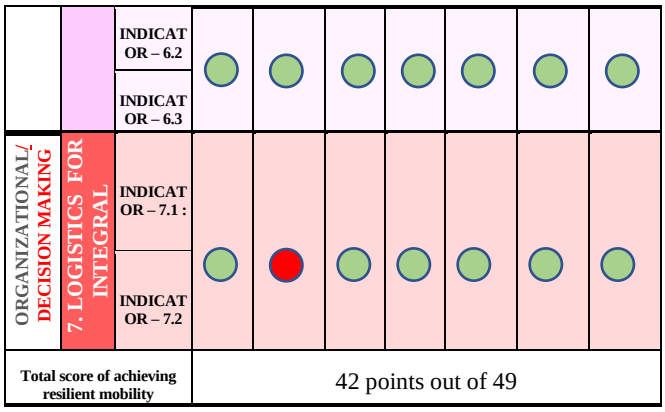
6. Results

By evaluating the strategy applied to the study area, 42 points out of 49 were obtained TABLE 4. which makes urban mobility in the study area resilience to any expected flash flood crises after applying the strategy and its goals.

Table 3

The assessment of the proposed strategy on the application area, source: the author

DIMENSIONS	GOALS	RESILIENT SUSTAINABLE MOBILITY INDICATORS (RSSI)	The Indicator levels of measuring (49 points)						
			PRINCIPLES FOR ENHANCING RESILIENCE						
			REFLECTIVE	ROBUSTNESS	REDUNDANCY	FLEXIBILITY	RESOURCEFUL	INCLUSIVE	INTEGRATED
RESILIENCE TECHNICAL / SYSTEM	1. VEHICULAR TRAFFIC CONTROL	INDICATOR – 1.1 :	●	●	●	●	●	●	●
		INDICATOR – 1.2 :							
		INDICATOR – 1.3							
	2. ATTENTION TO TURN TOWARDS PUBLIC TRANSPORT	INDICATOR – 2.1 :	●	●	●	●	●	●	●
		INDICATOR – 2.2							
		INDICATOR – 2.3 :							
		INDICATOR – 2.4 :							
	3.IMPROVISING ACCESSIBILITY (REDUCE THE NEED TO	INDICATOR – 3.1 :	●	●	●	●	●	●	●
		INDICATOR – 3.2							
	4. DEVELOP ALTERNATIVES TO MOTORIZED	INDICATOR – 4.1 :	●	●	●	●	●	●	●
		INDICATOR – 4.2 :							
	5. RESILIENT MULTIMODALITY	INDICATOR – 5.1 :	●	●	●	●	●	●	●
INFORMATION	6. ICT-SUPPORTED	INDICATOR – 6.1							



Conclusion

With rapid urban growth and instability in the current age of uncertainty and with the global trend towards finding resilience cities that can withstand the current sudden and unexpected crises. The urban mobility sector is on the list of sectors in any city, the most and the fastest to light up in the event of any turmoil. Moreover, the study noted that it is the future vision of the Egyptian cities and the new headquarters for any administrative transaction, which makes starting to develop a resilience strategy and applying it to it a first priority for the New Administrative City.

The principles of resilience must be established in Egyptian cities, especially since the general trend internationally has become directed towards joining international institutions such 100RC that support the resilience and that financially support the joining cities and increase their chances of increasing resilience and thus making them safer cities to live in. Accordingly, the government realizes and has the desire to strengthen the foundations of resilience and establish its principles, but it lacks study and planning.

This study examined the possibility of creating and using new strategy as a new basis for measuring the ability of smart Egyptian cities to achieve resilient urban mobility. It is an essential support for making strategic decisions about the resilient city as it provides the basis for local strategies rather than personal guesswork and opinions.

This study focused on smart cities, since ICT has a key role in news of crises, as well as accelerating the reaction and following up the situation accurately, but the matter still continues to move the strategy towards traditional cities and measure the extent of its success or whether it needs to be modified to keep pace The traditional solutions of the old cities, since there are many old cities that are exposed to risks that must be taken into consideration, especially as they contain a very large number of residents

This study is an ongoing research and is still in the process of searching for the preparation of resilience strategies that can support the planning and implementation process. It may take time. However, it is a call for researchers to activate resilience in sectors other than mobility so that the strategy becomes integrated in all sectors. in general, it shows the ability of Egypt as a Mediterranean country to join global institutions that care about and support the resilience of cities, as it proves that it has the willingness to modernize this the situation.

Recommendations

According to the analytical and empirical study, the following main recommendations should be considered, which will be directed according to their sectors to benefit from

- **Scientific community recommendations:**
  a) Future academic studies should concentrate on resilience in areas besides urban mobility.
  b) Researchers should work to build many more specific and accurate indicators of resilience in other sectors of cities as possible, then try mixing them with the proposed resilient urban mobility indicators after validating and examining them to be the basis of an integrated Egyptian resilience strategy.
  c) The massive bulk of social media data is going to waste. Future research could focus on how it can be used to better understand resilience decision-making behavior at the individual and group levels, as well as how social media data can help predict outcomes.
  d) Holding international conferences to promote resilience and generate actionable recommendations
  e) Cities should work with national and local research institutes, as well as hazard monitoring centers, to document and assess past and potential hazards, as well as risk scenarios.
- **Recommendations to the Ministry of Housing, Utilities, and Urban Communities.**
  a) In traditional, crowded cities, experts can integrate human behavior into emergency response and model it in real time, resulting in evidence-based policymaking and long-term urban resilience strategies.

b) Considering superblock and 15 minutes' concepts as some of the best district design solutions.

- **Recommendations to the Ministry of communications and information technology**

a) The significance of establishing communication and information technology in both new and traditional Egyptian cities, as it is a positive aspect that supports in response time and disaster prediction. To create an integrated local plan across all urban sectors.

b) The Egyptian Digital Transformation Strategy envisions a connected, participatory, and hard digital government intends to help citizens and promoting efficiency by establishing a connected, secure digital society.

c) Maintaining and expanding smart infrastructure, maintaining its privacy, and fending off possible cyber-threats

- **Recommendations to the government of Egypt's New Administrative Capital**

a) Expand the case study process to include the entire New Administrative Capital, dividing the city masterplan into resilient areas using a list of indicators to create a database, where maps can assist planners and stakeholders in decision-making later in the urban mobility development process through resilience.

b) Many projects are focusing on introducing modern distribution models and solutions, some of which can be implemented on a large scale to transform The Administrative Capital into a logistics project that focuses on several initiatives such as the use of environmentally friendly transportation, the introduction of traffic areas, logistics / shipping stations / and advanced information systems.

- **Recommendations to the Ministry of Transportation**

a) Effective mobility expansion, with offers and opportunities for young person to purchase bicycles and electric scooters.

b) Based on the plan and indicators provided, the Egyptian Ministry of Transport could also develop a separate policy aimed at resilient mobility. The indicators are suited to each city and its status, as well as the role of civic engagement in each city.

c) minimize individual transportation demand, which has begun to rise as a result of overpopulation issues.

d) Increasing service frequency to avoid overcrowding while keeping an appropriate degree of cleanliness and health in an attempt to reincorporate people to public transportation.

e) Pedestrian paths must be maintained and made more efficient, and bicycle parking must accommodate all types of bikes and be easily accessible.

- **political recommendations**

a) The local government must activate and implement general and integrated resilience strategies and tools in smart and traditional cities, so that the local goal is to achieve fully resilient cities that lead Egypt to become an resilient country that tops lists of organizations calling for resilience with its pioneering experiences.

b) Activating collaboration systems among policymakers, implementing agencies, and funders in order to achieve integration with in resilience plan

c) Calling for a Middle Eastern and African conference tables to build an integrated plan for the area that places its population on a secure road by allowing them to live in resilience cities.

d) Increase cities' potential to develop local resilience strategies/plans.

e) Local governments and national authorities must collaborate in order to apply and adapt national policies and legislation to local situations. Local governments, on the other hand, should have in place the legal and institutional framework required to implement disaster risk reduction and resilience-building measures.

f) This research is a proactive step toward the development of Egypt's Resilience Authority, which will be led by the Council of Ministers. This authority will lead by the Chief Resilience Officer, will be in charge of putting Egypt's resilience strategy into action, working closely with city mayors, city council department heads, and other key partners. The Resilience Office will be responsible for:

- As needed, the Resilience Strategy will be monitored and revised.
- encouraging best practices, by supporting in the establishment of a network of organizations and stakeholders involved in the resilience field,
- Fostering a resilient culture; this may require collaborating with a variety of municipal departments to assist them plan, identify annual priorities, and set budgets in a coordinated, cross-departmental manner.
- Coordination of multi-sector grant and funding applications with Egypt City Hall departments and other key stakeholders in order to implement projects that enhance and resilience Egypt.

- **Recommendations for the society and civic engagement**

a) In high-risk areas, citizen groups such as informal settlements, business owners, and other associations should participate in risk assessments and share their findings, and come up with solutions and plans to solve them.

b) Residents and users must accept the challenge of changing their modes of transportation, and companies must implement smarter and more appropriate multimodal transportation solutions.

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