

Transportation Feasibility: Visions and Strategies of the Proposed Urban Transport Project in Port Said City

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ABSTRACT

In urban areas, transportation planners go towards forecasting changes in travel demand induced by alternative transportation policies. This paper aims at determining transportation problems that need to solve such as the inflation of car ownership and taxis that occupies the most usable transport modes in Port Said city. A study area includes seven main zones; origins and destinations that are considered links producing and attracting trips every day. This study is organized into two parts. The first part is about how to clarify visions needed to achieve social and economic goals with the suggested Port-Said Strategy Transport (PSST) project. The second part concerns studying the proposed strategies suggested for rising the effectiveness and mobility of transport from the base year (2019) to the forecasting year (2030). Such enhancement can be reached using modern public transport policies such as BRT and sustainable transport strategies. After analysing the proposed strategies according to the social, economic, and environmental aspects using the sustainable and green strategy is the most effective solution to achieve the pre-clarified visions.

Keywords: Feasibility visions, BRT, sustainable transport strategy, social fairness, urban environment

1. INTRODUCTION

The feasibility study is a main revise to manage and forecast how to control the upcoming transportation projects with many visions. It tends to reach the social and economic goals according to the nature of each region. For example, Port Said city is considered the third most important city in Egypt after Cairo (the capital) and Alexandria [1]. It is located in at the entrance of the Suez Canal and located on the shores of the Mediterranean Sea. It should be a strong engine to drive the Egyptian economy towards keeping its position as the economic and cultural center in the Arab world as well as Egypt in the future [2]. The following part describes the proposed FS visions on Port Said transport system and a relationship between the feasibility study visions and transport modes that assist such visions.

1.1. Feasibility Study (FS) Visions

In transport sector, FS aims at social and economic goals to ultimately achieve three visions illustrated in Fig.1; each of them is the vital factor to improve the quality of life.



Figure 1: FS social and economic visions

Vision 1: Achievement of sustainable growth is the most important vision for any feasibility study. A sustainable social and economic growth, in terms of people's quality of lives and the urban economy, needs to be assured.

Vision 2: Declaration of social fairness benefits of the development should not be concentrated on selected groups but also should be equitably prevailed for all the people. Getting one happy must not worsen another. The social fairness is the key for that vision.

Vision 3: Improvement of urban environment is one of essential human rights for urban habitants to enjoy a sustainable urban life and economic activities keeping away from any fear of environmental risks.

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1.1 Transport Sector (TS) and Feasibility Study (FS) Visions

Transport sector (TS) means all modes of transport and responsible governments that should offer a suitable way to transport for each person with different in income. An economically effective urban transport system should be re-structured in such ways that travel time and costs spent for all urban activities can be minimized. Also, capital investment for construction of the system and recurrent expenditures for the operation and maintenance of the system can be economically feasible. There is a definite relation between the transport sector in Port Said city and each one of visions.

TS and vision1: Transport sector plays a significant role to materialize first visions. The Port-Said urban transport system should be developed to satisfy the following three missions: economically, operationally, and long-term usefully. Economically effective urban transport systems since a transport cost is a part of diseconomies against the economic efficiency, the transport cost needs to be minimized to realize a sustainable social and economic growth. An economically effective urban transport system should be re-structured in such ways that travel time and costs spent for all urban activities can be minimized. This can be obtained from using a public and mass transport mode to reduce car ownership. While, the capital investment for construction (operationally) of the system and recurrent expenditures for the operation and maintenance of the system can be economically feasible in future (long-term usefully).

TS and vision 2: It is significantly responsible for assuring the social fairness that provides users with equitable movement accessibility for their employments, medical cares, educations, and social services places. Then, user's transport movement should be guaranteed by the fairness public sector for making their daily activities.

TS and vision 3: the mechanized transport means generates less environmental pollutions such as fossil fuels used for the energy source. It is expected to reduce risks from traffic accidents. Making best use of modern technologies and human intelligence, smart and environment-friendly transport systems should be realized to improve the urban environment.

2.THE PROPOSED PORT-SAID STRATEGY TRANSPORT PSST STRATEGY

2.1 PSST strategy steps

The proposed PSST strategy has five main steps that are illustrated as follows:

STEP 1: Improvement of the urban mobility

For the future evolution of People's mobility improvement, converging forces will transform the urban transport mobility such as:

- Maturing power train technologies
- Using stronger and lightweight materials
- Rapid advances in connected vehicles
- Shifts in mobility preferences
- Emergences of autonomous vehicles

STEP2: Optimal infrastructure development & management

Port Said public transport system is an impediment of optimal infrastructure development. Public transport system PTS should be undertaken. PSST efficient user-friendly system, as the backbone of urban mobility infrastructure, is considered as an application of an integrated system network structure for passenger and cars. It is expected to be the effective infrastructure investment.

STEP 3: Safe and environmental-friendly Transport

Safety is a critical factor to alleviate social and economic losses. At a social standard, pedestrians may take a priority in traffic operations and should be fostered among all people. At the environmental level, risky society should be remodelled to realize a sustainable wealth of people. Safety plan of transport have many sides:

- Improving traffic management with using Information Technology System (ITS)
- Implementing environmental measures
- Facilitating the human factors such as a training and traffic awareness

STEP 4: Provide the right of transition for all classes of people

The right of transition should be equally provided for all people with either low or high incomes. The social welfare sector needs to address effective measures even in the transport sector based on a definite policy that any social exclusion may not be accepted referring to the constitution. For this step, the same previous plan sides of step 3 are recommended.

STEP 5: Establishment of sustainable transport policy

An integrated policy implementation, a strong leadership for appropriate and timely decision-making and a sustainable mechanism to meet financial demands need to be established to make the PTS more rational and functional. For these reasons, several institutional reforms should be taking into action such as:

- Organizing a single authority for policy coordination and integration
- Strengthen the financial mechanism for capital investment such as Port-Said Bus Rapid Transit BRT project, Monorail, and the integrated public network.
- Using non-traditional transport policies to make streets for all applicable transportation modes that is called "complete streets policy" to enable safe access for all users, including pedestrians, bicyclists, motorists and transit riders of all ages and abilities [3].

2.2 PSST strategy objectives

PSST strategy is designed to alleviate urban transport problems and contribute to the sustainable development of Port Said city. Three key objectives form the foundation of planning efforts:

- To formulate a furcating master plan for the urban transport network in the study area at 2030;
- To conduct a feasibility study for the priority project(s) identified under the master plan (however, this object shall be undertaken as a follow-up effort to the master plan study); and
- To carry out technology transfer to the Egyptian counter personnel in the course of the study.

The transport strategy embedded in the Master Plan must concurrently contribute to an efficient economic structure of the region, strengthen linkages with other inter-parts as well as Port Fouad region and neighbouring countries and provide a base for market-oriented transport activity.

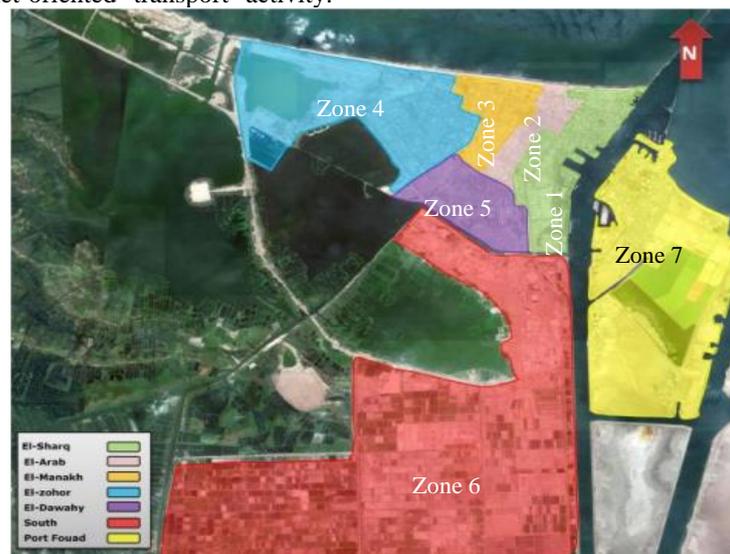


Figure 2: Port Said Study Area Map

Source: <https://www.sciencedirect.com/science/article/pii/S1110016814000969>

3.1. Characteristics and Problems of the Present Port Said Transport System

Personal cars and taxis are the most usable transport modes unless in few links that using minibuses with un-arranged network and management system. The study area includes seven main origins and destinations that produce and attract many of trips; work or non-work trips every day. There is another kind of trips that transport from PS to PF by ferries over Suez Canal. Furthermore, cargo transport trips in Port Said port that is a focal point for commercial, cultural, religious and economic activities.

The urbanization is still progressive and its entire transport system has worsen despite that the government has striven massive efforts to tackle with transport issues such as road traffic congestions and environmental deterioration, and introducing a bus network. Yet, an intermodal system has not been structured to lead to a substantial solution. All previous master plans are concentrated on ports development [5] or in pavement replacement.

The inflation of population causes many problems if the transport system still without development with its small

Future planning efforts must gradually shift from improvement of present deficiencies to realization of a transport system founded upon sustainable evolution and integrated, mutually supportive transport solutions.

3. CHARACTERISTICS OF THE CASE STUDY

The surface area of Port Said city is around 1350 square kilometres with a population around 890,000 inhabitants in 2019. Also, the city has seven main administrative divisions: El Arab, Ganoub, El Zohour, El Dawahy, El-Manakh, El Shareq, and Port Fouad [4] as shown in Fig. 2. The city hosts some remarkable monuments and sites making it the second largest port in one of the most important cities in Egypt besides its vital location at the Northern entrance to the Suez Canal. The present Port Said transport system characteristics and problems are briefly illustrated.

area and increasing number of trips in Port Said city. This study discussed seven problems noticed in Port Said transport systems which are as follows:

1) The rapid growth of private car ownership and usage

In the period since 1990 has rarely been accompanied by a corresponding upgrading of the road network. These increases will probably continue into the twenty-first century, further exacerbating the problem. In Port Said city, the annual car ownership increases by 22.3 % [6].

1) Crowding operating impact

While urban transport has had a tremendous liberating impact, it has also posed a very serious problem to the urban impact in which it operates. The motor vehicle has been responsible for that adversely effects of physical surrounding problems.

2) Traffic congestion

The congestion occurs when urban transport networks are no longer capable of accommodating the volume of movements. The location of congested areas is determined by the substantial transport framework and the patterns of urban land use and their connected trip-generating

activities. Very well-marked peak during the daily journey-to-work periods varied in time and the level of traffic congestion.

3) Passengers congestion

It occurs inside public transport vehicles at such peak times and causes injury. A very high proportion of the day's journeys are made under conditions of peak-hour loading during which there will be lengthy queues at stops, crowding at terminals, and excessively long periods of claustrophobic travel jammed in overcrowded vehicles. If there are enough sufficient vehicles to meet peak-hour demand provided by public transport operators, there will be insufficient aid off-peak to keep them economically employed.

4) Pedestrians Safety

Attempts to increase their safety have usually failed to deal with the source of the problem (i.e., traffic speed and volume) and instead have concentrated on restricting movement on foot. This obviously worsens the pedestrian's environment, making large areas 'off-limits' and forcing walkers to use footbridges and underpasses, which are inadequately cleaned or policed. Additionally, there is obstruction by parked cars. The increasing pollution of the urban environment with a traffic noise and exhaust fumes affecting pedestrians that suffering in most Port Said zones.

5) Parking difficulties

Port Said city is suffering from few parking spaces. Car drivers, stuck in city traffic jams, are not actually trying to go anywhere. They are just looking for a place to park which are considered the added trips. So, the parking problem is an urban transport problem. Fuel consumption is one thing but being smart enough to find a stall to park is another thing. However, it is not just the motorist that suffers, Port Said city is disfigured by parking ground areas or multi-storey parking garages with high fares that are turned into un-used areas.

6) Traffic environmental negative impact

The operation of motor vehicles is a polluting activity. While there are innumerable other activities which cause environmental pollution as a result of the tremendous increases in vehicle ownership, society is only beginning to appreciate the upsetting and dangerous consequences of motor vehicle usage. Pollution is not the only issue. Traffic noise is a serious problem in the central area of Port Said city and there are other environmental drawbacks brought

about through trying to accommodate increasing traffic volumes. The vast difference between private and social costs is one, which has so far been allowed to continue without any real check. The un-aware society of such effects makes the motorcar is the base offender.

3.2. Port Said socio-economic data

Using individual grouping based and the recent modal split [7]; mode choice percentage is estimated and illustrated in Fig. 3. Economic expansion is well on-going continuing improvements in productivity and well-being are expected. As economic growth continues, changes in transport activities and behaviour will follow outfit. Thus, transport planning must gradually shift from improvement of present deficiencies to realization of a transport system founded upon sustainable evolution and integrated mutually supportive transport solutions.

The proposed strategy is particularly suitable in the 30-year planning horizon. The future growth in income will inevitably cause an increase in trip making as well as changes in the types of modes used to accomplish such trips. It is likely that private modes of transport, such as passenger cars, will continue to become increasingly popular with the area's people. The key issue is how to manage growth in transport demand by developing transport systems that ultimately enhance economic productivity, increase personal mobility, and improve the urban environment and ensure financial viability. A key consideration in this regard is that ultimately the need to move people must take superiority over the need to move vehicles.

A need for capital-intensive improvement projects has been confirmed as part of investigative efforts. So, this will require careful thought regarding investment decisions. Domestic funds will likely be limited for the foreseeable future, thus, international funding in the form of aid, grants and other monetary mechanisms is expected to evolve as an important source of finance including the participation of the private sector. Data collection for the seven administrative zones (see Fig. 2). Forecasting trip generation using trip rates according to population and passenger car variables are illustrated in table 1. The data was collected using questionnaires with stated preference questions to predict the socio-economic data in future using the empirical sequential method technique. The trip generation, trip distribution, modal split has been predicted. The forecasted generating trips are estimated using Port Said city trip rates depending on population changes [8].

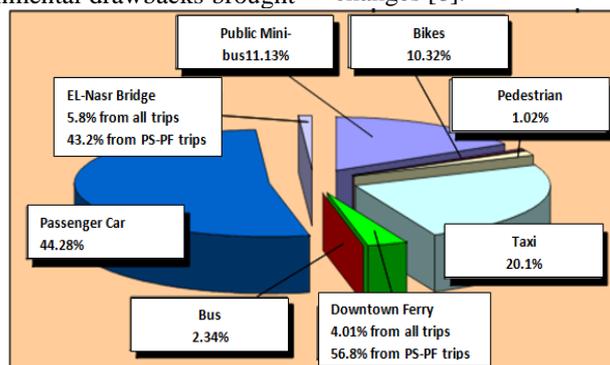


Figure 3: Forecasting modal split values 2030 [12]

Table 1: Number of the current and forecasting population, trips, economic and motorization rates

Data	In base year 2019	In 2030
POPULATION (persons)	890,000	1,300,630
TOTAL NO. of TRIP GENERATION (trips/days)	114590	197655
ECONOMIC GROWTH	6.1%	9.3%
MOTORIZATION	65.3%	32.9%

Source: current trip generation and no. of trips was calculated by manual survey and trip generation rates [8]

The population, no. of trips, and the economic growth are forecasted to increase by 46%, 72% and 3.1%; respectively in 2030. This increases the need for many modern transport strategies that can accommodate those changes and congestion of roads. The motorization is expected to reduce by 32.4%. Such reduction may be a reaction of go towards using sustainability policies to reduce car ownership [8, 9].

4. ALTERNATIVE STRATEGIES AND OPTIMAL TRANSPORT NETWORK ANALYSIS

Strategies are evaluated by using indices of the effects to the three basic visions:

- 1) Economically efficient urban transport system.
- 2) Equitable people's mobility; and
- 3) Alleviation of environmental problems.

There were treatments to reduce delays and travel time for the next ten years in Cairo study [10]. A contribution protocol between Egyptian ministry of transportation and Port Said government, the new plan of transportation had been set for the next ten years. This study takes two proposed treatments that were introduced in that protocol. Strategy1 (the current case of transport), strategy 2 using Bus Rapid Transit BRT line system that were proposed by this study [11], plus several projects which are proposed

by government such as improvement of the PS-PF transport system, strategy 2 (BRT public transport system) for vision 1.2, strategy 3 (Sustainable transport strategy) such as using bikes to reduce congestion and increase green transport culture in developing countries for visions 2 and 3. This strategy is assumed to be the most ambitious transport network [12]. Traffic assignment is the most important goal of the study which the proposed strategies can show the effect on transport status on urban city network. This study used ArcGIS software with PS Google Earth Road map, traffic assignment had been developed at current year and for all strategies achieved 2030 using forecasting traffic data and links of the future plan. The methodology is the empirical 4-steps sequential modeling method. O-D matrix for the generated and attracted trips is shown in appendix 1. To get O-D matrix for base year, a sample size is taken from each zone and revealed data is collected by making questionnaire. Road classification according to functions, capacity, and speed is shown in Table 2. Capacity of roads is calculated using the simplified highway calculation method [13].

4.1. Strategy 1: the existing status of the base year (2019)

This strategy is a mirror for the present situation of PS transportation system with some under construction plan to increase the width of lanes in the arterial roads. The transportation status in the base year 2019 is explained in table 3. Port Said city traffic demand (pc/day/direction) estimation map (strategy1) is shown in the Fig.4.

Table 2: Road classification according to functions, capacity, and speed

Road	Function	No. of lanes/direction	Capacity (pc/day/direction)	Speed (Km/h)
Mohamed Ali St.	Urban Arterial	3	46,000	60
23 July St.	Urban Arterial	3	42,000	55
23 December St.	Urban Collector	3	23,000	40
El-Obor St.	Urban Collector	2	16,500	40
Other roads	Urban Locals	2	5,000-1,000	20- 45

Source: road function classification according to *Federal Highway Administration* [14]

Table 3: transportation status of strategy 1, base year 2019

Modes	Project components
Road network	Under construction plan [15]
Taxi	All links
Minibus	30 th st. and 23 july st.

Source: manual survey and PS governmental transportation authority, 2019 [15]



Figure 4: Port Said city traffic demand map, base year 2019

4.2. Strategy 2: Bus Rapid Transit BRT line system

For 2030 forecasted data, Bus Rapid Transit BRT line system will be assumed to be one of the big projects to decrease using of passenger car and to solve the problem of few links to PS downtown [15]. It delivers fast and efficient service that may include dedicated lanes, bus ways, specialized vehicles, and enhanced stations. The rectangular line will be proposed to take Mohamed Ali St., 23 July St., 23 December St., and El-Obor /Moubarak St.

to conflict on the main station at position 1, five main stations will be assumed to be for BRT line as shown in Figure 5. It is supposed to connect with work and school destinations (industry, commercial, education) and accommodate most of trip purposes. Feeder roads are main collector roads that intersect with the main BRT routs at stations. Minibuses will be available to reach stations from any zone. The estimated Port Said city traffic demand (pc/day/direction) is shown in Figure 6.

Table 4: transportation status of strategy 2, forecasted year 2030

Modes	Project components
Road network	The proposed project [15]
Taxi	All links
Minibus	30 th st. and 23 July st.
BRT	BRT line(see Fig. 7)



Figure: 5 the proposed BRT line (strategy 2)



Figure: 6 the estimated Port Said city traffic demand map for strategy 2

The traffic assignment is made before policy using data collection of trips in 2019. The assignment is estimated using two stages capacity restraint method using *Bureau* function for the relation between the estimated times and travel demand after BRT [16]. The expected time is calculated according to the speed and distances. When comparing the previous assignment with other in strategy 1, traffic demand at all links inside the polygon had been reduced as shown in Figures 5, 6. More than 37% of car users are expected to use BRT instead of their cars when transport from/to any zone on the selected main arterial roads. The reason of such reduction that people who use passenger car is expected to go towards using BRT with low fare according to low income levels. For trips from/to downtown, the travel time is expected to be reduced compared with travel time using any other transport mode because of a high speed of BRT.

4.3. Strategy 3: Sustainable Transport Strategy

Using data of the base year and forecasting data (2030) [12], the sustainable transport strategy is proposed. Sustainable transport also called green transportation such as making continuous safe bikes lane beside cars with maximum safety considerations and standards. The proposed project is expected to reduce car occupied from 56% to 33% in the project year 2030 and reduce CO₂ emitting by 22.1% [15, 17]. This will be with awareness rising towards green transportation. The evaluation summary is illustrated in table 6.

Table 5: transportation status of strategy 3, forecasted year 2030

Modes	Project components
Road network	Under construction plan for 10 years [15]
Public transport	
Taxi	All links
Minibus	30 th st. and 23 July st.
Bikes	30 th st., 23 July st., 23 December street

Table 6: Evaluation summary of all strategies

Competability aspects	strategy 1 (Base year 2019)	strategy 2	strategy 3
Economically efficient urban transport system			
Cost (L.E million)	-	180	12
Economy(B/C)	-	92	-
Trip speed(km/h)	18.2	23.5	12.5
Modal share of public transport%	42	75	45
Congestion(v/c)	0.86	0.68	0.81
Equitable people Mobility			
Population within 500m along PT(thousands)	235	568	311
Allevation of environmental pollution			
Co ₂ emission(x 10 ⁶ ton)	10.8	9.2	5.6

From the previous table, for Port Said city, strategy 3 is recommended because of the low cost and high CO₂ emission reduction of strategy 3 with approximately 50%. Strategy 2 is a perfect solution for big cities such as Cairo or Alexandria to have the benefit that cover the huge cost.

5. CONCLUSION

Feasibility study is the first step for the transportation development. The inflation of population will cause many problems if the transport system still without development, with small area, and increasing of buildings of Port Said city. This study is discussed seven problems noticeable in Port Said transport system, such as the rapid growth in private car ownership and use in Port Said city, crowding operating impact, traffic congestion, person congestion, pedestrians safety, parking difficulties, and traffic environmental impact.

To increase transportation management efficiency, this study proposed PSST that classified into the following five steps:

- 1)Improvement of urban mobility for the future evolution of people's mobility
- 2) Optimal infrastructure development & management
- 3) Safe and environmental-friendly Transport
- 4) Provide the right of transition for all classes of people
- 5) Establishment of a sustainable transport policy

To achieve the maximum results of transportation management efficiency, the study proposed two strategies and compared with the current transport status (strategy 1) in the base year (2019). Strategy 1 is the status, strategy 2 is BRT public transport system, and strategy 3 is

sustainable transport strategy such as using bikes to reduce congestion and increase green transport culture in developing countries. More than 37% of car users are expected to use BRT instead of their cars when transport from/to any zone on the selected main arterial roads. The study analyses the network after strategy 2 is perfect for big cities such as Cairo or Alexandria to have the benefit that cover the huge cost which is estimated to be 180 L.E millions.

Using policies that make streets safer and increase mobility for any users that uses cars, bikes, on foot, and any other mode such as complete street policy can be assumed to enhance public transport system. It encourages street connectivity and aims to create a comprehensive, integrated, connected network for all modes to reach sustainability transportation in urban areas.

Also, green transportation is a good solution. Using new versions of bikes such as light -electrical vehicles and solar -assisted personal devices help people to leave cars and go towards riding safe bikes. This will reduce air pollution by assisting non-motorized vehicles and expand land accessibility.

In future work, the macroscopic demand modelling will be important especially after implementing new projects. Also, the impact analysis of transport network for the new projects of Port Said Million City to increase its area and capacity will be assumed. This will be made by simulating the actual traffic, for each strategy, using simulation software such as VISSIM and analysing the real transportation network using ArcGIS network analyse facility.

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Appendix 1

O-D matrix of the generated /attracted trips (forecasting cases) person trips/day

To \ From	1	2	3	4	5	6	7	Total generated trips
1	4,232	5,400	3,574	5,786	6,000	10,546	5,565	41,103
2	11,364	2,543	4,500	7,878	2,768	2,991	1,453	32,044
3	12,034	3,654	5,776	2,345	1,879	2,243	2,220	30,151
4	8,342	7,444	3,211	2,330	1,789	2,675	1,244	27,035
5	5,352	3,768	4,400	1,767	2,545	2,454	1,232	21,518
6	6,002	4,990	4,100	2,789	1,900	1,654	2,822	24,257
7	10,003	2,545	3,000	1,244	1,213	2,556	986	21,547
Total Attracted trips	57,509	30,348	28,561	24,139	18,094	25,120	14,970	

Inter-zonal trips are illustrated in the diameter that use the main local roads in Port Said traffic network (see fig.4)