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Creation of a transport system in Port Said, Egypt

What kind of transport for a developing country?



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Founded in 1859, the town of Port Said was created as a place to live for those building the Suez Canal. The city is situated at the end of the Canal, by the Mediterranean Sea. Nowadays, it is the third largest urban agglomeration in Egypt. The harbor is this town's central point. Close to Port Said, on the other side of the Canal, there is another town called Port Fouad. The two cities have experienced rapid growth and used to be a tax-free area that brought a lot of foreign business into the country. But in the 1970s, Port Said and Port Fouad experienced an economic crisis.

On August 2015, a new canal was created on the other side of Port Fouad. The project added a new 35 km long (22 miles) shipping lane to the existing 164 km long (102 miles) canal, allowing the sailing of ships in both directions. It also included the deepening and expansion of a 37 km long (23 miles) section from the existing canal.

Furthermore, in the near future, the agglomeration of Port Said-Port Fouad will experience a lot of changes, as the Egyptian government wants to create a new hub in Suez's region, making Port Said regain its past prestige and become a center for logistics and harbor activities. A lot of money will be invested in that project and soon, the town of Port Fouad will build a new harbour, gaining new inhabitants.

There is, however, an important issue to take into consideration. Indeed, the agglomeration is becoming bigger and bigger but there is no organized system of transport in the city, which is becoming overwhelmed by traffic jams. There are lots of cabs, minibuses and personal cars – all of which are informal means of transport. Moreover, another struggle at this point is the physical isolation of Port Fouad, because of the canal. That's why we want to create an organized public system of transport that could resolve the congestion and reconnect the two siblings towns.

First, we will make a diagnosis on the agglomeration to find the right solution and solve the different issues of the town. Our proposal would be to install three lines of BRT, a metro cable and a shuttle bus system to answer the transportation needs. Finally, we will explain every operation, provide a guideline for maintenance and establish the costs and benefits of our project.

1. Diagnosis

In 2011, Egypt experienced a big revolution which led to the resignation of the president Mubarak, and currently, the new President is Fatah al-Sisi. Egypt has been badly affected and has suffered an economic crisis. Today, things are getting better thanks to a growth of 4% and a lot of Arabic countries contributing to the Egyptian economy. Those financial loans help Egypt invest in a lot of infrastructure projects which focus on transport and electricity. Transport is organized by a ministry called the MOT. There are two big urban transport systems in Egypt – one underground, in the town of Cairo, and one tramway in the city of Alexandria.

In Port Said, the population isn't experiencing a large, natural increase but it will with all the projects starting there, there will be a lot of work migration in Port Said. There were 676 412 inhabitants in 2015 and the projection for 2026 is 848 605 inhabitants.

In the town of Port Said, there are six districts: Al Zohour, Al Manakh, Al Arab, Al Sharq, Al Dawahy et Al Ganoud and we must add the city of Port Fouad. To understand the urbanization of Port Said, it is important to know that the town was at the beginning, composed of only two districts, settled to the north-east of the city: one Arabic district and one European. It impacts our diagnostic because the width of the streets and alleyways are different between the two districts- the streets are smaller in the Arabic district. These two old districts are in a bad condition and are protected as a UNESCO World Heritage Site. This part of the town lost a part of its population and today, there are only public administration and public services. But the four other districts (to the west and south of the city) which were built later, have a different structure, are more dense and most of the population lives there.

In Port Said-Port Fouad, there are three ports and many inhabitants work for the port or for the factory area settled to the south of the town. But Port Said is also a really religious town that attracts students. Most of the population is working but the unemployment has grown from 11 % in 2007 to 26 % in 2014.

Between Port Said and Port Fouad, there is only a small ferry to cross the Suez-Canal but it has little use because of a low frequency and the difficulty to sail next to the huge ships coming from the Canal. It is significant for a town as big as Port Said that there is no public transport. There is only private and informal mini-buses and taxi inside the town, there is no transport plan, timetable, or any organization. For the road transport, there are two big highways that serve Port Said. The modal share of walking is 27%, 26% for the taxis, 16% for mini-buses and 28% for private cars. There is also a terminus railway station in Port Said that brings flows of people from all around Egypt. With that many cars in the city, this town has a lot of traffic jams: it is really hard to go through the city.

A powerful participant in Port Said district is the authorities of the Suez Canal, who get money from the canal taxes. This participant wants to develop Port Said and is ready to invest together with the government 15 million dollars.

The Suez Canal Economic Area project involves developing a free zone and trade hub along the banks of the newly-expanded Suez Canal area and especially in Port Said-Port Fouad. The Area will be 461 km² and is composed of four areas and six harbors. The harbors are East Port Said Harbor, West Port Said Harbor.

This means a lot of people will arrive, but also the huge need for an organized transport to relieve the city of traffic congestion and to connect the two cities. We will have to do with a denser city, a not really stable ground and a population who is not accustomed to public transport.

We want to create a new network of transport in Port Said-Port Fouad. It's obvious that we needed a BRT, less expensive than a tramway. Plus, it needs less work, it is easier to use and quicker to set up. We also want to create a strong line between Port Said and Port Fouad with a metrocable.

To connect Port Said and Port Fouad, two solutions were possible: either an underground crossing, with a road tunnel for a BRT; or an air crossing. The first solution is actually not suitable for our transport project because the Suez Canal has been made very deep to let the biggest and most heavily loaded ships to pass. That kind of tunnel will exponentially increase the cost of civil engineering. For these reasons, a cable transport has been chosen and is justified because it crosses a major obstacle. The length of the metrocable will be 800 m and it is connected to the future BRT. We want 3 000 pphd. Our choice was made according to costs, speed, lift and desired height. We chose a double cable car solution which provides us with 150 seats. It allows us to cross the canal in 155 seconds.

2. The future transport network

Despite the interest that the local government has shown to develop the governorate of Port Said, the city doesn't have yet an organized and reliable public transport system for its residents.

History has taught us that future income growth will inevitably catalyze an increase in trip making. Therefore, in order to enable the population to keep up with the future economic growth, it is important to provide everyone with fair access to places for jobs, education, medical care, social services and other daily activities.

Thus, the main objective of a first public transport would be to fulfill these daily needs for the inhabitants of Port-Said, offering regularity and a high-quality service.

In order to do so, we tried to understand the main travel trends around the city of Port Said. Lacking information about travel flows and their distribution, we based our

analysis on the socioeconomic information we had about the city and its population. Then, we defined both emitting areas and receiving ones.

The first ones are areas from which travel flows arise at morning hours. They were defined considering that the traffic emitted from a given area would be proportional to the population living in it. Therefore, we have chosen to aggregate the densest neighborhoods in terms of population ('Al Zohour' and 'Al Dawahy').

The second ones (receiving areas) were defined by listing the main centers of activity of the city, such as universities, hospitals, main train stations, main markets, mosques, harbors, big factories...

This first step has enabled us to draw the main traffic corridors at Port Said. They coincide with the arterial roads.

In order, to insure an adequate service, we have thought about morning rush hours, since it is when traffic gets to its peak. To do so, we have considered the commutes from and to work and school.

Then, we included many local constraints related to the city. First, we have chosen not to serve the historical center, as it is considered a UNESCO World Heritage Site. Secondly, we have decided to double the capacity in certain parts that would have to support heavy traffic.

We have also designed our offer such as to provide many connections between the three lines that constitute our transport network. Finally, considering the low traffic by the airport of Port Said, we have decided not to serve it.

In order to make our system even more attractive, we have also added a shuttle bus to serve the industrial zone. This supplementary line will be connected to the main ones, the railway station and the harbor. Its main objective is to cover the commutes for people working in factories there, providing them with a fast line. Therefore, it will insure a regular service at morning hours (one bus every 15 minutes) and a less regular service for the rest of the day (one bus per hour).

3. Infrastructure

The platform of the BRT requires a width of 2.55 m corresponding to the width of the rolling stock, plus 0.5 m on each side for the leads, thus resulting in a width of 3.5 m per track. In the context of the project, the roads where the BRT would pass have a width of approximately 30 m. This width will enable the installation of two roads, allowing a two-way circulation. The platform will have a width of 7.50 m including a sidewalk of 50 cm.

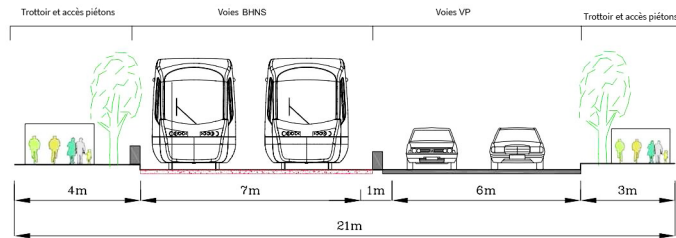


Figure 1: Distances

It would be necessary for the track dedicated to the BRT to be easily spotted by all the users, whether they are users of the BRT or the drivers of private vehicles. A red surface bituminous mix has been proposed.

The length of the platforms will depend on the gauge of the rolling stock (18 m) plus 1 m on each side and the length of the ramps (5 m). In short, we foresee a total length of platforms of 30 m.

The platforms will have a maximum height of 21 cm to allow an easy climb of the travelers by adding an access for disabled people. The width of the station will be of at least 3.5 m to make the routing easier. To the right of the shelters and ticket dispensers, a minimum width of 1.40 m must be established in order to avoid saturation on the platforms. We will provide a total area for each station: $S = 30 \times 3.5 = 102 \text{ m}^2$.

The model scheme of the station is given below:

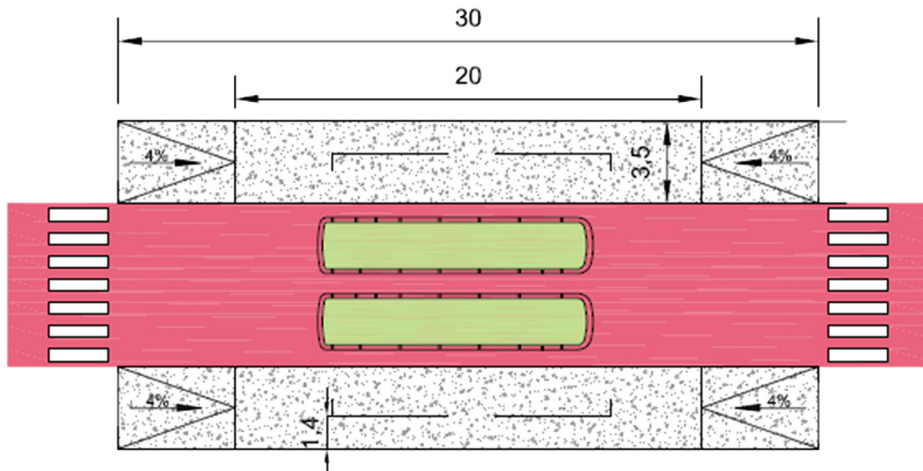


Figure 2: Model scheme of the station

All the intersections the BRT will pass through will be equipped with a specific "R17"-type signaling. This will control the right of the various crossroads (approximately 60 crossroads on the route of the BRT) to manage safely the flows, and give priority to the BRT.

4. Operation and maintenance of the metrocable

There is no standard model for the metrocable, that could make precise ranges of the costs allocated to it. We have therefore used the STRMTG statistical database that provides suitable orders of magnitude we can modulate.

The investments are, as indicated in the table below, in 4 different fields:

Decomposition of costs by post		Unit Price	Cost
Stations	One power station + one return station	€3.5 M and €2 M	€5.5 M
Cables	Tractor cable	€50 per meter	€0.2 M
Cars	10 cabins with 25 seats	€3.5 M	€3.5 M
Pylones	Conventional pylon for a double mono-cable system	€3 M	€3 M
Mishaps, Study-related expenses, contracting authority		15 % of the project	€1.4 M
TOTAL			€10.9 M

4.1. Operations and their costs

Operating costs can be split into three parts:

- expenses related to the operation staff;
- maintenance costs;
- energy consumption related to the operation of cable transport.

Annual operating costs are estimated to be around €1.5 million, based on a daily operation of 16 hours, at a rate of 355 days of operation. The division of the costs is indicated in the table below:

		Unit	Unit price	Cost (million euros)
Personal costs	Staff responsible for the motorization and control of the landing	4 (2 per station) x 2 (slot of 16 hours) = 8	For the year: €45,000	360
Maintenance and service costs	Staff responsible for continuous maintenance	8 x 2 (slot of 16 hours) = 16.	For the year: €48,000	768
	Cost of maintenance and daily maintenance	5680 work hours (16 hours x 355 days)	€60,000 per 1,000 hours of work	340
Energy consumption	Annual consumption	200 MGW/h for 3,000 pphpd	Price of MW: €0.08 / kWh	110
Total				€16 M

4.2. Maintenance of metrocable

The aging of the infrastructure requires maintenance of the equipment until it is renewed. In the particular case of cable transport, there are three types of operations:

- routine maintenance;
- continuous maintenance or systematic preventive maintenance;
- large inspections.

A planning of different aspects of maintenance is described in the table below.

Operation	Frequency	Stop exploitation
Inspection of clamps	Every year by rotation	No
Vehicle inspection	Every three years per rotation	No
Inspection of stations and supports	Every three years per rotation	During the annual shutdown (7 days recommended)
Cable Inspection	Every 6 months	A day

4.3. Conditional preventive maintenance

Continuous maintenance would be managed by the operator in charge of the urban transport network in Port Said, but major inspections and heavy renovation work will be done by the builder who has a more important technical background to deal with this aspect of maintenance. An annual sum will be awarded to the builder, divided into two parts: a fixed annual amount resulting from a tacit agreement between the two parties and a variable amount depending on the operations carried out.

5. Operation and maintenance of the metro cable

5.1. Operation

The chosen transport means is a BRT, 18 m long and 2.55 m wide. Thanks to its capacity, reaching at best 130 passengers, it can transport 1560 passengers per hour and per direction (PPHPD) when the ride is 5 minutes long, 975 passengers with 8 minutes. Thus, the three BRT lines will ensure a maximum flow of 3310 PPHPD, which covers a major part of the estimated needs.

We have then to determine the rolling stock roster in order to estimate the number of necessary buses. The commercial speed has been calculated thanks to the theoretical formula depending on the length of each line the number of crossroads, the average acceleration and deceleration and the normal speed. This commercial speed gives us the travel time for each line: 38 min for the first, 21 min for the second, 28 min for the third. It allows us to estimate the necessary number of buses for each line during rush hour by adding the turnaround and reversal times. Therefore, the fleet is composed of 45 BRT, including a number of vehicles for the reserve. They can drive on the three lines to help the operation.

We have chosen to make the distances between two stops of every 300 m or 500 m of our BRT, which is longer than the distances of a conventional bus line and much more like distances of a tramway. The interval in peak hour will be of 5 min on line 1 and 8 min on lines 2 and 3. A shuttle is also planned between the railway station and the industrial zone. At off-peak times, we plan to reduce the frequency of vehicles to adapt to the demand. As it is done at the Cairo metro, we have dedicated seats to women at the front of the buses: 1/3 of the seats on each bus will be reserved for women to avoid harassment.

With any transport project, efficient intermodality is a key issue for the success of the project. The BRT route allows connections between the metro cable at the commercial harbor. They also provide connections between the BHNS and the train at the railway station, and three connections with the shuttle.

We will also create a car park relay, called P+R, located on the outskirts of the city, to encourage car drivers to access the city center by public transport, by allowing

them to park their vehicles until their return. Therefore, users will benefit from an advantageous rate combining parking + round trip BHNS.

We decided to put the relay car park at the subway cable station in Port Fouad to allow people to park their cars safely until their return. It also allows car drivers to have easier access to the subway cable station to reach the city center of Port Said with the subway cable or taxi boat.

A car park at the crossing of line 3 and the shuttle will allow employees in the industrial zone to leave their cars to return to Port Said and then use public transport. Vehicles will be parked in the 24/7 car park. The users can easily reach the city center with an efficient relay to the different lines of the BHNS.

6. Maintenance

The maintenance of infrastructure and rolling stock is an important activity to ensure the sustainability of all installations. It must be defined to ensure optimal cost management while respecting safety requirements. It will provide availability and reliability of infrastructure and rolling stock, while ensuring quality of service. For this project, two maintenance and storage centers will be built. They consist of maintenance workshops to accommodate the BRT, storage tracks and spare parts stores to ensure the minimum stock required to maintain the availability of the system. The planned maintenance for this TCSP project will include two areas of activity: fixed installations and rolling stock.

The maintenance must be done in a preventive and/or corrective manner, systematically or conditionally. It will be done either with internal means or by a subcontractor. The way in which the maintenance will be carried out will be defined later by the future operator. At this stage of the study we have considered that a large part of the maintenance is carried out by the operator. It can be classified into several levels:

- simple maintenance (lubrication...), which can be carried out by the drivers before each service;
- complex maintenance, requiring medium to large-scale operations such as component repairs or replacements, controls, examinations of internal parts of equipment, visits. This is entrusted to the production units;
- maintenance requiring major operations carried out in general by the manufacturer.

The fixed installations include on ground structures, platforms, hydraulic structures and civil engineering structures, as well as the roadway structure, stations and signaling systems. For the Port Said project, the route of the line will be established essentially following the ground's level so there will be few earthworks to be monitored.

6.1. Rolling stock

The maintenance of the rolling stock concerns the buses and the embedded equipment. It will be classified in two categories:

- preventive maintenance or routine maintenance of rolling stock. This consists of scheduled operations and regular maintenance to avoid failures. It can be carried out according to time (e.g every 6 months) or kilometers (e.g every 10 000 km).
- corrective maintenance, which is subdivided into two classes:
 - rolling stock troubleshooting;
 - repair is a corrective action on rolling stock when there is a working problem.

6.2. Characteristics of the maintenance and storage center

Two storage maintenance sites are planned as part of the Port Said project. The first is located at Pk 0 + 000 of line 1, in the EL Zouhour district, and the second on Pk 13 of line 3, south of the AL Dawahy district towards the industrial zone.

The two sites have no particular constraints towards the neighbours, as they are installed outside urbanized neighbourhoods. They are accessible by road. The location of these two sites was selected near the BRT terminals: one to the northwest and the other to the south, so as to optimize operation by reducing the number of kilometers to be traveled between storage and terminals of the line.

For the operations' division, there will be offices for operating staff, controllers, maintenance staff and the person in charge of maintenance staff. This staff is responsible for the maintenance of rolling stock, signalling equipment, infrastructure and stations. Every line will be managed from the control station (PCC).

The social offices are intended for workshop and network operators. There will also be sanitary facilities, locker rooms, a refectory, etc.

6.3. The rolling stock maintenance center

This center will allow BRT vehicles to be sheltered from the weather. It also provides the following functions:

- storage of buses;
- fuel-filling of buses;
- external washing of buses;
- interior cleaning of vehicles;

- storage and supply of spare parts;
- storage of service and maintenance vehicles;
- storage and management of waste.

For the outside areas, the center also includes the bus storage area, a service station, a cleaning station and parking spaces for staff and service vehicles.

6.4. Estimation of the maintenance and storage center:

The storage center has a size so as to contain 45 BRT vehicles 18 m long. The site provides parking areas for service vehicles and staff vehicles. It needs to contain 5 service vehicles and at least 60 seats for staff vehicles.

At this stage of the study, a total area of 2.5 hectares is estimated for the two centers. The estimated staffing for the center is 142 staff members.

How will the maintenance be organized ? The project provides for 25 km of line operated by a fleet of about 46 buses with intervals of 5 to 8 min, depending on the line. The maintenance team will consist of a team leader and 5 persons (5 km per person), who will be responsible for the maintenance of fixed installations (infrastructure, signaling equipment, hydraulic works, etc.).

Infrastructure maintenance staff can help with the exploitation of the line by driving of BRT during rush hours, replacing the WD driving staff on some of their time. They will therefore be entitled to drive.

7. Governance, pricing and founding

7.1. Governance

Port Said does not currently have a urban transport network, so it is necessary to think about the transport governance. The three BRT lines and the metrocable brings a new demand which includes an existing transport network. Access to the information and access for the disabled people remain main issues that a public authority could handle as a leader for the local transport policy. Like in Cairo or Alexandria, a Transport Organizing Authority needs to rule and master the urban transport system to propose a strong and reliable network where multimodality is promoted.

For this reason, as the National Authority of Tunnels acts in this way for Cairo and Alexandria, it could be qualified to rule, since it has already experienced transport management. The NAT as TOA would have four missions:

- define the current transport offer with its lines and its pricing policy. This former should be reconsidered each year in order to be coherent with the local demand and its socioeconomic specifications;
- develop the urban transport network with a long-range planning. This goal will be supported by a research center focused on the transport demand;
- fund and invest in urban transport, which is a direct consequence of the first point;
- provide and define a quality of service required. This mission goes with the passenger information.

In order to have a consistent offer, minibuses could be added to the whole range of skills of the public authority. They currently propose an irregular and widespread service that could be more regulated and complementary to the rest. The organization would be composed of approximatively 100 civil servants dispatched in four directions. Each one will deal with one of the topic described above, two other general directions would complete the structure to manage the activity of the organization and one would deal exclusively with the public service delegation. Before detailing the socioeconomic evaluation, the pricing will be specified.

The main mission for the NAT is the transport report. This policy must meet the social expectations of the users but also cover its operation costs. Feedbacks proved that pricing is not sufficient to cover it. Two others sources of funding will complete it: public funding will be granted from the governorate of Port Said and the ministry of transport via the NAT and the "versement transport" tax. The government of Egypt is indeed interested in this French measure and wishes to apply it to fund transport infrastructures.

Now, the question is what is the optimal price for users? According to the pricing settled in Cairo and Alexandria and the life cost in Port Said, we have estimated that a one-trip ticket would cost E£0.5. A discriminatory pricing have been thought to provide an accurate subscription transport for some targeted socioeconomic classes. Basing on the age distribution and socioeconomic stats that we dispose, settled pricing would bring €2,220,000 per year, a comfortable income for the operation.

7.2. Funding

More generally, a financial settlement must be done to get a sustainable business plan. It can occur in two distinct phase of the project.

The first one before starting the project: it aims at finding loans with lower interest rates granted by national and international banks to support the project launch. The "Agence Française de Développement" already acts in Egypt since 2007. The longs-

tanding partnership has been visible in many public and private projects to develop urban planning in many fields. Especially, a think-tank took place in November 2016 to discuss about the financing arrangements for Egyptian transport project. Moreover, Japan has built strong relationships through economic help in the whole African territory. The JICA, Japan International Cooperation Agency, proposes financial help but also a support to train future workers in the maintenance field. It could be a true change for Port Said to have a very qualified staff. It would operate its own urban transport network without requiring foreign companies to deal with heavy maintenance like it would be in the short term for the cable railway. The possible amounts for these financial helps remain undetermined and need to be negotiated.

The second one is mainly public funds to assist the operation. The governorate of Port Said will contribute to cover operation costs and will be joined by the NAT, which will act in two ways: it collects the "versement" transport tax as a public transport authority and it will invest in the urban transport network, whether it is for the rolling stock, the infrastructure or the studies to plan a long-term project in Port Said. It can rely on an annual E£700 financing.

Conclusion

One of the major problems highlighted in our prospective study is the need to free the city of Port Said from traffic jams in order to meet the growth targets planned by the Egyptian government. To make these achievements possible, it is essential to create a real transport system in the city to simplify daily mobility and make it a more attractive city. Our network will be accompanied by a new transport governance with the introduction of an ATO. The work project will last 3 years starting 2019. A phasing of four steps was estimated in a way to enable a successive commissioning of the lines. The socioeconomic analysis made for the project has shown that the project of urban transport system designed for Port Said has a positive value and its internal output is higher than 4.5 %. These results confirm the socioeconomic added value the project will have on people's daily life.