TRAFFIC CONGESTION SUSTAINABLE SOLUTIONS: MASS TRANSPORTATION
(RAILWAY UPGRADE)

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Abstract. Traffic Congestion is a major problem in most cities. It’s a non-productive, time-wasting activity for most people especially private transportation. It causes the inability to forecast travel time accurately, leading to drivers allocating more time to travel "just in case", and less time on productive activities. The stress and frustration possessing the motorists encourages road rage and reduces their ability to be productive thus decreasing their health. The traffic congestion also reduces the air quality and is a major cause of using enormous amounts of non-renewable energy. The size of the problem varies from one area in a city to another but at the end of the day is a major problem for all mega cities. Alexandria is directly affected by this problem and its linear planning may be helping the increase of the congestion due to the long distances one has to travel to reach a certain destination, but it can also be used as a suitable solution if handled properly. Various attempts to solve the problem have been made but none have been proven to be affective. Surprisingly some of the solutions caused even more traffic congestion. In order to find the proper solutions for the traffic congestion in Alexandria various factors must be studied carefully to lead the proper choice of decision based on previous experiences of other cities with similar conditions. This research aims to study the traffic congestion caused by the increase in private vehicle ownership and the possible sustainable solutions which will be directed towards the upgrade of the railway which is categorized as mass transportation. Mass transportation ensures safety, improves air quality and saves energy, time, money and space. Upgrading the existing railway and choosing suitable parking spots to encourage the “park and ride” concept is the suggested solution to decrease the congestion problem. A careful study of the railway’s current conditions and the important points it can connect is essential to reaching the right design decisions. If done properly this proposal can solve a big part of the traffic congestion problems in many areas in the city.

1. Traffic congestion

1.1. Introduction

Traffic congestion is a relative problem and is directly related to the chosen area of study. Not all the causes and solutions of the problem can be generalized. The street network design, landuse, traffic management and operation, passengers and motorists’ behavior, street network design are all factors that affect the traffic flow. While studying an area none of these factors can be ignored as they are all directly connected to each other.

Since Alexandria is a developing, growing, crowded megacity mass transportation should be a priority in the government’s upgrading plans, which is not the case. The public mass transportation network in Alexandria barely exists. The affordable public transportation modes are the bus, tramway, mini-bus and “toktok”, which are undependable as there are no specific routes nor is there a specific schedule or stop for any of them. The conditions a person has to bare to use the public transportation system is inhumane because of the lack of maintenance and overcrowded vehicles. This drives most of the middle and upper class to avoid using it totally, leaving the public transportation to “the poor”. When in desperate need of using the public transportation, the upper and middle class’ choice is the taxi which is expensive and also undependable.

The government prefers spending money on developing roads ignoring other solutions that might me more effective and efficient serving the users. This encourages more people to buy cars, convinced that it’s the wisest and fastest choice as a mode of transportation.’
There are multiple solutions for the traffic congestion problems. Every solution is suitable for a certain area and has its pros and cons. The solutions can be widening the roads, bypasses (inner ring roads, outer ring roads), bus lanes, one way streets, increased cost of car parking, banning cars from the city center, improved public transportation and the “park and ride” system. A suggested solution is the upgrade of the railway system, combined with the “park and ride” system, along the linear city which is an efficient mass transportation mode, serving and covering most of its sectors. Therefore, this paper will handle the process of upgrading the railway system and justifying the idea, it will also handle the possible solutions of marketing the idea to the public.

1.2. Traffic congestion in megacities

Developing megacities without a rail-transit system suffer from a major congestion problem and a disastrous CO2 emission level. Mass transportation combined with the “park and ride” system, especially the railway has been found to be very effective in maintaining mega-cities sustainable. Many metropolitan areas have developed transportation plans and strategies to outline their vision for the future. For example, New York’s regional transportation plan (PLANYC, 2007) goal is to meet the city’s and region’s transportation needs through 2030 and beyond, and to improve travel speed. The specific initiatives include improving local commuter rail service. São Paulo’s integrated urban transportation plan—PITU 2020 (Governo do Estado de São Paulo, 2009)—includes the integration of the transportation network and thereby efficiently utilize the available resources and the reduction in the use of private means of transportation, to reach a certain improvement in the quality of transportation services, preservation and promotion of urban spaces.

Both plans aim to reduce the traffic congestion by improving mass transportation systems and reducing the use of private vehicles. The aim is to enforce this concept on the case of Alexandria while creating a suitable framework guided by the previous experiences of other mega cities.

Yoshitsugu Hayashi created a method of three steps to reduce the traffic congestion and therefore reduce the CO2 emission level which is the guideline of the framework that will be enforced in the case of Alexandria. The three steps are: firstly, AVOID trips, secondly, SHIFT from high carbon mode to low carbon transport systems, and finally, IMPROVE the mode through technology and policy.

1.2.1. AVOID

The construction of new roads encourages the users to own private vehicles and therefore it’s possible for them to choose a residence that is far away from their workplace. This causes further trips and more CO2 emissions. To AVOID these long trips, the spotlight must be directed on the mass transportation system and in this case the railway.

Three mega-cities are selected for comparison: Tokyo, Bangkok and Beijing. Benefitting from the priority given to its rail transit system, Tokyo suffered less from road congestion during its urbanization process. On the other hand, Bangkok experienced its infamous congestion in the 1980s due to a highly car dependent transport system, with no urban rail transit system. The deferral of rail construction has an important relationship with heavy road congestion in these cities. It can be observed that the slowest development of urban rail transit systems has led to the poorest traffic conditions in Bangkok. Comparing the two Chinese cities, the reason why Beijing suffers from heavier traffic congestion can be explained by the earlier completion of its road network, which formed the habit of prevalent car-use in its citizens at the start of rapid urbanization.

1.2.2. SHIFT

The first question to be asked is which mode is a better solution for less congestion? Most decision makers prefer to develop the road system to relieve traffic congestion overlooking the fact that developing the railway system can absorb the traffic.
demand and reduce the demand of car use. One of the reasons developing the railway system is avoided is its high construction cost.

The second question to be asked is which mode is a better investment for lower CO2 emissions? According to Yoshitsugu Hayashi’s research, in urban transport, the per person-km carbon dioxide emission of each transport mode varies according to the urban population density. It is pointed out that the higher the population density, the greater the advantages accrued in improved rail transit systems.

Cars are regarded as the most optimal transport mode for low CO2 emissions only when the population density is below 3,500 person/km2. In most developing megacities, the population density is often much higher than that, hence the rail transit systems are highly recommended for them, while cars are not.

1.2.3 IMPROVE

If we really need to use cars – a high carbon emission system – in densely populated areas because public transportation is not available for some origins and destinations, we should then improve the technology for engines, fuels and networks.\(^{11}\)

As we can see in the analysis, advancements in engine and energy consumption technology alone would be hardly sufficient to achieve CO₂ reduction targets. In this forecast, it is assumed that, firstly, the vehicle statistics are provided by the Ministry of Land, Infrastructure, Transport and Tourism (Japan) and IEA (China) and, secondly, that vehicle-km is proportionate to the number of vehicles.

One scenario is that CO₂ emission rate per vehicle is the same as that in 2010, and the other scenario is that frontier technology for vehicles and their energy consumption (e.g., Electric Vehicles, Fuel Cell Vehicles, and Carbon Capture and Storage) will be improved and proliferated. Japan has declared its target for 80% reduction of CO₂ in 2050 compared with 1990. However, the eventual reduction will obviously be lower than 80% if it hinges only on technological progress. In China, the CO₂ emission will still increase dramatically if mitigation efforts are dependant only on advancements in technology. Therefore, we do need to parallel promote the AVOID, SHIFT and IMPROVE measures outlined above.

2. Problem statement

As for Alexandria, the lack of organized controlled public transportation systems is frightening and the government can’t disregard this issue. The available public transportation in Alexandria are the tramway, which doesn’t cover the whole city and is overcrowded in rush hours and is hardly maintained, the railway, which is in terrible condition therefore only used by the lower class, most of the train cabins don’t even have seats or doors, the bus, which is also in terrible condition with no fixed stations or timing and no place to sit or even stand, micro- and mini-bus, which are not safe especially for females, “toktok”, which is illegal but still exists, the Red Bus which is sometimes used by the middle class because it’s more expensive than the other public transportation which makes it harder for the lower class to use it so it’s mainly oriented towards the middle and upper class, and finally “Taxi Call” which is ridiculously overpriced but safe and clean.

This has lead the middle and upper class to purchasing private vehicles, in some cases, for every member of the family who has a valid driving license. The capacity of the streets and the available parking spots are not designed to contain this enormous number of vehicles. The increase in private cars ownership in Alexandria is causing a major problem and it will continue to increase as nothing is being done to solve or at least decrease the problem.

Therefore this paper will concentrate on the upgrade of the railway system combined with the “park and drive” system. The suggested case study is upgrading the existing railway and choosing suitable spots where an individual can park their vehicle and ride the rail. The railway of Alexandria starts at “Mehatet Masr” station and ends at Abou Quir. “Sidi Gaber” station is considered to be the main terminal although it’s not at the beginning of the line. This goes back to the station’s location, as it’s more suitable than “Mehatet Masr” due to Alexandria’s linear form. The secondary stations are neglected and unfamiliar to many of the middle and upper class category.

The theory of the increase of private car ownership is based on observation as a user and proven by a questionnaire targeting the middle and upper class. The questionnaire is expected to back up the theory. A full study of all the existing stations locations and their surrounding urban context is crucial to the upgrading process. The social aspect has to be regarded as it

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\(^{11}\) Transport Solutions for Congestion and Climate Change Control in Developing Mega-Cities Yoshitsugu HAYASHI
affects the behavior of users which is a major issue reflecting directly on the upgrading process.

Fig. 2 The space required to transport sixty people using private cars, a bus or bicycles

3. Proposed Solutions

Since Alexandria is a linear city, the solutions mentioned above can be very effective. This railway can connect important spots and make it possible for the users to reach them without having to go through the trouble of being stuck in traffic jam. Therefore studying the landuse around the railway line will have a major effect on the decisions taken regarding the upgrade and the chosen areas for the parking.

The challenge will not only be the upgrading of the railway, it will also be trying to change people’s behavior. The citizens of the city are used to riding their own vehicles and are convinced that this is the easiest, safest most comfortable way of travel. Therefore the authorities must involve the people while taking the decision of upgrading the railway system. Public participation can have a major effect on the project.

People must realize the advantages of using the public transportation system and how it can save them time and energy and even money.

The first suitable step to be taken is involving the users, ask about their problems concerning the traffic and in their point of view, how they can be solved. This can be done through a questionnaire that can lead to a better understanding of the people’s needs and problems. This questionnaire can help to identify the major congestions points. After locating these points, they must be studied to identify the cause of the congestion and whether the mass transportation concept can help solving the problem or not. It can also help when deciding which points will be chosen as a parking zone for the people wanting to ride the rail to a certain destination and then come back and pick up their cars and ride for a much shorter distance. This questionnaire will also prove if the theory of most families owning as many cars as the members’ number is true or false.

As mentioned before, one of the main causes of the congestion is the increase of private vehicles and this increase is caused mainly because of the lack of public transportation. So, the conclusion is that this railway will be mainly oriented towards the middle and upper class who own private vehicles. Therefore, the questionnaire will also be oriented towards this class.

Based on the analysis of the questionnaire only 20% of the females who took this questionnaire use the available public transportation while 25% of the males do. The rest rarely uses it and almost never. The percentage of the males using public transportation was expected to be a lot larger than the percentage of the females. Surprisingly, they were almost the same percentage which is even more alarming. When asked about the reasons why they don’t use public transportation most of the females’ answers were safety issues and sexual harassment while both genders complained about people’s behavior, lack of cleanliness, lack of availability, the transportation methods being too crowded, lack of seats, lack of time respect and lack of speed limit respect and therefore being a life threat. Some summed it up in saying “I’d rather use my car than deal with the drivers of public transport.”

Fig. 2 The lack of mass transportation is obvious in this picture

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83 Google images
transportation”. When asked about the reasons of traffic congestion in their opinion, most answers were the increased haphazard number of the mini- and micro buses and toktok, poor urban design, lack of traffic management and many agreed on the increased ownership of cars, although they are a part of the problem.

98% of the families of the people who took the questionnaire own at least one car. The average number of the family members was 4 people, so if we calculate the number of the family members and the number of cars owned by them we’ll find that 106 people of 172 own an individual car used only by this person (62%). The percentage is alarming and should be considered as an alert for a disaster coming sooner that the government expects it to. When asked if they are willing to use a railway as a transportation method instead of using their car 98% answered YES. Some added that they prefer using public transportation and wish it was available, safe and comfortable and that this is their only method of transportation when travelling abroad. This acceptance of the idea is very encouraging and should motivate the government to taking action as people are willing to cooperate and give up using these private vehicles. The users’ acceptance of the project is the first step towards its success.

The second step is carefully studying the road network infrastructure leading to the railway. The railway can be considered to be an attraction like any other attraction that leads to the increase of traffic at certain times which are called “rush hour”. Therefore the network of street must be improved and upgraded as well, or else the railway stations are going to become a cause of traffic congestion instead of being the solution. The suggested method is to divide the railway into sectors and dealing with every sector at a time. This method makes it possible to study these sectors in detail and cover all the points of study that are needed to get the optimum results. It will make it possible to identify every area’s problems and causes of congestion and therefore find the suitable spot of the stops and also deal with the poor urban design and the lack of traffic management. This method can be applied only if the idea is supported by the government and is essential before taking any final design decisions.

When starting to think about upgrading the railway one of the first questions that come to mind will be where will the people wanting to ride the railway park? Therefore, a parking lot will be included in every train stop design. If there is no enough space for a parking lot it can be an underground- or a multi story-garage. The park and ride concept is a suitable compromise for the both sides, the user and the government. It won’t eliminate the problem of increased private vehicle ownership but it will decrease its negative effect.

Another issue is the cost. The government often avoids these kinds of projects because of the increased cost. Therefore, there has to be an alternative source to finance mega projects like this one. Marketing the project among the private sector of investors might be a wise decision. The government could be a partner so there would be supervision on the tickets’ cost to avoid the possibility of exploitation of customers.

The next step is to suggest where the train stops will be. In order to decide the train stops spots there has to be a certain criteria. First, the distance between the stations has to be suitable, the stations should be close to major attractions, there has to be an appropriate space for parking if possible.

According to Christopher MacKechnie, the appropriate distance between the stops is 1.5 kilometers and in some cases it’s prefers to be 0.75 kilometers.***

*** Christopher MacKechnie, The Proper Stop Spacing of Rapid Transit Lines

Fig 3. The percentage of males and females using public transportation in Alexandria
4. Case study

In our case the stations are placed every 1.5 kilometers. There are five existing stations that will be upgraded and used as stops (Masr Station, El Hadara Elbahareya Station, Sidi Gaber Station, El Souk Station and Abu Quir Station) and seven other additional stops will be added to the railway line.

![Fig.4 A map of the existing and proposed stations spots](image)

These stations can be the link to the uses round it. For example, Masr Station is close to the Alexandria stadium, so the railway can serve this area especially in the time of football matches where masses of people need transport to this area. El Hadara station is a 5 minute walk away from the College of Engineering, Alexandria University, the College of Science, English Girls School and the English Boys School. This station can serve an enormous number of students needing transportation to college. As for the Sidi Gaber Station, it’s close to Sporting Club and Somua club. These are all existing stations; the proposed stations are also close to congestion attraction spots like El Montazah, which is a major tourist attraction and also an entertainment spot especially during the summer time, El Mamoura, and the Arab Academy for Science and Technology (AAST) which is a major congestion cause in the area of Abu Quir especially during the fall semester where the college works with full capacity. The number of students and staff trying to reach the college every morning compared to the size of the street network and its capacity is unimaginable. All the places mentioned above are a cause of traffic congestion at some point of the day or at a certain season of the year, according to their use.

The Abu Quir Station leads to El Tabya which could be a tourist attraction if upgraded and renovated. So, the railway can also be reason certain spots are being revived and reused instead of being ignored and disregarded inspite of its potential and importance. These stops are a suggestion based on general study of the railway line. The detailed study of the each sector as mentioned above might, and most probably will, affect those decisions and might result into some changes of the locations when taking the design decisions

5. Conclusion

According to the analyses and discussions above, this paper’s conclusions may be summarized as follows: Alexandria is a developing mega city with a major congestion problem. Therefore, it’s caught up in an endless cycle of CO2 emissions production and non-renewable energy waste.

After studying the case in Alexandria through a questionnaire the experiment proved that the increased ownership of private vehicles is one of the main causes of the congestion. The study of the physical aspects will clarify the problem furthermore.

The plan to decrease the problem is to AVOID the construction of new roads, which can only be done with the cooperation of the government and the reconsidering of its policies to solve the congestion problem.

SHIFT to low carbon mode, which in this case is the railway, and decrease the number of vehicles producing CO2 emissions. IMPROVE the mode through technology and policy, which is also the role of the government.†††

††† Transport Solutions for Congestion and Climate Change Control in Developing Mega-Cities Yoshitsugu HAYASHI
Raising people’s awareness to the importance of public transportation and its benefits on their lives financially and physiologically is important for the plan to work properly. The railway must be managed properly and maintained on regular basis to avoid future failure of the project.

The financing system for rail transit infrastructure construction may also avert catastrophe for mega-cities on the verge of chaotic traffic congestion and thus emitting unacceptable amounts of CO2. It should be reformed to allow proper reclamation of benefits from the construction of rail transit systems, making invisible windfall benefits to be visibly reclaimed to encourage more investors to fund rail transit spontaneously.

Value capture should be effectively applied in rail transit infrastructure construction and operation projects in domestic financing.††

6. References

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