PUBLIC PRIVATE PARTNERSHIPS IN TRANSPORT INFRASTRUCTURE DEVELOPMENT: A CASE STUDY FOR THE GREATER CAIRO REGION

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Abstract

While charging transport is increasingly used to control the increase of private traffic or to finance the development of new road infrastructure, introducing toll roads is less evident in the developing world, particularly when considering the social implications related to its introduction. Cairo, among many other cities, is presently facing this problem. Although inviting the private sector to participate in the construction of new infrastructure is increasingly perceived a possibility, the discussion of toll roads and charging people for using new road infrastructure can no longer be avoided.

A recent study into the transport system of Cairo[1] demonstrated that among many other needs, new roads will be necessary to keep Cairo moving the next 20 years. Two major questions were investigated in this study and have been presented to the public decision-makers. The first is on how to finance its construction and the second relates to the way a possible participation of the private sector will have to be structured.

Keywords: Transport infrastructure development; Toll roads; Public private partnerships; Optimal toll level; Social impact
Topic area: H2 Public/Private Partnerships and Major Infrastructure Projects

1. Introduction

In a *first* part of the paper, charging on transport and private sector participation in urban transport infrastructure development will be briefly discussed. The paper's *second* chapter will demonstrate on the basis of the CREATS study results, that the transport system in Cairo needs a continued and accelerated development of road transport infrastructure. In particular an Elevated Expressway System has been recommended to accommodate future traffic demand. The conditions for a private participation in the development of that expressway w ill be evaluated in a *third* part of this paper. It is argued by different stakeholders that the participation of the private sector is imperative because the necessary capital expenditure of 7.8 billion Egyptian Pounds for the expressway is difficult to support by the public sector. In a *fourth* chapter, a financial analysis will compare private participation to publicly funding the Expressway System. Computer-based sensitivity analyses will calculate the effects on traffic of toll roads as revenue generating tool and derive an optimal toll level.

[1] "Transportation Master Plan and Feasibility Study of Urban Transport Projects in Greater Cairo Region in the Arab Republic of Egypt" (**CREATS – Cairo Regional Area Transportation Study**); Japan International Cooperation Agency (JICA) Pacific Consultants International, Tokyo, Japan (lead consultant). *All tables and figures originate from the Study, except where stated otherwise.*

In the conclusions, the attractiveness for Cairo of introducing a toll for the Expressway System will be discussed and compared to the conditions under which the development of the Expressway System can be realized by public funding alone.

The conclusions in this paper could be valuable to assess similar situations in mega-cities where toll charging as part of the urban transport policy is considered.

2. Toll charging and the social dimension

Public decision-make rs both in the developed and in the developing world, intent to guarantee future mobility in major cities by introducing a wide variety of measures, focusing on intermodality and public transport. But even with these measures, the increase in private car use is strangling many cities and new road infrastructure will have to be developed to accommodate the ever increasing number of private vehicles. One problem (among many) that occupies public decision-makers is how to finance the construction of new road infrastructure and in that context toll charging is considered a viable option.

In recent years, considerable research has been undertaken on the conditions of introducing toll roads in the developing world. In spite of these studies, many uncertainties re main concerning the terms and conditions for a successful implementation in particular in an urban environment.

One objective of introducing toll charges is to reduce congestion by shifting traffic to other alternative routes and hours with less congestion. In other words, public decision-makers show here the intent ion to manage traffic by imposing a toll on roads where traffic is problematic and congestion a frequent phenomenon.

But toll revenues can be and is also used to finance new road infrastructure and in many cases implies a private participation in the road infrastructure development. In this case , the objective of the toll is to generate revenues for the private partner that (should) reflect a stable return on his investment during the period of his concession. Including the private sector into the development of road infrastructure comes in many variations among which the most important are represented in Table 1.

In most Build Operate and Transfer schemes (BOT), the private sector runs the investment risk, and the investor is re-paid by charges that the operator levies on the users of his road infrastructure. But in many cases, the attractiveness for the private partner remains low due to a high immediate capital investment in respect of a return on the initial investment which is in many cases in a distant future. There are additional risks that further reduce the attractiveness for the private investor, risks among which the political risks are the least controllable. In the developing world, the political risk is higher than in the developed world because of currency instability, complex political decision-making and social priorities which directly affect the possibility to raise a realistic level of toll.

Table 1: private participation in infrastructure development

Options	Asset Ownership	Operations & Maintenance	Capital investments	Commercial risks	Duration (Years)
Service contract	Public	Public & private	Public	Public	1 – 2
Management contract	Public	Private	Public	Public	3 – 5
Lease	Public	Private	Public	Shared	8 – 15
Concession	Public	Private	Private	Private	25 – 30
BOT (and variations)	Private	Private	Private	Private	20 – 25

Source: World BankGroup

To find a sustainable solution to this problem, the concept of Public Private Partnership (PPP) was introduced in the beginning of the eighties. “A public-private partnership is a sustained, collaborative effort between government agencies and private organizations in which each of the partners share in the planning of the project and programs designed to meet a public need and contribute a portion of the financial, managerial and technical resources needed to implement those plans” (Fosler, Berger, 1982). Also public decision-makers in the European Union expressed the opinion that PPP’s would appear to be an interesting tool to realize planned and future infrastructure investments in particular in the context of the Trans European Transport Network or TEN-T (European Commission, 1994).

Whatever form or structure applied in the end, any private participation will require a form of toll charging which will generate a return of investment that is sufficiently attractive for the private partner.

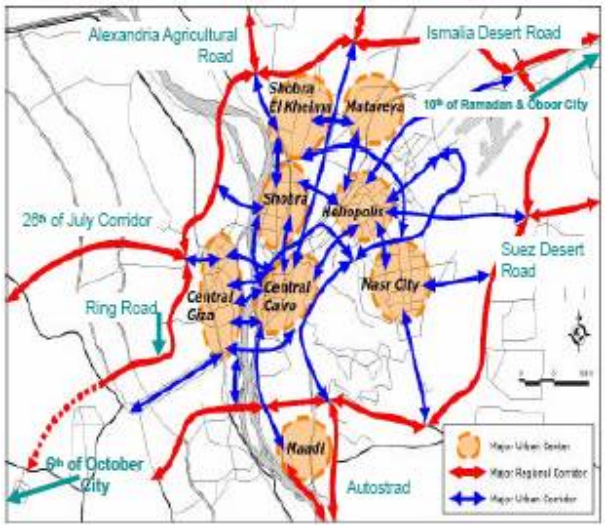
At this moment, many public decision-makers in Cairo agree that the Expressway System is needed to accommodate the expected increase of traffic. Whether toll charging will be a viable option for the expressway is not yet clear and even if it can be proven that a reasonable toll can be calculated for expressway users, introducing the toll is a completely different discussion on the social dimension. But even if a toll system could be introduced under socially acceptable conditions, the expressway will at the end have to be build and it is unclear whether the necessary resources will be available. This implies that a private participation could become necessary and their expected return on investment could become an important factor in the decision-making process.

But an even more problematic question is who would benefit from the introduction of toll for the new Expressway System. It is frequently argued in the professional literature that high-income households would not suffer from the measure or could even benefit from the introduction of road pricing. That same literature argues that the big losers are the low income households who have lesser possibilities to decide their time and travel method for work, and thus cannot avoid road pricing charges. Poorer people generally live more distant from the city centre in areas where public transport alternatives are scarce or not available and their destination is more often located outside the inner city where the public transportation is poorer (see, e.g., Foster, 1974; Arnott, et. al., 1994; or Thomson, 1998).

3. Cairo traffic: now and in the future

3.1. Traffic in Cairo year 2000

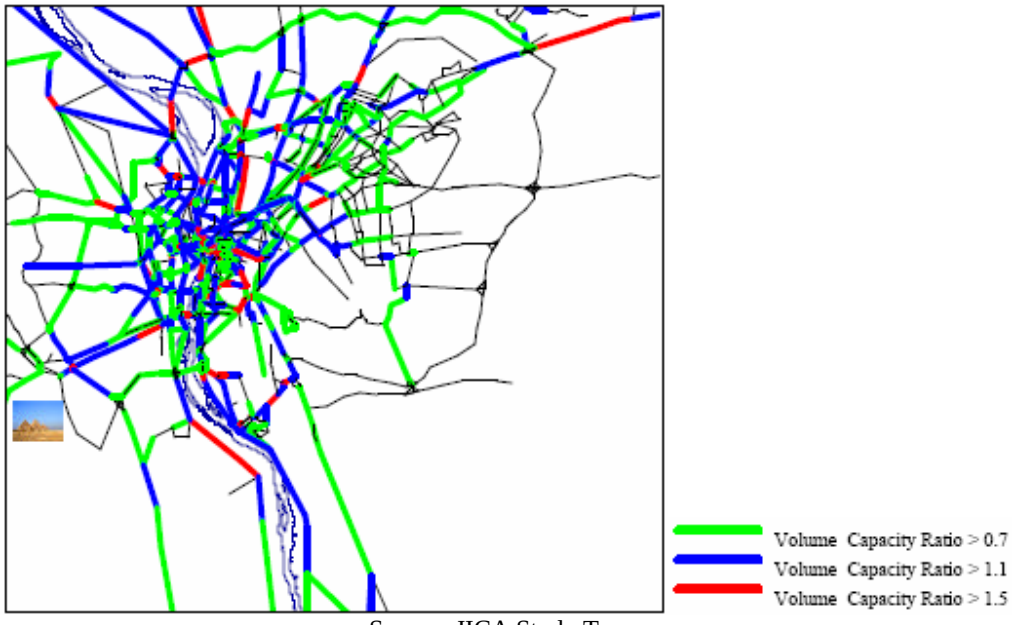
Figure 1 shows the main inter-city corridors, the urban corridors as well as the major districts inside Cairo. The regional corridors have generally a high design standard with a multi-lane structure, having the capability to accommodate high levels of traffic. The Ring Road was planned as physical boundary of urban area, serving as bypasses for regional traffic. The Autostrad was planned to carry a major portion of traffic traveling between Helwan/15th of May City and the urban centres.



Source: JICA Study Team

Figure 1 : Major corridors and urban communities

At present, Cairo is already suffering from major mobility problems, as can be seen in Figure 2. Actual volume to road capacity indicates that many streets inside Cairo's city centre, including several sections of the Ring Road as well as most access roads are over-crowded. The results of various traffic counts show that a daily total volume of 322,411 vehicles per day, or 480,134 PCU (Passenger Car Units) per day goes out and comes into the Greater Cairo Region (Cairo including the satellite cities). Table 2 demonstrates that traffic to and from Cairo city is constantly increasing. National traffic count data show a steady growth of traffic volume on the national highways. Alexandria Agriculture Road is by far the busiest corridor, followed by the Ismailya Desert Road, which experienced a constant double -digit growth in traffic during the last 10 years.



Source: JICA Study Team

Figure 2: Volume over road Capacity (V/C)

Table 2: National Traffic Count Data

No.	Corridor Name	1991 Volume (vpd)	2000 Volume (vpd)	2000/1991	Annual Growth
NH11	Alex. Desert Road	8,821	17,886	2.03	7.32%
NH01	Alex. Agriculture Road	38,919	55,163	1.42	3.55%
NH04	Ismailya Desert Road	8,961	*32,772	3.66	13.83%
NH41	Ismailya Agriculture Road	5,724	10,109	1.68	5.35%
NH03	Suez Desert Road	4,907	10,962	2.23	8.37%
NH21	Upper Egypt Desert Road	8,604	10,349	1.20	1.86%
NH22	Fayoom Desert Road	4,846	10,792	2.08	8.34%

Source: General Authority for Roads, Bridges and Land Transport vpd = vehicles per day
*Note: NH41 Year 2000 Volume is an estimated value from 1999 volume due to the change of counting location.

Traffic on these corridors will continue to rise because economic activity will also in the future remain concentrated in Greater Cairo. At the same time, the population in the main satellite cities is expected to grow and new cities such as Oboor, 6th of October City, 10th of Ramadan City, Shorooq, Badr and New Cairo will have to accommodate for a high influx of people and business, to reach nearly 3 million people in 2022.

Inside the city limits, traffic conditions around major districts inside Cairo show that the traffic flow from Central Giza, Central Cairo through Heliopolis area and Nasr City is the major flow direction in the urban area. Particularly, the 6th of October Expressway is a heavy volume corridor. This inner-city corridor, which is locally called "6th of October Flyover", functions as de-facto Elevated Expressway inside the city. The length of this Expressway is still short (11.3 km) but it can be considered a major aorta for traffic entering and exiting the center of Cairo. Following number can be indicative to appreciate the height of the traffic volume inside the city limits. A total of 896,085 vehicles per day or 1,003,753 PCU per day cross the Nile River and of all bridges over the Nile, the volume on 6th of October Bridge is by far the highest.

3.2. Estimating future traffic: the scenarios

To estimate future traffic in Cairo and assess the therewith related road infrastructure needs, various network scenarios with target year of 2022 were developed, taking into account the urban development evolution and the expected transport demand structure in the future. These scenarios are:

. *Scenario A*: only the network developments, at present committed by public authorities were tested against year 2022 transport demand.

. *Scenario B*: The Maximum Network Scenario tested year 2022 transport demand with the most extensive public transport and road network expansion designed from a capacity building point of view.

. *Scenario C*: the Optimized Network Scenario is the result of various road network tests. Scenario B considered as slightly modified road network as compared to the road network in scenario B, based upon sensitivity tests of various scenario variations.

The test results for each scenario were evaluated via several indicators among which average vehicle speed (km/hr), the share of private (vehicle) transport (%), daily vehicle-kilometers (in terms of PCU/km), and the Volume/Capacity Ratio (V/C).

Also person trips were assessed in other traffic count. These results indicated that, independent of the scenario, it is expected that the current 1.05 million vehicles in the study area will increase up to 2.5 million in Year 2022. This means urban Cairo will have to accommodate 2.5 times more number of vehicles in the area. Furthermore, the impact of the metro (at present 2 lines and line 3 committed) and other high-capacity rail based public transport will certainly increase the average trip speed for entire modes, but it does not mean that the traffic on the road will drastically decrease as can be noted in the review of present and future road utilization. Also this was taken into account when analyzing road infrastructure needs for the future.

The first scenario, Scenario A, consists of only the projects which are already committed in the government and certain to be realized. These "committed" projects include projects under construction, and projects planned under the Egyptian governments current five-year plan and do not include any major infrastructure developments. The main purpose of testing Scenario A is to analyze what would occur if nothing were to be done in addition to these committed projects and identifies the both the future needs and problems in the network. The road investments planned by each Governorate in Cairo would amount to a total investment of 1,566 million billion Egyptian Pounds (LE).

The second scenario, Scenario B, supposes the realization of all the projects which are proposed by CREATS to satisfy future the traffic demand forecasts in the planning horizon of Year 2022. These projects consist of a wide variety of network improvements as well as the implementation of the Elevated Expressway. T he total road sector investment amount according to Scenario B is 11.9 LE, of which LE 9.1 billion is the cost of the Elevated Expressway.

The third scenario, Scenario C, consists of almost the same road network as in Scenario B, but a more fine-tuned elevated expressway network has been considered. In accordance with various testing results, it was identified that one section of the Elevated Expressway was unpopular and since diverted traffic is at present relatively small on these two routes compared with other routes, this section were omitted from the Scenario C network, although it can be considered as a future extension. The total investment amount is LE10.6 billion, of which LE7.9 billion is the cost of the Elevated Expressway. The difference is due to the fine-tuned expressway links only.

The different scenarios also incorporate the public transport network and the testing results demonstrated that the difference in the road network between the two scenarios has no major impact on overall network performance which is similar in Scenario B and C. The real difference in overall network efficiency is generated by the introduction of an optimal public transport network which, in the future, will affect travel choice and patterns. But all tests also demonstrated without any doubt that a comprehensive and modern road network is indispensable for Cairo's future mobility.

The results in Table 3 show that the vehicle trip speed on the road will increase from the "committed network" (Scenario A) to the "Do Maximum" network in Scenario B (9.3 to 11.9 km/hr), which will reduce the congestion by 30%. The daily vehicle -km will increase (127 million to 144 million PCU/km) due to the improvement of the congestion
(1.5 to 1.2) as a consequence of infrastructure improvement for both the public transport and the road network. The table also shows that there is no significant difference between Scenario B and Scenario C because of the similarity of both scenarios. But it is important to note that in the various traffic simulations, large differences are generated by the proposed improvements in the public transport network.

Table 3 : general traffic indicators various scenarios

Indicator	Year 2001 Simulation Results	Scenario A (Year 2022)	Scenario B (Year 2022)	Scenario C (Year 2022)
Average Trip Speed for All Modes (km/hr)	19.0 km/hr	11.6 km/hr	18.2 km/hr	18.0 km/hr
System Average Vehicle Speed (km/hr)	21.4 km/hr	9.3 km/hr	11.9 km/hr	11.8 km/hr
Private Transport Share (%)	29.1 %	38.3 %	42.0 %	42.1 %
2022 Daily Vehicle-km (pcu-km)	62,800,000	127,300,000	144,000,000	139,700,000

Source: JICA Study Team

Between Scenario B and Scenario C, the daily vehicle-km will decrease from 144 million to 140 million PCU/km. But at the same time, the congestion level at selected evaluation points stays almost the same except for the ones where the expressway capacity will influence the V/C value.

As a first general conclusion, the comparative evaluation demonstrates that overall traffic will increase in Cairo, generating a substantial reduction in average vehicle speed. It was also demonstrated that all road infrastructure developments identified on the basis of the study results are indispensable to *keep Cairo moving*, be-it that the introduction of this additional road capacity will not be sufficient to fully accommodate future traffic volumes (V/C is 1.2). Also important to note is that the benefits of Scenario B and Scenario C, as compared to Scenario A, are more in the public transport side, since the average trip speed for all modes will significantly improve (11.6 to approximately 18 km/hr) compared with the average vehicle speed improvement (9.3 to around 11.9 km/hr).

3.3. Future traffic conditions in Greater Cairo: the simulation results

The general traffic indicators suggest that either Scenario B or Scenario C would achieve substantial improvements of road network performance compared with Scenario A, the committed network but, as was already indicated, the difference between Scenario B and Scenario C would remain limited. The V/C ratio for entire network in each scenario is summarized by capacity range and by area (inside/outside the Ring Road) in Table 4.

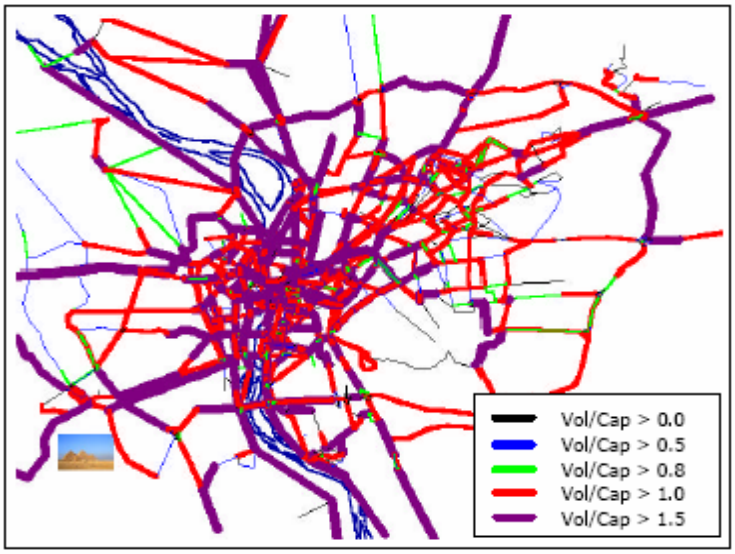
The results in Table 4 suggest that the average congestion on the road will drastically increase from Year 2001 current situation to Scenario A - situation in Year 2022. The V/C for Scenario B is the lowest because the traffic demand on the road would decrease due to the positive effect of the highly developed public transport. The V/C value for Scenario C is higher than that of Scenario B, but it can still maintain an average value of 1.0, which means that the traffic demand on the road is at the level of their capacity on average, even though the congestion on the individual road link will have severe congestion at certain corridors.

Table 4 : Average volume to capacity ratio for entire road network

Capacity Class	One -way Daily Capacity Range (PCU)	Year 2001 Current Situation	Scenario A (Committed Network)	Scenario B (Do Maximum Network)	Scenario C (Master Plan Network)
Inside Ring Road					
Low	<20,000	0.92	1.32	1.24	1.25
Medium	20,000 - 40,000	0.72	1.17	1.04	1.03
High	>40,000	0.61	0.94	0.85	0.91
Total		0.74	1.11	0.93	0.97
Outside Ring Road					
Low	<20,000	0.89	1.33	1.09	1.09
Medium	20,000 - 40,000	0.58	1.11	1.06	1.11
High	>40,000	0.45	1.07	0.98	1.06
Total		0.55	1.12	1.01	1.08
Study Area Total					
Low	<20,000	0.92	1.32	1.17	1.18
Medium	20,000 - 40,000	0.68	1.15	1.04	1.06
High	>40,000	0.52	1.02	0.89	0.96
Total		**0.67**	**1.11**	**0.96**	**1.00**

Source: JICA Study Team

Additional and targeted traffic simulations and analyses focused on the more congested parts of the road network clearly assess road capacity needs for the future. The V/C for Scenario A (Figure 3) shows that many sections of regional primary and urban primary roads will in the future year 2022 become very congested (V/C>1.5). This congestion is also notable on many sections of the Ring Road and on most of the inter-city access roads.

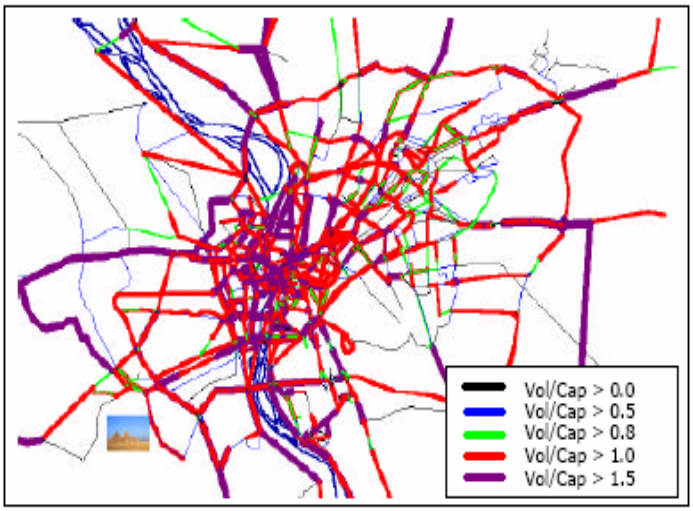


Source: JICA Study Team

Figure 3: V/C Chart for Scenario A Road Network

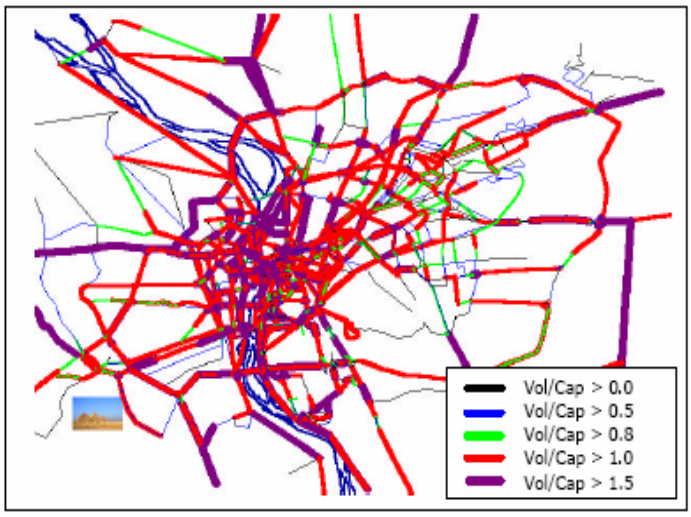
Without any further road construction, traffic in and around Cairo will permanently be congested. All access roads, the Ring Road and most of the inner-city roads have V/C ratio's above 1 and many even over 1.5, indicating that the presently available road infrastructure will not be able to accommodate future increase in road traffic.

Even with major road improvements including the construction of the proposed Elevated Expressway Network, the V/C assessment for Scenario B (Figure 4) and for Scenario C (Figure 5) suggests that in Year 2022, it will be difficult to maintain a daily average of V/C below 1.0 at most of the major roads. This supports the conclusion that the proposed road infrastructure improvements are imperative and need to be completed for traffic conditions in the Cairo region to remain acceptable.



Source: JICA Study Team

Figure 4: V/C Chart for Scenario B Road Network



Source: JICA Study Team

Figure 5 : V/C Chart for Scenario C Road Network

However, the Integrated Transport Master Plan also included a wide range of public transport improvements. If also these investments are realized, overall traffic conditions will

provide because more modal choices of travel will be available at times when roads are congested.

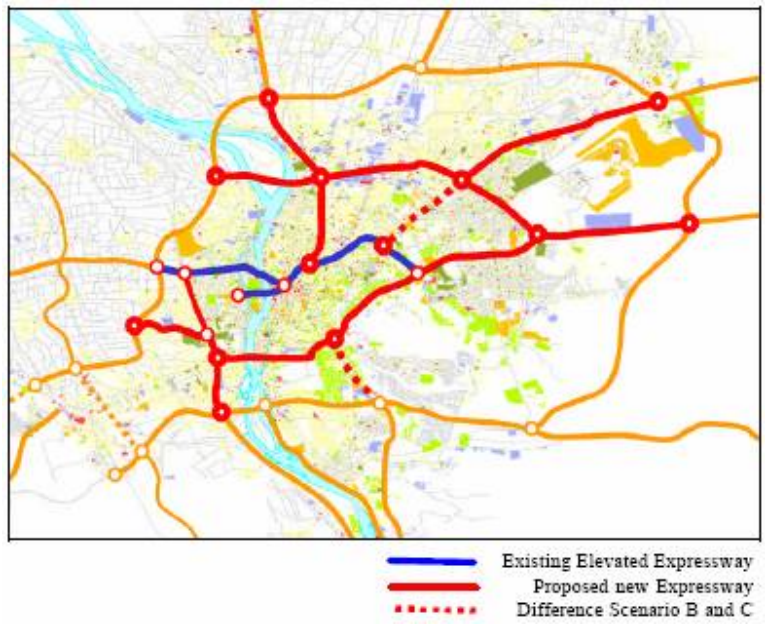
Only with a balanced combination of road infrastructure improvements and public transport developments, traffic conditions in future Cairo will remain acceptable. The joint development of public transport and road infrastructure will significantly improve the all-mode average trip speed as compared to exclusively building road infrastructure.

Although the urban transport policy of the future, as proposed in the CREATS study, gives a higher priority to "people's mobility" rather than "vehicle's mobility", this prioritization does not mean that further road development can be ignored. On the contrary, the sharp increase in vehicle ownership suggests that a substantial increase of road capacity will be indispensable and that for a mega-city as Cairo with a population of over 20 million persons (Year 2022), a well-planned Elevated Expressway System is the only realistic solution.

4. Building roads for the future: the case of the elevated expressway in Cairo

4.1. The alignment of the elevated expressway

The recommended elevated expressway network is formulated with two major planning policies in mind: (1) to establish an "inner ring road" to serve as a bypass for the already heavily congested 6th of October and 26th of July elevated corridors, and (2) to function as a "mini-ring-road" for each urban centre inside Cairo, therewith reducing the congestion by preventing unnecessary through-traffic from entering into these urban centers. The alignment of the proposed Elevated Expressway is presented in Figure 6.



Source: JICA Study Team

Figure 6 : Alignment of proposed elevated expressway network

Although improving traffic bottlenecks continues to be an important issue to solve the local traffic problem, adding a number of new links to the existing network cannot solve the chronic congestion in the urban area. The completion of the 6th of October Elevated Expressway gave a large impact on traffic movement in Cairo. It offered a bypass route from Giza central district

through Helipolis and Nasr City without passing through the congested areas in Cairo main centre. The traffic count results showed that the 6th of October Expressway carries 177,000 – 127,000 pcu/day between Abdel Minim Riyad Square and Nasr Road, and the 6th of October Bridge accessing the expressway accommodates a daily traffic volume of 261,000 pcu/day.

It is clear that this single 11.3 km stretch of expressway cannot solve the future traffic problems in the urban area. The viaduct is at present already always filled with cars, and chronic congestion is observed all through the day. For the long-term road sector transport planning for Greater Cairo, the extension of the Elevated Expressway network will be an important alternative. It will give a bypass function to major vehicular trips with the better level of service. Increasing road capacity by an extensive expressway network should thus give a way to better cargo flows. From an engineering point of view, there is no major difficulty to construct the new Elevated Expressway in Cairo. In fact, Cairo has a greater advantage in this respect compared with other mega cities in the world, which is the available wide road space on many of the arterial streets.

4.2. Financing the elevated expressway: analysis and sensitivity testing

It is not easy in practical terms to develop this expressway network with conventional financing methods such as direct funding through government budgets. Even if it is possible, would it be fair to the tax payer? The main users of this expressway are passenger car owners, and people who cannot afford a car and use public transport modes cannot enjoy the benefit s from such an investment. This issue is frequently raised, as was briefly mentioned in Chapter 2 in this paper.

Given also future expected budget limitations and the need for substantial investments in for example the public transport network, it is highly recommended that a direct road user charge system is introduced to finance the road network. One probable way is the introduction of the toll road system, in which the user pays a toll for using the infrastructure and the revenues are used to finance the project. Another less easy way is an earmarked road fund in which certain portion of fuel or vehicle taxes will be exclusively used for financing such projects.

These road user charge systems can offer a fairer scheme for these projects, because the users will directly pay for the better level of service. It will also give a choice to car users between a higher cost for a higher level of services and a lesser cost for the normal level of services. Once such an alternative is given, it will give a way to implement a priority treatment to road-based public transport on at-grade streets, in which the benefit of Elevated Expressway can be eventually shared with public transport users. The expressway can also offer opportunities for a higher level of road-based public transport on itself.

The development of the entire road infrastructure network as proposed in the CREATS study will require some 10.6 billion constant year-2001 LE, including 1.6 billion LE for the projects already committed by the Egyptian government. The cost for building the expressway has been estimated at 7.9 billion constant year-2001 LE. Given this financial brake-down, it can be assumed that a toll road system is introduced to, at least, partly finance the expressway construction.

The idea of the toll road system is to finance the project cost and pay back the investment by the toll revenue. In the evaluation, the question whether the investment should be done by public authorities or private investors was left aside. The main question is how much revenues the toll can generate based upon the traffic volume on the expressway system. The purpose of the financial analysis is to observe what is the expected financial performance of the toll road project will be. The analysis also took into consideration a segmented construction to better reflect the

time line of future revenues. The two parts are Package 1 (P1) including the Inner Ring Road Link Components and Package 2 (P2) that refers to all other Radial Link Components. The expected traffic volume on P1 is assumed flat (no increase) between year 2017 and 2021. The volume on the whole system (P1+P2) is assumed flat from year 2022 and afterwards. These should be considered very conservative assumptions for this type of analysis. The loan repayment period is assumed 20 years from year 2022, which will be until year 2041. Two cases are considered for the equity/loan balance of the project, which are, equity 10 % (loan 90 %) and equity 20 % (loan 80 %). The traffic volume on the toll road will vary depending on the designated toll level. In the preliminary financial analysis, it was assumed a LE 3.0/entrance toll when opening Project Package P1 between year 2017 and 2021, and a LE5.0/entrance toll after the opening of Project Package P2 in year 2022. In this type of toll road project, the key will be normally the short -term finance. In the preliminary analysis, it was assumed that the short-term borrowing interest is 15 %, considering the financial market conditions in Egypt at the moment of the analyses. The assumptions used during the preliminary financial analysis are summarized in Table 5.

Table 5: Assumptions for financial analysis

A) Traffic Volume:	2017-:	337,000 pcu/day	2022-:	502,000 pcu/day	
B) Toll Level:	2017-22:	LE3.0/Entrance	2022-41:	LE5.0/Entrance	
C) Annual Revenue: (300 days/year)	2017-:	LE303 mil./year	2022-:	LE753 mil./year	
D) Investment Cost:	[P1] 2012-16:	LE3,896 mil.	(5 year average distribution)		
	[P2] 2017-2022:	LE3,888 mil.	(5 year average distribution)		
E) Fund Raising Conditions:			(Case 1)	(Case 2)	
	Equity Share:		10 %	20 %	
	Loan Share:		90 %	80 %	
F) Condition of the Loan:	Repayment of Capital:		20 years		
	Repayment Schedule (P1):		2017 - 2036		
	Repayment Schedule (P2):		2022 - 2041		
G) Short-term Loan:	15 % per annum				

Source: JICA Study Team

The results of the preliminary financial analysis for the two cases, Case-1 (10 % Equity + 90 % Loan) and Case-2 (20 % Equity + 80 % Loan) are shown in Table 6 and Table 7, respectively. The results of the preliminary financial analysis indicate that the accumulated surplus reduces as the loan interest increases. It shows that the maximum loan interest to maintain the project financially feasible is around 5 % in Case-1, and 6 % in Case-2.

The return on investment (ROI) or the financial internal rate of return (FIRR) is 7.0 % for the project. This means the project can pay off if the loan can be borrowed with less than these interest rates.

Table 6 : Financial Analysis Case 1: Equity 10 %, Loan 90 %

Interest Rate (Unit: LE million)	**3.0 %**	**4.0 %**	**5.0 %**	**5.2 %**
First Year of Cash Flow Surplus	2022	2026	2039	2042
Accumulated Surplus up to Year 2041	LE6,186	LE4,923	LE1,250	LE0
Year of Maximum Short-term Loan	2019	2021	2031	2036
Total Amount of Short -term Loan	LE52	LE1,511	LE18,634	LE33,410
Max. Annual Short-term Loan	LE16	LE291	LE1,247	LE2,164

Source: JICA Study Team

In these cases, however, the assumed equity is 10 % (LE778 million, assumed to be paid during the 10 year construction period), and 20 % (LE1,557 million, the same condition), which will most probably be invested by the government, and will be reimbursed at a period after repayment of the loans.

Table 7 : Financial Analysis Case 2: Equity 20 %, Loan 80 %

Interest Rate (Unit: LE million)	3.0 %	4.0 %	5.0 %	6.2 %
First Year of Cash Flow Surplus	2017	2022	2026	2041
Accumulated Surplus up to Year 2041	LE7,284	LE6,336	LE5,133	LE270
Year of Maximum Short-term Loan	---	2020	2021	2034
Total Amount of Short-term Loan	LE0	LE171	LE1,703	LE25,809
Max. Annual Short-term Loan	LE43	LE168	LE312	LE1,666

Source: JICA Study Team

This implies that the project will be financially feasible if the financing entity is successful in obtaining the reasonable financial structure. It is, however, difficult to fully privatize the whole project, such as full BOT, due in particular to the low FIRR.

Sensitivity tests were next performed to optimize the toll level in order to maximize the financial performance. Table 8 shows the base case toll system of LE5.0 per entrance flat toll and three other cases of no toll, LE2.0 and LE10.0. Based on these toll assumptions, expected Year 2022 daily traffic volume in PCU were calculated and the therewith expected daily toll revenue of the entire Elevated Expressway identified.

Table 8 : Toll Level vs. Traffic Volume and Revenue

Toll Level (2001 Price)	**Traffic Volume (pcu/day)**	**Revenue (LE mil./day)**
No Toll	2,146,700	0.00
LE2.0 per Entrance	877,800	1.76
LE5.0 per Entrance	501,600	2.51
LE10.0 per Entrance	244,600	2.45

Source: JICA Study Team

These results are transposed in graphs visualized in Figure 7 for traffic volumes and Figure 8 for revenues. Figure 7 shows that the traffic volume will sharply drop in accordance with the toll level. The economic benefit of the expressway will be maximized in the no-toll case, simply because it will maximize the traffic volume on the system. However, if the system is analyzed from the financial point of view, the increase of revenue caused by the higher toll will compensate for the decreasing traffic volume.

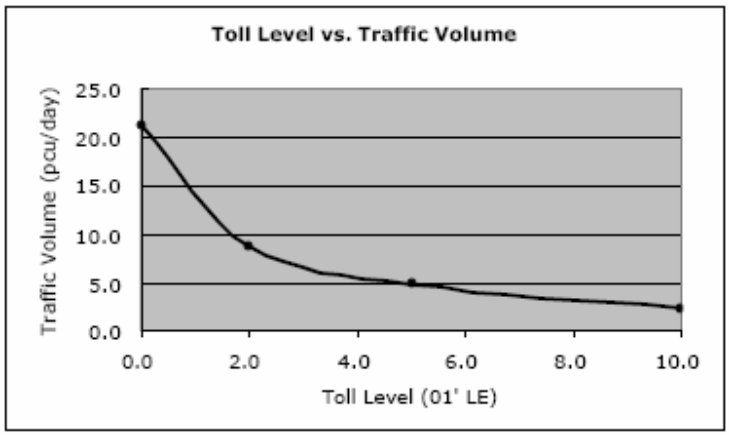


Figure 7: Toll Level vs. Daily Traffic Volume on Expressway
Source: JICA Study Team

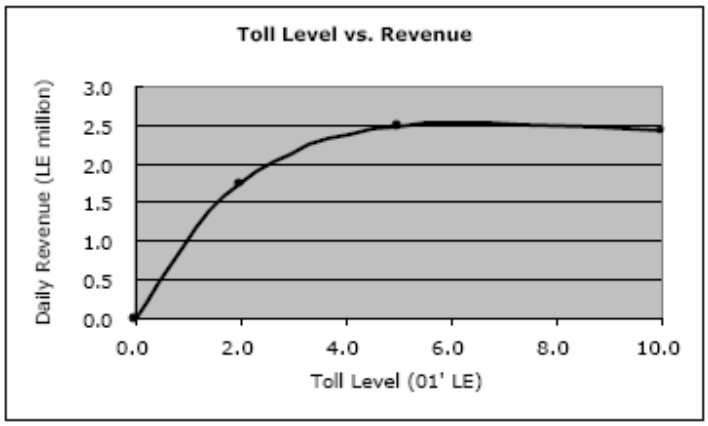


Figure 8: Toll Level vs. Daily Revenue on Expressway
Source: JICA Study Team

Figure 8 shows that the revenue is optimized with LE5.0 per entrance. The total revenue will not decrease sharply with the toll higher than LE5.0 because of the balance of traffic volume drop and increase of the toll level, but there will be no reason to impose higher toll if the revenue is not significantly different. This sensitivity testing results suggests that the toll level of LE5.0 will give the best financial revenue for the system, if the expressway system is developed as a toll road.

A well-planned expressway network will be the only possible method for Cairo to increase the capacity and improve the vehicle movement, which is vital for the urban economy. In this final part of the sensitivity analysis, a hypothetical elimination of the Elevated Expressway from the final Master Plan Network (Scenario C) was tested in order to observe its impact on the entire road network. Table 9 shows the results of comparison among the several indicators. Without the expressway, the average vehicle speed will decrease from 11.8 km/hr to 10.7 km/hr and average trip speed from 18 km/hr to 15.7 km/hr. Also all other indicators show a decrease. It is however interesting that the all-mode average trip speed will decrease by 13 %, which is more than other indicator values.

Table 9 : WITH and WITHOUT Expressway Performance Evaluation

Indicator	WITH Expressway (Year 2022)	WITHOUT Expressway (Year 2022)
Average Trip Speed for All Modes (km/hr)	18.0 km/hr	15.7 km/hr
System Average Vehicle Speed (km/hr)	11.8 km/hr	10.7 km/hr
Private Transport Share (%)	42.1 %	41.5 %
2022 Daily Vehicle-km (PCU/km)	139,700,000	137,800,000
Average Volume/Capacity Ratio at Mini-screen Lines (V/C)	1.2	1.3

Source: JICA Study Team

These results imply that the role of the Elevated Expressway will not only benefit vehicle movements but will also improve all-mode trip speed. The expressway system will increase the average person trip speed more than the average vehicle speed on the road. This shows that the modal choice of person trips is not simple and is affected by many complex causes.

5. Financing the Elevated Expressway: is private participation necessary?

The implications of the financial analysis and sensitivity testing are that the most appropriate entity composition to realize the project would be either a government guaranteed public authority to independently raise the fund with lower interest rates, or a Public Private Partnership (PPP) structure in which the private investor is invited to participate on equal terms. But the question is whether the private sector would be interested in this project. This question should be answered taking into consideration the broader effects on economic development and social welfare and the financing potential of public authorities.

One very important observation related to the results of the socio-economic analysis is that in the next 20 years, public authorities would be able to finance independently the necessary transport infrastructure investments, exclusively from public funds. The estimated cost of implementing all components of the Integrated Transport Master Plan is LE 59.8 billion. This amount constitutes about 1.7 % of the for the Greater Cairo Region forecasted year 2022 GRDP of LE 3,570 billion.

To assess the affordability of the estimated investment, required outlay is compared to past performance in public investment both at the national level and at the regional level. At the national level, data published in the National Conference for Transport in Egypt (2001) indicate that the total transport investment for the period 1982-2001 has been LE 150 billion. This amount, which included pipelines and Suez Canal outlays, represented about 3.0~3.3% of the Egyptian GDP. It is to be noticed that most of the investment in the mentioned period has been government investments. On the regional level, the transport investment for Greater Cairo in the Five Year Plan 1997-2002 was LE 10.25 billion. Assuming that each of the coming four Five Years Plans will only increase this investment amount by the estimated economic growth rate over the next two decades, the total expected available investment could be on the order of LE 73 billion (Table 10).

Table 10 : Transport investment potential in Greater Cairo Item

	Description	Unit	Value
1	Estimated GRDP for Greater Cairo	LE Billion	3,570
2	Estimated Cost of the Master Plan	LE Billion	59.8
3	Ratio of item 2 to item 1	%	1.7
4	Transport investment level in the Five Year Plan 1997-2002	LE Billion	10.25
5	Increase the Transport investment level by the economic growth rate for the next 4 Five year plans	LE Billion	73.0

Source: JICA Study Team

The transport investment in the Five Year Plan 1997-2002 has been exceptionally high (56.6% of the total investment planned for the four Five Year Plans 1997-2017) due to the implementation of several high cost projects such as Cairo Metro Line 2 and Azhar Tunnel. However, such investment level should be maintained for the coming 20 years to alleviate the probable economic loss if the recommended plan is not implemented. It is to be notice d that transport improvement is linked with forecasted economic growth. Without implementing the recommended Master Plan, not only the targeted economic growth rate is unlikely to be attained but also much higher economic losses can be expected in the form of congestion cost and environmental deterioration. The huge amount of funds, approximately LE 60 billion, is necessary to prepare urban transport in Greater Cairo for the future. This amount is equivalent to 1.7% of the accumulated GRDP (Gross Regional Domestic Product) during the period between 2003 and 2022. This ratio, in comparison with the magnitude of economic activities, seems to be rational and affordable in view of the macro economic forecasts.

However, the government should at the same time strive to deliberately procure and allocate the funds for the transport infrastructure projects. In order to make these procurements sure and stable, some innovative approaches are necessary to strengthen the financial base and even expand the financial framework.

Possible measures are:

1) Introduction of “User Pay Systems” such as a toll system for development of the proposed expressway network and a parking charge system;
2) Restructuring of the current public transport fare system so as to be flexible;
3) Preparation of proper guidelines and regulations for the Public-Private Partnership scheme for the development of public transport facilities and joint service operations wherever opportune ; and
4) Pursuance of external resources from international aid community to support the implementation.

As suggested in measure 3, external private funds could and maybe should be sought for. But in order to achieve real partnerships between public and private partners, it is imperative to establish a clear legal and regulatory framework that specifies and clarifies without a shadow of a doubt the conditions according to which private investors can participate in the development of (public) transport infrastructure in Cairo. One of the most important reasons for establishing a clear and transparent legal framework is to clearly establish the role and contribution of each partner. In most cases, there is no explicit definition or qualification of the commitments of both partners in respect of sharing the risks and the responsibilities. In particular the clarity and the commitments of both partners differentiate the PPP from the traditional forms of “co-operation” such as BOT and other concession schemes.

It is in that context imperative that the private sector is involved at the early stages of a project, in order to maximize the possibility of finding the optimal PPP structure for the implementation of a specific project. One possibility could be to install a "research group" for the evaluation of the feasibility of the project and to identify the optimal collaboration structure. Such approach is only feasible if the interested private partners are involved in the project from the beginning.

Things are not different in the case of the Elevated Expressway in Cairo city. The financial structure of the partnership will be a clear-cut test case for the potential of using a PPP structure for developing the Elevated Expressway in Cairo. Both the private and the public partner will have a crucial role to play and their willingness to introduce a realistic toll will be the deciding factor. Very few transport infrastructure projects namely turn out to be viable economic propositions for the private partner. This is due to the long construction period, the time it takes to generate positive cash flow and, quite often, the fact that the project cannot generate sufficient revenues as well. The public sector steps in by offering tax breaks, subsidies, loan guarantees or straight co-financing. In conventional BOT-contracts, the success of fully private sector financing for the project is evaluated by the private sector in respect to the level of revenues that can be generated by "selling" the product (toll, passenger tickets, rent, electricity, water,…). These revenues are generally calculated based upon forecasted traffic volumes and optimal toll structures.

One of the major problems for a possible PPP construction for the expressway in Cairo is the transfer of a considerable portion of the financial risk to the private sector. This implies that the risk premium for the private partner should be relatively high, which is in direct contradiction with a number of characteristics that require a sufficiently high-risk premium:

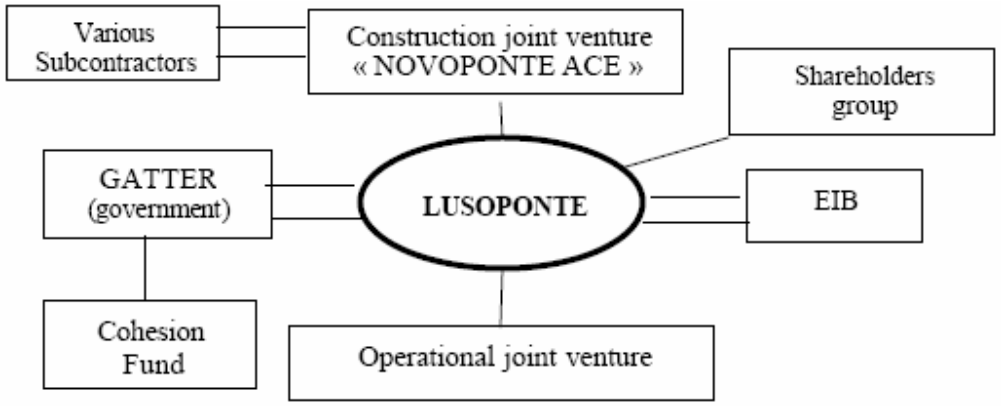
1. The returns on public infrastructure projects are relatively low at least in the initial stages;
2. The public partner has no intention of engaging itself financially, and the budgets of public authorities to compensate the low return to the private partner are unavailable;
3. The risk is high given the uncertainty related to changing regulatory and policy conditions, in particular in relation to social implications and the mobility needs of the poor and less advantaged people in Cairo.

The final decision will thus be based upon the result of a difficult risk-balancing act by the private sector and the value of the commitments by public authorities. Consequently, the private sector could shy away from the project because the uncertainties (and thus risks) are still too high. Given the above considerations, three elements are crucially important in the development of the Elevated Expressway in Cairo for the possible participation in a public-private partnership structure of the private sector :

1. Well defined period of time for the concession, sufficiently long to be attractive for the private partner;
2. Responsibilities (financial, technical and managerial) for both partners are well defined and are based upon agreed upon premises;
3. Punitive damages on both sides are foreseen in the concession agreement in case of non compliance to the terms of the agreement.

An example that clearly illustrates the problem is the partnership established for the construction and exploitation in Lisbon (Portugal) of the "Vasco da Gama Bridge" over the Tagus River between Sacavém and Montijo, a project in which the European Investment Bank (EIB) was directly involved. For the project, a public private partnership was installed named "LUSOPONTE". This company signed a concession agreement with GATTEL, a governmental

body that as public partner benefited from a Cohesion Fund grant from the European Commission. The EIB provided an investment loan, hence providing financial security for the company. LUSOPONTE also installed an operational joint venture that was responsible for the subcontracting of construction works. Finally, for the exploitation of the bridge, LUSOPONTE signed an O&M (operations and management) contract with a joint venture company. The complex structure is visualized in Figure 9.



source: Barrett, 1998

Figure 9 : TAGUS Bridge Contractual Structure.

According to Mr. Barrett, “the development of EMU and the Euro has emphasized the need for the public sector to increase the efficiency of its investment programs in economic and social infrastructure and to reduce budget deficits. (…) Governments have chosen to manage the provision of services through Public and Private Partnerships, which enable them to limit public expenditure while improving the efficiency of the public services provided and sharing certain cost, supply or demand risks with the private sector” (Barrett, 1998, 4-5).

But reality proved quickly to be substantially different. The concession agreement also incorporated the 25 April Bridge on which LUSOPONTE would also introduce a toll, therewith generating the necessary revenues to warrant the investment in the Vasco da Gama Bridge. In spite of the successful construction of the bridge, the concession was confronted with a range of legal procedures, both during construction and since the beginning of operations. The main cause of the conflict between the public and private partners was the lack of transparency in the conditions of the concession agreement, in particular in relation to the level of the toll on both bridges, the structure of the repayment of the loans by the private partner and the compensation payments by the public partner to balance the difference between forecasted traffic volumes and toll level. Traffic forecasts were used by the private partner to estimate the optimal toll level on both bridges and on the basis of the estimated future revenues, for the repayments of the loans and grants. From the beginning, Macquarie Infrastructure Investment Management Limited (MIIML), the management company of Macquarie Infrastructure Group (UK) who owned 24,8% of the shares of the Lusoponte Group and therewith major private shareholder, had serious doubts about the strong relationship in the original agreement between traffic forecasts and the toll levels (and consequent revenues). A suitable solution for the conflict was found in June 2000 and included following components :

1. All claims and counterclaims are dismissed;
2. Toll will remain in the medium-term below the levels as fixed in the original concession agreement, this to allow the Portuguese government to continue their social policy;

The agreed-upon solution stated that the Portuguese government will receive a payment of 5,6 million € from the Lusoponte consortium at the moment of signing the agreement. As a compensation for the economic implications of their social policy, the Portuguese government will pay the consortium a total amount of 319 million € over a period of 19 years. The new concession period has been set at 30 years for both bridges and the relationship between traffic volumes and toll level has been abandoned.

The comment of MIIML, the main shareholder, on the terms of the agreement clearly demonstrates the conflicting elements in the cooperation between private and public partners. According the MIIML, the agreement "*… removes a number of significant points of uncertainty and provides Lusoponte with greater management flexibility. The removal of the link between the term of the Concession and traffic volumes provides equity with the opportunity to receive higher returns if traffic volumes continue to exceed the forecasts made at the time the concession agreement was signed. We expect that this will, over time, have a positive impact on the value of this investment.*"

6. Final conclusion

Using external (private) funds to develop the expressway in Cairo is a possibility, although in the Cairo case not an explicit requirement. Some will argue that the introduction of private funds will alleviate public funds for other socially oriented purposes and is therefore to be recommended. Others will argue that mobility is a right for all and that the introduction of a toll system inside the city limits is socially unacceptable.

A final decision will only be possible if a compromise can be found between the economic needs of the private sector and the social needs of the government , this to avoid a conflict similar to the one in Portugal between the government and the Lusoponte Group. It is clear that this compromise will directly influence the optimal (economic) level of the toll and a clear and transparent agreement will have to be found which simultaneously accommodate s the needs of the private partner without abandoning the public partner's social objectives.

In other words, a public private partnership for the Elevated Expressway in Cairo can only be successful if the toll level is fixed independently from any traffic forecasting and balances social and economic priorities of both the public and the private stakeholders. Once the toll level is fixed by the government, compensation payments to the private partner will probably have to be installed to level the gap between the optimal "economic toll" and the "social toll".

It is under present circumstances far from sure that a reasonable balance can be found and even if such balance could be found, if a practical (financial) structure can be put in place. In the case of Cairo, this thus raises the acute question if the participation of the private sector is the optimal approach to build the urban Elevated Expressway.

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