Chapter 9
Hidden Cost in Public Infrastructure Project: A Case Study of Kolkata East–West Metro

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Introduction

In developing countries, various types of infrastructure projects have gained momentum to address the growing need for public facilities (Mahalingam et al. 2011). Among these, public transportation in urban India deserves a special mention because of its pressing demand to provide a safer, faster, cheaper and less polluting travel option for the ever-increasing urban population (JNNURM 2006). The total number of people living in Indian cities has swelled up in last four decades—rising from 109 million in 1971 to 160 million in 1981, 217 million in 1991, 286 million in 2001 and to 377 million in 2011 (Ministry of Home Affairs 2011; Padam and Singh 2001). As most of the present developments are taking place at the fringe areas, people are forced to stay and work in the suburbs and often need to travel for hours between home and office, while being exposed to alarmingly high air pollution, noise, congestion and traffic fatality levels.

Tiwari and Mohan (1999) identified that the worst sufferer among this group is a huge population that can afford only non-motorised mode of transport including walking. They also argued that catering for these people's requirements by redesigning the existing roads would effectively increase the safety and efficiency for both motorised and non-motorised modes. This fact is more applicable for low- and middle-income countries, where non-motorised traffic is huge, and even for motorised traffic, more than 50 % comprised of public transport and para-transit modes (Mohan 2008).

Given these caveats, in order to purportedly create better living and travel conditions for people, several Indian cities, such as Delhi, Kolkata, Bangalore, Mumbai, Hyderabad etc., are developing metro-rail network. These projects, being loss making (except Delhi Metro), are traditionally built and operated with government funds (Dalvi and Patankar 1999). India's National Urban Transport Policy or NUTP

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(MUD 2006) suggests that Government of India (GOI) or central government will provide maximum 20% of capital funds with equity share from the concerned local government. The rest of the funding will come from other sources. However, the users, i.e., the direct and indirect beneficiaries within the city, must pay for the operating costs and the rolling stock. Though NUTP is framed 'in favour of sustainable development', it can be questioned whether this costing model itself is sustainable, as metro tickets are usually subsidised at least 10–15 times more heavily than a bus ticket for the same journey (Tiwari 2007). This is possible only through a huge subsidy from government, using tax payers' money. That means a person from a remote village who may never use the metro service is also paying for its construction and operation.

Such burdensome nature of public infrastructure projects is well researched, but their dire necessity forces government and other financing bodies to make massive investments (Dalvi and Patankar 1999; JICA 2010). Hence, viability of such projects is judged by social cost–benefit analysis. However, there exist few cost components similar to those used as social benefits. These cost components go unnoticed as neither the financer nor the user need to bear them. The present study probes into these unnoticed or hidden costs of mega infrastructure projects in order to find their significant impact on national resources, using the case study of Kolkata East–West Metro by Kolkata Metro Rail Corporation (KMRC).

Kolkata Traffic Scenario

The overcrowded city of Kolkata (24,718 people/km^2.), under Kolkata Metropolitan Corporation, has a North–South linear growth with its main traffic spine running parallel as: (1) ferry service on the River Hoogly at West; (2) existing metro-rail at centre and (3) Eastern Metropolitan Bypass at East. However, the city occupies just 14% of 1,851.41 km^2 of Kolkata Metropolitan Area (KMA) with a population of 14.1 million (Ministry of Home Affairs 2011) and traffic scenario of the main city is intertwined with the same of KMA. Length of highways, arterial and other major roads in KMA is about 700 km, while mainly arterial, sub-arterial and local roads run at city level (Chakraborty and Roy 2005).

Even with the most varied types of transport modes than any other Indian city and being the first metro-rail system in Asia, Kolkata's traffic scenario is bleak. In a recent study by MUD & Wilber Smith Associates (2008), various transport-related indexes were reported (Table 9.1). In comparison to the country's average, Kolkata falls far below in positive parameters such as accessibility or safety, and exceeds in negative parameters such as congestion, parking interference etc.

With many extinct bus routes and reduction in number of buses (in average 3.5% p.a.), people are increasingly opting for private cars, two-wheelers and para-transit modes such as autos (3-wheeler) for comfortable and faster travel. Two-wheelers and autos have the two lowest occupancy rates with highest pollution per person per unit distance, in addition to risks associated with reckless driving and

Table 9.1 Index for public transportation for Kolkata

Index for	Definition	Value
Public transport accessibility	1/ Avg. distance in km to the nearest bus stop or railway station	11.12
Service accessibility	% of work trips accessible within 15–30 minutes time	114.00
Congestion	$1-\frac{\text{Avg. speed on major roads during peak hours}}{\text{Desirable avg. speed on major roads during peak hour}}$ The desirable avg. speed taken as 30 km/h.	0.40
Walkability	Availability of footpath (i.e., Footpath length/Length of major roads in the city) + Pedestrian facility (i.e. score estimated based on opinion on available pedestrian facility)	0.81
City bus transport supply	No. of city buses (both public and private operations) for 1,00,000 population	26.20
Safety	1/ (No. of road accident deaths per 1,00,000 population)	0.08
Para-transit	No. of para-transit vehicles for 10,000 population	28.50
Slow-moving vehicle	Availability of cycle tracks + Share of slow-moving vehicles in trips	0.03
On-street parking interference	1/ (% of major road length used for on-street parking + on-street parking demand on major roads)	3.00

violating traffic rules. Moreover, safety is a major issue for autos that are notoriously infamous for over-speeding, over-crowding and driving in the opposite lane. As a high number of autos in Kolkata are not registered and ply with fake number plates or drivers do not have licences, it is difficult to punish such auto-drivers for breaking traffic rules especially when such auto-drivers are protected by unions.

In spite of the fact that Kolkata has the highest road length of 4,613 km among the four metropolitan areas of the country, in terms of both area and total length (Sridhar and Kashyap 2012), city roads suffer from inadequate width, unscientific geometrics, close intersections and same right-of-the-way for all types of vehicles. Narrow roads have an added problem of illegal parking and hawkers; these reduce the vehicular speed and increase emission. The pathetic conditions of present traffic scenario as noted in various studies (Ghose et al. 2005; IDFC & Superior Global Infra. Consult. 2008; KMDA 2008; MUD & Wilber Smith Assoc. 2008) are:

- Only 6 % of area for transport is present, which is far below the recommended value of 15–18 %.
- 65 % of the roads have D or lower level of service.
- 72 % of roads have travel speed less than 20 kmph.
- 7 % is the annual vehicle growth.
- 70 % of buses and 50 % of cars are older than 10 years, causing 35 % and 16 % of the total pollution, respectively.
- Autos using adulterated fuel contribute to 31 % pollution.
- Noise during peak hours is around 81.60 dB. It is much higher than the acceptable limit of 60–65 dB and little below 85 dB, causing hearing damage over long-term exposure.

- Suspended particulate matter is 150–250 μg/m^3 against World Health Organization (WHO) limit of 90 μg/m^3. It is the highest pollution level in country. The average respirable suspended particulate matter (RSPM) values for Kolkata district averaged over the 3 years, 2009–2011, is 109.35 (Sridhar and Kashyap 2012), which is higher than the National Ambient Air Quality (NAAQ) standard of 60 for residential and industrial areas set by the Ministry of Environment and Forest (2009).
- There was an incidence of around 25 road accidents per 1,00,000 population with a fatality rate of 13 % in 2005.

Overview of Kolkata East–West Metrorail Project

The main objective of the Kolkata East–West Metrorail project is to meet the ever-rising traffic demand in KMA, by developing a mass rapid transit system. Indirectly, it will contribute to the economic development and improvement of the urban environment in the region, by reducing traffic congestion and vehicular pollution (JICA 2010). With a high primacy factor, KMA serves a vast hinterland, extending over 11 Indian states of east and northeast (Roy 2009). Connectivity of KMA with its neighbouring region is served by road network and rail route emerging from Howrah and Sealdah. As the Kolkata East–West Metro connects the city's eastern growth boundary with Howrah at west via Sealdah at central location, it is expected to positively influence the eastern India as a whole.

KMRC, as a joint-venture company of GOI and state government of West Bengal, is carrying out the project with partial financial assistance of ₹ 2,983.9 crore (1 crore = 10 million) as loan from Japan International Cooperation Agency (JICA). The original plan was to build a 13.74 km long line between Howrah Railway station and Sector–V of Salt Lake, using a budget of ₹ 4,676 crores. In 2009, the project was extended up to Howrah Maidan with an increased budget of ₹ 4,874.58 crore (Table 9.2). The revised route of 14.58 km consists of 8.84 km of underground corridor and 5.74 km of elevated corridor. The grade change takes place between the stations of Salt Lake Stadium and Phoolbagan. Between the two stations of Mahakaran and Howrah, 470 m of tunnel will pass 12 m below the river bed (Fig. 9.1). Such underwater tunnelling is first of its kind in India (KMRC 2011).

Project Schedule

After approval in 2008 by GOI, the project schedule has changed several times. Originally, the duration of execution was 3.5 years (01.07.2006–31.12.2010) and the next 3 months were set aside for testing and commissioning (DMRC 2006). However, the project actually started on 7 February 2009, targeting October 2014 as the date of completion and next 5 months for testing and commissioning (KMRC

Table 9.2 Cost breakdown of Kolkata East–West Metro Project (KMRC 2011)

Construction cost in ₹ crores		Other cost heads in ₹ crores	
Description	Cost	Description	Cost
Traction and power supply	157.92	Land cost	126.06
Underground tunnelling	1,856.93	Escalation at 5 % p.a.	364.00
Viaduct of elevated portion	154.50	Interest on borrowed money	234.00
Construction of stations	75.00	Tax and duty	300.00
Depot for rolling stock maintenance	280.00	Cost to be paid to E. Rly.	30.00
Detailing of elevated stations	3.15	Contingency	180.00
Lifts and escalators	59.00	Interim consultancy charges	5.00
Platform screen door	82.30		
Roof work of elevated stations	47.99		
Track work of entire stretch	82.94		
Auto fare collection system	43.02		
Rolling stock	467.20		
Signal, telecom, train control	134.72		
Station security	10.00		
General consultants	180.85		
Subtotal	3,635.52	Subtotal	1,278.30
Grand total		4,874.58	

This excludes design charge of ₹ 39.24 crore (KMRC 2011) and environment management of ₹ 56.86 crore (DMRC 2006)

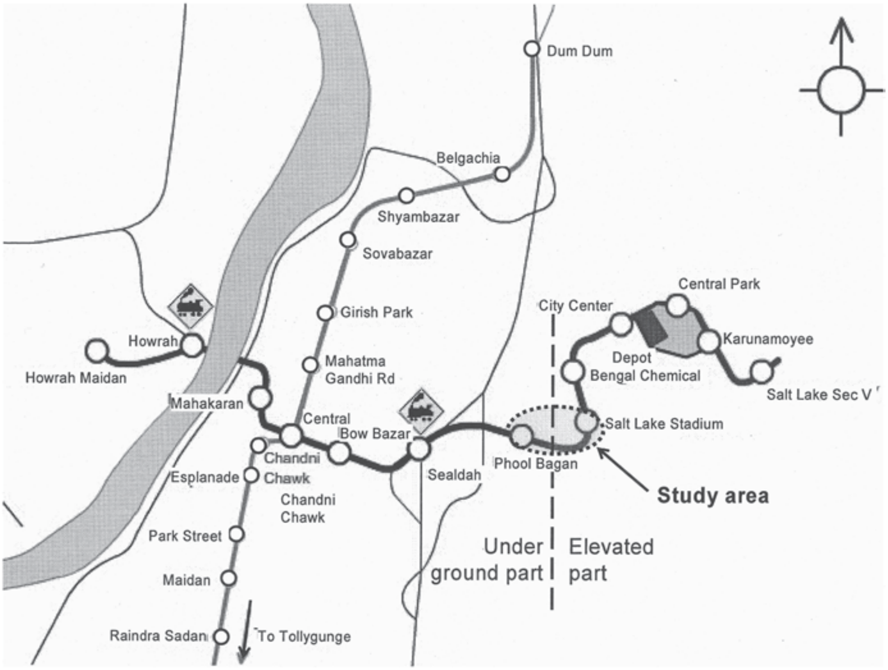

Fig. 9.1 Kolkata East–West Metro corridor (DMRC 2006)

2011). It was also planned to start partial operation between Sealdah Station and Salt Lake Sector–V by November 2013. However, very recently, the managing director of KMRC forecasted a delay of 2 years to July 2016, i.e., total duration of 7.5 years that will incur significantly high cost of Rs 5,000 crore (Pramanik 2012).

Project Cost Breakdown

Various direct and indirect costs involved in the project can be grouped under broad categories as: construction, pre-operative (tax, duty, escalation etc.) and interest during construction. Apart from these, there is cost involved in environmental mitigation and management plan (Table 9.2).

Traffic Diversion

KMRC planned for temporary traffic diversion for different roads along the proposed corridor only where alignment is in transition phase. Diversion will be for a short period to facilitate construction such as decking etc. The alternate routes were proved suitable to cater for diverted traffic. For example, 1.5 km stretch of Narkeldanga Main Road, between Swabhumi cultural complex near Salt Lake Stadium and Phoolbagan, is presently closed. The planned alternative routes parallel to it are: (1) Satin Sen Sarani near Bengal Chemical; (2) Suresh Ch. Banerjee Road near Beliaghata and (3) Canal Circular Road near Chingrihata (DMRC 2006). However, in reality, the roads along the bank of Subhas Sarobar lake is used (Banerjee 2010). From now, this road will be mentioned as Lakeside Road for easy understanding.

Methodology

As the project is under construction, a complete study of the entire alignment is not feasible. Instead, one of the critical parts—the above-mentioned stretch of 1.5 km—has been chosen for this research where tracks go underground from elevated level. Hence, instead of pre-cast piling or tunnel boring, cut-and-cover method is used, which leads to the closure of the busy Narkeldanga Main Road and traffic diversion becomes unavoidable. A three-pronged data collection approach was adopted to capture the economic impact of this diversion:

- Road network inventory survey
- Classified volume count survey
- Opinion survey of people

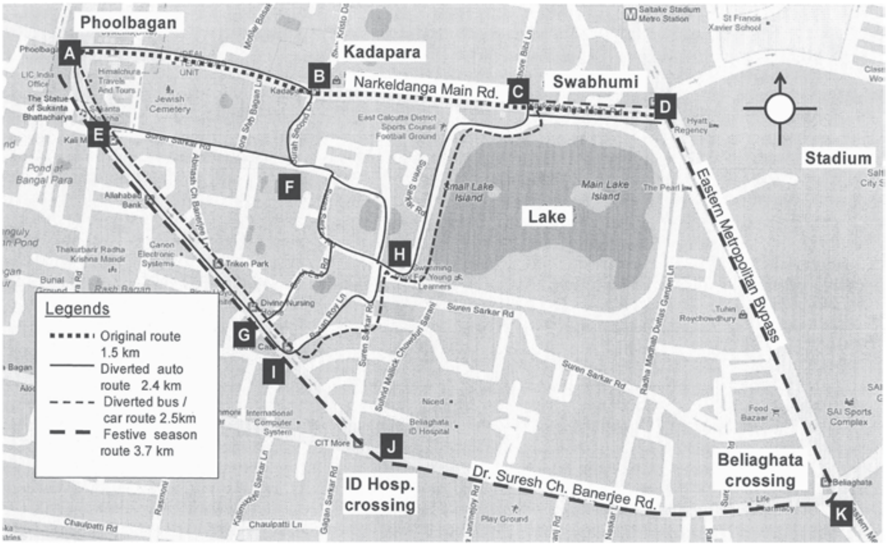

Fig. 9.2 Normal routes and various diverted routes

Road Network Inventory Survey

Inventory survey was conducted on Suren Sarkar Road, Badan Roy Lane, Surah Second Lane and Lakeside Road through which majority of the diverted vehicles pass (Fig. 9.2). Information was noted such as: lanes, median availability, intersection facilities, pedestrian facility details, driving condition, on-street parking and traffic control measures.

Classified Volume Counts Survey

The survey was conducted on a Wednesday—a normal working day—from 6 am till 10 pm for both directions. Classified traffic volumes in 15-min intervals were recorded for buses, minibuses, cars, taxis, autos and two-wheelers. Slow-moving vehicles and trucks were neglected. The survey location was near Swabhumi (Point C in Fig. 9.2) where traffic flow of Narkeldanga Main Road shunts to Lakeside Road.

Opinion Survey of People

This area is mainly residential with a few large gated communities such as Rukmani–Parashmani and Lake District. Apart from that there are:

- Offices for state government and IT industry;
- Educational institutes: Sir Gurudas Banerjee College and four big high schools;
- Health-care facilities: Apollo Gleneagles Hospital, Suraksha Lab, B.C. Roy Children's Hospital etc;
- Commercial complex: Pantaloons, Mani Square, Khudiram Hawkers Market etc;
- Sports facility: Salt Lake Stadium, SAI (Sports Authority of India) complex and
- Others: Swabhumi cultural complex, Hyatt Regency hotel.

People predominantly using this closed road stretch are local residents or people enjoying above mentioned facilities or who need to access far-away places via EM Bypass, Sealdah station or Sir Gurudas Banerjee halt station. Respondents were randomly selected for survey from this sampling frame along with auto and bus drivers who travel regularly in this route (one private bus, one minibus and two auto routes). They were mainly asked about safety, convenience and driving condition of roads and pedestrian facilities.

Calculation of Hidden Cost

From the results of the road network inventory and the classified volume count survey, the detour for different types of vehicles and passengers carried by them were found respectively. Using unit values for fuel consumption, pollution and emission for different types of vehicles, the total values for each of these entities per day were found. Similarly, loss for man-hour per day was also calculated. The fuel for detour is also associated with subsidy for diesel and health impact, which in turn can be quantified as cost/litre of diesel (Sengupta and Mandal 2002). All these values were summed for 1 year as annual hidden cost, assuming full traffic operation on 260 working days and 50 % traffic operation on weekends. As the unit rate for different cost heads has a different reference year, the cost heads were adjusted for escalation and reported as present cost. The mathematical calculations for computing are simple and self-explanatory as shown in the section for hidden cost analysis.

Results and Discussion

From Road Network Inventory Survey

Refer Fig. 9.2 for interpretation of the results. Until February 2011, 1.5 km stretch of Narkeldanga Main Road (A–B–C–D route) was open. In June 2011, the stretch between Point A and Point C was blocked. Only a narrow strip between Phoolbagan and Kadapara Crossing (Point A to Point B) was open and autos entered through Surah Second Lane to reach Lakeside Road, i.e., A–B–F–H–C–D route. Autos also used Suren Sarkar Road (A–E–F–H–C–D route) and Surah East Road (A–G–H–

Fig. 9.3 **a** Dangerous road curve near Swabhumi. **b** Footpath occupied by KMRC

C–D route). Buses, cars and taxis used Badan Roy Lane to access Lakeside Road, which is a 2.5-km-long A–I–H–C–D route resulting in a detour of 1.0 km. As the name itself suggests, Badan Roy Lane and Surah Second Lane are lanes through residential areas and are not meant for catering to public transport especially the long Jawaharlal Nehru National Urban Renewal Mission (JNNURM) buses. Suren Sarkar Road is meandering in nature with many intersections with narrow lanes. Though it has two lanes, residents often park their vehicles on the road, effectively leaving one lane for the moving traffic. Also, instead of following Suren Sarkar Road or Surah Second Lane, autos take all possible shortcuts (shown in solid line) suitable for pedestrians only. It is apparent that these roads cannot have crossing bays, medians, signals or manual traffic control. As a result, there is no convenience or safety for the pedestrians.

Lakeside Road is wider (two lanes), but it is also not designed or constructed for such heavy traffic including construction vehicles. As a result, all the roads show signs of deterioration. Debate between Kolkata Municipal Corporation and KMRC on the responsibility to maintain the roads keeps these roads in a bad shape. Often construction vehicles or KMRC staff buses are parked on Lakeside Road. Presently, the yard has swallowed almost one lane at the curve near Swabhumi (Point C in Fig. 9.2). One cannot see the opposite side traffic at this bend which is very dangerous (Fig. 9.3a), and there is no traffic surgeon or traffic signal available to help. Footpaths are also occupied by KMRC (Fig. 9.3b).

During festive season of Durgapuja and Diwali, in 2011 and 2012, buses could not enter Lakeside Road as religious and cultural activities blocked the Badan Roy Lane and parallel lanes for almost 1 month. As a result, those buses had to ply via Dr. Suresh Ch. Banerjee Road and EM Bypass (3.7 km long A–E–G–J–K–D route in Fig. 9.2) to reach Swabhumi. These activities are local traditions, but neither traffic police nor KMRC envisioned the problem. Hence, for buses, cars and taxis, there is a detour of 1.0 km for 240 days (5 week days × 48 weeks) and a detour of 2.2 km for 20 days (5 weekdays × 4 weeks) of festive season, leading to an average of 1.09 km/day of detour. Detour details are summarised in Table 9.3.

Table 9.3 Summary of various detours

Route type	Path followed	Route length (km)	Detour (km)
Normal route	A–B–C–D	1.5	0.0
Diverted auto route	A–B–F–H–C–D, A–E–F–H–C–D, A–G–H–C–D etc. shown in solid line	2.4 km in avg.	0.9
Diverted bus/car route in non-festive season	A–I–H–C–D	2.5	1.0
Diverted bus/car route in festive season	A–E–G–J–K–D	3.7	2.2
Avg. Diverted bus/car route year-round	–	2.59	1.09

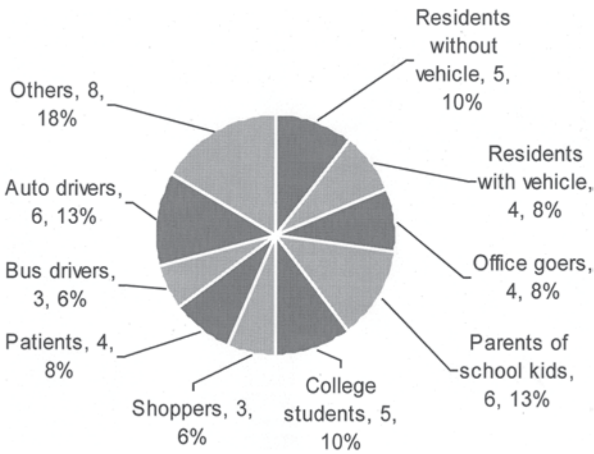

Fig. 9.4 Demography of the respondents

Results from Opinion Survey

Demography of the respondents is shown in Fig. 9.4. Member from each group being small and sampling method being rather informal, it is justified to draw a very broad conclusion. In general, people appreciated the benefits of the project and the need for traffic diversion. However, they blamed unplanned and unorganised diversion routes without any traffic control for unsafe and uncomfortable ride, congestion, loss of time and money. They also noted the delay in project schedule as a critical issue.

Auto-drivers charged ₹ 1.00 extra or 20 % over the regular fare of ₹ 5.00 when preliminary detour via Surah Second Lane started. Presently, a longer detour is compensated by taking up to six passengers (while maximum four is allowed) or breaking the licensed route into smaller segments. Buses and cars are not only suffering from lengthy route, but congestion and bumpy drives are causing wastage of time and fuel. Drivers are uncomfortable with poor visibility at the narrow turn near Swabhumi as mentioned in the previous section and also of the fact that children

Table 9.4 Average number of passengers (Excludes driver)

Vehicle type	No. of motorised vehicles on a typical weekday						Avg. occupancy[a]	Total passengers
	Early morning	Morning	Afternoon	Evening	Late evening	Total		
	6–8 hr	8–12 hr	12–16 hr	16–20 hr	8–10 hr			
Bus	9	24	18	21	8	80	53.8	4304
Minibus	4	11	7	9	4	35	29.1	1018.5
Taxi	9	34	20	31	12	106	3.3	349.8
Car	17	155	113	104	86	475	4.1	1947.5
Auto	14	85	57	78	36	270	4.6	1242
2-wheeler	20	63	40	47	19	189	1.8	340.2

[a] Source: Datta et al. 2008

of the neighbourhood frequently cross or play on the inner roads or Lakeside Road. Plying on bad roads was reported to damage vehicle parts and increase maintenance costs roughly by 30 %.

Local residents complained about the ordeal to access their homes, increased pollution and were of the view that continuous flow of public vehicles in inner roads is affecting safety, especially of children. Shoppers and patients reported to have restricted choices and usually they preferred to avoid the rough ride through Lakeside Road.

Results of Classified Volume Counts Survey

Average speed noted in normal condition is 18 km/h. (KMDA 2008). The average speed noted here is 14 km/hr as per the local traffic police.

Economic Analysis: What is Lacking?

Usually, for public infrastructure projects, economic analysis is carried out within a broad framework of social cost–benefit analysis. Here apart from first cost and operating cost, tangible and intangible benefits are considered. The Kolkata East–West Metro is also evaluated over a period of 5 years of construction and 32 years of operation by DMRC (2006) who mentioned, in the detailed project report, the benefits of the current project, which are:

- Cost savings for operation of all vehicles due to decongestion.
- Time saving of metro-commuters and also of those using the existing modes but on less congested roads.
- Reduced pollution and fuel consumption by fewer vehicles and their improved speed.
- Reduced number of road accidents.

- Savings in road infrastructure and development costs that would be needed to handle increasing traffic if metro-rail is not introduced.
- Intangible benefits: reduced road stress; better accessibility and mobility; economic stimulation in the micro region and increased business opportunities; improved image etc.

Recollecting the results from road network survey or people's opinion, it was found that exactly these points were mentioned to be lacking in the present scenario due to traffic diversion. In fact, previous studies have shown that people opt for diversion to avoid unexpected delays or to decrease overall travel time or both. When a forced diversion affects these factors, people usually feel very frustrated especially on their return trip (Heathington et al. 1971). Moreover, the diesel used by buses and many cars are highly subsidised, whose cost is borne by the entire nation. As the construction time is also a significant part (here 19 %) of project life cycle, socio-economic loss due to traffic diversion must be calculated for all such public infrastructure projects.

Proposed Hidden Cost Analysis Due to Diversion

This cost analysis is based on the following assumptions. For precise values, more accurate data collection should be carried out. Refer Fig. 9.2 for point locations. The calculations are shown in Tables 9.5 and 9.6.

- Vehicles only near Swabhumi and Lakeside Road crossing (Point C) are considered as diverted vehicles.
- Number of days of operation is 260 days per year (5 working days /week for 52 weeks).

Table 9.5 Calculation of lost man-hours due to traffic diversion

Vehicle type	Route details[a]	Trip time (min)	Time loss (min)	No. of passenger per day[b]	Lost man-hrs per day by all passengers (h)	Value loss /man-hrs (₹)[c]	Value loss /day (₹)
Bus	2.59 km at	11.1	6.1	4,304.0	437.57	10.23	4,476.38
Minibus	14 km/h		6.1	1,018.5	103.55	10.23	1,059.29
Taxi			6.1	349.8	35.56	17.50	622.35
Car			6.1	1,947.5	198.00	35.81	7,090.23
Auto	2.4 km at	10.3	5.3	1,242.0	109.71	10.23	1,122.33
2-wheeler	14 km/h		5.3	340.2	30.05	21.67	651.21
						Total	15,022

Annual loss of man-hour (for 260 weekdays) = ₹ 3905665
Extra fair of ₹ 1.00 paid by auto passengers = ₹ 1242/day or ₹ 322,920/year
[a] From Table 9.3; [b] from Table 9.4; [c] from DMRC (2006)

Table 9.6 Calculation of loss of fuel and increased emission. (Source: [a] Nesamani 2010; [b] Datta et al. 2008)

Vehicle type	No. of vehicles/day	Detour (km)	Fuel consumption (L/km)[a, b]	Extra fuel for detour/vehicle (L)	Total extra fuel for detour/day (L)	Daily Pollution emission (gm/km)[b]	Daily total emission for detour (gm)
Bus	80	1.09	0.279	0.304	24.33	5.2426	457.15
Minibus	35	1.09	0.182	0.198	6.94	3.2376	123.51
Taxi	106	1.09	0.077	0.084	8.90	2.8333	327.36
Car	475	1.09	0.077	0.084	39.87	1.1906	616.43
Auto	270	0.09	0.046	0.004	1.12	8.0163	194.80
2-wheeler	189	0.09	0.029	0.003	0.49	9.7350	165.59
						Total	1884.85

- For buses, taxis and cars, the operation is 240 days by diverted route and 20 days (4 weeks) by festive route leading to average 1.09 km/day of detour, i.e., diverted route length of (1.5 + 1.09) km. = 2.59 km (refer Table 9.3).
- Normal trip duration is 5 min (for 1.5 km at18 km/h).

As bus, minibus, taxi and about 30 % of cars use diesel, total extra diesel for detour can be calculated from the sixth column of Table 9.6 as (24.33 + 6.94 + 8.90 + 30 % of 39.87) = 52.129 L/day or 13,553.5 L/year (for 260 working days).

- Approximate annual expenditure for this extra diesel = ₹ 609,906.00.
- Annual subsidy at ₹ 13.55/L = ₹ 183,649.00.
- Similarly, cost for petrol for bikes and 70 % of cars is at ₹ 70/L = ₹ 507943.80
- Cost of LPG for autos at ₹ 48.67/L = ₹ 14172.70.
- Annual damage cost of pollution from detour at ₹ 38.40/kg. (DMRC 2006) = ₹ 18,818.34.
- Annual health cost at ₹ 5.77/L of diesel (Sengupta and Mandal 2002) for 13,553.5 L of diesel = ₹ 78,203.70.

Summary of All Hidden Costs in ₹ per Year Due to Traffic Diversion

After adjustment for escalation at 5 % p.a. (DMRC 2006) for items with unit rate from past, all hidden costs excluding consideration for accidents and vehicle maintenance cost are totalled as ₹ 7,000,460 for 260 weekdays of a year (Table 9.7). If it is assumed that on weekends the traffic flow and number of travellers constitute 50 % of that of a weekday, the cost for the remaining 105 days of year will accrue ₹ 1,413,554 resulting in ₹ 8,414,014 p.a for road closure of 1.5 km and detour of 0.9–1.09 km. From the list, it is apparent that loss of man-hour, subsidy, pollution and health effect has a socio-economic impact at the national level.

Table 9.7 Summary of hidden costs excluding accidents and vehicle maintenance

Cost head	Reference year for unit cost	Cost in ₹	Present cost in ₹ after adjustment for escalation
Man-hour	2006	3,905,665.00	5,233,964.64
Extra fare	2012	322,920.00	322,920.00
Diesel cost	2012	609,906.00	609,906.00
Diesel subsidy	2012	183,649.00	183,649.00
Petrol	2012	507,943.80	507,943.80
Auto LPG	2006	18,818.34	18,818.34
Health damage from diesel	2002	78,203.70	127,385.59
		Total	7,004,587.37 ≈ 7,000,460.00

Conclusion

This present study to identify and to quantify the hidden cost of a mega infrastructure project using case study of Kolkata East–West Metro is the first of its kind. Other studies done on similar projects mainly cover social benefit vs. economic cost (Dalvi 1999; JICA 2010; Mury et al. 2007). However, these two entities—the former being subjective and the latter being objective in nature—do not fit into the same scale. Hence, judging a project without the substantial social cost is not scientific.

In this research, it was found that factors considered as social benefits of a project are contributing to the hidden cost burden on the society itself during construction. A traffic diversion of 1.5 km causing a mere detour of 0.9–1.09 km was found responsible for a loss of ₹ 8,414,014.00 p.a. for extra fuel, subsidy, loss of man-hour, pollution etc., and excludes higher vehicle maintenance cost and accident-related cost. As these, costs are not directly borne by the financer or the metro-user; they remain unnoticed or hidden. However, definitely, it has a significant socio-economic impact. As such, road closure and diversions are unavoidable in cases like this one; their impacts must be considered in initial planning of mega public infrastructure projects and also during construction if the project is heavily delayed. Else, strictly speaking the technical analyses and cost projections are manipulated.

However, the aim should be to minimise its duration or impact by proper project planning and its strict implementation. For example, in this case, prohibition of unauthorised parking, temporary signalling and traffic control could have been implemented. Similarly, festive activities on these roads could have been restricted by seeking co-operation of local residents. By adopting good construction practices, KMRC could have avoided project delay, parking of construction vehicles on Lakeside Road, spill over of construction yard on road and dumping of debris on footpath.

Considering the magnitude of public infrastructure project in terms of both cost and its expected return, time management in work completion has immense implications. Longer gestation period will, in fact, not only eat away maximum of estimated budget with shorter output but also add up public cost in the form of extra-pay for diverted route along with additional time spent on travelling. Although the present study focuses on a single area, it throws light on policymaking for mega infrastructure projects in the transport sector of the developing world with similar situations. Apart from the predominant factor of traffic diversion, other common issues related to public infrastructure projects such as congestion, slow speed of vehicles, air pollution, etc. are the major concerns. A comparative study of their contribution towards the hidden cost with or without diversion can be a promising direction of future research in this domain. As high-capacity bus system costs only 5–10 % of metrorail (Tiwari and Mohan 1999), such alternatives should also be considered while deciding upon the best option of mass rapid transport system.

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