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Importance of Integrated Transport Planning for Congestion Alleviation at Major Road Corridors: A Case Study

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1. Introduction

Since the new Parliament of Sri Lanka was shifted from Colombo to Sri Jayewardenepura Kotte in the 1980s, Sri Jayewardenepura Mawatha has become an important road corridor. The shift of the many government offices to the new capital city gradually developed the entire area with microeconomic activities being set up over time. More residential developments and private business entities migrated to the area due to the change in demand for land use. Later, Sri Jayewardenepura Road became the most important land transport corridor connecting Colombo City, with radical changes in land use.

Traffic along the main road corridor is increasing at present at a high rate, and hence traffic congestion has become a huge problem for the road users. Therefore, some major improvement projects were implemented after year 2016: namely Rajagiriya Flyover, integrated signalisation at intersections, introduction of a bus priority lane (BPL) and re-routing of buses.

The six-lane highway corridor at the Welikada Plaza Intersection was observed to have carried 60,000 to 75,000 vehicles in October 2015 after the flyover was opened. The maximum traffic flow at the main corridor has increased from 74,316 to 119,320 which is an increment of 45,000 vehicles, and an increase from a minimum of 20% to a maximum of 66% over two year period. Intersection traffic has increased by 62% from 107,143 to 173,206 vehicles. This is an extremely high growth and a remarkably strange situation. Therefore, it is evident that there is a highly sensitive traffic attraction at the Rajagiriya main corridor after the introduction of the flyover.

Even though travel speeds including peak hours have improved compared with those prior to the improvement projects, congestion issues are still observed during peak hours. Many external factors obstruct the flow of traffic at and near the Rajagiriya Intersection as observed at the post project evaluation stage. Some such externalities arise due to the *non-integration* of the projects formulated in the recent past.

This research is an attempt to understand how such huge traffic attraction affects to flow conditions through an empirical analysis based on data collected before and after the flyover is constructed at the Rajagiriya Intersection. It also aimed at examining how such impacts could be minimised by integrating major transport projects implemented in the road corridor.

2. Methodology

The research methodology adopted was an empirical analysis based on various traffic data collected over the time and their comparison with traffic characteristics of the road network before and after the opening of the flyover. Category analysis techniques and graphical representations of analysed data were used to disclose behavioural changes of traffic after the projects are completed. This included a comprehensive traffic study carried out at and around the Welikada Plaza intersection, including classified traffic counts, turning movement counts at all turnings at the intersection, and travel time surveys over a length of five kilometres along the main road corridor between Battaramulla and Baseline Road after the flyover came into operation in January 2018. This data was compared with a similar dataset collected in 2016 (before the flyover construction commenced) and comparative statements were developed to understand travel behaviour such as change in traffic levels, change of speed and travel time savings. Also, corridor impact analysis, benefit estimations, and economic analysis [1] were carried out to support the objectives of the research to see whether expected outcomes have effectively been achieved or further integration would be necessary through further innovation.

3. Results and Analysis

3.1. Role of Main Road Corridors for its Road Users and Important Attributes

As per the statistics available, 2,117,352 passengers cross the CMC within a day (two-way) using 568,725 vehicles/day. There are 12 main road corridors and 38 lanes, and this is averaged to 14,950 vehicles/lane/day.

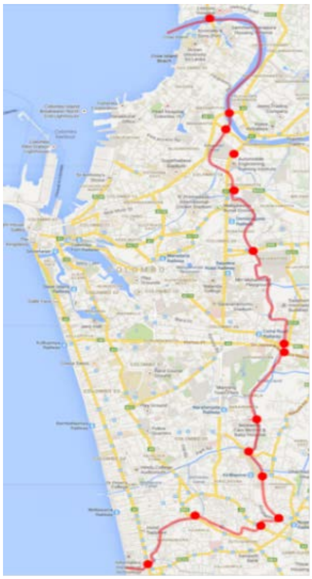
Figure 1: Main Corridors

This is approximately 1,155 vehicles/lane at the peak hour. There are 120,000 vehicles plying Sri Jayewardenepura Mawatha daily as in January 2018. Two way traffic exceeds 10,200 vehicles/hour at the Battaramulla approach in the evening peak hour while it is over 8,100 in the morning peak. The one-way peak directional traffic varies from 5,250 to 5,550 in the morning and the evening peaks respectively. This traffic has to be carried through maximum of three lanes over the length of the main road at and near the approach to the flyover. Even though the implementation of flyover was expected to reduce traffic congestion level significantly, the average traffic flow conditions such as speed, level of service etc along the main corridor are still low during peak hours. It is assumed that there are some external factors than flyover capacity that affect peak flow speeds while permitting high speeds in off peak hours.

3.2. Road Space utilization for trips at main traffic corridors and congestion

It has been verified that nearly 50% of passengers are carried by buses, which utilise only 10% of the road space in the main radial road corridors to Colombo City. Other motorised modes carry 45% of passengers using 62% of road space. Sri Jayewardenepura Road has now become the highest traffic carrying corridor with recent increased traffic as a result of the introduction of the flyover and associated traffic management, and it contributes as the second highest passenger carrying corridor to Colombo.

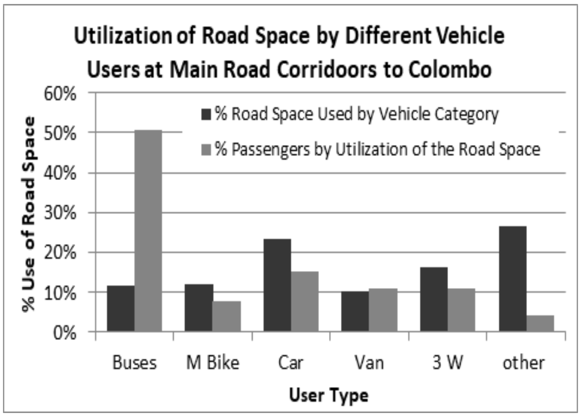

Figure 2: Utilization of Road Space by Different Vehicle Users at Main Road Corridors

In general terms, traffic congestion is a condition that occurs with increased use of the road space. The adverse effects of road congestion are simply the time cost to the user (VOT), missing schedules/activities, increased vehicle operating cost (VOC), externalities including health issues, environmental impacts, accidents as well as impacts to the national economy such as loss of productivity [2].

The best solution in mitigating such adverse effects is to implement appropriate traffic demand management (TDM) techniques to reduce travel demand or to redistribute this demand in space or in time. Successful implementation of TDM techniques is a way to introduce integrated transport planning for congestion alleviation at major road corridors as per past experience from cities in the Asian region as well as in most developed countries in the world. Implementation of new infrastructure does not give the expected outcome unless there are parallel strategic integrations between each development and traffic planning measure. Implementation of the bus priority lane, centre median closure, introducing one-way system at identified locations are some such planning strategies that have already been implemented along

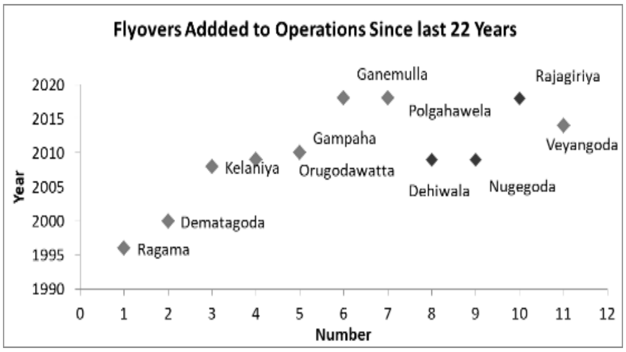

Figure 3: Flyovers in Western Province Since 1995

Sri Jayewardenepura Road and adjoining road network at and around the Walikada Plaza Intersection.

Construction of flyovers is one of the techniques used to separate the traffic conflicts in space sharing such as at intersections, junctions, railway crossings etc. Two types of flyovers were identified in the Sri Lankan scenario, as over railway crossings to avoid gate closure delay and across road intersections to avoid intersection conflicts.

More focus has been paid to railway crossings as they all make high returns while having no major externalities at operational level. However, many external impacts can be expected if road intersections are not planned well, such as high traffic attractions, overloading, capacity imbalance in the network, change of the network performance, inadequate node capacities etc.

Table 1: Economic Feasibility of Flyovers

No	Flyover Location	Road	Type	Year	ADT at Start	Total Gate Closure / Day (Hrs)	Peak Hour Volume	Daily Savings (NPV) Rs.	Economic Returns		
									Savings (NPV) (Rs. M:)	EIRR	B/C
1	Dematagoda	AC5	R.C	2000	130,985		10,253				
2	Kelaniya	A01	R.C	2008	75,852	3.9	5,937	3,015,895	10,063	51.0%	5.6
3	Ragama	B13	R.C	1996	50,952		3,988				
4	Orugodawatta	B435	R.C	2009	21,966		1,616				
5	Ganemulla	B58	R.C	2018	23,307	4.4	1,944	333,117	379	37.8%	1.57
6	Polgahawela	A19	R.C	2018	17,002	6.0	1,350	381,988	635	40.8%	2.13
7	Gampaha		R.C	2010	22,590		2,310				
8	Veyangoda	B445	R.C	2015	25,385	4.2	1,527				
9	Dehiwala	A02	Int:	2009	44,332		3,930				
10	Nugegoda	A04	Int:	2009	71,470		5,515				
11	Rajagiriya	A00	Int:	2018	120,352		11,642	5,674,639	10,163	45.3%	8.88

Travel speeds on Sri Jayewardenepura Mawatha in 2018 reveals that average speeds over the 5.2 km stretch from Battaramulla to Baseline Rd have improved from 3.9 km/h to 8.2 km/h in the morning peak towards Colombo and all the other times it has been improved at high significance, with speeds of over 30km/h on average. The speed increased from 2.0 km/h in 2016 to 12km/h in 2018 to cross the flyover from the Battaramulla end. However, it reduced to 6km/h at Ayurveda Junction due to poor intersection capacity and other conflicting situations.

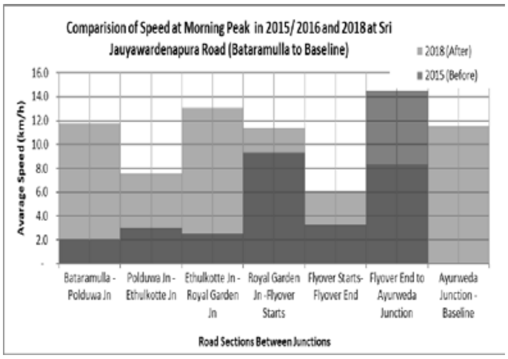

Figure 4: Comparison of Speed at Main Rd

Travel time savings on the main corridor between Battaramulla and Baseline Road (over 5.2 km) with the flyover is 36 minutes at present. Similarly, the minimum travel time reduction is 8 - 10 minutes in any direction in off peaks now compared with travel times in 2016.

Comparison of traffic data for 2016 and 2018 reveals that link flow (at different sections of the entire road) has increased by a minimum of 20,000 to a maximum of 45,000 (minimum of 25% to maximum of 66% with respect to that of 2016) while nodal flow varies from (-25%) to +70%. The traffic flow at service roads has reduced while traffic at all other links is increased with the introduction of the flyover. The traffic across the intersection (via flyover) is increased by 62% at present.

Table 2: Travel Time on Sri Jayewardenepura MW

Description	Morning Peak		Evening Peak		Mid Peak		Off Peak	
	WB	EB	WB	EB	WB	EB	WB	EB
Travel Time in 2018 (Min)	37	12	13	16	12	11	10	8
Travel Time in 2015/2016 (Min)	79	21	33	32	18	15	12	18
Savings of Travel Time (Min)	42	9	20	16	6	4	2	10
Precentage Time Savings	53%	42%	61%	51%	31%	25%	19%	54%

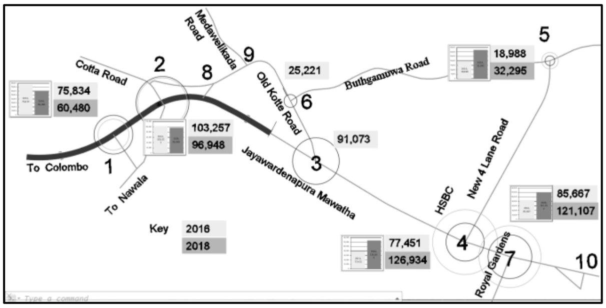

Figure 5: Traffic Attraction to Main Road (Comparison 2016 - 2018)

Therefore, the traffic attraction to Sri Jayewardenepura Road and the Rajagiriya Intersection has increased at a higher than expected rate. The expected travel speeds have been reduced by around 50% as a result of increased traffic flows that lead to capacity issues at Ayurveda Junction. However, the observed aggregated net benefits are close to the estimate as a result of increased volumes, despite reduction in expected speeds.

Table 3: Estimated and Observed Economic Benefits

Item No	Item Description	NPV of Savings Amount (Rs.) With Flyover	
		Estimated (2016)	Observed (2018)
1	Savings in VOT	5,283,451.00	2,971,487.00
2	Savings in VOC	1,179,194.00	405,128.00
3	Savings in Extra Emission	18,777.00	826,821.00
5	Accident Cost (Not collected)	-	-
Total Daily Savings in **12 hours** Period		6,481,422.00	4,203,436.00

The main congestion issues observed at the post evaluation stage of the flyover is that there are buses from BPL cross the three approach lanes to the Ayurveda Junction to enter Cotta Road towards Borella in morning peaks, signal inefficiency improvements at Ayurveda Junction which has not been attended to after the opening of the flyover, high pedestrian flow across Sri Jayewardenepura Mawatha between Flyover and Ayurveda Junction attracted from Cotta Road due to the continuation of BPL in main road whereas the demand is coming from Cotta Road of which buses were directing in 2016. The comparison of the economic analysis of the Rajagiriya flyover with actual observed benefits shows that estimated total savings from the flyover over the next 20 years will be Rs. 27 billion despite the predicted savings are Rs. 41 billion [3]. It is again expected that around Rs. 38 billion benefits can be derived if said conflict at Ayurveda Junction is addressed properly with simple short and medium term interventions such as rerouting buses to Cotta Road under the flyover, signal adjustments at Ayurveda Junction, and widening road approach near the intersection within available RoW at present.

4. Conclusion & Recommendation

Research outcomes show that there is no proper integration between Rajagiriya Flyover, BPL, signalling systems as well as pedestrian facilities when they were planned and implemented. This has led to significant network delays and economic losses. Travel time could have been further reduced with improved overall efficiency if all projects were planned with required operational integrations. This was observed to have been lacking throughout the project cycle.

The study reveals that there are unexpected traffic levels after opening the Rajagiriya Flyover. This indicates this infrastructure has improved the capacity of the main road corridor. Travel speeds have increased more than twice but are still at half the expected speed for peak hours. However, aggregated benefits have been reached over 65% of the estimate at feasibility stage. It is expected that identified externalities can be avoided with the intervention of all project partners through an integrated approach to optimise project outcomes considering overall benefits to the users rather than isolated benefits from each project. It is also observed that traffic diversions from the already congested road network to any large scale improvements would always happen to restore overall network equilibrium. Also, such attractions would have reduced the congestion of the road network at the close catchment of the main road and hence could be treated as a benefit to the entire road network and included in the benefit analysis. Improvements by rerouting the buses, signalisation and widening bottle necks are important factors to be attended to immediately after the major road infrastructure is implemented. This will result in improved benefits, and greater overall efficiency in the road traffic system.

References

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