

Effect of Well-being on People Surrounding the Airport Corridor using Predictive Analysis on Road Accident Correlation

Jotirmay Chari, B Shankar



Abstract: *Transportation demands in urban regions continue to upsurge due to population growth and travel modes' alterations. Due to Bangalore airport location and improper road planning, there is an increase in the traffic volume, which leads to traffic congestion and road traffic accidents in the city. The present study analyses the effect of well-being on the airport corridor residents based on road traffic accidents, traffic volume, and road design. The study collected the traffic accident data from the Traffic Police department for the period from 2014-2015 to 2018-2019, and traffic volume data collected from Essel Devanahalli Tollway Pvt Ltd (EDTPL) for the similar period was analyzed. The study found a significant relationship between improper road pl Manuscript | Research Paper anning, increased traffic volume, and road traffic accidents. The study could be used for road planning as well as better traffic management*

Index Terms: Airport; Road Traffic Accident; Traffic Volume; Road Planning; Well-being

I. INTRODUCTION

Road traffic accidents are one of the significant public health challenges that require intensive efforts for sustainable prevention. The road traffic systems are the most intricate and the most dangerous systems that the public has to deal with every day (Hiroe et al., 2016). Each year traffic accidents have resulted in death and injuries (fatal and non-fatal) and numerous property damages in various parts of the world (Gopalakrishnan, 2012). In the global scenario, an estimated 1.2 million lives get lost, along with 50 million gets hurt each year due to road-related fatalities. The future projections point out that these numbers will upsurge by 65% in the next 20 years if new policies prevent it (Maqbool et al., 2019). Road traffic accidental deaths and injuries are a significant problem in developing nations where more than 90% of accidental disabilities and 85% of lives were lost from road traffic accidents. Road traffic accidents have been a key concern across India. The country reported 178 thousand fatalities in 2018 due to road traffic accidents. About 3% to 5% of India's GDP each year is spent on road traffic accidents.

Notably, India contributed to 1% of the world's vehicle population and accounted for 6% of worldwide road traffic accidents (Vehicles and Road traffic, 2018). Two-wheelers vehicles had the maximum contribution in fatal road accidents across the country, with 70% of the accidents involved young peoples.

Over speeding, rash driving, risky maneuver, and illegal street races on roads and highways have been a concern throughout the country irrespective of day-time driving or night-time. Symons et al. (2019) state that traffic accidents were listed as the 9th prominent cause in 2004 for the loss of lives and are projected to reach 5th by 2030. The primary factors attributed to road traffic accidents are human, vehicular, environmental factors and urbanization, industrial development, populace irruption, and increased vehicles on the streets (Oreko et al., 2017). Bengaluru is one of the preferable cities in the country with the growth in the IT sector and the upsurge in the city's number of employment opportunities. With the growth in population in the city, there is an equivalent increase in vehicles and a rise in demand for real estate properties. The city's traffic pressure is quite alarming as there is minimal scope for road expansion; the need to use prevailing roads to smooth traffic movements is even more prominent. The highest rate of injuries and fatalities is borne disproportionately by pedestrians, cyclists, two-wheelers, residents, and passengers of buses and minibusses.

Table 1. Road Traffic Accidents Data of Bengaluru
[Source: Bengaluru Traffic Police, accident data 2020]

Accident Statistics					
YEAR	Fatal Cases	Number Killed	Non-Fatal	Number Injured	Total Cases
2009	737	761	6138	5668	6875
2010	816	858	5667	5343	6483
2011	727	757	5297	4976	6024
2012	740	760	4767	4471	5502
2013	737	771	4493	4289	5230
2014	711	737	4293	4096	5004
2015	714	740	4114	4047	4828
2016	754	793	6752	4193	7506
2017	609	642	4455	4256	5064
2018	661	684	3950	4133	4611
2019	744	766	3944	4253	4688

Table 1 exhibits the road traffic accident data for 2009-2020.

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The data shows that the year 2010 experienced the highest number of deaths in road accidents (858). In contrast, in 2016, the total number of road traffic-related accidents jumped to 7506 cases, with 793 deaths and 754 in a fatal condition. Road traffic accidents are mainly due to reckless speed driving, decline to follow traffic rules, overcapacity haulage of transport vehicles, drunk driving, vehicle condition, fatigue, choked roads, and roads' improper planning (Stubig et al., 2012).

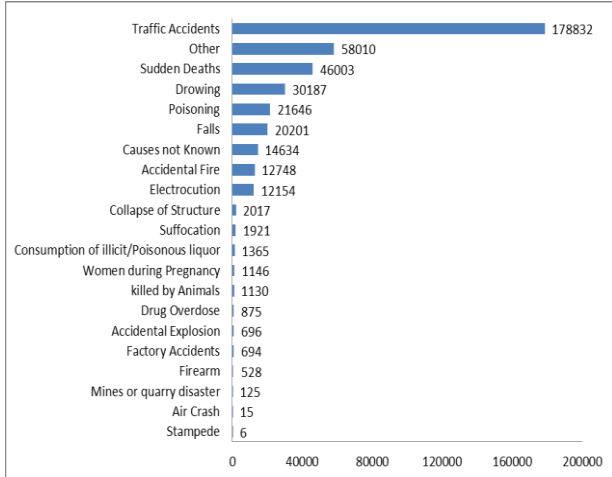


Fig.1. Cause of Accidental Deaths in India [Source: Statista Research Department, 2018]

Fig.1 shows the total number of accidental deaths in 2018. The statistics show that most deaths across India are due to road traffic accidents (178 thousand deaths). Vehicle transportation has enriched individuals' and societies' lives as a whole, but the benefits come with a price. Traffic accident injuries place a heavy burden on household finances (Zegeer and Bushell, 2012).

II. METHODOLOGY

A. Study Area

Bengaluru is one of the world's most dynamic cities, spreading over an area of 709km² known for its weather, diversity, culture, and IT industries. It is India's third-biggest road system. Bengaluru's road network exceeds 3,000 km (1,800 mi) and consists of ring roads, arterial roads, sub-arterial roads, and residential streets (Bharath et al., 2018). As a result of the city's airport's shift from the old location (HAL) to the current location (Devannahalli), there has been an upsurge in vehicular movement resulted in an increase in traffic congestion. Thus, NHAI has constructed six aerial pathways outside the Hebbal flyover prompting to the airport terminal. The ground-level road is improved to a six-lane road with a service road of two-lanes on both sides. The vehicular movement from these paths is presently congregating the blockage in the existing Hebbal flyover (Sreenatha et al., 2020). The Bellary road city-bound traffic congregates from ten-lane to present four-lane flyovers in the opposite direction, resulting in traffic congestion. The

converging traffic towards Majestic and bottleneck descend causes more significant traffic congestion, a higher matter of consent for the traffic movement.

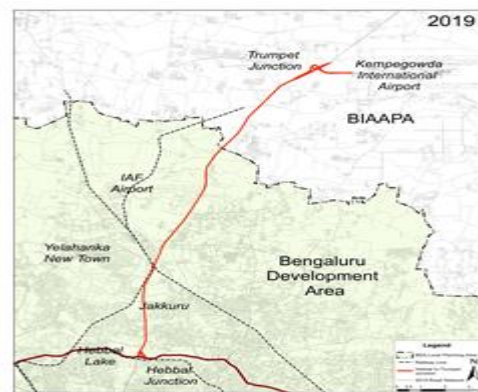
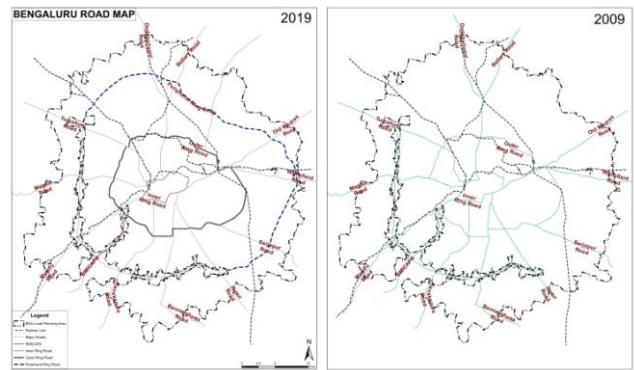


Fig.2. Maps of Bangalore showing major roads [Source: Author analysed 2021, Revised Master Plan 2031, Revised Master plan 2015]

B. Model Framework

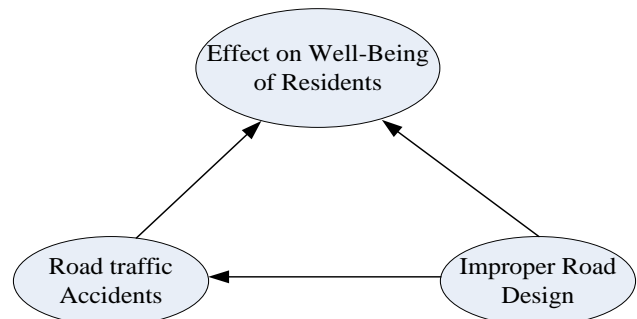


Fig.3. Theoretical Framework

The psychological and physical aspects of well-being are difficult to disentangle: physical damage provokes mental responses (pain, anguish, distress), and psychological disturbances can lead to physical ill-health (Evans, 2003). Vehicular traffic can affect commuters in many ways. Reckless driving, drunk driving, and over-speeding can affect the person and other commuters as well. Regular exposure to traffic congestion impairs health, psychological adjustment,

Table 2 Statistics of Traffic Volume Data [Source: NHAI (2013-2019)]

Traffic Data from April 2013 to December 2019								
Year	Car	LCV	Bus	Truck	MAV	OSV	Others	Total
2013	7346025	942473	574045	0	331317	474	0	9194365
2014	10881770	1286721	769412	27	471944	462	1	13410337
2015	12373709	1244206	698736	0	475546	546	12	14792755
2016	14854714	1337086	691898	0	492799	334	11	17376842
2017	15178351	1311828	677383	15503	453613	1408	1166553	18804639
2018	19696095	1372233	771421	62165	619255	516	536458	23058143
2019	20214308	1190060	850254	59167	537213	1092	51546	22903640

The table constitutes of, two constructs, year (Y) = {2013, 2014, 2015, 2016, 2017, 2018, 2019} and the second one, vehicle type (VT) = {Car, LCV, Bus, Truck, MAV, OSV, Others}, where LCV = Light commercial vehicles, MAV = Multi-axle vehicle and OSV = Oversized vehicle. The graphical representation of the total vehicular movement from the year 2013 till the year 2019 is shown in figure 4. Over the years, the number of vehicle movements through the EDTPL has skyrocketed, causing traffic noise and accident risks to the populace residing near the airport’s surrounding area. The year 2013 witnessed an overall traffic movement of 9194365 vehicles comprising 7346025 cars, 942473 light commercial vehicles, 574045 busses, 331317 multi-axle vehicles, and 474 oversized vehicles. The number of vehicle movements for the corresponding years increased by 45.85% in 2014 with 13410337 vehicles, 10.30% in 2015 with 14792755 vehicles, 17.46% in 2016 with 17376842 8.21% in 2017 with 18804639 vehicles, and 22.61% in 2018 with 23058143 vehicles. The year 2019 showed a gradual reduction in the number of vehicle movements with 22903640 cases, i.e., 0.67% than the previous year. Road traffic is a significant contributor to work performance, mental fatigue, and overall life satisfaction.

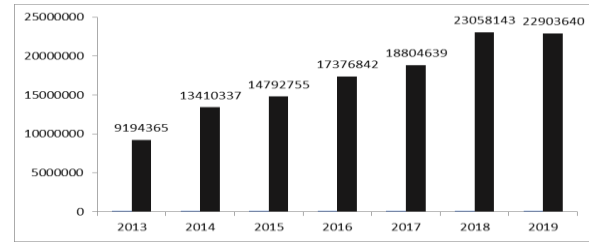


Fig.4. Total Traffic Volume Data [Source: NHAI (2013-2019)]

The health effects of air pollution, observed from both indoor and outdoor environments, have been of great concern due to the high exposure risk, even at relatively low concentrations of air pollutants (Kim et al., 2013). Traffic is the significant contributor of air contamination; the air pollutants composition depends on the quantity of vehicle movement as well as on vehicle age period, its engine condition, fuels utilized to run the vehicle, meteorology, the state of the urban climate, and how traffic is coordinated (Burdzik and Konieczny, 2013). Traffic noise and traffic-related air pollutants co-exist in the traffic environment.

B. Road Traffic Accident Statistics

The road traffic accident data is presented in Table 3. The data is collected for the period 2014-2015, 2015-2016, 2016-2017, 2017-2018, and 2018-2019 to understand better the road conditions, junction type, and the number of accident cases in the area near Kempegowda International Airport. The data has been collected from EDTPL (Essel Devanhalli Tollway Pvt Ltd).

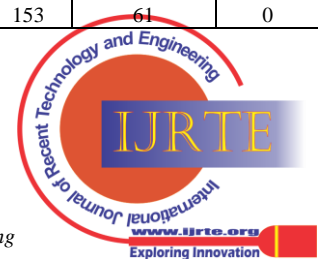
Table 3 Statistics of Road Traffic Accident Data [Source: EDTPL (2014-2019)]

Year	Fatal Cases	Grievous Cases	Minor Cases	Non-Injured	Animals Died
2014-2015	16	157	204	623	1
2015-2016	26	72	251	571	2
2016-2017	21	98	330	878	2
2017-2018	15	54	135	265	0
2018-2019	20	48	153	61	0

III. RESULTS AND DISCUSSION

A. Traffic Volume Statistics

The traffic volume data of various vehicles are presented in Table 2. The data collected at the EDTPL tollgate have been analyzed to understand better traffic movement and traffic noise exposure on the residents living near the surrounding airport corridor. human exposure to noise and accidents. The sound levels have steadily increased because of the growing numbers of vehicle movements (Levy et al., 2010). Transportation-associated air contamination has numerous aspects, with two being of serious threat to the environment: i) dangerous emission of vehicle fumes and ii) vibro-acoustic impact due to noise (Jacyna et al., 2015).



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The table 3 constitutes of, six constructs; first construct is year (Y) = {2014-2015, 2015-2016, 2016-2017, 2017-2018, and 2018-2019}, the second construct is fatal cases (FC) = {No of People Died}, the third construct is grievous cases (GC) = {critical cases}, the fourth construct is minor cases (MC) = {non-fatal cases}, the fifth construct is non-injured (NIC) = {non-injured cases}, and the sixth construct is animals died (AD) = {No of animals died}.

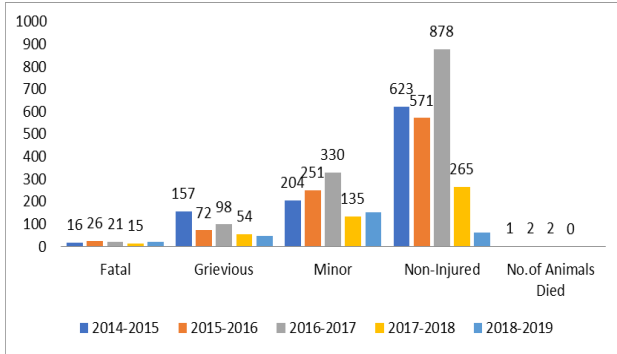


Fig.5. Total Road Traffic Accident Data [Source: EDTPL (2014-2019)]

The graphical representation data illustrated that the number of road traffic accidents has skyrocketed over the years, causing safety risks to the populace residing near the airport's surrounding area.

Table 4. Statistics of Junction and Number of Accidents [Source: EDTPL (2014-2019)]

Junction Type	No. of Accidents	Junction Type	No. of Accidents
Elevated Flyover	922	Underpass	5
Main Road	2668	Unknown	3
Service Road	357	DODDAJALA Flyover	1
Flyover	34	Main Carriage	1
Zebra Crossing	12		

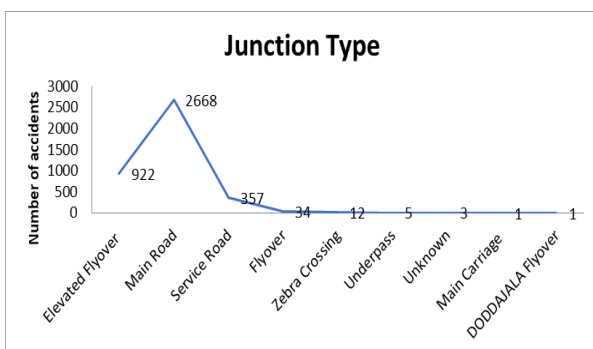


Fig.6. Road Traffic Junctions and Accidents [Source: EDTPL (2014-2019)]

Figure 6 shows the junction type and the number of accident cases near Kempegowda International Airport. The data from the NDTPL exhibits the utmost traffic accidents reported in Main Road junction with an entire case of 2668 accidents. In contrast, Elevated Flyover junction reported with accident cases of 922. Service Road, Flyover, and Zebra Crossing lane stand at 357, 34, and 12 road accident cases, respectively. Few accidents are reported in the Underpass junction with 5 cases, and three accidents occurred in an unknown location.

The remaining one accident each is reported in Main Carriage and Doddajala Flyover junction.

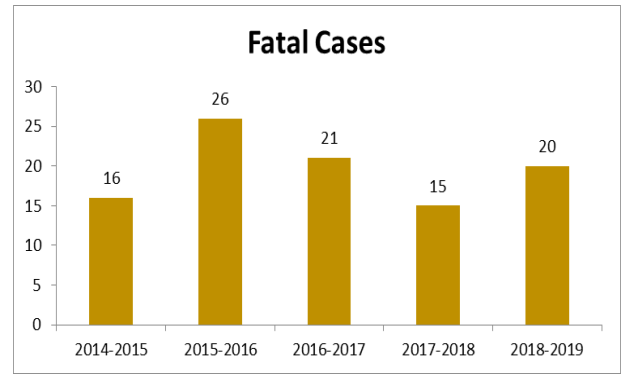


Fig.7. Number of Fatal Cases [Source: EDTPL (2014-2019)]

Figure 7 shows the data of traffic-accidental death for the period 2014-2015 to 2018-2019. The year 2015-2016 had witnessed the highest number of deaths in road accidents with staggering cases of 62.5%. The following years saw a dip in the number of deaths in road traffic accidents with 19.23% in 2016-2017 and 28.57% in 2017-2018. The year 2018-2019 showed an increase in the number of cases, with 33.33% of road traffic accidental deaths.

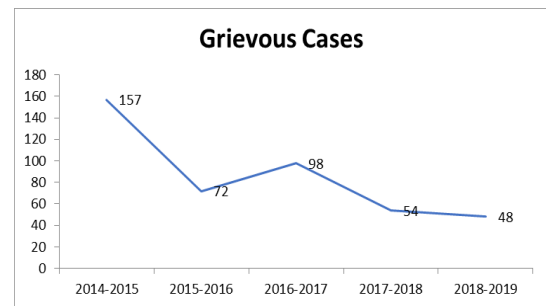


Fig.8. Number of Grievous Cases [Source: EDTPL (2014-2019)]

Figure 8 shows the total number of people who suffered from critical injuries in a road traffic accident from 2014-2015 to 2018-2019. The year 2014-2015 had witnessed the highest number of people suffered from grievous injuries with 157 cases. The subsequent year showed a decline in the number of accident cases (54.14%). In 2016-2017, the rate of critical injuries expanded by 36.11%, whereas the road accident severe cases dropped by 44.89% in 2017-2018 and 11.11% in 2018-2019.

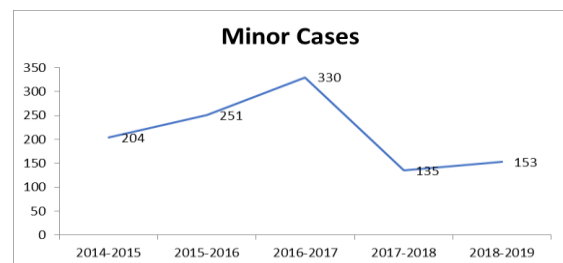


Fig.9. Number of Minor Accident Cases [Source: EDTPL (2014-2019)]



Figure 9 shows the total number of people who have suffered minor injuries in road traffic accidents from 2014-2015 to 2018-2019. The year 2015-2016 had witnessed 23.03% of road accident cases with minor injuries. The accident case hikes up in 2016-2017 by 31.47% and declines by 46.21% in 2017-2018.

The number of road accident cases in 2018-2019 exhibits growth of 13.33%.

Figure 10 shows road accident cases for the period 2014-2015 to 2018-2019. The year 2014-2015 had witnessed 1001 road accident cases, whereas, in 2015-2016, the number of cases decreases by 7.89%. The year 2016-2017 exhibits the highest number of road traffic cases with 44.14%. The number of cases quietly dropped in 2018-2019 by 39.87%, with merely 282 accident cases.

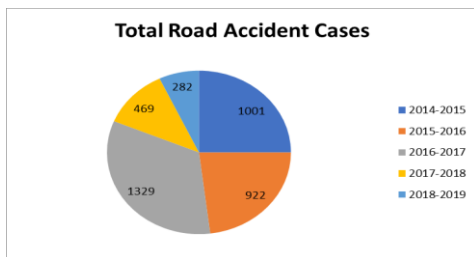


Fig.10. Road Traffic Accident Cases 2014-2019 [Source: EDTPL (2014-2019)]

From the road traffic accident data, it can be analyzed that the total number of fatal accidents from 2014-2019 is 98, severe cases stand at 429, minor cases at 1073, and non-injured cases at 2398. Therefore, the total accumulated accidents ensued near Kempegowda International Airport is 4003 road traffic accidents. Improper road planning and heavy vehicle traffic movement have several negative impacts on the population/residents in the Airport corridor’s surrounding area.

Table 6. Analysis of Traffic Volume, Improper Road Design and Road Traffic Accidents

Coefficients						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error			
1	(Constant)	1044.46	516.207		2.023	.180
	Traffic Volume	.477	.586	.485	.814	.001
	Improper Road Design	.085	.227	.223	.373	.035
**** Dependent Variable: Road traffic Accidents						
**** R= 0.590						

Table 6 provides the R-value, which helps in determining the regression model fit. The R-value is to predict the dependent variable, i.e., Road Traffic Accidents. A value of 0.590 shows a good level of prediction value. The general form of the regression model to predict Road Traffic Accidents from Traffic Volume and Improper Road Design is:

$$Y = a + bX_1 + bX_2$$

Here, Y= dependent variable, X₁ and X₂ = independent variable

$$\text{Road traffic Accidents} = 1044.46 + (0.477 * \text{Traffic Volume}) + (0.085 * \text{Improper Road Design})$$

Therefore, a multiple regression model was run to predict the Road traffic Accidents from Traffic Volume and Improper Road Design. Hence, the data suggest an influence of Traffic

C. Role of Improper Road Design on Road Traffic Accidents

Table 5. Analysis of Improper Road Design on Road Traffic Accidents

Correlations			
		Road Traffic Accident	Improper Road Design
Road Traffic Accident	Pearson Correlation	1	.363
	Sig. (2-tailed)		.048
Improper Road Design	Pearson Correlation	.363	1
	Sig. (2-tailed)	.048	

From the above table, it is observed that there is a significant relationship between improper road design and road traffic accidents. Therefore, it can be said that due to improper road design/ planning, there is an increase in road traffic accidents in the surrounding area of the airport corridor. (r = .363, n = 41, p = .048).

D. Role of Traffic Volume and Improper Road Design on Road Traffic Accidents

expected growth of traffic, road design to obviate accidents should be included at the drawing board stage. Policymakers, government, and transport authorities must join forces and make decisions concerning road infrastructure and urban planning and take appropriate actions considering the various consequences of society as a whole and the residents living near the airport corridor's surrounding area. Governments should actively implement more appropriate policies for the well-being of people.

Volume and Improper Road Design on Road Traffic Accidents.

IV. CONCLUSION

Road traffic accidents are predictable and preventable. To cope with traffic accident issues, there is a need for proper coordination and collaboration, using an integrated, holistic approach across various departments and sectors. Due to the shift of the city’s airport to devanahalli, the amount of traffic movement has increased.



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It has resulted in an increased traffic flow, leading to the airport. The improper planning of airport location has resulted in significant traffic congestion, a higher percentage of vehicle movement, and increased road traffic accidents. The present study analyses the effect of well-being on the airport corridor residents based on road traffic accidents, traffic volume, and road design. The study found that the residents near the airport corridor were impacted by the traffic volume and the improper road planning, and road accidents. Whenever an extensive public utility infrastructure like the airport is conceived, the focus should not be restricted to only the width of an access road to accommodate a large traffic volume. However, factors such as historical data of traffic, traffic other than commuting to the airport, existing & future land use flanking the access corridor in the vicinity, the

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