

Urban Land-Use Planning for Road Safety in Developing Countries

Towards for Live able and Safer Cities

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ABSTRACT: This paper examines the road accident and safety aspects at the planning level. Road accident has become a matter of concern with increasing private vehicles. More than 90% of road accident deaths occur in low- and middle-income countries and the leading cause of death for children and young adults aged 5-29 years (WHO, 2018). Road accident is an outcome of interaction among various factors, some of which are related to urban planning. It is important to analyze road accident spatially to understand the various factors and for improving transportation and land use planning. The harmful effects of road accidents are to be considered in urban planning. It is necessary to understand the various levels and aspects of urban planning that influence the occurrence of road accidents. In a macro scale, urban planning concept such as compact city transit-oriented development promotes non-motorized vehicles through mixed-use development, public transport, walkability, etc. It is necessary to adopt strategies that decrease exposure to accidents. Urban road safety is a prime concern as the cities strive to be livable (International Transport Forum, 2018). Safer streets add to the liveability of the city. The type of urban development is one of the causes of road fatalities such as ribbon development encourages development along the major roads, creating urban issues- congestion, road accidents and deterioration of the urban living condition. Distance traveled and the number of trips can be reduced by mixed land use. Shifting to more sustainable land use and transportation planning is expected to improve road safety sustainably. Sustainable transport and land use require a combination of policy, investment, land management, housing, and spatial planning.

KEYWORDS: Urban planning approaches, Strategies, Urban planning concepts

1. INTRODUCTION

It is estimated that the urban population in developing countries is increasing at 4% per annum and as a result, many cities are increasing the road network capacity to meet the growing population (UNDESA, 2010). Road accidents are one of the major causes of accidents in both developing and developed countries. In developing countries, the situation is often exaggerated by rapid and unplanned development. Recent years witnessed the rapid growth of vehicles in developing countries. Road safety has been included as a sub-target in the 2030 Agenda for Sustainable Development. Road traffic crashes account for approximately 1.35 million death each year and are the tenth leading cause of death globally (WHO, 2018).

Road safety is multidimensional as well as multi- sectoral (Planning Commission, 2007; Kadiyali, 2013). Factors such as types of road network; land use, local business, and activity patterns increase the risk of accidents in an area (Komba, 2006; Zhang et. al, 2015). The presence of different modes of travel makes the road unsafe. Development stimulates

economic growth, which in turn generates traffic. India is an example of a developing country where the growth of vehicles has stimulated economic growth and consequently has a negative impact on road safety (Khanal and Sarkar, 2014). In the year 2006 India accounts for 10% of the total world road fatalities (A Manual on Road Safety Audit, 2010). Road and development are interlinked. 10-25% of the urban area is occupied by road transportation infrastructure, with lesser space for non-motorized transportation.

2. METHODOLOGY

- T Literature review of various urban planning aspects of road safety.
- T Findings by case studies of the influence of urban planning in road safety.
- T Various strategies for implementing road safety at the urban planning level.

3. LITERATURE REVIEW

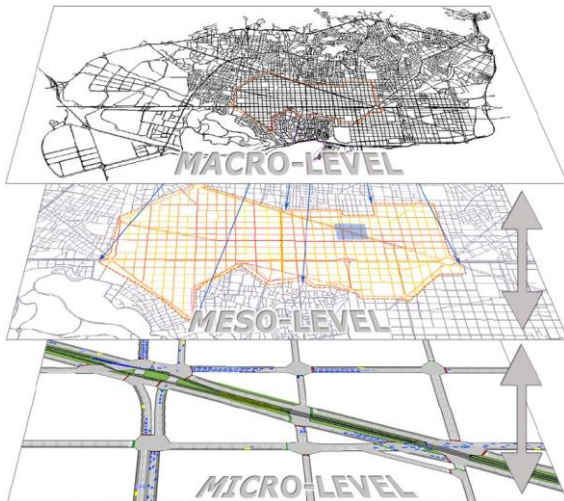
The changes in land use, road design, and traffic management have been found to result in a potential reduction of 5% to 10% in the total injury accident (Srinivasan, 1987). The decisions regarding land use

largely define travel needs, travel modes and, more particularly, traffic and safety conditions. Because these decisions are taken before the urban development of the territory and because they have a long-term effect, they may be an efficient way to prevent road safety issues. Travel behavior in any city is guided by its land use distribution and transport network and planning (Puntambekar, 2011). The traffic generated on roads is due to the movement of the population between workplace, leisure, and residence. The travel distance increases with the increase of the share of vacant land. The travel behavior can be made to change by bringing change in either the land-use system or transport system. Mixed land use functions affect the behavior patterns of travel agents because the density of residential settlements can reduce travel length and travel time and travel costs (Dieleman and Wegener, 2004).

3.1. Macro, meso, micro approaches of road safety

In city road accidents and its safety measures can be approached at three levels- macro, meso, and micro level.

Figure 1: Micro, Meso and macro approach. (Methodological notes on combining Macro, Meso and Micro models for transportation analysis retrieved from



https://www.researchgate.net/figure/From-macro-to-meso-and-micro_fig1_242154775.

- Micro level- Road entity, driver, vehicle at this level road entity, driver and vehicle is considered. Road safety can be ensured by considering elements such as road users, vehicle and road design.
- Meso level- Meso level is commonly associated with micro level. It is the investigation of factors at the community level, neighborhood, clusters, traffic environment, and building surrounding.

- Macro level- It is the geographic area usually a region or a metropolitan area. These areas are investigated to understand factors such as land use, transportation, infrastructure, and demographics that influence the occurrence of road accidents (Montella, 2019). Such an approach promote Sustainable development pattern. This approach provides tools for planners regarding road safety and takes into consideration aspects such as improvement in infrastructure, land use, neighborhood, socio- economic conditions and increased walkability (Sun, 2009).

3.2. Urban development concepts and road safety

Various urban development concepts and theories can ensure road safety such as new urbanism, transit-oriented development (TOD), compact city, smart growth, and urban village.

a) TOD is a mixed-use community within walking distance from a transit station. It is a place of high density that includes residential, retail, office, open space, and public uses in a walk-able environment, reducing the dependency of a car (Calthorpe, 1993; Still, 2002; Bernick and Cervero, 1997).

b) New Urbanism- New urbanism focus on human- scale urban design that promotes compact, mixed- use cites, environment-friendly habits that reduce the dependence on private vehicles such as walking and cycling.

c) Smart growth- Smart growth is an urban planning theory that encourages mixed-use building types and transportation options. This approach provides various housing options; compact walk able cities to avoid urban sprawl.

d) Compact city- Compact city or short distance city is a concept in urban planning and urban design that promotes mixed-use and high-density residential building. It emphasizes that urban activities are located closer together to better utilize the facilities through the use of public transport and walking.

e) Urban village- Urban village is a development concept characterized by mixed-use, medium to high residential area, quality public transport and pedestrian-friendly neighborhood.

Comparison of components of TOD, new urbanism, smart growth, compact city, and urban village areshown in table 1.

Mixed land use, public transport, facilities for non-

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motorized vehicles, walkability, high density, and community development are common components. Considering these components in the planning level promotes safer streets.

4.1. Ribbon development in Savar, Bangladesh

Savar is a city in the Dhaka district. This city was a traditional rural-based settlement and without necessary infrastructure until 1950. The first phase of development came along with the construction of the

4. CASE STUDY

Components	TOD	New Urbanism	Smart Growth	Compact City	Urban Village
Mixed land use	✓	✓	✓	✓	✓
Public transport	✓	✓	✓	✓	✓
Non motorised Vehicle	✓	✓	✓	✓	✓
Medium density					✓
High density	✓	✓	✓	✓	
Connectivity	✓	✓		✓	
Mixed income development	✓	✓			
Employment	✓		✓		✓
Reduced private vehicle	✓			✓	✓
Reduced parking requirement	✓				
Liveability	✓	✓			
Walkability	✓	✓	✓	✓	
Sustainability		✓	✓	✓	
Traditional Neighbourhood structure		✓			
Urban design		✓			✓
Affordable housing		✓	✓		
Community development			✓	✓	✓
Open spaces/ Public space			✓		✓
Environment			✓	✓	
Cost effective			✓		
Participatory			✓		
Infrastructure			✓	✓	
Energy Performance				✓	
Services				✓	

national highway in 1960. The government acquired land for various infrastructure developments. This gradually resulted in ribbon development with a considerable amount of agricultural land shifting towards built use (figure 2).

As a consequence, it resulted in urban sprawl, congestion, inefficient use of resources, an uneconomic extension of utilities and deterioration of the urban living conditions.

Roughly, a standard city should have 25% of its total space for road infrastructure, while the city has only about 7.5%. In places where residential and commercial activities are close to the arterial roads, there is an increase in the number of road accidents. This involves pedestrians and vehicles going in and out of those buildings. This is revealed by Dhaka’s pedestrian accident statistics, which show that pedestrians are vulnerable to road accidents.

Best use practices **Superblock- Barcelona, Spain**
Micro approach-

- Traffic calming measures inside superblocks
- reduced speed of 10km/h.

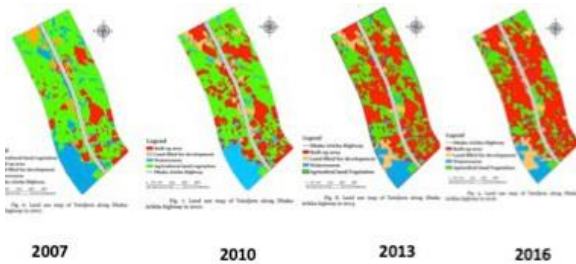


Figure 2: Land use of Savar city from 2007 to 2016. (Impact of Ribbon Development on Land Use along Dhaka Aricha Highway. The Case of Savar Upazila. 2017 retrieved from

[https://www.semanticscholar.org/paper/Impact-of-Ribbon-Development-on-Land-Use-along-The-Hasan-Hossain/f4a7d15f3a4978dce2cbc8c9fd98fe7c9879df80.\)](https://www.semanticscholar.org/paper/Impact-of-Ribbon-Development-on-Land-Use-along-The-Hasan-Hossain/f4a7d15f3a4978dce2cbc8c9fd98fe7c9879df80.)

Meso approach-

- Superblock of about 400 x 400 meters.
- Octagonal spaces dedicated for public use.
- Inner streets are reserved for pedestrians and cyclists.
- Increase the green and recreation space for pedestrians.
- Extending car-free spaces by more than 23 hectares and adding 300 km of bike lanes.
- Orthogonal bus network.
- Less than 300 meters from a bus stop

Macro approach-

- Superblocks- mini neighborhoods around which traffic will flow.
- A superblock will consist of nine existing blocks of the grid.
- Car, scooter, lorry and bus traffic will then be restricted to just the roads in the superblock perimeters, and they will only be allowed in

SUPERBLOCKS MODEL

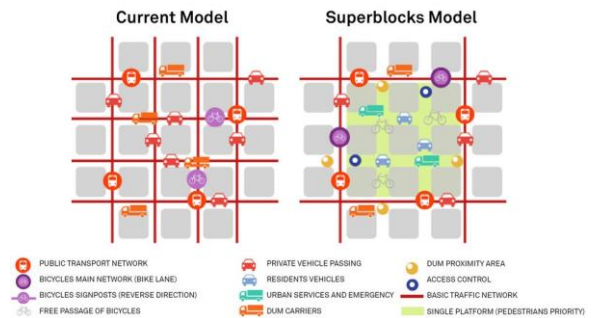


Figure 3: Superblock model, Barcelona.

(A sustainable strategy for regenerating the city. 2019 retrieved from <https://barcelonarchitecturewalks.com/superblocks/>) the streets in between if they are residents or providing local businesses.

Curitiba, Brazil

Micro approach-

- Barter System Street Maintenance.
- “Green exchange” employment program.
- Reduction of private vehicle use.
- The promotion of public transport use and cycling in order to encourage a low-carbon and resilient city.

Meso approach-

- Specially marked bike and pedestrian paths.
- Neighborhood parks- parks within a maximum of 500 meters.
- BRT-Concentric circles of local bus lines connect to five radial lines that go outward from the center of the city.
- Public- Private Partnership for bus lines.
- Axis marks the spot- these corridors serve as the city’s main transport arteries.
- Curitiba had limited financial capacity- scaled up its existing transportation services with an adaptive BRT transit strategy to complement the City’s new urban development policies. This phased approach allowed for the timely deployment of buses while allotting time for the necessarily gradual development of transit infrastructure.

- Tertiary Road System.



Figure 4: Greenline- BRT, Curitiba.

(Curitiba: Integrated Urban Planning. 2008 retrieved from <https://www.ecovillagefindhorn.com>, 2018.)

Macro approach

- Transit- oriented development.
- Reduce traffic congestion and urban sprawl.
- High-density, mixed-use communities along mass public transport corridors.
- Increased social equity and well being through the provision of more leisure areas and pedestrian zones in the center of the city.
- The relief of traffic and congestion in the downtown Curitiba by decentralizing the location of employment providers.
- Zoning for mixed-use, walk-able neighborhoods.
- Rezoning to encourage higher density along bus lines.
- Builders get tax breaks if their projects include green space.
- A close relationship between public transportation and land-use legislation as guidance and development.

5. SAFER STREETS AND LIVEABILITY

Many cities are focusing on ways of reducing cars on the streets to create liveable streets. Traffic calming is one of the effective measures to improve the safety and livability of streets. According to Rob Krier in his book, “Urban space (1979)” streets are functional only when it is a part of pedestrian access and residential streets are universally seen as areas of public circulation and recreation.

Most of the road safety measures focus on the behavioral aspects of the driver such as wearing a helmet and seat belt. Safety and efficiency are important for the success of an urban street network

(Dumbaugh, 2005). Safer streets not only make the city safer but also improve the quality of life. It encourages

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Phases		Human/ Host	Injury agent	Environment
PRE CRASH	Crash prevention	Alcohol/drugs, Driving Behavior, Education, Enforcing law, impairment, perception, health, age	Technology of safety measures, Vehicle type, Lighting, Road worthiness, Speed management	Road engineering factors- pavement, grades etc., Traffic engineering factors, Urban form, Land use, Zoning, Inadequate Urban development, Non motorized facility, External factors- weather, temporal variations
CRASH	Injury prevention during the crash	Age, Use of helmet, seat belt etc., Speed,	Speed and direction of impact, Vehicle condition, Occupant restraint, Crashworthiness	Protective road side objects, Warning systems
POST CRASH	Life sustaining	Age, Sex, Pre medical condition, Physical Condition	Ease of access, Fire risk,	Rescue facilities, Access to Emergency facilities, Congestion, Road side factors

walking, cycling, public transport and thus improving the air quality as seen in the case of Superblock in Barcelona. To make a city more liveable it is necessary to reduce urban sprawl, reduce traffic congestion, high-quality public transport and dedicated space for pedestrians and cyclists.

6. STRATEGIES FOR ROAD SAFETY

The strategies that can be employed to improve road safety are (Roess, 2013):

- Exposure control
- Accident risk control/ Accident prevention
- Behavior modification
- Injury control
- Post injury management

At the urban planning level, the strategy that can be adopted is the exposure control which aims at providing and promoting public transport, walking, biking, reducing the traffic and travel demand. This strategy can be implemented by integration of land use and transportation for short term and long-term, urban renewal, reorganizing land uses to

minimize the travel needs and trips generated.

William Haddon in 1970 developed a matrix (table 2) that relates various factors and phases of road accidents. Evaluation of this framework gives an understanding of the various factors that should be incorporated in the design of a city.

7. CONCLUSIONS

Innovative measures are needed at the urban planning level to reduce the risk of accidents.

There is a need for:

- An integrated approach of land use and transportation planning such as transit-oriented development.
- Coordination between various stakeholders.
- Legal framework for controlling ribbon development.
- Defined perimeters for urbanization.
- Development based on the hierarchy of roads.
- Modification and strict enforcement of development control regulations such as maintaining building line and minimum setback.

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