

Integration of Cycling with Urban Transport Systems

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Abstract - Traffic congestion is a growing problem for cities in India and around the world, causing air pollution, greenhouse gas emissions and long commuting times which together damage human health, environmental quality, urban sustainability and the economic viability of our urban centres. The question is not just how to accommodate rapidly increasing travel within, to and from cities using existing concepts and practices but also not to harm environment while using these concepts or doing such practices. India is facing a lot of problems like haphazard traffic growth and congestions in traffic streams. In most of the large and mid-sized cities of India, about 50% to 70% of people make short trips having trip lengths less than 5km, which offers a huge potential for bicycle use. The conversion to bicycles trips is highly likely if cycling infrastructure is made available. Urban cycling is therefore clearly a topic of immense interest to the transport research community, and this special issue captures key themes amongst the rapidly growing body of research. The main objectives of this paper is to identify the influencing factors affecting the bicycle mobility and to set a foundation for the future in-depth studies on the inclusion of cycling in existing urban transportation systems programs and their overall effectiveness.

Introduction

The transportation sector accounts for one-third of CO₂ emissions. In recent researches by various agencies across the world, motor vehicles have proven to be the main contributor of atmospheric pollution in the world. It is observed that the short trips with motorised vehicles contribute disproportionately to transportation emissions. Major cities throughout the world have sought to reduce transportation emissions through the implementation of policies aimed to increase non-motorized transport use. The growing interest in transport cycling from the research community is matched by the increasing interest shown by city governments in beginning the process of making their urban environments more bicycle friendly.

Bicycling is considered as one of the most efficient mode of sustainable transportation for shorter commutes. Also, cycling as a mode of transport is a low-cost, health-improving way to travel and offers environmental benefits for the cities that promote it. It is only recently, though, with concerns over climate change, pollution, congestion, and obesity among others, that have cities throughout the world have begun to implement policies to promote cycling.

European countries such as the Netherlands, Denmark, and Germany are the global leaders in this context with their high level of bicycling for commute. They achieved it by providing safe and efficient bicycling infrastructure over the years. During recent years, we have witnessed an effort to reintroduce cycling in the life of people living in cities in various developed nations but in India, which is the second largest producer of bicycle in the world, bicycle usage is decreasing year by year and one of the major reasons is the lack of safety standards. Although it is expected to be attractive option for short commute trips in urban India are mostly lower income group people and students due to its extremely low cost of operation but it is not at all an attractive mode among commuter belonging to high and middle income group. They are predominantly captive riders. There is also a high level of safety concern among Indians regarding bicycling. In order to improve the bicycling level in India, development of bicycle friendly infrastructures and implementation of policies promoting bicycling is essential.

Advantages

Inclusion of cycling in urban transportation systems have not only transport benefits but other various advantages as well and are listed as follows:

Benefits to transport

- Bicycles offer door-to-door service.
- They are often quicker than cars over short distances.
- Bicycles do less damage to road surfaces than cars. Also, cycle tracks give people 'freeways' for the price of footpaths.
- More bicycles and less cars on the road can reduce this congestion and its associated costs.
- Bicycle parking is usually free, easily accessible and more convenient than car parking.
- Cycling conserves roadway and residential space, thereby providing opportunities for less cement and more plant life in urban areas.
- Bicycle lanes and paved shoulders on roads create a number of benefits for motorists, cyclists and pedestrians. These include:
 - i. improved safety for cyclists and motorists, that is due to reduced need to travel out of the lane to pass cyclists
 - ii. additional space for motorists to stop in the event of a mechanical difficulty, emergency, or to escape potential crashes or reduce their severity

- iii. access for emergency vehicles as motorists have more space to move out of their path
- iv. extra sight distance and turning space.

Benefits to environment

Bicycle riding uses minimal fossil fuels and is a pollution-free mode of transport. Bikes reduce the need to build, service and dispose of cars. According to reports, cycling 10 km each way to work would save more than 1500 kg of greenhouse gas emissions each year. Also, as traffic delays and interruptions to traffic flow in India's six major cities account for around 13 million tonnes of greenhouse gas emissions each year, cycling during peak hours would contribute to further emission reductions by reducing congestion and improving traffic flow.

Benefits to health

Regular exercise, such as cycling and walking is important. Health professionals recommend at least 30 minutes of moderate-intensity physical activity each day. This is enough to maintain good health, even if the exercise is broken up into short 10 minute bursts. Therefore, riding to work, school or college, or taking your bicycle on short neighbourhood trips is a convenient and practical way to incorporate regular exercise into your busy day.

Economic benefits

Transport (approximately 16%) is second only to food (approximately 18%) as the largest item of household expenditure. The family car costs up to Rs.5 per kilometre to run. In comparison, the cost of buying and maintaining a bicycle is around one per cent of the cost of buying and maintaining a car. Also, using a bicycle for shorter trips may allow you to avoid buying more cars, which will save families thousands of rupees every year.

Benefits to society

Bicycles are more affordable to run. While only around 10% of the world's population can afford a car, an estimated 80% of people can afford a bicycle. Cycling provides economic and independent travel for those who might otherwise have their travel options restricted. It offers increased mobility to many groups of the population with low rates of car ownership, such as low-income earners, unemployed people, seniors and those under 18 years of age. Shared cycling and pedestrian facilities also create benefits for pedestrians and people with disabilities by providing an increased network of paths and improved road crossings.

Disadvantages

Dangerous Driving

While some areas have wide shoulders and bicycle lanes, drivers frequently disregard bicyclists and are at fault for causing cyclist injuries and even deaths. With only clothing and a helmet for protection, bicycle riders have a significant safety disadvantage in case of an accident. Many of the bicycle crashes caused by motorists go unreported, so it's almost impossible to determine the exact number of cyclist injuries per year. The dangers of sharing a road with cars has made some cyclists decide that the risk of bicycle is too high and they instead turn to driving cars or other forms of transportation.

Weather Conditions

Riding a bicycle is not recommended in icy, snowy or rainy weather. Also, cyclists may be uncomfortable when the wind is high or there are high temperatures. In areas that have adverse weather conditions frequently, bicycling is not an option as a reliable form of transportation. In order to be safe, cyclists have to check weather conditions before setting out in order to ensure they will be able to get where they need to go safely.

Increased Risk of Injury and its Severity

Cyclists may experience traumatic and overuse injuries. While traumatic injuries can primarily be attributed to accidents, overuse injuries frequently occur in cyclists who ride regularly. Lower back pain is common in cyclists since they use their lower backs to control and power the bike. The stress added onto the back may produce chronic pain. Bicyclists may also suffer a variety of injuries to the tendons or muscles in the knee areas. In some of these cases, it may be necessary to see a doctor or physiotherapist.

Topography

Use of bicycle is very difficult in hilly or mountainous regions because of the topography. Although it is easy while moving down the hill but it is very difficult to ride a bicycle while going upward.

Comfort

Cycling is least comfortable when we compare it to all the modes of transport. It requires a lot of physical effort and also bicycle riding becomes even more uncomfortable when the weather is not suitable (such as rain, heat wave, high temperature etc.).

Factors affecting bicycle use

There are several factors that affects the use of bicycle, some of which will be promoting the bicycle use (motivators) while others will demotivate the users (deterrents). The major factors will work as motivators and deterrents are listed below:

- Safety
 - Motivators
 - ✓ Safety Education
 - ✓ Low Traffic Volume
 - ✓ Presence of Safety Cameras
 - ✓ Low Traffic Speed
 - ✓ Better Lighting
 - ✓ Higher Population Density
 - ✓ Good Land-use Mix
 - ✓ Shorter Commuting Distances
 - Deterrents
 - ✗ Dangerous Traffic Condition

- ✗ Lack of Daylight
- ✗ Percentage of Heavy Traffic
- ✗ Street with Auto Parking
- ✗ Number of Difficult Intersections
- ✗ Inconsiderate Drivers
- Cycleways
 - Motivators
 - ✓ Beautiful Scenery
 - ✓ Continuous Bike Facilities
 - ✓ Infrastructure
 - ✓ Smooth Surface Quality
 - ✓ Traffic Calming for Cyclists
 - ✓ Direct Route (Shorter Distances)
 - ✓ Flat to Moderate Hills
 - ✓ Off-street Path
 - ✓ Segregated Bike Paths and Routes
 - Deterrents
 - ✗ Gradient
- Discourage car use
 - Motivators
 - ✓ Presence of Safety Cameras
 - ✓ Increase Fuel Cost
 - ✓ Limited Auto Parking
 - ✓ Speed Limit in Residential Area
 - ✓ Car Free Zones
 - ✓ Give Cyclist Priority (Cycling Right-of-way)
 - ✓ Low Traffic Speed
 - Deterrents
 - ✗ Pollution & Noise
- Convenience
 - Motivators
 - ✓ Secure Parking at Work
 - ✓ Availability of Rental Bikes
 - ✓ Detailed Hardcopy Maps
 - ✓ Presence of Shower and Locker at Workplace
 - ✓ Providing Internet Route
 - ✓ Promotional programs and Financial incentives
 - ✓ Linking Bicycles with Public Transport
 - ✓ Parking Facilities at Stations
 - Deterrents
 - ✗ Type of Destination
 - ✗ Time of Departure
 - ✗ Longer Travel Time
 - ✗ Employment Status (i.e. part/full-time, etc.)
 - ✗ Adverse Weather Condition

Conclusions

- Factors that impact or influence the use of bicycles are numerous but it also has its own set of roadblocks, mainly dependent on the local land use, bicycle infrastructure and public perception of cycling.
- Positive impacts of integration of cycling with urban transport system for an individual and communities are obvious and tangible.
- Integration of cycling acts as a substitute and complement to urban transportation system simultaneously.
- Literature review has revealed that cycling schemes are a cheap, convenient and eco-friendly alternative for an individual, communities and nature.
- Although cycling as an integrated part of urban transport schemes are exploding all over the world in total but a huge number of them needs improvement and the new ones require proper design and implementation.
- It is important to check the signal plan for the bicycle compatibility. Currently, the signal engineers tend to exclude cyclists from the design considerations of the signals which leads to inefficient and unsafe designs for cyclists.
- The number of factors influencing population to use or not use cycling as a mode of transportation varies in different areas according to the attitude, perception and willingness of the people.
- Trip purpose does not have any clout on the people's decision making regarding the use of cycling as a mode of transportation but trip distance has immense effect on it.

- Bad weather (rain and extreme temperatures) negatively impacts bicycle use and discourages the people to use bicycles more than any other mode of transportation.
- People with lower income are more inclined to use bicycles than the people with higher income
- More parking spots at the destinations means greater probability of choosing cycling as an effective mode of transportation.

Recommendations

This research study agrees with the fact that to increase the bicycle use, authorities should work on individual, social and physical environment levels. It should also be noted that, individual attitude toward bicycling is most essential factor in increasing regular use of bicycles. The results of this study correspond to this conclusion. Therefore, to change the attitude of people towards bicycling, promotional and awareness programs must be launched by the government or private organizations. Moreover, people with higher incomes must be the special target of these campaigns because the analysis of this study suggest they are not using cycling as an alternative mode of transportation in urban areas in the same amount as the people with lower incomes.

Transport authorities must involve urban planners and vice versa in decision making regarding the density, size and accessibility issues of city or region concerned. Smaller and compact towns are conducive for the bicycle use because it reduces the distance to the destinations. Therefore, these professionals must work hand in glove to achieve the desirable urban form. Lastly, governments must invest in providing bicycle infrastructure, which includes segregated cycle tracks, parking facilities, proper design for the safety of cyclists, lighting facilities at cycle tracks etc. Also, government must run awareness programs for the promotion of cycling as an integrated part of urban transportation system.

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