

Bicycle – As a feeder mode for bus service

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ABSTRACT

Public transit systems are the lifeline of an urban transport network. Buses make more than 60% trips in city like Delhi. To encourage use of public transport system, it is necessary to understand the various factors (e.g. Access, egress, cost, age, income etc.) affecting the trip profile of a person. The access and egress are the weakest links in a public transport chain and greatly determine the availability and convenience of a public transport system. Mostly these trips are made by non-motorized vehicles like cycle or rickshaw.

This paper presents the results of a survey carried out of bus commuters on different bus routes of existing bus service. It shows the negligence of bicycle users' comfort/needs. It demands for some provision of bicycle parking/other basic facilities at/near to bus stops. It demands for bicycle to be considered as an effective access trip mode for public transit users. Approximately 42% of the people surveyed had a personal vehicle of some kind or the other. Nearly 5% of the people interviewed had personal cars and 30% have two-wheeler, 20% have one or more bicycles and 0.5% has some other kind of vehicles. Use of bicycles for access trip among this group is negligible.

This shows that the people owning bicycle are not using it for their access trip. The reason behind this can be (1) absence of parking facility at bus stops, (2) short distance from their origin to bus stop, (3) lack of safe cycling facility along the road. Data shows, 43% among bicycle owners walk less than or equal to 500m, 48% walk more than 500 m but less than 1 km and 9% walk more 1 km distance. Accepted walking distance to access the public transit is 500 m, in the present case 58% commuters have to walk more than acceptable walking distance of 500 m to reach at their bus stop. If a bicycle friendly infrastructure is created, these 58% commuters can shift to bicycles. This would reduce travel time by approximately 33% without any additional cost investment.

This makes a demand for better facility of cycle parking and other cycle friendly bus stops to encourage bicycle users.

1. INTRODUCTION

Bicycle is an accessible, low-cost, non-polluting and healthy mode of travel. We need to encourage lifestyle changes that improve our health, reduce greenhouse gas emissions and our dependence on fossil fuel. This requires an increase in the share of trips made by bicycle significantly by better meeting the needs of bicycle users.

One of the ways to promote bicycling is to encourage its use for making access and egress trip of public transit services.

One significant gap involves the bicycle and public transit. Far too often, potential transit users who ride their bikes to the nearest bus stop or light rail station will find themselves without a safe place to park. And, with bicycle theft estimated to cost Americans more than \$400 million per year, the lack of safe bicycle parking can be a deterrent to this form of multimodal transportation (www.bikewalk.org).

Another aspect of the problem is inadequate or unsafe bicycle access to transit stops and stations. In some instances, transit stations can only be reached via an interstate highway or a high-volume/high-speed arterial street. In such cases, it would be the rare (and brave) bicyclist who would attempt to reach the station by bicycle. In addition, some transit users would appreciate being able to use their bicycles on both ends of their transit journey. However, that generally means carrying their bikes on board in some fashion and this is often forbidden or discouraged, or is inconvenient for bicyclists and for other transit users.

There are three primary services that transit operators and transportation agencies can provide to improve access for bicycling customers:

- 1) Secure parking at key transit stops,
- 2) Safe and convenient connections to transit stops, and
- 3) The means to conveniently carry bikes on the system.

The influence of the access and egress on the availability and catchments area of public transport has received much attention in the literature. Most of the research focused on the absolute access and egress distance with less attention placed on the share of access and egress to total trip distance or time. (Krygsman, 2003)

Access and egress trip together plays a major role in decision making for mode choice for any trip. As distance, time, cost and comfort at access and egress trip makes impact on total trip profile.

Average walking speed is approximately 1.2 m/sec and average bicycling speed is approximately 3 times higher than the walking speed i.e. 3.6 m/sec. Therefore, use of bicycle as an access trip makes significant addition in catchment area of public transit service, and time savings to individual users. Use of motorized two wheelers and cars also increases catchment area however, user cost increases subsequently. Therefore, in many cases this may not be a real choice for people who either do not own vehicles or their income level does not allow using these vehicles.

Multimodal bicycle/transit trips expand the catchment area of public transit stations without the large expense and space requirements of automobile parking. Over longer distances, using the bicycle as a feeder mode for public transit can result in shorter trip times than a point-to-point bicycle trip, despite the delay while waiting for a train to arrive. If the public transit system transports bicycles, then a passenger's bicycle may be used at both ends of a trip. (Allen, 1999)

Replogle (1992) discusses that bicycles are the fastest growing and predominant mode of access to express public transportation services in many European communities and in Japan. Provision of secure bicycle storage at rail stations, development of bicycle-friendly street networks, and the creation of a climate of community opinion supportive of bicycling are all important factors behind the success of bike-and-ride systems in these countries. Today in the Netherlands, the bicycle is used as transport to the station for more than 35% of all train journeys, while one in ten passengers use a bicycle to travel from the station to their final destination. Japan's metropolitan regions, where much growth is being experienced, bicycle access trips account for as much as one-half of all station access trips. In the Tokyo region, bicycles accounted for 4% of suburban rail transit access in 1975, 11% in 1980, and 13% in 1985, while in the Chukyo region, bicycle access grew from 12% in 1975 to 23% in 1980, and 27% in 1985.

This paper presents result of On-board Commuter's Survey to understand the role of bicycle plays part as a feeder in Public Transit.

2. ON-BOARD COMMUTER SURVEY

On-Board Commuter Survey was carried out on 130 different routes out of total 650 routes of local Public transport service of Delhi. Around 4000 commuters were interviewed for their full trip profile including access and egress time, cost and mode. A pre-designed survey form was prepared and whole survey was carried out by trained surveyors and administered.

This method of survey has many advantages such as:

- Passengers are seating inside the bus therefore they are comfortable in replying
- No wastage of their time.
- They are inside the bus and therefore, they are not in hurry not stressed. Therefore their co-operation is much better.

In this survey, sample was chosen in such a way, that it could represent the whole study area. Delhi has been divided in five major zones (South, North, West, East and Rural zones). Number of bus stops and number of commuters alighting and boarding at each of these bus stops in five zones were collected in 2002 (Juneja, 2002).

Table 1: Number Of Bus Stops In Five Different Zones Of Delhi

Zone	Bus stops
East	1000
North	628
Rural	754
South	1110
West	752

Table 1 shows number of bus stops in each of the zone. This data of bus stops includes number of passengers boarding and alighting in every 15 minutes. According to this demand, number of bus stops for each category was selected and number of users to be interviewed was divided among these bus stops such that sample users can represent the region in a best way.

3. BICYCLE AS A FEEDER

Results of the 'On-board Commuter's Survey' are analyzed and use of bicycle as a feeder mode is tried to extract. When and why bicycle is used or not used for making access trip to the bus transit service? What parameters the commuter is considering to choose bicycle for making such access/egress trips?

3.1 BICYCLE OWNERSHIP OF BUS COMMUTERS AND ITS USE AS ACCESS TRIP TO BUS.

As shown in table 2, out of the total selected sample of 3632, 711 persons (20%) own bicycle. 652 (18% of total) have 1 bicycle and 58 (2% of total) have 2 bicycles at home. However, only 6 (0.15%) persons out of total 3632 are using bicycle for access trip to bus.

Table 2: Bicycle Ownership In Delhi

Sample=	3632
Having bicycle=	711
1 bicycle	652
2 bicycle	58
Bicycle used for access trip	6

This shows, out of all bicycle owners (711), less than 1% use bicycle as an access trip mode.

Table 3: Bicycle Users and Their Income

Personal income	Records	Using as access trip
<1000	3	2
1000-5000	362	4
5000-10000	238	0
10000-20000	30	0
>20000	1	0
	77	Data not available

As shown in table 3, out of six users of bicycle, 2 persons have income less than 1000 Rs. per month and 4 have income between 1000 and 5000 Rs. per month. Access trip distance for these commuters varies from 3 km to 8 km. This shows that walking is not a feasible mode for their access trip, however, as shown in table 3, their income is very low which does not allow them to take any other mode which adds additional cost to their total trip cost. Bicycle provides much better speed than walk (three times higher) and it adds negligible cost to their trip. Therefore, despite the absence of bicycle friendly infrastructure they are using bicycles. These are captive users of bicycles, people who use bicycles due to lack of choice.

3.2 ACCESS TRIP OF BICYCLE OWNERS.

Table 4: Access Trip of Bicycle Owners

Access trip			
Mode	Average length	Numbers	Percentage
Cycle	6.67	6	0.84
Two wheeler	2.9	5	0.70
Auto	2.5	2	0.28
Rickshaw	1.61	11	1.55
Walk	0.78	686	96.48

As shown in above table 4, 711 persons own one or two bicycles, but around 99% of bus commuters owning cycle have made access trip by other than cycle mode. Around 96% of trips are walking trips.

Table 5: Access Trip by Walk With Trip Length

Walk Distance	686	Percentage (%)
<0.5	311	45.33
0.5-1.0	329	47.44
1.0-1.5	27	3.21
1.5-2.0	25	2.91
>2	18	1.11

Table 5 shows that around 45% are walking less than 0.5 km, around 47% are walking more than 0.5 km but less than 1.0 km, 8% are walking more than 1.5 km as their walking trips. Bicycles may not provide any significant advantage to persons who walk less than 0.5 km. However, persons walking more than 0.5 km and owing bicycle are indicating that they can not afford to take other modes (auto or rickshaw) because most of them (91%) are from lower income group whose income ranges from 1000 Rs. to 10000 Rs. and these are potential bicycle users.

Table 6: Access Trip Made By Walk and Income Group Relationship

Walking distance in Km	Number of commuters	Income (<1000 Rs)	Income (1000-5000 Rs)	Income (5000-10000 Rs)	Income (10000-20000 Rs)	Income (>20000 Rs)	Data not available
<0.5	265	2	63	90	37	13	60
0.5 – 1.0	275	1	84	110	12	5	63
1.0 – 1.5	15	0	2	8	2	0	3
1.5 – 2.0	19	0	3	7	1	1	7
> 2.0	5	0	3	2	0	0	0

Table 7: Access Trip Made By Two Wheeler and Income Group Relationship

Distance in Km	Number of commuters	Income (<1000 Rs)	Income (1000-5000 Rs)	Income (5000-10000 Rs)	Income (10000-20000 Rs)	Income (>20000 Rs)	Data not available
<0.5	0	0	0	0	0	0	0
0.5 – 1.0	1	0	0	0	1	0	0
1.0 – 1.5	1	0	0	1	0	0	0
1.5 – 2.0	0	0	0	0	0	0	0
> 2.0	3	0	0	1	1	1	0

Table 8: Access Trip Made By Auto and Income Group Relationship

Distance in Km	Number of commuters	Income (<1000 Rs)	Income (1000-5000 Rs)	Income (5000-10000 Rs)	Income (10000-20000 Rs)	Income (>20000 Rs)	Data not available
<0.5	0	0	0	0	0	0	0
0.5 – 1.0	0	0	0	0	0	0	0
1.0 – 1.5	0	0	0	0	0	0	0
1.5 – 2.0	0	0	0	1	0	0	0
> 2.0	0	0	0	0	0	0	1

Table 9: Access Trip Made By Rickshaw and Income Group Relationship

Distance in Km	Number of commuters	Income (<1000 Rs)	Income (1000-5000 Rs)	Income (5000-10000 Rs)	Income (10000-20000 Rs)	Income (>20000 Rs)	Data not available
<0.5	1	0	0	0	0	0	1
0.5 – 1.0	2	0	0	2	0	0	0
1.0 – 1.5	5	0	0	2	3	0	0
1.5 – 2.0	2	0	0	0	0	2	0
> 2.0	1	0	0	0	1	0	0

Table 6,7,8 and 9 together indicate that commuters having more than 0.5 km access trip distance are also using other modes like rickshaw, auto-rickshaw, two wheeler and car but all are from higher income group whose income ranges from 5000 to 20000 Rs. and above. This shows that with the higher access distance and higher income, commuters do not walk but for the same distance, if income group is lower, commuters have to walk.

Table 7 shows the number of bicycle owners from different Income group whose access trip is more than 0.5 km. It shows that bicycle owners from lower income group can easily shift to cycle mode if they are provided with basic bicycle friendly facilities.

Table 10 shows the access trip made by non-bicycle owners. It represents that 97% passengers makes access trip by walking. Table 11 represents how these walking trips are categorized according to the access trip length. It shows around 48% of commuters are walking for more than the acceptable walking distance that is 500 m. Proportion of these commuters is around 45% of the total bus commuters who do not own bicycle. These commuters are again potential users for bicycle. Use of Bicycle will increase their speed of

access trip by three times since average walking speed is 1.2 m/s and average cycling speed is 3.6 m/s. This will reduce their access trip time by 33% without adding any additional cost.

Table 10: Access Trip Made By Non-Bicycle Owners

Access trip			
Mode	Average length (in km)	Numbers	Percentage
Two wheeler	3	3	0.10
Auto	4.06	8	0.27
Rickshaw	1.61	62	2.12
Walk	0.74	2835	97.05

Table 11: Walking Access Trips According To Trip Length

Access trip length in Km	Number of Commuters	Percentage %
< 0.5	1528	52.32876712
0.5 - 1.0	1155	39.55479452
1.0 - 1.5	99	3.390410959
1.5 - 2.0	98	3.356164384
> 2.0	40	1.369863014

4. ACCESSIBILITY TO PUBLIC TRANSIT

As results of the survey shows, there is no facility provided to encourage the use of bicycles to make access trip to bus transit service. Few commuters are using bicycle for access trip and because they do not have any other option. It is possible that if bicycle friendly infrastructure is created which includes parking space for bicyclist at or near the bus stop, and safe bicycle paths, number of such commuters may increase.

Table 12: Access Trip Of Bicycle Owners And Their Income Group

Income Group	No. of Commuters owning Bicycle
below 1000 Rs	1
1000 – 5000 Rs	121
5000 – 10000 Rs	158
10000 – 20000 Rs	31
above 20000 Rs	9

This shows that if facility is provided at or near bus stops, these commuters can reach the bus stop using their bicycle. People who are presently using their own vehicle for the complete trip may shift to public transit if some basic facilities are provided to them.

5. CONCLUSION

Integration of bicycle with public transit enhances travel potential for both modes of travel by offering a number of advantages that each mode alone cannot provide:

- Bike-on-transit service enables bicyclists to travel farther distances and overcome topographical barriers.
- Bike-on-transit services to recreational destinations during off-peak periods can increase overall transit ridership and increase efficient use of capacity.
- Bicycle-to-transit services (trails, on-road bike lanes, and bike parking) enlarge transit's catchment area by making it accessible to travelers who are beyond walking distances from transit stations

The results of survey shows that 91% of bicycle owners and 45% of the total bus commuters who do not own bicycle are potential users of bicycle if bicycle friendly Infrastructure is provided. If bicycle has to be promoted as an access mode to public transit, all facilities have to be considered. This includes parking facilities at bus stops and safe cycling paths.

6. REFERENCES

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