IMPACT ASSESSMENT OF E-RICKSHAW IN CENTRALIZED BUSINESS DEVELOPMENT AREA FOR SUSTAINABLE TRANSPORTATION SYSTEM

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Abstract - *Transportation System plays a very important as well as a vital srole in the urban transportation in today's emerging and developing cities. There must be need of the proper planning of the transportation system and as the e rickshaw is the para transit mode of transportation then the study of this mode of transportation is must. A para transits procure a more and more importance in the developing cities of India. As every growing city of Maharashtra, which seems a very vast growth in the counting of e-rickshaw service in the very short period of time. The centralized business development areas (CBDA) are mostly the commercial area where the traffic is more as compared to the other area like residential. There are more than 2 lakhs e-rickshaw running on the roads of the India, which plays the important role in the short travelling for the passengers as well as the material transport movement. As developing metro city do not have a proper urbanization, uncontrolled population growth, and such a rapid growth in the counting of e-rickshaw which became a headache in the traffic and the existing transport field. Beside this, it is a most efficient mode of transportation, which is noiseless, eco-friendly, and even a sustainable mode of transportation, but it creates congestion in the traffic in centralized business development area. This review study is mainly focuses on the proper execution of the e-rickshaw on the roads of India to attain the smooth flow of traffic of para transit mode of transportation in the centralized business development area*

Key Words: *Transportation system, E-rickshaw, urban transportation, para transit mode of transportation, centralized business development area (CBDA), noiseless, eco-friendly, sustainable*

1. INTRODUCTION

The term "paratransit" literally means "side" of a mode of transportation. It's a type of public transportation that doesn't have a set route or schedule. The concepts apply to public-access modes of urban passenger transportation that differ from traditional modes (organized bus and rail) and can operate on highways and transportation systems (Kirby, 1974). It is not a fully public transit system, but it does have some basic private car elements.

In other terms, it can be defined as a cross between regular public transportation and private vehicles, and it is sometimes referred to as "Intermediary Public Transportation" (IPT) (MUD, GOI, 2008). In industrialized countries, it is the "Demand Responsive Transit" programed (Lave and Mathias, 2009), which uses the "Dial-a-Ride" programmed to follow a route defined by the demands of each passenger. In underdeveloped countries, on the other hand, a lack of public transportation has led to an increase in the use of paratransit. It bridges the gap between public and private transportation.

Figure 1: E-rickshaw in CBD area in Nagpur

The Capacities project conducted an initial assessment in the city in order to obtain the bigger picture on transport and Greenhouse Gas (GHG) emissions in the city, identify problem areas and potential mitigation options. The assessment includes a Greenhouse Gas (GHG) transport inventory for the city of Udaipur for the year 2013 (refer table below), a GHG projection to 2030 and a quantification of potential GHG mitigation measures for the city.

1.1 Objectives

- To assess the importance of e-rickshaw services in the urban transport scenario of CBD area in Nagpur city.
- To identify the problems and future prospects associated with the e-rickshaw service.

- To investigate the future scope of development of e-rickshaw service along with its potentiality.

2. METHODOLOGY

The methodology is adopted as follows –

1. The primary and secondary survey i.e. area survey for CBD area and Questionnaire survey had been conducted to find the service provided by the e-rickshaw.

2. Besides relevant books and journals has also been consulted. Primary data has been acquired through direct interaction with the e-rickshaw drivers, passengers and pedestrian.

3. The RII (Relative Importance Index) which is used for ranking the parameters derived from the Questionnaire is used as a methodology.

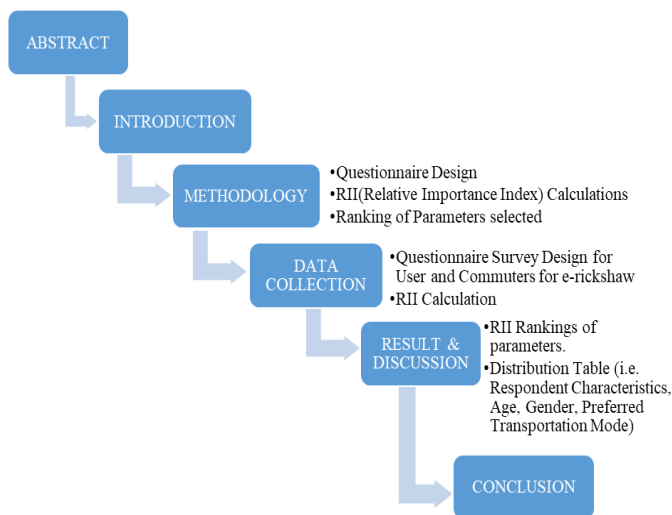4. Then the parameters are ranked accordingly.

Figure 2: Methodology Adopted

The methodology is followed by the questionnaire design prepared from consulting the people. The questionnaire design prepared to get the rating for the each questions. Then RII calculation are done from the collected data. Then, the questions (parameters) are ranked accordingly.

Followed by the data collection, the questionnaire survey spread and got filled up from passengers as well as the drivers/commuters to get the individual questions rating. Then, the RII calculation are done to get the ranking for the questions.

The growth in the number of rickshaws is causing considerable traffic congestion due to a lack of road space. The unregulated growth of e-rickshaws, according to 90% of pedestrians and city inhabitants, causes traffic congestion. Because there is a certain amount of road space. As a result,

the increased number of e-rickshaws puts a lot of strain on the roads, restricting traffic flow. All nooks and little corners (lanes and trails) confront the same difficulty in various proportions, just like highways.

3. DATA COLLECTION

3.1 Study Area

The study has been divided into two parts to cover the different aspects of the functioning of e-rickshaws:

a. The Socio-Economic impact of the battery rickshaw industry

b. The Technical Specifications of the battery rickshaws

The Central Avenue road, Agrasen Square, Nagpur (21.1510207, 79.1038247) to Indora Square (21.1729766, 79.0996689) situated in the west part of the Nagpur. The study area is selected as per the Centralized Business Development area of Nagpur.
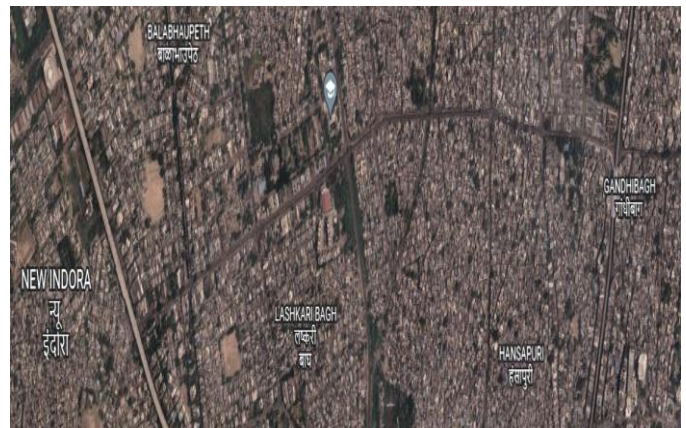

Figure 3: Study Area (CBD AREA)

3.2 Questionnaire Design:

Firstly, the data has been collected by using the Questionnaire Survey of near about 300 people. The sample questionnaire survey is been collected from passengers as well as commuters. The sample Questionnaire survey is as follows

Annexure A (The user of e-rickshaw point of view):
The questionnaire for Annexure A is designed to collect the responses as per the users point of view shown in Figure 3.

Figure 4: Annexure A (e-rickshaw users point of view)

Annexure B (The drivers/commuters point of view):

The questionnaire for Annexure A is designed to collect the responses as per driver's point of view shown in Figure 4.

Figure 5: Annexure B (e-rickshaw driver's point of view)

Rating given by people:

Rating For Annexure A:

The rating provided by number of people for Annexure A (e-rickshaw users point of view) is shown in Figure 5.

SR No	Questions	Rating people rated for				
		1	2	3	4	5
1	Provide the rating for the e-rickshaw as the business perspective?	1	9	50	69	171
2	Rate the speed of e-rickshaw if you are travelling in the CBD area.	50	33	105	55	57
3	Provide the compatibility rating of e-rickshaw when compared to other mode of transport if you are particularly travelling in CBD area.	12	26	77	109	76
4	Rate the overall level of comfortness of the e-rickshaw	20	11	145	75	49
5	Rate the fare of e-rickshaw as compared to other mode of transportation.	4	6	81	87	122
6	Provide the rating for ease of access to e-rickshaw in the CBD area	3	6	2	80	209
7	Provide the availability rating of e-rickshaw in CBD area.	1	9	10	87	193
8	Give the rating for e-rickshaw in accordance to creating environmental impact .	5	5	75	167	48
9	Rate the e-rickshaw for the safety parameter.	43	45	78	97	37
10	Rate the e-rickshaw on its aesthetic appearance.	2	3	5	81	209
11	Provide the rating for e-rickshaw for its ride quality.	2	9	55	89	145
12	Rate the journey time of the e-rickshaw compared with other modes of public transportation.	69	84	78	47	22
13	As per the environmental impact by e-rickshaw. Do you prefer e-rickshaw as the best mode of transportation as per the todays scenario of pollution?	7	3	5	172	113
14	Please provide the overall rating to e-rickshaw.	4	3	3	115	175

Table 1: Data collected from Annexure A(ratings by people)

Rating For Annexure B:

The rating provided by number of people for Annexure B (e-rickshaw drivers point of view) is shown in Figure 6.

SR No	Questions	Rating people rated for				
		1	2	3	4	5
1	Rate the availability of allocated parking spaces.	77	89	106	20	8
2	Provide the rating for facility for Charging of batteries.	56	66	95	44	39
3	Fare regulation is required to avoid confrontations with passengers, give the rating for.	3	4	80	137	76
4	Restriction on the maximum speed limit slowdowns the speed of electric rickshaws, provide its rating.	7	2	5	183	103

5	Provide the rating for the registration/permit processes should simple	75	56	45	77	47
6	Rate the availability of fixed charging stations are necessary for electric rickshaws	1	10	9	19	261
7	Give the rating whether more number of charging stations are required	17	13	20	10	240
8	Rate the proper maintenance cost is reliable	45	12	29	100	114
9	As in comparison with convectional auto rickshaw rate the safety features of e-rickshaw	4	5	75	96	120
10	Purchasing price of electric rickshaws should be subsidized	19	21	15	85	160
11	Electric rickshaws should offer greater mileage/range	20	11	19	10	240
12	Riding slopes should get easy	1	7	10	93	190
13	Is Earnings from electric rickshaw service an issue	177	29	71	12	11
14	Please provide the overall rating to e-rickshaw.	8	9	13	92	178

Table 2: Data collected from Annexure B (ratings by people)

3.3 DATA ANALYSIS

RII (Relative Importance Index):

The relative importance (RII) is used to determine the relative importance of the quantitative factors taken into consideration. The points of liker scale used is equal to the value of W, weighting given to each factor by the respondent.

The RII calculated data is given below in Figure 5 and Figure 6 for questionnaire survey of given sample of Figure 3 and Figure 4 as correspondence.

The equation of RII calculation is given by –

$$\frac{\sum W}{(a \times n)}$$

Where,

W = weightage that respondent give to factor that range from 1-5

a = Highest Weightage

n = Total number of respondent

For example,

The calculation for 1st question

$$\frac{\sum W}{(a \times n)}$$

$$= \frac{1 \times 1}{5 \times 300} = 0.0006$$

$$= \frac{2 \times 9}{5 \times 300} = 0.0120$$

$$= \frac{3 \times 50}{5 \times 300} = 0.1000$$

$$= \frac{4 \times 69}{5 \times 300} = 0.1840$$

$$= \frac{5 \times 171}{5 \times 300} = 0.5700$$

Now, the addition of all the decimals, which is RII value

RII = 0.0006 + 0.0120 + 0.1000 + 0.1840 + 0.5700

RII (for question 1) = 0.8666

NOTE : The RII value lies in between 0 to 1.

Therefore, after the RII value is given to every survey question, then the questions are line up from 1 to 14 respectively as shown in Figure 7 & 8.

RII Questions sort by rank for Annexure A:

SR No	Questions	Rating people rated for					RII (Relative Importance Index)	Ranks of parameters
		1	2	3	4	5		
10	Rate the e-rickshaw on its aesthetic appearance.	2	3	5	81	209	0.9279	1
14	Please provide the overall rating to e-rickshaw.	4	3	3	115	175	0.9259	2
6	Provide the rating for ease of access to e-rickshaw in the CBD area	3	6	2	80	209	0.9239	3
7	Provide the availability rating of e-rickshaw in CBD area.	1	9	10	87	193	0.9079	4
1	Provide the rating for the e-rickshaw as the business perspective?	1	9	50	69	171	0.8666	5
13	As per the environmental impact by e-rickshaw. Do you prefer e-rickshaw as the best mode of transportation as per the	7	3	5	172	113	0.8448	6

SR No	Questions	Rating people rated for					RII	Rank
		1	2	3	4	5		
	todays scenario of pollution?							
11	Provide the rating for e-rickshaw for its ride quality.	2	9	55	89	145	0.8439	7
5	Rate the fare of e-rickshaw as compared to other mode of transportation.	4	6	81	87	122	0.8112	8
8	Give the rating for e-rickshaw in accordance to creating environmental impact .	5	5	75	167	48	0.7649	9
3	Provide the compatibility rating of e-rickshaw when compared to other mode of transport if you are particularly travelling in CBD area.	12	26	77	109	76	0.7405	10
4	Rate the overall level of comfortness of the e-rickshaw	20	11	145	75	49	0.6812	11
9	Rate the e-rickshaw for the safety parameter.	43	45	78	97	37	0.6265	12
2	Rate the speed of e-rickshaw if you are travelling in the CBD area.	50	33	105	55	57	0.6243	13
12	Rate the journey time of the e-rickshaw compared with other modes of public transportation.	69	84	78	47	22	0.5126	14

Table 3: RII calculation table for Annexure A

RII Questions sort by rank for Annexure B:

SR No	Questions	Rating people rated for					RII (Relative Importance Index)	Rank of questions
		1	2	3	4	5		
6	Rate the availability of fixed charging stations are necessary for	1	10	9	19	261	0.9586	1

	electric rickshaws							
1	Rate the availability of allocated parking spaces.	77	89	106	20	8	0.9236	2
12	Riding slopes should get easy	1	7	10	93	190	0.9109	3
7	Give the rating whether more number of charging stations are required	17	13	20	10	240	0.8953	4
11	Electric rickshaws should offer greater mileage/range	20	11	19	10	240	0.8926	5
14	Please provide the overall rating to e-rickshaw.	8	9	13	92	178	0.8816	6
4	Restriction on the maximum speed limit slowdowns the speed of electric rickshaws, provide its rating.	7	2	5	183	103	0.8485	7
10	Purchasing price of electric rickshaws should be subsidized	19	21	15	85	160	0.8303	8
9	As in comparison with convectional auto rickshaw rate the safety features of e-rickshaw	4	5	75	96	120	0.8153	9
3	Fare regulation is required to avoid confrontations with passengers, give the rating for.	3	4	80	137	76	0.7859	10
8	Rate the proper maintenance cost is reliable	45	12	29	100	114	0.7507	11
5	Provide the rating for the registration/permit processes should simple	75	56	45	77	47	0.5766	12
2	Provide the rating for facility for Charging of batteries.	56	66	95	44	39	0.5626	13
13	Is Earnings from electric rickshaw service an issue	177	29	71	12	11	0.3672	14

Table 4: RII calculation table for Annexure B

4. RESULT AND DISCUSSION

Financial Impact:

Based on detailed financial calculations for the pilot consisting of 18 e-rickshaws, the payback period is observed at 418 working days. Based on project life of 5 years (conservative estimates), FIRR is around 35% and EIRR around 49%.

	Year 0	Y1	Y2	Y3	Y4	Y5
Income						
Fare		2016000	2217600	2439360	2683296	2951626
Advertisement		0	0	0	0	0
Total Income		**2016000**	**2217600**	**2439360**	**2683296**	**2951626**
Outflows						
Total Capex :	3274646					
Opex : Electricity Charges		151200	155736	160408.1	165220.3	170176.9
Opex : Battery replacement		580000	591600	603432	615500.6	627810.7
Opex : Maintenance		72000	79200	87120	95832	105415.2
Total Expenditure	**3274646**	**803200**	**826536**	**850960**	**876553**	**903403**
Net(Incomes-Outflows)	-3274646	1212800	1391064	1588440	1806743	2048223
Present value		1133457.944	1215009.171	1296607	1378356	1460355
Discount Rate	7%					
Financial IRR	35.5%					
Economic IRR	**49%**					

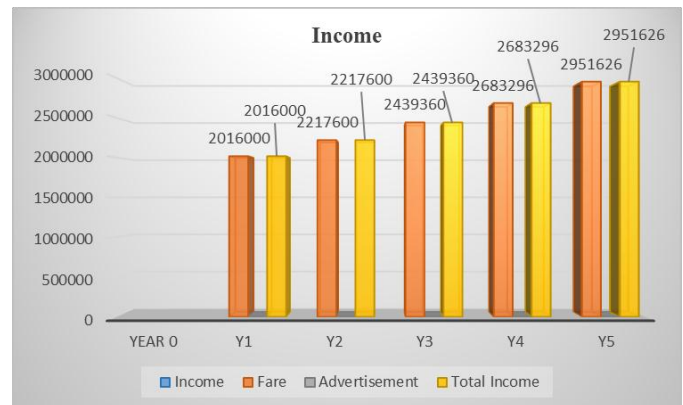Table 5: Detailed financial implications (INR)

Figure 6: Income Impact graph

5. CONCLUSION

ANNEXURE A

1. According to survey of user point of view, the parameters that are giving the clear exposure and are the most critical one are it's aesthetic appearance, overall rating, easy access, availability and as a business perspective respectively.

2. The middle order that user thinks are the average as a service of e-rickshaw are environmental impact, ride quality, fare compared to other 3 wheelers, compatibility respectively.

3. The last order that user rated the lowest to parameters are for level of comfort, safety, speed and journey time respectively.

4. Overall, the e-rickshaw as a service is seen to be positive impact on the roads of Nagpur in centralized business development area.

5. And mostly the users for e-rickshaw in CBD area are preferring to travel in.

ANNEXURE B

1. According to survey of drivers/commuters point of view the e-rickshaw are needed to be ranged that affect the service of e-rickshaw in the following parameters necessity for charging station, need available parking space, slopes should get easy, more charging station required, offer more mileage respectively.

2. The middle order that the drivers/commuters rated the average are overall rating, restriction on speed, subsidize, safety, fare regulation respectively.

3. The last order that drivers/commuters rated the lowest are maintenance cost, registration process, charging of batteries facility and earning from e-rickshaw an issue respectively.

4. Overall, according to the drivers, the rickshaw needs more focus on the facilities as the point 1 of 7.2 says.

5. Other than any parameters, the e-rickshaw is the best business perspectives as for the commuters.

Thus, e-rickshaw holds the capacity to run on the CBD area of the Nagpur. But, still needs some updates to run smooth on the same roads.

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