

Establishing the Market Potential of a Rental Model Multipurpose Electric Vehicle (MPEV) for Individuals with Lower Limb Disabilities in India

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Abstract

Electric vehicles (EV) were developed as a sustainable and cost-effective solution to the environmental problems resulting from petroleum-based forms of transportation. In recent years, renting of vehicle systems has garnered a great deal of interest and activity internationally as an innovative transportation solution. Existing research about EVs is largely concentrated on a purchase model. Results included perceptions of high costs to purchase and maintain EVs. This study, in contrast, focused on a rental model of EVs offering the potential to lower transportation costs and cost-sustainable option. The objective also included understanding the users' perception of a potential rental model of electric vehicles (EV). The study used the survey method to assess the perception, potential benefits, and drawbacks of a rental model of EVs. The expected findings included positive perceptions of the cost savings associated with the EV rental model versus the hybrid rental model.

Keywords: electric vehicles, user perception, rental model

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According to the World Health Organization, more than 80% of the physically handicapped individuals live in developing countries (Shadel, 2014). In developing countries, disability is associated with a lower educational status, decreased employment, and ultimately poverty (Mitra, Posarac, & Vick, 2013). According to St. John's Medical College Hospital, the estimate of people living with a physical disability in the city of Bangalore is roughly 8.4 million people. The United Nations Statistical Office estimated that more than 20 million people with disabilities worldwide do not have access to a wheelchair (Frye, 2013).

Improving accessibility for individuals with physical disabilities transcends merely physical access to vehicles and systems. Improved understanding among the general public, disability training for transportation officials, and improved urban design are all necessary to improving accessibility. Limited mobility and lack of transportation options, exacerbated by lack of accessibility and cost, result in disabled individuals either staying at home or laboring to walk significant distances. According to Frye (2013), the annual sale of wheelchairs in developed countries was approximately 30 units per 10,000 population, compared to 2 - 3 wheelchairs per 10,000 population globally, where individuals simply do not have access to this basic mobility infrastructure. Since 1990, the city of Bangalore, in Karnataka has witnessed an increase in personalized vehicles, especially in 2-wheelers and cars (Mathews, 2015). Exploratory research into transportation options in Bangalore found that people prefer

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personalized vehicles to public transportation due to increased individual mobility and freedom of choice (Pangotra & Sharma, 2006). Electric vehicles (EV) were developed as a sustainable and cost-effective solution to the environmental problems resulting from petroleum-based forms of transportation.

Ramakrishna (2012) highlighted the contribution of manufacturing sector to the concept of green marketing. The process of manufacturing and selling goods and services with minimum threat to the environment is a big issue before the business houses. Green marketing requires awareness not only from the consumers, but also from the manufacturers of such goods. Ultimately, green marketing requires extra cost, but the stakeholders should be ready to bear that cost. Business firms have also started responding to environmental challenges by adopting and practising green marketing strategies. The most important advantage of green marketing is that eco-friendly goods have a competitive advantage over other firms selling non-eco featured goods. At the same time, it should be noted that in the era of green marketing, each and every stakeholder should take part in this process as a social responsibility.

Yadav and Govind (2013) emphasized on protection of the environment. They were of the opinion that consumers are increasingly becoming concerned about the environment and various issues related to it at the global level. This change has encouraged a couple of organizations and has also compelled many organizations to respond with 'environmentally' friendly products. Green marketing is perceived as an opportunity by many organizations to achieve their long-term goals. Green marketing incorporates a broad range of activities, including product modifications, changes to the production processes, packaging changes, as well as modifying advertising. The paper reveals that green marketing is gaining importance in India for various issues concerning sustainable development.

In recent years, renting of vehicle systems has garnered a great deal of interest and activity internationally as an innovative transportation solution. A multipurpose electric vehicle (MPEV) is a transportation option aimed at providing means for short-distance commutes. The vehicle contains an electric motor, and can assist people with mobility impairment and at the same time, it can be used for day to day short distance commute. This research study aims to understand the perceptions of rental MPEVs among physically handicapped individuals living in Bangalore.

Presently, mobility devices like Segway and T03 Patroller exist. These devices are not only expensive, but are also incapable of being used by paraplegics due to their ergonomic infeasibility and stand-and-drive features. The lack of mobility means for disabled lead to the development of motorized wheelchairs in which a disabled person could sit and drive a wheelchair powered by an electric source. These disability based devices turn out to be way more expensive and their aesthetics are not appealing. As a result, companies are attempting to develop a MPEV prototype that is affordable, comfortable, and aesthetically appealing.

Need for the Study

There is a very limited amount of research available about physical disability and transportation options in developing countries. In developing countries, the WHO reports that disability is associated with a lower educational status, decreased employment, and ultimately poverty. One factor that is responsible for this association is due to limited mobility and lack of transportation options. However, according to the World Health Organization (WHO), there is a limited amount of research available about physical disability and transportation options in developing countries. Additional research about the current perceptions of transportation options among those who are physically disabled, in addition to transportation priorities, would inform the transportation industry of what products are desirable among those who are physically handicapped. This study is done so as to fill this gap.

The Multi-Purpose Electric Vehicle (MPEV) Prototype : An Introduction

The multi-purpose electric vehicle (MPEV) developed at PES has many functions, and can be used for locomotion around an office space or on the roads by people who are either physically challenged or not. The vehicle runs on electricity and doesn't require the use of gasoline or other fossil fuels, thus making it economical and environmental friendly. For a physically challenged person who will be using a wheelchair, a hooking mechanism is developed. The person can simply ride the wheelchair into the provided space of the vehicle. Separate attachments have been made on the chassis and also on the wheel chair for hooking. Thus, the wheelchair will be attached to the vehicle and move along with it.

Safety is an important factor that is considered during both designing and manufacturing stages of the vehicle. The vehicle is a three-wheeled electric type vehicle. In this case, only rear wheels are engaged with breaks. The front wheel is attached to a shock absorber. The various loose fits are taken care of, and areas of high friction are properly lubricated. As this vehicle is designed only for the Indian public, improvement in this can also be expected in the future.

Literature Review

Electric vehicles have many advantages over other forms of transportation, even vehicles that also emphasize environmental sustainability (Cowan & Hultén, 1996). For example, steam cars have less range before needing water than an electric vehicle's range on a single charge (Balducci, 2008). However, EVs coupled with low-carbon electricity sources offer the potential for reducing greenhouse gas emissions and exposure to tailpipe emissions from personal transportation (Hawkins, Singh, Majeau - Bettez, & Strømman, 2013). EVs are also being developed for individuals with lower limb disabilities in an effort to create sustainable transportation options for this population. Customized MPEVs can be designed for physically handicapped individuals, and can be restricted for the use of paraplegics only.

Physical disability in developing countries is also strongly associated with poverty. Sharma and Deppeler (2005) contended that disability not only causes poverty, but that poverty also causes disability. A major contributing factor to this cycle of adverse events is lack of transportation options for physically handicapped individuals. Transportation policy and infrastructure is extremely important for individuals with physical disabilities, and comprehensive policies and systems are most often lacking in developing countries. India's National Urban Transport Policy (NUTP) takes the first step in emphasizing the importance of developing transportation services for disadvantaged groups such as disabled individuals (Litman, 2002).

Individuals with disabilities have frequently reported the sheer volume of transportation barriers that hinder their everyday living. The National Organization on Disability (NOD), which sponsored the Harris polls, found that transportation issues are the most commonly cited concern. In a 2004 survey, it was found that one-third of the physically handicapped individuals experienced inadequate transportation. Of those individuals, over half perceived it to be a major issue. Individuals with more serious disability reported the transportation problem as having more gravity (National Organization on Disability-Harris Interactive, 2004).

Sharma and Deppeler (2005) contended that lack of inclusive transportation options and disability-friendly buildings are far greater social problems than prejudice and negative attitudes in the country of India. Urban transportation options in India are also uniquely different than those of other countries due to the increased usage of 2-wheeler vehicles (Mathews, 2015). According to a review of urban transportation options in Bangalore City, it was found out that most people prefer not to take a vehicle while they travel short distances. Results also indicated that people prefer 2-wheelers for distances less than 5 kilometres. However, integration of electric 2-wheeler technology has been slow in India. According to a study of consumer perceptions of EVs in Bangalore, the majority of the respondents were not aware of EVs and the options available in the market. The majority of EV consumer

research is conducted in developed nations and largely examines purchasing behavior as opposed to rental preferences.

Axsen and Kurani (2013) examined technical factors, cost factors, and contextual factors that are driving forces toward positive or negative perceptions of EVs. They concluded that social and emotional networks are driving forces towards adoption of EVs, and that those factors should be integrated into future EV consumer research.

Another paper by Axsen, Bailey, and Castro (2015) explained how different lifestyles of people have different preferences of plug-in electric vehicles. The results demonstrated the importance of perceived speed capacity, perceived environmental benefits, and vehicle design in influencing EV purchasing behavior. The authors also emphasized the importance of tailored marketing strategies to different audiences. It is imperative to integrate features of existing disability and transportation research with typical measures examining perceptions of EVs in order to accurately capture perceptions of our target demographic.

Khandelwal, Bajpai, Tripathi, and Yadav (2016) measured consumer purchase intention of hybrid cars in India and discussed the various factors and previous studies associated with purchase intention of hybrid cars in different nations. The results served as a reference for automobile companies planning to launch hybrid cars in the near future in India. Five different constructs were extracted from literature for measuring intention to purchase hybrid cars in India, including seeking green products information, self image effects, social value of hybrid car purchase, emissions importance, and social value of green product purchases that are associated with owning a hybrid car in India. This study would be helpful for the automobile sector to better understand the various dimensions needed for developing a positive intention towards hybrid cars.

The existing research throws light on general public in purchasing or renting of EVs. There is no research specifically to find out the results of marketing or renting of EVs to physically disabled. However, from the literature on EVs to general public, the following points can be considered to see the commercial viability of renting or purchasing EVs to the disabled.

Rezvani, Jansson, and Bodin (2015), in their paper, presented a comprehensive overview of the drivers for and barriers against consumer adoption of plug-in EVs and consumer intentions and adoption behavior towards EVs. Singer (2016) highlighted a set of factors which affects consumers' willingness to purchase electric vehicles. The report revealed that for a new vehicle technology to succeed, consumers will need to become aware of the technology and accept how the new technology can meet their needs.

Weiller and Neely (n.d.) highlighted growth of electric vehicles (EVs) market. The global stock of electric vehicles was 180,000 vehicles in 2012, just 0.02% of total passenger cars. In the early-stage EV market, electric car rental services allowed drivers to trial an EV for a short time. This experience with EVs increases awareness and facilitates diffusion of the technology. One such example is from Okinawa Electric Vehicle (EV) Rental Service, one of the first EV projects of its kind in the world; the service is dedicated to supporting the use of electric cars and improving the environmental sustainability of tourism. Chen, Wang, and Ni (2014), in their paper, studied and developed about the charging mode of electric cars and parking facilities.

Objectives of the Study

- (1)** To assess the relationship between perceptions towards EVs and respondents' willingness to rent MPEVs.
- (2)** To determine the preference for vehicles with higher speeds among individuals with varying levels of mobility.
- (3)** To establish a relationship between individual's level of mobility and their willingness to rent MPEVs.
- (4)** To assess an individual's preference for differing rental pricing models of MPEVs across their level of mobility.
- (5)** To analyze whether daily transportation mode, distance traveled, levels of mobility, and amount spent are good predictors for respondents' willingness to rent a MPEV.

Hypotheses

- ↳ **H01** : There is no significant difference between perception of electric vehicles between respondents who were willing or unwilling to rent a MPEV .
- ↳ **H02** : There is no significant difference between individuals with varying levels of mobility and their preference for vehicles with high speeds.
- ↳ **H03**: Respondents' willingness to rent MPEVs and level of mobility are independent.
- ↳ **H04** : Preference for a certain rental model and respondents' level of mobility are independent.

Research Methodology

The research method used in this research paper is descriptive research. Descriptive research is a study designed to understand the respondents, who are part of the study in an accurate way. Survey method, which is one of the three types of descriptive research, is used in this paper. The study also uses exploratory research methods in the form of perception-based questions about the potential of a new MPEV product. Because there has not been any prior research on understanding EV perceptions among physically handicapped individuals, this study attempts to combine multiple data collection tools to understand more about this new area of study.

This study utilized an observational, cross-sectional research design for one-time data collection. A cross-sectional design was helpful in collecting demographic and social characteristics and perceptions of the physically handicapped audience. The types of information collected through the survey included age, gender, perception of electric vehicles, and the willingness to use rental MPEVs. For this research study, sample elements were selected from the physically handicapped population at different universities and NGOs in Karnataka. Eligible subjects were those who were unable to walk on their own and were between the ages of 15 and 60 years. The survey was conducted at various NGOs and the survey link was also emailed to various NGOs. A total of 86 respondents participated in the study.

The sampling method chosen was non-probability sampling, namely snowball sampling, due to increased access to a sampling frame of individuals with a physical disability. Links were shared via social media groups of physically handicapped people. The survey included both closed and open-ended questions, using Likert-type responses, 10-point attitudinal scales, and qualitative questions.

↳ **Formulation of Questionnaire** : The survey was organized in four parts: exploring consumer perception on EVs; attitudes towards environmental sustainability of EVs ; understanding about rental model of electric vehicles; and demographic data (age, ethnicity, and gender). The survey used a questionnaire, which had both categorical and continuous quantitative variables. Exploring consumer perception on electric vehicles was assessed with a combination of six 10-point attitudinal scale questions asking about their awareness of the vehicle and what they feel about using it. Responses included whether the respondents are aware of a multi-purpose electric vehicle and whether they would be willing to use it.

Analysis and Results

The data collected is coded into numeric form and statistically tested using the SPSS software. The variables are coded in a particular format to analyze frequencies and measure the significance of independent variable on the dependent variable, and the results are tabulated. The data relating to the age, gender, income, transportation, and mobility were collected. A frequency distribution for the same is depicted in the Table 1.

Table 1. Demographics of the Survey Respondents

Variable		<i>n</i>	Percent of Respondents
Gender	Male	69	80%
	Female	17	19.8%
Age	<20 years	10	11.5%
	20-29 years	46	53.5%
	30-39 years	30	34.9%
	40-49 years	0	0%
	50+ years	0	0%
Income	Less than ₹ 8000	22	25.6%
	₹ 8000 - ₹ 25000	22	25.6%
	₹ 25000 - ₹ 50000	7	8.1%
	₹ 50000 - ₹ 75000	4	4%
	₹ 75000 - ₹ 100000	5	5.8%
	₹ 100000 & above	5	5.8%
	Don't know	23	26.7%
Transportation	Private vehicle-2-wheeler	38	44.2%
	Private vehicle 4-wheeler	14	16.3%
	Auto rickshaw	6	7%
	Public Transit	28	32%
Mobility	Independently	56	65.1%
	Wheelchair	13	15.1%
	Walker	13	15.1%
	Accompaniment	2	2.3%
	Elbow Stick	2	2.3%
Education	School	6	7%
	Pre-university	18	20.9%
	Graduation	35	40.7%
	Post-graduation	27	31.4%
Occupation	School	37	43%
	Salaried	49	57%

According to the Table 1, the respondents were primarily male, between 20 to 29 years of age, and travelled independently. The level of education among respondents varied significantly. Only a few of the respondents were in school ($n = 6$) and at the pre-university level ($n = 18$). The majority of respondents, however, had either completed graduation ($n = 35$) or were at the post-graduate level ($n = 27$). Occupational status was pretty evenly split among respondents. The number of respondents who were still in school was slightly less ($n = 37$) than those who were salaried ($n = 47$). Around one-fourth of the respondents ($n = 23$) chose not to disclose their income due to reasons unknown. Among those that did share the statistic, around one-fourth of the respondents fell into an income category less than ₹ 8000 ($n = 22$), and another one-fourth of the respondents fell into the income category of ₹ 8000 - ₹ 25000 ($n = 22$). There were only several respondents in the following income brackets: ₹ 50000 - ₹ 75000 ($n = 4$), ₹ 75000 - ₹ 100000 ($n = 5$), and > ₹ 100000 ($n = 5$).

The respondents all had varying preferences of modes of transportation. The majority of the respondents preferred a private vehicle, with the majority preferring a 2-wheeler option ($n = 38$) or a 4-wheeler option ($n = 14$). After private vehicles, the majority of the respondents preferred public transit ($n = 28$). Very few respondents ($n = 6$) preferred auto rickshaws as their main mode of transportation. Despite their physical handicap, the respondents all had varying levels of mobility. The significant majority of the respondents ($n = 56$) were independently mobile. In addition, only a small proportion of respondents utilized a wheelchair ($n = 13$) or a walker ($n = 13$). Very few respondents were mobile with accompaniment ($n = 2$) or with an elbow stick ($n = 2$).

(1) Objective 1 - To Assess the Relationship Between Perceptions Towards EVs and Respondents' Willingness to Rent MPEVs : Data was collected about the perception of electric vehicles using six different questions, each with an attitudinal scale ranging from *complete disagreement* to the statement to *complete agreement* to the statement. These six questions were coded and averaged to create the variable of overall general perception of electric vehicles.

The following hypotheses were framed :

↯ **H01 :** There is no significant difference between the perception of electric vehicles between respondents who were willing or unwilling to rent a MPEV.

↯ **Ha1 :** There is a significant difference between the perception of electric vehicles between respondents who were willing or unwilling to rent a MPEV.

Data relating to the perception of electric vehicles using an attitudinal scale was collected. The perception and willingness to rent are collated using independent samples t - test. Independent samples t - test compares the means of two independent groups. The difference between the groups' means are then tested for their significance at the 95% confidence level.

From the Table 2, the Levene's test value of 0.002 indicates that the two groups have unequal variance. The t - test value can be interpreted with the calculated statistic under the equal variances not assumed. An independent samples t - test comparing these two groups yielded the t - statistic value of 2.989, with 33.248 degrees of freedom. The corresponding two-tailed p - value is 0.005, which is less than 5% level of significance. Therefore, H01 can be rejected at the 5% level of significance. This signifies that average EV perception differed among respondents based upon willingness to rent a MPEV. These results confirm that respondents who positively perceived MPEVs were more willing to rent them.

Table 2. Independent Samples T - test

		Levene's Test for Quality of Variances				t-test for Equality of Means			95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
EV Perception	Equal variances assumed	10.7	.002	3.605	84	.001	1.08120	.29994	.48474	1.67765
	Equal variances not assumed			2.989	33.248	.005	1.08120	.36177	.34539	1.81701

(2) Objective 2 - To Determine the Preference for Vehicles with Higher Speeds Among Individuals with Varying Levels of Mobility : The respondents' level of mobility and preference for vehicles with higher speed is analyzed by one-way ANOVA test.

Table 3. Descriptive Statistics of Perceptions of Speed by Individuals of Varying Mobility

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
1	56	7.11	2.270	.303	6.50	7.71	1	9
2	13	5.46	2.537	.704	3.93	6.99	2	9
3	13	8.62	1.387	.385	7.78	9.45	4	9
4	2	1.00	.000	.000	1.00	1.00	1	1
5	2	9.00	.000	.000	9.00	9.00	9	9
Total	86	6.99	2.495	.269	6.45	7.52	1	9

Table 4. Test of Homogeneity of Variances

Levene Statistic	df1	df2	Sig.
1.326	4	81	.267

Table 5. ANOVA Test Results of Perceptions of Vehicle Speed by Individuals of Varying Mobility

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	79.514	4	19.879	3.821	.007
Within Groups	421.416	81	5.203		
Total	500.930	85			

The following hypotheses were framed :

↳ **H02** : There is no significant difference between individuals with varying levels of mobility and their preference for vehicles with high speeds.

↳ **Ha2** : There is a significant difference between individuals with varying levels of mobility and their preference for vehicles with high speeds.

According to the Table 3, individuals with elbow stick mobility had an average high-speed perception score of 9, which differed from individuals with walker mobility, who had an average high-speed perception score of 8.6. Individuals who were independently mobile had an average high-speed perception score of 7.11. The Table 4 shows that as per the Levene statistic, the significance value for homogeneity of variances is > 0.05 , so the variances of the groups are same. Hence, the results can be interpreted using the Table 5. As displayed in the Table 5, an ANOVA comparing these five groups yielded a statistically significant result ($F(4, 81) = 3.821$). The results show that the significance value is < 0.05 . Hence, H02 can be rejected, which shows that there is a significant difference in the average high speed preference among handicapped individuals.

In order to determine how high speed differs by different groups, a Tukey posthoc test is used, and the results are displayed in the Table 6. The significance value in Table 6 signifies whether the two conditions that are being compared are significantly different or not. Most of the significance values are greater than 0.05. However, the p -values that are statistically significant correspond to the following : independent and accompaniment ($p = 0.018$), walker and accompaniment ($p = 0.010$), and elbow stick and accompaniment ($p = 0.013$). It can be concluded that the above combinations are significantly different in terms of preference for vehicle speed.

These results provide more insights into transportation preferences of physically handicapped individuals and provide insights into the importance of speed when designing MPEVs. MPEVs are designed for short-distance

Table 6. Tukey Test Results of Perceptions of Vehicle Speed by Individuals of Varying Mobility

(I) Mobility	(J) Mobility	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Independent	wheel chair	.927	.702	.679	-1.03	2.89
	walker	-.611	.702	.907	-2.57	1.35
	accompaniment	5.196*	1.641	.018	.62	9.78
	elbow stick	-2.304	1.641	.627	-6.88	2.28
Wheel chair	independent	-.927	.702	.679	-2.89	1.03
	walker	-1.538	.895	.428	-4.03	.96
	accompaniment	4.269	1.732	.109	-.56	9.10
	elbow stick	-3.231	1.732	.345	-8.06	1.60
Walker	independent	.611	.702	.907	-1.35	2.57
	wheel chair	1.538	.895	.428	-.96	4.03
	accompaniment	5.808*	1.732	.010	.97	10.64
	elbow stick	-1.692	1.732	.865	-6.53	3.14
Accompaniment	independent	-5.196*	1.641	.018	-9.78	-.62
	wheel chair	-4.269	1.732	.109	-9.10	.56
	walker	-5.808*	1.732	.010	-10.64	-.97
	elbow stick	-7.500*	2.281	.013	-13.86	-1.14
Elbow stick	independent	2.304	1.641	.627	-2.28	6.88
	wheel chair	3.231	1.732	.345	-1.60	8.06
	walker	1.692	1.732	.865	-3.14	6.53
	accompaniment	7.500*	2.281	.013	1.14	13.86

Note : * The mean difference is significant at the 0.05 level.

commutes and ,therefore, do not travel that fast. When marketing MPEVs to consumers, it is important to know how valued speed is when making a vehicle purchase or rental decision.

(3) Objective 3 - To Establish a Relationship Between Individuals' Level of Mobility and their Willingness to Rent MPEVs : Willingness to rent a MPEV was also analyzed across individuals of varying levels of mobility. This data was collected and analyzed across respondents' level of mobility by running a chi - square test.

The following hypotheses were framed :

Table 7. Mobility vs Willingness Chi Square Result

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	8.398 ^a	4	.078
Likelihood Ratio	10.080	4	.039
Linear-by-Linear Association	2.807	1	.094
N of Valid Cases	86		

a. 6 cells (60.0%) have expected count less than 5. The minimum expected count is .60.

Table 8. Mobility vs Willingness to Rent Model Strength

		Value	Approx. Sig.
Nominal by Nominal	Phi	.312	.078
	Cramer's V	.312	.078
	Contingency Coefficient	.298	.078
N of Valid Cases		86	

↳ **H03** : Willingness to rent MPEV's and respondents' level of mobility are independent.

↳ **Ha3**: Willingness to rent MPEV's and respondents' level of mobility are dependent.

From the Table 7, it can be interpreted that the Pearson chi-square value (0.078) is greater than 0.05, making us unable to reject H03. Hence, there is no significant difference between mobility and willingness to rent. In other words, mobility and willingness to rent are independent. From the Table 8, it can be concluded that there does not exist a strong association between mobility and willingness to rent because the Phi, Cramer, and contingency coefficient values are less than 0.5 (coefficient = 0.312, 0.312, and 0.298, respectively).

(4) Objective 4 - To Assess Individuals' Preference for Differing Rental Pricing Models of MPEVs Across their Level of Mobility : Preference for certain rental models was also analyzed across individuals of varying levels of mobility. This data was collected and analyzed across respondents' level of mobility by running a Pearson's chi-square analysis.

The following hypotheses were framed :

↳ **H04**: Preference for a certain rental model and respondents' level of mobility are independent.

Table 9. Chi - Square Descriptive of Rental Pricing Preferences Versus Level of Mobility

		Mobility					
		Independent	Wheel Chair	Walker	Accompaniment	Elbow Stick	Total
Rental Pricing Model	hourly	6	0	0	0	0	6
	daily	29	8	6	0	2	45
	monthly	4	3	4	2	0	13
	metre-based	17	2	3	0	0	22
Total		56	13	13	2	2	86

Table 10. Chi-Square Results of Rental Pricing Preferences Versus Level of Mobility

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	22.364 ^a	12	.034
Likelihood Ratio	21.178	12	.048
Linear-by-Linear Association	.033	1	.856
N of Valid Cases	86		

a. 15 cells (75.0%) have expected count less than 5. The minimum expected count is .14.

Table 11. Phi and Cramer's V Results of Rental Pricing Preferences Versus Level of Mobility

		Value	Approx. Sig.
Nominal by Nominal	Phi	.510	.034
	Cramer's V	.294	.034
	Contingency Coefficient	.454	.034
N of Valid Cases		86	

✎ **Ha4 :** Preference for a certain rental model and respondents' level of mobility are dependent.

The cross-tabulation Table 9 shows the inter-relationship between the level of respondents' mobility and the rental pricing preferences. The Pearson chi-square value from Table 10 yields statistically significant results ($\chi^2 (12, N = 86) = 22.364, p < 0.05$). Therefore, H04 can be rejected. From this result, it can be concluded that preference for certain rental models differs based upon the respondents' level of mobility. From the Table 11, it can be concluded that there exists a strong association between the mobility and rental models, because the Phi and contingency coefficient value is greater than or equal to 0.5 (coefficient = 0.510 and 0.5, respectively).

(5) Objective 5 - To Analyze Whether or not Daily Transportation Mode, Distance Traveled, Levels of Mobility, and Amount Spent are Good Predictors for Respondents' Willingness to Rent a MPEV : Willingness to rent a MPEV was also analyzed across individuals of varying levels of mobility, transportation mode, and distance travelled. This data was collected and analyzed by running a logistic regression test.

The rows in the Table 12 give the number and percent of cases that are included in the analysis. As there were no missing data in the data set, this corresponds to the total number of cases. The Table 13 shows the chi square statistic and its significance level. The value in the significance column determines the probability of obtaining a chi-square statistic given the null hypothesis is true. The p -value of 0.007, as seen from the Table is < 0.05 , which shows the statistical significance of the model.

The Table 14 shows the pseudo R^2 , the -2 log likelihood value. Nagelkerke R^2 value is 0.384 which indicates that

Table 12. Case Report of Analysis

Unweighted Cases ^a		N	%
Selected Cases	Included in Analysis	86	100.0
	Missing Cases	0	.0
	Total	86	100.0
Unselected Cases		0	.0
Total		86	100.0

a. If weight is in effect, see classification table for the total number of cases.

Table 13. Strength of Model Test Results

		Chi-square	df	Sig.
Step 1	Step	27.230	12	.007
	Block	27.230	12	.007
	Model	27.230	12	.007

Table 14. Nagelkerke R-square of the Logistic Regression Model

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	78.175 ^a	.271	.384

Table 15. Hosmer and Lemeshow Test of Logistic Regression

Step	Chi-square	df	Sig.
1	8.160	7	.319

Table 16. Predictive Power of Logistic Regression Model with Predictor Variables

			Predicted		
			WillingtoRent		Percentage Correct
Observed			No	Yes	
Step 1	WillingtoRent	No	11	15	42.3
		Yes	5	55	91.7
	Overall Percentage				76.7

a. The cut value is .500

Table 17. Variables in the Logistic Regression Model

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I. for EXP(B)	
								Lower	Upper
Step 1 ^a	DistanceTraveled			4.881	4	.300			
	DistanceTraveled(1)	1.284	1.071	1.437	1	.231	3.612	.442	29.489
	DistanceTraveled(2)	-.967	.986	.962	1	.327	.380	.055	2.625
	DistanceTraveled(3)	.055	.954	.003	1	.954	1.056	.163	6.857
	DistanceTraveled(4)	-.365	1.344	.074	1	.786	.694	.050	9.672
	TransportOption			6.928	3	.074			
	TransportOption(1)	1.597	.734	4.732	1	.030	4.937	1.171	20.815
	TransportOption(2)	2.883	1.329	4.702	1	.030	17.860	1.319	241.757
	TransportOption(3)	1.194	1.406	.721	1	.396	3.300	.210	51.901
	MoneySpent	-.012	.005	6.907	1	.009	.988	.980	.997
	Mobility			5.506	4	.239			
	Mobility(1)	-17.343	40192.850	.000	1	1.000	.000	.000	.
	Mobility(2)	-18.680	40192.850	.000	1	1.000	.000	.000	.
	Mobility(3)	-16.789	40192.850	.000	1	1.000	.000	.000	.
	Mobility(4)	-16.736	40192.850	.000	1	1.000	.000	.000	.
	Constant	18.618	40192.850	.000	1	1.000	1.218E8		

a. Variable(s) entered on step 1: DistanceTraveled, Transport Option, Money Spent, Mobility.

the model is good. We can conclude that 38.4% of the variance in a respondent's willingness to rent MPEVs is explained by the variance in the predictor variables, which are distance travelled, degree of mobility, amount of money willing to spend on daily transportation, and distance travelled every day. That is, 40% probability of the event renting the vehicle is explained by the model.

According to the Table 15, the Hosmer and Lemeshow test of the goodness of fit suggests the model is a good fit to the data as $p = 0.319$, which is greater than > 0.05 . Therefore, the logistic regression model is valid.

The Table 16 indicates the number of 0s and 1s that are observed in the dependent variable. The predicted value column shows the predicted value of the dependent variable based on the logistic regression model. The Table 16 indicates 55 cases as observed cases of 1 and is correctly predicted as 1 and 11 cases are observed to be 0 and are correctly predicted as 0. However, 15 cases observed to be 0 are predicted as 1 and similarly, 5 cases observed to be 1 are predicted as 0. Hence, 76.7 % of the cases are predicted correctly by the model. This is a relatively strong logistic regression model.

From the significance column of Table 17, it can be interpreted that money spent is an important contributor to the model as its significance value (0.009) is < 0.05 . The Table 17 also estimates the coefficients for the predictors that could be included in the model. The important statistic is the Wald statistic, which has a chi-square distribution and denotes whether the 'b' coefficient for the predictor is significantly different from zero. For the predictor variables - distance travelled, money spent, and transportation option, the coefficients are significantly different from zero. So, the three predictors significantly contribute to the prediction of willingness to rent. The Table 17 also gives us the odds ratio ($\text{Exp}(B)$). For transportation option and distance travelled, the odds ratio is greater than 1, which shows that the probability of willingness to rent increases with increases in them.

Discussion

In a rapidly urbanizing world with increasing transportation options, it is important that all users of the road are considered and make our cities more inclusive. One sizable population that has significantly limited transportation options are individuals with physical disability. While there are some policies that have provisions for physically handicapped individuals on public transportation, the current transportation infrastructure in India is challenging and unnavigable for these individuals. In order to promote inclusion of physically handicapped individuals in current and upcoming transportation infrastructure, this research paper strives to understand the gaps in the current transportation system perceived by physically handicapped adults in India, in addition to gauging their opinions on a multipurpose electric vehicle transportation option that is yet to be released to the market.

Our analysis reveals that respondents who positively perceived MPEVs were more willing to rent them than respondents who did not perceive positively about MPEVs. While this may seem to be an intuitive finding, further analysis can be conducted into which exact features of MPEVs are perceived positively, and which are the key factors that influence the willingness to rent MPEVs. This type of analysis would be valuable for creators of MPEVs, to discern what features are essential when building and marketing the product.

The study also reveals few patterns about preference of speed. These results provide more insight into transportation preferences of physically handicapped individuals, and provide insight into the importance of speed when designing MPEVs. MPEVs are designed for short-distance commutes, and therefore, do not travel that fast. When marketing MPEVs to consumers, it is important to know how valued speed is when making a vehicle purchase or rental decision. Research outcome also highlights the customer perception towards different rental models. These results provide more insight into the probabilistic rental behavior of individuals with lower limb disabilities, and will allow for more focused and targeted marketing of the product when it comes to launch. In addition, market researchers can explore further why these factors are better predictors of willingness to rent an MPEV, and whether or not these factors can be integrated into future communication of the MPEV product. The research also provides useful information about the relative budget of physically handicapped individuals, and

how much they would be willing to spend per rental model. These results will allow for more targeted marketing of the MPEV to consumers based upon their level of mobility, and the possibility of customizing rental option based on an individual's level of mobility.

Managerial Implications

- (1) The organizations which lend vehicles on rent have to add more values per customer and have to focus on 'more revenue' from the limited customer base.
- (2) The organizations have to focus on their promotional activities based on self confidence and 'not inferior to anybody on this earth attitude' of the disabled in making this planet more sustainable.
- (3) The organizations can use social media to connect with all prospective customers and use this platform to offer these services based on cross subsidized or what that people can afford.
- (4) The organizations can tie up with NGOs and all disabled friendly corporates to reach the disabled.
- (5) The organizations can tie up with transport providers like railways, roadways, and airways to integrate different modes of transport.
- (6) The organizations, through advocacy, have to prevail upon civic authorities across the country to make all commercial, public, and residential buildings disabled friendly. This enhances the use of electric vehicles, and in turn, the demand for rental vehicles increases.
- (7) The vehicles have to be upgraded both in terms of hardware and software from time to time so that customers should feel that going in for rental vehicles would give them upgraded and updated model every time they use the same. This makes them go for rental rather than buying the vehicle.

Conclusion

MPEVs are a potential sustainable solution for transportation for physically handicapped residents. However, there is limited research on transportation options and perceptions among physically handicapped, and the existing research about EVs is largely concentrated on a purchase model. This study examined current perceptions of transportation options, rental versus pricing models, willingness to purchase and rent MPEVs, and general perceptions of the sustainability and performance of EVs.

Limitations of the Study and Scope for Further Research

It was difficult to access non-governmental organizations (NGO) and seek approval for surveying physically handicapped individuals. Finding respondents within our inclusion criteria was difficult. The disproportional breakdown of respondents by demographic characteristics leads to limitations with regards to our external validity. Due to the social desirability bias, some respondents may have answered with positive views on electric vehicles as opposed to their true feelings.

Future research can concentrate on the benefits of renting versus purchasing MPEVs and on the additional barriers that physically handicapped individuals might face with transportation. Further research can also be focused on adding more value-added services to the vehicle. Research can also be conducted on assessing the spending pattern on daily transportation by individuals of certain mobility and its relativity with choice for a particular rental option. Even the research can focus on subsidizing these vehicles to them. Any additional research

which contributes to the market of EVs to benefit the lives of those who are living with physical disability can be considered.

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