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ASSESSMENT OF MODE SHIFT TOWARDS NON- MOTORIZED TRANSPORTATION IN INFOPARK, KOCHI

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Abstract The widespread usage of motorized transportation has improved our everyday comfort and convenience, particularly in the growing urban surroundings. However, the greater reliance on automobiles have also resulted in many environmental problems, significantly raising pollution and blurring the metropolitan landscape. Motorization has an impact on human health, the environment as a whole, and the balance of nature. It is essential to switch to sustainable forms of transportation to handle this growing problem. One of the sustainable solutions for this is shifting towards non-motorized transport (NMT). But nowadays the willingness to shift towards NMT is depriving. The key step in achieving the goal is to find a creative solution to promote NMT transit. In this study, we focus on the idea of introducing piezoelectric pathways at Infopark, Kochi (from Infopark phase 1 main gate to phase 2) and to analyze the willingness of commuters to shift to piezoelectric pathways. From an extensive literature review, a self- descriptive questionnaire was created, which included socio-demographic characteristics, trip characteristics, and questions about people's attitudes and behaviours. The goal is to explore the behavioural factors that play a crucial role in influencing mode shift. Through our research, we aim to develop a mode shift model and devise policy strategies that encourage the people to adopt Non-Motorized Transportation.

Key words: Non-motorized transit, Piezoelectric power generation, Mode shift, policy- making.

1 INTRODUCTION

In an era of rising urbanization, urban transportation plays a critical role in defining our lives and communities and exposes important issues including sustainability, public health, and efficient mobility. To promote sustainability, clean air, and better health, mode shift towards Non-Motorized Transportation is a better solution. It can help improve urban living, lessen noise pollution, and ease traffic. This project is done to learn more about commuter's travel habits and preferences, as well as how willing they are to shift to more sustainable choices like piezoelectric pathways at Infopark, kochi Phase 1 to Phase 2. This is achieved by conducting a questionnaire survey which helps to understand more about the factors affecting commuter's mode choices and acceptance of integrating eco-friendly transportation options. Mathematical models are developed on basis of the data collected to have a better understanding of the basic mechanism of mode choice and commuter's tendency for mode shift. In the end, we aim to come up with suitable policy plans to promote sustainable transportation habits, which will eventually promote a culture of environmental awareness and make non-motorized transportation more accessible to all.

1.1 NEED FOR STUDY

Motorized Transportation have been increasingly contributing to various environmental concerns like pollution, congestion, noise etc during the paat decades. Shifting towards sustainable options reduces there impact on environment, public health and livability. This study tries to promote innovative ideas non motorised transportation options like piezoelectric pathways. However commuters are majorly not willing to adopt such alternatives. This study focuses on exploring various factors influencing commuters behaviour and their willingness towards the mode shift. Also, it can help in analyzing whether there is an increase in willingness to shift towards NMT based on the framed scenarios.

1.2 OBJECTIVES

- To identify the factors that influence mode shift towards NMT from the literature review.
- To study the mode choice behaviour of the commuters in the study area by developing a mode choice model.
- To develop a mode shift model to calculate the percentage of a shift towards NMT.
- To prepare policy-making strategies for encouraging walking and cycling.

2 METHODOLOGY

2.1 GENERAL

The project assesses the mode shift to non-motorized transport in Infopark, Kochi, using surveys, data analysis, model development, and policy formulation to promote NMT. The project will be conducted within Phase 1 to Phase 2 of Infopark Kochi, acting as the site chosen for the research project. From the extensive literature review various factors that can influence mode shift were found and a questionnaire was prepared on its basis. A pilot survey was conducted to validate the prepared questionnaire. A questionnaire survey was done for a minimum sample size of 400 at the selected location. The collected data was cleaned and later it was analysed using SPSS.. Mode choice model were used to understand the travel mode distribution of the commuters (using the multi-nominal logistic model) and mode shift model (using the binary logistic model) were used to analyze the willingness to shift towards NMT based on the framed scenarios, followed by validating them. Policies are framed and analysed to encourage more people towards Non- Motorized Transportation.

2.2 STUDY AREA

The study area selected is located in the centre of Kochi, Infopark acts as an important centre for innovation and technology. The route from the main gate of Phase 1 to Phase 2 is the selected for the pathway which consists of 2.4 kilometer route (as shown in Fig2.1. According to annual report of Infopark 2022, the population of Infopark is 61,740. Institutional buildings used mostly for offices line this route, which is busy with commuters travelling to and from work. Cars are convenient, but as more people use them more ecological issues are seen in Kochi. The average time for walking from Phase 1 to Phase 2 is 30 minutes and similarly, it takes 15 minutes while cycling.

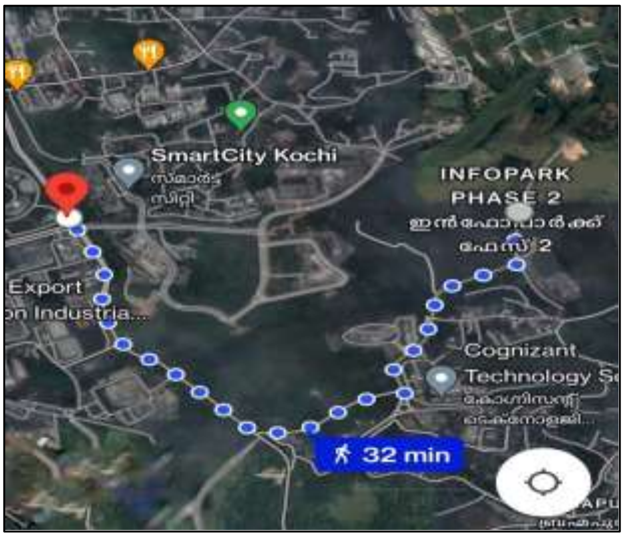

Figure no. 2.1 Study Area

2.3 FACTORS INFLUENCING MODE CHOICE BEHAVIOUR

Table 2.1: Different factors influencing mode choice

Journals	Variables
[18]	Age, income, physical abilities, ride-sharing, travel distance, average cost, and infrastructure.
[20]	Age, gender, occupation, trip length, willingness, infrastructure availability, cost, journey time, weather conditions, accessibility to footpaths, comfort level, and safety measures.
[15]	Mode of transport, willingness to shift to private transport and public transport, cycle ownership, income, last mile connectivity, household size, trip information.
[9]	Travel time, cost of travel, comfort level, convenience, branch utility, eco- friendliness, accessibility, security, cleanliness, occupation, income, gender, trip frequency, trip transfer, household size, and weather.
[2]	Age, Waiting time, travel time, travel cost, discomfort, travel mode, frequency of each mode, size of family, place of residence, gender, parking residence, and place of work.
[1]	Gender, age, income, the purpose of the trip, vehicle ownership, current using mode, occupation, discomfort.
[7]	Availability of access modes, satisfaction, vehicleownership, traffic, education, comfort, occupation, vehicle availability, income, and different school travel modes.

From the extensive literature review shown in Table 2.1 following are the variables chosen for this study:

Socio-demographic factors: Age, Gender, Marital Status, Education Level, Monthly Income, Employment, Vehicle Ownership, Driving License, No. Of Working Members, Household Size, Residential Location.

Travel characteristics: Origin & Destination, Purpose of Travel, Mode of Travel, Time of Travel, Travel Cost, Travel Distance, Frequency of Travel, Access, and Egress.

Latent characteristics: Infrastructure, Health Benefits, Safety, Economic Benefits, Connectivity, Time Requirement, Cleanliness, Convenience & Comfort Level.

2.4 DESIGN OF QUESTIONNAIRE AND DATA COLLECTION

A questionnaire is created using both stated preference and revealed preference methods as it is regarded as the most appropriate approach for constructing a questionnaire. We developed a questionnaire that gathers a variety of factors that can influence the shift to NMT. We've opted for a combination of paper and pencil interviews, alongside internet interviews conducted through Google Forms, as the most suitable methods for data collection. The questionnaire covers a wide array of variables categorized into three main domains: Socio- demographic factors, Travel characteristics, and Behavioural characteristics. Firstly, the socio-demographic factors consist of variables such as age, gender, marital status, education level, monthly income, employment status, vehicle ownership, driving license possession, number of working members in the household, household size, and residential location. Secondly, travel characteristics include variables such as origin and destination, purpose of travel, mode of travel, time of travel, travel cost, travel distance, frequency of travel, access, and egress. Lastly, behavioural characteristics that influence mode shift such as infrastructure, health benefits, safety, economic benefits, connectivity, time requirements, cleanliness, convenience, and comfort levels. The questionnaire was developed with care to obtain Likert-type replies from commuters, revealing detailed insights into their opinions and choices about non-motorized transportation options. Sample size calculation was done using Levy and Lemeshow equation which is given by,

$$N_0 = (Z^2 \times p \times (1-p)) \div e^2 \qquad [13]$$

Where,

N_0= required sample size
Z= z score corresponding to desired confidence level
p=estimated proportion of population
e= desired margin of error Sample size calculation

For this study:

N_0 = 1.962 x 0.5 x (1-0.5) / 0.052
= 384.16 ~ 385 no. of samples.

385 number of samples is found out to be the minimum amount to be considered for data collection.

Out of a total of 616 surveys conducted, 30 were completed using Google Forms, while the remaining 586 surveys were carried out through traditional paper and pencil interviews.

3 PRELIMINARY

3.1 DESCRIPTIVE ANALYSIS

The various variables were selected and the questionnaire was prepared. The survey was conducted and the required data was collected (616 surveys were collected). From this preliminary analysis of socio- demographic characteristics, travel characteristics were found and is given below.

Table 3.1: Characteristics Distributions

Factors	Distribution					
Age	18-25 yrs	26-40 yrs	41-55 yrs	Above 55 yrs		
	149(24.1%)	417(67.6%)	44 7.1%	6 0%		
Gender	Male	Female				
	377(61.2%)	239(38.7%)				
Marital status	Married	Unmarried				
	355(57.6%)	261 (42.3%)				
Education	12th	Degree	Graduate	Pg & above		
	20 (3.2%)	116 (18.8%)	331 (53.7%)	149 (24.1%)		
Employment	Private	Self-employed	Student	Retired		
	557 (90.4%)	41 (6.6%)	13 (2.1%)	5 (0%)		
Monthly income	Nil	Up to 10000/-	10000-25000/-	25000-50000/-	50000-75000/-	Above 75000/-
	27 (4.3%)	16 (2.5%)	116 (18.8%)	267 43.3	161 26.1	29 4.7
Vehicle ownership	2-wheeler	4-wheeler	Both	None		
	303(49.1%)	79 (12.8%)	206 (33.4%)	28 (4.5%)		
Driving license	2-wheeler	4-wheeler	Both	None		
	49 (7.9%)	28 (4.5%)	523 (84.9%)	16 (2.5%)		
Travel purpose	Work	Education	Others			
	599 (97.2%)	5 (0%)	12 (1.9%)			
Travel mode	Walk	Bus	Car	2-wheeler	Auto	Institutional

	9 (1.4%)	214(34.7%)	61(9.9%)	303(49.1%)	8(1.2%)	2 (3.4%)
Travel frequency	Daily	Twice or thrice a week	Once a week	Once a month	Once in a while	
	454 (73.7%)	78 (12.6%)	46 (7.4%)	24(3.8%)	14 (2.2%)	
Travel time	2-10 min	11- 20 min	21- 40 min	41- 60 min		
	112 (18.1%)	279 (45.2%)	216 (35%)	9 (1.4%)		
Travel cost	Below Rs.30	Rs.31-60	Rs.61-100	Rs.101-200		
	143 (23.7%)	355 (27.6%)	93 (15%)	25 (4%)		
Travel distance	0-3 km	4-10 km	11-25 km	26-50 km		
	22(3.5%)	379(61.5%)	202(32.7%)	13 (2.1%)		

3.2 RELATIVE IMPORTANCE INDEX

Relative Importance Index (RII) is a non-parametric technique widely used by construction and facilities management researchers for analyzing structured questionnaire responses for data involving ordinal measurement of attitudes.

$$R = \sum W \div (A \times N) \quad [21]$$

The terms:

- W = weighting that is assigned to each variable by the respondents ranging from 1 to 5,

  $\sum W=(1n_1+2n_2+3n_3+4n_4+n_5)$ [21]

- A = highest weight (5)
- N = total number of respondents (616)

Table 3.1: Characteristics Distributions

Factors Favorably Influencing NMT	5	4	3	2	1	Total	Score (W)	N	A×N	W÷(A×N)	Rank
Quality of infrastructure	427	152	33	2	2	616	2848	616	3080	0.924	**1**
economic benefits	182	364	66	4	0	616	2572	616	3080	0.835	**2**
Health benefits	241	240	135	0	0	616	2570	616	3080	0.834	**3**
Cleanliness	122	234	258	2	0	616	2324	616	3080	0.754	**4**
Connectivity	84	198	301	27	6	616	2175	616	3080	0.706	**5**
Safety	44	107	344	107	14	616	1908	616	3080	0.619	**7**
Comfort & Convenience	46	207	225	116	22	616	1987	616	3080	0.645	**6**
Time requirement	18	9	45	145	399	616	950	616	3080	0.308	**8**

From RII method shown in the table 3.2 it was found that Quality of infrastructure (92.4%) was the most significant factor that influences mode shift towards NMT, followed by Economic considersations (83.5%) , Health benefits(83.4%).

4 MODE SHIFT ANALYSIS

For computing the mode shift, we have framed 6 scenarios, 3 for walking and 3 for cycling. Each scenario was framed with different percentage profit for different distance. We have selected binary logit model for analyzing the mode shift as the dependent variable is binary in nature.

For the binary logit model, shift towards NMT is taken as the dependent variable and independent variables taken are the following behavioral characteristics: Infrastructure, Economic, Health benefits, Comfort, Connectivity, Cleanliness, Safety and Time requirement.

Taking these variables, we have generated mode shift model for each of the 6 sce-narios. The outputs and parameters of the model is given in the upcoming sessions.

4.1 MODEL RESULT – IF 5% OF PROFIT IS PROVIDED TO THE COMMUTERS WALKING

Table 5.1 Model Summary

-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
163.275[a]	0.513	0.693

Model summary provides the pseudo R square values of the model which is a measure how well the variables explain the variation of dependent variable. Higher values indicating better fit, a value of above 0.5 can be considered acceptable. Here the nagalkerke value is obtained as 0.693 which is well above 0.5.

Table 5.2: Parameter estimates

	B	S.E.	Wald	Df	Sig.
Infrastructure	1.404	0.239	34.581	1	.000
Health	0.880	0.308	8.161	1	.004
Economic	0.436	0.259	2.843	1	.092
Cleanliness	-0.110	0.254	0.188	1	.664

Connectivity	1.090	0.286	14.562	1	.000
Comfort	-0.842	0.262	10.17	1	.001
Safety	-0.628	0.250	6.293	1	.012
Time requirement	-1.019	0.182	31.229	1	.000
Constant	-3.848	2.131	3.260	1	.071

From this parameter estimates, positive B values indicate favourable influence towards shift and negative B values indicates unfavourable influence towards shift to NMT of that variable. In this model Infrastructure(1.404), health(0.880), economic factor(0.436), and connectivity(1.090) has a positive correlation towards the shift and cleanliness(-0.110), comfort(-0.842), safety(-0.628) and time requirement(-1.019) has negative correlation with the shift.

Table 5.3: Classification table

Observed		Predicted					
		Training data			Validation data		
		5% FOR WALKING		Percentage Correct	5% FOR WALKING		Percentage Correct
		No	Yes		No	Yes	
5% PROFIT FOR WALKING	No	58	24	70.7	12	2	85.7
	Yes	11	243	95.7	6	55	90.2
Overall Percentage		20.05	79.46	89.6			89.3

79.46% commuters agree to shift under the mentioned policy whereas 20.05% were not willing to shift towards NMT
As the overall correct percentage value of model data and validation data does not differ by more than 5%, it can be said that the model is valid.

4.2 MODEL RESULT – IF 10% OF PROFIT IS PROVIDED TO THE COMMUTERS WALKING

Table 5.4 **:**Model Summary

-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
170.386[a]	0.503	0.630

As pseudo R square of above 0.5 indicates a better fit of model, we have obtained a value of nagalkerke as obtained as 0.630 which is well above 0.5. Hence the model is of good fit.

Table 5.5 Parameter estimates

	B	S.E.	Wald	Df	Sig.
Infrastructure	1.090	0.214	26.022	1	.000
Health	0.288	0.288	1.002	1	.317
Economic	0.066	0.245	0.073	1	.788
Cleanliness	-0.775	0.271	8.205	1	.004
Connectivity	0.316	0.247	1.640	1	.200
Comfort	-1.257	0.250	25.263	1	.000
Safety	-0.168	0.214	0.619	1	.431
Time Requirement	-0.547	0.158	12.054	1	.001
Constant	2.916	1.828	2.546	1	.111

From this parameter estimates, positive B values indicate favourable influence towards shift and negative B values indicates unfavourable influence towards shift to NMT of that variable. In this model Infrastructure(1.090), health(0.288), economic factor(0.066), and connectivity(0.316) has a positive correlation towards the shift and cleanliness(-0.775), comfort(-1.257), safety(-0.168) and time requirement(-0.547) has negative correlation with the shift.

Table 5.6 Classification Table

Observed		Predicted					
		Training data			Validation data		
		10% FOR WALKING		Percentage Correct	10% FOR WALKING		Percentage Correct
		No	Yes		No	Yes	
10% PROFIT FOR WALKING	No	46	24	65.7	11	4	73.3
	Yes	8	258	97.0	3	57	95.0
Overall Percentage		16.07	83.92	90.5			90.7

83.92% commuters agree to shift under the mentioned policy whereas 16.08% were not willing to shift towards NMT.
As the overall correct percentage value of model data and validation data does not differ by more than 5%, it can be said that the model is valid.

4.3 MODEL RESULT – IF 15% OF PROFIT IS PROVIDED TO THE COMMUTERS WALKING

Table 5.7 Model Summary

-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
294.446[a]	0.510	0.534

As pseudo R square of above 0.5 indicates a better fit of model, we have obtained a value of nagalkerke as obtained as 0.534 which is well above 0.5. Hence the model is of good fit.

Table 5.8 Parameter estimates

	B	S.E.	Wald	Df	Sig.
Infrastructure	1.003	0.199	25.343	1	.000
Health	0.165	0.237	0.487	1	.485
Economic	0.128	0.198	0.418	1	.518
Cleanliness	-0.690	0.200	11.960	1	.001
Connectivity	0.622	0.181	11.748	1	.001
Comfort	-0.625	0.188	11.012	1	.001
Safety	-0.074	0.166	.200	1	.655
Time requirement	-0.128	0.136	.886	1	.346
Constant	-2.494	1.533	2.647	1	.104

From this parameter estimates, positive B values indicate favourable influence towards shift and negative B values indicates unfavourable influence towards shift to NMT of that variable. In this model Infrastructure(1.003), health(0.165), economic factor(0.128), and connectivity(0.622) has a positive correlation towards the shift and cleanliness(-0.690), comfort(-0.625), safety(-0.074) and time requirement(-0.128) has negative correlation with the shift.

Table 5.9 Classification Table

Observed		Predicted					
		Training data			Validation data		
		15% PROFIT FOR WALIKNG		Percentage Correct	15% PROFIT FOR WALIKNG		Percentage Correct
		No	Yes		No	Yes	
15% FOR WALKING	No	48	58	45.3	11	9	55.0
	Yes	20	210	91.3	4	51	92.7
Overall Percentage		20.23	79.76	79.8			82.7

79.76% commuters agree to shift under the mentioned policy whereas 20.24% were not willing to shift towards NMT.
As the overall correct percentage value of model data and validation data does not differ by more than 5%, it can be said that the model is valid.

4.4 MODEL RESULT – IF 5% OF PROFIT IS PROVIDED TO THE COMMUTERS CYCLING

Table 5.10 Model Summary

-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
333.367[a]	0.508	0.614

As pseudo R square of above 0.5 indicates a better fit of model, we have obtained a value of nagalkerke as obtained as 0.614 which is well above 0.5. Hence the model is of good fit.

Table 5.11 Parameter estimates

	B	S.E.	Wald	Df	Sig.
Infrastructure	0.565	0.168	11.271	1	.001
Health	0.803	0.227	12.549	1	.000
Economic	0.229	0.183	1.568	1	.210
Cleanliness	-0.768	0.188	16.725	1	.000
Connectivity	0.011	0.169	0.004	1	.947
Comfort	-0.534	0.180	8.849	1	.003
Safety	-0.005	0.158	0.001	1	.977
Time requirement	-0.536	0.139	14.776	1	.000
Constant	-1.150	1.521	0.572	1	.450

From this parameter estimates, the positive B value indicates the favourable influence towards shift and and negative B values indicates unfavourable influence towards shift to NMT of that variable. In this model Infrastructure(0.565), health(0.803), economic factor(0.229), and connectivity(0.011) has a positive correlation towards the shift and cleanliness(-0.768), comfort(0.534), safety(0.005) and time requirement(-0.536) has negative correlation with the shift.

Table 5.12 Classification Table

<table>
<tr><td colspan="2" rowspan="4">Observed</td><td colspan="6">Predicted</td></tr>
<tr><td colspan="3">Training data</td><td colspan="3">Validation data</td></tr>
<tr><td colspan="2">5% PROFIT FOR CYCLING</td><td rowspan="2">Percentage Correct</td><td colspan="2">5% PROFIT FOR CYCLING</td><td>Percentage Correct</td></tr>
<tr><td>No</td><td>Yes</td><td>No</td><td>Yes</td><td></td></tr>
<tr><td rowspan="2">5% FOR CYCLING</td><td>No</td><td>86</td><td>58</td><td>59.7</td><td>24</td><td>7</td><td>77.4</td></tr>
<tr><td>Yes</td><td>32</td><td>160</td><td>83.3</td><td>10</td><td>34</td><td>77.3</td></tr>
<tr><td colspan="2">Overall Percentage</td><td>35.23</td><td>64.76</td><td>73.2</td><td></td><td></td><td>77.3</td></tr>
</table>

64.76% commuters agree to shift under the mentioned policy whereas 35.23% were not willing to shift towards NMT.
As the overall correct percentage value of model data and validation data does not differ by more than 5%, it can be said that the model is valid.

4.5 MODEL RESULT – IF 10% OF PROFIT IS PROVIDED TO THE COMMUTERS CYCLING

Table 5.13 Model Summary

-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
414.620[a]	0.538	0.583

As pseudo R square of above 0.5 indicates a better fit of model, we have obtained a value of nagalkerke as obtained as 0.583 which is above 0.5. Hence the model is of good fit.

Table 5.14 Parameter estimates

	B	S.E.	Wald	Df	Sig.
Infrastructure	0.036	0.141	0.066	1	.797
Health	0.179	0.202	0.786	1	.375
Economic	0.129	0.169	0.581	1	.446
Cleanliness	-0.295	0.165	3.207	1	.073
Connectivity	0.126	0.152	0.688	1	.407
Comfort	-0.120	0.163	0.541	1	.462
Safety	-0.231	0.146	2.490	1	.115
Time requirement	-0.271	0.120	5.080	1	.024
Constant	-0.989	1.328	0.554	1	.456

From this parameter estimates, the positive B value indicates the favourable influence towards shift and and negative B values indicates unfavourable influence towards shift to NMT of that variable. In this model Infrastructure(0.036), health(0.179), economic factor(0.129), and connectivity(0.126) has a positive correlation towards the shift and cleanliness(-0.295), comfort(-0.120), safety(-0.231) and time requirement(-0.271) has negative correlation with the shift.

Table 5.15 Classification Table

Observed		Predicted					
		Training data			Validation data		
		10% PROFIT FOR CYCLING		Percentage Correct	10% PROFIT FOR CYCLING		Percentage Correct
		No	Yes		No	Yes	
10% PROFIT FOR CYCLING	No	166	35	82.6	30	2	93.8
	Yes	60	75	55.6	21	22	51.2
Overall Percentage		67.16	32.73	71.7			69.3

32.73% commuters agree to shift under the mentioned policy whereas 67.16% were not willing to shift towards NMT.
As the overall correct percentage value of model data and validation data does not differ by more than 5%, it can be said that the model is valid.

4.5 MODEL RESULT – IF 15% OF PROFIT IS PROVIDED TO THE COMMUTERS CYCLING

Table 5.16 Model Summary

-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
289.600[a]	0.517	0.605

As pseudo R square of above 0.5 indicates a better fit of model, we have obtained a value of nagalkerke as obtained as 0.605 which is well above 0.5. Hence the model is of good fit.

Table 5.17 Parameter estimates

	B	S.E.	Wald	Df	Sig.
Infrastructure	0.032	0.173	0.034	1	.253
Health	0.192	0.249	0.594	1	.441
Economic	0.114	0.216	0.278	1	.598
Cleanliness	-0.021	0.197	0.011	1	.915
Connectivity	0.146	0.196	0.559	1	.455
Comfort	-0.333	0.195	2.896	1	.089
Safety	-0.120	0.181	0.442	1	.506
Time requirement	-0.130	0.130	1.001	1	.317
Constant	-3.688	1.592	5.368	1	.021

From this parameter estimates, the positive B value indicates the favourable influence towards shift and and negative B values indicates unfavourable influence towards shift to NMT of that variable. In this model Infrastructure(0.032), health(0.192), economic factor(0.114), and connectivity(0.146) has a positive correlation towards the shift and cleanliness(-0.021), comfort(-0.333), safety(-0.120) and time requirement(-0.130) has negative correlation with the shift.

Table 5.18 Classification Table

Observed		Predicted					
		Training Data			Validation Data		
		15% Profit For Cycling		Percentage Correct	15% Profit For Cycling		Percentage Correct
		No	Yes		No	Yes	
15% Profit For Cycling	No	221	20	91.7	44	2	95.7
	Yes	34	61	64.2	12	17	58.6
Overall Percentage		75.89	24.10	83.9			81.3

24.10% commuters agree to shift under the mentioned policy whereas 75.89% were not willing to shift towards NMT.
As the overall correct percentage value of model data and validation data does not differ by more than 5%, it can be said that the model is valid.

5 POLICY FRAMING

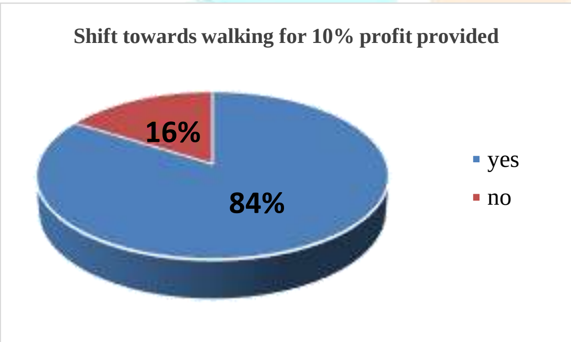

Fig 6.1 shift towards walking for 10% profit provided

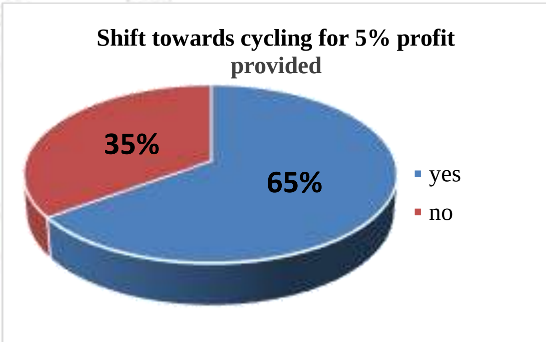

Fig 6.2 shift towards cycling for 5% profit provided

We have provided 6 scenarios based on the calculated profit from the piezoelectric pathway, 3 for walking and 3 for cyclingFrom the 3 scenarios provided for walking and cycling and 6 mode shift models were formed according to the data collected.

From the 3 scenarios in walking, it was found that a majority of 84% of the commuters were willing to shift towards walking if 10% of the profit(Rs.6/km) for walking 2km/day. From the 3 scenarios in cycling, it was found that a majority of 65% of the commuters were willing to shift towards cycling if 5% of the profit(Rs.3/km) for cycling 2km/day. Comparitively commuters are more willing to shift towards walking than cycling.

To optimize the amount of shift towards NMT using the pathway, the policies of giving 10% profit to people walking 2 kms per day and providing 5% profit to commuters cycling 1km per day should be implemented.

6 CONCLUSION

Encouraging people to walk or bike instead of driving can make a big difference in cities. Cars cause a lot of problems like pollution and traffic jams, which harm both our health and the environment. So, we wanted to see if we could get more people to use non-motorized transportation, like walking or biking, by making special paths with piezoelectric technology. We asked people about their travel habits and preferences, and most said they'd be willing to walk or bike a bit more if they got a small reward. Our analysis showed that offering incentives could make a lot of people choose walking or biking over driving. We tested our ideas with some data, and the results showed that our models were pretty accurate. This means our ideas could really work in real life to make cities cleaner and healthier. The mode choice model predicted 60.1%, and it turned out that commuters who use an auto through the pathway made up 30.7%, followed by commuters who use two-wheelers (30.6%), cars (19%), and walkers (19.6%). Different mode shift models were made by the arrangement situations that were presented in this review. The investigation showed that a greater part piece of suburbanites would be learned to walk 2 km/day for a 10% benefit impetus (83%), while others would favour cycling a similar distance for a 5% benefit motivator (64%). The accuracy difference between the models that were created using the training data (80%) and the validation data (20%) was found to be very small, so the models were validated.

REFERENCES

[1]Abhishek Pratap Singh Sikarwar, Mr. Yusuf Sultan , "Mode Shift Behaviour Study with Respect to Introduction of Metro Rail System in Indore City" I*JERT Vol. 9 Issue 11, November(2020)*

[2]Aditya V Sohoni, Mariam Thomas, K V Krishna Rao ,"Mode shift behavior of commuters due to the introduction of new rail transit mode", *Transportation Research Procedia 25C (2017) 2607–2622 .*

[3]Anshu Bamneya , Devrishi Tiwarib (2019),"Study on willingness to use Non-motorized modes in a tier 3 city: A case study in India" ,*Transportation's Research Procedia 48*

[4]Ashalatha R ,V. S. Manju,and Arun Baby Zacharia,"Mode Choice Behavior of Commuters in Thiruvananthapuram City", *JOURNAL OF TRANSPORTATION ENGINEERING © ASCE / MAY 2013.*

[5]Devika R ,M Harikrishna "Analysis of factors influencing mode shift to public transit in a developing country," *IOP Conf. Series: Earth and Environmental Science 491 (2020) 012054*

[6]Hamed Taherdoost, "Designing a Questionnaire for a Research Paper: A Comprehensive Guide to Design and Develop an Effective Questionnaire",*Asian Journal of Managerial Science, 2022, 11, pp.8 - 16.*

[7]Jerry Soman1, Vincy Verghese, "Mode choice Behaviour Analysis of Students in Thrissur city" *Volume: 06 Issue: 06 ,June (2019) 7*

[8]Jingyue Zhang, "Explore daily activity-travel behaviour of the elderly using multiyear survey data" *Mapping the Travel Behaviour Genome. (2020)*

[9]Kelvin Ryan S. MARCELO , Karl B. N. VERGEL , "Survey Method Creation of Stated Preference Method to Model Modal Shift to MRT Line 7"

[10]Kunal Soni, Nikhil Jha, Jai Padamwar, Devanand Bhonsle, Tanu Rizv, "footstep power generation using piezoelectric plate", *IRJMETS Volume:04Issue:03 March(2022)*

[11]Marsden G, Reardon L, "Questions of Governance:Rethinking the Study of Transportation Policy." *Transportation Research Part A: Policy and Practice, 101. pp. 238-251. ISSN 0965-8564(2017) 8*

[12]Omer Khan, "Modelling passenger mode choice behaviour using computer-aided stated preference data." *School of urban development Queensland University of Technology,Doctors of philosophy (IF149) ,(2007)*

[13]Paul Louangrath, "Sample Size Determination for Non-Finite Population" *International Conference on Discrete Mathematics and Applied Sciences. 9*

[14]Pravin Wale, Chetna Patil, Aditya Thakare, Ajeta Vinchurkar, Purvi Pagare, "Generation of electricity from roads by using piezoelectric sensors" *IJCRT Volume 9, Issue 6 June (2021)*

[15]Priyanka Joshi, Prof. Jagruti Shah,"Analysis for the adoption of Non-Motorized Transport(NMT) Facilities for the BRTS Corridor :A Case Study of Ahmedabad*", Journal of Emerging Technologies and Innovative Research (JETIR) November 2018, Volume 5, Issue 11.*

[16]Rafan Halomoan Tua Sinaga, Open Darnius,(2023), "Binary Logistic Regression Analysis Using Stepwise Method on Tuberculosis Events", *Journal of Mathematics Education and Application (JMEA) Vol. 2, No 1,pp. 01- 10.*

[17]Rebecca L. Morrison, Don A. Dillman, Leah M. Christian, "Questionnaire Design Guidelines for Establishment Surveys" *Journal ofOfficial Statistics, Vol. 26, No. 1, 2010.*

[18]Rietveld, Piet "Biking and Walking: The Position of Non-Motorised Transport Modes in Transport Systems", *Tinbergen Institute Discussion Paper, No. 01-111/3, Tinbergen Institute, Amsterdam and Rotterdam(2001)*

[19]Roopa S, MS Rani, “Questionnaire Designing for a Survey”, *The Journal of Indian Orthodontic Society, October-December 2012;46(4):273-277*

[20]Vaishnavi Shinde , Omkar Sonavane, and Shishir Dadhich (2023) “Study to Shift From Motorised to Non-Motorised Transport – A Case of Nashik City”, *ICSTCE*

[21]Vishal D. Sakhare, Gomatesh S. Patil, “Construction Equipment Monitoring: By Using Relative Important Indices (RII) Analysis” *IRJET Volume: 06 Issue: 11, Nov 2019*

[22] https://www.leadingedgeonly.com/