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Study on Factors of Urban Transportation Service Quality Based on Analytic Hierarchy Process: A Case Study of Gangtok City

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Abstract: ***Promoting the use of public transportation requires an in - depth knowledge of the variables that affect the choice of public transportation mode, including the process of implementing policy, as it has become a crucial component of government strategies to reduce carbon emissions from the transportation sector globally. A variety of factors impacting the usage of public transportation have been identified in previous studies, but few have been included in a single study. In order to boost the use of public transportation, it is essential to make it more attractive to travellers by conducting frequent Service Quality (SQ) assessments and adjustments. Understanding the passengers' expectations towards public transportation are important, and assessing the SQ is an important tool for evaluating the total performance of the Gangtok's public transportation system. The purpose of the existing study was to study the expectations and perceptions of city's passengers regarding SQ in public transportation. In order to comprehend how the present commuters' prefer a particular service quality attribute a series of interviews with passengers were undertaken. MCDM technique was adopted for this. The paper focuses on service quality factors for urban transportation system by adopting AHP technique. In this study perception of passengers using public transport in Gangtok is taken from the field. The case study is taken for Gangtok city in the state of Sikkim. The study involves study of passengers from various bus stop locations of the city. The results of the research showed substantial discrepancies among expectations and perceptions of city's commuters, along with widespread dissatisfaction with the delivery of public transit services in hilly areas as a whole. The reliability and adaptiveness of these service have been critical in describing the overall quality of transportation services in hilly areas, and best practices were used to develop a set of recommendations for transportation operators and local officials.***

Keywords: Service quality, public transportation, MCDM, AHP

1. Introduction

Transportation science includes both observational and experimental studies as well as the underlying theories of transportation dynamics. For instance, choosing a respectable transportation company may be prejudiced due to probable interrelated issues like delivering on time but efficiently, which makes decision - making more difficult. For many years, experts and decision - makers have focused their attention on planning and development in the transportation sector. Urban transportation contributes to a variety of complicated difficulties in large cities, such as traffic congestion, environmental issues, and economic and health issues. Not just in the large rising cities, but also in the large developed cities, these issues are serious. By taking a clear step forward that will improve user happiness and encourage people to use public transit instead of private vehicles, these complicated problems may be resolved. It should be underlined that the trends are against them, particularly in developing - nation cities where a lacklustre public transportation system has caused people to rely more on private vehicles. Service Quality is an essential aspect in enhancing the public transportation usage in any city, particularly in hilly areas.

To improve decision - making, which can be seen as the prerequisite for developing sustainable plans, local authorities must, however, make it a fundamental duty to involve societies in the tactical development process. Cities are the primary link between human and natural systems, and they not only promote economic growth but are crucial in many important social issues. The worldwide urbanisation rate was only 2% in 1800, and it first reached 50.16% in 2007. It is anticipated to reach a maximum of 68.36% in 2050 (UN World urbanisation Report) [1]. Promoting the use of public transportation requires an in - depth knowledge of the variables that affect the choice of public transportation mode, including the process of implementing policy, as it has become a crucial component of government strategies for lowering greenhouse gas emissions from the transportation sector globally.

A seminar paper on transportation by Louviere et al. (1973) [2] made us aware of the usage of techniques for assessing a person's reaction to amalgamations of levels of characteristics of diverse transportation modes that are not witnessed but which reflect a possible level of service. However, due to greater interest in the development of discrete choice models active methods to the study of continuous sequences of human activities through time, widespread awareness in this method towards travel behaviour was sluggish to develop. Litman (2013) [3] assessed the way individuals move is greatly impacted by the urban transportation systems. The requirement and dependency on motorised transportation, however, has increased as a result of growing urbanisation, population development, urban expansion, and the distribution of activity and amenities. Melia et al., (2011) [4] evaluated that promoting public transportation use in

accordance with land - use and transportation planning has been incorporated into policymakers' mitigation measures so as to decrease emissions. Because of intensive industrialisation, the decentralised character of development, and the global population rise, transportation needs are growing steadily. Alternative forms of transportation are widely available today. A report by World Bank [5] highlighted that understanding the elements that affect demand for public transportation and preferred travel mode is essential for developing transportation services that are well - used. According to the United Nations (Department of Economic and Social Affairs, 2011), 22 out of the 38 megacities anticipated to exist in 2025, will be found in the Asia - Pacific area. A report by Ministry of Finance, Government of India [6] Asian cities have been dealing with the phenomenon known as "the paradox of intensification" as a result of this rapid urbanisation and motorization. This paradox states that while increasing urban density may result in a reduction in vehicle miles travelled and encourage the use of public transportation and active modes, it may also worsen environmental conditions due to heavy traffic.

India has traditionally relied significantly on public transportation as its main source of mobility. People still use public transit systems for transportation in practically all Indian cities. Private automobile ownership has increased along with rising purchasing power, nevertheless. Table 1 and Fig.1 shows the sales trends of passenger vehicles and two - wheelers from FY 2016 - 17 to 2021 - 22.

Table 1: Automobile Domestic Sales Trends

Category	2016 - 17	2017 - 18	2018 - 19	2019 - 20	2020 - 21	2021 - 22
Passenger Vehicles	30, 47, 582	32, 88, 581	33, 77, 389	27, 73, 519	27, 11, 457	30, 69, 499
Two Wheelers	1, 75, 89, 738	2, 02, 00, 117	2, 11, 79, 847	1, 74, 16, 432	1, 51, 20, 783	1, 34, 66, 412

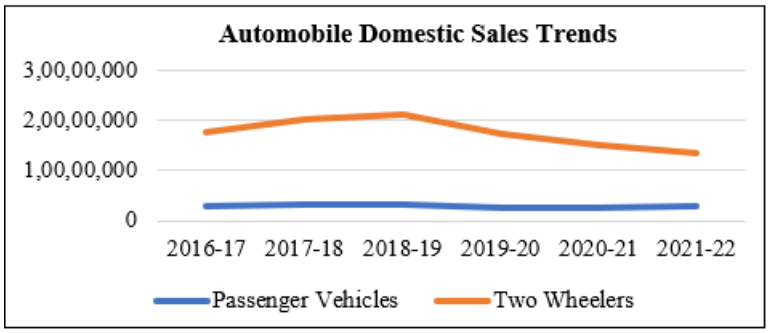

Figure 1: Automobile Domestic Sales Trends (Source: SIAM Report, 2022)

Society of Indian Automobile Manufacturers (SIAM) [7] reported that cities in India are known for their high density, diversified land uses, and quick motorization. In 2021, India's population density was 464 persons per square kilometres, which was three time that of European nations. Public transportation is a necessity for getting to work, school, leisure, and travel, particularly who don't drive, live in low - income households, have impairments, are young, are students, or are elderly and can't drive.

According to the last census, more than one - third of Indians commute to work on foot or by bicycle, and 30% do not need to travel because they reside close to their place of employment. In addition, 18% of people commute by public transportation, with the remaining 16% of workers commute to work on their own time, 13% on two wheels and 3% in cars. Although public transportation's share may appear high, it is actually declining in urban areas. Research by the Centre for Science and Environment (CSE) predicts a drop in the percentage of public transportation from 75.7% in 2000–2001 to 44.7% in 2030–31.

2. Literature Review

A form of transportation known as public transportation involves using a vehicle that does not belong to the passenger. A public transit system includes any vehicle that is openly utilised to transport passengers. In terms of social equality, specific user groups including older people, children, and low - income people should prioritise using public transit more (UITP 2015). Various previous research studies have extensively agreed that there is a solid association between service quality and PT ridership. Zhao et al, (2020) [10] in their study studied that all cities in the world, whether they are developing or emerging, are dealing with rapid suburbanization and population increase. The use of public transportation can help to considerably alleviate problems with public health, the environment, and traffic congestion. Mass transportation involves moving a lot of people to and from predefined locations. Due to financial concerns, buses are among the most significant forms of public transit in developing nations.

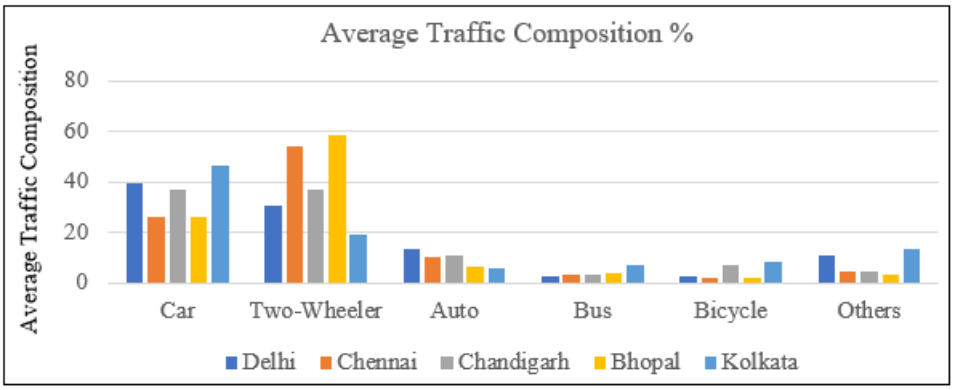

Figure 2: Average Traffic Composition in Selected Cities
(Centre for Science and Environment Report, 2021)

Hay (1986) [11] analysed how commuters' travel patterns are impacted by the cost of public transportation has been done to identify the key problem and encourage more people to use PT. They proposed implementation of a new fee policy to lessen traffic and congestion during peak hours. Maghrour et al., (2017) [12] in order to improve passenger happiness, a novel planning and operational technique called demand - capacity coordination was used to design stops, routes, operating time, trip frequency, and model the seat reservation process. Gaal et al., (2015) [13] emphasised the primary role of PT in decreasing environmental consequences and brought to light the ineffective judgments made by decision - makers as a result of the discrepancy between values and practise. Kwan et al., (2018) [14] examined the significance of the quality of bus service and how it affects passengers' satisfaction. Moving commuters to public transportation is an effective strategy for sustainability. Duleba et al., (2012) [15] emphasised by employing the pairwise comparison method, the major factors for effective public transportation. Van der Wardens et al., (2018) [16] employed a hierarchical information integration approach to assess how much demand there was for the interior of public transportation. Mishra et al., (2019) [17] in a different study gave priority to the characteristics that travellers value when selecting a method of transportation. For urban commuters in Delhi and New York (USA), researchers employ AHP (India). Anand and Bharatraj (2019) [18] used MCDM procedure in order to select the most environmentally friendly method of transportation, in which weather conditions, trip time, comfort, cost, and safety were taken into consideration. The factors with the biggest weights are trip time and expense. Hrelja (2015) [19] in his study evaluated that motivating people to switch from using private vehicles to public transportation could be a clear step forward for urban mobility. However, there are opposing trends, particularly in developing - nation cities where people are using private automobiles due to a poor public transportation system.

The details of service quality attributes are as follows:

1) **Accessibility** – is determined on the basis on how far away a region is from public transportation. Accessibility is a very important factor in determining how well customers feel about public transportation services.
2) **Comfort (Transit Station Comfort) -** Traditional definitions of comfort focus on the level of service offered by a particular modality under various demand conditions. The cleanliness of the transit system, the level of noise, and vibration can all affect how comfortable a ride is.
3) **Frequency and Information provision -** Users of public transportation value a frequent transportation service. One of the most frequently discussed aspects of service quality while assessing the calibre of public transportation is frequency of service.
4) **Reliability** – One of the key characteristics that must be examined from the user's standpoint is reliability. Reliability is a crucial quality characteristic that indicates how well consumers are transported by public transportation to their destinations.
5) **Responsiveness -** Response time is a measure of how well the team responds to consumer requests. Understanding user wants and readiness, willingness, and the rapidity with which service providers respond to customer problems and needs are some examples.
6) **Safety -** The journey to and time spent inside public transit facilities are indicators of how safe the services are. The primary factor in determining the quality of a public transportation service is believed to be travel safety and personal security on board.
7) **Ticketing -** Systems for purchasing tickets or paying for services are significant aspects of service quality that can impact the processing time and ultimately the trip time. Working vending machines and other comparable kiosks are a crucial component in raising user happiness on public transportation.
8) **Travel Cost -** is typically described as the expense of using public transportation. Users contrast an existing tariff with what they feel to be a fair pricing, which is the supposed to be worth of the service in terms of money.
9) **Empathy -** Users' impressions of the service's quality are influenced by the attitudes and behaviours of the staff providing it. It is one of the utmost crucial factors when assessing how satisfied customers are with the rail transit service.
10) **Distance -** Distance refers to the distance travelled in kilometres. When distance is taken into account in this study as one of the factors influencing the mode of transportation chosen, the criteria for choosing between the various means of transport arise into play.

3. Methodology

An approach to decision - making known as "multi - criteria decision making" incorporates different techniques to assist

decision - makers and stakeholders in choosing between two or more criteria. Among decision - making strategies, MCDM is one of the techniques that is most frequently applied. Various studies have used a variety of MCDM techniques to make decisions about public transit networks during the past fifty years. The methodologies have emerged as one of the most popular methods for deciding on transit systems in recent years.

The decision - making challenge of choosing an appropriate transport mode for the can be resolved utilising the AHP approach. The process used to process the literature review also supports this. The AHP method is a methodical strategy that may be used to other decision - making problems as well as choosing the best mode of transportation. People generally struggle when forced to make choices on intricate issues that involve numerous qualitative and quantitative input elements. Making the appropriate decision for these issues is really challenging. The AHP technique facilitates decision - making by assisting individuals in reflecting the pertinent criteria for a particular decision problem.

Table 2: Saaty's importance scale

Definition	Assigned Value
Equally important	1
Weak importance	3
Strong importance	5
Demonstrated importance	7
Absolute importance	9
Intermediate values	2, 4, 6, 8

The 'multiplicative preference relations matrix' has the following 'quadratic shape' if n elements at one level of the hierarchy are compared to elements at the next higher level.

$$\begin{bmatrix} a11 & a12 \cdots & a1n \\ a21 \vdots & a22 \ddots & a2n \vdots \\ an1 & a2n \cdots & ann \end{bmatrix} \quad (1)$$

Each entry of the matrix, a_{ij}, represents the decision - subjective maker's assessment of the relative weight of the two elements, i and j. The transitive rule '$a_{ij}a_{jk} = a_{ik}$' should be applicable for i j, and k in the range of 1 to n if the decision - maker is entirely consistent. Each a_{ij} equals to the assumption of perfect consistency.

$$a_{ij} = w_i/w_j \quad (2)$$

where w_i and w_j are elements i and j's and the component in the higher level, respectively, local weights. The local weights of all the essentials in the current hierarchy level with relation to the element in the upper level are therefore included in the weight vector w = (w1, w2,. . ., wn), which corresponds to the matrix (1).

However, the 'vector w' is unknown, and the issue is that there isn't a single vector that fits all situations because of the decision - well - known maker's inconsistencies or the restrictions given by Saaty's (or any other) scale. One can create a number of metrics and contrast the novel matrix A and related matrix X to assess the effectiveness of the w vector computed using any of the available techniques.

$$\begin{bmatrix} w1/w1 & \cdots & w1/wn \\ \vdots & \ddots & \vdots \\ wn/w1 & \cdots & wn/wn \end{bmatrix} \quad (3)$$

Due to scale defects or the decision - maker's lack of understanding of the choice problem, a large number of hierarchy members may not have an impact on the degree of equivalence amongst 'matrices A and X'. Irregularities of the 'decision - maker' are often interpreted as differences between matching elements in matrices (1) and (3). The Consistency Ratio (CR), which [119] suggested as a gauge of personal inconsistency, is regarded as a component of the typical AHP. The total Euclidean distance, in addition to CR, is frequently employed in research to denote differences between the 'initial judgements a_{ij} from matrix (1) and corresponding ratios w_i/w_j from matrix (3) '. An improvement in overall agreement between computed weights of choice elements and judgements drawn from the decision - maker is correlated with a decreased Euclidean distance.

Sikkim – Introduction: The Indian state of Sikkim is situated in the 'easterly Himalayas' in the north - eastern region of the nation. One of India's tiniest states is this one. Sikkim is bordered to the north and northeast by the Tibetan Autonomous Region of China, to the southeast by Bhutan, to the south by the Indian state of West Bengal, and to the west by Nepal. Sikkim, a long - established independent political entity, was made an Indian protectorate in 1950 and a state in 1975. Despite its tiny size, Sikkim is very important to India politically and strategically for its position along many international borders. It is 2, 740 square miles in size (7, 096 square km). As per 2011 census, Sikkim population was 607, 688.

Transportation System in Sikkim: According to estimates, 50, 000 automobiles were registered in the Sikkim in 2019, which has a population of about 6.6 lakh. One of the most well - known tourist attractions in North East part of India is Sikkim. One may get to Sikkim using almost all of the existing transportation systems. Airways and roads connect Sikkim to the outside world. By train, there are no direct transit options to Sikkim. New Jalpaiguri, 125 km from Gangtok (the capital of Sikkim), is the closest railway station to Sikkim. It has good connections to various towns across the nation, including Delhi and Kolkata.

Table 3: Order of Urbanization

State	Share of Urban population (%)	Rate of Urbanization (%)
Sikkim	25.0	253.4

Table 4: Percentage of Workers in Different Trip Length Categories

State	No travel	Up to 1 km	2 - 5 km	6 - 10 km	11 - 20 km	21 - 30 km	31 - 50 km	> 50 km
Sikkim	39.3	24.9	19.6	9.3	3.1	1.5	1.2	1.2

Table 5: Percentage of Work Trips in Different Travel Mode Categories

State	NMT		Personal		Para - transit	Public Transport		
	Walk	Bicycle	MTW	Car	IPT	Bus	Train	Others
Sikkim	62.4	0.5	1.5	21.1	9.5	3.5	0.4	1.1

Transportation System in Gangtok: The municipal area of Gangtok covers 19.2 square kilometres. Similar to Darjeeling, traffic congestion throughout urgency hours and particularly throughout the tourist spells is one of the issues that plague the hill town. Sikkim's capital, Gangtok, has a population density of in excess of 5, 000 people per square kilometre. Due to its topography, which features steep hills and erratic road alignments that result in limited carriageways, it experiences significant congestion. This reduces the modal share of traditional public transportation to just 2%.

Data Collection: There are various quality of service factors affecting the passenger's satisfaction levels on various bus transportation amenities. A feedback form based on those quality - of - service factors is prepared. These satisfaction levels mainly differ from person to person. So, in this study perceptions of all the bus service users regardless of gender, age group and road transport travel mode has been collected. In this study, data was collected using urban transport users intercept surveys. Survey was conducted at residential and commercial areas in all the major routes of Gangtok city. The survey included personal information such as gender, age and their experience. Questionnaire includes about questions based on various QOS factors. In the survey about 250 urban transport users from the Gangtok city were interviewed and were asked to do pair - wise rating of service quality perception on a scale ranging from 1 to 10.

AHP Methodology: The analytical hierarchy process (AHP) is a key branch of the MCDM method that deals with decision problems in the presence of many choice criteria. In the AHP technique, there are three levels, with goal setting constituting the first level. Level 2 has the criteria or element first, followed at the bottom by the alternative. The objective of this study is to describe and compute the most important public bus transport supply quality in Gangtok. AHP method was implemented based on questionnaire survey where the transit users were the evaluator group. The evaluators used Saaty's judgment scale of relative importance by comparing the criteria that belong to the same branch in AHP method.

Table 6: Random Consistency Index Table

n	1	2	3	4	5	6	7	8	9	10
Random Index	0	0	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49

Table 7: Pair Wise Comparison Matrix

Factors	Accessibility	Comfort	Frequency	Reliability	Responsiveness	Safety	Ticketing	Travel Cost	Empathy	Distance
Accessibility	1	2	1	6	5	2	6	4	5	7
Comfort	0.5	1	1	4	5	3	6	4	5	4
Frequency	1	1	1	7	6	5	8	3	8	9
Reliability	0.167	0.25	0.143	1	1	1	2	3	3	2
Responsiveness	0.2	0.2	0.167	1	1	1	2	3	1	3
Safety	0.5	0.333	0.2	1	1	1	8	8	7	8
Ticketing	0.167	0.167	0.125	0.5	0.5	0.125	1	2	3	3
Travel Cost	0.25	0.25	0.333	0.333	0.333	0.125	0.5	1	2	3
Empathy	0.2	0.2	0.125	0.333	1	0.143	0.333	0.5	1	1
Distance	0.143	0.25	0.111	0.5	0.333	0.125	0.333	0.333	1	1
Sum	4.126	5.65	4.204	21.667	21.167	13.518	34.167	28.833	36	41

Table 8: Normalised Pair Wise Comparison Matrix

Factors	Accessibility	Comfort	Frequency	Reliability	Responsiveness	Safety	Ticketing	Travel Cost	Empathy	Distance	Row Sum	Criteria Weight (Average)
Accessibility	0.24	0.354	0.238	0.277	0.236	0.148	0.176	0.139	0.139	0.171	2.12	0.2119
Comfort	0.12	0.177	0.238	0.185	0.236	0.222	0.176	0.139	0.139	0.098	1.73	0.1730
Frequency	0.24	0.177	0.238	0.323	0.283	0.37	0.234	0.104	0.222	0.22	2.41	0.2414
Reliability	0.04	0.044	0.034	0.046	0.047	0.074	0.059	0.104	0.083	0.049	0.58	0.0581
Responsiveness	0.05	0.035	0.04	0.046	0.047	0.074	0.059	0.104	0.028	0.073	0.55	0.0554
Safety	0.12	0.059	0.048	0.046	0.047	0.074	0.234	0.277	0.194	0.195	1.3	0.1296
Ticketing	0.04	0.029	0.03	0.023	0.024	0.009	0.029	0.069	0.083	0.073	0.41	0.0411
Travel Cost	0.06	0.044	0.079	0.015	0.016	0.009	0.015	0.035	0.056	0.073	0.4	0.0403
Empathy	0.05	0.035	0.03	0.015	0.047	0.011	0.01	0.017	0.028	0.024	0.27	0.0266

Distance	0.03	0.044	0.026	0.023	0.016	0.009	0.01	0.012	0.028	0.024	0.23	0.0227
Sum	1	1	1	1	1	1	1	1	1	1	10	1

Table 9: Consistency

Factors	Accessibility	Comfort	Frequency	Reliability	Responsiveness	Safety	Ticketing	Travel Cost	Empathy	Distance	Weighted Sum Value	Criteria Weights	Ratio (L/M) Lambda
Accessibility	0.212	0.346	0.241	0.348	0.277	0.259	0.246	0.161	0.133	0.159	2.383	0.212	11.246
Comfort	0.106	0.173	0.241	0.232	0.277	0.389	0.246	0.161	0.133	0.091	2.050	0.173	11.852
Frequency	0.212	0.173	0.241	0.406	0.333	0.648	0.329	0.121	0.213	0.204	2.880	0.241	11.932
Reliability	0.035	0.043	0.035	0.058	0.055	0.130	0.082	0.121	0.080	0.045	0.684	0.058	11.786
Responsiveness	0.042	0.035	0.040	0.058	0.055	0.130	0.082	0.121	0.027	0.068	0.658	0.055	11.868
Safety	0.106	0.058	0.048	0.058	0.055	0.130	0.329	0.322	0.186	0.181	1.473	0.130	11.366
Ticketing	0.035	0.029	0.030	0.029	0.028	0.016	0.041	0.081	0.080	0.068	0.437	0.041	10.637
Travel Cost	0.053	0.043	0.080	0.019	0.018	0.016	0.021	0.040	0.053	0.068	0.413	0.040	10.251
Empathy	0.042	0.035	0.030	0.019	0.055	0.019	0.014	0.020	0.027	0.023	0.284	0.027	10.658
Distance	0.030	0.043	0.027	0.029	0.018	0.016	0.014	0.013	0.027	0.023	0.240	0.023	10.597
Sum												Total	112.1922

λ_{max} = 11.219

Consistency Index, CI = (λ_{max} – n) / (n - 1) = (11.219 – 10) /9 = 0.135468

Consistency Ratio, CR = CI/RI = 0.135468/1.49 = 0.090918 (<10%)

4. Discussion and Conclusions

According to theory, management action that affects business performance broadly encompasses and is always associated with decision - making. Many academics regard the AHP decision - making method as an approach that raises the standard of decision - making. We can infer that the AHP is a useful technique for making multi - criteria decisions. In this situation, the AHP appears to be one of the best techniques for resolving challenging business issues. Many various factors are taken into account when making decisions. In competitive markets, they are strategic variables that affect corporate success. The AHP carries out a comparative investigation of the factors influencing decision - making. It selects the most advantageous option this way. The paper has explored the data supporting the advantages of public transportation for commuters that can be gathered utilising an analytical decision - making approach based on the AHP. The practical use of the AHP approach for different fields might operate as a manual or as a good illustration of how it can be used. The phase of the adopted survey does decrease its significance and applicability to the current situation. It is likely that there have been changes in the quality of transport in Gangtok in the past few years, and those changes may affect the study's conclusions. Therefore, it is important to consider the limitations of the study while interpreting its results and applying them to current situations.

References

[1] United Nations. World Urbanization Prospects The 2018 Revision. Available online: https: //population. un. org/wup/ Publications/Files/WUP2018 - Report. pdf (accessed on 1 December 2021).

[2] Louviere JJ, Meyer R, Stetzer F & Beavers LL (1973) Theory, methodology and findings in mode choice behaviour. Working Paper No.11, The Institute of Urban and Regional Research, The University of Iowa, Iowa City.

[3] Litman, T.2013. The New Transportation Planning Paradigm. ITE Journal, 83.

[4] Melia, S., Parkhurst, G. and Barton, H.2011. The paradox of intensification. Transport Policy, 18, 46 - 52.

[5] https: //data. worldbank. org/indicator/EN. POP. DNST?locations=IN. Accessed on 2nd Oct 2022.

[6] Ministry of Finance, Department of Economic Affairs, Economic Division, Monthly Economic Report, July 2019, Government of India, https: //dea. gov. in/sites/default/files/MER_June_201 - 9. pdf, Accessed date: 10 July 2022.

[7] https: //www.siam. in/statistics. aspx?mpgid=8&pgidtrail=14. (Accessed on 3rd Oct 2022)

[8] Urban Transportation Challenges and Way Forward (2019). A Report by INAE Forum on Civil Infrastructure.

[9] Ardila, A., & Menckhoff, G. (2002). Transportation Policies in Bogota, Colombia: Building a Transportation System for the People. Transportation Research Record. https: //doi. org/10.3141/1817 - 16.

[10] Zhao, X., Yan, X., Yu, A., Van Hentenryck, P., 2020. Prediction and Behavioural analysis of travel mode choice: a comparison of machine learning and logit models. Travel Behaviour. Society 20, 22 – 35.

[11] Hay, A. (1986) 'The impact of subsidised low - fare public transport on travel behaviour', Environment and Planning C: Government and Policy. SAGE Publications Sage UK: London, England, 4 (2), pp.233–246.

[12] Maghrour Zefreh, M. et al. (2017) 'Economic investigation of a public transport support policy: A Case Study at Budapest', Promet - Traffic & Transportation. Fakultet prometnih znanosti Sveučilišta u Zagrebu, 29 (1), pp.77–84.

[13] Gaal, G. et al. (2015) 'Analysis of public transport performance in Budapest, Hungary', Periodica Polytechnica Social and Management Sciences, 23 (1), pp.68–72.
[14] Kwan, S. C., Sutan, R. and Hashim, J. H. (2018) 'Trip characteristics as the determinants of intention to shift to rail transport among private motor vehicle users in Kuala Lumpur, Malaysia', Sustainable cities and society. Elsevier, 36, pp.319–326.
[15] Duleba, S., Mishina, T. and Shimazaki, Y. (2012) 'A dynamic analysis on public bus transport's supply quality by using AHP', Transport. Taylor & Francis, 27 (3), pp.268–275.
[16] Van der Waerden, P., Couwenberg, E. and Wets, G. (2018) 'Travelers' preferences regarding the interior of public buses: a hierarchical information integration approach', Public Transport. Springer, 10 (3), pp.529–543.
[17] Mishra, A. R., Singh, R. K. & Motwani, D.2019. Multicriteria assessment of cellular mobile telephone service providers using intuitionistic fuzzy WASPAS method with similarity measures. Granular Computing, 4, 511 - 529.
[18] Anand, M. C. J. & Bharatraj, J.2019. Interval - Valued Neutrosophic Numbers with WASPAS. In: Kahraman, C. & OTAY, İ. (eds.) Fuzzy Multi - criteria Decision - Making Using Neutrosophic Sets. Cham: Springer International Publishing.
[19] Hrelja, R. (2015) 'Integrating transport and land - use planning? How steering cultures in local authorities affect implementation of integrated public transport and land - use planning', Transportation Research Part A: Policy and Practice. Elsevier, 74, pp.1–13.