

Performance Evaluation of RMTS Bus Routes by using Multi Criteria Decision Making Method

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Abstract— Bus routes evaluation is one of the important aspects of transit planning system. It provides valuable information based on which important operating decisions can be taken. The evaluation identifies the operating conditions and existing problems so as to provide an objective basis for requisite decision for regulating routes, such as withdrawing a route, or combining routes or establishing new routes, and improving service and efficiency of routes. One of the important aspects that affect the performance of the bus transportation is the performance of the routes. Hence it is proposed to develop a model to evaluate the performance of routes. The performance of route depends on several criteria. Some of these criteria are quantitative (on time performance, bus stop spacing, fuel consumption, etc.) in nature and some are qualitative (road condition, safety, comfort). So, it is proposed to use a Multi Criteria Decision Making (MCDM) tool to evaluate the routes. The MCDM tool which can deal with both qualitative and quantitative factors is Analytical Hierarchy Process (AHP). In this study 5 RMTS bus routes out of 45 RMTS bus routes have been taken. Considering all mentioned performance indicators, the develops system prioritized all five routes from best to worst.

Key words: Decision Making, Multi Criteria

I. INTRODUCTION

Transport affects the economic and social life of everyone. Public Transportation is the backbone of the development of urban areas. Bus is a very crucial and critical component of the mass transportation system in a country. Buses carry majority of the public transport passengers in Indian cities. An efficient, reliable bus service can be an attractive alternative to those who have access to a car. But, now a days Bus services in particular have deteriorated, and their relative output has been further reduced as passengers have turned to personalized modes and intermediate public transport. Improved public transports services are necessary to ameliorate these problems as bus system plays a major role in all the motorized trips in any city as per the global experience. The public agencies operating public transport systems often fail to restructure service types to meet with the changing demand pattern. As a result public transport becomes financially less viable, speeds reduce, and congestion levels increase and the transportation becomes a source of environmental problem.

II. LITERATURE REVIEW

R.Baskaran K.Krishnaiah“Performance Evaluation of Bus Routes using AHP” In this paper they present the development of bus route evaluation system, for a public bus transportation system in Chennai city of India. Analytic Hierarchy Process (AHP) model is built, which integrates quantitative and qualitative attributes of the routes. To

demonstrate the real world application of this developed system 7 bus routes from Chennai city have been taken for study. The sensitivity analysis is carried out to find the importance of the criteria and sub criteria for the alternatives using Expert Choice 11.5, the performance of route depends on several criteria. Some of these criteria are quantitative in nature and some are qualitative.so, it is proposed to use a Multi Criteria Decision Making (MCDM) tool to evaluate the routes. The MCDM tool which can deal with both qualitative and quantitative factors is Analytical Hierarchy Process (AHP). The model consists of five main criteria and eighteen sub-criteria. It is observed that route 3 has the highest overall priority value of 0.284 and ranked as first. Similarly, all other routes are ranked based on the overall priority. Route 6 has the least rank.

Mayank P. Patel, H.K.Dave, V. R. Gor, V. M. Patel “ Impact of Irregularity and Loss of Punctuality on the Performance of Public Transportation System” In this paper a study is conducted to quantify the causes and influence of such delays and irregularities in the services. Suggestions are made for appropriate improvement in services based on present study. Various performance indicators are defined. All the bus routes which connect Himatnagar city Depot in Sabarkantha district of Gujarat state to important locations like Ahmadabad, Mehsana, Deesa and Modasa is taken as study area. Here study is made to measure irregularity and loss of punctuality on the basis of which performance of depot, route is evaluated. Also causes for irregularity and loss in punctuality are highlighted with suggestions to improve transit system performances.

EshetieBerhan, BirhanuBeshah, Daniel Kitaw“Performance Analysis on Public Bus Transport of the City of Addis Ababa”In this paper tries to assess the existing operational and financial performances of Anbessa City Bus Service Enterprise (ACBSE), which is the sole and government owned transport enterprise. The research used primary data, and secondary data collected from ACBSE for the last nineteen months. The bus routes of ACBSE are both radial and tangential. IN this paper, the performance of ACBSE is evaluated based on two broad performance measurement parameters namely:- operational & financial performances. Primary and secondary data were collected and analyzed for this research. The primary data were collected through interview of officials of ACBSE. Primary data related to bus scheduling, route design and challenges faced in the transportation service. Secondary data related to the no. of passengers, number of buses, revenue generated and different expenses to operate the bus services were also collected. From the findings of the study it can be concluded that both the operational and financial performances of the enterprise, as compared to the standard, are relatively low in most of the performance measuring parameters.

Jiabing Li, Xumei Chen, Xin Li, XiuchengGuo“Evaluation of Public Transportation Operation Based on Data Envelopment Analysis”This paper presented method on evaluating the performance of bus routes within a public transportation system using revised DEA method and sensitivity analysis of indexes. The bus routes 16, 87, 105 in Beijing were chosen as study cases in this paper. The data on each Thursday were collected from March 8, 2012 to March 22, 2012 by GPS and manual counting. In this paper six aspect are included as follow:-safety, speediness, punctuality, comfort, economy and convenience. In this paper four index are selected as follow:-Service reliability, average running speed, average dwell time, passenger load rate. The software MATLAB was used to solve the formulated linear programming problems. It can be observed that the operation for each route/direction in its off-peak period is better than that in its peak period. The case study shows that the method has good applicability, and can be used to improve the operation of public transportation system.

AliSoltani Ebrahim Zargari Marandi; Yousef EsmailiIvaki “Bus route evaluation using a two-stage hybrid model of Fuzzy AHP and TOPSIS”In this study, first six routes among the 71 bus routes of metropolitan Shiraz were chosen. Subsequently, 16 criteria based on the theoretical literature and the data collected in a survey conducted by the Shiraz Public Bus Organization (SPBO) were produced. They considered criteria were Bus route Design , Population density , employment density , Route directness , route overlapping , network connectivity , scheduling criteria , headway evenness , dispatching evenness , duration of standee time , standee vs no standee , non equilibrium factor economic and productivity criteria , kilometer utilization rate , passengers safety and comfort , operational speed . Then by using a two-stage multiple-criteria decision making (MCDM) model containing hierarchical Fuzzy Analytical Hierarchal Process (Fuzzy AHP) and TOPSIS methods the data was analyzed and the existing situation of the selected bus routes was evaluated. This study attempted to evaluate the efficiency of system through investigating different aspects of bus routes. It explains how to create a scientific evaluation framework basing on multi-criteria techniques that incorporates various aspects of the system. It discusses how to rank particular public bus routes in terms of technical, economical and social characteristics. This framework can be developed for evaluating other public and semi-public systems of transportation such as taxis and trains.

III. DATA COLLECTION

For the purpose of this study qualitative and quantitative data collected from bus commuters through Questionary form and select five routes of Rajkot city , Route no. 1:- Trikon baug to Saurashtra university , Route no.8:- Mavdi gam to Greenland chowkdi , Route no.14:- Kotharia to Nava gam , Route no. 18:- Aaji dam to G.I.D.C. gate no.3 , Route no. 28:- Gujarat Housing quarter to jivraj park. Parameter included in survey form.

1	Gender
2	Age group
3	Type of house
4	Number of family members

5	Number of license holder
6	House hold monthly income
7	Own vehicle
8	Purpose of trip
9	Para transit available
10	Origin & destination area
11	Frequency of visiting RMTS
12	Used RMTS monthly pass
13	Waiting time for bus
14	Walking distance of bus
15	When u got seat
16	Theft problem

Table 1:

IV. METHOD USE FOR DATA ANALYSIS

A. Analytic Hierarchy Process (AHP)

- Decompose the decision-making problem into a hierarchy
- Make pair wise comparisons and establish priorities among the elements in the hierarchy.
- Synthesis judgments (to obtain the set of overall or weights for achieving your goal).
- Evaluate and check the consistency of judgments.
- Developing a pair wise comparison matrix for each criterion.
- Normalizing the resulting matrix.
- Averaging the values in each row to get the corresponding rating.
- Calculating and checking the consistency ratio.
- Calculate the weighted average rating for each decision alternative. Choose the one with the highest score.

B. Structure of The Hierarchy

- Decompose the decision-making problem into a hierarchy of criteria and alternatives.
- Level 1 is the goal of the analysis. Level 2 is multi-criteria that consist of several criterions; you can also add several other levels of sub-criteria. The last level is the alternative choices.

V. DATA ANALYSIS

A. Qualitative Analysis for All Routes

Route no.	Safety	Comfort	Road condition
1	Excellent	Excellent	Good
8	Excellent	Very good	Very good
14	Excellent	Very good	Good
28	Excellent	Very good	Fair
18	Excellent	Excellent	Good

Table 2:

B. Calculation of Quantitative Analysis for All Routes

- 1) Bus Stop Spacing = (Total route length in km / no. of bus stop)*1000
- 2) On time performance: $((2*12)+(5*38)+(10*24)+(15*19)+(20*7))/(12+38+24+19+7)$
- 3) Fuel cost:
Idle fuel consumption = 0.86 lit/hr

Assume Fuel efficiency = 5 km/lit
 Now assume fuel cost = 52.83 Rs/lit

- 4) Average travel speed (km/hr) = total travel distance / Avg. travel time
- 5) Average passenger per trip = bus seating capacity + no. of standing passenger count at bus
- 6) Bus hour Utilization = (total travel time * Frequency) / (No. of bus at that route * working hour)

C. Quantitative Analysis for All Routes

Route no./ Criteria	1.	2.	3	4	5	6
1	460	8.79	11.4	16.5	32	0.42
8	471	9.25	11.6	16.2	37	0.29
14	461	8.35	11.4	15.1	43	0.37
28	329	5.71	11.8	17.0	41	0.28
18	517	8.77	11.3	19.8	60	0.40

Table 3:

VI. THE USE OF AHP FOR SELECTING BEST ROUTE

A. Ranking of All Routes

Route name	Priority value	Ranking
University	0.3942	1
Greenland	0.2943	4
Nava gam	0.2724	5
Jivaraj park	0.302	3
Aaji dam	0.3507	2

Table 4:

VII. CONCLUSION

- 1) Socioeconomic analysis of the study shows that more number of passengers is travelling daily for work and education trip as a maximum purpose.
- 2) It also reveal that maximum passengers has their own house and own vehicles. It means that after having their own vehicles still they are preferred to use public transportation.
- 3) So it indicates that there is a huge potential for public transportation.
- 4) As the analysis shows that age of maximum user is between 10 to 30 years and average trip length is between 4 to 6 km which conclude that by introducing special types of buses such that space for standing is more and seating is less should be provide to cater more nos. of users comfortably. Except route no.28 because age of maximum user is more than 51 years.
- 5) As our consistency ratio value came very less it means our judgments is very much nearness to perfection.

REFERENCES

- [1] Jiabin Li, Xumei Chen, Xin Li, XiuchengGuo, "Evaluation of Public Transportation Operation Based on Data Envelopment Analysis", ScienceDirect 13th COTA International Conference of Transportation Professionals (CICTP 2013)
- [2] Gautam Raj Godavarthi; Ravi SekharChalumuri; and SenathipathiVelmurugun, "Measuring the Performance of Bus Rapid-TransitCorridors Based on Volume by Capacity Ratio", 10.1061/(ASCE)TE.1943-5436.0000698. © 2014 American Society of Civil Engineers.
- [3] R.Baskaran,K.Krishnaiah, "Performance Evaluation of Bus Routes using AHP",European Journal of Scientific Research, ISSN 1450-216X Vol.66 No.4 (2011), pp. 631-642
- [4] Laura Eboli, Gabriella Mazzulla, "Performance indicators for an objective measure of public transport service quality", European Transport \ TrasportiEuropei (Year) Issue 51, Paper n° 3, ISSN 1825-3997
- [5] EshetieBerhan, BirhanuBeshah , Daniel Kitaw, "Performance Analysis on Public Bus Transport of theCity of Addis Ababa" , International Journal of Computer Information Systems and Industrial Management Applications.ISSN 2150-7988, Volume 5 (2013) pp. 722-728
- [6] Mayank P. Patel, H.K.Dave, V. R. Gor, V. M. Patel "Impact of Irregularity and Loss of Punctuality on the Performance of Public Transportation System" , International Journal of Engineering Research ISSN:2319-6890)Volume No.3, Issue No.7, PP : 469-471 01 July 2014
- [7] Mahmood Othman Ku Ruhana Ku-Mahamud "Fuzzy Multi Criteria Evaluation for Performance of Bus Companies"Computer and Information Science Vol. 3, No. 2; May 2010
- [8] Ali Sultana Ebrahim Margaric Marandi; Youssef Esmaililvaki"Bus route evaluation using a two-stage hybrid model of Fuzzy AHP and TOPSIS"J. Transp. Lit. vol.7 no.3 Manaus July 2013.