

Assessing Public Transport Service Attributes Using Factor Analysis

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Abstract: The success of any regional development project is determined by several factors. One vital factor is its public transportation system. The main attributes of an effective public transport system are reliability, efficiency, safety, security and comfort. Any public transportation system that does not measure up to these attributes will jeopardise the success of the development project. This article analyses the public bus system in Iskandar Malaysia, a new high profile regional development project in southern Peninsular Malaysia. The survey method pre-tested questionnaires and involved 352 regular users of conventional buses at five bus terminals in Iskandar Malaysia. The data were subjected to descriptive statistical and factor analyses. The results show that based on the 25 service attributes measured, the factor analysis managed to delineate six significantly different dimensions of the bus service characteristics, namely, basic requirement, space, availability, mobility, communication and rest. The average rating for all service attributes was 5.6 out of 10, thus indicating only a 56% satisfactory level. In conclusion, users were yet to be satisfied with the services provided by the conventional bus system in Iskandar Malaysia. It is imperative, therefore, that the authorities take a serious look at the task of improving its the region's public transport services.

Key words: Factor analysis · Public transport · Accessibility · Development corridor

INTRODUCTION

A development corridor requires a set of effective public transport systems as a means of facilitating the mobility of people, goods and services [1-6]. These systems need to be able to provide reliable, comfortable and affordable services so as to harness the opening up of new economic opportunities and catalyse the overall economic growth of the region [7-12]. A well thought public transport system should also be able to respond to the growing challenge of environmental degradation [13] in the course of the region's accelerated development.

The main attributes of an ideal public transport system such as the public bus transport system are reliability, efficiency, safety, security, comfort and hygiene. Any public bus transportation system that does not measure up to these attributes will jeopardise the development agenda of the region it is designed to serve. In developing countries not only does this call for proper planning but that failure to do so will definitely not augur

well for the prospects of directing foreign investment into the region.

One case in point is the Iskandar Malaysia, a current high profile regional development undertaking in a fast developing economy. Given the scale of its operation, it is only crucial and urgent that the public transportation envisaged for the region is equal to the high ambitions of the programme. The objective of this paper is to analyse the public bus transport attributes of Iskandar Malaysia in order to gauge its potential impact on the development agenda of the region.

MATERIALS AND METHODS

The Study Area: Located in South Johor of Peninsular Malaysia, Iskandar Malaysia is set to become a regional development hub, where living, entertainment, environment and business converge within a bustling and vibrant metropolis [14]. It is only six to eight flight hours away from Asia's burgeoning growth centres such as

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Bangalore, Dubai, Hong Kong, Seoul, Shanghai, Taipei and Tokyo enabling it to be reached by some 800 million people. The largest single development project ever to be undertaken in the region, the government allocated some RM6.83 billion (US\$2.27 billion) to turn the vast acreage of mostly virgin forests into a region well-equipped with first class infrastructures to facilitate investments in industrial, biotechnology, education and entertainment sectors. The region is accessible by air from the Senai International Airport, by sea through the nearby Tanjung Pelepas Port or PTP, by rail through a link to the KTM Railway network and by land by means of well-maintained and world class highway network in the Peninsula.

Being the southern gateway to Peninsular Malaysia, its attractiveness to investors is also associated with the fact that it is flanked by three major ports, the Pasir Gudang Port, Port of Tanjung Pelepas and Tanjung Langsat Port. However, apart from basic infrastructures and utilities, Iskandar Malaysia has limited modes of public transport of conventional buses and taxis, while other modes such as rail-based transport and paratransit such as mini buses are an exception.

Data Collection: The study was conducted at five bus terminals in Iskandar Malaysia region, namely, the Larkin, Pasir Gudang, Masai, Gelang Patah and Kulai. A total of 25 attitude statements regarding various aspects of public transport service attributes were presented to regular users of conventional buses in each terminal. For each statement, the public transport passengers were asked to indicate their level of agreement on a 10-point Likert like scale. The questionnaire-based interviews were carried out by trained enumerators with close supervision by the authors. For each terminal, temporary counters attended by the enumerators were set up at strategic sites where passing passengers were requested to fill up the pre-tested questionnaires. At the end of the survey sessions, a total of 352 completed questionnaires were obtained.

Data Analysis: The responses to attitude statements on public bus service attributes were subjected to factor analyses. Factor analysis represents a set of variables (such as the performance of bus service attributes) y_1, y_2, \dots, y_p , as linear combinations of a few random variables f_1, f_2, \dots, f_m , ($m < p$) called factors. The factors are underlying constructs or latent variables that “generate” the y 's.

A factor analysis model expresses each variable as a linear combination of underlying factors, with an

accompanying error term to account for that part of the variable that is unique [15, 16]. Essentially, the loadings indicate the importance of an underlying factor to an indicator and can be used in the interpretation of the factor [17].

An and Noh [18] used factor analysis to establish the quality dimensions of public transport services of prestige and economy class airlines. They found that in the case of the prestige class, there were six service quality factors of importance, namely, alcoholic and non-alcoholic beverage, responsiveness and empathy, reliability, assurance, presentation style of food and food quality; while the economy class showed five important service quality factors namely responsiveness and empathy, food quality, alcoholic beverage, non-alcoholic beverage and reliability. Handy *et al.* [19] used this technique to create indices of factors for using bicycles in the USA. In a study on customer loyalty and the impacts of service quality of five star hotels in Jordan, Ramzi and Mohamed [20] found that dimensions of service quality such as empathy, reliability, responsiveness and tangibility significantly predict customer loyalty and among these the most significant predictor of customer loyalty is tangibility. Hsu and Chiu [11] used factor analysis to examine evaluations of teaching from the standpoints of lecturers and students to reveal perceived differences of teaching performance in a large-scale Taiwan university.

RESULTS AND DISCUSSION

Data analysis revealed that ticketing system, waste disposing facilities, air-conditioning, fares, driver factor and weather protection were the service attributes that obtained the most favourable responses from the respondents with a rating of not less than 6, while facilities for the disabled, behaviour of conductor, smoke from exhaust, road congestion and bus journey timetable received the most unfavourable responses with a rating of less than 5 on the Likert scale (Table 1).

Data analysis also revealed a large number of significant correlations of attitude statements some coefficients of which are presented in Table 2.

Initial multivariate analyses on the 25 statement of service attributes showed that factor analyses techniques had succeeded in constructing up to ten dimensions with the first factor accounting for the highest variance of 31.3% followed by the second at the much reduced 5.845% (Table 3, Figure 1).

Table 1: Attitude statement, mean and standard deviation

Attitude statement	Mean	Standard Deviation
Air-conditioning	6.34	2.885
Availability	5.26	3.020
Beauty	5.66	2.507
Choice	5.78	2.960
Conductor	4.76	2.805
Congestion	4.99	2.467
Disable	4.65	3.064
Driver	6.23	2.795
Exhaust	4.90	2.862
Fare	6.26	2.852
Friends	5.58	2.744
Luggage	5.16	2.664
Music	5.12	2.919
Notice board	5.60	2.985
Reading	5.88	2.705
Safety	5.96	2.435
Seat	5.90	2.667
Sleep	5.49	2.595
Space	5.16	2.801
Speed	5.60	2.519
Ticket	6.58	2.796
Timetable	4.99	2.752
Uniform	5.77	2.973
Waste	6.57	2.702
Weather	6.20	2.806

Table 2: Correlation matrix of selected attitude statements

1.000	0.408	0.356	0.328	0.319	0.319	0.326	0.348	0.300	0.342	0.327
0.408	1.000	0.388	0.349	0.243	0.258	0.315	0.317	0.234	0.233	0.284
0.356	0.388	1.000	0.268	0.253	0.222	0.231	0.241	0.204	0.280	0.299
0.328	0.349	0.268	1.000	0.505	0.308	0.353	0.341	0.413	0.366	0.346
0.319	0.243	0.253	0.505	1.000	0.375	0.332	0.313	0.376	0.333	0.250
0.319	0.258	0.222	0.308	0.375	1.000	0.283	0.256	0.328	0.246	0.283
0.326	0.315	0.231	0.353	0.332	0.283	1.000	0.472	0.294	0.395	0.340
0.348	0.317	0.241	0.341	0.313	0.256	0.472	1.000	0.479	0.344	0.403
0.300	0.234	0.204	0.413	0.376	0.328	0.294	0.479	1.000	0.412	0.399
0.342	0.233	0.280	0.366	0.333	0.246	0.395	0.344	0.412	1.000	0.557
0.327	0.284	0.299	0.346	0.250	0.283	0.340	0.403	0.399	0.557	1.000

Table 3: Initial Eigenvalues

Component	Total	% Variance explained	Cumulative %
1	7.835	31.341	31.341
11	1.461	5.845	37.185
111	1.389	5.558	42.743
1V	1.246	4.986	47.729
V	1.174	4.697	52.425
V1	1.054	4.215	56.641
VII	0.955	3.819	60.460
VIII	0.909	3.638	64.098
IX	0.901	3.605	67.703
X	0.791	3.164	70.867

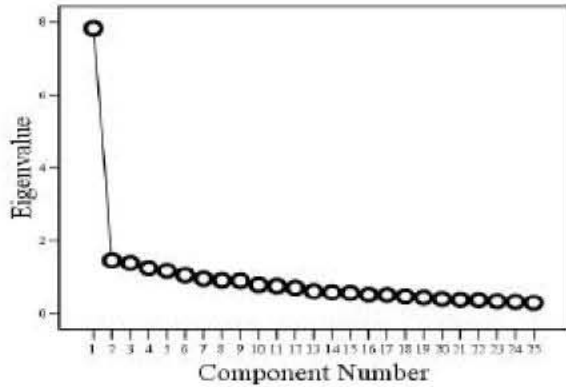


Fig. 1: Scree plot of the eigenvalue

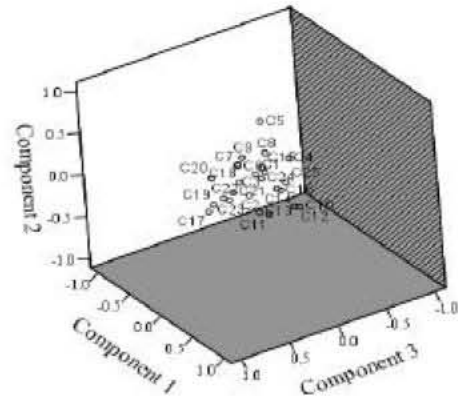


Fig. 2: Component plot in rotated space

Table 4: Rotation Sums of Squared Loadings

Component	Total	% Variance explained	Cumulative %
1	2.901	11.604	11.604
11	2.606	10.424	22.028
111	2.417	9.666	31.694
1V	2.394	9.576	41.270
V	1.983	7.933	49.203
V1	1.859	7.438	56.641

Table 5: Rotated Component Matrix

Service Attributes	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
Beauty	0.665	0.119	0.080	0.235	0.284	0.050
Air-conditioning	0.645	0.116	0.330	0.056	0.239	-0.051
Fare	0.643	0.073	0.008	0.191	0.006	0.231
Weather	0.603	0.349	0.201	0.087	0.039	0.111
Timetable	0.569	0.117	0.374	0.152	0.165	0.138
Luggage	-0.070	0.694	-0.086	0.330	0.141	0.043
Seat	0.382	0.648	0.162	0.006	0.104	0.066
Exhaust	0.216	0.485	0.348	0.071	0.260	0.075
Congestion	0.361	0.477	-0.084	0.300	0.137	0.061
Waste	0.359	0.471	0.189	0.074	-0.096	0.370
Space	0.097	0.470	0.226	0.072	0.259	0.186
Music	0.094	0.404	0.272	-0.006	0.250	-0.063
Availability	0.258	0.157	0.643	0.119	0.147	0.111
Notice-board	0.178	0.415	0.598	0.212	-0.042	0.163
Safety	0.038	-0.070	0.569	0.085	0.270	0.414
Choice	0.276	0.233	0.450	0.440	0.128	-0.075
Speed	0.109	0.036	0.391	0.708	0.148	0.088
Driver	0.115	0.157	0.056	0.636	0.104	0.326
Disable	0.313	0.166	-0.066	0.623	0.082	0.174
Reading	0.148	0.109	0.473	0.617	0.203	-0.062
Ticket	0.149	0.039	0.215	0.032	0.734	0.244
Friend	0.113	0.220	0.018	0.209	0.673	0.014
Conductor	0.163	0.268	0.141	0.175	0.601	-0.015
Uni form	0.017	0.130	0.223	0.113	0.082	0.772
Sleep	0.290	0.077	-0.026	0.178	0.083	0.747

The large number of dimensions obtained but with greatly reduced variance, however, means that this initial analysis was not very efficient. For a more convincing number of dimensions, the data was subject to a varimax rotation for easy interpretation. The result was a more balanced distribution of variance among dimensions with the first factor accounting for about 12% of the total variance, the second 10% and the last 7%. The rotated loadings succeeded in establishing six factors with a clearer cut variance among factors, indicating a more efficient representation of the service dimensions (Table 4).

The scree plot depicting the relationship between the eigenvalue and the number of component established in this study shows the prominent role of the first component which contributed 7.835 of total eigenvalues and explained 31.34% of total variance (Figure 2).

The rotated component matrix exhibits all the six factors established in this study with the number items highly loaded to each factor (Table 5).

The first factor, constructed with an eigenvalue of 2.9, explains 11.6% of the total variance and five attributes load highly to this factor. This factor forms the basic requirement of a public transport service with the attributes of beauty, air-conditioning, fare, weather and timetable grouped under this dimension. Fare is a very important item in this component because most passengers came from the low socio-economic strata of the community with an income of RM1, 500 (US\$500) or less. Air-conditioning was also important in this dimension because the passengers were travelling in a hot tropical climate, while timetable was equally vital for without it passengers' work schedule will be disrupted. It is rather interesting that the beauty and appearance of the rolling bus was considered important by passengers.

The second dimension reflects the need for space when public transports such as buses are used. Passengers need space to accommodate their luggage, to sit comfortably especially when in a long journey, to dispose waste from left-over food and to avoid overloading while on board. It is also interesting to note that the item 'music' was highly loaded on this factor which means that space and entertainment are two inseparable things that passengers expect when on board of a public transport vehicle.

Availability is the third factor and this is closely associated with information about the service itself as well as safety of passengers and space all of which are loaded highly to this factor. For the fourth factor, speed of the vehicle, the behaviour of the driver and the infrastructure to facilitate mobility among passengers who are disabled

show high loadings to this factor implying the importance of minimising times and hassles when patronising a public transport mode. The fifth factor which was established based on eigenvalue of 1.9 and accounts for approximately eight percent of the total variance, is strongly associated with the possibility of meeting friends on board, with the ease of getting a ticket and the behaviour of the conductor. Lastly, the sixth factor was to be constructed based on workers' uniforms and opportunities for the passengers to take a rest on board.

The wide range of the ratings of between 4.65 and 6.58 obtained from service quality surveys indicates that regular bus users in the study area did not agree unanimously to all of the 25 aspects of bus service quality presented to them. In general, with the highest rating of 6.85 out of the possible 10, it may be concluded that users were yet to be fully satisfied with the services provided by the conventional bus system in Iskandar Malaysia. The average rating for all service attributes was 5.6 out of 10, indicating only a 56% satisfaction level. Nevertheless, none of the service attribute statements received extremely low ratings as the lowest obtained was 4.56, which was approximately half of the possible maximum. The factor analyses techniques managed to delineate six significantly different dimensions of the bus service characteristics, namely, basic requirement, space, availability, mobility, communication and rest. Based on the result of the factor analyses used in this study, it should now be easier for the local public transport planners to focus on each dimension of the public bus services for further improvement.

CONCLUSION

The study indicates that the public did enjoy a certain level of satisfaction with the transport services provided in Iskandar Malaysia but which was not high enough as to warrant the conclusion that the service was good. The general state of the region's public bus services is relatively inferior in relation to the proliferation of activities and influx of people into it. It is therefore imperative that the authorities in Iskandar Malaysia take a very serious look at the task of improving the existing state of public bus services.

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