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Analysis of Factors Affecting Customer Satisfaction with Rail Transits and Intermodal Connectivity in Sri Lanka

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1. Introduction

Railways play a major role in the Sri Lankan transport system by connecting different provinces rapidly and is a potential solution to the extreme congestion problem. Sri Lanka loses millions of rupees annually in lost labour hours and energy due to traffic congestion. A successful or sustainable city would be one with a large number of people and less vehicles (Kumarage, 2004) [1]. The railway system in Sri Lanka is a natural monopoly. The problems in the railway sector range from lack of passenger comfort/convenience, employee rights and disruptive trade union behaviour to continued loss making. The main cities in Sri Lanka such as Colombo, Kandy, Kurunegala, Galle, Matara *et cetera* act as hubs for rail and bus. With no proper intermodal connectivity to these terminals, city congestion increases as do passenger travel length, time and discomfort/inconvenience. A proper rail system has great potential to reduce traffic congestion significantly. However, in Sri Lanka not enough facilities have been provided to improve intermodal connectivity, thus people have to travel long distances to transfer from rail to bus, use different types of tickets and have less proper information; thus, people are discouraged from using rail. To develop railways customer satisfaction should be increased to attract more passengers. Therefore, the objective of this research was to identify factors affecting customer satisfaction with railway transits and intermodal connectivity.

2. Literature Review

A study on developing and evaluating criteria for transit stations with regard to intermodal connectivity discusses the challenges faced by passengers from arrival to transit and to occupying a seat in transit vehicles. The study establishes minimum design criteria which focus on intermodal connectivity of stations (Mbatta, 2008) [2]. Factors included in the evaluation of the proposed design are comfort, safety, pedestrian access, automobile access, cycle access and connectivity. However, this study lacks new technology to improve passenger convenience and transit facilities (Mbatta, 2008). Additionally, Hualiang (2014), discusses the number of arrival and departure facilities for each mode, transfer time and arrival time intervals [3]. Loukaitou-Sideris et.al.

(2015), have analysed spatial connectivity, operational connectivity, information provision, ticketing, passenger perceptions and integrated transit systems and recommended that operational and spatial connectivity are improved [4]. Operational connectivity includes integration of ticketing, luggage transfer between modes, clear signs/signals and increase of advance information systems. Under spatial connectivity this study has identified that station layout should include short walking distances for passengers and visual connectivity between platforms. A study which has focused on evaluating transit stations from the perspective of transit users has found out that frequent, reliable services and safety/security directly influence passenger satisfaction of transit use. Five passenger perception evaluation criteria that were used in a previous study are access, connection and reliability, information, amenities, security and safety (Iseki et al., 2007) [5].

3. Methodology

A sample size of 400 passengers who transit/transfer through the Fort railway station were selected. A questionnaire developed on the basis of factors identified in the literature review was administered to the 400 passengers selected, through both online surveys and on site distribution and consisted of 23 factors. The Fort station was selected as it is the hub and main transit station of the rail system. 298 valid responses were obtained (75% response rate). The exploratory factor analysis method was used to analyse the data gathered through primary data collection.

4. Results

Cronbach's Alpha was 0.938: therefore, the internal consistency (reliability) of the data set is confirmed. The KMO test statistic for sample adequacy is 0.880 (greater than 0.6); assuring adequacy. The number of factors in Table 1 is similar to the number of variables used which is 23. As in Table 1, five components (whose eigenvalue is greater than '1') were obtained, and the total variance explained by those 5 components were computed as being 70%. The first factor explained 42.958% of variance, the second, third, fourth and fifth, 10.321%, 6.435%, 5.869% and 4.535% of variance respectively. Components were defined in the next stage, using Table 2. Rotation Sums of Squared Loadings represent the distribution of the variance after the varimax rotation. Varimax rotation tries to maximise the variance of each of the factors extracted, so the total amount of variance accounted for is redistributed over the five extracted factors. Table 2 shows the variables which come under each component and the rotated factor loadings, which represent both how the variables are weighted for each factor and the correlation between the variables and the factor. Each variable of the study is assigned to the component with which it has the highest correlation as emboldened in Table 2. Table 3 interprets the factors which were obtained through the analysis by taking into consideration the variables assigned to each factor.

Table 1: Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	9.880	42.958	42.958	9.880	42.958	42.958	4.631	20.134	20.134
2	2.374	10.321	53.280	2.374	10.321	53.280	3.554	15.451	35.585
3	1.480	6.435	59.715	1.480	6.435	59.715	2.871	12.481	48.067
4	1.350	5.869	65.584	1.350	5.869	65.584	2.589	11.257	59.324
5	1.043	4.535	70.119	1.043	4.535	70.119	2.483	10.796	70.119
6	.947	4.116	74.235						
7	.741	3.222	77.457						
8	.728	3.165	80.622						
9	.627	2.728	83.350						
10	.501	2.177	85.527						
11	.457	1.986	87.513						
12	.436	1.898	89.411						
13	.373	1.623	91.034						
14	.351	1.526	92.561						
15	.331	1.440	94.001						
16	.284	1.233	95.234						
17	.257	1.120	96.353						
18	.218	.946	97.299						
19	.176	.767	98.066						
20	.167	.726	98.792						
21	.124	.540	99.332						
22	.108	.472	99.803						
23	.045	.197	100.000						

Extraction Method: Principal component Analysis.

Table 2: Rotated Component Matrix

	Component				
	1	2	3	4	5
Banking/ATM service	.310	.076	**.690**	.171	.166
Food/restaurants	.324	.214	**.803**	.089	.056
Restroom facilities	.147	.177	**.806**	.188	.097
Safety security at station	.188	.429	**.431**	.194	.271
Seating capacity/comfortable	.297	.249	**.396**	.348	.321
Online ticketing /mobile ticketing	**.748**	.058	.242	.356	.052
Online train schedule	**.796**	.152	.322	.213	.067
Information technology usage railway services	**.868**	.165	.262	.046	.116
Information system usage railway services	**.875**	.179	.260	.021	.134
Ease of getting information	**.799**	.277	.197	.169	.042
Train schedule compatibility with bus schedule	.195	**.747**	.184	.176	.179
Combine ticket with bus and train	.123	**.743**	.004	.239	.090
Ease of Access to train from bus	.063	**.641**	.165	.189	.447
Ease of Access to train from private vehicles	.122	.228	.018	**.500**	.437
Ease of Access to train from cycle	.221	.050	.198	.005	**.822**
Distance to travel from bus station	-.004	.509	.211	.202	**.654**
Distance to travel from Parking lot	.041	.181	.120	.571	**.634**
Infrastructure available for railway transit	.295	.181	.224	**.799**	.101
Superstructure available for railway transit	.208	.220	.308	**.758**	.072
Price of Train ticket	.194	**.659**	.278	-.083	.033
Cost of travel to/from train from/to other modes	.298	**.639**	.123	.194	.066
Time taken to transfer from rail to other mode	**.501**	.434	-.033	.367	.275
Time taken to transfer from train to train	**.552**	.290	-.151	.147	.439

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

Table 3: Interpretation of factors

	Variables	**Interpretation**
1	Online/mobile ticketing, Online train schedule, IT usage, Information systems in railway, Easy of getting information, Time to transfer from rail to other mode, Time to transfer from train to train	Technology and transfer time
2	Compatibility of train schedule & bus schedule, Combine ticket for bus & train, Ease of access to train from bus, Price of Train ticket, Cost of travel between train & other modes	Affordability and connectivity
3	Banking/ATM service, Restaurants/food, Restroom facilities, Safety/security at rail station, Seating capacity/comfort	Convenience
4	Ease of Access to train from private vehicles, Infrastructure available for railway transit, Superstructure available for railway transit	Accessibility
5	Ease of access from cycle, Distance from bus station, Distance from parking lot	Walking distance

5. Conclusion/Recommendation

In order to identify the determinants of customer satisfaction with rail transit and intermodal connectivity, the structured questionnaire with 23 variables was administered to a sample of 400 passengers using the Fort railway station. A response rate of 75% was achieved. Exploratory factor analysis was conducted, and five factors were extracted. The five factors account for 70% of total variance. The factors are ‘technology and transfer time’, ‘affordability and connectivity’, ‘convenience’, ‘accessibility’ and ‘walking distance’. Therefore, more online ticketing facilities, accurate information displays, combination of bus and train schedules as suitable, shortening the access distance and providing access pathways which are safe are some recommendations which will improve the customer satisfaction and help to attract more passengers to railways.

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