Identifying and Prioritizing Ergonomic Needs of Staff Transportation Buses

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Abstract: Travel for work by employees through buses is common in large industries. A survey was conducted to identify the problems associated with such commuters. Seventy five users participated in the survey with age group ranging from 20 years to 60 years with wide range of travelling distances from 4 kms to 44 kms. Their problems and requirements were then prioritized to determine the sequence in which each problem is to be dealt with. The results showed that, while some problems were associated with a specific category of respondents, the remaining were universal pain points. Further, some modifications were suggested to solve the current problems and to enhance comfort and safety of the buses.

1 Introduction

Bus is the most popular mode of road transport among company employee. The interactions between a person and a bus start from identification of the bus, entry into the bus, movement within the bus, the journey and finally end with exit from the bus. All these interactions must take place comfortably and safely for high satisfaction of the user.
Satisfaction measures related to each of these interactions were identified. They are as follows:

1. External Looks/Condition of bus
2. Sitting Comfort and personal Space
3. Cleanliness
4. Safety
5. Ease of Entry/Exit
6. Internal ambiance
7. Cost of Commuting

1.1 Background

Approximately 50% of the employees working in companies commute to work and back home by the staff transportation buses. For most of these people, the commuting time is an important personal time during the day as they are tied up with responsibilities at work and at home. Thus, the bus journey should be very comfortable and safe.

1.2 Objectives

The objectives of this study are:
1. Identify the pain and delight points related to each of the above interactions.
2. Find the probable reasons for the positive or negative responses to the survey questions.
3. Prioritize the pain points on the basis of the importance rankings given to each of the satisfaction measures.

4. Determine the additional features required by the commuters to make the most of their daily journey.

2 Literature Review

Staff Transportation Buses are intra-city buses used for movement of working population from home to work and back. Miguel A. Márquez et. al.[3] analyzed the urban public transport buses in San Cristóbal city from the ergonomic point of view. The analysis is for all age groups including children, senior citizens and physically disabled people. Ben Barkow [1] studied the requirements of the Canadian population regarding the interior features of the transit buses. K. Munshi [2] described the ideal features of a good seat. Sriram Srinivasan et. al. [5] suggested use of spring box to dampen the vibrations and improve seat comfort. R. Ramani et. al.[4] developed a system to track and lock vehicles in case of theft. The needs of the employees identified in the present work differ from those identified in the previous study as the staff transportation buses ply on the same route and carry same passengers every day. Also, this study does not include children, senior citizens and physically disabled people. The characteristics of ergonomically designed chairs are applied to bus seats. The system used to control vehicle theft can be coupled with a security buzzer for the safety of employees working in night shifts.

3 Methodology

The study comprises of qualitative and quantitative surveys. The data collected from the survey was further processed and analysed to determine the problems and suggest suitable solutions.

3.1 Survey Methodology

The qualitative survey was conducted using interview techniques while the quantitative survey was conducted online using a website named Qualtrics. The questionnaire included questions related to personal details, ranking of satisfaction measures in order of importance, current delight and pain points and additional features requirements.

3.2 Data Processing

Weightages were assigned to the satisfaction measures. The most important measure had the least weightage. Weighted averages were calculated for each of these measures and arranged in ascending order to determine the overall ranks of the satisfaction measures. Each question was further analysed, taking into account the relevant parameters, to find the reasons for negative responses. These parameters are of three type viz. respondent demographics (height, weight, age, gender, type of service, type of industry) bus details (type of bus) and journey details (duration of travel, activity during travel). Table 1 and Table 2 shows the division of these parameters into classes and the percentage of respondents in each class. According to the attained unanimity on the points of issue and the ranks of the satisfaction measures, the pain points were prioritized to determine the order in which each of them has to be addressed. Solutions were then suggested for the pain points with highest priority.

Table 1 Respondent Details

Parameter	Classes			
Height (cm)	<162.56	162.56-172.72	172.72-182.88	>182.88
% respondents	27	45	11	18
Weight (kg)	<55	55-65	65-75	75-85
>85				
% respondents	13	27	23	27
10				
Age	20-30	30-40	40-50	50-60
% respondents	63	14	11	12
Gender	Male	Female		
% respondents	68	32		
Type of Industry	IT	Manufacturing		
% respondents	29	71		

Table 2 Bus and Journey Details

Parameter	Classes			
Type of Service	Free	Paid	Subsidized	
% respondents	29	30	41	
Type of Bus	Big-Bus	Mini-Bus	Tempo-Traveller	
% respondents	43	39	18	
Duration (minutes)	<90	90-120	120-150	>150
% respondents	32	23	18	27
Activity	Read	Sleep	Chat	Listen to music
% respondents	25	61	34	63

Note: The total of percentage is more than 100% as the respondents were allowed to choose more than one option.

4 Results

Based on the data collected through survey, detailed study of respondents' demographics, bus and journey details. Based on importance ratings given by respondents for identified satisfaction measures, weightages were calculated. Depending on negative responses for given interaction, universal pain points were identified.

4.1 Satisfaction Measures Rating

In the Survey respondents were asked to rate the satisfaction measures related to each of the human-bus interactions on the scale of 1-7. Based on the ratings received, weightages for each of these satisfaction measures were calculated. Table 3 shows the satisfaction measures in order of their importance.

Table 3 Weightages for Satisfaction Measures

Weightage / Parameters	1	2	3	4	5	6	7	Weighted Average
• Safety	31	7	5	4	2	3	3	2.26
• Seating Comfort and personal space	26	9	6	4	4	3	3	2.46
• Cleanliness	12	9	12	12	6	1	3	3.16
• Internal ambiance	14	3	12	12	9	5	0	3.26
• Ease of entry/exit	7	8	9	2	17	8	4	3.96
• Cost of commuting	6	9	5	4	9	7	15	4.53
• External looks of bus/ condition of bus	4	3	4	9	5	15	15	5.05

4.2 Inferences

Table 4 shows the inferences that can be drawn from the data analysis. The order of importance of the satisfaction measures is maintained.

Table 4 Inferences

Satisfaction measures	Responses				
Safety features	Adequate	Inadequate			
% respondents	43	57			
Overall sitting comfort	Poor	Fair	Good	Very Good	Excellent
% respondents	21	48	29	2	0
Cleanliness	Very Clean	Moderately Clean		Dirty	
% respondents	52	41		7	
Internal Ambiance	Roomy	Moderately Roomy		Cramped	
% respondents	16	52		32	
Ease of Entry/Exit	Difficult	Neutral	Easy		
% respondents	27	12	57		
Cost of commuting	Very High	Comparable			
% respondents	16	48			
External Looks of bus	Modern	Traditional			
% respondents	32	68			

A detail study of responses for each of the survey questions led to identification of universal pain and delight points. While safety and sitting comfort were most important to the passengers, these were the major pain points. The people were satisfied with rest of the satisfaction measures.

5 Recommendations

Since safety and sitting comfort were most important to the respondents, modifications were suggested to improve the above two satisfaction measures in Table 5.

Table 5 Recommendations

Satisfaction Measures	User's Recommendations	Our Recommendations
Safety	Armrests on passage side	Seatbelts for every seat
	Supports along roof of bus	Security Buzzer with GPS
	Adequate handholds	Speed limiter
Sitting Comfort and Personal space	Provision for luggage storage	Adjustable Backrest
	Increased leg space	Footrests and armrests
	Wider Seats	Spring-Box
	Increased Seat spacing	Lumbar support

The above recommendations will increase the satisfaction of the users of staff transportation buses. The above study can be used by bus manufacturers to improve their product features.

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Appendix

List of tables

References

1. Ben Barkow.1991. "Customer Perspectives on the Interior Design of Urban Buses"
2. K.Munshi. "Chairs the human factor"
3. Miguel A. Márquez Jesús M. Garcia. 2004. "Ergonomics of Urban Public Passengers Transport".
4. R.Ramani, S. Valarmathy, Dr. N. SuthanthiraVanitha, S.Selvaraju, M.Thiruppathi, R. Thangam. 2013. "Vehicle Tracking and Locking System Based on GSM and GPS". I.J. Intelligent Systems and Applications, 2013, 09, 86-93, DOI: 10.5815/ijisa.2013.09.10
5. Sriram Srinivasan, Prasanna S, Sambasivam S M. 2014. "Passenger Bus - Seat modification to avoid accident damages and for comfort level", International Journal of Scientific & Engineering Research, Volume 5, Issue 1, January-2014, 1518, ISSN 2229-5518.