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Risk in Maintenance and Fuel Economy of Buses

[1]R.Shanthi, *[2]K.Senthil Kumar

[1]Research Scholar, [2]Assistant Professor,
Department of Business Administration, Government Arts College, Paramakudi, Tamil Nadu, India

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Abstract:
Maintenance of buses and fuel economy are inter-related. By identifying the specific elements of maintenance, there is a need to identify areas that need improvement and allocate resources. Since fuel makes up a relatively large fraction of total bus operating costs, fuel economy means a lot. The procedures to improve fuel economy are not achieved 100% through any simple technique. It is possible with the contributions of all the employees, like drivers, conductors, managers and technicians. Participation of all the employees in a balanced way leads to achieve the goal of maximum fuel efficiency. About 552 employees from Government and private sectors of Transport Industry have been chosen from Ramnad and Sivagangai Districts of Tamil Nadu for the study. Primary data has been collected by the focus on maintenance and fuel economy. The impact of age, experience and training on fuel economy was analysed in the study. The effect of various risk factors like maintenance, operational and technical on fuel economy has also been studied.

Keywords*: Fuel, economy, maintenance, risk, etc.*

I. INTRODUCTION

The transport industry plays a significant role in world energy consumption. In India many cities are flushed with old and fuel-consuming buses with very high operating costs. At the same time, no proper bus management systems are available that led to the problem of inefficiency of buses. The road condition also plays a vital role on fuel efficiency of buses. In many Indian cities, the operating cost of a bus per kilometer exceeds the income generated. The bus fares are often low irrespective of the cost of the service provided [1]. If the buses are not maintained properly then the emissions due to diesel exhaust causes environmental damage due to incomplete combustion of fuel [2,3]. In order to reduce the environmental damage, CNG has been implemented in buses in other Indian cities [4]. There are lot of public transport crisis in India, with a tremendous increase in the number of private vehicles. Many of the public bus corporations are operating with financial losses and completely rely on government subsidies to keep smooth operations and investment in new buses and technology upgrades is rare [5]. With the available buses, directing the attention towards monitoring of maintenance activities of vehicles fleet, can achieve desired results [6]. This study focus on the co-relation between maintenance and fuel economy.

II. METHODOLOGY

The size of the sample is an important aspect to be decided in case of sampling. All different categories of the 552 employees were selected for this study to give a fair representation on the sample. The researcher has used a selection process that is subjective which is the stratified sampling and probability sampling. Totally 600 numbers of self-administered questionnaire were distributed among the employees in three different cadres. A structured questionnaire has been prepared to study the opinion of the employees in different designations mainly Drivers, Technicians and Conductors of TNSTC, Omini Buses and Mini buses in Ramnad and

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Sivagangai District. The details of attended questionnaire by the employees at each cadre are given in Table-1.

Table 1: Details of Respondents

S.No	Respondents (Designation Wise)	Sampling Frame	No. of respondents approached	No. of respondents participated	No. of valid questionnaires taken for the study
1	Drivers	200	200	190	186
2	Conductors	200	200	180	172
3	Technicians	200	200	200	194
Total		**600**	**600**	**570**	**552**

III. RESULTS AND DISCUSSION

The study revealed that 34 % (190) of the respondents are in the age group of 40 – 50 Years, 26 % (146) are 30 – 40 Years, 25 % (138) are below 30 years and 14 % (78) respondents are in the age group of above 50 years. It is inferred that respondents with 40-50 Years age group of respondents have thorough knowledge regarding handling the bus and save the fuel. 34% (190) are Degree holders, followed by 26% (145) are Diploma holders 23% (128) are ITI holders and the remaining 16 % (89) are in other qualification. It is inferred that the majority of the respondents have technical knowledge. A considerable portion of respondents , 32 % (178) of them have 5 -10 years of experience, 30 % (167) have below 5 years of experience,27 % (149)have 15- 20 years of experience and the remaining 11% (58) have above 20 years of experience. It is inferred that the majority of the respondents have effective skills. The study revealed that the reason for reducing the strength of buses is the continuous running of buses, poor maintenance and overload. Normally the types of maintenances following in buses are break down maintenance, periodic maintenance, preventive maintenance and operational maintenance. The schedule of maintenance is weekly maintenance, monthly maintenance , daily and tri-monthly maintenance. The study showed that 56% of the employees are not maintaining the 6 KMPL and 44 % are maintaining 6KMPL fuel consumption. The respondent's opinion about the level of speed to maintain fuel efficiency is 80 km/h (66%). The main factor which affect fuel economy of buses are technical risk , operations risk and management risk.

From the Figure-1, it is clear that the maximum 63% of the employees agreed that their performance has improved after the training.

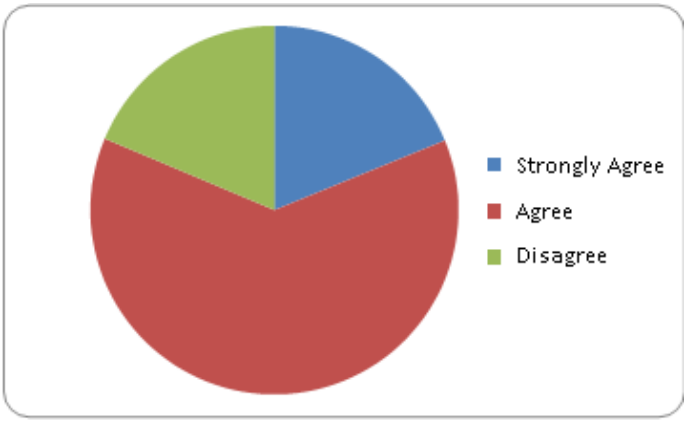

Figure-1 Performance after training

3.1 Analysis of reason for fuel efficiency

The following hypothesis is framed to theoretically analyse the reason for fuel efficiency.

Null Hypothesis (H_o) : There is no significant difference observed of the impact of experience and components of maintaining risk in fuel economy.

Alternative Hypothesis (H_a): There is no significant difference observed of the impact of

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experience and components of maintaining risk in fuel economy

Table:2 ANOVA for the impact of components of maintaining risk in fuel economy and experience

Components of maintaining risk in fuel economy		Experience in years				F Value	P Value
		Below 5 years	5-10 years	15-20 years	Above20 years		
Management risk	Mean	25.38 [b]	23.13 [b]	23.48 [a]	23.26 [a]	6.494	0.000**
	SD	(4.02)	(4.01)	(3.76)	(4.04)		
Operational risk	Mean	25.87 [b]	24.11 [b]	22.63[a]	22.96 [b]	10.986	0.000**
	SD	(4.29)	(4.38)	(4.67)	(3.07)		
Technical risk	Mean	45.68[c]	43.81 [b]	40.18 [a]	41.09 [a]	8.530	0.000**
	SD	(7.07)	(7.25)	(8.50)	(6.40)		

(**) denotes 1 per cent level of significance

Since, the p value is less than 0.01, the null hypothesis is rejected at1 per cent level of significance. There is significant difference in the impact of experience and all the components of maintaining risk in fuel economy.

Based on **Duncan's Multiple Range Test** (Pairwise Tests), the following results are arrived.

The impact of experience on the components of maintaining risk in fuel economy of management risk at 5 per cent level was studied. The significant difference is nil between below 5 years and 5-10 years of experience. But there is significant difference between the respondents who are having above 20 years of experience and those who are having below 5 years and 5-10 years of experience.

The impact of experience on the components of operational risk in fuel economy at 5 per cent level was observed. The significant difference is nil between below 15 -20 years of experience and above 20 years of experience. But there is significant difference between the respondents who are having 15-20 years of experience, above 20 years of experience and those who are below 5 years of experience.

The impact of experience on the components of technical risk in fuel economy at 5 per cent level was observed. The significant difference is nil between below 5 years of experience and 5-10 years of experience. But there is significant difference between the respondents who are having above 20 years of experience and those who are having below 5 years, 5-10 years and 15-20 years of experience.

Multiple regression analysis

Regression is the determination of statistical relationship between two or more variables. In simple regression, two variables are used. One variable (independent) is the cause of the behaviour of another one (dependent). When there are more than two independent variables, the analysis concerning relationship is known as multiple correlations and the equation describing such relationship is called as the multiple regression equation.

Regression analysis is concerned with the derivation of an appropriate mathematical expression derived for finding values of a dependent variable on the basis of independent variables. It is thus designed to examine the relationship of a variable Y to a set of other variables $X_1, X_2, X_3 \ldots\ldots X_n$ the most commonly used linear equation in $Y=b_1X_1+b_2X_2+\ldots\ldots b_nX_n+b_o$, Y is the dependent

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variable, which is to be found, and X_1, X_2, X3,.are the known variables.

In the present study, multiple regression analysis was performed to determine the extent of relationship between one dependent variable is fuel economy of buses and 3 independent variables of risk in fuel economy are management risk, operation risk, and technical risk and the dependent variable is fuel economy of buses and the independent variables (3 in number). Here multiple regression analysis was performed whether a relationship exists between Y and $X_1$to X_3, as well as to determine the strength of the relationship between Y and X1 to X3. The analysis result is presented as follows:

Dependent variable (Y)

Y = Fuel economy of buses

Independent Variables (X_1 X_6)

X_1= Technical risk,

X_2= Operation risk,

X_3= Management risk

MultipleRvalue :0.814

RSquarevalue :0.765

Fvalue :112.979

Pvalue :0.000**

Multiple correlation co- efficient (R) is 0.814, and measures the degree of relationship between the actual values and the predicted values of the adjustment. Because the predicted values are obtained as a linear combination of independent variables, the coefficient value of 0.814 indicates that the relationship between dependent variable and the 3 independent variables is quite strong.

The coefficient of determination R - square measures the goodness of fit of the estimate sample regression plane (SRP) in terms of the proportion of the variation in the dependent variable explained by the fitted sample regression equation. Thus, the value of R is 0.765 simply means that about 76 per cent of the variation in adjustment is explained by the estimate SRP that uses of 3 variables as the independent variables and R square value is significant at 1 per cent level.

The multiple regression equation is

$$Y = -22.914 + 0.858X_1 + 0.0538X_2 + 0.552X_3$$

Table:3 Multiple regression analysis for risk in Fuel economy of buses

Risk	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	-22.914	2.355		-9.731	0.000**
Technical risk	0.858	0.138	0.132	4.180	0.000**
Operation risk	0.538	0.171	0.152	4.591	0.000**
Management risk	0.352	0.119	0.085	2.549	0.011*

** Significant level at 0.01 levels

* Significant level at 0.05 levels

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Dependent Variable: Fuel economy of buses.

The co-efficient of X_1 is 0.858 and it represents the partial effect of the technical risk on the fuel economy of buses. The positive estimate implies that the value of Y would increase 0.858 for every unit increase of X_1 and is significant at 1 per cent level. Similarly, The co- efficient of X_2 is 0.538 and it represents the partial effect of the operation risk on the fuel economy of buses. The positive estimate implies that the value of Y would increase 0.538 for every unit increase of X_1 and is significant at 1 per cent level. The co-efficient of X_3 is 0.352 and it represents the partial effect of the management risk on the fuel economy of buses. The positive estimate implies that the value of Y would increase 0.352 for every unit increase of X_3 and is significant at 5 per cent level. To decide which independent variables in the model are good explanatory variables of the dependent, the individual t-test for each variable needs to be looked (Table:3). If the value is significant (less than .01), it indicates that the concerned variable is significant in the model.

IV. CONCLUSION

There are three risk factors that decide the fuel efficiency of buses. Majority of the respondents are aware of fuel efficiency and fuel economy. There is a close correlation between experience and fuel economy of buses. All the three risk factors, management risk, operational risk and technical risk are closely co-related with fuel economy in buses. The cost of fuel can be reduced by improving the bus drivers driving style and proper maintenance practices. A suitable driving style will reduce the costs of fuels, repairs, maintenance, etc. Similarly, properly maintained buses are safer and consume less fuel than less maintained vehicles.

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