A Study of Factors Influencing Supplier Evaluation and Selection Decision in Automotive Industry

Charu Sharma, [1*]Research Scholar, [1]Maharishi Markandeshwar Institute of Management, Maharishi Markandeshwar (Deemed to be University), Mullana, Ambala, Haryana, India
Dr. Meenu Gupta, [2]Associate Professor, [2]Maharishi Markandeshwar Institute of Management, Maharishi Markandeshwar (Deemed to be University), Mullana, Ambala, Haryana, India

Abstract:
It is predominant to a manufacturer to determine and identify a supplier that who provides required quality material or components continuously and adequate quantity to support for a manufacturing flow in an automotive industry. By intensive literature review the three higher order factors such as reliability, technical excellence and geographical location of the supplier factors are considered as being effecting supplier evaluation and selection. An empirical examination was performed through a survey by considering the sample size of 50 respondents working as managers and about 10 were suppliers in the state of Punjab. Descriptive and inferential statistical techniques are performed such as factor analysis and multiple regressions and also cost and corporate responsibility factors were determined as control variable contributing the decision for selecting a supplier. It is found that the considered higher ordered factors has shown a positive significant impact and change in variance was observed due to control factors effect. Observations are presented and discussions are made as per the results.

Keywords: *Technical Excellence, Reliability, Geographical Location, Supplier Selection.*

INTRODUCTION: INDIAN AUTOMOTIVE INDUSTRY

The automotive industry is a pillar of the Indian economy and a key driver of macroeconomic growth and technological progress. The automotive industry currently contributes more than 7% to total GDP and provides jobs to around 32 million people, directly and indirectly. The strong domestic demand along with favorable government policies has led the Indian automotive industry to climb the ladder to become one of the world leaders (SESI, 2019). The Indian automotive industry is undergoing a major transformation in terms of sustainable growth and profitability (SESI, 2019).

The industry is crucial for the economy as it accounts for 7.1% of the country's Gross Domestic Product (GDP) and as per Automotive Mission Plan (AMP) 2016–26, its contribution is projected to increase to 12%1. India is expected to emerge as the world's third-largest passenger vehicle market by 2021 (PWC, 2019). An emerging trend observed in the automotive sector (among other segments as well) is the increase in outsourcing of certain core and non-core R&D activities (CII, 2019).

OBJECTIVES OF THE STUDY

- To determine the effect of the factor, Technical Excellence of the supplier in Supplier evaluation and Selection.
- To determine the effect of the factor, Geographical Location of the supplier in Supplier evaluation and Selection.
- To determine the effect of the factor, supplier Reliability in Supplier evaluation and Selection.
- To determine the effect of the controllable factors, to the cost delivered and CSR of the supplier in the supplier evaluation and selection process.

REVIEW OF LITERATURE

Supplier selection is one of the most critical activities in purchasing management in the supply chain. The selection of suppliers is a complex problem that involves multiple qualitative and quantitative criteria(Tahriri et al., 2008). With the rapid development of computers and communication technologies on the Internet, the emergence of many new technologies that change the basic rules of competition has posed new challenges to the traditional manufacturing mode (Xiong et al., 2015). Due to the multiple criteria that affect the evaluation and selection process, deciding which criteria have the most critical roles in decision making is a very important step for the selection, evaluation and development of the provider (Omurca, 2013).

It is necessary to evaluate suppliers based on contributions from the strategic, functional and operational level (Agarwal et al., 2011). Selecting equipment suppliers is an important issue in renewable energy projects, as a decision maker must take into account qualitative and quantitative factors. Choosing the right equipment supplier is one of the most important success factors for sustainable energy projects in general and wind projects in particular (Wang et al., 2019). The factors that influence this choice and evaluation are quality, cost, flexibility, technical expertise, delivery, geographical location, time, service, reliability, corporate social responsibility (Lin et al., 2018; Pi & Low, 2005, 2006; Wang et al., 2019).

Research Questions

- Does Technical Excellence show any effect on Supplier Selection?
- Does Geographical Location show any effect on Supplier Selection?
- Does Reliability show any effect on Supplier Selection?
- Do the controllable factors, to the cost delivered and CSR of the supplier have any effect on supplier evaluation and selection process?

Hypothesis Formulation

H1: Technical Excellence has a positive significant impact on Supplier Selection.

H2: Geographical Location has a positive significant impact on Supplier Selection.

H3: Reliability has a positive significant impact on Supplier Selection.
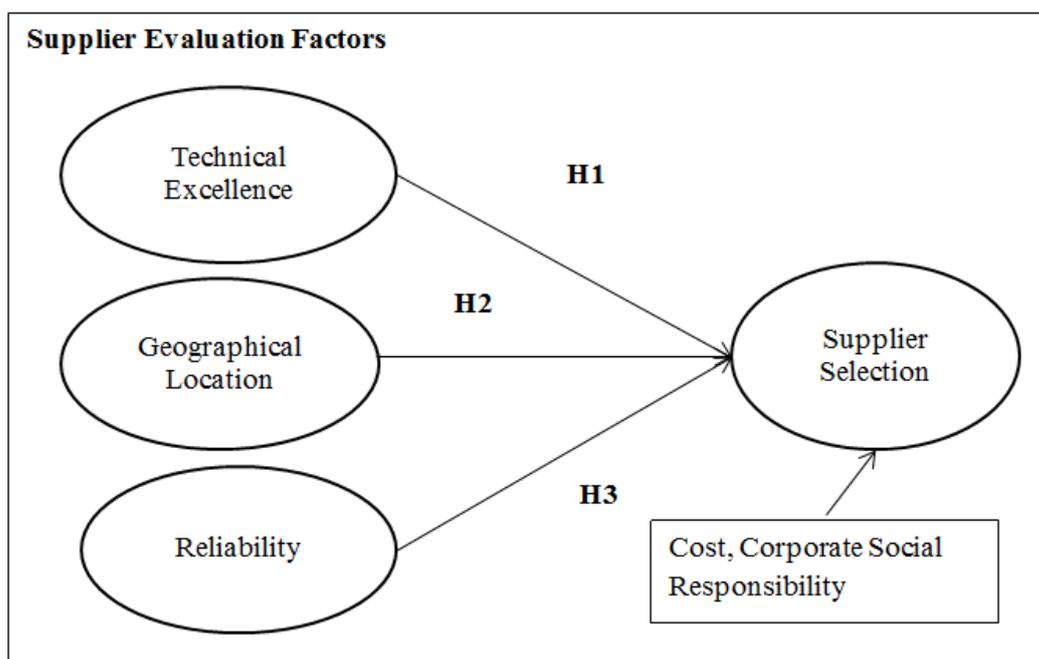
Research Design:

Figure 1: Proposed Model: Supplier Evaluation and Selection

METHODOLOGY:

The questionnaire consists of nine questions and all the questions were made in relevance to likert scale which is very famous in capturing the criteria for selection determents for a rational decision for supplier. The items in the scale are validated using explorative factor analysis. The scale under the construct Technical Excellence is as follows:' the supplier equipped with adequate software for maintenance of stock', 'the supplier has relevance with technology' and the third question 'the supplier updates to new versions in technology'. The scale items under Reliability are: 'The previous transactions with supplier are successful' and 'The supplier has financial stability'. The items under the construct Geographical Location: 'The location of supply is approachable' and 'the location is convenient and feasible for transit' and finally, Supplier Selection was measured with the items: 'I select this supplier' and I recommend this supplier for future association'. The measurement on the scale is 7 point likert scale (1= Very strongly agree to 7= Very strongly disagree). The independent and dependent relations are represented in Figure 1 along with control variables.

Demographic Analysis

Demographics	Category	Frequency	Valid Percent	Cumulative Percent	Mean	Std. Deviation
Gender	Male	34	56.7	56.7	-	-
	Female	26	43.3	100		
	Total	60				
Age	40-55 years	10	16.7	16.7	2.61	0.91
	25-40 years	30	50	66.7		
	<25 years	20	33.3	100		
	Total	60	100			
Educational Qualification	Graduation	13	21.7	21.7	2.28	0.57
	Post-Graduation	12	20	41.7		
	PG Certified	35	58.3	100		
	Total	60	100 0			
Corporate Social Responsibility in organization	Yes	34	56.7	56.7	1.5	0.52
	No	26	43.3	100		
	Total	60	60			
Cost	Low	41	68.3	68.3	2.1	0.63
	Medium	12	20.0	88.3		
	High	7	11.7	100		
	Total	60	100			
Mode of Delivery	Road ways	39	65.0	65.0	2.5	0.45
	Rail ways	13	21.7	89.7		
	Cargo Shipment	8	13.3	100		
	Total	60	100			

Table 1: Demographic Characteristics

The method adopted for data collection is a non-probabilistic sampling method- snowball sampling such that, referrals from as a chain process responses are collected and about 70 responses are collected in that after eliminating the inappropriate and semi-filled responses are removed in the final process of data analysis and only a few about 4 responses cases are replaced with mean values and that task is achieved by SPSS. Finally, 60 samples are considered for analyzing the results in which 50 respondents are managers and the rest 10 respondents are material suppliers. The effect of demographic factor 'cost and CSR' is observed in the study as control factor which contribute for decision making in supplier selection process.

Analyzing the demographic characteristics of the respondents, from the total sample adopted: about 56.7 percent are male and the rest i.e., 43.3 percent are females. When come to age of the respondents about 16.7 percent of the respondents are between 40

to 50 years of age, about 50 percent of the respondents are in the age of 25-40 years, and about 33.3 percent of the participants are in the age category of 25 years and below. Finally, the other demographical factors educational qualifications and mode of delivery are summarized in the demographic analysis under table 1. The most important aspect considered for our study is cost of delivery with a range of low, medium and high were also represented, and about 56.7 percent actively participate for CSR and the rest 43.3 percent were silent for CSR.

INFERENTIAL ANALYSIS

A principal component factor analysis was performed to determine the factors from the adopted questionnaire. Before to that, KMO and Bartlett's test was performed to determine the sample adequacy and it is found that by test it is 0.669 which is sufficient enough for performing factor analysis. This is represented in the table 3. The items of the model are measured on a seven point likert scale were, mean and standard deviation of the model constructs are represented in the table 2, it can be seen from the table that the mean of Technical excellence is 3.62, the mean of Supplier Selection is 4.30, the mean of Geographical Location is 4.21 and the mean of Reliability is 4.77.

Study Construct	Mean	Std. Deviation	N
Technical Excellence	3.62	1.62	60
Supplier Selection	4.30	1.16	60
Reliability	4.77	1.23	60
Geographical Location	4.21	1.10	60

Table 2: Descriptive Statistics

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.669
Bartlett's Test of Sphericity	Approx. Chi-Square	180.881
	Df	36
	Sig.	.000

Table 3: Sample Adequacy

The constructs and the items are drawn from the literature, but the validity and to examine the variance explained by these constructs to the proposed model, a dimension reduction technique is used in the present study. All the items and its responses are loaded in SPSS and Exploratory factor analysis is performed and it is found that four constructs evolved and the variance explained by these constructs is about 79.503 percent.

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	2.603	28.924	28.924	2.603	28.924	28.924	2.248	24.982	24.982
2	2.089	23.216	52.141	2.089	23.216	52.141	1.723	19.147	44.128
3	1.432	15.912	68.053	1.432	15.912	68.053	1.667	18.520	62.648
4	1.030	11.450	79.503	1.030	11.450	79.503	1.517	16.855	79.503
5	.550	6.112	85.615						
6	.474	5.267	90.882						
7	.360	3.998	94.880						
8	.286	3.176	98.055						
9	.175	1.945	100.000						

Table 4: Factor Loadings and Explained Variances

As per the literature, a model explaining 60 percent of variance is considered valid and the factors are decided based on the eigenvalue, if the eigenvalue is >1 it is considered as a factor (Manideep, 2019b, 2019a, 2019e, 2019c, 2019d). The SPSS out below table 5 displays the result along with Rotation Sums of Squared Loadings.

Rotated Component Matrix				
	Component			
	Technical Excellence	Supplier Selection	Reliability	Geographical Location
TE1	0.925			
TE2	0.868			
TE3	0.775			
SS1		0.873		
SS2		0.857		
R1			0.899	
R2			0.895	
GL1				0.862
GL2				0.836

Table 5: Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization. Rotations converged in 5 iterations

The rotation technique in this model is varimax rotation, which is an non-orthogonal method. From table 5, it can be determined that out of 15 items about 6 items are removed due to cross loadings and item loadings under that factor is less that 0.6 and this is dome as per the literature.

Study Construct	Technical Excellence	Supplier Selection	Reliability	Geographical Location	α
Technical Excellence	1	.903	.447	.678	0.737
Supplier Selection	.903	1	.607	.751	0.688
Reliability	.447	.607	1	.423	0.65
Geographical Location	.678	.751	.423	1	0.54

Table 2: Correlation and reliability Test
* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

It can be observed from table 4, that all the items are >0.6(Correlated with that factor) and 3 items are under Technical Excellence, and 2 items are under Geographical Location, Reliability and at last 2 items under Supplier Selection construct. The factor analysis does not define any causal relation between the factors but the validity of convergent and divergent validity is evaluated by this.

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.678	.247		2.743	.008
	Technical	.472	.045	.662	10.601	.000
	Reliability	.211	.048	.224	4.414	.000
	Geographical Location	.216	.064	.207	3.357	.001
2	(Constant)	.953	.301		3.160	.003
	Technical	.469	.044	.657	10.558	.000
	Reliability	.215	.048	.229	4.508	.000
	Geographical Location	.218	.064	.209	3.384	.001
	Corporate Social Responsibility	-.123	.104	-.053	-1.178	.244
	Cost	-.081	.074	-.049	-1.097	.277

Table 7: Standardized coefficients for the proposed model

A serial multiple hierarchal regression method is used to observe the impact of the independent variables Technical Excellence, Geographical Location and Reliability on Supplier Selection from table 7 it can be determined that Reliability is positively and significantly effects (β =0.224, P<0.05) impact on Supplier Selection, Technical Excellence would also significantly effects(β =0.662, P>0.05) on the Supplier Selection and Geographical Location positively and significantly effects (β =0.207, P<0.05) on the Supplier Selection and the awaited objective of the study that cost and the CSR do not impact much on the Supplier Selection.

Two models are evaluated using hierarchal multiple regression method. Model 1: the effect of independent constructs predicted 5 percent of proportional variation in the dependent variable Supplier Selection, which is observed from table 8, the coefficient of determinant R^2 is 0.11.

RESULTS AND DISCUSSION:

From the second model: message attributes along with educational qualification of the respondents have predicted a 14 percent of proportional variation (coefficient of determinant R^2 is 0.14). It is observed that the proportion of variation has increased by 3 percent (R^2 = 0.11, change in R^2=0.05) about 3 percent of the variance is explained by qualification of respondents and it is a key element in forming Supplier Selection.

Model Summary						
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics	
					R Square Change	Sig. F Change
1	.943[a]	.889	.883	.39700	.889	.000
2	.945[b]	.894	.884	.39492	.005	.282

Table 8: Change in variance

Predictors: (Constant), Geographical Location, Reliability, Technical

Predictors: (Constant), Geographical Location, Reliability, Technical, Cost, CSR

Dependent Variable: Supplier Selection

Hence, it is proved that all the hypothesis, H1, H2 and H3 are positive significantly associated with Supplier Selection which means, both can contribute to evaluation and Supplier Selection. The control variables cost of the consignment and CSR of the supplier are also a major decision contributing factor.

REFERENCES

1. Agarwal, P., Sahai, M., Mishra, V., Bag, M., & Singh, V. (2011). A review of multi-criteria decision making techniques for supplier evaluation and selection. International Journal of Industrial Engineering Computations, 2(4), 801–810. https://doi.org/10.5267/j.ijiec.2011.06.004
2. CII. (2019). Innovation , NPD and globalisation imperatives. Confideration of Indian Industry, March, 1–51.Retrived on Dec, 2019
3. Lin, C. T., Hung, K. P., & Hu, S. H. (2018). A decision-making model for evaluating and selecting suppliers for the sustainable operation and development of enterprises in the aerospace industry. Sustainability (Switzerland), 10(3). https://doi.org/10.3390/su10030735
4. Manideep, A. S. (2019a). Factors Influencing the Adoption of Social Media Marketing in the Wellness Industry : An Empirical Analysis. Journal of Advanced Research in Dynamical and Control Systems, 11(6), 356–362.
5. Manideep, A. S. (2019b). Impact of Social Network Advertisements on Brand Equity of Wellness Firms and the Mediating Role of Brand Awareness : An Empirical Analysis ABSTRACT : International Journal of Management and Business Research, 9(June), 46–53.
6. Manideep, A. S. (2019c). Nanotechnology And Its Implications In Manufacturing. International Journal of Mechanical and Production Engineering Research and Development, 2(Special Issue), 284–292.
7. Manideep, A. S. (2019d). The Effect of Adoption

of E-commerce on Business Performance : An Empirical Analysis. International Journal of Basic and Applied Research, 9(5), 376–382.

8. Manideep, A. S. (2019e). The strategic implications of worksite wellness programs: A review. Journal of Advanced Research in Dynamical and Control Systems, 11(5), 141–144.

9. Omurca, S. I. (2013). An intelligent supplier evaluation, selection and development system. Applied Soft Computing Journal, 13(1), 690–697. https://doi.org/10.1016/j.asoc.2012.08.008

10. Pi, W. N., & Low, C. (2005). Supplier evaluation and selection using Taguchi loss functions. International Journal of Advanced Manufacturing Technology, 26(1–2), 155–160. https://doi.org/10.1007/s00170-003-1975-5

11. Pi, W. N., & Low, C. (2006). Supplier evaluation and selection via Taguchi loss functions and an AHP. International Journal of Advanced Manufacturing Technology, 27(5–6), 625–630. https://doi.org/10.1007/s00170-004-2227-z

12. PWC. (2019). Indian automotive sector : Creating Table of contents. May. https://www.pwc.in/assets/pdfs/industries/automotive/indian-automotive-sector.pdf Retrieved on Dec, 2019

13. Sharma,C.,& Gupta,M.(2018). Lean Suppliers in Indian Automotive Industry: A Review. OmniScience : A Multi-disciplinary Journal,8(1),20-24. http://sciencejournals.stmjournals.in/index.php/osmj/article/view/177

14. Sharma,C.,& Gupta,M.(2019). Different Factors and Techniques for Supplier Evaluation and Selection in Automotive Industry of Punjab. International Journal of Innovative Technology and Exploring Engineering, 8 (12),1338-1345. https://www.ijitee.org/wp-content/uploads/papers/v8i12/L39241081219.pdf

15. Tahriri, F., Osman, M. R., Ali, A., Yusuff, R. M., & Esfandiary, A. (2008). AHP approach for supplier evaluation and selection in a steel manufacturing company. Journal of Industrial Engineering and Management, 1(2), 54–76. https://doi.org/10.3926/jiem.2008.v1n2.p54-76

16. Wang, C. N., Yang, C. Y., & Cheng, H. C. (2019). Fuzzy multi-criteria decision-making model for supplier evaluation and selection in

awind power plant project. Mathematics, 7(5), 1–15. https://doi.org/10.3390/math7050417

17. Xiong, G., Chen, Y., Shang, X., Liu, X., & Nyberg, T. R. (2015). AHP fuzzy comprehensive method of supplier evaluation in social manufacturing mode. Proceedings of the World Congress on Intelligent Control and Automation (WCICA), 2015-March(March), 3594–3599. https://doi.org/10.1109/WCICA.2014.7053314