

Contribution of Environmental Certification as a Green Supply Chain Practice-A Pilot Empirical Study of the Indian Automobile Manufacturing Sector

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Abstract: This paper tests empirically through a pilot study of the Indian Automobile Manufacturing Sector, the contribution of the variables constituting the construct Environmental Certification in Green Supply Chain Practices. Also the paper establishes the reliability of the questionnaire instrument developed previously for measuring the construct Environmental Certification and also for measuring the five variables that constitute the construct Environmental Certification. Further the paper establishes the correlation among these five variables. Finally this paper conducts Confirmatory Factor Analysis (CFA) to arrive at one factor (linear combination of variables constituting the construct Environmental Certification) to aid in measuring the construct Environmental Certification.

Keywords: Automobile, CFA, Green Supply Chain Practice, Indian, Manufacturing Sector, Pilot Study, Environmental Certification.

I. Introduction

Environmental Certification has been identified as one of the five green supply chain practices having an influence over ten green supply chain performance measures [12]. Accordingly, this paper identifies the variables constituting the construct Environmental Certification. Environmental Certification in turn is a sub-construct of the main construct Green Supply Chain Practices. Since environmental certification has been identified as being constituted of five variables, it is of interest to know how these five variables fare in the pilot empirical study of the Indian automobile manufacturing sector by means of a questionnaire instrument [12]. The 50 automobile manufacturing plants that were surveyed during the pilot empirical study are all listed in [3]. The survey methodology was used in line with the findings of [4].

II. Research Questions

The five research questions identified are as follows:

Research Question 1.To have a feel of the responses of the Indian Automobile Manufacturing Sector pertaining to the five variables constituting the construct Environmental Certification.

Research Question 2.To know the reliability of the questionnaire instrument for measuring the construct Environmental Certification.

Research Question 3.To know the reliability of the questionnaire instrument for measuring the five variables constituting the construct Environmental Certification.

Research Question 4.How are the five variables constituting the construct Environmental Certification correlated?

Research Question 5. How many factors are retained by the five variables constituting the construct Environmental Certification?

III. The Construct And Variables Used In The Study

There are five variables that constitute the construct Environmental Certification. They are depicted in the Table 1 in their abbreviated form.

Table 1. The five variables constituting the construct Environmental Certification

The five variables constituting the construct Environmental Certification	EC1	EC2	EC3	EC4	EC5
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IV. The Descriptive Statistics Of The Data Scaled

A five point balanced Likert scale was used to scale the data from respondents on whom a questionnaire was administered. The respondents were employees of Indian automobile manufacturing firms and /or their plants as mentioned in [3]. The data collected revealed the descriptive statistics of the five variables constituting the construct Environmental Certification as shown in the Table 2.

Table 2. Descriptive Statistics of the variables of Environmental Certification scaled by the questionnaire

Simple Statistics						
Variable	N	Mean	Std Dev	Sum	Minimum	Maximum
EC1	50	4.12000	0.89534	206.00000	3.00000	5.00000
EC2	50	4.56000	0.92934	228.00000	1.00000	5.00000
EC3	50	4.54000	0.86213	227.00000	1.00000	5.00000
EC4	50	4.58000	0.78480	229.00000	2.00000	5.00000
EC5	50	4.58000	0.78480	229.00000	2.00000	5.00000

V. The Reliability Of The Instrument For The Variables And The Construct Used

The reliability of the questionnaire instrument developed by [12] for the construct Environmental Certification is shown in the Table 3 as 0.850132 which is considered to be an indicator of good internal consistency reliability [5].

Table 3. Reliability by Cronbach's Coefficient Alpha for the construct Environmental Certification

Cronbach Coefficient Alpha	
Variables	Alpha
Raw	0.839954
Standardized	0.850132

The reliability of the questionnaire for the five variables that constitute the construct Environmental Certification is shown in the Table 4. Out of the five variables in Table 4 the variable EC1 has a reliability of 0.983796 which is considered to be an excellent internal consistency reliability; and the variables EC2, EC3, EC4 and EC5 have reliabilities greater than 0.7 but less than 0.8 which means that their internal consistency reliability is acceptable [5]. Further there is enough evidence from existing literature to support these five variables [1], [2], [6], [7], [8], [9], [10], [11], [13] and [14]. So all the five variables are retained.

Table 4. Reliability of the individual five variables constituting the construct Pollution Prevention

Cronbach Coefficient Alpha with Deleted Variable				
Deleted Variable	Raw Variables		Standardized Variables	
	Correlation with Total	Alpha	Correlation with Total	Alpha
EC1	0.802990	0.981818	0.803960	0.983796
EC2	0.921600	0.719164	0.932339	0.742551
EC3	0.827992	0.753999	0.834980	0.771139
EC4	0.919869	0.734545	0.925495	0.744602
EC5	0.919869	0.734545	0.925495	0.744602

VI. The Pearson’s Correlation Coefficient Among The Variables Used In The Study

The Pearson’s Correlation coefficient between different pairs of variables that constitute the construct Environmental Certification is shown in the Table 5. Since all the values of correlation coefficient are above 0.5 and less than 1, it indicates that all the five variables that make up the construct Environmental Certification are oriented towards the goal of Environmental Certification in a unidirectional manner. This is again an indicator of internal consistency reliability.

Table 5. Pearson's Correlation coefficient among the variables of the construct Environmental Certification

Pearson Correlation Coefficients, N = 50					
Prob > r under H0: Rho=0					
	EC1	EC2	EC3	EC4	EC5
EC1	1.00000	0.57880 0.6897	0.11210 0.4383	0.72030 0.6191	0.72030 0.6191
EC2	0.57880 0.6897	1.00000	0.91392 <.0001	0.97263 <.0001	0.97263 <.0001
EC3	0.11210 0.4383	0.91392 <.0001	1.00000	0.88497 <.0001	0.88497 <.0001
EC4	0.72030 0.6191	0.97263 <.0001	0.88497 <.0001	1.00000	1.00000 <.0001
EC5	0.72030 0.6191	0.97263 <.0001	0.88497 <.0001	1.00000 <.0001	1.00000

VII. Factor Analysis

Using a statistical analysis software, SAS 9.2, Confirmatory Factor Analysis (CFA) was conducted on the construct Environmental Certification which consists of five variables. Principal Components method was used as the initial factor method. Accordingly the Eigenvalues were obtained as shown in the Table 6.

Table 6. Eigen values of obtained by using Principal Components Method as the initial factor method

Eigenvalues of the Correlation Matrix: Total = 5 Average = 1				
	Eigenvalue	Difference	Proportion	Cumulative
1	3.82475517	2.83120332	0.7650	0.7650
2	0.99355184	0.84171068	0.1987	0.9637
3	0.15184116	0.12198933	0.0304	0.9940
4	0.02985183	0.02985183	0.0060	1.0000
5	0.00000000		0.0000	1.0000

From Table 6 it is clear that the first factor can explain 3.82475517 variables. Hence it is a desirable factor. No other factor in the Table 6 can explain at least one variable. Hence the first factor will be retained by MINEIGEN criterion as shown by the factor pattern of Table 7. The variance explained by the factor is 3.8247552.

Table7. Factor pattern obtained for the single factor retained by MINEIGEN criterion

Factor Pattern	
Variable	Factor1
EC1	0.10799
EC2	0.98718
EC3	0.94244
EC4	0.98752
EC5	0.98752

The final communality estimates for the five variables constituting the construct Environmental Certification are shown in Table 8.

Table 8. The final communality estimates for Environmental Certification

Final Communality Estimates: Total = 3.824755				
EC1	EC2	EC3	EC4	EC5
0.01166213	0.97452462	0.88819428	0.97518707	0.97518707

VIII. Conclusion

The aim of this paper was to study the contribution of the five variables constituting the construct Environmental Certification as a component of Green Supply Chain Practices. It was found that all the five variables in the study were reasonably positively correlated with each of the other variables meaning that the variables are strongly oriented towards environmental certification. The reliability of the construct Environmental Certification was 0.850132 which is considered good. Also the reliability of the five variables constituting the construct Environmental Certification was above 0.9 in case of EC1 which is an indicator of excellent internal consistency reliability and greater than 0.7 but less than 0.8 in case of EC2, EC3, EC4 and EC5 which is an indicator of acceptable internal consistency reliability. This means that the questionnaire is reliable to measure each of the variables and also the construct Environmental Certification as a whole. Also the results of Confirmatory Factor Analysis reveal that one factor accounting for 3.82475517 variables is retained.

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References

- [1] Corbett, Charles J., and David A. Kirsch. International diffusion of ISO 14000 certification, *Production and Operations Management* 10(3), 2001, 327-342.
- [2] Elkinjton, John. Partnerships from Cannibals with Forks: The Triple Bottom Line of 2 1st Century Business. *ENVIRONMENTAL QUALITY MANAGEMENT*, 1998, 37.
- [3] Gandhi, M.A., A Review of the Indian Automobile Manufacturing Sector, *IOSR Journal of Business and Management*, 19(3), Ver II, 2017, 9-15.
- [4] Gandhi, M.A. and Sharma, S., A Review of Research Methodologies Linking Green Supply Chain Practices and Green Supply Chain Performance, *International Journal of Supply Chain Management*, 3(4), 2014.
- [5] George D, Mallery M., Using SPSS for Windows step by step: a simple guide and reference, 2003.
- [6] Hartwell, R. V., and L. Bergkamp, Eco-labeling in Europe: New market-related environmental risks. *International Environment Reporter* 15(19), 1992, 623-32.
- [7] International Institute for Sustainable Development, *Business and Sustainability Development: A Global Guide*, 2001.
- [8] King, Andrew A., and Michael J. Lenox. Lean and green? An empirical examination of the relationship between lean production and environmental performance. *Production and operations management* 10(3), 2001, 244-256.
- [9] Montabon, Frank, et al. ISO 14000: assessing its perceived impact on corporate performance, *Journal of Supply Chain Management* 36(1), 2000, 4-16.
- [10] OECD (Organization for Economic Cooperation and Development). *Technologies for Cleaner Production and Products*. Paris, France: OECD, 1995.
- [11] Puri, Subhash C. *Stepping up to ISO 14000: Integrating Environmental Quality with ISO 9000 and TQM*. Productivity Press, 1996.
- [12] Sharma, S., and Gandhi, M.A., Exploring correlations in components of green supply chain practices and green supply chain performance, *Competitiveness Review*, 26(3), 2016, 332-368.
- [13] www.ceres.org
- [14] www.iccwbo.org