

Contribution of components of Green Supply Chain Execution-Packaging in Green Supply Chain Performance measurement-A Pilot Empirical Study of the Indian Automobile Manufacturing Sector

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Abstract : *This paper is one of the several extensions of the research works done by [5]. Green Supply Chain Practices have been known to have an impact on Green Supply Chain Performance [5]. This paper tests empirically through a pilot study of the Indian Automobile Manufacturing Sector, the contribution of the four variables constituting the construct Green Supply Chain Execution-Packaging in Green Supply Chain Performance measurement. Also the paper establishes the reliability of the questionnaire instrument developed previously for measuring the construct Green Supply Chain Execution-Packaging and also for measuring the four variables that constitute the construct Green Supply Chain Execution-Packaging. Further the paper establishes the correlation among these four variables. Finally this paper conducts Confirmatory Factor Analysis (CFA) to arrive at a single factor (linear combination of four variables constituting the construct Green Supply Chain Execution-Packaging) to aid in measuring the construct Green Supply Chain Execution-Packaging. Finally the paper establishes the order of contribution of the four variables constituting the construct Green Supply Chain Execution-Packaging.*

Keywords: *Automobile, CFA, Green Supply Chain Execution-Packaging, Green Supply Chain Performance, Green Supply Chain Practices, Indian, Manufacturing Sector, Pilot Study.*

I. Introduction

Green Supply Chain Execution-Packaging has been identified as one of the ten Green Supply Chain Performance measures which are impacted by five Green Supply Chain Practices [5]. Accordingly, this paper identifies the variables constituting the construct Green Supply Chain Execution-Packaging [5]. Green Supply Chain Execution-Packaging in turn is a sub-construct of the main construct Green Supply Chain Performance. Since Green Supply Chain Execution-Packaging has been identified as being constituted of four variables, it is of interest to know how these four variables fare in the pilot empirical study of the Indian automobile manufacturing sector by means of a questionnaire instrument [5]. It is also of interest to know the order of contribution of these four variables constituting the construct Green Supply Chain Execution-Packaging. The 50 automobile manufacturing plants that were surveyed during the pilot empirical study are among the ones listed in [2]. The survey methodology was used in line with the findings of [3].

II. The Research Questions Addressed

The six research questions addressed are as follows:

Research Question 1. To have a feel of the responses of the Indian Automobile Manufacturing Sector pertaining to the twelve variables constituting the construct Green Supply Chain Execution-Packaging.

Research Question 2. To know the reliability of the questionnaire instrument for measuring the construct Green Supply Chain Execution-Packaging.

Research Question 3. To know the reliability of the questionnaire instrument for measuring the four variables constituting the construct Green Supply Chain Execution-Packaging.

Research Question 4. How are the four variables constituting the construct Green Supply Chain Execution-Packaging related?

Research Question 5. How many factors are retained by the four variables constituting the construct Green Supply Chain Execution-Packaging?

Research Question 6. What is the order of contribution of the four variables constituting the construct Green Supply Chain Execution-Packaging?

III. The Construct Green Supply Chain Execution-Packaging And Its four Component Variables Used In The Study

There are four variables that constitute the construct Green Supply Chain Execution-Packaging. They are depicted in Table 1 in their abbreviated form.

Table 1. The four variables constituting the construct Green Supply Chain Execution-Packaging

The four variables constituting the construct Green Supply Chain Execution-Packaging	GSCEXPACK1	GSCEXPACK2	GSCEXPACK3	GSCEXPACK4
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IV. The Descriptive Statistics Of The Scaled Data On Green Supply Chain Execution-Packaging

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 [2]. The data collected revealed the following descriptive statistics of the four variables constituting the construct Green Supply Chain Execution-Packaging.

Table 2. Descriptive Statistics of the data scaled by the questionnaire on Green Supply Chain Execution-Packaging

Simple Statistics						
Variable	N	Mean	Std Dev	Sum	Minimum	Maximum
GSCEXPACK1	50	4.38000	1.10454	219.00000	2.00000	5.00000
GSCEXPACK2	50	4.38000	1.10454	219.00000	2.00000	5.00000
GSCEXPACK3	50	4.34000	1.09935	217.00000	2.00000	5.00000
GSCEXPACK4	50	4.38000	1.10454	219.00000	2.00000	5.00000

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

The reliability of the questionnaire instrument developed by [5] for the construct Green Supply Chain Execution-Packaging is shown in the Table 3 as 0.997972 which is considered to be an excellent indicator of internal consistency reliability [4].

Table 3. Reliability by Cronbach's Coefficient Alpha for the construct Green Supply Chain Execution-Packaging

Cronbach Coefficient Alpha	
Variables	Alpha
Raw	0.997976
Standardized	0.997972

The reliability of the questionnaire for the four variables that constitute the construct Green Supply Chain Execution-Packaging is shown in Table 4. All the four variables in Table 4 namely GSCEXPACK1, GSCEXPACK2, GSCEXPACK3 and GSCEXPACK4 have reliabilities above 0.9 but less than 1, which is an indicator of excellent internal consistency reliability [4].

Table 4. Reliability of the four variables constituting the construct Green Supply Chain Execution-Packaging

Deleted Variable	Cronbach Coefficient Alpha with Deleted Variable			
	Raw Variables		Standardized Variables	
	Correlation with Total	Alpha	Correlation with Total	Alpha
GSCEXPACK1	0.998220	0.996394	0.998209	0.996391
GSCEXPACK2	0.998220	0.996394	0.998209	0.996391
GSCEXPACK3	0.983876	1.000000	0.983876	1.000000
GSCEXPACK4	0.998220	0.996394	0.998209	0.996391

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 Green Supply Chain Execution-Packaging is shown in Table 5. Since all the values of correlation coefficient are positive, it indicates that all the four variables that make up the construct Green Supply Chain Execution-Packaging are oriented towards the goal of Green Supply Chain Execution-Packaging in a unidirectional manner. This is also an indicator of high internal consistency reliability.

Table 5. Pearson's Correlation coefficient among the four variables of Green Supply Chain Execution-Packaging

Pearson Correlation Coefficients, N = 50 Prob > r under H0: Rho=0				
	GSCEXPACK1	GSCEXPACK2	GSCEXPACK3	GSCEXPACK4
GSCEXPACK1	1.00000	1.00000 <.0001	0.98388 <.0001	1.00000 <.0001
GSCEXPACK2	1.00000 <.0001	1.00000	0.98388 <.0001	1.00000 <.0001
GSCEXPACK3	0.98388 <.0001	0.98388 <.0001	1.00000	0.98388 <.0001
GSCEXPACK4	1.00000 <.0001	1.00000 <.0001	0.98388 <.0001	1.00000

VII. Factor Analysis

Using statistical analysis software called SAS 9.2; Confirmatory Factor Analysis (CFA) was conducted on the construct Green Supply Chain Execution-Packaging which consists of four variables. Principal Component method was used as the initial factor method. Accordingly the Eigenvalues were obtained as shown in the Table 6.

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

Eigenvalues of the Correlation Matrix: Total = 4 Average = 1				
	Eigenvalue	Difference	Proportion	Cumulative
1	3.97586400	3.95172800	0.9940	0.9940
2	0.02413600	0.02413600	0.0060	1.0000
3	0.00000000	0.00000000	0.0000	1.0000
4	0.00000000		0.0000	1.0000

An Eigen value indicates the relative importance of each factor in accounting for the particular set of variables being analysed. From Table 6 it is clear that the first factor can explain 3.97586400 variables. No other factor in Table 6 can explain at least one variable. Hence only one factor will be retained by MINEIGEN criterion as the only factor as shown by the factor pattern of Table 7. The variance explained by the by the single factor is 3.9758640.

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

Factor Pattern	
Variables	Loadings of Factor1
GSCEXPACK1	0.99901
GSCEXPACK2	0.99901
GSCEXPACK3	0.99087
GSCEXPACK4	0.99901

The final communality estimates for the four variables constituting the construct Green Supply Chain Execution-Packaging are shown in Table 8.

Table 8. The final communality estimates for Green Supply Chain Execution-Packaging

Final Communality Estimates: Total = 3.975864			
GSCEXPACK1	GSCEXPACK2	GSCEXPACK3	GSCEXPACK4
0.99801324	0.99801324	0.98182429	0.99801324

Communality estimates are indicative of how much of each variable is accounted for by the underlying factors taken together. A high value of communality means that not much of the variable is left over after whatever the factors represent is taken into consideration. In short the communality estimates are indicative of the relative contribution of each of the variables in the construct. Accordingly Figure 1 shows in the descending order, the relative contribution of each of the four variables of the construct Green Supply Chain Execution-Packaging as follows: GSCEXPACK1, GSCEXPACK2, GSCEXPACK4 at the same level followed by GSCEXPACK3 at the lower level.

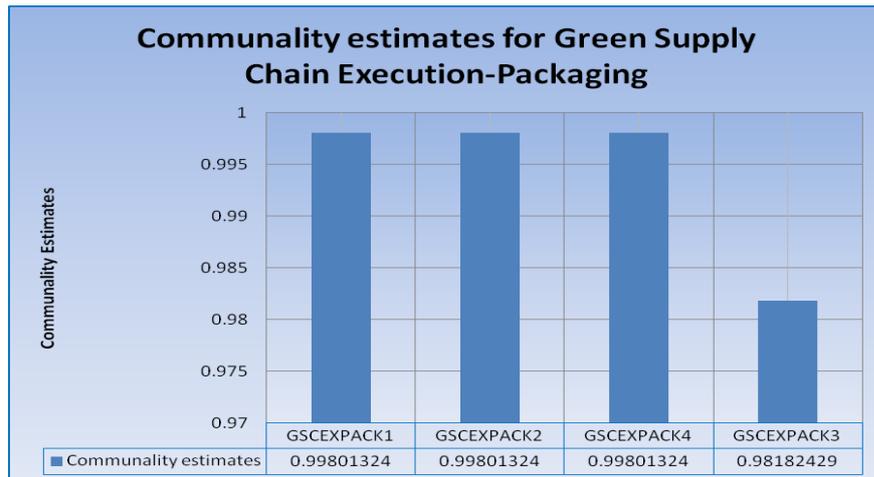


Figure 1. Contribution of the four components of Green Supply Chain Execution-Packaging in descending order

VIII. Conclusion

The aim of this paper was to study the contribution of the four variables constituting the construct Green Supply Chain Execution-Packaging in Green Supply Chain Performance measurement. It was found that all the four variables in the study were positively correlated with each of the other variables in varying degrees meaning that all the four variables involved are oriented towards Green Supply Chain Execution-Packaging. The reliability of the construct Green Supply Chain Execution-Packaging was 0.997972 which is considered to be an indicator of excellent internal consistency reliability. All the four variables in Table 4 namely GSCPACK1, GSCPACK2 and GSCPACK3 have reliabilities above 0.9 which is an indicator of excellent internal consistency reliability. The four variables constituting the construct Green Supply Chain Execution-Packaging are reduced to a single factor which can explain 3.9758640 variables or in other words the single factor has a variance of 3.9758640. Finally the contribution of the four variables of the construct Green Supply Chain Execution-Packaging in descending order of their contribution in the construct is as follows: GSCPACK1, GSCPACK2 and GSCPACK4 at the same level followed by GSCPACK3 at the lower level.

Acknowledgements

I express my heartfelt thanks to Dr. Abdul Razak Honnutagi for permitting me to go ahead with my research work from NITIE, Mumbai though our institute was at its formative stage. Also I acknowledge the patience and support of my wife Yasmin Mohd. Asif Gandhi for bearing with me during my long research hours for years. I also express my thanks for the support and love of my loving children Mohd. Hasan Gandhi and Binish Gandhi. I express my heartfelt thanks to my parents Mr. Indravadan Chimanlal Gandhi and Mrs. Sarmista Indravadan Gandhi for encouraging me and motivating me to complete my research work. I dedicate all my success to them. Special thanks to my guide Dr. Sanjay Sharma from NITIE, Mumbai.

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