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Identification and Validation of GSCM Critical Success Factors & Performance Measures for manufacturing industries in Micro, Small and Medium Enterprises

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ABSTRACT: Purpose: To develop and validate the Critical Success Factors and Performance Measures of green supply chain management for micro, small and medium enterprises in manufacturing industries to reduce the gap between stakeholders and GSCM.

Design methodology/approach: The literature reviewed from the authors on green initiatives and practices gave the various input factors and output factors related to green supply chain which were listed using a Likert scale. A survey questionnaire was conducted and the data collected was then analyzed using Statistical Package for survey of Social Sciences (SPSS). To investigate and identify the critical success factors and performance measures for improving the performance of green supply chain the various statistics such as mean, median, mode, variance, standard deviation, etc were computed. The research data was then tested for Adequacy, Normality, Reliability and Validity of instruments. Factor Analysis was done to reduce the number of variables and study the relationship between them to study the dimensionality of the set of variables. With the help of factor loading it was explained how closely the variables are related to each other. Eigen value was used to indicate the importance of each factor in relation to particular set of variables being analyzed. The items were then correlated and using stepwise multiple regression it was found out how a particular dependent variable responds to a set of input variables and hypothesis was tested for the same.

Findings: After the rigorous analysis, the paper combines the factors from electronics, food and automobile industries to give the 6 main critical success factors and 6 main performance measures for micro, small and medium enterprises in manufacturing industries in the direction of green supply chain management.

Research limitations/implications: The various aspects are not researched in detail except for few studies and leaves a lot of angles to be explored in the direction of green supply chain.

Practical implications: The combination of improved strategies of production and ecofriendly concept keeping in mind the performance improvement factors and performance measurement to produce the goods and services can provide for a strategic approach to many organizations to have a competitive advantage in local as well as global circuit.

Originality/Value: The paper identifies, develops, analyzes and validates the 6 main Critical Success Factors of green supply chain management such as Vision & Mission, Human Capital, Green Process, Finance, Environment & Organization Culture and the 6 main Performance Measures viz., Quality Performance, Resource Conservation, Financial Performance, Productivity/ Competitiveness, Employee Satisfaction and Customer Satisfaction to slacken and reduce the gap between stake holders along with providing a competitive edge in the market.

Keywords: Green Supply Chain Management, Critical Success Factors, Performance Measurement Factors, Green Practices, Green Design, Green Manufacturing, Reverse Logistics, Green initiatives.

Type: Research Paper

I. INTRODUCTION

The Green Supply Chain Management has emerged as a very hot topic in the recent years to add value to the traditional supply chain. Zhu et al. claimed Green Supply Chain Management can be regarded as an environmental innovation[4]. Today, most of the organizations are more interested in knowing how the green supply chain will actually affect the bottom line rather than saving the environment. The green supply chain management (GSCM) can provide a very systematic approach for any company to gain advantage over its competitors by affecting the

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improvements in the extraction of raw materials to the disposal of final goods thereby helping in achieving plan success.[2] The green supply chain management (GSCM) is becoming increasingly important for Indian manufacturers due to increasing awareness among the producers to corporate social responsibility and the need to cope with the environmental policies and norms. Thus, the green supply chain management is becoming an integral part of a company's various processes in a supply chain.

According to Mr. Srivastava(2007), GSCM can be defined as integrating environmental thinking into traditional supply chain management which includes design of product, material sourcing and selection, manufacturing process, delivery of the final product to the consumers as well as end-of-life management of the product after its useful life (EOL management due to addition of GSCM)[6].

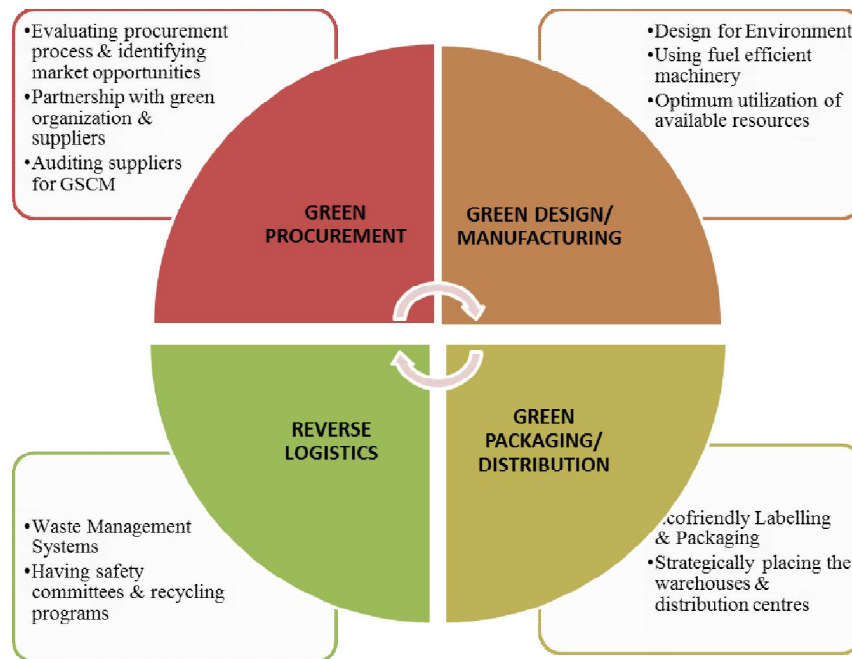


Figure :Activities involved in Green Supply Chain Management

GSCM = Green purchasing + Green manufacturing/materials management + Green distribution/marketing + Reverse logistics [1]

Table 1: Differences between the Conventional SCM & Green SCM [37]

Characteristics	Conventional SCM	Green SCM
Objectives and values	Economic	Economic and ecological
Ecological optimization	High ecological impacts	Integrated approach Low ecological impacts
Supplier selection criteria	Price switching suppliers quickly Short-term relationships	Ecological aspects (and price) Long-term relationships
Cost pressure and prices	High cost pressure Low prices	High cost pressure High prices
Speed and flexibility	High	Low

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II. LITERATURE REVIEW

With the increase in the awareness for the green supply chain, the literature on the eco-friendly supply chain has increased in the recent years. The literature was extensively reviewed from electronics industry, food industry and automobile industry to find the green success factors and performance measures from the papers cited below which were then further tested and analysed to give the main critical success factors and performance measures of the green supply chain management in the manufacturing industries for micro, small and medium enterprises. The papers cited in a table format are given below:

Table 2: *Research Papers used for finding sub critical success factors and sub performance measures*

Serial No.	Author	Topic	Journal
1.	Javad Soroor, Ramin Gorgjian	An Analysis of Key Success Factors of Green Supply Chain Management (Case Study: Faradast Energy Falat Co.)	Sorooret <i>et al.</i> , Int. J. Rev. Life. Sci., 5(10), 2015, 977-984, ISSN 2231-2935
2.	Norlinda Mohd Rozar, Wan Hasrulnizam Wan Mahmood, Abdullah Ibrahim, Muhammad Ashlyzan Razik	A Study of Success Factors in Green Supply Chain Management in Manufacturing Industries in Malaysia	Journal of Economics, Business and Management, Vol.3, No.2, February 2015.
3.	Walter Ndege Machogu	Factors influencing the adoption of Green Supply Chain Management Strategy in industries: A Case of Delmonte Company	International Journal of Social Sciences and Project Planning Management, 1 (2), 2014.
4.	Yan Li	Research on Performance Measurement of Green Supply Chain Management in China	Journal of Sustainable Development, Vol. 4, No. 3; June 2011
5.	Sarabjit Singh, Arvind Bhardwaj	Current Status of Green Supply Chain Practices and Initiatives in the Indian SMEs: An Exploratory Study	International Journal of Engineering, Business and Enterprise Applications (IJEBA)
6.	Dixit Garg, S. Luthra, A. Haleem	Ranking of Performance Measures of GSCM towards Sustainability :Using Analytical Hierarchy Process	International Journal of Social, Human Science and Engineering, Vol.8 No.3, April 2014.
7.	Ming-Kuei Chien	Influences of green supply chain management practices on organizational sustainable performance	International Journal of Environmental monitoring and protection, Vol.1, No.1, 2014, pp12-23
8.	Qinghua Zhu	Green supply chain management in leading manufacturers: Case studies in Japanese large companies.	Management Research Review, Vol.33 Iss 4 pp380-392
9.	Mahsa Pishdar, Mohammad Reza Seyyed Hashemi Toloun, Sima Zamani, Fereshteh Farzianpour	Development of factors effective in the success of Green Supply Chain Management	American Journal of Agricultural and Biological Sciences 9(1) : 33-43, 2014
10.	Sumeet Gandhi, Sachin Kumar Mangla, Pradeep Kumar, Dinesh Kumar	Evaluating factors in implementation of successful green supply chain management using DEMATEL: A case study	International Strategic Management Review 3, 2015 96-109
11.	Victor Guang Shi and Scleenny Koh, Fames Baldwin, Federica Cucchiella	Natural resource based Green Supply Chain Management	Supply Chain Management: An International Journal
12.	Azmawani Abd Rahman, Joann Ho, Khairul Anuar Rusli	Pressures Green Supply Chain Management practices and performance of ISO 14001 certified manufacturer in Malaysia	International Journal of Economics and Management (2014)

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13.	Dr Howard Frederick, Jens Elting	Factors affecting green SCM in New Zealand Food and Beverage Sector	Anzam 2010
14.	Qinghua Zhu, Joseph Sarkis	Relationships between operational practices and performance among early adopters of green supply chain management practices in Chinese manufacturing enterprises	Journal of Operation Management (2004)
15.	A.M.A. El Saadany, M.Y Jaber, M.Booney	Environmental performance measures for Supply Chain	A.M.A. El Saadany, M.Y.Jaber, M. Bonney, (2011) "Environmental performance measures for supply chains", Mangt Research Review, Vol. 34 Iss: 11, pp.1202 – 1221
16.	PurbaRao,Diane Holt	Do Green Supply Chain lead to competitiveness and economic performance	International Journal of Operations and Production Management
17.	K.Y Tippayawong,T.Tiwaratreewit, A Sopadang	Positive influence of Green Supply Chain Operations on Thai Electronics firms Financial Performance	Procedia Engineering 118 (2015)
18.	Ram Bhool,M.S. Narwal	An Analysis of Drivers affecting the implementation of green supply chain management for the Indian manufacturing industries	International Journal of Research in Engineering and Technology
19.	Su Yol Lee	Drivers for the participation of small and medium sized suppliers in green Supply Chain initiatives	Supply Chain Management: An International Journal, Vol 13
20.	Ninlawan C., Seksan P., Tossapol K., and Pilada W.	The Implementation of Green Supply Chain Management Practices in Electronics Industry	Preceeding of the International MultiConference of Engineers and Computer Scientists 2010 Vol III, IMECS 2010, March 17-19, 2010, Hong Kong
21.	HamidehShekari, SkandarShirazi, Mohamad Ali Afshari, Said Mehdi Veysseh	Analyzing the key factors affecting the green supply chain management: A case study of steel industry	Management Science Letters ISSN 1923-9343 (Online) - ISSN 1923-9335 (Print) Quarterly Publication Volume 1 Issue 4 pp. 541-550 , 2011
22.	SashiSekharParamanik, Surjit Kumar Kar	Green Technology performance measures using BSC-DEA approach	The IUP Journal of Knowledge Management, Oct 2013.
23.	NimawatDheeraj, Namdev Vishal	An Overview of Green Supply Chain Management in India	Research Journal of Recent Sciences ,ISSN 2277-2502 Vol. 1(6), 77-82, June (2012) Res.J.Recent Sci.
24.	Joseph Sarkis	A strategic decision framework for green supply chain management	Journal of cleaner production 11(2013)
25.	ToshiH.Arimura, Nicole Darnall, Hajime Katayama	Is ISO 14001 a gateway to more advanced voluntary action? The case of green supply chain management	Journal of Environment Economics and Management 61 (2011)
26.	Qinghua Zhu, Yong Geng, Tsuyoshi Fujita, ShizukaH.	Green Supply Chain Management in leading manufacturers	Management Research Review, Vol.33 Iss4 pp.380-392
27.	Surajit Bag	Designing the Green Supply Chain strategy for Indian Manftg firm	Journal of Supply Chain Management system
28.	Tareq Al Khidir, Dr SuhaizaMohamadZailani	Greening of the Supply Chain through Supply Chain initiatives towards environmental sustainability	Department of Business Studies, Marketing and E-Business Section, Salalah College of Technology, Oman and School of Management, Universiti

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			Sains Malaysia
29.	A.Kamolkittiwong, B.Phrukashphanrat	An Analysis of Drivers affecting Green Supply Chain Management implementation in Electronic Industry in Thailand	Journal of Economics Business and Management Vol 3,No 9,Sept 2015
30.	James EduPeprah, Isaac Opoku-Fofie, KwabenaNduro	Factors influencing green supply chain in the mining sector in Ghana	European Journal of Logistics, Purchasing and Supply Chain Management Vol.4, No1, pp.32-50,February 2016

Table 3: Identification of subcritical factors based on researcher's findings

Electronics Industry	Food Industry	Automobile Industry
Internal Environmental Audits [1,5,11,14,20]	Supplier evaluation and selection [4,5,11,16,29]	Commitment from the top management [1,2,4,10,29]
Supplier evaluation and selection [4,5,11,16,29]	Internal Environmental Audits [1,5,11,14]	Green purchasing [1,4,5,7,8,9,11,12,18,26,28]
Cooperation with customers [1,2,4,8,9,12,18,26,28]	Green Purchasing [1,3,4,5,7,8,9,11,12,18,26,28]	Training employees [2,10]
Commitment from the top management [1,2,4,10,20,29]	Operational performance [6,8,9,11,24,27]	Government regulations and legislations [7,8,9,10,18,19,29]
Green purchasing [1,4,5,7,8,9,11,12,17,18,20,26,28]	Government regulations and legislations [3,7,8,9,10,18,19,29]	Supplier evaluation and selection [4,5,11,16,29]
Reverse logistics [1,9,10,12,17,20,21,27,29]	Commitment from the top management [1,2,3,4,10,13,29]	Eco-friendly design [1,4,8,9,11,14,17,26]
Ecofriendly packaging [1,11,17]	Process auditing [1,3,14,15]	Environmental management systems [1,6,8,11,14,25,26]
Government regulations and legislations [7,8,9,10,18,19,29]	Pre-shipment inspection [3,4,5,10,16,22]	Lifecycle management [1,3,9,10,12,17,20,21,27,29]
Green Manufacturing and product recovery [1,5,11,14]	Environmental Management systems [1,6,8,11,14,20,25,26]	Social performance [6,18,28]
IT support systems [1,7,11,16,18,22,27]	Green Manufacturing and product recovery [1,5,11,14]	Operational performance [6,8,9,11,20,24,27]
Process auditing [1,14,15,20]	Ecofriendly packaging [1,11,17]	Competitiveness [10,13,18,29]
Pre-shipment inspection [4,5,10,16,22]	Waste Management [11,16,18,27]	Organization involvement [2,10,15,16,30]
Transportation and distribution [1,4,5,11,15,17,20]	Organization Strategy [3,13,27]	Investors and Stake holder pressure [7,18,22,29]
Increasing the cube utilization of the products [1,5,11,14,15]	Training employees [2,3,10]	Process Auditing [1,14,15]
Strategically placing the warehouses [1,5,15,17,20,27]	Transportation and distribution [1,4,5,11,15,17]	Performance appraisal [2,3,10,16,18,30]
Training Employees [2,10]	Increase the cube utilization of products [1,5,11,14,15]	Green Manufacturing and product recovery [1,5,11,14]
Waste Management [11,16,18,27]	Reverse logistics [1,3,9,10,12,17,21,27,29]	Organization Strategy [13,27]
Organization involvement [2,10,15,16,20,30]	Performance appraisal [2,3,10,16,18,30]	IT support systems [1,7,11,16,18,22,27]
Environmental management systems [1,6,8,11,14,25,26]	Competitiveness [10,13,18,29]	Waste Management [11,16,18,27]

The 37 green supply chain subcritical success factors from the different industries were listed. The success factors important from the green perspective for the supply chain management after thorough perusal by different authors from the various literatures and citation has been given below.

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TABLE 4: Citation of subcritical success factors from different literatures

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	TOTAL
Commitment from the top management	✓	✓	✓	✓																										8	
Green Purchasing	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓				✓			✓	✓					✓	✓	✓		15	
Cooperation with the customers	✓	✓	✓	✓				✓	✓	✓	✓	✓	✓					✓		✓	✓					✓	✓			11	
Internal Environmental audits	✓				✓						✓	✓	✓	✓						✓	✓									5	
Government regulations and legislations			✓				✓	✓	✓	✓								✓	✓								✓			8	
Training employees		✓	✓							✓	✓	✓																		3	
Eco-friendly packaging	✓									✓	✓	✓					✓													3	
Reverse Logistics	✓	✓	✓						✓	✓	✓	✓	✓				✓			✓	✓						✓	✓		10	
Eco-friendly design	✓			✓				✓	✓	✓	✓	✓		✓			✓									✓	✓			9	
Supplier evaluation and selection				✓	✓					✓	✓	✓	✓				✓											✓		5	
Cooperation with the suppliers	✓				✓					✓	✓	✓	✓				✓										✓			7	
Environmental management systems	✓					✓		✓		✓	✓	✓	✓								✓				✓	✓				8	
Investment recovery								✓					✓							✓			✓							5	
Economic performance						✓	✓	✓	✓	✓	✓	✓	✓										✓			✓				4	
Environmental performance	✓					✓	✓	✓	✓	✓	✓	✓	✓							✓				✓						10	
Social performance						✓	✓	✓	✓	✓	✓	✓	✓						✓							✓	✓			3	
Operational performance						✓	✓	✓	✓	✓	✓	✓	✓							✓				✓		✓	✓			7	
Competitiveness										✓	✓	✓	✓						✓								✓	✓		4	
Employee involvement		✓								✓	✓	✓	✓						✓								✓	✓		4	
Audit Suppliers for green SCM		✓	✓	✓	✓					✓	✓	✓	✓						✓		✓							✓		5	
Awareness programs		✓	✓	✓	✓					✓	✓	✓	✓						✓		✓							✓		7	
Transportation and Distribution	✓			✓	✓					✓	✓	✓	✓				✓			✓	✓									7	
Encouragement for employees		✓	✓							✓	✓	✓	✓						✓		✓							✓		6	
Investors and stake holder pressure							✓													✓				✓			✓			4	
Process auditing	✓		✓											✓	✓						✓									5	
Preshipment inspection		✓	✓	✓	✓					✓	✓	✓	✓								✓			✓						6	
Increasing the cube utilization of the products	✓				✓					✓	✓	✓	✓										✓							4	
Green Manufacturing and product recovery	✓				✓			✓			✓	✓	✓							✓			✓							8	
Strategically placing warehouses	✓			✓						✓	✓	✓	✓						✓		✓						✓			8	
Logistics	✓			✓						✓	✓	✓	✓						✓		✓						✓			8	
Organization strategy		✓	✓							✓	✓	✓	✓							✓							✓	✓		4	
Programs to promote and track the reduction of waste	✓									✓	✓	✓	✓						✓		✓						✓			5	
Performance appraisal of the employees		✓	✓							✓	✓	✓	✓							✓								✓		6	
Waste Management										✓	✓	✓	✓							✓							✓			4	
TOTAL	17	7	11	8	11	5	5	9	8	12	16	5	4	11	5	8	7	11	2	17	2	2	2	2	1	6	8	2	7	5	

Table 5: Identification of sub performance measures factors based on researcher's findings

Electronics Industry	Food Industry	Automobile Industry
Waste management helps in better resource utilization [1,4,5,11,15,17,20]	Reduced raw material inventory level [3,13,27]	Increased market share [7,18,22,29]
Corporate image improvement [1,5,11,14,15]	Increase in sources of finance from market [2,3,10]	Favorable press coverage [6,8,9,11,20,24,27]
Allows to offset financial & environmental risk [1,5,15, 17,20,27]	Transportation and distribution [1,4,5,11, 15,17]	New market opportunities [2, 3,10,16,18,30]
Increased pressure on organization to become more responsible to environment [2, 10,12,17,20,21,27,29]	Improved fuel efficiency [1,5,11,14,15]	Green image reflects positively over the financial status of the firm [1,5,11,14]
Waste Management [11,16,18,27]	Reverse logistics [1,3,9, 10, 12,17,21,27,29]	Organization Strategy [1,7,11,16,18,22,27]
Reduced wastage of empty trailer space and in-house traffic movements [1,9,10, 12,17,20,21,27,29]	Cost reduction benefits from the supplier's improved performance [1,2,3,4,10,13,29]	Incorporates social responsibility within the firm [1,4,8,9,11,14,17,26]
Innovative ideas from employees to improve GSCM [1, 11,17,20,21,27,29]	Increased output from the employees [1,3,14,15]	Increase in awareness level towards environment [1,6,8,11,14,25,26]
Increase in team spirit & mutual coordination [7,8,9, 10,18,19,29]	Customer satisfaction & involvement through environmental performance [3,4,5,10,16,22]	Reduction in procurement costs for raw materials through reverse logistics [1,3, 9,10,12,17,20,21,27,29]
Recycling packaging from customer to reduce packaging costs [1,5,11,14]	Satisfaction towards eco-friendliness resulting in loyalty of customers [1,6,8,11,14,20,25,26]	Recycling from the customer also resulting in decrease in disposal costs [6,18,28]
Optimum utilization of available	Reduction in environmental risks	Decrease in fines for breaking

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resources [1,7,11,16,18,22,27]	[1,5,11,14]	environmental laws [1,14,15]
Reduced miles,carbon footprint & improved transportation [1,14,15,20]	Increase in environmental quality of products [1, 11,17]	Usage of energy, water & by-products in a more efficient way. [10,13, 18,29]
Reduced mining & consumption of virgin material [4,5,10,16,22]	Decrease in costs for purchasing environment friendly raw materials [11,16,18,27]	Minimization of resource consumption & pollution [2,10,15,16,30]
Reduced raw material inventory level [3,13,27]	Increased market share [7,18,22,29]	Waste management helps in better resource utilization [1,4,5,11,15,17,20]
Transportation and distribution [1,4,5,11, 15,17]	New market opportunities [2, 3,10,16,18,30]	Allows to offset financial & environmental risk [1,5,15, 17,20,27]
Reverse logistics [1,3,9, 10, 12,17,21,27,29]	Organization Strategy [13,27]	Increased pressure on organization to become more responsible to environment [2, 10,12,17,20,21,27,29]
Increased output from the employees [1,3,14,15]	Increase in awareness level towards environment [1,6,8,11,14,25,26]	Innovative ideas from employees to improve GSCM
Satisfaction towards eco-friendliness resulting in loyalty of customers [1,6,8,11,14,20,25,26]	Recycling from the customer also resulting in decrease in disposal costs [6,18,28]	Reduced mining & consumption of virgin material [4,5,10,16,22]
Increase in environmental quality of products [1, 11,17]	Usage of energy, water & by-products in a more efficient way. [10,13, 18,29]	Optimum utilization of available resources [1,7,11,16,18,22,27]

The 32 green supply chain subcritical performance measures factors from the different industries were listed. The success factors important from the green perspective for the supply chain management after thorough perusal by different authors from the various literatures and citation has been given below.

TABLE 6: Citation of subcritical success factors from different literatures

Sr No	Sub Performance Measures	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Total			
1	Optimum utilization of available resources	✓																															10		
2	Reduction in environmental risks		✓	✓	✓	✓	✓	✓																									9		
3	Decrease in fines for breaking environmental laws					✓			✓				✓	✓					✓		✓					✓							8		
4	Reduced miles,carbon footprint & improved transportation		✓		✓	✓	✓	✓	✓	✓	✓	✓																					10		
5	Increase in environmental quality of products				✓				✓																								9		
6	Usage of energy, water & by-products in a more efficient way.			✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	12		
7	Reduced mining & consumption of virgin material	✓						✓					✓							✓							✓	✓	✓	✓	✓	✓	7		
8	Decrease in costs for purchasing environment friendly raw materials		✓		✓					✓					✓	✓													✓				7		
9	Minimization of resource consumption & pollution	✓					✓				✓									✓			✓		✓				✓	✓	✓	✓	9		
10	Waste management helps in better resource utilization	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	11		
11	Reduced raw material inventory level	✓				✓				✓																✓	✓	✓	✓	✓	✓	✓	✓	8	
12	Increased market share			✓												✓																	7		
13	Corporate image improvement		✓			✓		✓					✓																				8		
14	Increase in sources of finance from market			✓						✓																							7		
15	Allows to offset financial & environmental risk			✓				✓			✓		✓							✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	11		
16	New market opportunities	✓			✓								✓																				6		
17	Favorable press coverage					✓			✓				✓								✓						✓	✓	✓	✓	✓	✓	✓	8	
18	Increased pressure on organization to become more responsible to environment	✓				✓						✓		✓											✓					✓	✓	✓	7		
19	Improved fuel efficiency		✓				✓																										✓	8	
20	Green image reflects positively over the financial status of the firm		✓				✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	9	
21	Reduced wastage of empty trailer space and in-house traffic movements			✓		✓				✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	9	
22	Cost reduction benefits from the supplier's improved performance	✓					✓						✓													✓	✓	✓	✓	✓	✓	✓	✓	✓	8
23	Incorporates social responsibility within the firm	✓					✓																											13	
24	Innovative ideas from employees to improve GSCM		✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	12	
25	Increased output from the employees		✓				✓						✓																					10	
26	Increase in awareness level towards environment				✓				✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	16	
27	Increase in team spirit & mutual coordination								✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	8	
28	Customer satisfaction & involvement through environmental performance	✓			✓																													8	
29	Reduction in procurement costs for raw materials through reverse logistics	✓			✓								✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	11	
30	Recycling packaging from customer to reduce packaging costs	✓				✓																												7	
31	Satisfaction towards eco-friendliness resulting in loyalty of customers		✓							✓				✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	9	
32	Recycling from the customer also resulting in decrease in disposal costs		✓																															9	
		12	7	10	8	12	8	9	11	10	13	11	9	11	11	5	11	9	12	6	7	7	11	10	10	7	11	9	10	12	11				

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III. RESEARCH METHODOLOGY

From the literature review, the various input factors and output factors related to green supply chain were listed using a Likert scale. A survey questionnaire was prepared based on it and got filled by various officials of manufacturing sectors related to production of mechanical parts/elements. The questionnaire designed comprised of two sections. Section I had the inputs given in bold which were basically what effort to be applied to achieve target from green perspective that are expected to provide firms with a competitive advantage and in Section II the expected outputs/performance based on effort applied were listed. The respondents' level of agreement on the corresponding outputs for the respective inputs under different factors based on their experience working in company were recorded. The ratings were unipolar i.e 1=None, 2=Slightly Agree, 3=Fairly Agree, 4=Mostly Agree, 5=Strongly Agree. The data was collected using mail questionnaires as well as on one to one interview basis to obtain individual perceptions and attitudes as they are more responsible for the performance of the firm.

The data collected was then analysed using Statistical Package for survey of Social Sciences (SPSS) which can perform highly complex data manipulation and analysis with simple instructions. To investigate and identify the critical success factors for improving the performance of green supply chain the various statistics such as mean, median, mode, variance, standard deviation, etc were computed. The research data was then tested for Adequacy, Normality, and Reliability. Factor Analysis was done to reduce the number of variables and study the relationship between them to study the dimensionality of the set of variables. With the help of factor loading it was explained how closely the variables are related to each other. Eigen value was used to indicate the importance of each factor in relation to particular set of variables being analysed. The items were then correlated and using stepwise multiple regression it was found out how a particular dependent variable responds to a set of input variables and thus hypothesis was tested for the same

IV. DATA TESTING ANALYSIS

Out of 143, there were 115 respondents who took part in this study covering around 47 micro, small and medium enterprises in Mumbai, India. The response rate was 80.42%. The respondents were the senior officials of the various manufacturing industries out of which 21.11% were post graduates, 57.77% were graduates, 15.55% were diploma holders and 5.55% respondents had done ITI. With respect to experience, 68.89% respondents have experience of more than 20 years.

Data Analysis

The data collected was then analyzed using Statistical Packages for Social Sciences (SPSS). In order to analyze the data collected, descriptive statistics including percentages, frequencies, mean, standard deviation, etc were computed.

Findings of Input Data

Table 7 :Descriptive Statistics for Input Data

	No. of items	Min	Max	Range	Mean	Variance
Item Means	37	1.83	3.83	2	2.933	0.197

Findings of Output Data

Table 8 :Descriptive Statistics for Output Data

	No. of items	Min	Max	Range	Mean	Variance
Item Means	32	1.71	4.02	2.31	2.957	0.339

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Sample Adequacy

A sample population of 90 was arrived at by calculating the target population of 115 with a 95% confidence level and an error of 0.05 using the Slovin's Formula as given below[22]:

$$n = N / (1 + N * e^2)$$

where n = Sample Size

N = Size of population

e = error

$$\text{therefore, } n = 115 / (1 + 115 * 0.05^2)$$

$$= 89.32$$

$$= 90 \text{ (round up)}$$

The study made use of stratified random sampling technique to come up with a sample size of 90 respondents from a total of 115 respondents.

Normality

Normality test was done to check whether the data was normally distributed and is generally represented by a bell shaped curve. The data was analyzed using Shapiro Wilk's test for normality as our sample size is less than 2000 elements. For both input factors as well as performance measures it was found out that the data was normally distributed.

Reliability of the Instrument

The measures of reliability helps in checking for the internal consistency of the elements. The results of Cronbach's coefficient alpha for 37 assessment items of input variables (critical success factors) came out to be 0.947 and the same for 32 assessment items of output (performance measures) came out to be 0.940 which indicate high reliability of green supply chain operational performance measurement as a data collection tool for this study. The results Cronbach's coefficient alpha are as shown in the table given below.

Table 9 :Reliability Statistics for CSFs

	Cronbach's alpha	No. of items
CSF	0.947	37

Table 10: Reliability Statistics for PM

	Cronbach's alpha	No. of items
PM	0.940	32

Internal Consistency Analysis

Internal Consistency was used to assess the reliability which indicated how well the different items of a scale measure the same concept. The results of reliability are generally measured by Cronbach's coefficient alpha which ranges from 0-1. The higher value of alpha indicates more reliability. Cronbach's alpha was measured for each of the main factors from both the groups. The value of Cronbach's coefficient alpha for critical success factors was in the range of 0.815-0.895 and for performance measures it was in the range of 0.746-0.887. All the items showed internal consistency as the value of alpha was more than 0.7.

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Table 11 :Internal Consistency Analysis for CSF

Sr No.	Critical Success Factors	Cronbach's alpha	No. of items
1	Vision & Mission	0.872	5
2	Human Capital	0.863	7
3	Green Process	0.847	7
4	Finance	0.857	4
5	Environment	0.895	7
6	Organization Culture	0.815	7

Table 12 :Internal Consistency Analysis for PM

Sr No.	Performance Measures	Cronbach's alpha	No. of items
1	Quality Performance	0.887	5
2	Resource Conservation	0.766	6
3	Financial Performance	0.844	6
4	Productivity/ Competitiveness	0.829	5
5	Employee Satisfaction	0.746	5
6	Customer Satisfaction	0.810	5

Factor Analysis

The main idea behind factor analysis was to find less number of factors that can be used to find relationships among set of many interrelated variables. The research analysis showed that the correlations between performance improvement factors and performance factors were positive. The factor analysis was then applied to six main factors of green supply chain using dimension reduction which had 37 sub critical factors. The factors having the value of Eigen value more than one were extracted. Out of 37 sub critical factors, only 21 Sub critical factors were extracted using SPSS through dimension reduction.

Table 13: Factor Analysis of CSF

CSF	Total Sub factors	No of Extracted Sub factors	Values of item loaded (Range)	Eigen Value	% Variance	Coefficients Range
Factor 1 (Vision & Mission)	5	3	0.715-0.838	2.340	78.010	0.361-0.391
Factor 2 (Human Capital)	7	4	0.389-0.667	2.198	54.958	0.284-0.371
Factor 3 (Green Process)	7	4	0.605-0.787	2.815	70.386	0.276-0.315
Factor 4 (Finance)	4	3	0.711-0.761	2.305	76.823	0.366-0.396
Factor 5 (Environment)	7	3	0.813-0.871	2.521	84.034	0.358-0.370
Factor 6 (Organization Culture)	7	4	0.488-0.634	2.250	56.253	0.310-0.354

Factor 1 Vision & Mission: The three sub critical factors extracted under our first main factor labeled as 'Vision & Mission' are Commitment from the top management, Implementing Environmental Management Systems and Giving preference to ISO 14000 certified suppliers. Commitment from the top management came out to be the most important factor amongst the three extracted factors.

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Factor 2 Human Capital:The four sub critical factors extracted under second main factor labeled as ‘Human Capital’ are Attracting talented professionals, Retaining trained professionals, Motivation & awareness programs for the employees and having Company specific GSCM training programs. Out of the extracted four sub critical success factors, implementing company specific GSCM training program came out to be the most important factor.

Factor 3 Green Process: The three sub critical factors extracted under third main performance improvement factor ‘Green Process’ are Auditing of process to reduce pollution, Designing for disassembly, remanufacturing & reassembly, Increasing cube utilization & use of gravity wherever possible and Strategically placing the warehouses and distribution centres. Greening the process means improving the technology to have less impact on environment. Strategically placing the warehouses and distribution centres came out to be the most significant factor amongst the extracted factors under Green Process.

Factor 4 Finance:The fourth factor ‘Finance’ extracted three sub critical factors viz., Building partnership with green organization and suppliers, Ensuring government regulations & legislations and Green image building of the firm. These factors will help us convert improved environmental operational performance into increased market share, sales, return on assets and benefits from financial markets. Ensuring government regulations and legislations came out to be the most important factor amongst the extracted factor under Finance.

Factor 5 Environment:The three sub critical factors extracted under the fifth main factor ‘Environment’ are Designing for environment, Reverse logistics and Having safety committees and recycling programs. Having safety committees & recycling programs came out to be the most significant factor amongst the extracted factors under the fifth main factor Environment. These factor suggests that the improvement in environmental performance would reduce waste and thereby improving operational performance leading to increased profits as there will be decrease in procurement costs.

Factor 6 Organization Culture:The sixth and the last group formed in the factor analysis named ‘Organization Culture’ contains the extracted factors viz., Providing technical assistance, Selecting supplier on green practices criteria, Identifying the low hanging fruit & areas for improvement and Keeping a track on whether the goods delivered on time to be a strong competitor in the market. From the extracted factors, Keeping a track on whether the goods delivered on time to be the most important factor. These factors tends to focus on eco-friendly market and react if the demand of the consumer increases. It tries to find a systematic approach to cope up with the environmental issues as well as to have a competitive advantage which will basically help us maintaining the momentum in greening the business and will keep the people more interested in our product. The factor analysis was also applied to group the 32 performance measurement items into six main factors of green supply chain practices using dimension reduction. The factors having the value of Eigen value more than one were extracted. Out of 32 sub critical factors, only 19 Sub critical factors were extracted using SPSS through dimension reduction.

Table 14: *Factor Analysis of PM*

PM	Total Sub factors	No of Extracted Sub factors	Values of Item loaded (Range)	Eigen Values	% Variance	Coefficients Range
Factor 1 (Quality Performance)	5	3	0.812-0.829	2.460	82.009	0.366-0.370
Factor 2 (Resource Conservation)	6	4	0.567-0.662	2.392	59.809	0.315-0.340
Factor 3 (Financial Performance)	6	3	0.393-0.817	1.990	66.335	0.315-0.454
Factor 4 (Productivity/Competitiveness)	5	3	0.744-0.855	2.434	81.117	0.355-0.380
Factor 5 (Employee Satisfaction)	5	3	0.319-0.728	1.741	58.017	0.325-0.490
Factor 6 (Customer Satisfaction)	5	3	0.740-0.852	2.412	80.390	0.357-0.383

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Factor 1 Quality Performance: The first main performance measurement factor labeled as ‘Quality Performance’ contains the extracted sub factors viz., Optimum utilization of available resources, Decrease in fines for breaking environmental laws and Improvement in environmental quality of products. Out of the extracted factors, decrease in fines for breaking environmental laws came out to be the most important sub factor under the first main performance measurement factor.

Factor 2 Resource Conservation: The second performance measurement factor can be labeled as ‘Resource Conservation’ contains the four extracted sub factors viz., Use of energy, water & by products in a more efficient way, Reduced mining & consumption of virgin material, Better Resource utilization and Reduced raw material inventory. Out of extracted four sub factors, reduced raw material inventory came out to be the most important dimension. This factor ensures satisfaction of customer through involvement in environmental performance and thereby resulting in loyalty of customers by reduction in procurement costs by reduction in procurement costs for raw material through reverse logistics and recycling packaging from customers to reduce the packaging costs.

Factor 3 Financial Performance: This third performance measure can be labeled as ‘Financial Performance’ which had three underlying dimensions as Increased market share, Increase in sources of finance from market and Allows to offset financial and environmental risks. This factors favors that the efficient use of energy and different resources has a positive impact on financial performance of the firm. Offsetting financial & Environmental risks came out to be the most dimension. However, the short term measures will not have a good impact on the financial performance.

Factor 4 Productivity/Competitiveness: This performance measure labeled as ‘Productivity/Competitiveness’ consists of extracted factors viz., Improved fuel efficiency, Reduced wastage of empty trailer space & in-house traffic movements and Cost reduction benefits from supplier's improved efficiency. Out of the three sub performance measures, Cost reduction benefits from supplier's improved efficiency came out to be the most important dimension.

Factor 5 Employee Satisfaction: This performance measure labeled as ‘Employee Satisfaction’ had three underlying dimensions viz., Recycling packaging from customer to reduce packaging costs, Satisfaction towards eco-friendliness resulting in loyalty of customers and Recycling from the customer also resulting in decrease in disposal costs. Out of extracted dimensions, Incorporating social responsibility within the firm came out to be the most dimension. The performance measures extracted under this group leads to increase in team spirit and mutual coordination among the employees.

Factor 6 Customer Satisfaction: The last performance measure labeled as ‘Customer Satisfaction’ had three underlying dimensions viz., Recycling packaging from customer to reduce packaging costs, Satisfaction towards eco-friendliness resulting in loyalty of customers and Recycling from the customer also resulting in decrease in disposal costs. Satisfaction towards eco-friendliness resulting in loyalty of customers came out to be the most important dimension amongst the extracted performance measures. These factors reduces the costs for purchasing environment friendly raw materials, reduced mining and consumption of virgin material, minimization of resource consumption and pollution and better utilization of available resources.

Factor Adequacy

Table 15: *KMO and Bartlett's Test for CSF and PM*

KMO and Bartlett's Test for CSF		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.811
Bartlett's Test of Sphericity	Approx. Chi-Square	1959.600
	df	351
	Sig.	.000

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KMO and Bartlett's Test for PM		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.820
Bartlett's Test of Sphericity	Approx. Chi-Square	1789.630
	df	325
	Sig.	.000

The results of KMO and Bartlett's Test for CSF and PM are given in the table above. The Kaiser-Meyer-Olkin (KMO) measure of sample adequacy gave the value of Kaiser criterion as more than 0.8 for both independent variables as well as dependent variables which indicates that the data is highly appropriate for factor analysis and the Bartlett's test of sphericity also showed Sig. of the test is 0.0 which is less than 0.5, which means that the factor analysis could structuralize the construct of the research. The results of Bartlett's Test of Sphericity for input as well as output variables is given below.

Table 16: Results of Bartlett's Test of Sphericity for input variables

Sr No.	Critical Success Factors	KMO	Bartlett's Test of Sphericity		
			Approx Chi-Square	df	Sig
1	Vision & Mission	0.867	331.795	10	0.00
2	Human Capital	0.800	115.734	21	0.00
3	Green Process	0.835	241.190	10	0.00
4	Finance	0.772	177.410	6	0.00
5	Environment	0.822	526.014	21	0.00
6	Organization Culture	0.817	292.075	21	0.00

Table 17: Results of Bartlett's Test of Sphericity for output variables

Sr No.	Performance Measures	KMO	Bartlett's Test of Sphericity		
			Approx Chi-Square	df	Sig
1	Quality Performance	0.866	346.637	10	0.00
2	Resource Conservation	0.760	234.815	15	0.00
3	Financial Performance	0.762	324.041	15	0.00
4	Productivity/ Competitiveness	0.818	245.043	10	0.00
5	Employee Satisfaction	0.692	170.744	10	0.00
6	Customer Satisfaction	0.694	230.971	10	0.00

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MERGING OF SUB CRITICAL SUCCESS FACTORS

Thus, the 6 main critical success factors were then formed for the micro, small and medium enterprises of mechanical elements/parts manufacturing industry viz., Vision and Mission, Human Capital, Process, Finance, Environment and Organization Culture from the 37 subcritical success factors. The given below is the pie chart of critical success factors formed along with the weightage of acceptance by the authors in the previous studies listed in the paper before.

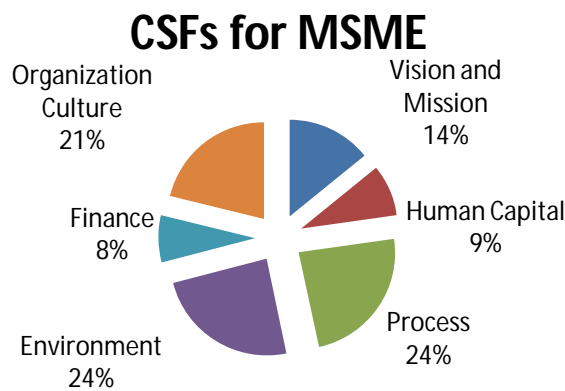


Figure 10: Percentage of each critical success factor from the total success factors mentioned by the authors in previous literatures

MERGING OF SUB PERFORMANCE MEASUREMENT FACTORS

Thus, the 6 main performance measurement factors were then formed for the micro, small and medium enterprises viz., Quality Performance, Resource Conservation, Financial Performance, Productivity/Competitiveness, Employee Satisfaction and Customer Satisfaction. from the 32 sub performance measurement factors. The given below is the pie chart of performance measurement factors formed along with the weightage of acceptance by the authors in the previous studies listed in the paper before.

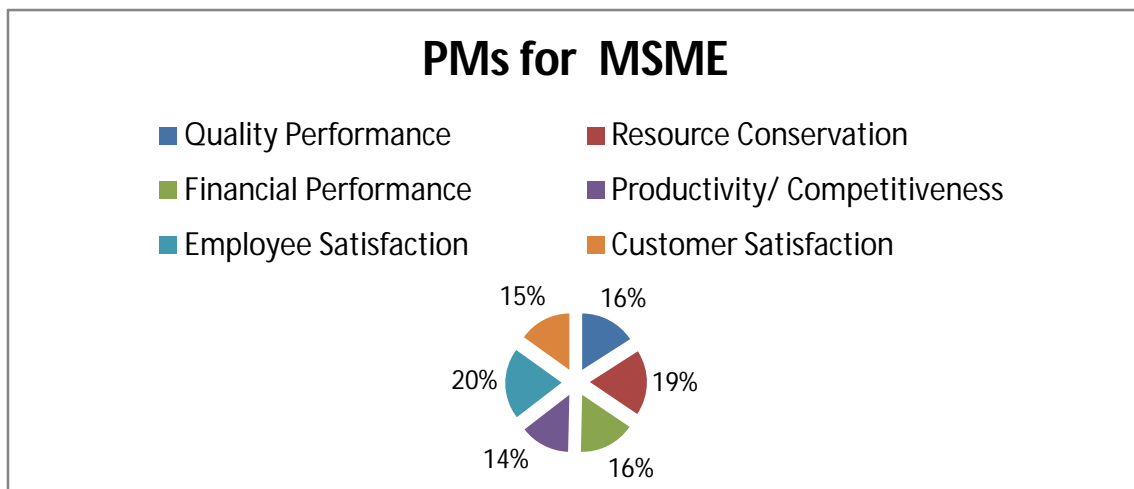


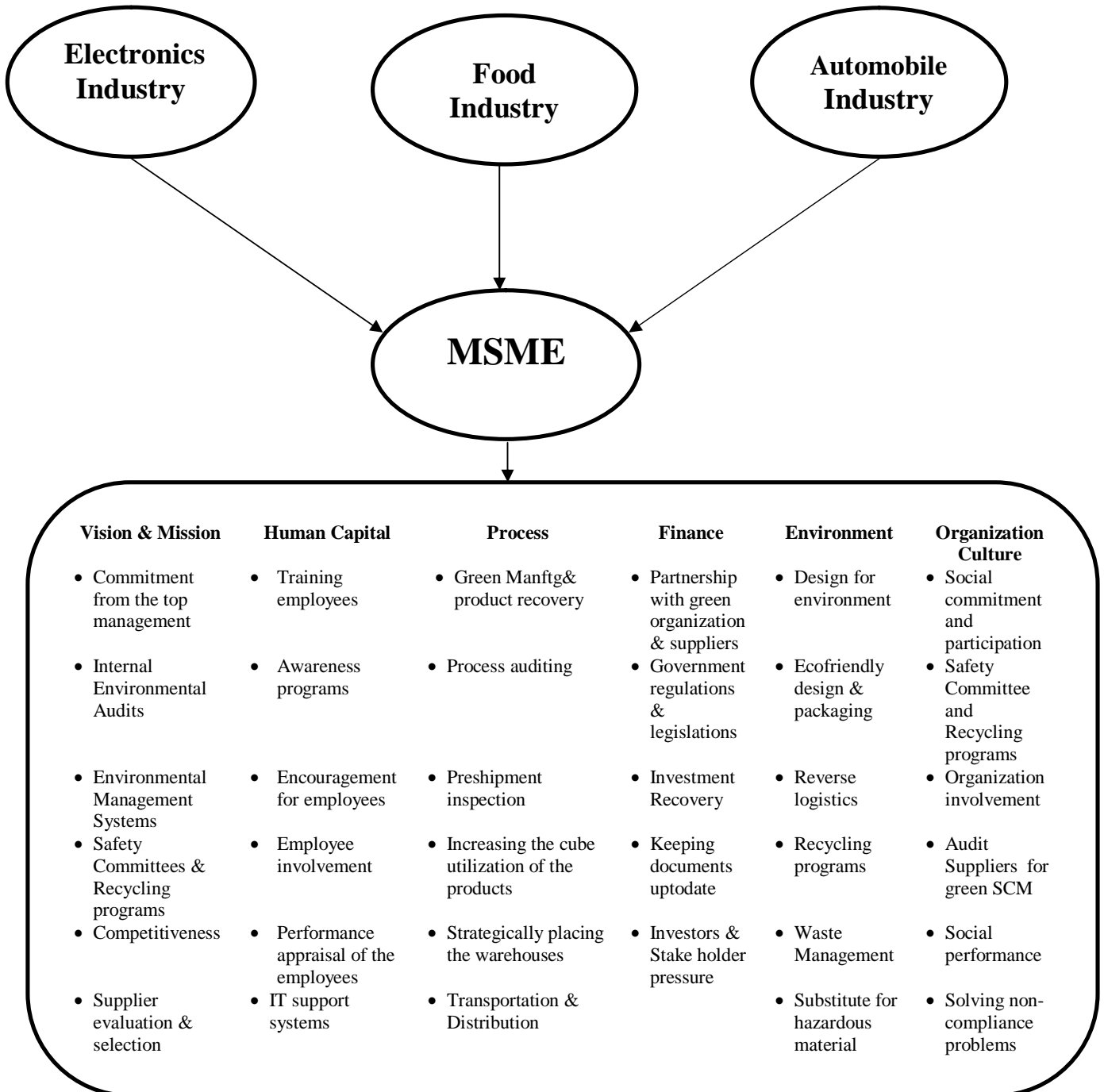
Figure :Percentage of each performance measurement factor from the total factors mentioned by the authors in previous literatures

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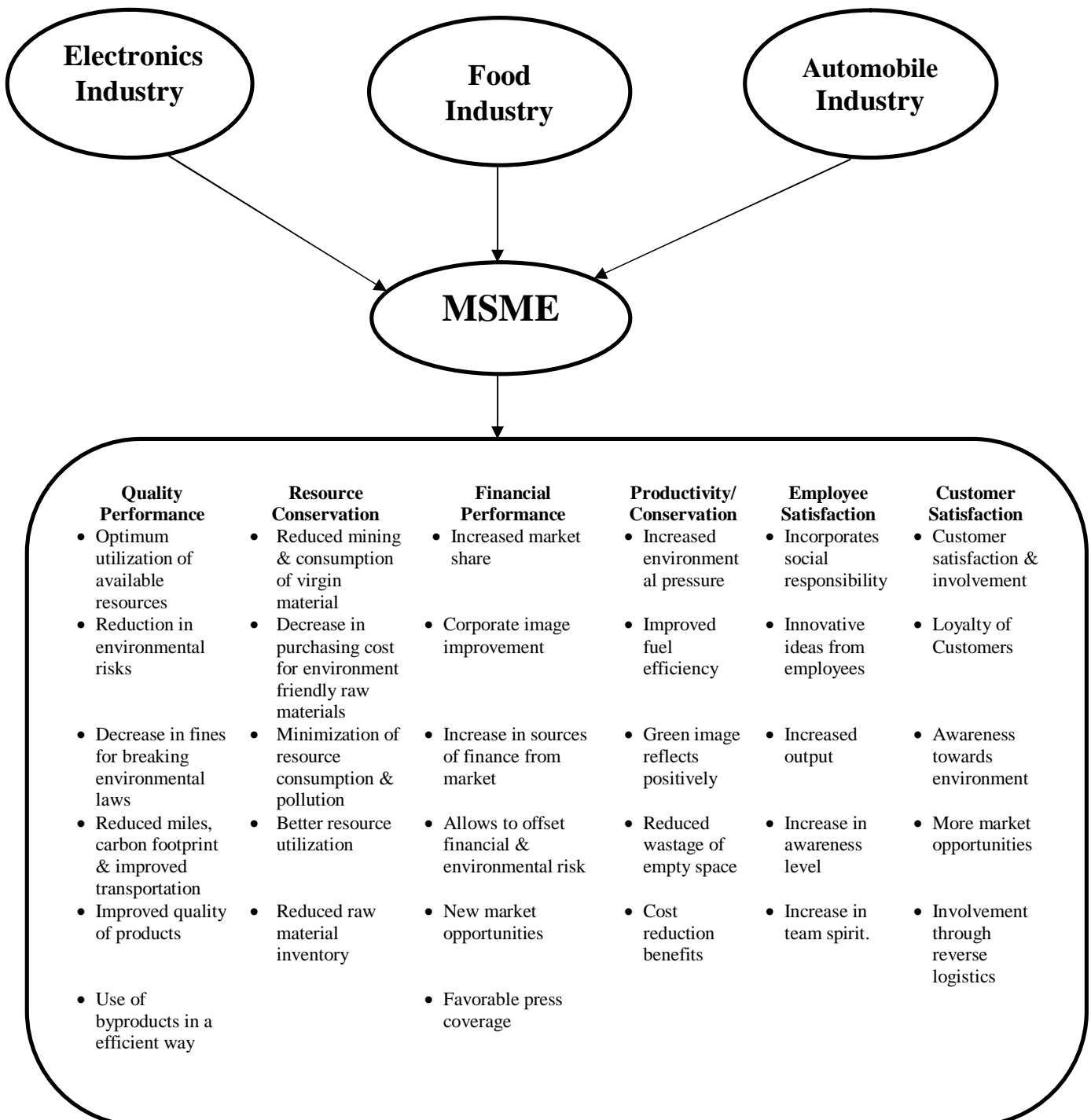


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4.10 Performance Improvement Factors (CSFs) & their relationship with Performance Measurement Factor

Table 18 : Performance Improvement Factors & their relationship with Performance Measurement Factors

Correlations						
	CSF-1	CSF-2	CSF-3	CSF-4	CSF-5	CSF-6
PM-1	.731**	.564**	.661**	.675**	.856**	.535**
PM-2	.711**	.730**	.868**	.459**	.590**	.629**
PM-3	.452**	.794**	.661**	.622**	.597**	.635**
PM-4	.837**	.865**	.796**	.670**	.550**	.662**
PM-5	.622**	.642**	.645**	.702**	.544**	.671**
PM-6	.777**	.761**	.847**	.571**	.581**	.755**

** . Correlation is significant at the 0.01 level (2-tailed).

* . Correlation is significant at the 0.05 level (2-tailed).

Relationship between Vision & Mission(CSF-1) with outputs

The above matrix shows that our first critical success factor Vision & Mission is highly correlated with performance measures Quality Performance, Resource Conservation, Productivity/Competitiveness and Customer Satisfaction. However, performance improvement factor has the highest correlation with the Productivity/Competitiveness. It implies that Commitment from the top management to take initiatives and designing policies keeping in mind eco-friendly supply chain is very important to create a sense of competitiveness within the firm which will help us increase the productivity by improving the fuel efficiency and have cost reduction benefits from supplier's improved efficiency. The input factor also shows the positive correlations with Employee Satisfaction but it has the least correlation with the Financial Performance which is also quite significant. Vision and Mission have an indirect impact as it only provides a path for the long term planning by the senior most officials. An optimistic vision from top management can have the ability to influence, support and implement green initiatives. The firms showing strong commitment towards environment will enjoy long lasting benefits to have a competitive advantage over others but the firms have also pointed out that investing to reduce pollution will have a negative impact on financial performance.

Relationship between Human Capital (CSF-2) with outputs

Human Capital is highly correlated with Quality Performance, Financial Performance, Productivity/Competitiveness and Customer Satisfaction. This performance improvement factor also has the highest correlation with Productivity/Competitiveness. Spreading awareness and educating employees about the eco-friendliness is very necessary to extract innovative ideas from them and create a sense of competitiveness amongst them. Attracting talented professionals, retaining trained professionals and having company specific GSCM programs is very necessary to improve fuel efficiency and have cost reduction benefits from supplier's improved efficiency. Human Capital also believes in having Company specific GSCM training programs which is will directly help us in increasing the productivity as well as competitiveness. Human Capital also shows the significant positive correlations with Quality Performance and Employee Satisfaction.

Relationship between Green Process (CSF-3) with outputs

Green Process is highly correlated with Resource Conservation, Productivity/Competitiveness and Employee Satisfaction. However, our third critical success factor has the highest correlation with the Quality Performance and Customer Satisfaction. Designing for disassembly, remanufacturing and reassembly, auditing of process, increasing cube utilization and strategically placing the warehouses & distribution centers will help us using the energy, water and by-products in a more efficient way. It will reduce mining and consumption of virgin material, reduced raw material inventory and better utilization of available resources to earn the loyalty of customers and satisfy them. Strategically

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placing the warehouses and distribution centers will reduce the miles which will result in improved fuel efficiency along with reduced carbon footprint. The Green process also shows significant correlations with Quality Performance, Financial Performance as well as Employee Satisfaction. However, the increasing awareness among the customers has led to the need for the green technology ecofriendly products resulting resource conservation.

Relationship between Finance (CS-4) with outputs

The fourth critical success factor Finance is highly correlated to Employee Satisfaction. As the Finance is interested in green image building of the firm to improve the corporate image. Finance has always stood out as the main factor for implementation of GSCM. The initial investment required for these eco-friendly technologies is very high. The institutions at the initial stage are very reluctant to invest for improving their existing technologies which is the basic difference between the traditional supply chain management and green supply chain management. Increase in the training and purchasing costs at the initial phase shows negative financial performance for the firm however in the long run these factors are going to benefit the firm with the cost reduction benefits, reduced charges for disposal and fines for breaking the environmental laws. The Finance shows significant and positive but least correlations with Resource Conservation. The initiative from top management to be eco-friendly is necessary but the problem is they need to balance the regulations compliance with profit making strategy at the same time to have a competitive advantage is necessary as well. The senior officials in crunch situations tend to get incline towards non certified suppliers in the race for making profit due to lack of priority for eco-friendliness at the initial stage. The Finance also shares a positive significant relationship with the remaining four performance measures.

Relationship between Environment(CS-5) with outputs

The fifth performance improvement factor Environment is highly correlated to Quality performance. However, it showed positive correlations with Resource Conservation, Financial Performance, Productivity/Competitiveness, Customer Satisfaction and Employee Satisfaction as it is concerned with having safety committees and recycling programs to identify and eliminate the sources of pollution. Designing for environment, having safety committees and recycling programs and reverse logistics is necessary for the optimum utilization of available resources and improving the environmental quality of products. Improving the existing practices to green practices brings in new market opportunities to explore. Environment is basically related to designing with keeping in mind eco-friendly aspects, proper waste disposal methods for hazardous substance and making use of reuse & recycle technologies which requires innovations in the technology available.

Relationship between Organization Culture(CS-6) with outputs

Organization Culture had the highest correlation with the Customer Satisfaction. It shows significant positive correlations with remaining performance measures as well. An organization should be more concerned with finding out the non-compliance problems of the employees, inspiring and spreading awareness amongst them towards eco-friendliness which will result in increase in team spirit, better innovative ideas and as a result incorporating social responsibility and satisfaction within the firm. Organization Culture can provide for a competitive edge over others as it gives sustainable advantage and thereby had relationship with Resource Conservation, Quality Performance, Financial Performance, Productivity as well as Employee satisfaction.

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Regression Analysis

In this study, a multiple regression analysis was conducted to test the influence of different performance improvement variables on the performance measurement factors of GSCM. The research used Statistical Package for Social Sciences (SPSS V 21.0) to analyze the measurements of the multiple regressions. The parameters are adjusted so that a measure of fit is optimized.

The regression model was:

$$Y = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \beta_5X_5 + \beta_6X_6 + \varepsilon$$

Where: Y = Performance Measurement Factor;

β_0 = Constant Term;

$\beta_1, \beta_2, \beta_3, \beta_4, \beta_5$ & β_6 = Beta coefficients;

X1= Vision & Mission=CSF_1;

X2= Human Capital=CSF_2;

X3= Green Process=CSF_3;

X4= Finance=CSF_4;

X5= Environment=CSF_5;

X6= Organization Culture=CSF_6;

ε = Error term

Regression Equations based on Regression Analysis Coefficients

Table 19 :Regression Equations based on Regression Analysis Coefficients

Output Factors	Regression Equations	R Square
1. Quality Performance	$Y_1 = - 0.101 + 0.494(\text{Green Process}) + 0.132(\text{Finance}) + 0.771(\text{Environment}) - 0.357(\text{Organization Culture})$	0.879
2. Resource Conservation	$Y_2 = 0.025 + 0.382(\text{Human Capital}) + 0.778(\text{Green Process}) - 0.124(\text{Finance}) + 0.311(\text{Environment}) - 0.368(\text{Organization Culture})$	0.840
3. Financial Performance	$Y_3 = 0.026 - 0.529(\text{Vision \& Mission}) + 0.654(\text{Human Capital}) + 0.575(\text{Green Process}) + 0.212(\text{Finance}) + 0.281(\text{Environment}) - 0.246(\text{Organization Culture})$	0.790
4. Productivity/ Competitiveness	$Y_4 = - 0.166 + 0.395(\text{Vision \& Mission}) + 0.475(\text{Human Capital}) + 0.173(\text{Green Process}) + 0.266(\text{Finance}) - 0.206(\text{Environment})$	0.942
5. Employee Satisfaction	$Y_5 = 0.068 + 0.177(\text{Green Process}) + 0.572(\text{Finance}) - 0.178(\text{Environment}) + 0.449(\text{Organization Culture})$	0.707
6. Customer Satisfaction	$Y_6 = - 0.049 + 0.235(\text{Vision \& Mission}) + 0.363(\text{Green Process}) + 0.186(\text{Finance}) + 0.277(\text{Organization Culture})$	0.828

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Framework Model developed on the basis of relationship assessed between performance improvement factors and performance measures on regressed equations

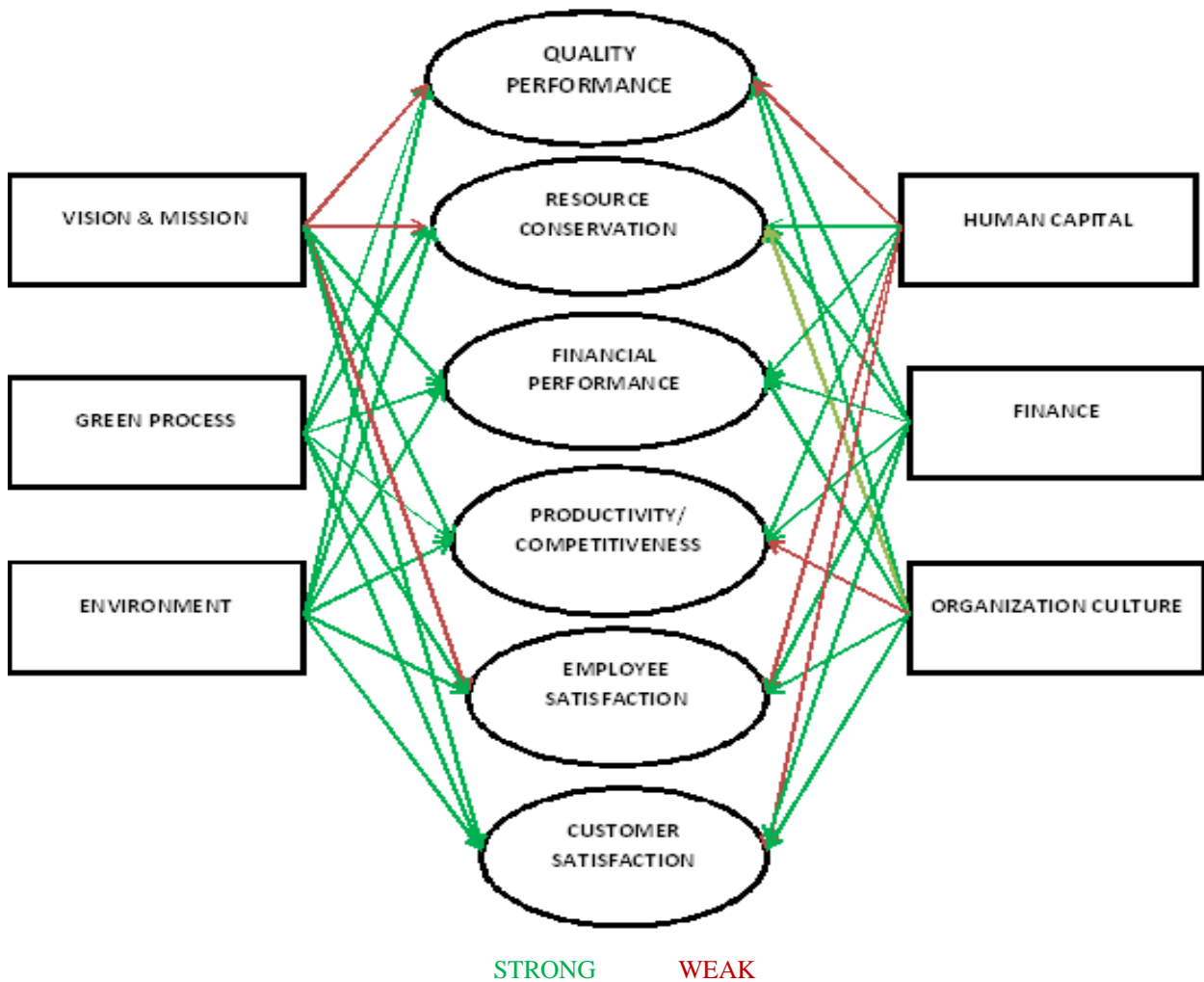


Figure :GSCM Framework Model based on Analysis

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Strong and Weak relationship between the Critical Success Factors and Performance Measurement Factors is as shown below

Table 20 :Strong and Weak relationship between the Critical Success Factors and Performance Measurement Factors is as shown below

Performance Measurement Factors	Relationship with Critical Success Factors	
	Strong	Weak
1. Quality Performance	Green Process Finance Environment Organization Culture	Vision & Mission Human Capital
2. Resource Conservation	Human Capital Green Process Finance Environment Organization Culture	Vision & Mission
3. Financial Performance	Vision & Mission Human Capital Green Process Finance Environment Organization Culture	Nil
4. Productivity/ Competitiveness	Vision & Mission Human Capital Green Process Finance Environment	Organization Culture
5. Employee Satisfaction	Green Process Finance Environment Organization Culture	Vision & Mission Human Capital
6. Customer Satisfaction	Vision & Mission Green Process Finance Organization Culture	Human Capital Environment

Hypothesis Testing

In order to analyze the influence of critical success factor on the performance measures the following hypothesis were developed.

Table 21 : Hypothesis Developed and Tested

Hypothesis No.1	Output Factors	Input Factors
1	Quality Performance is positively related to	Vision & Mission
2	Resource Conservation is positively related to	
3	Financial Performance is positively related to	
4	Productivity/Competitiveness is positively related to	

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5	Employee Satisfaction is positively related to	Human Capital
6	Customer Satisfaction is positively related to	
7	Quality Performance is positively related to	
8	Resource Conservation is positively related to	
9	Financial Performance is positively relatively to	
10	Productivity/Competitiveness is positively related to	
11	Employee Satisfaction is positively related to	Green Process
12	Customer Satisfaction is positively related to	
13	Quality Performance is positively related to	
14	Resource Conservation is positively related to	
15	Financial Performance is positively relatively to	
16	Productivity/Competitiveness is positively related to	
17	Employee Satisfaction is positively related to	Finance
18	Customer Satisfaction is positively related to	
19	Quality Performance is positively related to	
20	Resource Conservation is positively related to	
21	Financial Performance is positively relatively to	
22	Productivity/Competitiveness is positively related to	
23	Employee Satisfaction is positively related to	Environment
24	Customer Satisfaction is positively related to	
25	Quality Performance is positively related to	
26	Resource Conservation is positively related to	
27	Financial Performance is positively relatively to	
28	Productivity/Competitiveness is positively related to	
29	Employee Satisfaction is positively related to	Organization Culture
30	Customer Satisfaction is positively related to	
31	Quality Performance is positively related to	
32	Resource Conservation is positively related to	
33	Financial Performance is positively relatively to	
34	Productivity/Competitiveness is positively related to	
35	Employee Satisfaction is positively related to	Organization Culture
36	Customer Satisfaction is positively related to	

Accepted and Rejected Hypothesis

Table 22: Accepted and Rejected hypothesis

Hypothesis Accepted	Hypothesis Rejected
Hypothesis Numbers: 3,4,7,8,9,10,13,14,15, 16,17,18,19,20,21,22,23,24,25, 26,27,28,29,31, 32,33,35,36	Hypothesis Numbers: 1,2,5,6,11,12,30,34

Based on the statistical results and the regression analysis, with the help of significant and interpretable coefficients and equations we can conclude that this modelling approach was effective in measuring the relationship between performance improvement factors and performance measurement factors. The use of experimentally designed scenarios that simulate actual design performance decisions were successful in performance improvement.

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V. RESULTS & DISCUSSION

1. The comprehensive study of previous literatures founded the 37 sub critical factors and 32 performance measures for the green supply chain. The factor analysis reduced these extracted factors to 21 sub critical success factors and 19 sub performance measures which were then grouped into six main critical success factors and six main performance measures of the green supply chain for micro, small and medium enterprises of mechanical elements/parts manufacturing industries. Thus, the six critical success factors founded were Vision & Mission, Human Capital, Green Process, Finance, Environment and Organization Culture and the six performance measures were Quality Performance, Resource Conservation, Financial Performance, Productivity/Competitiveness, Employee Satisfaction and Customer Satisfaction.
2. 'Commitment from the top management' came out to be the most important factor from Vision & Mission as top management is very much responsible for taking initiatives and design policies keeping in mind eco-friendly supply chain to create a sense of competitiveness within the firm which will help in increasing the productivity by improving the fuel efficiency and have cost reduction benefits from supplier's improved efficiency. An optimistic vision from top management can have the ability to influence, support and implement green initiatives. Vision & Mission has the highest correlation with the Productivity/Competitiveness and Organization Culture.
3. 'Implementing company specific GSCM training program' came out to be the most important factor for Human Capital which will help in spreading awareness among the employees resulting in innovative ideas along with increasing the productivity as well as competitiveness. Human Capital has the highest correlation with Financial Performance and Productivity/ Competitiveness.
4. 'Strategically placing the warehouses and distribution centres' came out to be the most significant factor amongst the extracted factors under Green Process. It will reduce mining and consumption of virgin material, reduced raw material inventory and better utilization of available resources to earn the loyalty of customers and satisfy them. The Green process also shows significant correlations with Quality Performance, Financial Performance as well as Employee Satisfaction. However, the increasing awareness among the customers has led to the need for the green technology ecofriendly products resulting resource conservation.
5. 'Ensuring government regulations and legislations' came out to be the most important factor amongst the extracted factor under Finance. Finance has always stood out as the main factor for implementation of GSCM. The institutions at the initial stage are very reluctant to invest for improving their existing technologies which is the basic difference between the traditional supply chain management and green supply chain management. Increase in the training and purchasing costs at the initial phase shows negative financial performance for the firm however in the long run these factors are going to benefit the firm with the cost reduction benefits, reduced charges for disposal and fines for breaking the environmental laws.
6. 'Having safety committees & recycling programs' came out to be the most significant factor amongst the extracted factors under the Environment to identify and eliminate the sources of pollution. Designing for environment, having safety committees and recycling programs and reverse logistics is necessary for the optimum utilization of available resources and improving the environmental quality of products. Improving the existing practices to green practices brings in new market opportunities to explore.
7. 'Keeping a track on whether the goods delivered on time' to be the most important factor. It shows significant positive correlations with remaining performance measures as well. An organization should be more concerned with finding out the non-compliance problems of the employees, inspiring and spreading awareness amongst them towards eco-friendliness which will result in increase in team spirit, better innovative ideas and as a result incorporating social responsibility and satisfaction within the firm. These performance

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improvement factors intends to focus on eco-friendly market and react if the demand of the consumer increases. It tries to find a systematic approach to cope up with the environmental issues as well as to have a competitive advantage which will basically help us maintaining the momentum in greening the business and will keep the people more interested in our product.

8. 'Decrease in fines for breaking environmental laws' came out to be the most important sub performance measure under Quality Performance. Quality Performance showed the highest correlation with the fifth performance improvement factor Environment. Implementing green practices like reverse logistics, proper disposal of hazardous substances and designing with the eco-friendly concept in mind is very necessary for the success of Quality Performance.
9. Out of extracted four sub factors, 'Reduced raw material inventory' came out to be the most important dimension for Resource Conservation. This factor ensures the reduced mining and consumption of virgin material, reduced raw material inventory and better utilization of available resources to slow down the depletion of natural resources earning the loyalty and satisfaction of customers through involvement in environmental performance and reduction in procurement costs for raw material through reverse logistics and recycling packaging from customers to reduce the packaging costs. Resource Conservation showed the highest Correlation with Green Process while the least correlation with Finance.
10. 'Offsetting financial & Environmental risks' came out to be the most dimension. Financial Performance showed the highest correlation with Human Capital and the least correlation with Vision & Mission. Attracting trained professionals and retaining them, Having company specific GSCM training programs and investing for technological innovations is very necessary for Financial Performance. However, the short term measures will not have a good impact on the financial performance like just investing to reduce the pollution. Therefore, the firms at the initial stage are very much reluctant to shift towards green supply chain. However, with increasing awareness and the need to have a competitive edge in the market will easily overcome this hurdle.
11. 'Cost reduction benefits from supplier's improved efficiency' came out to be the most important sub performance measure for Productivity/Competitiveness. It showed the highest correlation with Vision & Mission, Human Capital & Green Process. An optimistic vision from top management has the ability to implement green initiatives which requires to invest in for the technological innovations as well motivation and awareness of employees to increase the productivity as well as competitiveness.
12. Out of extracted dimensions for Employee satisfaction, 'Incorporating social responsibility within the firm' came out to be the most dimension. Employee Satisfaction showed the highest correlation with Finance. The performance measures extracted under this group leads to increase in team spirit and mutual coordination among the employees resulting in better innovative ideas from the employees. However, for this firm needs to shell out capital for attracting trained professionals, retaining them and their performance appraisal on timely basis so as to keep them motivated for better productivity and good environmental quality of products.
13. 'Satisfaction towards eco-friendliness resulting in loyalty of customers' came out to be the most important dimension for Customer Satisfaction. Customer Satisfaction showed the highest correlation with Green Process. The increasing awareness among the customers has led to the need for the green technology ecofriendly products which reduces the costs for purchasing environment friendly raw materials, reduced mining and consumption of virgin material, minimization of resource consumption and pollution and better utilization of available resources resulting in loyalty and satisfied customers.

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VI. CONCLUSION

The Green Supply Chain Management, in spite of having its existence in late 90s the Environmental Performance Index(EPI) of India is worst. Green Supply Chain Management combines the traditional supply chain with the environment friendly perspective but the proper designing of policies require correct understanding of obstacles and steps towards sustainability to slacken issues related to environment. Thus, the combination of improved strategies of production and ecofriendly concept keeping in mind the critical success factors to produce the goods and services can provide for a strategic approach to many organizations to have a competitive advantage in local as well as global circuit. With respect to the rising global awareness for environmental protection, the organizations have started paying attention towards ecofriendly supply chain which reduces the detrimental effects of traditional supply chain without compromising for cost and quality to have a competitive advantage over others. This aspect is not researched in detail except for few studies and leaves a lot of angles to be explored in the direction of green supply chain for various sectors in the industry.

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