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The Impact of Green Supply Chain Management on Transportation Cost Reduction in Turkey

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ABSTRACT: Supply chain management (SCM) has become an important competitive approach for organizations. The issue of green supply chain management is critical for the successful implementation of industrial ecosystems and industrial ecology. Organizations have a number of reasons for implementing these green supply chain policies, from reactive regulatory reasons, to proactive strategic and competitive advantage reasons. From an overall environmental and organizational perspective, it is important to understand the situation and what issues exist in this field. Many organizations worldwide have already experienced globalization and a shifting focus to competition among networks of companies in this environment. Multinational enterprises have established global networks of suppliers that take advantage of country-industry specific characteristics to build this competitive advantage. To success having this competitive advantage, logistics and supply chain managers have to balance efforts to reduce costs and innovate while maintaining good environmental (ecological) performance (Pagell et al., 2004). Therefore, today, competition is not between companies, between supply chains. This study brings us the effect of Green Supply Chain Management (GSCM) on the Transportation Cost Reduction (TCR).

Keywords: Green Supply Chain; Transportation Cost; Cost Reduction
JEL Classifications: L90; L91

1. Introduction

Global enterprices are permanently trying to develop new, flexible, applicable and innovative methods to enhance their succes and competitiveness. Some of these organizations are enhancing their competitiveness through improvements in their environmental activities performance to comply with environmental law and regulations (Bacallan, 2000). The main point of complying with environmental law and regulations is customers environmental concerns and environmental impact of production and service activities. Besides, increasing of awareness of the propensity for environmental pollution within organizations' supply network to cost them in consumer complains, cleanup and punishment.

To response the requirement of environmental law and regulations, minimum standards of environmental performance have become increasingly prevalent in the purchasing agreements of multinational corporations for their local and global suppliers (Bowen et al., 2001a; Zhu and Sarkis, 2004). This requirement has become a new customer expectiation from suppliers therefore suppliers have to reduce costs and improve quality and service to complete their responsibility for their customers.

It is generally thought that green supply chain management has a great effect in increasing environmental performance, minimizing waste and achieving cost savings. Besides because of increasing synergy among business parties, green supply chain management enhances efficiency through partner and their supply networks. This synergy is expected to enhance the corporate image, competitive advantage and marketing exposure.

However, if green supply chain management practices are to be fully adopted by all organizations in Turkey, a demonstrable link between such measures and cost saving, specifically transportation cost saving is very necessay. Bowen et al., (2001) state that organizations will adopt green supply chain management practices if they identify that this will result in specific financial and operational benefits.

Thus, there is a clear research need to establish the potential link between structure of green supply chain and effective transportation cost saving, to provide an acceleration for enterprices to establish effective green their supply chains.

Many enterprices have demonstrated significant efforts to establish green supply chain management initiatives in Turkey. Whilst there is not enough study which examine about cost reduction through Green Supply Chain Management (GSCM) and tested an empirical link between such efforts and Transportation Cost Reduction (TCR). Therefore, this paper presents the results of a survey of organizations in Turkey to investigate the proposition that there is a significant relation between GSCM and TCR.

2. Literature Review

This paper encompasses previous "functional" specific research on aspects of GSCM, to develop a conceptual model of GSCM and TCR. In this paper, the structrue of green supply chain management encompasses environmental parameters as:

(1) Purchasing And In-Bound Logistics,
(2) Production Or The Internal Supply Chain,
(3) Distribution And Out-Bound Logistics,
(4) Reverse Logistics.

2.1 Purchasing and In-Bound Logistics

From the purchasing - *the beginning point of supply chain* - perspective of the supply network it is under discussion that GSCM has several benefits, ranging from cost reduction to integrating suppliers in a participative decision-making process that promotes environmental innovation (Bowen et al., 2001; Hall, 2003; Rao, 2002). Green purchasing strategies which the largest part of inbound logistics side is adopted by the companies to response global concern of environmental stability.

Green purchasing might enhance issues such as using environmental transportation, cost reduction, material substitution and waste minimization of hazardous materials. The involvement and support of suppliers is crucial to achieving such goals. Therefore, companies are increasingly managing their suppliers' environmental performance to ensure that the materials and equipments supplied by them are environmentally-friendly in nature and are produced using environmentally-friendly processes.

Integration of suppliers into environmental management system could be completed in two steps (Walton et al, 1998). First step, Walton et al suggest that environmental issues become main part of strategic planning to response regulations and the demands of environmental accountability. In second step, organizations integrate their supplier to their supply chains to make reduction operational costs and improve customer service.

2.2 Greening The Production Phase Or The Internal Supply Chain

There are several notions that could be explained about green supply chain in production phase, such as cleaner production, design for environment, remanufacturing and lean production. Lean production has an importance to decrease the environmental impact of the internal supply chain. Lean production improves environmental performance by reducing general waste and minimizing hazardous wastes.

Besides, production phase has an important role in keeping same quality level of organization that: having environmentally-friendly production; prevention of pollution at source; cleaner production practices are adopted; closed loop manufacturing (reverse logistics) is incorporated to the fullest extent possible, re-use and recycling of materials is maximized; material usage is reduced; the recyclable content of a product is increased; the production processes are optimized so that generation of waste, both hazardous or otherwise, is minimized; and products are redesigned (design for the environment). Also additionally design of the facility based on lean production is able to minimize vehicle movement.

2.3 Greening The Outbound Function And Reverse Logistics

On the outbound side of the green supply chain, reverse logistics, environment-friendly packaging, and environment-friendly distribution, are all initiatives that might improve the environmental performance of an organization and its supply chain. Management of wastes in the outbound function such as reverse logistics and waste exchange can lead to cost savings and enhanced

competitiveness (Rao, 2003). Many of these initiatives involve compromises between various logistics functions as reverse logistics and environmental consideration in order to improve the environmental performance of an organization.

In an eco-transportation system, required parameters of a transportation system such as type of transport, fuel sources, infrastructure, operational practices and organization, can be considered. These parameters and the dynamics that connect them, determine the environmental impact generated in the transportation logistics phase of the supply chain (Kam et al., 2003).

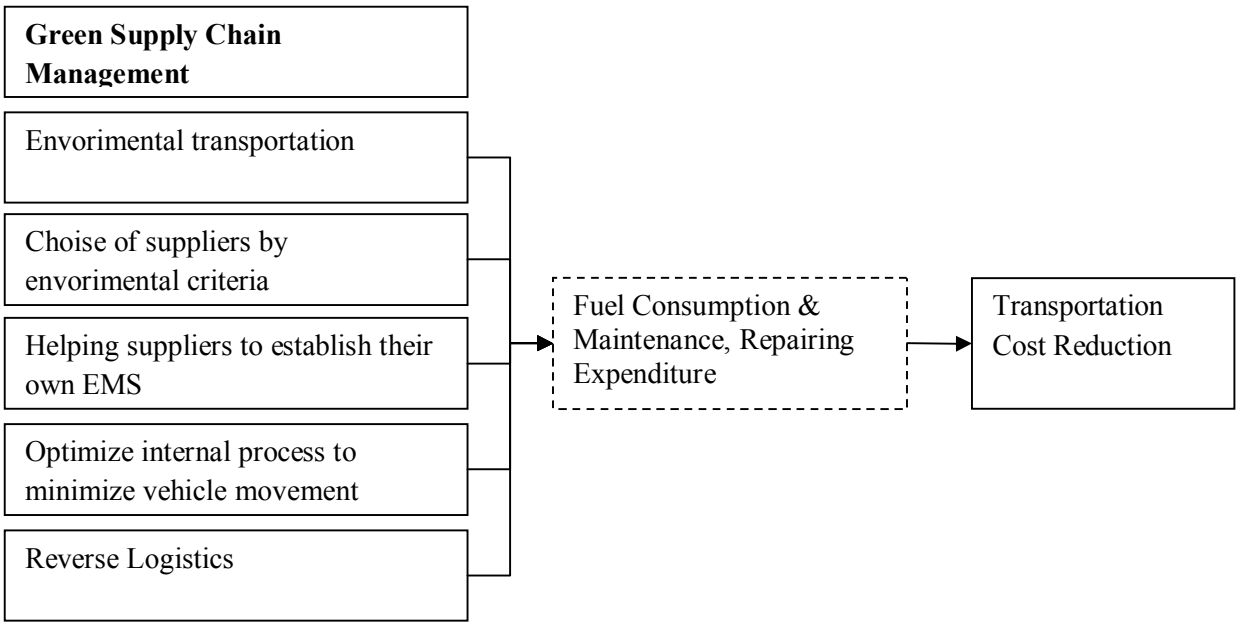
3. Model and Methodology

At this section, w investigate research question by using a questionnaire to collect data. After collecting, I use SPSS software to control relation between our variables by regression analysis.

Model have three phases. In first phase, five dimensions are used of all GSCM dimensions which affect fuel consumption & maintenance, repairing expenditure. In second phase, the well known relation with fuel consumption & maintenance, repairing expenditure (FCMRE) and transportation cost reduction is used to get result for this study. Transportation cost reduction side is third phase in our model. One point about methodology should be clarified in second phase (see Model 1).

The reverse relation between fuel consumption & maintenance, repairing expenditure and transportation cost reduction. But the diffuculties of finding fluctuation in transporation cost reduction in a direct way. To get result about transportation cost reduction, I use the second phase as a step phase. Through second phase, I get effect of five dimensions into fuel consumption & maintenance, repairing expenditure, then using result and using reverse relation, I reach the point which explains the effect of five dimensions into transportation cost reduction.

Model 1. Impact of Green Supply Chain Management (GSCM) in Transportation Cost Reduction



3.1 Questionnaire

To validate the model given in the preceding section, regression analysis is used to determine the causal relationships between environmental transportation, choise of suppliers by environmental criteria, helping suppliers to establish their own environmental management system (EMS), optimize internal process to minimize vehicle movement, reverse logistics and transportation cost reduction.

An empirical survey-based research approach was adopted, comprising of 38 items. The questionnaire was distributed to the environmental management representative (EMR) or the logistics representative (LR) of ISO 14001 certified organizations in Turkey. Responses for each item were collected on a five-point Likert scale (ranging from strongly disagree-1 to strongly agree-5). The justification for using a five-point scale served to understand that there might have been a tendency of

having most negative responses loading heavily on the median level, the center point of the scale. The research instrument was distributed to corporations using an online survey website. Company representatives enter the website and response the questions through website.

That website serves data as in SPSS file and SPSS estimates a series of separate but interdependent regression equations simultaneously. We have drawn upon the theory and the research objectives to determine which independent variable will predict which dependent variable. The proposed relationships are then translated into a series of structural equations for each dependent variable. The structural model expresses these relationships among independent and dependent variables.

3.2 Hypothesis

At this section, There are five different hypothesis' to examine the impact of GSCM on TCR. Five different hypothesis' are coming from five different dimensions of GSCM. Of course, total dimensions are not only five but as representing in the preceding section, only five of all dimensions are used to create hypothesis'. Hypothesis' are in representing as below.

3.2.1 Using More Environmental Transportation Affects Transportation Cost

First hypothesis concerns the impact of using more environmental transportation on the transportation cost. Certainly environmental transportation has an effect on transportation cost from financial perspective.

3.2.2 Reverse Logistics Affects Transportation Cost

Reverse Logistics is a part of total transportation but has a great effect on cost. Also reverse logistics is the main difference of GSCM from standard SCM. Because management of wastes in the outbound function such as reverse logistics and waste exchange can lead to cost savings.

3.2.3 Choice of Suppliers By Environmental Criteria Affects Transportation Cost

Green purchasing have focused on internal operations and one of the most important purchasing function is selection of vendors. Liability and complying with environmental regulation issues seem to be a major concern for supplier selection. Because of this reason selection of correct suppliers by environmental criteria and integrate into supply chain has an effect to transportation cost.

3.2.4 Helping Suppliers To Establish Their Own EMS Affects Transportation Cost

Multinational enterprises have established global networks of suppliers that take advantage of country-industry specific characteristics to build this competitive advantage. To establish this network by success these companies always encourage their suppliers to settle their own EMS and also audit in a periodic base.

3.2.5 Optimize Internal Process To Minimize Vehicle Movement Affects Transportation Cost

Lean production is an important consideration in reducing the environmental impact of the production phase and expected to improve environmental performance of the firms through good housekeeping practices, such as minimizing vehicle movement and hazardous wastes and general waste reduction.

3.3 Results

Based on model and hypothesis', results has been gotten by using regression analysis method. In this analysis FCMRE and TCR is dependent variables and the other five dimensions of GSCM (Using more environmental transportation, Reverse logistics, Choise of suppliers by environmental criteria, Helping suppliers to establish their own EMS, Optimize internal process to minimize vehicle movement) are independent variables.

Before explaining results, the relation between FCMRE and transportation cost should be mentioned. In logistic field, there is a equation between these two variables such as (Kruse, 2003);

Transportation Cost= % X * Maintenance, Repairing Expenditure + % Y * Fuel Consumption (1)

As in this study, transportation cost data of companies can not be reached directly so that first FCMRE fluctuation has to be checked. Based on this information and (1) formula, any fluctuation in maintenance, repairing expenditure and fuel consumption gives the fluctuation and effect in the transportation cost. Also, maintenance, repairing expenditure and fuel consumption are positively relavite with transportation cost because of (1). Results of the developed hypotheses are presented in the next sections.

3.3.1. Using More Environmental Transportation Affects Transportation Cost

The regression equation is;

FCMRE = 3,888 – 0,545*Using More Environmental Transportation

Regression equation has limitation about these R values. R is equal 0.704, R^2 is equal 0,495 and adjusted R^2 is equal 0,484. It seems that using more environmental transportation and FCMRE has a reverse relation which means using more environmental transportation negatively affects FCMRE. Also independent variable can represent %48 of dependent variable.

Variables Entered/Removed[b]

Model	Variables Entered	Variables Removed	Method
1	Using More Envorimental Transportation[a]	.	Enter

a. All requested variables entered.

b. Dependent Variable: Fuel Consumption & Maintenance, Repairing Expenditure

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,704[a]	,495	,484	,627

a. Predictors: (Constant), Using More Envorimental Transportation

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	17,393	1	17,393	44,188	,000[a]
	Residual	17,713	45	,394		
	Total	35,106	46			

a. Predictors: (Constant), Using More Envorimental Transportation

b. Dependent Variable: Fuel Consumption & Maintenance, Repairing Expenditure

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	3,888	,354		10,993	,000
	Using More Envorimental Transportation	-,545	,082	-,704	-6,647	,000

a. Dependent Variable: Fuel Consumption & Maintenance, Repairing Expenditure

3.3.2. Reverse Logistics Affects Transportation Cost

The regression equation is;

FCMRE = 0,497 + 0,421*Reverse Logistics

R is equal 0.393, R^2 is equal 0,154 and adjusted R^2 is equal 0,136. It seems that reverse logistics and FCMRE has a reverse relation which means using more environmental transportation positively affects FCMRE.

Variables Entered/Removed[b]

Model	Variables Entered	Variables Removed	Method
1	Reverse Logistics[a]	.	Enter

a. All requested variables entered.

b. Dependent Variable: Fuel Consumption & Maintenance, Repairing Expenditure

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,393[a]	,154	,136	,812

a. Predictors: (Constant), Reverse Logistics

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	5,423	1	5,423	8,222	,006[a]
	Residual	29,683	45	,660		
	Total	35,106	46			

a. Predictors: (Constant), Reverse Logistics

b. Dependent Variable: Fuel Consumption & Maintenance, Repairing Expenditure

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	,497	,408		1,216	,230
	Reverse Logistics	,421	,147	,393	2,867	,006

a. Dependent Variable: Fuel Consumption & Maintenance, Repairing Expenditure

3.3.3. Choise Of Suppliers By Environmental Criteria Affects Transportation Cost

The regression equation is;
FCMRE = 3,821 – 0,529*Choise of suppliers by environmental criteria

R is equal 0.671, R^2 is equal 0,451 and adjusted R^2 is equal 0,439. It seems that choise of suppliers by environmental criteria and FCMRE has a reverse relation which means using more environmental transportation negatively affects FCMRE. Also independent variable can represent %43 of dependent variable.

Variables Entered/Removed[b]

Model	Variables Entered	Variables Removed	Method
1	Choice Of Suppliers By Environment Criteria[a]	.	Enter

a. All requested variables entered.

b. Dependent Variable: Fuel Consumption & Maintenance, Repairing Expenditure

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,671[a]	,451	,439	,655

a. Predictors: (Constant), Choice Of Suppliers By Environment Criteria

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	15,823	1	15,823	36,924	,000[a]
	Residual	19,284	45	,429		
	Total	35,106	46			

a. Predictors: (Constant), Choice Of Suppliers By Environment Criteria

b. Dependent Variable: Fuel Consumption & Maintenance, Repairing Expenditure

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	3,821	,375		10,187	,000
	Choice Of Suppliers By Environment Criteria	-,529	,087	-,671	-6,076	,000

a. Dependent Variable: Fuel Consumption & Maintenance, Repairing Expenditure

3.3.4 Helping Suppliers To Establish Their Own EMS Affects Transportation Cost

The regression equation is;
FCMRE = 3,649 – 0,513*Helping suppliers to establish their own ems

R is equal 0.671, R^2 is equal 0,450 and adjusted R^2 is equal 0,438. It seems that helping suppliers to establish their own EMS and FCMRE has a reverse relation which means using more environmental transportation negatively affects FCMRE. Also independent variable can represent %43 of dependent variable.

Variables Entered/Removed[b]

Model	Variables Entered	Variables Removed	Method
1	Helping Suppliers To Establish Their Own EMS[a]	.	Enter

a. All requested variables entered.

b. Dependent Variable: Fuel Consumption & Maintenance, Repairing Expenditure

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,671[a]	,450	,438	,655

a. Predictors: (Constant), Helping Suppliers To Establish Their Own EMS

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	15,798	1	15,798	36,819	,000[a]
	Residual	19,308	45	,429		
	Total	35,106	46			

a. Predictors: (Constant), Helping Suppliers To Establish Their Own EMS

b. Dependent Variable: Fuel Consumption & Maintenance, Repairing Expenditure

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	3,649	,348		10,478	,000
	Helping Suppliers To Establish Their Own EMS	-,513	,085	-,671	-6,068	,000

a. Dependent Variable: Fuel Consumption & Maintenance, Repairing Expenditure

3.3.5 Optimize Internal Process To Minimize Vehicle Movement Affects Transportation Cost

The regression equation is;
FCMRE = 4,313 – 0,643*Optimize internal process to minimize vehicle movement
R is equal 0.698, R^2 is equal 0,487 and adjusted R^2 is equal 0,475. It seems that optimize internal process to minimize vehicle movement and FCMRE has a reverse relation which means using more environmental transportation negatively affects FCMRE. Also independent variable can represent %47 of dependent variable.

Variables Entered/Removed[b]

Model	Variables Entered	Variables Removed	Method
1	Optimize internal process to minimize vehicle movement[a]	.	Enter

a. All requested variables entered.

b. Dependent Variable: Fuel Consumption & Maintenance, Repairing Expenditure

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,698[a]	,487	,475	,633

a. Predictors: (Constant), Optimize internal process to minimize vehicle movement

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	17,082	1	17,082	42,645	,000[a]
	Residual	18,025	45	,401		
	Total	35,106	46			

a. Predictors: (Constant), Optimize internal process to minimize vehicle movement

b. Dependent Variable: Fuel Consumption & Maintenance, Repairing Expenditure

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	4,313	,423		10,195	,000
	Optimize internal process to minimize vehicle movement	-,643	,099	-,698	-6,530	,000

a. Dependent Variable: Fuel Consumption & Maintenance, Repairing Expenditure

4. Conclusion

This study concludes that green supply chain management encompassses potential to make cost saving in transportation. From production firm perspective, spesifically in Turkey, main concerns of firms are continuously tracking, controlling and thinking how to manage their all kinds of cost, espacially transportation cost.

As mentioned in preceding sections, there is a relation as in formula mode between fuel consumption & maintenance, repairing expenditure (FCMRE) and transportation cost. Because of the difficulties to collect and get the transportation cost data, model has fuel consumption & maintenance,

repairing expenditure as a connection variable. This study proves the existing relation between GSCM and FCMRE. After proving this relation and using the relation between FCMRE and TCR, this study explains the impact of GSCM on transportation cost. Also, these research findings suggest that green their supply chains management affect not only fuel consumption, maintenance and repairing cost, but also through these variables affect transportation cost indirectly.

The main limitation of this study is the focus on production companies in Turkey and the lack of study in Turkey is the powerful side of this study. The focus of this study is on a sample of Turkish production companies which have ISO14001 Quality Management System.

Future research should empirically test the relationships suggested in this paper in different countries, to enable comparative studies. A large sample would also allow detailed cross- sectoral comparisons, which are not possible in the context of this study.

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