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RESEARCH

Evaluation of relationships between GSCM practices and SCP using SEM approach: an empirical investigation on Iranian automobile industry

Armin Aalirezaei[1] · **Niloofar Esfandi**[2] · **Alireza Noorbakhsh**[3]

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Abstract Today, in advanced companies, the supply chain managers have attempted to use green logistics in order to improve the environmental performance in the whole supply chain. This could be taken as a strategic key to achieve the stable competitive advantage. Based on an environmental perspective, the Supply Chain Performance (SCP) can be enhanced through making utility and satisfaction for stakeholder. The purpose of the present study is to evaluate the impacts of Green Supply Chain Management (GSCM) practices on economic, environmental, and operational performance in Iranian automobile industry by using a Structural Equation Modeling (SEM). To do so, a model with four hypotheses has been proposed which illustrates the relationship between GSCM practices and SCP in terms of their indices. GSCM practices include four factors: the supplier management, the product recycling, the organizational involvement, and the product lifecycle management. In addition, SCP includes four aspects, namely the environmental performance, the positive economic performance, the negative economic performance, and the operational performance. To collect data in the practical area, questionnaires and field researches were used, then the proposed model has been analyzed and confirmed by applying Pearson Correlation Coefficient and SEM. The confirmation of the research hypotheses showed that the improvement of GSCM practices in Iranian automobile industry has positively promoted the SCP with the prediction rate of 70.56% and in the 95% confidence level. After implementing this model in Saipa automobile company as a case study cooperating with more than 1000 suppliers, the decision processes were enhanced so as to create sustainable value chain, develop opportunities for customers, produce sustainable benefits for both shareholders and employees regarding the organization

✉ Armin Aalirezaei
a.aalirezaei@semnan.ac.ir

[1] Department of Industrial Engineering, Semnan University, Semnan, Iran

[2] Management Department, University of Tehran, Tehran, Iran

[3] Department of Industrial and Information Engineering, Politecnico di Milano, Milan, Italy

involvement, the product lifecycle management, the product recycling and the suppliers management. Using this model, the Iranian automobile companies' managers also manage effectively to create sustainable values for stakeholders through creating positive economical, operational and environmental impacts on its own value chain performance.

Keywords The green supply chain management practices · Environmental · Economic and operational performance · Structural equation modeling (SEM) · Automobile industry

Introduction

The universality of the economy and the development of information technology have changed the supply-oriented market to the demand-oriented one and have made the organizations to understand the importance of the customers' need satisfaction. [1, 2] Based on this, the Supply Chain Management (SCM) has gained prime importance since the customers' interests and need satisfaction depend not only on the last identity attached to the customer, i.e., the final product but also on the other upstream suppliers.

In a traditional perspective, the SCM includes guiding all supply chain members in an integrated and coordinated way in order to improve the performance and promote the utility and benefit. Therefore, the supply chain managers were seeking the fast delivery of products and services, cost reduction and the quality increase. However, the improvement of the environmental performance of the supply chain and social costs and the destruction of environment are not considered. The pressure of governmental rules to achieve the environmental standards in one hand, and the increasing growth of the customer demands to supply the green products on the other hand have stabilized the concept of the Green Supply Chain Management (GSCM).

Today, in advanced companies, GSCM is attempting to use the green logistics and the environmental improvement in the whole supply chain as a strategic weapon to achieve a sustainable competitive strategy and organize their goals based on three important subjects: the green (product) design, the green (process) production and the product recycling [3]. In the past, the product life cycle included the processes of some phases from designing to consumption [4]. Environmental management includes the processes of preparing raw materials, designing, composing, using and recycling and reusing of materials and forming a closed loop of material to reduce the resource consumption and to reduce the environmental destructive effects. [5]. So, organizations should use the environmental management in the whole life cycle of their products to assure that the improvement of the environmental performance of the supply chain has taken place.

The review of literatures shows that the practices of the green supply chain have some impacts on the Supply Chain Performance (SCP). By studying the references, it seems that there are remarkable studies in international articles on different aspects of the GSCM practices. [6, 7]. Ahi and Searcy [8] have identified and analyzed the metrics that had been used to address the energy-related issues in GSCM and Sustainable Supply Chain Management (SSCM). These metrics were identified based on a structured content analysis of 445 articles published up to the end of 2012.

Youn et al. [9] have pointed out that the environmental SCM practices have some special impacts on the environmental and business performance. Moreover, Zhu has pointed out that GSCM practices have important roles in the environmental, economic, and operational performance in China automobile industry [7].

Moreover, gaining competitive edge through effective implementation of sustainable practices in a highly competitive environment becomes increasingly difficult. Such increased competition has even greater effect on industry such as the automobile undoubtedly which is large, diverse and influential of many other business sectors [10].

In Iran, however, little attention has been paid to the GSCM. So, there is a large gap between the desirability of GSCM in theory and its implementation in practice in Iran. In this research it has been attempted to study the relationship between the GSCM practices and the environmental, economic, and operational performance in the supply chain of Iranian automobile industry. Being the 12th largest automaker in the world and the largest in the Middle-East [11], Iran has a crucial role in this large industry. The Iranian automotive industry was first developed in the 1960s by relying on foreign vehicle manufacturers. Today, the industry is dramatically growing and has become one of the Iran's key industries, after oil industry. In 2006, Iran was ranked as the 16th biggest automaker of the world, and soon after, in 2009, it experienced a 9.5% growth in production and was ranked as fifth in car production growth standing next to China, Taiwan, Romania and India [12].

As a developing country, Iran has been emphasizing on the economic development, while seeking to maintain a balance with environmental protection. These burdens have made quota status too difficult for organizations to strike the balance between the economic advantages and environmental, and operational performance. Iran's automotive supply chains have not been excluded from this adjustment. In Iran, the motor vehicle production has dramatically progressed. Hence, the environmental liabilities particularly in Iranian automotive industry have made grave concerns. The restricting pressures altogether have made the Iranian automobile supply chain managers to contemplate and commence the implementation of GSCM practices to improve the economic, environmental, and operational performance. Therefore, there is a huge demand for Iranian automobile industry, while challenges such as climate change, energy provision and shortage of natural resources need to be handled [13].

In the present paper, the research questions are as follows: Is there a causal relationship between GSCM practices and the firm performance in Iranian automobile industry? Moreover, which aspects of GSCM influence on SCP and how this influences could be measured?

The main purpose of the present study is to investigate the relationship between GSCM practices and their performance. For this, Saipa as a sample of automobile supply chain players, which includes suppliers, original equipment manufacturers in Iran is considered for the investigation. Hence, in this paper, to achieve this purpose, section "Review of literature" presents the review of the literature in GSCM and its practices and performance. Section "The conceptual model and research method" describes the methodology to make a conceptual framework in order to study the effect of GSCM practices and performance in the supply chain of Iranian automobile industry. In section "Data analysis", the data analysis of Saipa Company as a case study will be presented and the model hypotheses are confirmed based on the extracted results. Finally, in section "Conclusions and suggestions", the general conclusions and suggestions are presented.

Review of literature

Based on the existence literature, hypotheses of the GSCM model, SCP model, and the main model are developed with respect to the proposed relationships among GSCM and SCP (Fig. 1) in Iranian automobile industry.

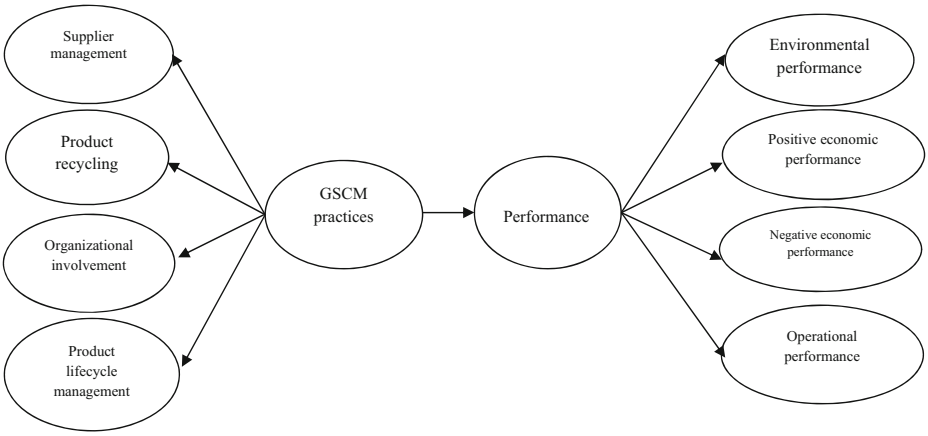

Fig. 1 The conceptual model proposed by this study

GSCM practices

Today, sustainable development assurance in every country depends on the optimal use of the limited source of that country. Different strategies have been taken by government to face this issue including applying the rules and green principles such as using raw materials which are consistent with the environment in industrial and productive centers, decreasing the use of oil and fossil energy sources, increasing the use of paper recovery, and reusing the waste materials in companies with both private and governmental sections [14].

In this context, the great desire to make government regulations to get environmental standards in one hand, and the increasing demands of consumers to consume the green products on the other hand, has made a new concept as GSCM which includes the life cycle stages of product from designing to recycling ([15]/64/EC).

There are wide reviews in the area of GSCM especially in the late 1990 in which different issues such as the green production, planning, green construction and the product recycling were discussed [16–19].

Knowing a wider perspective related to the green supply chain is an important step in knowing the sustainable environment branch. GSCM has had a rich literature especially since 1989. However, some concepts have been studied more in the past 20 years, concepts such as the green design, green operations, reverse logistics, green production and the waste material management. [20]. In a general definition, the green supply chain includes a collection of the enterprise internal and external practices in the whole supply chain which leads to the improvement of the environment and preventing pollution. Green supply chain management has been defined as the management of raw materials, pieces and sections and all processes from suppliers to the producers and finally to the customers and take back [21]. In other words, GSCM includes the green purchasing, green productions, green distribution, green marketing and reverse logistics [22].

Darnall has also presented a critical article concerning the SCM and he has pointed out that the environment management systems have had little progress in decreasing the environmental damages [23]. Some studies have had a more limited focus. For example, Van der Laan et al. [19] have just discussed the reconstruction and removing the wastes and Zhang et al. [24] have just discussed designing and environmental technologies.

SCP

In the economic performance perspective, when the environmental performance of the company improves, it stimulates the economic performance from both negative and positive point of view which increases the market share and make more opportunities in the market [25]. The positive economic performance is reflected through the cost reduction in buying the materials, energy consumption, waste materials deals and the wastes disposal. In contrast, the negative economic performance will be seen through the increase of the costs related to the investing and buying the materials which are compatible with environment [26, 27].

The operational performance has been defined as follows: Increasing the amount of timely-delivered goods, decreasing the inventory levels, increasing the scrap rate, promoting the products' quality, increasing the product line, and improving the capacity utilization [7].

In the environmental performance perspective, there exists a plenty of experimental studies focused on the supply chain environmental performance. Tsoulfas and Pappis [28], for example, have presented a model to analyze the supply chain environmental performance in Greece. Zhu et al. [29] have studied the economical practices of the producers cooperation in the environmental supply chain and its performance requirements in China. Youn et al. [9] in an article titled supply chain strategic participation and the performance outputs have pointed out to the relationship between the environmental SCM practices and the environmental performance and business performance.

Impact of GSCM practices on the SCP

However, a few studies have achieved good conclusions on the impact of GSCM practices on the SCP. Govindan et al. [13] have used the decision-making trial and evaluation laboratory method with intuitionistic fuzzy sets to handle the important and causal relationships between GSCM practices and SCP can be considered as an example. In their study, a case study taken from the automotive industry is presented to evaluate the efficiency of the proposed method and their results have revealed the "internal management support", "green purchasing" and "ISO 14001 certification" are the most significant GSCM practices.

There are different factors which affect the acceptance and application of green supply chain practices. One of these important studies for investigating the effective indices in GSCM is Hu and Hsu's [6] article. In their study, they have studied and recognized some essential factors to administer the SCP in the electricity industry and in electronic industries in Taiwan. In fact, their purpose was studying the critical success factors to administer the GSCM in Taiwan electronic and electricity industries in comparison with European Union instructions. Their study results show that there are 20 important factors in GSCM in Taiwan electronic and electricity industries. Moreover, Kuei et al. [30], identifies the critical factors influencing the adoption of green supply chain practices in Chinese firms. The participating firms were classified into central, downstream, and upstream firms. They could show that external environmental factors (including customer pressures, regulatory pressures, government supports, and environmental uncertainty) are the most important in adopting green practices. In another study, Kusi-Sarpong et al. [31] have introduced a comprehensive framework for SSCM implementation in Ghana's gold mining industry. This framework is made of six constructs including the green information technology and systems, strategic supplier partnership, operations and logistics integration, internal environmental management, eco-innovative and end-of-life. Environmentally sustainable supply chain management practices in Ghana's

gold mining industry are examined by using the decision-making trial and evaluation laboratory (DEMATEL) and the analytical hierarchy process. The evaluation models have found that the strategic supplier partnership and the end-of-life practices are the most prominent and influential factors whereas lean and green operations, substituting toxic inputs with environmentally friendly ones and resale of used parts or components are prominent sub-factors. Furthermore, Geng et al. [32] have tried to understand the relationship between GSCM practices and the firm performance in the manufacturing sector in Asian Emerging Economies (AEE) based on empirical evidence. They have developed a conceptual framework and analyzed it through a meta-analysis of 130 effects from 25,680 effect sizes. The findings revealed that the GSCM practices lead to better performance in four aspects: the economic, environmental, operational, and social performance. Moreover, the results have indicated that the industry type, the firm size, ISO certification, and the export orientation moderate several of the GSCM practice-performance relationships.

Despite the importance of this issue, there are still a limited number of studies in the area of GSCM and in its application in Iran. Regarding the importance of GSCM and its relationship with environmental, economic and operational performance in the supply chain, the growth of automobile industry, and the considerable role of the industry among other production industries in Iran in the generating the national net income, in the present study, based on the review of the related literature of the green supply chain and the environmental, economic and operational performance, a conceptual framework has been proposed to understand the relationship between the GSCM practices and the SCP in the supply chain of Iranian automobile companies. In addition, this study is a significant step in maturing the academic field by adopting a hybrid method for confirming GSCM practice-performance relationships.

The conceptual model and research method

In the model proposed by this study, a conceptual framework has been used in order to study the effect of the practices of GSCM on the SCP of automobile companies in Iran and all purposes and hypotheses of this study have been investigated through this framework. In the following figure, the proposed conceptual model has been presented in Fig. 1.

As shown in Fig. 1, the proposed conceptual model of the study has used the classification of Hu and Hsu to study the GSCM model. To study the GSCM, they have considered four aspects including the organization involvement, the product lifecycle management, the product recycling and the suppliers management [6].

For the factor of organizational involvement, the following aspects have been recognized which include the green designing, top management support, environmental policy for GSCM, cross-function integration, manpower involvement, effective communication platform within companies and with suppliers, establishing an environmental risk management system for GSCM, supplier evaluation and selection, Information System (IS), research and development associated with the university professors and experts in the field of recycling.

For the factor called the product lifecycle management in green supply chain management, the following aspects have been recognized which include the application of the life cycle assessment to carry out the eco-report and the establishment of an environmental database of products.

For the factor of the product recycling in GSCM the following aspects have been recognized which include joining the local recycling organizations, collaboration on products recycling with the same sector industry, and produce disassembly manuals.

For the factor called the supplier management in GSCM, the following aspects have been recognized which include the environmental auditing for suppliers, suppliers environmental questionnaire, the compliance statement, product testing report, bill of materials, establishing the environmental requirements for purchasing items, and green purchasing.

Moreover to study the SCP model Zhu et al. [7] classification is taken into account to investigate the SCP model of Iranian Automobile industry.

The purpose of the present study is to determine the relationships among the GSCM practices. The type of this study is a covariance or correlation matrix analysis. In order to devise the research hypothesis, based on the inductive reasoning, the library studies of the related literature and the research background about the relationship between GSCM and SCP have been carried out. Finally, the proposed conceptual model as the contribution of this study has been analyzed by using the factor analysis method, Pearson correlation coefficient and SEM.

The research hypotheses

As it is categorized in section "Review of literature", all hypotheses extracted from literature review are as follows:

The main hypothesis:

- In the supply chain of Iranian automobile Companies, there is a significant and positive relationship between the GSCM practices and its performance.

Secondary hypotheses:

- *Secondary hypothesis 1*: in the supply chain of Iranian automobile Companies, the suppliers management practice on the SCP has a positive and significant relationship.
- *Secondary hypothesis 2*: in the supply chain of Iran automobile Companies, the product recycling practice on the SCP has a positive and significant relationship.
- *Secondary hypothesis 3*: in the supply chain of Iranian automobile Companies, the organization involvement practice on the SCP has significant and positive relationship.
- *Secondary hypothesis 4*: in the supply chain of Iranian automobile Companies the product lifecycle management on SCP has a significant and positive relationship.

Hypotheses of GSCM model:

- *GSCM hypothesis 1*: the latent variable of GSCM in Iranian automobile companies is comprised of four factors such as: organization involvement, product lifecycle management, product recycling and suppliers management.
- *GSCM hypothesis 2*: the organization involvement is of significant positive correlation with GSCM in Iranian automobile companies.
- *GSCM hypothesis 3*: the product lifecycle management is of significant positive correlation with GSCM in Iranian automobile companies.
- *GSCM hypothesis 4*: the product recycling is of significant positive correlation with GSCM in Iranian automobile companies.
- *GSCM hypothesis 5*: suppliers management is of significant positive correlation with GSCM in Iranian automobile companies.

SCP model hypotheses:

- *SCP hypothesis 1:* the latent variable of SCP in Iranian automobile companies is comprised of four factors such as: the environmental, positive economic, negative economic and operational performance.
- *SCP hypothesis 2*: the environmental performance is of significant positive correlation with SCP in Iranian automobile companies.
- *SCP hypothesis 3:* the positive economic performance is of significant positive correlation with SCP in Iranian automobile companies.
- *SCP hypothesis 4:* the negative economic is of significant positive correlation with SCP in Iranian automobile companies.
- *SCP hypothesis 5*: the operational performance is of significant positive correlation with SCP in Iranian automobile companies.

Saipa with 100 subsidiaries and affiliates and approximately 40,000 employees, has been considered as one of the largest industrial groups in Iran. Currently, the company has cooperated with more than 1000 suppliers throughout the country with the capacity of the annual production of 950,000 vehicles. The Saipa Group manages effectively to create sustainable values for stakeholders through creating positive economic, social and environmental impacts on its own value chain activities. To do this, Saipa focuses its attention on the following cases: to create sustainable value chain in auto industry, to create and develop opportunities for customers, to produce sustainable benefits for shareholders and to produce sustainable benefits for employees (http://www.Saipacorp.com).

With regard to the fact that Iranian automobile industry is monopolized by Saipa as the greatest manufacturer in Iran, this company is chosen to evaluate the hypothesis devised in this paper.

Pearson correlation coefficient

The correlation coefficient is often referred to as Pearson's correlation or r coefficient. The correlation r value requires both a magnitude and a direction of either positive or negative. It may take on a range of values from −1 to +1, where the values are absolute and non-dimensional with no units involved. A correlation coefficient of zero indicates that no association exists between the measured variables. The closer the r coefficient approaches ±1, regardless of the direction, the stronger is the existing association indicating a more linear relationship between the two variables. The strength of the correlation is not dependent on the direction or the sign. Thus, for example, $r = 0.90$ and $r = -0.90$ are equal in the degree of association of the measured variables. A positive correlation coefficient indicates that an increase in the first variable would correspond to an increase in the second variable, thus implying a direct relationship between the variables. A negative correlation indicates an inverse relationship whereas one variable increases the second variable decreases. If there is no linear relationship between the variables, r will be virtually zero.

It is necessary to perform a significance test to decide whether based upon the sample there is any or no evidence to suggest that the linear correlation is present in the population. Hence, the null hypothesis (H0) and the alternative hypothesis (H1) of the significance test for correlation can be expressed in the following ways, depending on whether a one-tailed or two-tailed test is requested:

Two-tailed significance test:

H0: $\rho = 0$ (the population correlation coefficient is 0; there is no association)
H1: $\rho \neq 0$ (the population correlation coefficient is not 0; a nonzero correlation could exist)

One-tailed significance test:

H0: $\rho = 0$ (the population correlation coefficient is 0; there is no association)
H1: $\rho > 0$ (the population correlation coefficient is greater than 0; a positive correlation could exist)

Or

H1: $\rho < 0$ (the population correlation coefficient is less than 0; a negative correlation could exist)

Where ρ is the population correlation coefficient. [33, 34].

Structural equation modeling (SEM)

SEM is a comprehensive statistical approach which tests the hypotheses regarding the relationships among the observed and latent variables. A major advantage of SEM is the ability to estimate a complete model incorporating both measurement and structural considerations. There are a variety of indices to evaluate the model fitness. In this paper, five common fit indices recommended in the literature are used as follows which their values are indicating an acceptable model fit:

1. Chi-square/degree of freedom ($\chi 2$/df) of less than 3 indicating the acceptable fit;
2. *P*-value associated with $\chi 2$/df of less than .05 indicating the acceptable model fit;
3. The Root Mean Squared Error of Approximation (RMSEA) with values less than 0.1 representing the acceptable fit;
4. The Goodness of Fit Index (GFI) with values greater than 0.9 indicating the good fit;
5. The Adjusted Goodness of Fit Index (AGFI) with values greater than 0.8 indicating the acceptable fit. [35]

The aim of the present study is to investigate the relationship between GSCM and SCP in a practical way. The Research method used in this article is a descriptive-correlation.

On the ground that, in this study, the distribution of weights between variables is normal and parametric, Pearson correlation coefficient is used to find the linier relationship between them.

In descriptive-correlation researches, the correlation matrix or covariance analysis could be implemented by using a factor analysis and SEM. In the factor analysis, the main goal is to summarize the sets of data or finding the latent variables (construct). Also, in SEM, testing the structural relationships is based on the hypotheses and literature.

SEM has two important benefits. First, SEM allows a sophisticated analysis of the quality of measurement of the conceptual model by observable criteria. Also, SEM specifies an explicit measurement model in which SCP and GSCM are linked to the concept and

measurement error. More complex measurement models in which the other sources of systematic covariation between observed measures besides a common underlying construct are present can also be formulated. This is critically important because most conceptual variables can be only measured with error (both random and systematic errors) and ignoring the measurement errors has undesirable effects on the model estimation and testing. Second, SEM makes it possible to investigate the complex patterns of the relationships among the constructs in one's theory and assess both in an overall sense and in terms of specific relationships between the constructs [36].

Statistical population and the sample size

The statistical population classified in three main classifications of upstream, central, and downstream sections has included the top managers, commercial and production managers, and logistics experts, all with at least 3 years of experience in the supply chain of Saipa Company as case study. The number of experts in 9 studied companies cooperated with Saipa were about 412 people. To determine the sample size, Cochran formula has been used as eq. (1):

$$n = \frac{NZ_{\frac{\alpha}{2}}^2 pq}{\varepsilon^2(N-1) + Z_{\frac{\alpha}{2}}^2 pq} \tag{1}$$

Where:

p the degree of variability ($p = 0.5$)
q 1-p
ε the permitted error value (ε =0.05)
Z the normal variable corresponding with 95% confidence level. ($Z_{\alpha/2} = 1.96$)
N the population size

$$n = \frac{412 \times (1.96)^2 \times 0.5 \times 0.5}{(412-1) \times (0.05)^2 + (1.96)^2 \times 0.5 \times 0.5} = \frac{382.2392}{1.9529} = 199.0466 \approx 200$$

Regarding the statistical population number (412 people), the statistical sample size has been estimated 200 people based on the sampling formula of the limited population. Morgan table suggests a sample of 196 for the statistical population of 400 population size. For more certainty, 285 questionnaires have been distributed and 217 of them were collected. To carry out this study, the classified random sampling method has been used. Table 1 illustrates the ratios of these groups and the number of samples. The statistical population of each company (the number of experts) has been determined based on the interviews with companies' managers. So, first the statistical population was classified and then a random sample of each classification was selected.

Information gathering instruments

In this study, the most important methods of data collection include the library studies and field researches. In the data collection process, the library resources, articles, books, magazines and

Table 1 The statistical population of each 9 studied companies in Saipa's supply chain

Company	Saipa	Saze Gostar	Seetco	Saipapress	Pars Khodro	Mega Motor	Saipaazin	Zamyad	Saipayadak	Total
Position in SC	Central part	Up stream	Up stream	Up stream	Up stream	Up stream	Up stream	Up stream	Down stream	.....
Population size	48	156	14	32	24	42	35	17	44	412
% in population	13.1%	45.2%	9.1%	9.1%	9.1%	11.3%	9.8%	9.1%	11.5%	100%
Sample size	28	69	8	20	11	25	18	9	23	217
% in sample	14.5%	38.4%	9.1%	9.9%	9.1%	13.9%	11.4%	9.1%	11.9%	100%

the internet has been used. To collect data in the practical area, the questionnaire and field researches have been used. The practical questions of the questionnaire include two sections: a) the general questions which include general information and the cognitive population of respondents. b) questions related to the practical aspects of GSCM practices with 22 questions; (According to table 18 in appendix) the suppliers management aspect has 7 questions, the product recycling has 3 questions, organization involvement has 10 questions, and the product lifecycle has 2 questions, furthermore the questions related to the aspects of SCP includes 21 items (Environmental performance has 6 questions, positive economic performance has 5 questions, negative economic performance has 4 questions, and operational performance has 6 questions) (According to table 19 in appendix). Tables 2 and 3 illustrate the questions related to the aspects of GSCM practices and SCP.

Now, the validity and reliability of the questionnaire will be discussed in the following section.

Validity and reliability of the questionnaire

Reliability

To evaluate the reliability of the evaluation instrument, Cronbach's alpha [37] method was used. A sample of 47 questionnaires was the pretest and Cronbach's alpha coefficient of the questionnaire of GSCM practices was 88.8% and the SCP questionnaire was 82.5%. Since all these numbers are above 70%, the questionnaire meets the reliability or validity characteristics. The result of the questionnaire reliability test in Cronbach's alpha method was completed for 217 questionnaires which has been summarized in Table 4.

Table 2 Analysis of GSCM practices aspects and indices [6]

Aspects	Indices
Suppliers management (SM)	SM1- Environmental auditing for suppliers
	SM2- suppliers environmental questionnaire
	SM3- Compliance statement
	SM4- Product testing report
	SM5- Bill of materials
	SM6- Establishing environmental requirements for purchasing items
	SM7- Green purchasing
Product recycling (PR)	PR1- Joining local recycling organization
	PR2- Collaboration on products recycling with the same sector industry.
	PR3- Produce disassembly manual
Organizational involvement (OI)	OI1- Green design
	OI2- Top management support
	OI3- Environmental policy for GSCM
	OI4- Cross-function integration
	OI5- Manpower involvement
	OI6- Effective communication platform within companies and with suppliers
	OI7- Establish an environmental risk management system for GSCM
	OI8- Supplier evaluation and selection
	OI9- Information system
	OI10- the relationship of research and development unit with university professors and experts
Lifecycle of products (LCM)	LCMI- Applying Life cycle assessment (LCA) to carry out eco-report
	LCM2- Establish an environmental database of products

Table 3 Analysis of SCP aspects and indices [7]

Aspects	Indices
Environmental performance (ENP)	ENP1- Reduction of air emission
	ENP2- Reduction of waste water
	ENP3- Reduction of solid waste solid waste
	ENP4- Decrease of consumption for hazardous/harmful/ toxic materials
	ENP5- Decrease of frequency for environmental accidents
	ENP6- Improve a company's environmental situation
Positive economic performance (PECP)	PECP1- Decrease of cost for materials purchasing
	PECP2- Decrease of cost for energy consumption
	PECP3- Decrease of fee for waste treatment
	PECP4- Decrease of fee for waste discharge
	PECP5- Decrease of fine for environmental accidents
Negative economic performance (NECP)	NECP1- Increase of investment
	NECP2- Increase of operational cost
	NECP3- Increase of training cost
	NECP4-Increase of cost for purchasing environmentally friendly material
Operational performance (OPP)	OPP1- Increase amount of goods delivered on time
	OPP2- Decrease inventory levels
	OPP3- Increase scrap rate
	OPP4- Promote products' quality
	OPP5- Increased product line
	OPP6- Improved capacity utilization

Validity

To determine the questionnaire validity, there are different methods. In this study, the content validity and structure validity methods were used.

Content validity First, to evaluate the proposed framework, the viewpoints of 12 experts (including 10 managers and experts of the studied organization and 2 university professors) were used. Generally, this evaluation was mainly focused on the content validity of the indices presented for the evaluation of the considered aspects of the study. So, in the first stage, the content validity method was used to evaluate the questionnaire validity rate.

The result of the questionnaire content validity test in Content validity ratio (CVR) [38] and Content validity index (CVI) [39] was compiled for 12 experts, summarized in Tables 5 and 6, as follows:

According to Lawshe, for 12 experts, the minimum value for CVR is 0.56. So in this case, any question perceived essential by more than 9 panelists has content validity. Waltz and Bausell [39] also posed a minimum value of 0.79 to the CVI factor for the assessment of content validity. Thus, Tables 5 and 6 showed that the contents of SCP and GSCM questionnaires are validated.

Table 4 The result of the questionnaire reliability test in Cronbach's alpha method

Test area	The number of questions	Cronbach's alpha coefficient
The whole questionnaire	43	0.922
GSCM practices	22	0.868
SCP	21	0.825

Table 5 CVR and CVI for SCP questions

SCP questions	Content validity ratio	Content validity index
SM1	0.71	0.92
SM2	0.75	0.87
SM3	0.62	0.83
SM4	0.93	0.83
SM5	0.87	0.91
SM6	0.71	0.87
SM7	0.56	0.93
PR1	0.88	0.82
PR2	0.70	0.90
PR3	0.88	0.83
OI1	0.71	0.92
OI2	0.90	0.95
OI3	0.79	0.80
OI4	0.82	0.84
OI5	0.93	0.95
OI6	0.59	0.84
OI7	0.71	0.92
OI8	0.75	0.98
OI9	0.81	0.89
OI10	0.75	0.91
LCMI	0.87	0.88
LCM2	0.97	0.95

Construct validity Construct validity determines the extent to which a scale measures a variable of interest in this research. For considering convergence in the construct of GSCM and SCP, the factor analysis is used. Exploring factor analysis and criteria factor was used to investigate the construction of questionnaire. Factor analysis has depicted that all mentioned criteria are measured in these questionnaires [40].

Table 6 CVR and CVI for GSCM questions

GSCM questions	Content validity ratio	Content validity index
ENP1	0.98	0.92
ENP2	0.90	0.95
ENP3	0.69	0.87
ENP4	0.80	0.86
ENP5	0.87	0.98
ENP6	0.94	0.81
PECP1	0.96	0.91
PECP2	0.57	0.87
PECP3	0.98	0.90
PECP4	0.84	0.89
PECP5	0.83	0.99
NECP1	0.68	0.89
NECP2	0.58	0.91
NECP3	0.77	0.89
NECP4	0.98	0.93
OPP1	0.80	0.96
OPP2	0.65	0.85
OPP3	0.94	0.99
OPP4	0.89	0.92
OPP5	0.79	0.91
OPP6	0.68	0.89

The construct validity aimed at establishing the degree to which an instrument measures the construct it has been designed to be measuring. It is formed by convergent and discriminant validity. All these forms are related to and dependent on the quality of the construct. Convergent validity refers to the degree to which two measures of constructs that theoretically should be related are indeed related. Although, the discriminant validity describes the extent to which the measurements that should be unrelated are, in fact, unrelated [41].

In this paper, according to the conceptual model, the research hypotheses in which the relationship between GSCM practices and SCP in Iranian automobile industry is in question are in contrast to the concept of discrimination of GSCM and SCP variables. Furthermore, to understand the correlations between GSCM practices and SCP dimensions, the outputs of the canonical correlation analysis are as follows (Table 7):

Data analysis

The data analysis is accomplished by inferential statistical techniques particularly the exploratory factor analysis and the confirmatory factor analysis.

The relationships between the variables have been identified by using the exploratory factor analysis and then the factoring has been implemented. Then the result is applied in SEM is used in the confirmatory factor analysis. The variables are properly factored in the exploratory factor analysis. Through the confirmatory factor analysis in SEM, factoring is either accepted or rejected [42].

The software SPSS 22.0 has been applied for the first analysis and Lisrel 9.2 has been applied for the second. In the following sections, the results of the exploratory factor analysis and after that the results of Pearson correlation test and SEM will be presented. Then, the secondary hypotheses will be studied. Finally, the main hypothesis will be explained after the confirmatory factor analysis of both sides of the model. Indeed, latent variables of GSCM, latent variables of SCP, and then the impact of GSCM on SCP will be analyzed.

The results of the exploring factor analysis

Exploring factor analysis for the questionnaire of GSCM practices

After the factor analysis of 22 variables based on the extracted data of 217 questionnaires, the following results were achieved; Kaiser-Meyer-Olkin Measure (KMO) was 0.881 showing

Table 7 Canonical correlation analysis for GSCM and SCP variables

SCP dimensions GSCM practices	environmental performance	positive economic performance	negative economic performance	operational performance
supplier management	0.888	0.529	0.567	0.333
product recycling	0.367	0.577	0.592	0.402
organizational involvement	0.309	0.463	0.541	0.827
product lifecycle management	0.499	0.456	0.697	0.670

Confidence level is 0.99

that the sample size was enough. KMO Test is a measure of how suited the data is for factor analysis. The test measures the sampling adequacy for each variable in the model and for the complete model. The statistic is a measure of the proportion of variance among variables that might be a common variance. The lower the proportion, the more suited the data is to factor analysis [43]. And, "sig. In Bartlett's test of Sphericity" was lower than 0.05. Bartlett's test of sphericity tests the hypothesis that the correlation matrix is an identity matrix, which would indicate that the variables are unrelated and therefore unsuitable for structure detection. Small values (less than 0.05) of the significance level indicate that a factor analysis may be useful with the data [44]. Moreover, four factors with the total variance of more than 71.39% have been able to evaluate the GSCM practices (According to table 21 in appendix). Thus, this shows the suitable construct validity of the questions. A rotated component matrix of the GSCM practices questionnaire has been shown in Table 8.

Exploring factor analysis for the SCP questionnaire

For SCP exploring factor analysis, similar to GSCM, the following results were achieved after the factor analysis of 21 variables; KMO was 0.750 so that the sample size was adequate. In addition, "sig. In Bartlett's test of Sphericity" was less than 0.05. Furthermore, it is obvious that four factors with the total variance of more than 71.39% could be able to assess the SCP (According to table 20 in appendix). This indicates the suitable construct validity of the questions. Table 9 has shown the rotated component matrix of the SCP questionnaire as follows:

Table 8 Rotated component matrix of the GSCM practices questionnaire. Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization

Factor model aspects	components			
	Organizational involvement	Suppliers management	Product recycling	Product lifecycle
SM1	.112	.805	−.159	.145
SM2	.115	.816	.114	.088
SM3	.136	.764	−.085	.083
SM4	.165	.809	−.045	.070
SM5	−.024	.702	.306	.257
SM6	−.026	.784	.220	−.010
SM7	.090	.604	.419	−.310
PR1	.173	−.006	.863	.117
PR2	.115	.063	.879	.081
PR3	.153	.149	.889	.030
OI1	.780	.072	.020	.163
OI2	.754	.026	.067	.053
OI3	.875	.051	.148	.140
OI4	.857	−.103	.115	−.054
OI5	.901	.104	.035	−.003
OI6	.898	.153	.041	−.082
OI7	.874	.119	.028	.056
OI8	.790	.178	.114	.021
OI9	.635	.163	.275	.155
0I10	.893	.047	.045	−.065
LCM1	.122	.160	−.032	.779
LCM2	.026	.146	.268	.796

a. Rotation converged in 5 iterations

Table 9 Rotated component matrix of the SCP questionnaire. Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization

Factor model aspects	components			
	Operational performance	Positive economic performance	Environmental performance	Negative economic performance
ENP1	.137	−.175	.798	.181
ENP2	.120	.086	.809	.125
ENP3	.209	−.058	.777	.132
ENP4	−.026	.265	.712	.275
ENP5	.091	.350	.644	−.160
ENP6	−.016	.131	.819	.047
PECP1	.097	.856	.094	.080
PECP2	.127	.908	.172	.019
PECP3	.144	.905	.166	.026
PECP4	.123	.893	−.009	.119
PECP5	.064	.897	−.007	.133
NECP1	.003	.273	.113	.806
NECP2	.120	.028	.103	.840
NECP3	.009	.125	.129	.819
NECP4	.099	−.071	.121	.839
OPP1	.787	.076	.023	.085
OPP2	.800	.118	.166	.073
OPP3	.880	.183	.014	.112
OPP4	.902	.077	.127	−.055
OPP5	.888	.040	.113	.074
OPP6	.906	.082	.064	−.002

a. Rotation converged in 5 iterations

It is worthwhile to say that, in questionnaire related to SCP a Likert is provided to scale for participants which is of a prime conceptual difference between positive economic performance and negative one. First below Tables 10 and 11 is considered for the positive and the second is allocated to negative economic performance questions:

As it is shown, according to Hwang and Yoon [45], scaling for negative economic performance is in reverse order with respect to positive economic performance's order with the aim of compensating the revers effects of increasing and decreasing criteria of interest.

Pearson correlation coefficient analysis

To evaluate the strength of the correlation and the direction of the variable relationship of the proposed model and to test the hypothesis, SPSS 22.0 software and Pearson have been used. The results of this parametric test have been presented in Table 12.

Based on the SPSS 22.0 output in Table 12, the significance level is less than 0.5. So, the null hypothesis (H0) is rejected and with 99% confidence level, it can be said that there is a significant and positive relationship between GSCM practices and its aspects with the SCP.

Table 10 Scaling for positive economic performance

Strongly disagree	disagree	natural	agree	Strongly agree
1	2	3	4	5

Table 11 Scaling for negative economic performance

Strongly disagree	disagree	natural	agree	Strongly agree
5	4	3	2	1

Since the correlation coefficients have a positive sign, it can be concluded that there is a direct positive relationship between the GSCM practices and its aspects with SCP. It means that when the aspect of suppliers management, the product recycling, organizational involvement, and the product lifecycle management of GSCM practices increase, the SCP will increase too. Moreover, the correlation coefficient shows the strength of this positive relationship. As shown in Table 10, among all aspects of GSCM, the product recycling is of the most association with SCP with the correlation coefficient of 0.555.

The result of SEM analysis

Now that the existence of the correlation relationship has been recognized, the structural and causal relationship between variables and the latent constructs of GSCM practices and SCP can be evaluated by SEM method using the confirmatory factor analysis and Path Analysis, using the computer software program LISREL 9.2.

The confirmatory factor analysis of GSCM practices model

To confirm GSCM hypotheses, the confirmatory factor analysis of GSCM practices model is applied. The fitness indices of the model show that the model is fitted (Table 13). As it can be seen in Fig. 2, all significance numbers related to the model's main aspects have been significant because their significance number is more than 1.96. So, it can be asserted that the factors of suppliers management with significance number of 4.67, the product recycling with 5.52, organizational involvement with significance number of 3.89, and the product lifecycle with significance number of 2.57 have a positive and significant relationship with GSCM practices. In other words, based on the fitness of the latent prediction model (Fig. 2), it is confirmed that four mentioned factors meaningfully comprise the GSCM practices in Saipa.

Table 12 The hypothesis and the statistical hypothesis of correlation

Variables	The number of samples	Mutual significance	Pearson correlation coefficient
GSCM practices and SCP	217	.000	.803**
The aspect of suppliers management and SCP	217	.000	.484**
The aspect of product recycling and SCP	217	.000	.555**
The aspect of organizational involvement and SCP	217	.000	.498**
The aspect of product lifecycle management and SCP	217	.000	.537**

H0: $\rho = 0$ (the population correlation coefficient is 0; there is no association)
H1: $\rho \neq 0$ (the population correlation coefficient is not 0; a nonzero correlation could exist)

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

Table 13 GSCM model fitness indices

fitness indices	Measure of Index
Chi-Square/df	2.8795
P-value	0.000
Root mean square error of approximation (RMSEA)	0.096
Goodness of fit index (GFI)	0.95
Adjusted goodness of fit index (AGFI)	0.97

Figure 3 shows the extent to which each factor affects the GSCM practices in Saipa. The priority of these factors is as follows:

1. The product recycling (PR) with the path coefficient of 0.61;
2. The product lifecycle (LCM) with the path coefficient of 0.55;
3. The suppliers management (SM) with the path coefficient of 0.48;
4. The organizational involvement (OI) with the path coefficient of 0.37.

Also, in the following section, the results of the Fig. 3 have been presented:

1. The most significant factors in suppliers management are SM2 and SM4 with the correlation coefficient of 81 and 77% which are the "Suppliers environmental questionnaire" and "Product testing report".

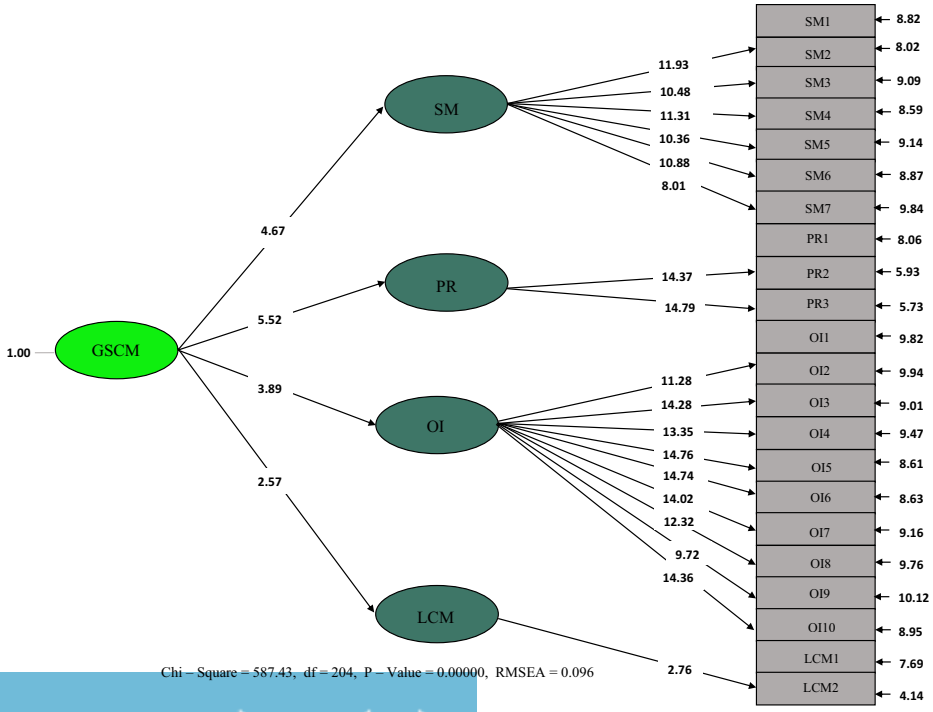

Fig. 2 Latent prediction model of GSCM practices

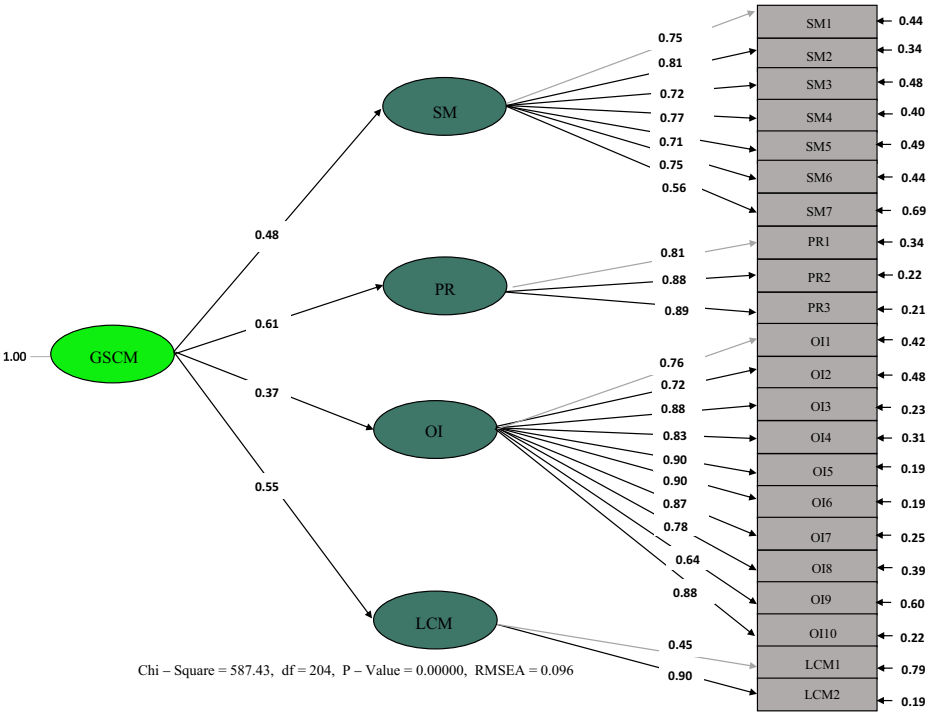

Fig. 3 Path Diagram of Model for GSCM practices

2. The most significant factor in the product recycling is PR3 with the correlation coefficient of 89%, which is "Produce disassembly manual". The next considerable factor is PR2 with the correlation coefficient of 88%, which is the "Collaboration on products recycling with the same sector industry".
3. The significant factors in organizational involvement are OI5 and OI6 with the same correlation coefficient of 90%, which are the "Labor involvement" and the "Effective communication platform within companies and with suppliers".
4. The significant factor in the product lifecycle is LCM2 with the correlation coefficient of 90%, which is "Making a database of the products".

Confirmatory factor analysis of the SCP model

The analyses of the confirmatory factor of the SCP model are as follows:

The relationship between SCP latent and its indicators has been tested. Fitness's indices in Table 14 have demonstrated a good fitness of the model, proving that the selected indicators are good representatives for each dimension of SCP. In Fig. 4, as all significance numbers corresponding to the dimension of SCP model are in excess of 1.96, these numbers have been significant. So, in Saipa the factors of the environmental performance with significance number of 5.38, the positive economic performance with number of 5.13, the negative economic

Table 14 SCP model fitness indices

fitness indices	Measure of Index
Chi-Square/df	2.0528
P-value	0.000
Root mean square error of approximation (RMSEA)	0.083
Goodness of fit index (GFI)	0.94
Adjusted goodness of fit index (AGFI)	0.92

performance with that of 4.15, and the operational performance with 4.15 are all in a positive significant relationship with SCP.

Figure 5 shows that in the final model, how much impact each factor imposes on the SCP in Saipa. The priorities of these factors are as follows:

1. The environmental performance with the path coefficient of 0.60;
2. The positive economic performance with the path coefficient of 0.51;
3. The negative economic performance with the path coefficient of 0.47;
4. The operational performance with the path coefficient of 0.41.

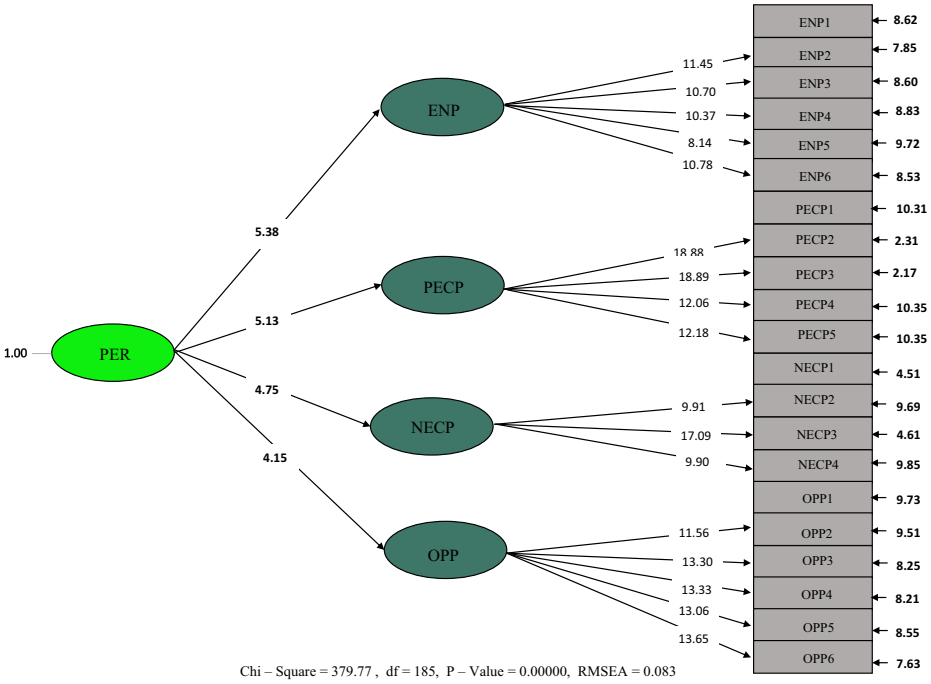

Fig. 4 Latent prediction model of SCP

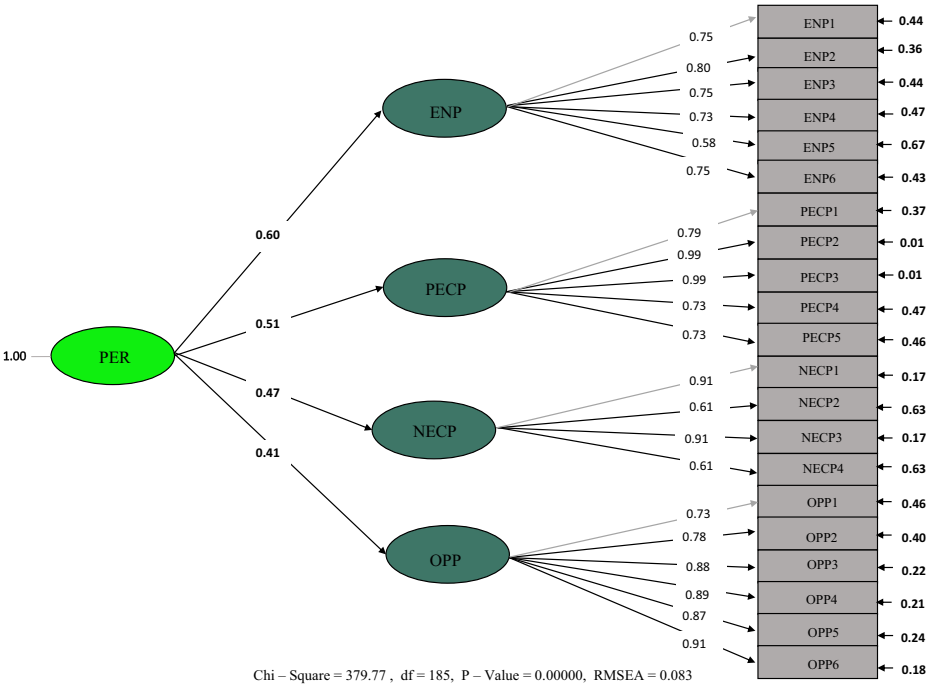

Fig. 5 The Path Diagram of the Model for SCP

Moreover, in the following section, the results of Fig. 5 have been presented:

1. The most significant factor in the environmental performance is ENP2 with the correlation coefficient of 80% which is the "Reduction of waste water". The other three considerable factors include ENP1, ENP3 and ENP6 with the same correlation coefficient of 75% which are the "Reduction of air emission", the "Reduction of solid wastes" and to "Improve a company's environmental situation"
2. The significant factors in the positive economic performance are PCEP2 and PCEP3 with the same correlation coefficient of 99%, which are the "Decrease of cost for energy consumption" and the "Decrease of fee for waste treatment"
3. The significant factors in the negative economic performance include NECP1 and NECP3 with the same correlation coefficient of 91%, which are "The investment increase" and "The increase of the training cost"

Table 15 The structural model fitness indices

fitness indices	Measure of Index
Chi-Square/df	2.836
P-value	0.000
Root mean square error of approximation (RMSEA)	0.074
Goodness of fit index (GFI)	0.96
Adjusted goodness of fit index (AGFI)	0.94

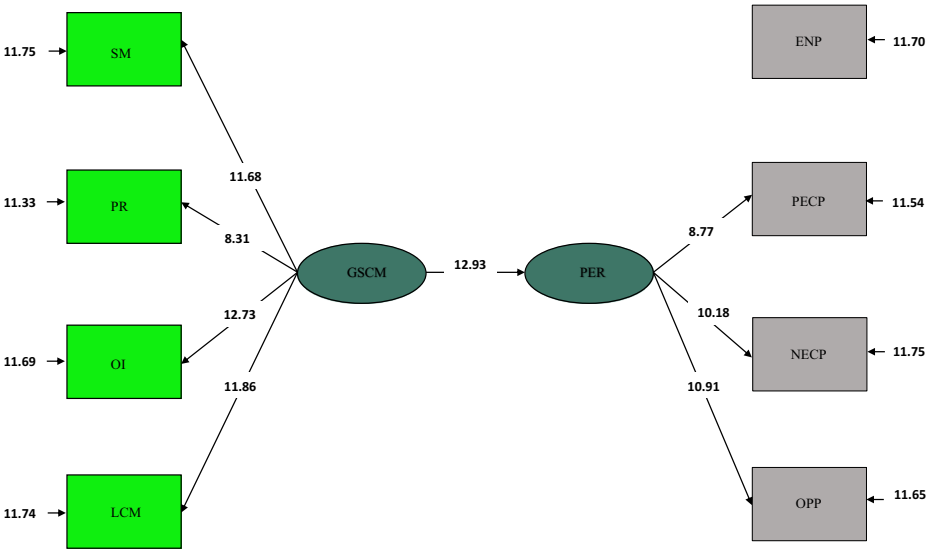

Fig. 6 Latent prediction of the general research model

4. The most significant factor in the operational performance is OPP6 with the correlation coefficient of 91%, which is "The improvement of the utilization capacity". The next considerable factor is OPP4 with the correlation coefficient of 89%, which is "The quality improvement of the products".

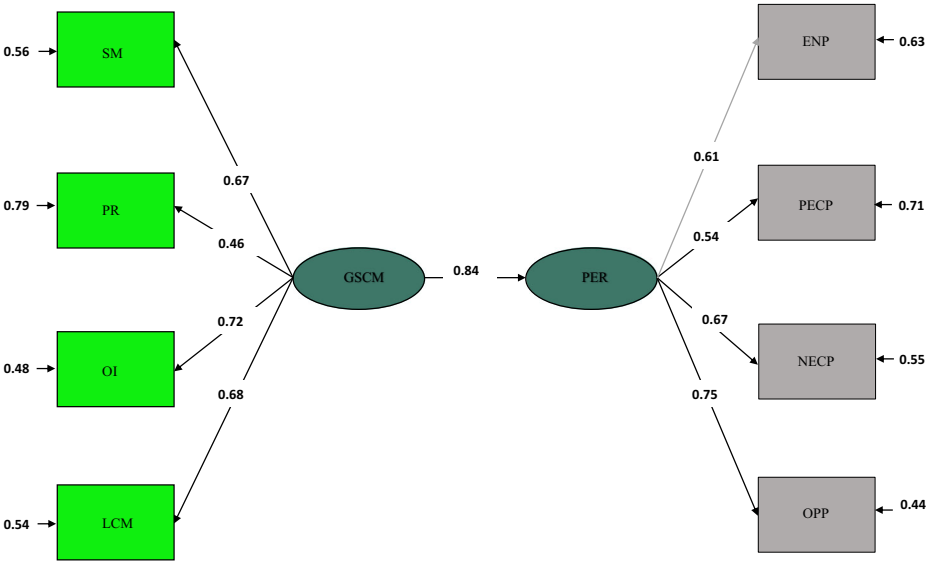

Fig. 7 Path Diagram of the general research model

Table 16 Priority of the GSCM practices indicators

GSCM practices	Product recycling	0.61	PR3- Produce disassembly manual	0.89
			PR2- Collaboration on products recycling with the same sector industry.	0.88
			PR1- Joining local recycling organization	0.81
	Product lifecycle	0.55	LCM2- Establish an environmental database of products	0.90
			LCMI- Applying Life cycle assessment (LCA) to carry out eco-report	0.45
	Suppliers management	0.48	SM2- suppliers environmental questionnaire	0.81
			SM4- Product testing report	0.77
			SM1- Environmental auditing for suppliers	0.75
			SM6- Establishing environmental requirements for purchasing items	0.75
			SM3- Compliance statement	0.72
			SM5- Bill of materials	0.71
			SM7- Green purchasing	0.56
	Organizational involvement	0.37	OI5- Manpower involvement	0.90
			OI6- Effective communication platform within companies and with suppliers	0.90
			OI10- the relationship of research and development unit with university professors and experts	0.88
			OI3- Environmental policy for GSCM	0.88
			OI7- Establish an environmental risk management system for GSCM	0.87
			OI4- Cross-function integration	0.83
			OI8- Supplier evaluation and selection	0.78
			OI1- Green design	0.76
			OI2- Top management support	0.72
			OI9- Information system	0.64

Table 17 Priority of the SCP factors

SCP	Environmental performance	0.60	ENP2- Reduction of waste water	0.80
			ENP1- Reduction of air emission	0.75
			ENP3- Reduction of solid waste solid waste	0.75
			ENP6- Improve a company's environmental situation	0.75
			ENP4- Decrease of consumption for hazardous/harmful/ toxic materials	0.73
			ENP5- Decrease of frequency for environmental accidents	0.58
	Positive economic performance	0.51	PECP2- Decrease of cost for energy consumption	0.99
			PECP3- Decrease of fee for waste treatment	0.99
			PECP1- Decrease of cost for materials purchasing	0.79
			PECP4- Decrease of fee for waste discharge	0.73
			PECP5- Decrease of fine for environmental accidents	0.73
	Negative economic performance	0.47	NECP1- Increase of investment	0.91
			NECP3- Increase of training cost	0.91
			NECP2- Increase of operational cost	0.61
			NECP4-Increase of cost for purchasing environmentally friendly material	0.61
	Operational performance	0.41	OPP6- Improved capacity utilization	0.91
			OPP4- Promote products' quality	0.89
			OPP3- Increase scrap rate	0.88
			OPP5- Increased product line	0.87
			OPP2- Decrease inventory levels	0.78
			OPP1- Increase amount of goods delivered on time	0.73

The path analysis for general research model

The fitness indices of the model show that the model is fitted (Table 15). According to Figs. 6 and 7 there is a positive and significant causal relationship between the GSCM practices and the SCP. The results show that the variable of GSCM practices predicts 70.56% of the SCP changes in Saipa. So, the main hypothesis is confirmed.

As the variables including the suppliers management, the product recycling, the organizational involvement, and the product lifecycle construct their latent variable (GSCM practices) and also according to the significant influential relationship between GSCM practices and SCP of Saipa Company (with the significant number of 12.92), the secondary hypotheses 1 to 4 (sec. 0-0) are confirmed, too.

Finally, Tables 16 and 17 show the priority of the indicators of the GSCM practices and SCP factors in Saipa, respectively. These tables can be considered as a quick reference to grasp the factors which would affect the SCP and GSCM in Iranian automobile industry.

Conclusions and suggestions

The aim of the present study is to assess the impacts of GSCM practices on the economic, environmental and operational performance with regard to Iranian automobile industry. According to this, a model has been developed in order to address the issue, comprised of the hypotheses which have depicted the relationship between GSCM practices and the SCP with respect to their indices. SCP has been included four dimensions of the environmental performance, positive and negative economic performance, and operational performance. GSCM practices also have been made of four aspects of supplier management, product recycling, organizational involvement, and the product lifecycle management. Then, the proposed model has been analyzed and confirmed by the combination of Pearson correlation coefficient and SEM.

The model's validity and reliability have been assessed. Then, the proposed model has been implemented and approved as an applicable model in Saipa as a major automobile manufacturer in Iran. Therefore, the model has validity, reliability, and generalizability for assessing the similar type of manufacturer.

Based on the obtained results of the study, four mentioned observed variables for GSCM in Saipa are compatible with results of Hu and Hsu [6]. Furthermore, four confirmed aspects of SCP as latent variable in Saipa are also consistent with the obtained results of Zhu et al. [7].

In addition, the confirmation of the research hypotheses shows that the improvement of GSCM practices in Saipa positively promotes the SCP with the prediction rate of 70.56% and in the 95% confidence level. This result is consistent with Zhu et al. [7] findings which had concluded that there is a significantly positive correlated relationship between the improvement of GSCM practices and the operational, economic, and environmental performance in Iranian automotive industry.

The results of the implementation of this model have showed that the product recycling among four GSCM practices is in the first priority. Moreover, the product disassembly manual has the greatest importance among all 22 GSCM practices indictors. To avoid the misinterpretation dimension of the product recycling as its' criterion, the product disassembly manual, the product

recycling initiatives is related to the disposal stage, while the product disassembly manual refers to the consumers education about the recycling and recovery options available to them, and explaining that they must not dispose the products together with their general trash. To facilitate an end-of-life disassembly, the product disassembly manuals need to be carried out as a reference for disassembly workers to implement the non-destructive detachment of components or modules and acquire the recovery of original functionality in order to contribute to the environmental benefit [6, 46]. In order for Saipa Company and similarly for Iranian automobile companies, to improve GSCM practices by considering the product disassembly manual as the most influential indicator from experts' point of view, it is recommended to set up a management system for their products disassembly manual which provides the required instructions on how to take care of items containing the environmental hazardous materials. Furthermore, based on the viewpoint of the product lifecycle management practice, it is beneficial to make a database including the information of the products for instance their end of life for making such database is scored as the most significant factor in LCM practice. As another practical solution to improve GSCM practices, concerning the suppliers management, Saipa is suggested to design the suppliers environmental questionnaires as an extended producer responsibility and distribute to suppliers for helping them conduct a self-assessment and for ensuring the suppliers to realize their environmentally potential capabilities which satisfy the environmental regulations particularly for high-risk components. All those aforementioned suggestions would result in the enhancement of GSCM practices by which SCP in Saipa would be improved as well.

As other researches, this paper has some limitations; first, the barriers related to why the company does not broadly implement GSCM practices have not been investigated. The governments need such information to formulate the applicable policies to enhance the environmental performances in automobile industries and support industrial organizations to break the barriers they may encounter. Second, in Iran, the basic knowledge on GSCM encumbers it to conduct the surveys since this confined understanding may result in the biased answers. Third, the research method has not considered the existed uncertainty.

Finally, the following cases are suggested for further studies:

- The Canonical correlation analysis (CCA) is another method, similar to SEM, for exploring the relationships between two multivariate sets of variables which is appropriate to answer the research question. For the further approval of the findings, it is suggested to apply CCA in order to evaluate the impacts of GSCM practices on the SCP.
- To study the mutual relationship between GSCM practices and SCP by considering the uncertainty and risk management in green supply chain.
- To study the impact of GSCM practices on social performance in addition to the economic, operational, and environmental SCP dimensions.

Appendix

Table 18 Questionnaire of GSCM practices in Iranian automobile industry

No	Please indicate how strongly you agree or disagree with the following statements:	Strongly disagree	disagree	No opinion	agree	Strongly agree
1	Saipa company environmentally audits its suppliers					
2	The suppliers environmental questionnaire is used in order to determine suppliers awareness level of environmental rules and conditions,					
3	Suppliers are committed to comply their products, parts and materials with environmental rules and they accept the responsibility of damaged parts.					
4	Product testing report and suppliers documents, are provided for all materials, series and equipment in order to confirm the products compliance with environmental rules					
5	A bill of allowed materials which are capable to return to the production cycle or environment is given to suppliers.					
6	Environmental requirements for purchasing items are established in order to manage dangerous materials and ensuring the products compliance with consumers environmental rules.					
7	The company purchases green materials					
8	The organization tries to join local recycling organizations in order to collect and recycle its products and similar products					
9	Research and development section collaborates with suppliers on products recycling with the same sector industry and environmental innovations and customer satisfaction..					
10	Disassembly manuals are produced to make people familiar with recycling product classification and the way they are separated from non-recycling ones.					
11	The products are designed in such a way to be capable of recycling and returning to the production cycle					
12	Top management supports environmental plans and guide them					
13	Environmental policies for GSCM are formulated to increase the customers, employees and suppliers awareness in environmental issues.					
14	In supply chain of Saipa company, there exists a team of the sale employees, environmental employees, purchase employees and other employees for Cross-function integration of stable information					
15	Manpower involves in administration of environmental plans					
16	An effective communication platform within companies and with suppliers is established to identify their needs and company performance.					
17	In Saipa company, an environmental risk management system has been formulated for GSCM					
18	Supplier evaluation and selection is carried out based on environmental rules, quality and timely supply of materials					
19	Information system has been developed to make more and faster connections between suppliers, producers and customers.					
20	Research and development unit has relationships with university professors and experts					
21	Saipa company applies Life Cycle Assessment (LCA) to carry out the eco-report					
22	An environmental database of products has been established for consumers awareness (such as the products compliance with environment management, their productivity and the parts which are capable to recycle to the production cycle)					

Table 19 Questionnaire of SCP Iranian automobile industry

No.	Importance in Saipa Supply Chain Performance	Extremely unimportant	Somewhat unimportant	Indifferent	Somewhat important	Extremely important
1	Reduction of air emission					
2	Reduction of waste water					
3	Reduction of solid waste solid waste					
4	Decrease of consumption for hazardous/harmful/ toxic materials					
5	Decrease of frequency for environmental accidents					
6	Improve a company's environmental situation					
7	Decrease of cost for materials purchasing					
8	Decrease of cost for energy consumption					
9	Decrease of fee for waste treatment					
10	Decrease of fee for waste discharge					
11	Decrease of fine for environmental accidents					
12	Increase of investment					
13	Increase of operational cost					
14	Increase of training cost					
15	Increase of cost for purchasing environmentally friendly material					
16	Increase amount of goods delivered on time					
17	Decrease inventory levels					
18	Increase scrap rate					
19	Promote products' quality					
20	Increased product line					
21	Improved capacity utilization					

Table 20 Total variance of SCP questionnaire

SCP dimensions	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Eigen value	% of Var.	Cumulative %	Eigen value	% of Var.	Cumulative %	Eigen value	% of Var.	Cumulative %
Operational performance	6.509	30.994	30.994	6.509	30.994	30.994	4.630	22.048	22.048
Positive economic performance	3.560	16.954	47.948	3.560	16.954	47.948	4.393	20.919	42.967
Environmental performance	3.242	15.439	63.388	3.242	15.439	63.388	3.669	17.472	60.439
Negative economic performance	2.352	11.201	74.589	2.352	11.201	74.589	2.972	14.151	74.589

Table 21 Total variance of GSCM questionnaire

GSCM dimensions	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Eigen value	% of Var.	Cumulative %	Eigen value	% of Var.	Cumulative %	Eigen value	% of Var.	Cumulative %
Organizational involvement	7.869	35.768	35.768	7.869	35.768	35.768	7.045	32.024	32.024
Suppliers management	3.993	18.151	53.919	3.993	18.151	53.919	4.226	19.207	51.231
Product recycling	2.446	11.119	65.038	2.446	11.119	65.038	2.880	13.089	64.321
Lifecycle of products	1.398	6.353	71.391	1.398	6.353	71.391	1.555	7.070	71.391

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