KMAN PUBLISHING INSTITUTE
Journal Website

Article history:
Received 10 April 2024
Revised 22 May 2024
Accepted 29 May 2024
Published online 01 July 2024

International Journal of Innovation Management and Organizational Behavior

Volume 4, Issue 3, pp 84-91

IJIMOB International Journal of Innovation Management and Organizational Behavior

E-ISSN: 3041-8992

Evaluating the Impact of Green Supply Chain Management Processes on New Products in Saipa Automotive Company

Ali. Einizadeh[1], Ahmad Reza. Kasraee[2*], Vahid. Mirabi[3]

[1] PhD Student, Department of Business Management, Central Tehran Branch, Islamic Azad University, Tehran, Iran
[2] Assistant Professor of Management, Department of Industrial Management, Central Tehran Branch, Islamic Azad University, Tehran, Iran
[3] Associate Professor, Department of Business Management, Central Tehran Branch, Islamic Azad University, Tehran, Iran

*** Corresponding author email address**: ahm.kasraee@iauctb.ac.ir

A r t i c l e I n f o

Article type:
Original Research

How to cite this article:
Einizadeh, A., Kasraee, A. R., & Mirabi, V. (2024). Evaluating the Impact of Green Supply Chain Management Processes on New Products in Saipa Automotive Company. *International Journal of Innovation Management and Organizational Behavior*, *4*(3), 84-91.
https://doi.org/10.61838/kman.ijimob.4.3.11

A B S T R A C T

Objective: The development of new products is a strategic activity for many automotive companies to gain a competitive advantage. This requires the examination of variables that affect the performance of new product development. This article evaluates the impact of green supply chain management processes on new products at Saipa Automotive Company.

Methodology: The research method is descriptive and survey-based. The research population includes managers from various departments at Saipa Automotive Company. Data were collected using a field method and a questionnaire with a convenience sampling technique. For data analysis, the Structural Equation Modeling approach with Partial Least Squares and the PLS software were used.

Findings: Findings indicate that internal processes positively impact green practices. Furthermore, the impact of variables such as green supply chain actions, environmental characteristics, and supply chain agility on supply chain value creation was positive. Additionally, the results showed that supply chain value creation significantly impacted the development of new (green) products.

Conclusion: Therefore, it is recommended that automotive industry companies use customer ideas in developing green products and seek their opinions on products and their modifications to enhance supply chain value creation and product quality.

Keywords: *Green supply chain management, new products, Saipa Company.*

1 Introduction

In recent years, significant advancements have been made in the automotive industries (Moser et al., 2021; Robinson & Malhotra, 2005). Amidst intense competition, the rapid obsolescence of technologies, and changing customer needs and preferences, the development of new products has garnered significant attention from thinkers in this industry. Nowadays, manufacturing industries are faced with fierce competition along with uncertainty and

continuous changes. Developing low-cost, high-quality products is no longer sufficient for the success of the automotive industry; instead, these industries need to develop new products effectively and efficiently to meet market needs. Supply chain management could prevent items and components that are restricted by authorities in the European Union from being used in electronic equipment due to their destructive and hazardous nature. Also, few studies have shown that green supply chain management can improve economic performance (Alem Tabriz et al., 2017; Gligor et al., 2013; Kauppi et al., 2016) and is vital for achieving corporate profitability. However, the changes and consequences of the supply chain are unique to each company, and project-based companies must adapt to these unique changes. To adapt to the environment, these companies are forced to adopt considerations in their internal and external strategies and structures (Kauppi et al., 2016).

On the other hand, in today's global market, maintaining a competitive position is a constant concern. Technological innovations and economic uncertainties are changing the competitive landscape, placing organizations' survival on their competitive advantage through new products. Therefore, organizations must learn and acquire new knowledge from their environment to ensure the competitive advantage of their new products (Alinezhad et al., 2019; Kauppi et al., 2016). Currently, companies operate in markets where continuous innovation and high-quality products are considered, and products have a short life cycle. Accordingly, companies are looking for ways to reduce product development time while simultaneously improving quality and reducing costs. New product development is a strategic and key activity for many companies, through which new products will have a significant share in sales and profits. In fact, new products are a crucial factor for organizations' success in the market, so managers can improve company performance through new product development. This requires more efficiency and effectiveness in the processes of new product development, especially in preventing the waste of resources in peripheral activities. New product development reduces the cost of activities (Haleem et al., 2023; Mbima & Tetteh, 2023; Sahafzadeh & Haghighi, 2023).

However, researchers in various studies have warned that the failure rate of new product development is still concerning (Blome et al., 2013). Many factors are critical for the success of new products, and it is necessary to identify and classify the factors of success or failure in new product development projects so that organizational planners can make appropriate decisions regarding the formulation and implementation of suitable programs and policies (Bonner, 2010). However, implementing green supply chain management as a system will be a comprehensive approach to understanding this phenomenon; a phenomenon composed of different components including managers, entrepreneurs, society, and environmental considerations. In such an environment, successful companies, especially automotive companies, seek to use green supply chain management as a key factor in achieving success by exploiting current competitive advantages and discovering innovations that will shape future competitive advantages (Kianfar & Barforoush, 2016).

In many cases, managers only pay attention to the green supply chain when they are trying to reduce costs or solve a problem. It could be argued that after managing customer relationships, the biggest challenge for manufacturing and service organizations is the proper management of the green supply chain and provisioning for manufacturing and service needs. The belief that supply chain management can make companies more responsive to customers and consequently more profitable has led managers to place greater emphasis on improving the process of developing new products (Hosseini & Sheikhi, 2012).

Furthermore, employing green supply chain management and recognizing and emphasizing conditions that facilitate the development of strategic market behaviors are effective for the development of new products in automotive companies. One of the fundamental features of such markets is that companies rapidly innovate and introduce new products using green supply chain management based on their internal capabilities and resources. Despite this, recent studies indicate that to achieve competitive advantage in the market, it is essential to make rational decisions about various aspects of new product development from the perspective of green supply chain management. These interdependent decisions will ultimately affect the success or failure of the new product. Therefore, the most important problems that the automotive industry faces are rooted in supply chain issues, which can be mainly attributed to several categories: lack of professionalism in market research and customer-centric production, low level of technical knowledge, low level of innovation in products, lack of professionalism in business management, and poor management of the green supply chain, especially in forming sustainable expert work teams. Given the discussed issues, these problems can be generally examined within the framework of the green supply chain and the process of new

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E-ISSN: 3041-8992

product development in this industry. Given the importance of green supply chain management and its role in developing new products in the automotive industry, the significance of this research is evident.

Based on theoretical foundations, the research hypotheses are formulated as follows:

Hypothesis 1: Internal processes have a positive impact on green actions.

Hypothesis 2: Green actions have a positive impact on supply chain value creation.

Hypothesis 3: Environmental characteristics have a positive impact on supply chain value creation.

Hypothesis 4: Supply chain agility has a positive impact on supply chain value creation.

Hypothesis 5: Supply chain value creation has a positive impact on outcomes.

2 Methods and Materials

The present research is considered an applied study in terms of its objectives and is classified as a survey research in terms of data collection. The structure of this research is based on the structural equation modeling design. Therefore, the Partial Least Squares (PLS) method has been used for data analysis because, firstly, this method does not rely on assumptions such as the normal distribution of observed indicators and a large sample size. Secondly, according to Chin (1998), this method is used for predicting and exploring potential relationships. The research population consisted of 100 individuals. Considering maximum variance and a 5 percent error level, 86 individuals were selected using a convenience sampling method. Additionally, to increase the response rate of the questionnaire and facilitate the research process, over 100 questionnaires were distributed electronically, of which 86 were completed by managers and used as the basis for hypothesis testing and analysis. Moreover, Cronbach's alpha and composite reliability were used to assess the reliability of the questionnaire. Reliability results for each variable showed all values exceeding 0.7, indicating satisfactory reliability. For validity assessment, convergent validity was used. The results of convergent validity for the model's latent variables were above 0.5, indicating satisfactory measurement model convergent validity.

3 Findings and Results

In this research, six main variables were selected to be examined based on a conceptual model. Describing these variables is important as the results of testing the research hypotheses are derived from the data and indices of these variables. The research data are on an interval scale. Central and dispersion indices have been used to describe the research variables, which are discussed below. Considering the selection of a 5-point Likert scale for the questionnaire items, it is necessary to examine the values obtained from the respondents' opinions to determine whether the average of their responses significantly differs from 3 (the midpoint of the Likert scale). If the obtained average value is less than 3, it indicates that the studied population has an undesirable situation regarding that index (the opposite is true for inverse variables). Moreover, the greater the absolute values of skewness and kurtosis coefficients, the more they indicate a deviation and difference of the sample from a normal distribution symmetry, such that if the absolute values of these coefficients are within the range (-1 to 1), it indicates no deviation of the distribution curve compared to a normal distribution.

Table 1

Descriptive Indices for the Dimensions of Research Variables

Research Variable	Sample Size	Mean	Standard Deviation	Skewness	Kurtosis
Internal Processes	86	3.26	0.291	-0.577	-0.291
Green Actions	86	3.17	0.210	-0.284	0.381
Green Supply Chain Actions	86	3.47	0.318	-0.737	-0.628
Supply Chain Value Creation	86	3.86	0.609	-0.322	-0.329
Supply Chain Agility	86	3.19	0.598	-0.344	-0.014
Development of New (Green) Products	86	3.69	0.247	-0.704	0.444

Based on Table 1, it can be observed that all variables are in a satisfactory condition.

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Table 2

Validity Results for Variables

Variable	AVE	Cronbach's Alpha	CR	R^2
Internal Processes	0.770	0.851	0.859	-
Green Actions	0.672	0.849	0.860	-
Green Supply Chain Actions	0.699	0.902	0.947	-
Supply Chain Value Creation	0.602	0.974	0.919	-
Supply Chain Agility	0.741	0.888	0.941	-
Development of New (Green) Products	0.710	0.836	0.932	0.721

In this research, the Partial Least Squares (PLS) method was used for data analysis because this method does not rely on assumptions such as the normal distribution of observed indicators or a large sample size. Secondly, this method is used for the purposes of prediction and the exploration of potential relationships. In other words, unlike covariance-based methods that attempt to fit the data to the theoretical model of the research, this method aims to discover the theory hidden within the data. The findings of this research have been categorized into two main groups; the first group of findings pertains to the validity and reliability of constructs and indicators. In the Partial Least Squares method, AVE (Average Variance Extracted) and CR (Composite Reliability) are typically used to assess the reliability of constructs. Since Cronbach's alpha provides a more stringent estimate of the internal reliability of variables, composite reliability is used in Partial Least Squares path models. Regardless of which reliability coefficient is used, the Cronbach's alpha value should be greater than 0.7. According to Table 2, the CR and Cronbach's alpha for all constructs are greater than 0.7. The determination coefficient (R^2) measures the proportion of the variance in a dependent variable explained by the independent variables. Values greater than 0.67 are considered strong, greater than 0.33 are moderate, and less than 0.19 are weak. This coefficient indicates the percentage of variation in the dependent variable explained by the independent variables.

Table 3

Correlation Matrix and the Square Root of the Extracted Model's Average Variance

Latent Variables	(1)	(2)	(3)	(4)	(5)	(6)	Square Root AVE
Internal Processes	1						0.825
Green Actions	0.260	1					0.802
Green Supply Chain Actions	0.549	0.378	1				0.900
Supply Chain Value Creation	0.575	0.259	0.528	1			0.811
Supply Chain Agility	0.511	0.449	0.563	0.497	1		0.729
Development of New (Green) Products	0.634	0.302	0.560	0.577	0.632	1	0.795

The second group of findings of this research is dedicated to testing the structural model and research hypotheses, using the path coefficient and the determination coefficient obtained through the Partial Least Squares algorithm with the Smart PLS software. The path coefficient indicates the contribution of each predictor variable in explaining the variance of the criterion variable. The T-statistic value was calculated using the bootstrap algorithm with 86 subsamples. Figure 2 shows the T-statistics for the path coefficients and Figure 1 estimates the path coefficients of the final model of the research.

Figure 1

Model with Standard Coefficients

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E-ISSN: 3041-8992

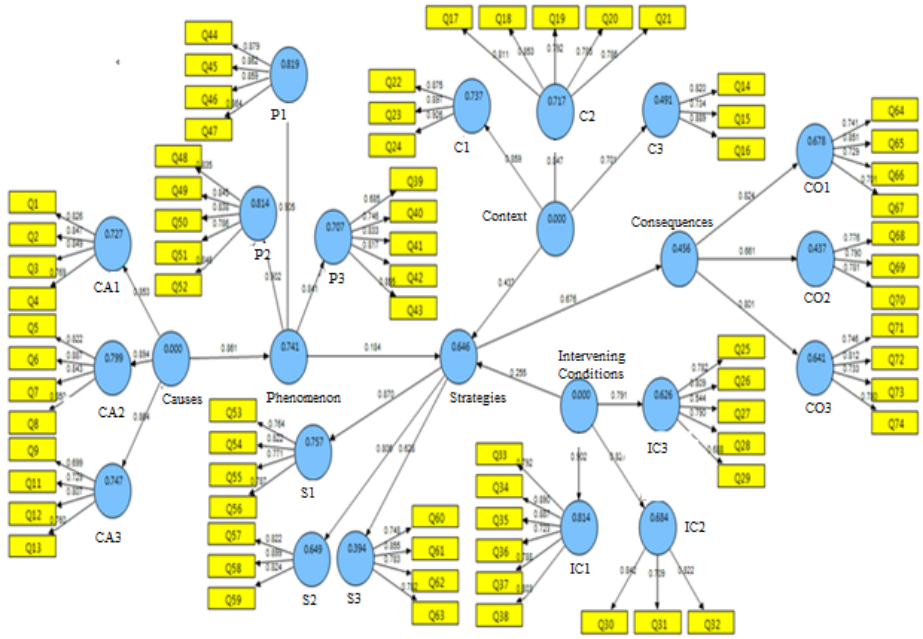
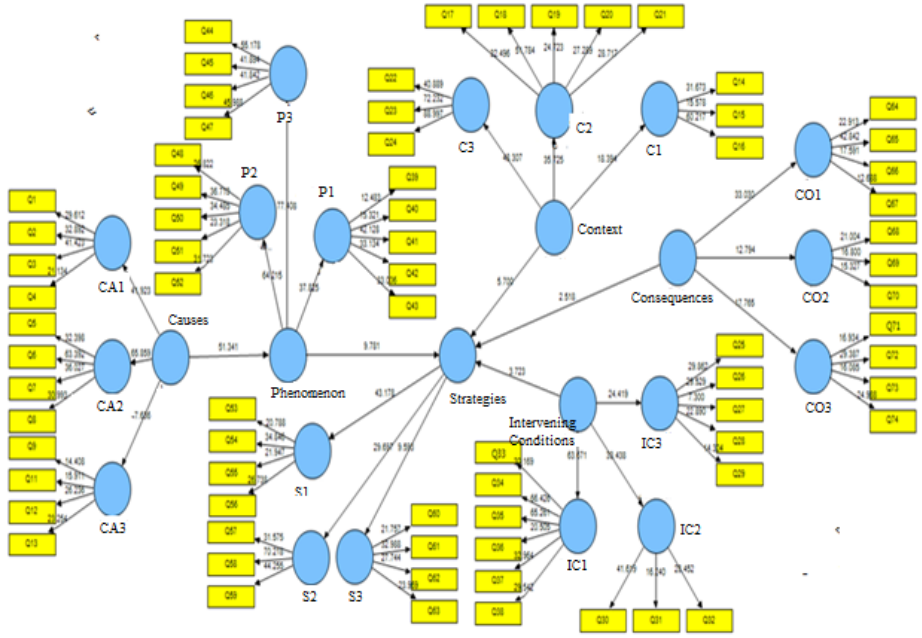


Figure 2

Model with T-Values



Hypothesis 1: Internal processes have a positive impact on green actions.

Based on the results for Hypothesis 1, the role of internal processes on green actions is established. The path coefficient for the effect of internal processes on green actions is 0.861, and this value is significant at the 95% confidence level. Given that the T-value is outside the critical range (greater than 1.96), the researcher's claim that "internal processes have a positive impact on green actions" is confirmed with a probability of 0.95.

Hypothesis 2: Green actions have a positive impact on supply chain value creation.

According to the results for Hypothesis 2, the role of green actions on supply chain value creation is established. The path coefficient for the effect of green actions on supply chain value creation is 0.184, and this value is significant at the 95% confidence level. Given that the T-value is outside

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E-ISSN: 3041-8992

the critical range (greater than 1.96), the researcher's claim that "green actions have a positive impact on supply chain value creation" is confirmed with a probability of 0.95.

Hypothesis 3: Environmental characteristics have a positive impact on supply chain value creation.

Based on the results for Hypothesis 3, the role of environmental characteristics on supply chain value creation is established. The path coefficient for the effect of environmental characteristics on supply chain value creation is 0.225, and this value is significant at the 95% confidence level. Given that the T-value is outside the critical range (greater than 1.96), the researcher's claim that "environmental characteristics have a positive impact on supply chain value creation" is confirmed with a probability of 0.95.

Hypothesis 4: Supply chain agility has a positive impact on supply chain value creation.

According to the results for Hypothesis 4, the role of supply chain agility on supply chain value creation is established. The path coefficient for the effect of supply chain agility on supply chain value creation is 0.437, and this value is significant at the 95% confidence level. Given that the T-value is outside the critical range (greater than 1.96), the researcher's claim that "supply chain agility has a positive impact on supply chain value creation" is confirmed with a probability of 0.95.

Hypothesis 5: Supply chain value creation has a positive impact on the development of new (green) products.

Based on the results for Hypothesis 5, the role of supply chain value creation on the development of new (green) products is established. The path coefficient for the effect of supply chain value creation on the outcome is 0.676, and this value is significant at the 95% confidence level. Given that the T-value is outside the critical range (greater than 1.96), the researcher's claim that "supply chain value creation has a positive impact on the development of new (green) products" is confirmed with a probability of 0.95.

The values of path coefficients and T-statistics, along with the hypothesis results, are presented in Table 4. Therefore, the data analysis using PLS software and the results of hypotheses testing or rejection are observable in Table 4.

Table 4

Hypothesis Testing Results

Hypothesis	Path Coefficient (Beta)	t	R^2	Result	Impact Direction
Internal Processes -> Green Actions	0.861	5.318	0.741	Confirmed	Positive
Green Actions -> Supply Chain Value Creation	0.184	2.679		Confirmed	Positive
Environmental Characteristics -> Supply Chain Value Creation	0.225	3.935		Confirmed	Positive
Supply Chain Agility -> Supply Chain Value Creation	0.437	6.265	0.646	Confirmed	Positive
Supply Chain Value Creation -> Development of New (Green) Products	0.676	17.657	0.456	Confirmed	Positive

|t|>1.96 Significant at P<0.05, |t|>2.58 Significant at P<0.01

4 Discussion and Conclusion

Today, due to intense global competition, rapid technological changes, and expanding product diversity, organizations operate in dynamic, complex, and unpredictable environments, competing with each other to improve their performance. In such circumstances, many leading companies are trying to make a profit and stay ahead in the competition through the process of green supply chain management. Moreover, despite the high failure rate of new product development, heterogeneous markets, short product life cycles, and changing regulations, automotive companies must simultaneously work on both new product development and green supply chain activities to enhance their performance. Researchers must operationalize the variables of interest in their studies to examine them and conceptualize them to generalize the research findings. For an operational definition to be useful, it must be based on theories that are generally recognized as valid. Reviews conducted up to the time of this study showed that no similar research had been carried out; we identified and evaluated components that impact green supply chains and new product development in automotive companies. Based on the results from the analysis of data outputs and the points mentioned in the conclusion, the following suggestions can be made to improve new product development.

The aim of this research was to demonstrate the importance of assessing the impact of green supply chain management on new products at Saipa Automotive Company. The results related to the analysis of the existing relationships among the research model variables were measured, and all hypotheses were confirmed in prior

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E-ISSN: 3041-8992

studies (Alem Tabriz et al., 2017; Gligor et al., 2013; Kauppi et al., 2016). The following practical suggestions are proposed:

It is suggested that for value creation in the supply chain and improving product quality, automotive industry companies should use customer ideas in developing green products and seek their opinions about the products and their changes.

Managers are advised to undertake actions such as reorganizing suppliers and customers, using reliable and diverse suppliers, ranking customers and suppliers, and implementing a rapid order system from customers to identify opportunities in the environment and deal with changes and environmental uncertainties to improve new product development performance.

It is suggested that managers, based on environmental characteristics and by creating communication opportunities through internal and external supply chain networks, provide a new perspective on value creation with a diversity of products and services.

In the development of green actions, current procedures and guidelines related to competitive advantage should be periodically reviewed and improved so that the direct opinions of employees in this regard are considered.

It is suggested that in the company's internal processes, there should be a strong knowledge transfer system between the supply chain and the research and development unit to encourage employees to create new ideas for product development, in addition to value creation.

Managers should have a comprehensive observation of competitors' products and market opportunities, relying on the strengths of competitors' products, customer feedback, and using agility in the green supply chain process to design, produce, and offer distinct products to the market.

Managers of companies are advised to focus on green supply chain capabilities to cope with rapid environmental changes and improve their new product development performance. In this direction, by fostering innovation through facilitating information sharing, integrating the supply chain, and improving collaboration among different parts of the green supply chain process, managers can enhance new product development performance.

Green supply chain management cannot achieve a reliable position among competitors without access to comprehensive information about customer preferences in product selection or service receipt. Using green supply chain actions and creating coordination between it and other parts of the supply chain, especially its management, is a positive step towards raising awareness of new green products and achieving better efficiency.

Emphasis on continuous training of all employees through specialized training seminars and workshops, organizing brainstorming sessions between different training groups, holding sessions for sharing experiences and ideas, establishing communication channels between customers and operational sectors, and providing necessary educational infrastructure can help develop value creation.

Managers are advised to carry out necessary training and planning to improve IT flexibility, supply chain integration capability, management, and business alignment capabilities.

For the improvement of new product development, automotive companies need to focus on agility capabilities. In this direction, they should enhance their marketing information. This is possible through having a well-defined and precise marketing plan. The next step after devising a marketing plan is its proper implementation, over time developing the marketing plan, continuously examining the internal and external environment in which the company operates, and regularly assessing the environment, ultimately leading to the development of new products competitive with rivals. For being active in today's competitive arena, examining and developing new products is of great importance and vital for the development of the automotive industry.

Managers are advised to undertake actions such as reorganizing suppliers and customers, using reliable and diverse suppliers, ranking customers and suppliers, and implementing a rapid order system from customers to identify opportunities in the environment and cope with environmental changes and uncertainties to improve new product development performance.

Future researchers are advised to test the current research model on other companies and are recommended to repeat the research topic with a comparative approach in different industries such as the insurance industry, hospitality, etc., and assess the generalizability of the research model in other geographical domains.

This study also faces limitations that define the direction of future studies. This research was conducted cross-sectionally, which makes drawing causal conclusions challenging. The large number of questionnaire questions resulted in a longer execution time, which was not without effect on the accuracy of the participants' responses. Research data were collected cross-sectionally; to achieve

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E-ISSN: 3041-8992

more accurate and reliable results, future studies could be conducted over a longer period.

Authors' Contributions

All authors have contributed significantly to the research process and the development of the manuscript.

Declaration

In order to correct and improve the academic writing of our paper, we have used the language model ChatGPT.

Transparency Statement

Data are available for research purposes upon reasonable request to the corresponding author.

Acknowledgments

We would like to express our gratitude to all individuals helped us to do the project.

Declaration of Interest

The authors report no conflict of interest.

Funding

According to the authors, this article has no financial support.

Ethical Considerations

In this research, ethical standards including obtaining informed consent, ensuring privacy and confidentiality were observed.

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E-ISSN: 3041-8992