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# IMPACTS OF COLLABORATION NETWORKS, OPERATIONAL PERFORMANCE AND REVERSE LOGISTICS DETERMINANTS ON THE PERFORMANCE OUTCOMES OF THE AUTO PARTS INDUSTRY

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Abstract
The objectives of this study were to develop a framework of the collaboration network, operational performance, and reverse logistics determinants on the performance outcomes of the auto parts industry, and to study the direct, indirect, and overall effects of the factors that influence the performance outcomes of the auto parts industry. This quantitative research utilized a questionnaire as the tool for data collection, which was completed by the managers in the auto parts industry from 320 companies. According to the analysis with the Structural Equation Modeling (SEM), it was found that the collaboration networks, operational performance, and reverse logistics positively affect the performance outcomes; whereas, the collaboration networks mainly affect the development of organizations by causing performance outcomes to continue growing unceasingly, including the enhancement of sustainable competitive capacity and the operational results of the auto parts industry.

Keywords
Collaboration networks, operational performance, reverse logistics, performance outcomes.

## Introduction

The automotive industry is currently changing due to the technological advancements, the development of the infrastructure, and the changes of consumers' demands. Thailand's automotive industry has a major role in the world's automotive manufacturing chain, which depends on the national capacity in terms of attracting investment. Due to the fact that all of the automotive manufacturers in Thailand are owned by foreign companies, the policies of the parent company, therefore, take the main role in setting the direction of Thailand's automotive industry [1]. Furthermore, Thailand is the leader in automotive manufacturing among the member states of the Association of Southeast Asian Nations (ASEAN), as the top producer in ASEAN, and also globally, as the quantity of automobiles manufactured in Thailand was ranked 12th in the world in 2018 [2] (Table 1). In addition, it is the primary base of the motorcycle and auto parts manufacturers located in the region. Considering the manufacturing in 2018 as seen in Table 1, it was found that China, as the country where there are the most automotive manufacturers in the world, accounted for 27,809,196 vehicles, followed by the USA and Japan, with 11,314,705 vehicles and 9,728,528 vehicles, respectively. Meanwhile, in Thailand, as the 12th ranking nation, the number of automobiles was 2,167,694, which is an increase of 9% compared with 2017.

Nevertheless, with regard to the growth of the auto parts manufacturers in the country, which is in accordance with the automotive manufacturing in the country and the exporting to other countries of cars and motorcycles and spare parts for repairs, in 2018, Thailand exported auto parts amounting to

Table 1
Quantity of Automotive Manufacturing in 2018.

| Item | Country | Cars | Commercial vehicles | Total | % change |
|---|---|---|---|---|---|
| 1 | Total | 70498388 | 25136912 | 95634593 | −1.1 |
| 2 | China | 23529423 | 4279773 | 27809196 | −4.2 |
| 3 | USA | 2795971 | 8518734 | 11314705 | 1.1 |
| 4 | Japan | 8358220 | 1370308 | 9728528 | 0.4 |
| 5 | India | 4064774 | 1109871 | 5174645 | 8 |
| 6 | Germany | 5120409 | 0 | 5120409 | −9.3 |
| 7 | Mexico | 1575808 | 2524717 | 4100525 | 0.1 |
| 8 | South Korea | 3661730 | 367104 | 4028834 | −2.1 |
| 9 | Brazil | 2386758 | 493051 | 2879809 | 5.2 |
| 10 | Spain | 2267396 | 552169 | 2819565 | −1 |
| 11 | France | 1763000 | 507000 | 2270000 | 2 |
| 12 | Thailand | 877015 | 1290679 | 2167694 | 9 |
| 13 | Canada | 655896 | 1364944 | 2020840 | −7.9 |
| 14 | Russia | 1563572 | 204102 | 1767674 | 13.9 |

Source: [2].

US$22,691 million, an increase from 2017 of 14%. The auto parts that have the highest export ratio include engines and parts at 27%, followed by wheels at 23%, and then, the various other types of parts. The member countries of ASEAN comprise the group to which Thailand mostly exports auto parts, or 25%, as well as engines and other parts, with the USA and Japan next at 14% and 10%, respectively [3]. The development of the automotive industry requires collaboration and participation from several organizations or institutes in order to build cooperation and create solutions through a co-mechanism [4]. This idea describes the process of providing convenience and operations in the co-management from organizations so as to cope with the problems that a single organization could not deal with alone [5]. The collaboration with several partners, such as the customers, suppliers, distributors, and even business rivals, can create innovations and the improvement of the participating organizations. Moreover, the changes or innovations depend on the different collaboration of various partners [6]. The success of the organization results from the knowledge and mutual target development, including the supporters and collaboration from any diverse academic institutes to build up the collective body of knowledge [7].

Currently, sustainable development is regarded as one of the main topics in organizational administration. The success of the administration process depends on the companies' cooperation in the supply chain [8] that affects the organization's operations depending on its capacity in the collaboration based on the quality of the employees [9]. Because the repeat customers and word-of-mouth based on providing satisfaction to customers are the keys to the success of a business [10], the development of a supply chain with responsibility toward society is required to pass any evaluations and build collaboration. The collaboration of the suppliers of raw materials relies on the collaboration between the buyers and the suppliers. The intention is to build cooperation in order to improve the organization's operations [11]. In order to create opportunities in sustainable growth, the company must maintain its relationship with suppliers in the supply chain and the customers, improve its internal processes and deal with the external pressures, and enhance the level of efficiency, including cost reduction. The improvement of sustainable process will result in cost savings and increase the profits from sales [12]. Due to this situation and its causes, this research is focused on studying the factors that will assist with the development of the auto parts industry that will lead to the sustainable operations and create advantages in the competition.

Objectives of the study

- To develop the framework of the collaboration network, operational performance, and reverse logistics determinants on the performance outcomes of the auto parts industry.
- To study the direct, indirect, and overall effects of the factors that influence the performance outcomes of the auto parts industry.

## Literature review

Thailand's operations in the first quarter of 2019 encountered the problems of environmental impacts caused by pollution, particularly PM 2.5. The state

sector, thus, pushed for and requested the collaboration from the private sector in order to raise the standards regarding the emissions of air pollution from automobiles to be equivalent to the Euro 5 limit within the year 2021 and the Euro 6 limit within 2022. Therefore, the automotive manufacturers and the importers began using electrical innovations and technology, and the launching of new products is continuing [3] so as to support the elevation of the automotive industrial operational standards and the reduction of the environmental impacts. The number of vehicles manufactured in Thailand in 2018 was 2,175,694, an increase of 9% from the previous year. This figure can be divided into 1-ton pick-up trucks with the highest percentage at 57% and cars at 41%, with the other amount accounting for commercial use. Additionally, it is expected that, in 2019, the amount of these two types of automobiles will continue growing at a similar rate [3].

## Collaboration networks

Successful business requires collaboration with the mutual objections among several companies or organizations in order to improve their performance and to build relationships for the exchange of data and learning from each other [11], as well as to improve the personnel in the organizations, who will add value, participate in the search for mutual benefits [13], or brainstorm together for finding solutions. It is possible that an organization can utilize the collaboration from customers, stakeholders, the state, and the external sources of knowledge to improve its operational performance [14], resulting in better operating results and success. The building of collaboration between the stakeholders in the supply chain affects the operating results of the various parties, as a means to develop the specific capacity in order to improve the performance of the organizations. This is the main role in building collaboration to achieve the goal of sustainability by improving the operating results throughout the supply chain [15]. The support of the executives influences the technological skills, technological capacity, and organizational learning, which were also found to impact organizational performance [16].

Findik and Beyhan [17] studied the effects of collaboration from outsourcing organizations on the operating results and found that this type of support can enhance the capacity in creating innovations within the company; in other words, it impacts the products and the process of innovation. A company that takes part in the collaboration with other companies to deal with innovations and processes effectively improves its products and marketing along with the others, which leads to the improvement of production. Furthermore, Grekova et al. [12] studied the situation of collaboration between suppliers and customers that influences the operating results of the company and found that creating the opportunities for the sustainable growth of the company in maintaining the sustainability of the relationship between the suppliers in the supply chain and the customers can improve the internal process for coping with the external pressures that influence the operating results of the company. The study of this type of situation can enhance the performance of the company, directly and indirectly, and the company should focus on sustainable collaboration for reducing costs and increasing the profits from sales [18, 19]. In conclusion, the results of the literature review are summarized in Table 2 below.

Table 2
Literature Review of Observed Variables of Collaboration Networks.

| | Customer | Partner | Government Support | Organization Support |
|---|---|---|---|---|
| Grekova et al. (2016) | √ | √ | | |
| Sancha et al. (2016) | | √ | | |
| Schøtt and Jensen (2016) | | √ | | √ |
| Graham and Potter (2015) | √ | √ | | |
| Wang et al. (2015) | √ | √ | √ | |
| Un and Asakawa (2015) | √ | √ | √ | √ |
| Fındık and Beyhan (2015) | √ | √ | √ | |
| Kuei et al. (2015) | √ | | √ | √ |
| Sinkovics and Kim (2014) | √ | | | √ |
| Tsai and Hsu (2014) | | | | √ |

Regarding the literature review related to the observed variables of the collaboration networks, the conclusion consists of the observable variables used in this research as follows:

1) 'Customer' is the collaboration network with customers involved in the improvement or development of products or services in accordance with the customers [12, 17, 19–21];
2) 'Partner' is the collaboration network in which partners assist the organization with the invention and development of collaboration to improve the processes or products throughout the supply chain [11, 12, 17, 19, 20, 22, 23];
3) 'Government Support' is the collaboration network with the governmental sector in order to support the relationships between the other units or the other business organizations for the exchange of knowledge for the development of performance or ideas for new innovations [17, 20, 21, 23];
4) 'Organization Support' is the collaboration network in which the organizations work as a cross-functional team. It is important that the directors support this collaboration in order to provide proficient teamwork and to integrate the diversity into the operating results of the organizations [20–22, 24].

## Operational performance

For the production strategy, which is the tool or the practice for efficient production and improvement of the organization's performance to gain the advantages in the competition, the focus is on making a connection between the production strategy and the working performance [25], including the productivity administration, adjustable size of the labor pool, various utilities, unceasing operations, and production for the stock [26]. This strategy responds to the products and services of the organization for more efficient performance and lower costs [12]. Moreover, it includes the changing of resources such as raw materials, machinery, labor, methods, and capital, resulting in more efficient production or services and creating added value to products and services through the change of resources for production [27] by the administration for the highest benefits.

In consequence, to maintain the constant and sustainable stability of the economic growth, it must be based on the limited exploitation of resources but with the highest level of efficiency. However, the design of the supply chain management and operations must cover the environmental-friendly production, reverse logistics, network design, and waste management. Gustavsson et al. [28] proposed that for the production that contains waste or damages, the organization must have strong competence in the systematic integration of the improvement, management, storage, and production processes [29], and the methods for efficiency enhancement [30]. Hence, the literature review is summarized in Table 3 below.

According to the literature review of the observed variables of operational performance in this research, the conclusions are as follows:

1) 'Waste Reduction' is when an organization sustainably improves its operations by reducing excess productivity, unnecessary materials, unnecessary transport and movements, inefficient production processes, waiting times, and waste production [12, 17, 26, 31].

2) 'Restock' is the operation of the organization in the control of the inventory quantity to be appropriate and to save costs in terms of storage [26, 31–33].

3) 'Delivery' is the management to deliver products, data or resources as based on the demand of the customers [26, 31, 33, 34].

4) 'Process Improvement' is the improvement process to reduce waste and unimportant tasks in order to use resources efficiently, save energy, reduce waste, recycle, and prevent pollution [12, 17, 26, 31, 32, 35].

Table 3
Literature Review of Observed Variables of Operational Performance.

| | Waste Reduction | Restock | Delivery | Process Improvement |
|---|---|---|---|---|
| Grekova et al. (2016) | √ | | | √ |
| Madueño et al. (2016) | | √ | | √ |
| Luthra et al. (2016) | | | | √ |
| Okongwu et al. (2016) | √ | √ | √ | √ |
| Wong et al. (2015) | √ | √ | √ | √ |
| Fındık and Beyhan (2015) | √ | | | √ |
| Bourlakis et al. (2014) | √ | √ | √ | |
| Ralston (2014) | | √ | √ | |

Table 4
Literature Review of Observed Variables of Reverse Logistics.

| | Reducing | Recycling | Remanufacturing | Reusing |
|---|---|---|---|---|
| Uygun and Dede (2016) | √ | √ | √ | √ |
| Luthra et al. (2016) | | √ | √ | √ |
| Kuei (2015) | √ | | | |
| Chin et al. (2015) | √ | √ | | √ |
| Muma et al. (2014) | √ | √ | | √ |
| Yang et al. (2013) | √ | | | |

**Reverse logistics**

The main idea of green supply chain management that can develop and grow along with sustainability is derived from the organization's operations that are always concerned with the stakeholders in the supply chain and are changed to be more environmentally-friendly for the gaining of the social benefits [36], sustainability [37], and the future of the organization's operating results [38]. This includes the management of the supply chain and the strategy to reduce energy usage and the footprints of product distribution by focusing on the management of materials, waste, packaging, reuse or recycle, transportation, integration of the environmental management into the practices of the organization in the supply chain, and reverse logistics [39]. In the operations, it is the effort to manage the environment through collaboration among organizations to achieve the goals and the targets in the operating results [37].

On the other hand, it could be said that reverse logistics is the environmental bound reduction at the final elimination, the reduction of the environmental costs, and the reuse of parts of expired products that are still valuable [40]. For the connection of reverse logistics to the operational activities such as repairs of errors and failures, the reusing of materials or the use of biodegradable materials, recycling materials and packages, the reverse logistics performance includes collection, gathering, examination, selection, cleaning, categorization, recycling, distribution, and elimination [41]. Moreover, the entire range of green logistics activities are composed of the activities related to the ecological administration of the reverse logistics of the products and data between the source and the consumers, which intends to respond to the over-expectations of the customers [42]. Consequently, the literature review is concluded as seen in Table 4.

In regards to the literature review of the observed variables of reverse logistics, the conclusions in this research are as follows:

1) 'Reducing' is the operation of an organization to reduce greenhouse gases, waste, wastewater, noise pollution, and consumption of hazardous/harmful/toxic materials [18, 43–46].

2) 'Recycling' is the operation of the organization to turn non-reusable objects, which might be damaged or broken, into raw materials by reproduction [35, 43].

3) 'Remanufacturing' is the operation of an organization to restore used parts, raw materials or devices to be the same as new or to prolong the working duration or to renew them [35, 43–45].

4) 'Reusing' is the operation of the organization to reuse things as a means to reduce the exploitation of resources [35, 43–45].

**Performance outcomes**

The determination for economic development and strategy implementation in the industrial development for the environment and society is focused on promoting and developing the industrial sector to grow and become advanced with sustainability throughout the supply chain. The evaluation of an organization's performance can be compared with its competency in providing services and the collaboration networks in the supply chain [47], including the development of the competency of personnel for the benefits of the organization [18]. However, the organizations must reduce the costs of supplying materials, the expenses in using energy, the expenses for waste treatment, the expenses for waste release, and the expenses resulting from accidents [48]. In addition, economic efficiency is related to the management of cost reduction and the capacity to increase profits [49]. This means that emphasizing the reduction of expenses and being aware of good performance will lead to the increase of on-time delivery of products, reduction of inventory, reduction of material wastes, increase of product quality, increase of product lines, and utilization of better productivity [48]. The economic performance is associated with the process efficiency, task reduction during production, time decrease in the production, flexible management, and increased profits from better performance [45]. Therefore, the literature review is summarized as seen in Table 5.

Table 5
Literature Review of Observed Variables of Performance Outcomes.

| | Process Efficiency | Product Quality | Economic Performance | Environmental Performance |
|---|---|---|---|---|
| Luthra et al. (2016) | | | √ | √ |
| Grekova et al. (2016) | | √ | √ | |
| Okongwu et al. (2016) | | √ | | |
| Kuei (2015) | √ | √ | √ | √ |
| Graham and Potter (2015) | | | √ | √ |
| Wang et al. (2015) | | √ | √ | |
| Fındık and Beyhan (2015) | √ | √ | | |
| Chin et al. (2015) | | | √ | √ |
| Muma et al. (2014) | | √ | | |
| Sinkovics and Kim (2014) | | √ | √ | √ |
| Sunhee (2011) | | | | √ |

According to the literature review of the observed variables of performance outcomes, the conclusions of this research are as follows:

1) 'Process Efficiency' is when the organization improves the process by considering economy, which means savings or worthiness (cost savings, resource savings, time-savings) punctuality, and quality [17, 18].

2) 'Production Quality' is when the organization's performance becomes systematic in order to produce quality products based on the customers' demands [12, 17, 18, 21, 23, 26].

3) 'Economic Performance' is the evaluation of economic performance by assessing the reduction of costs and the market share promotion for the return of income and profits [12, 18, 19, 23, 35].

4) 'Environmental Performance' is the evaluation of the environmental performance, waste release, materials use, and reduction of waste. It means to reduce the release of air pollution, wastewater, waste products, and hazardous/harmful/toxic materials [18, 19, 21, 35, 44].

Following the literature review, the model as seen in Fig. 1 was developed, and the hypotheses are as follows:

Hypothesis 1: Collaboration networks influence performance outcomes directly and indirectly.

Hypothesis 2: Collaboration networks directly influence operational performance.

Hypothesis 3: Collaboration networks directly influence reverse logistics.

Hypothesis 4: Operation performance directly influences performance outcomes.

Hypothesis 5: Reverse logistics directly influences performance outcomes.

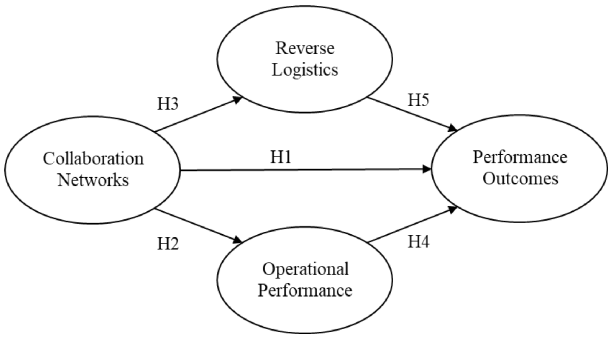



Fig. 1. The conceptual framework.

## Methodology

### Questionnaire design

The research tool that was created is the questionnaire that was developed to be applied in accordance with the scope of the research, using the 5-Point Likert Scale [50] as seen in Table 6. Five experts examined the consistency of the questionnaire to find the Index of Item Objective Congruence (IOC) before selecting the questions with the IOC of 0.5 and up. After that, revising the questionnaire and collecting the basic data from the 30 samples were conducted for the examination of the measurement using the $\alpha$-coefficient of Cronbach to find the mean of coefficient correlation. The questionnaire was used for the empirical variables with reliability of more than 0.70, which is regarded as a high level of reliability [51]. This research was processed with the Measure of Internal Consistency by Cronbach's Alpha, and the result was 0.913.

### Data collection

The population in this study were the manufacturers of auto parts who are the Tier-1 auto parts

Table 6
Measurement and Development of Questions.

| Exogenous Latent Variables | Manifest Variables | Development |
|---|---|---|
| Collaboration Networks | 1) Customer<br>2) Partner<br>3) Government Support<br>4) Organization Support | 12, 17, 19, 21, 23 |
| Intervening Variables | Manifest Variables | Development |
| Operational Performance | 1) Waste Reduction<br>2) Restock<br>3) Delivery<br>4) Process Improvement | 12, 17, 19, 31 |
| Reverse Logistics | 1) Reducing<br>2) Recycling<br>3) Remanufacturing<br>4) Reusing | 18, 35, 43 45, 53 |
| Endogenous Latent Variables | Manifest Variables | Development |
| Performance Outcomes | 1) Process Efficiency<br>2) Product Quality<br>3) Economic Performance<br>4) Environmental Performance | 12, 17, 18, 19, 23, 26, 31, 54 |

manufacturers as well as the Tier-2 and Tier-3 groups, totaling 1,820 companies [3]. The size of the sample group in this research was specified at 20 samples per 1 variable. Schumacker and Lomax [52] stated that the Structural Equation Modeling (SEM) must contain the larger sample size than other analyses for correct evaluation so that the results can accurately represent the population [51] and provide normal curve distribution. In consequence, the data collection of the units of analysis from 320 managers, chiefs or engineers used simple random sampling.

### Data analysis

The data collections were tested to confirm their reliability and validity. The cronbach's a reliability was .983. Then, the data analysis of the correlation analysis and the Structural Equation Modeling (SEM) were used for the structural causal relationship of factors, multiple correlations by advanced statistics, and patterns of correlation.

## SEM results

### Measurement model

The measurement model analysis by Confirmatory Factor Analysis (CFA) using Maximum Likelihood (ML) was conducted to analyze the reflective variables, the statistics to examine the consistency, and the Goodness of Fit Measures with acceptable standard criteria as seen in Table 7.

Table 7
Standard criteria of correspondence.

| Related statistics | Symbols | Criteria |
|---|---|---|
| Chi-square | $\chi^2$ | Ns.($p > .05$) |
| Relative Chi-square | $\chi^2$/df | $\chi^2/df < 2.00$ |
| Goodness of Fit Index | GFI | $> .90$ |
| Comparative Fit Index | CFI | $> .95$ |
| Normal Fit Index | NFI | $> .90$ |
| Adjusted Goodness of Fit Index | AGFI | $> .90$ |
| Root Mean Square Error of Approximation | RMSEA | $< .05$ |

Source: [44, 46 , 51, 52]

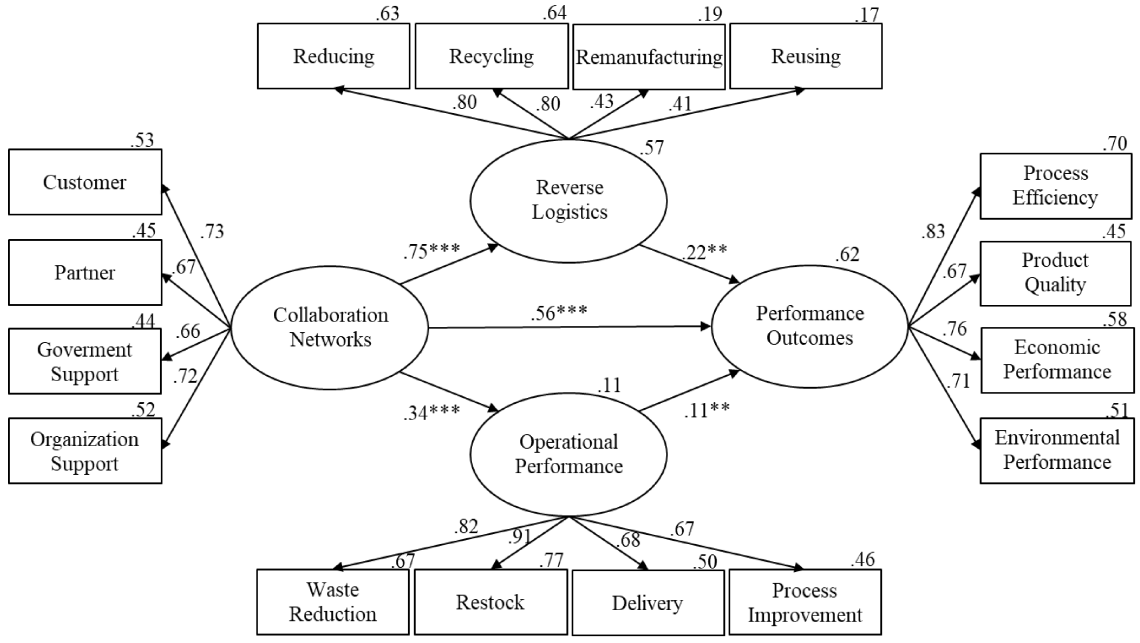
Structural Equation Modeling is a multivariate statistical analysis technique that includes factor analysis and multiple regression. This technique benefits the researcher in the examination of the relationships of variables in a single time [51].

The statistical program to check the Structural Equation Modeling is seen in Table 8, and the results indicated that Collaboration Networks has a standard regression weight within .665–.725, and the $R^2$ or Squared Multiple Correlation is within .442–.526. Meanwhile, the operational performance has a standard regression weight within .675–.912, and the $R^2$ or Squared Multiple Correlation is within .456–.769. Reverse Logistics has a standard regression weight within .406–.796, and the $R^2$ or Squared Multiple Correlation is within .165–.635. Performance Outcomes has a standard regression weight within .669–.834, and the $R^2$ or Squared Multiple Correlation is within .447–.695.

Table 8
Analysis of the Structural Equation Model.

| Relationships of Variables | | | Standard Regression Weights | S.E. | Squared Multiple Correlations | C.R. | P |
|---|---|---|---|---|---|---|---|
| Operational Performance | <— | Collaboration Networks | .338 | .060 | .114 | 5.202 | *** |
| Reverse Logistics | <— | Collaboration Networks | .753 | .077 | .566 | 10.659 | *** |
| Performance Outcomes | <— | Collaboration Networks | .555 | .106 | .619 | 6.437 | *** |
| Performance Outcomes | <— | Operational Performance | .111 | .058 | | 2.575 | .010 |
| Performance Outcomes | <— | Reverse Logistics | .222 | .094 | | 2.629 | .009 |
| Customers | <— | Collaboration Networks | .725 | | .526 | | |
| Partners | <— | Collaboration Network | .672 | .076 | .451 | 12.480 | *** |
| Government Support | <— | Collaboration Network | .665 | .076 | .442 | 12.051 | *** |
| Organization Support | <— | Collaboration Network | .724 | .071 | .524 | 13.251 | *** |
| Delivery | <— | Operational Performance | .676 | .068 | .496 | 14.020 | *** |
| Restock | <— | Operational Performance | .912 | .092 | .769 | 14.713 | *** |
| Waste | <— | Operational Performance | .817 | .089 | .668 | 15.033 | *** |
| Economics | <— | Performance Outcomes | .761 | .058 | .579 | 16.785 | *** |
| Environment | <— | Performance Outcomes | .712 | .056 | .507 | 15.538 | *** |
| Reusing | <— | Reverse Logistics | .406 | .071 | .165 | 7.661 | *** |
| Remanufacturing | <— | Reverse Logistics | .435 | .064 | .189 | 9.011 | *** |
| Recycling | <— | Reverse Logistics | .797 | | .635 | | |
| Reducing | <— | Reverse Logistics | .796 | .077 | .633 | 15.228 | *** |
| Products | <— | Performance Outcomes | .669 | .048 | .447 | 14.701 | *** |
| Processes | <— | Performance Outcomes | .834 | | .695 | | |
| Improvement | <— | Operational Performance | .675 | | .456 | | |

*Notes.* All factor loadings are standardized and significant to a level of .05




**Chi-square ($\chi^2$) = 87.974, df = 68, p = .052, CMIN/DF ($\chi^2$/df) = 1.294, GFI = .976, CFI = .994, AGFI = .952, NFI = .976 and RMSEA = .026**

Fig. 2. Final Model.

Table 9
Hypothesis Testing Results.

| Hypothesis | coef. | t-test | TE | DE | IE | Results |
|---|---|---|---|---|---|---|
| H1: Performance Outcomes <— Collaboration Networks | .555*** | 6.437 | .760 | .555 | .205 | Supported |
| H2: Operational Performance <— Collaboration Networks | .338*** | 5.202 | .338 | .338 | .000 | Supported |
| H3: Reverse Logistic <— Collaboration Network | .753*** | 10.659 | .753 | .753 | .000 | Supported |
| H4: Performance Outcomes <— Operational Performance | .111** | 2.575 | .111 | .111 | .000 | Supported |
| H5: Performance Outcomes <— Reverse Logistics | .222** | 2.629 | .222 | .222 | .000 | Supported |

Note: *** significant at p <0.001, Coefficient refers to the Beta ($\beta$)

TE: Total effects, DE: Direct effects, IE: Indirect effects, Coefficient: coef.

The SEM results are as follows:

Operational Performance = .34 Collaboration Networks,

$$R^2 = 0.11. \quad (1)$$

Reverse Logistics = .75 Collaboration Networks,

$$R^2 = 0.57. \quad (2)$$

Performance outcomes = .56 Collaboration Networks + .11 Operation Performance + .22 Reverse Logistics,

$$R^2 = 0.62. \quad (3)$$

According to the Goodness of Fit Measure, it was found the SEM results is the model fit (Fig. 2) at Chi-square ($\chi^2$) = 87.974, df = 68, p = .052, CMIN/DF ($\chi^2$/df) = 1.294, GFI = .976, CFI = .994, AGFI = .952, NFI = .976 and RMSEA = .026

### Hypothesis testing results

Based on the Hypothesis testing with t-Value (C.R.), p-value, correlation analysis, and influence between variables evaluation received from the regression coefficients, it was found that the regression coefficient (coef.) of each relationship in accordance with the hypothesis testing shows C.R. (t-test) with significance. In other words, every C.R. is greater than 1.96, resulting in all analytical results supporting all hypotheses. The results of the hypothesis testing and the influence of variables are displayed in Table 9.

Hypothesis 1: Collaboration networks has a direct and indirect influence on performance outcome. Regarding the hypothesis testing, coef. = .555, which supports the hypothesis with statistical significance at p <0.001.

Hypothesis 2: Collaboration networks has a direct influence on operational performance. Regarding the hypothesis testing, coef. = .338, which supports the hypothesis with statistical significance at p <0.001.

Hypothesis 3: Collaboration networks has a direct influence on reverse logistics. Regarding the hypothesis testing, coef. = .753, which supports the hypothesis with statistical significance at p <0.001.

Hypothesis 4: Operational performance has a direct influence on performance outcomes. Regarding the hypothesis testing, coef. = .111, which supports the hypothesis with statistical significance at p <0.01.

Hypothesis 5: Reverse logistics has a direct influence on performance outcomes. Regarding the hypothesis testing, coef. = .222, which supports the hypothesis with statistical significance at p <0.01.

## Discussion and implementation

Regarding this study of the impacts of the collaboration network, operational performance, and reverse logistics determinants on the performance outcomes of auto parts industry, the collaboration networks, operational performance, and reverse logistics were shown to affect performance outcomes as all of the hypothesis testing results support every hypothesis with statistical significance. This conforms to Grekova et al. [12], who studied the collaboration situation of suppliers and customers influencing the operating results of companies and found that the collaboration with suppliers could improve the performance efficiency of the company and lead to cost reduction, while the collaboration with customers could result in indirect efficiency in sustainable improvement that leads to cost reduction and higher profits from sales. Graham and Potter [19] demonstrated that the environmental management is linked to the creativity and efficiency of performance by considering the relationships between the active environmental strategy, the expenses, and the environmental efficiency that benefits the executives.

On the other hand, the impact of collaboration networks on the operations of the company supports the collaboration from the external units to enhance the capacity in building innovation. As a company makes an effort to understand the collaboration that affects the co-operation, it can improve productivity [17]. Furthermore, the Study of the Impact of Suc-

cess Factors for Managing the Green Supply Chain towards Sustainability: An Empirical Study of the Indian Automotive Industry, presented the pathways that are environmentally-friendly, which promote the environmental measures and improves the internal management and the competitive capacity that have important roles in the achievement of the company's goals, including the improvement of general practices and the practices for sustainable development [35]. Muma et al. [45] also discovered that the building of the relationships between the green supply chain management and the economic efficiency that focuses on design, production, green distribution, and reverse logistics is related to successful economic operations.

## Conclusion

In the world today, the development of the auto parts industry to achieve the goals of the organizations that are involved, while also being concerned with the environment and society, is an important and major issue that affects all of us. Several organizations currently aim at improving and developing the industry in order to promote sustainable growth and development with the support of eco-friendly and social-friendly production. Furthermore, this requires the creation of a positive and credible image by building the collaboration networks with others, including various organizations, the customers, the state, and the production partners. In addition, it involves the participation inside the organization by supporting the personnel and brainstorming for new creative ideas that will be beneficial to human resources themselves, the organizations, and the nation starting from developing the personnel, knowledge, databases, and creative ideas based on eco-friendly industrial production. When the organizations competently manage their operational performance and reverse logistics, it results in positive performance outcomes and maintains the competitive situation in the industry, as it can reduce the use of resources. Most importantly, the improvement of performance outcomes for quality products is based on the intention to improve the growth of the organizations that are concerned about providing benefits to the environment and society.

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