

# The Structural Equation Model of Supply Chain Sustainability in the Auto Parts Industry of Thailand

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## Abstract

This research aimed 1) to study factors influencing supply chain sustainability in the Thai auto parts industry in Thailand, 2) to model the structural equation of supply chain sustainability in the auto parts industry, 3) to provide recommendations from the study in policy, strategy and management to create the sustainability of the supply chain in the auto parts industry to create competitiveness at both regional and international levels. The primary data collected from an online questionnaire sent to 400 samples, obtained by random sampling method selected from a group of automotive parts manufacturers at level 1 (tier 1), level 2 (tier 2) and level 3 (tier 3). The structural equation model was applied for analysis. The results showed that uncertainty and risk factors, knowledge of internal management, green supply chain management, and performance in the supply chain influenced the supply chain's sustainability. The model is consistent with the empirical data with statistical results as:  $\chi^2 = 879.982$ ,  $df. = 488$  values  $\chi^2/df. = 1.803$ ,  $p\text{-value} = .050$  and  $CMIN/DF = 1.803$ ,  $GFI = .961$ ,  $TLI = .970$ ,  $AGFI = .966$  and  $CFI = .984$ ,  $RMSEA = .048$ , at the level of .05 statistical significance. The result of the study and recommendations will be applied in policy and practice for the auto parts industry in action to create sustainability for the auto parts industry in Thailand.

**Keyword:** Supply chain, Sustainability, Auto parts industry

## 1. Research Problem's Significance

One of the critical requirements of a successful sustainable supply chain is collaboration. Collaborative practices, such as distribution sharing, reduce waste by ensuring that half-empty vehicles are not thrown and deliveries to the same

address are on the car. Carry the same car cost reduction and environmental impact from the company's delivery collaboration platforms are emerging as fears of losing control of trade and competitive advantage by working closely with other companies. (Harding, 2005) New risks to the supply

chain and the need for increased flexibility measuring supply chain resilience on factors such as the availability of natural resources, infrastructure, financial resources, and other social security networks can help them respond to challenges and build a better supply chain. In the process ( USAID,2020) , sustainability and resilience, and ethical supply chain are essential to ensuring corporate social responsibility and adhering to a moral code of conduct. The working environment for workers should be ordinary and must not violate fundamental human rights. The supply chains of all industries are operating under challenging ways to simulate and assess where national and regional supply chains are affected at the heart of the global supply chain. ( Navavongsathian et. al. , 2020)The auto parts industry is an industry that has played a role in supporting the automotive industry, which Thailand is, one of the world's major production bases. It is essential to the national economy, both in the part that caused a lot of employment and creating links with various related industries and being an industry that can generate income into the country each year in the amount of hundreds of millions of baht. However, the auto parts industry in Thailand and auto parts manufacturers in Thailand need to be adjusted, emphasizing strengthening the design and development capabilities. Along with improving the quality of production and reducing production losses by upgrading production technology, creating competitive advantages in environmentally friendly logistics and supply chain management processes, and creating sustainability for enterprises and industries. The leads to the formulation of a national logistics and supply chain policy

so that the Thai auto parts industry can survive and compete in the global competitive arena. ( Navavongsathian et.al., 2020) Management organized within the company uncertainty and risk environmental supply chain management affects the performance of the supply chain and the performance of the automotive parts supply chain that is relevant and affects the supply chain for the parts industry's sustainability. Automotive is an issue that has not yet been researched, although it is of great importance for the auto parts industry supply chain's sustainability. Sustainable supply chain in the auto parts industry in Bangkok and its vicinity to explore factors that influence the sustainability of the Thai auto parts industry's sustainability chain. The study's scope was set for specific automotive parts manufacturers located in Bangkok and its suburbs in Thailand.

## **2. Research Objectives**

- 1 . To analyze factors affecting the sustainability of the supply chain of the auto parts industry in Thailand.
- 2 . To create a sustainability model of the supply chain of the auto parts industry in Thailand.
- 3 . To apply the recommendations from the research results in policy, strategy and management to create the sustainability of the supply chain in the auto parts industry to create competitiveness at both regional and international levels.

## **3. Literature Review and Concept**

The literature on sustainability management, in many cases, addresses the issues of drivers of production costs (Wiedmann et. al.,2008), quality (Schulze & Bals. ,2017) and risk. ( Govindan et. ,

al.,2015) Sustainability management to put into action. (Hollos et. al., 2012) It can be grouped into four groups together. The first group is the operational perspective, which discusses the operational process, operation activities and decisions efficiency and effectiveness. The second group of actions is the value perspective in the customer's eye. It is about customers and their industry needs quality, value and customer expectations. The literature on logistics, warehouse network, supply chain strategy, etc., and the last group, A green perspective that addresses greens or operations across an environmentally friendly supply chain. Corporate responsibility to the community, society, etc. (Klumpp&Saur,2010)

#### **Model of supply chain sustainability**

Liu et.al. (2019). describe the sustainable supply chain model as a sustainable supply chain. Refers to action through a center that accumulates expertise in each activity. Operational activity within a company has a function of its expertise, significantly handling damaged returns, stock returns, and returns. End of product life, or the destruction of end of life and discarded products from downstream members in the supply chain, is an activity that involves recycling and making products return to their value and benefit. At one time, a product chain activity. In this model, both forward logistics and reverse logistics were considered part of the supply chain. Leading to sustainability both upstream, midstream, and downstream activities are essential in building a green supply chain. However, all of these activities need to lead to action that meets green standards.

#### **Internal Management Cognition**

It is integrating a management system perspective within a sustainable supply chain. Discusses the sustainable supply chain management system within the organization, which has a central goal: management towards sustainability. The four perspectives explain it: the customer perspective, event and flexibility perspective, logistics perspective and supply chain, and green logistics perspective.

#### **Supply Chain Risk and Uncertain**

Logistics and supply chain management is a concern for many organizations. From upstream to downstream businesses and customers' good management results in the development of a lean organization to reduce lead times and lost time in the process. It can be seen that the supply chain is arranged in a systematic manner, as if all processes are connected to the same chain. It can be said that every process is continuous and cannot be tolerated. Therefore, most supply chain problems arise from unpredictable risks such as epidemics, natural disasters, and labor conflicts. Bankruptcy of the diver and the use of political violence the corona virus outbreak, or COVID-19, which occurred in early 2020, affects the entire supply chain, including the upstream auto-parts industry. Midstream and downstream the supply chain becomes even more important when green supply chain issues are added. Zhu and Lai (2018) also said that the green supply chain is involved from the seller of inputs to the manufacturer. Customers and back-to-back logistics along the way. Therefore, it is called a closed-loop supply chain.

## Green supply chain management

Many interlinked disciplines sequence the green supply chain in various activities within the supply chain. It has been compiled over the years, such as sustainable supply network management, supply chain and demand towards sustainability or responsibility network,

organizational society (Cruz, 2009), supply chain environment management, green purchasing, (Zhu and Sakis, 2007) green logistics and environmental logistics. (Murphy, 2000)

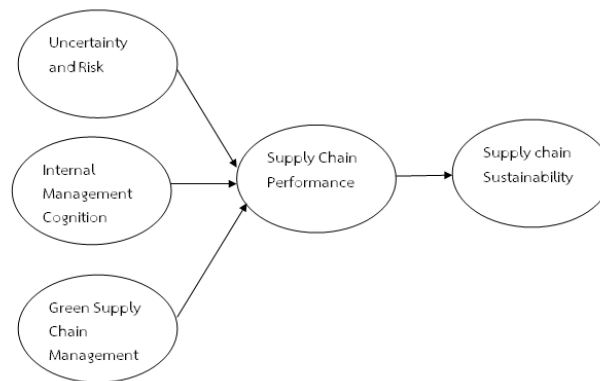


Figure 1. Research conceptual framework (Source: Updated from Navavongsathian et al., (2020), Klumpp and Saur,(2010) Zhu, Sarkis and Lai (2018), Murphy (2000)

## 4. Research Methodology

Regarding the quantitative research method, the survey method applies by creating a questionnaire focusing on the design of research tools with suitable criteria for accurate measurement, possessing both validity and reliability in terms of content, approaches, and concepts. For this research, a questionnaire with validity and reliability according to meets the criteria specified (Alpha value is lower than 0.60). If not, more questions added, and some may be cut and tested repeatedly until the questionnaire was accurate and reliable. Online surveys were sent directly to respondents from the sample's proportion randomized systematically—the values of the reliability coefficient of gauges used in this research. Cronbach's Alpha coefficient measuring the reliability or internal consistency, the amount between .814 and .810; meanwhile, the 16 questions gained

the criteria and concepts constructed. The questionnaire survey was thoroughly designed under the advice of three academics experts. Before collecting the data, the questionnaire tested to determine what needs to be measured before issuing the survey and before receiving data, reliability testing applying Cronbach's Alpha test statistics to check whether their liability the Cronbach's coefficient at .822, expressing a high-reliability level.

## Population and sample

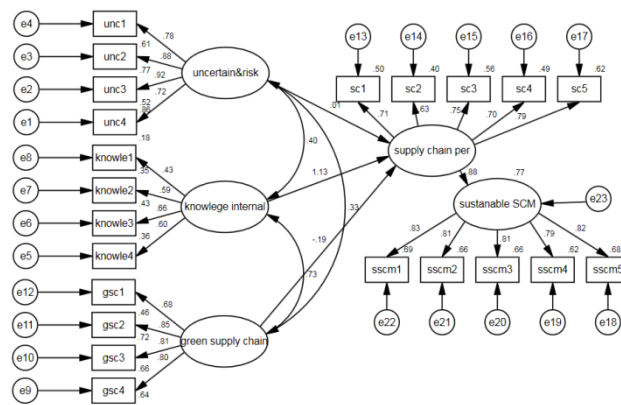
The population is the auto parts industry in Thailand. Several car automotive assembler 18 companies, motorcycle automotive assembler 8 companies, 1,700 companies in tier 2 and tier 3 auto parts manufacturer, and 709 companies tier 1 auto parts manufacturer (Thailand Automotive institute 2020). The sample group stratified sampling from the

auto parts industry in Thailand will be sampled. It is a group of automotive components Industrial groups of parts manufacturers, level 1 (tier 1), level 2, 3 (tier 2, 3), and sampling from industries with locations in each region ( northern, central, eastern, western, and southern regions) . Interviewed the manager of operations, logistics, and supply chain, a critical position that can provide excellent information and footprint on the auto parts industry's supply chain management. And complete as a junior executive and have a unique operational understanding. Method for selecting samples was based on probability principles ( Non-Probability Sampling) by stratified sampling from the auto parts industries in Thailand; without any selection rules at 400.

### 5. Research Result

To answer the question of the research, the study and analysis of influencing supply chain sustainability in the Thai auto parts industry in Thailand conducted. For exploratory factor analysis ( EFA ) , the Common Factor Analysis, Principal Axis Factoring ( PAF) method

applied. The Kaiser-Meyer-Olkin ( KMO) and Barlett's Test of Sphericity. KMO is 0.781 and Sig = .000 <0.05, where  $0 \leq KMO \leq 1$  was close to 1, meaning all variables were related to factors using for further factor analysis. Common elements could explain the relationship between variables at a reasonable level ( Wancihbancha, 2013) . The Statistical values for evaluating the structural validity of the empirical model showed that; values  $\chi^2 = 879.982$  df. = 488, the values of  $\chi^2/df. = 1.803$ , p-value = .050, which was less than 2. 0, had a good level of consistency ( Schumacker & Lomax, 2010) , meaning that the structural equation model was in harmony with empirical data in addition, GFI = .961, TLI = .970, AGFI = .966 and CFI = .984 were greater than 0.95. All values showed a good level of consistency, and found that RMSEA = .048. The assumption was that RMSEA was less than 0.05 ( Wirachatchai, 1999) . In conclusion, the index values check the consistency between the model and the empirical data was following the standard criteria and at a good level of conformity.



$\chi^2 = 879.982$  df. = 488,  $\chi^2/df. = 1.803$ , p-value = .050, GFI = .961 ,TLI = .970, AGFI= .966 and CFI = .984, RMSEA = .048 at significance .05

Figure 2. The structural equation model of supply chain sustainability in the auto parts industry of Thailand

The analysis of the confirmation elements of the measurement models based on the

standardized regression weights showed that.

1) Weight, uncertainty, and risk factors: Four observable variables found that weight factors were risk-looking forward. Risk on uncertain resources, risk from internal factors, risk from external factors. In order from highest to lowest as follows: internal factor risk (.92), uncertain resource risk (.88), forward-looking risk (.78) and external risk (.72).

2) Weight value, cognitive factor in internal management there were four observable variables. It was found that cognitive management weight factors, green management strategy, environmental management's attitude, sustainable organizational management sorted by weight, descending factors as follows: Environmental management's attitude (.66). Organizational management towards sustainability (.60), environmentally friendly management strategy (.59) and management Knowledge (.43).

3) Weight factor of supply chain management for the environment. There were four observable variables. Aiming to green standards, reverse logistics management, environmentally friendly supply chain found the move towards green Standards (.85), reverse logistics management (.81), environmental friendly

supply chain (.80), and environmental responsibility (.68).

4) The weight value of the operating performance factor in the supply chain has five observable variables. Availability of green products, on-time delivery, efficient inventory management, responding to customer satisfaction sorted by weight, descending elements as follows: response, customer satisfaction (.79), delivery on Time (.75), expands outward management for environment (.71), inventory management, efficiency (.70) and green product availability (.63)

5) The weight factor of the sustainability of the supply chain had five observable variables. All activities are conducted in an environmentally friendly manner. They support good green practice in reducing carbon dioxide emissions, focusing on environmental protection and business ethics sorted by weight, descending factors as follows: establishing efficiency throughout the supply chain (.83), focusing on environmental protection and business ethics (.82), all activities are environmentally friendly (.81), supporting good green practice (.81) and reducing carbon dioxide emissions (.79).

Table 1 Test results for the path coefficient

Cause variable	Effect variable	Estimate	S.E.	Z-test	p	R <sup>2</sup>
X <sub>1</sub> =uncertainty and risk factors, management,	X <sub>4</sub> = supply chain performance	.004	.031	.118	.006	.53
X <sub>2</sub> = knowledge of internal		.148	.134	8.540	.000	
X <sub>3</sub> = green supply chain management		.171	.089	1.925	.0454	
X <sub>4</sub> = supply chain performance	Y= Sustainable SCM	.073	.078	13.758	.000	.65

From Table 1 showed that the results of the testing of the path coefficient of factors influencing the sustainability of the supply chain in the automotive parts industry in Thailand were found that

1 . The path coefficient was between .004 and .148, with the cognitive factor in internal management having the highest path coefficient (.148), followed by supply chain performance (.073), the least path coefficient. The most include uncertainty and risk (.004)

2 . When considering the value of  $R^2$ , it was found that the cognitive factor in internal management Performance in the supply chain environmental supply chain management and uncertainty and risks can predict the sustainability of the supply chain in the auto parts industry in Thailand by 65 percent.

3 . When considering the consistency with the empirical data, it was found that the proportion between the  $\chi^2$  and the degrees of freedom was 1.803, which is less than 2, the concordance index (CFI) was .984, which was greater than 0.95. The non-conformity measure (TLI) was .970 which was greater than 0.95, the modified degree of harmonization index (AGFI) was .966, which was greater than .95, and the estimated fluctuation index. The parameter value (RMSEA) is .048, which is less than 0.05 Therefore, it can be concluded that the causal model of factors influencing the sustainability of the supply chain in the auto parts industry in Thailand is consistent with empirical data.

## **6. Conclusion, Discussion and Suggestions**

The results of the study of factors influencing the sustainability of the supply chain in the auto parts industry in Thailand

were found that; uncertainty and risk knowledge of internal management, environmental supply chain management have a direct influence on performance in the supply chain and indirectly influence the sustainability of the supply chain in the auto parts industry in Thailand. This research found that the investigation of direct influence and total factors affecting the sustainability of the supply chain in the auto parts industry in Thailand.

1. The cognitive factors in internal management have the most direct influence on the supply chain's performance in the automotive parts industry in Thailand. It is according to the research hypothesis. Consistent with Klumpp and Saur (2010) found that balanced integration of activities across four perspectives can create sustainability in the supply chain. Objectives for value in the customer's perspectives (cost and product quality) managing risk across the organization to avoid situations that threaten the organization. The efficient production process, 2) incident view and flexibility, consists of the objectives for transportation speed. Timely delivery acceptance of members throughout the supply chain from the upstream midstream and downstream implementation of activities throughout the supply chain. Efficiency and effectiveness are consistent with both the internal and external environment of the organization. 3) Incident perspective and flexibility. It consists of the objectives for transportation speed—timely delivery acceptance of members throughout the supply chain from the upstream Midstream. And downstream Implementation of activities throughout the supply chain. Efficiency and effectiveness are consistent with both the internal and external environment of the



organization. 4) The logistics perspective consists of objectives for logistics' essential functions to ensure the right products happen. At the right time, 5) The eco-friendly attitude consists of using recyclable inputs to minimize the use of information, such as energy, raw materials for production, and the use of recyclable inputs. Transportation and service in logistics activities, etc. If the auto parts industry can integrate all four areas, it can create a supply chain management system to lead to sustainability.

2. The environmental supply chain management factor have a second less direct influence on the supply chain's performance in the automotive parts industry in Thailand. It is according to the research hypothesis. The inline, with numerous researches, shows that organizations with environmental supply chain management perform sustainable supply chains, such as sustainable supply chain management Cruz (2009). Supply chain and demand towards sustainability or corporate social responsibility network, supply chain environment management, green logistics (Min & Galle, 1997), logistics environment, and sustainable supply chain (Saris et. al.,2008) etc.

3. Uncertainty and risk factors have the least direct influence on the supply chain's performance in the automotive parts industry in Thailand. It is based on research hypotheses and is consistent with Min and et. al., (1997) saying that uncertainty and supply chain risks impacting supply chain sustainability include delivery delays, interruptions to forecast. Intellectual property system capacity and inventory management.

4. Performance factors in the supply chain directly influence the sustainability of the supply chain in the

auto parts industry in Thailand. It is according to the research hypothesis. The consistent with the context of Murphy and Poist (2000) research findings that the supply chain process from operations plan, production sources, assembly and delivery until the end customer influence the sustainability of the supply chain in the auto parts industry. And a study by Zhu and et.al. (2018) found that logistics costs, which reflect supply chain performance, also influence supply chain sustainability in the auto part industry.

The results of this study lead to the following research suggestions:

1. The cognitive factors in internal management have the most direct influence on the supply chain's performance in the automotive parts industry in Thailand. In the auto parts industry, activities should be integrated into cost and product quality and timely delivery. The supply chain's acceptance of members throughout the upstream midstream and downstream. Implementation of activities throughout the supply chain. Efficiency and effectiveness are consistent with both the internal and external environment of the organization.

2. Environmental supply chain management factors influence the supply chain's performance in the automotive parts industry in Thailand. The auto parts industry should have supply chain management for the environment. It manages the sustainable supply network supply chain management for sustainability and goes for sustainability or corporate social responsibility. Network Managing the supply chain environment green purchasing, green logistics and environmental logistics, sustainable supply chain management.



3. Uncertainty and risk factors because of uncertainty and risks in the supply chain affect the supply chain's sustainability. Therefore, the auto parts industry should have risk management measures to mitigate or eliminate the following areas: delivery delays, interruptions to forecasting, intellectual

property systems, capacity and inventory management.

4. Supply chain performance factors in the auto parts industry should focus on activities. The supply chain process from operational plans, production sources, assembly and delivery. Logistics costs until the product are delivered to the customer.

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