The Influence of Supply Chain Integration on Supply Chain Performance of Auto-Parts Manufacturers in Thailand: A Mediation Approach

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***Abstract*-By reason of supply chain management difficulties of many firms from various industries in Thailand, it is crucial to comprehend which determining factor may tackle these difficulties. This research aims to study the effect of supply chain integration (SCI) on supply chain performance (SCP) by reflecting the mediation effects of supply chain collaboration (SCC) and logistics flexibility (LGF). The research design was based on the quantitative explanatory study. Using a confirmatory factor analysis, the study examined interactive dimensions of SCP, SCC, LGF, and SCI. The research model consisted of 4 latent variables assessing 13 observed variables. The only exogenous latent variable was SCI, whereas endogenous latent variables were SCC, LGF, and SCP. The stratified random sampling was used to select the questionnaire respondents. Data from a total 321 complete surveys were acquired from top managers working for auto-parts manufacturing companies in Thailand. The hypotheses were tested by using structural equation modeling (SEM). The results supported that SCI enabled auto-parts manufacturing firms to improve SCP successfully, and that SCC and LGF played an important role in mediating the effect of SCI on SCP. This research recommended that companies should consider strategies enhancing SCI, SCC, and LGF as they can increase their SCP.**

***Keywords*—** *Supply Chain Performance, Supply Chain Collaboration, Logistics Flexibility, Supply Chain Integration*

1. Introduction

Currently, businesspersons have changed the administrative method in doing their business as a result of the globalization, leading to a decline in complications on international trade [1]. The entrepreneurs, therefore, need to develop their businesses in extremely competitive circumstances by raising the sustainable competitiveness. The skills in examining and measuring supply chain performance (SCP) to compare with other firms' operations in the same industry are the main success factors. Nevertheless, in Thailand, it is difficult to inspire the businesses to assess their SCP and the firms in general preserve their confidential SCP information. Consequently, there is no official SCP information provided by any institutions in Thailand [2].

The previous research, however, depicts the problems in terms of supply chain management (SCM) of business organizations from different industries in Thailand [3;4;5;6;7;8;9;10;11;12;13;14;15] For that reason, it can be supposed that firms' SCP in Thailand might need to be improved. The study thus aims to study the factors increasing SCP of firms in Thailand, particularly in automobile industry since it is interested because the trend of automotive sales has been growth uninterruptedly. The driving factors are Thailand's economic development and government policy encouraging the purchase of automobiles, and many new auto models that will be launched during 2020-2022. This reveals the automobile sale expansion in both local and foreign markets. Likewise, there is the chance of Thai auto-parts manufacturing firms to export because in some countries, such as Toyota Motor Corporation (Australia) will decrease automotive manufacturing capacity and then entirely close it in 2019. Additionally, tax rate reduced to zero percent due to AEC agreement supports ASEAN countries to import automobiles from Thailand. Accordingly, this study emphasizes the enhancement of Thai auto-part manufacturers' SCP [16].

Preceding studies discovered a variety of studying logistics and supply chain elements that are able to improve SCP, e.g. SCM practices and supply chain integration (SCI) [17], logistics flexibility (LGF) [18], and supply chain collaboration (SCC) [19]. Nonetheless, the following elements affecting to the firm's SCP have been inadequately studied and undistinguishable, specifically in context of Thailand since there are the existing gaps in the literatures. First, an integrated model examining the complicated relationship among SCI, LGF, SCC and SCP is still absent. Even though the current study portrayed the moderation effects of technological and demand uncertainties on the relationship between SCI and customer delivery performance of first tier auto-part supplier in Thailand [20].Exploring the issues of how the effect of SCI on SCP are mediated by SCC and LGF, along with the effect of SCI on SCC are mediated by LGF, are still indistinct in the context of Thailand automotive industry. Second, the present systematic review of supply

chain flexibility suggested that more studies need to validate which flexibility factors are useful for the specific industries, sectors, supply chain settings and designs and between the supply chain members to deliver value to the customer and/or develop SCP [18]. The study, therefore, emphasizes the LGF in dissimilar flexibility dimensions. Third, many earlier studies only focused on the SCC relationship with other factors, not concentrated on dimensions [21]. Besides, only study found that SCC based on information sharing and decision synchronization with supply chain partners positively affects SCP of Thailand auto-parts and electronics manufacturers [22]. Consequently, the study, suggesting the diverse SCC dimensions and examining the relationship of SCC sub-dimensions, is important. Forth, most often academic work on supply chain tends to excessively emphasize the company's operational and financial performance measurement rather than SCP assessment [23]. This study, hence, focus on SCP measurement. Accordingly, the key objective of this research is to extend these earlier studies. The study aims to explore the levels of SCI, LGF, SCC, and SCP, the effects of SCI, LGF, and SCC on SCP, the effect of SCI on LGF and SCC, the effect of LGF on SCC, the mediating roles of SCC and LGF on the effect of SCI on SCP of auto-parts manufacturing firms in Thailand.

2. Literature Review

Supply Chain Performance

SCP is the operational measurement for each supply chain member and the full supply chain as involvement significance in a supply chain relationship [24]. Likewise, it refers to the advantages resulting from supply chain collaboration, comprising cost saving, competence increase, and cycle time development [25]. SCP metrics can be divided into efficiency (EFF) and effectiveness (ETN) as the important indicators [26; 27; 28; 29; 30; 31]. Two dimensions for measuring supply chain EFF are supply chain cash-to-cash cycle time, that evaluates the time used for an asset made to flow back into a firm after the firm has been paid for raw materials, and supply chain agility, that evaluates the time necessary for the supply chain to react to an unforeseen demand growth with no cost or service drawback. While, supply chain EFF is measured by order fulfilment lead time, that measures the time between order delivery and order entry, and perfect order fulfilment, that measures perfectly completed orders ratio over the total number of orders places. These two dimensions are based on SCOR Version 12.0 Key Performance Indicators measuring the characteristics of supply chain responsiveness and reliability, in order [32].

Supply Chain Collaboration

SCC has been described in many different approaches, and basically it has been theorized in terms of relational and practice importance. SCC has been perceived as a business process where two or more separate organizations manage together in supply chain operations in the direction of shared purposes and mutual profits [33]. SCC is the fellowship among independent organizations, but linked firms to share competences and resources to respond their customer desires which change vigorously [34]. The study assesses SCC in 4Rs dimensions as suggested by Christopher [35]. Firstly, responsiveness is how supply chain partners operate closely to expand an understanding of and respond to the market and competitive circumstances [33]. Secondly, reliability is honesty of one party in supply chain concerning the opportunity that the achievement or results of another will be delightful [36]. Thirdly, resilience is interactive uncertainty described as the feasible characteristic in unforeseen situations to meet supply chain partners' expectation [37]. Finally, relationship is the customer relationship promoter [38], long term relationship & mutual relationship effort [39], and interactive relationship [40].

Logistics Flexibility

LGF is the business's competence to respond promptly and skillfully to desires for distribution, services, and support. This is achieved by predicting and observing the flow as well as storage of merchandises, works, and related resources from the production to the consumption. It consists of flexible movements within firm and between its partners [41]. LGF allows better consumer service by organizing the delivery of goods with buyer requirements [42]. LGF has four dimensions, comprising physical supply (PSF), purchasing (PCF), physical distribution (PDF), and demand management (DMF) flexibilities. Firstly, PSF is the business capacity to deliver a range of reserved supplies for manufacturing, promptly and creditably. Secondly, PCF is the business competence to purchase a range of reserved supplies by making arrangement, promptly and creditably. Thirdly, PDF is the business competence ability to adapt the packing, inventory, warehousing, and delivery of physical merchandises to meet consumer requests, promptly and creditably. Fourthly, DMF is the business competence to respond to the range of customer needs regarding deliver time, services, and expense, promptly and creditably [43].

Supply Chain Integration

SCI is the degree to which a manufacturing firms intentionally interconnects [44] and interrelates [45] with its suppliers and customers plus coordinately operate managerial processes. The goal is to achieve the ingenious flows of goods and facilities, data, cash and alternatives, to deliver highest value to consumers at high fastness and little budget. SCI consists of supplier integration (SPI), internal integration (INI), and customer integration (CTI).

Firstly, SPI is the degree to which a manufacturer works together with its main suppliers to reach customer requirements by specifying decision-making preparations, plans, procedures, and tasks, mutually. Secondly, INI is the degree to which a producer builds its own managerial plans, procedures, and tasks cooperatively. Thirdly, CTI is the firm's usage of these client contributions in the service delivery procedure [46].

Supply Chain Integration and Supply Chain Performance

Feng et al. offer an inventive experimental examination of the influence of SCI on the performance of automobile manufacturing firms in China [47]. As an energetic competence, SCI positively links to operational performance. Li also discloses the effect of SCI on operational performance of manufacturers in diverse countries [48]. Whereas, Zhao et al. denotes that SCI is advantageous to financial performance of manufacturing companies' in China [49]. Charterina et al. designate that SPI in the dimensions of information-sharing practices positively impacts European Machine-tool companies' performance. Similarly, information sharing routines mediate in the influence of idiosyncratic investments on organization's performance [50]. Constantly, Wong et al. portray that the positive influence of SCI, based on information sharing, on the organizational performance. As information-sharing is an essential practice of SCI, so SCI conceivably has a positive effect on SCP [51]. This study, for that reason, proposes the following hypothesis:

H1: SCI positively affects SCP.

Supply Chain Integration and Supply Chain Collaboration

Yu et al. recommend that integration in terms of relationship between businesses and their customers is a significant part in enhancing collaboration [52]. Furthermore, Chou et al. disclose that the integration, focused on information exchange or communication, positively impact on collaboration [53]. Liu and Lee denote that SCI positively affects supply chain resilience. The structural capital is a whole system of suitable relationships among supply chain partners. So, it is considered as the integration between supply chain partners [54]. This study, for that reason, proposes the following hypothesis:

H2: SCI positively affects SCC.

Supply Chain Integration and Logistics Flexibility

Muntaka et al. designate that SCI positively affects supply chain flexibility [55]. Particularly internal integration, Khalaf and Mohadem signify the link between internal integration and manufacturing flexibility in the Egyptian industry [56]. Chaudhuri et al. also validate that internal integration have a direct effect on manufacturing flexibility [57]. Yu et al. represent that SCI, focused on information sharing, positively affects flexibility [58]. Goyal, et al., besides, expose that supplier relationship and process generalization in practice integration positively impacts supply chain flexibility [59]. As logistics and production are a part of supply chain management, this study, therefore, proposes the following hypothesis:

H3: SCI positively affects LGF

Logistics Flexibility and Supply Chain Performance

Yu et al. show that the level of supply chain flexibility, reactive and proactive flexibilities, increases frims' operational performance [58]. In addition, Muntaka et al. recommend that supply chain flexibility has a positive effect on business performance. As logistics is a part of supply chain management, logistics flexibility is probably affected SCP [55]. Aziz et al. exhibit that LGF has significant effect on forms' logistics performance. It endorses that logistics flexibility supports firms to recover logistics performance in term of increasing service responsive, flexibility, efficiency, and quality [60]. These evidences depicts that logistics flexibility capability has an important positive effect on performance. This study, as a result, proposes the following hypothesis:

H4: LGF positively affects SCP

Logistics Flexibility and Supply Chain Collaboration

Ma et al. suggest that a company can improve circumstantial resilience by the flexibility [61]. While, Yu et al. reveal that logistics flexibility has notable positive influences on the logistics service quality level the manufacturer proposes, which increase relationship, in turn. This stronger influence is under unstipulated circumstances [52]. Whereas, Badawi and Battor portray that flexibility can support supplier firms in developing reliability [62]. Additionally, Linnenluecke recommends that organizational flexibility study considered organizational flexibility as organizational responsiveness to outside threats [63]. As earlier studies reviewed on the relationship of the flexibility and these scopes regarding SCC, this study, thus, proposes the following hypothesis:

H5. LGF positively affects SCC.

Supply Chain Collaboration and Supply Chain Performance

Yunus exposes that supplier collaboration delivers essential innovation, while customer relationship delivers incremental innovation. Nonetheless, customer relationship negatively affects essential innovation. Both innovations moreover positively affect organizational performance [64]. Doganay and Ergun recommend that supply chain management needs administrative relationships between supply chain partners so as to develop supply chain to reach ultimately competitive advantage and consumer satisfaction. SCC is vigorous for

the focal company relationship at the present time. Reliance based and longtime relationships with suppliers have many profits for focal companies to accomplish enhanced SCP on the customer side [65]. Abdallah et al. describes that reliability with suppliers has a positive effect on hospital SCP performance [66]. Besides, Salam reveals that SCC positively affects operational performance in fast-moving consumer goods businesses in Thailand [67]. Therefore, according to this line of perception, the following hypothesis is proposed:

H6: SCC positively affects to SCP.

The Mediating Roles of Supply Chain Collaboration and Logistics Flexibility

The linkage of the two sub-hypotheses allows the researchers to account for the mediating effect [68]. Consequently, this study proposes the following hypotheses:

H7: SCC mediates the effect of SCI on SCP.

H8: SCC mediates the effect of LGF on SCP.

H9: LGF mediates the effect of SCI on SCP.

H10: LGF mediates the effect of SCI on SCP.

Conceptual Framework

The conceptual framework was developed from reviewing related literature, as shown in Figure 1. The supply chain integration comprises 3 observed variables - supplier integration, internal integration, customer integration - which are in line with Flynn et al.'s [46]. Supply chain collaboration contains 4 observed variables, based on Christopher's 4Rs [35] - responsiveness, reliability, resilience, relationship – as suggested by past studies [37; 38; 39; 40; 69]. The logistics flexibility consists of 4 observed variables - physical supply flexibility, purchasing flexibility, physical distribution flexibility, demand management flexibility – as revealed by previous research [43; 70; 71; 72]. Supply chain performance covers 2 observed variables - efficiency and effectiveness - based on earlier studies [26; 27; 28; 29; 30; 31].

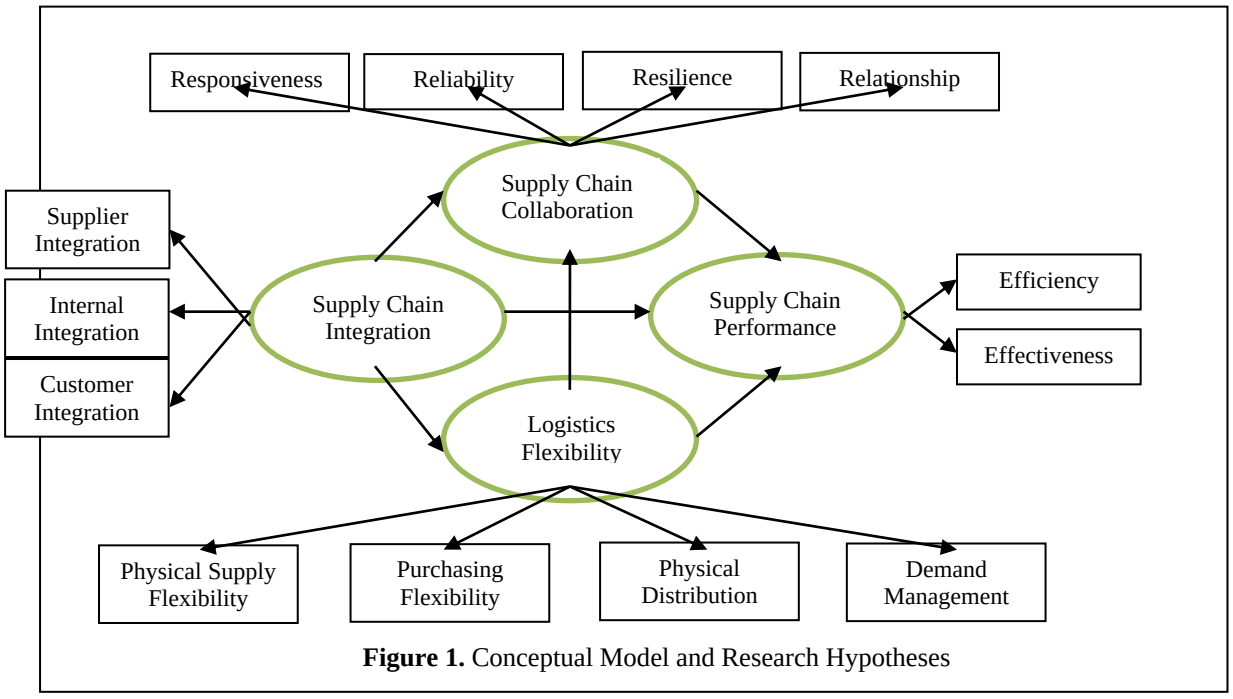

Figure 1. Conceptual Model and Research Hypotheses

3. Research Methodology

Population and Sample

The population in this study is top executives in 618 auto-parts manufacturers listed as the members of Thai Auto Parts Manufacturers Association or TAPMA. The study used TAPMA auto-parts manufacturers as the research population because they signified the trustworthy data about their companies available on TAPMA website as TAPMA were permitted by the Ministry of Commerce. Furthermore, they allowed the researcher to collect the data since their objectives are to study on auto-parts entrepreneurship, exchange or publicize the knowledge, and request from members information concerning their entrepreneurship [72].

As Comrey and Lee suggest that the sample size appropriateness is assessed very unevenly on the scale of 50-very poor; 100-poor; 300-good; 500-very good; and 1,000 or more-excellent [73], this study used systematic random sampling to select 350 companies form the total population. The stratified random sampling based on firm sizes – large firms and small-and-medium firms was used to proportionate the number of sample firms into 168 large firms and 182 SME firms. Top executives were asked to answer online questionnaire since they could represent their firm as the representatives of unit of analysis. Finally, there were 321 response firms, divided into 51 large firms (47.66%) and 56 SME firms (52.34%). The response rate is 91.71%. This numbers of sample is

acceptable as Kline recommend that the sample size of 10 respondents per estimated parameters is adequate [74]. As a result, the minimum sample size of this study was 320 respondents because this study comprised 32 parameters.

Research Instrument

This study was based on the quantitative method explanatory design, as a result, the questionnaire was used. For the questionnaire, the SCI nine items were used from the scale originally developed by Flynn et al. [46] and Tseng and Liao [75]. The SCC twenty four items were based on Paulraj and Chen [76], Lotfi et al. [77], Shin et al. [78], Brandon-Jones et al. [79], and Wieland and Wallenburg [80]. The LGF twenty four items were used from the scale initially created by Zhang et al. [43]. The SCP ten items were based on the concepts of Lee et al. [31], Tsanos et al. [81], and Odongo et al. [82]. After the questionnaire passed Index of Item-Objective Congruence or IOC, it was tried out with 30 non-sample managers to check reliability by considering internal consistency based on Cronbach's alpha coefficient. For the interview form, it was examined by specialists before gathering data.

Data Analysis

This study used Statistical Package for the Social Sciences (SPSS) 23 and Analysis of Moment Structures (AMOS) 22 to conduct the data analysis and hypotheses testing. Data was edited before analysis. The study replace missing data with maximum likelihood using the instruction "TYPE = MISSING H1" in AMOS [83]. Data analysis of all background information of the sample was analyzed by frequency and percentage. Since all variables in research conceptual framework were continues variables, the study used Mean, S.D., Skewness, and Kurtosis to study the distribution characteristics of variables. The interpretation of mean in measuring SCI, LGF, SCC, and SCP was considered from 5 levels of estimation based on Best and Kahn [84] approach.

The appropriateness of the meta-correlation was investigated by considering the Kaiser-Meyer-Olkin (KMO) value, > 0.5, and the Bartlett Test of Sphericity. They must have significant statistical significance (Sig.) 0.000, indicating that this set of variables is suitable for confirmatory factor analysis (CFA) [85]. Multicollinearity by correlation coefficient (r) was used to find the liner relationship between the variables. The correlation value can be from negligible (±00.00-0.30) to Very high (±0.90-1.00) [86] . The correlation coefficients between variables in SEM not to exceed +0.80 were considered [85].

CFA was used to test the relationship between observed variables of 13 observed variables and 4 latent variables. The model fit measurement was based on the eight indices (chi-square: P>0.05, relative chi-square<2, GFI, AGFI, TLI, &CFI >0.95, RMR&RMSEA<0.05) to test the consistency of the model based on hypothesis and empirical data. The researcher used these indices to validate the conformance of the model. If the calculated values do not meet the criteria or are unacceptable, as suggest by Diamantopoulos and Siguaw [87] the model must be adjusted.

4. Results

Testing for Measurement Model

This study considered the normal distribution of values from the Skewness values of -3 to +3 and Kurtosic values of 3. It also found that all factor loadings of 1st order CFA were between 0.3-1.0 and Cronbach's Alfa coefficients were greater than 0.7, as shown in Table 1. These values were acceptable as proposed by Rangsoongnern [88] and Wiratchai [89]. The model fit measurement, besides, were passed in eight indices, as suggested by Diamantopoulos and Siguaw [87]. These indicated that the measurement models were acceptable.

Moreover, the measurement models of SCP, SCC, LGF, and SCI were considered in terms of reliability, convergent validity, and discriminant validity with the criteria of CR>.70; Convergent validity: AVE>.50; Discriminant validity: AVE>MSV. CR = composite reliability; AVE = average variance extracted; MSV = maximum shared variance; ASV = average shared variance [90], as shown in Table 2. After that, the Goodness of fit by 2nd order CFA depicted passing values based on indices suggested by Diamantopoulos and Siguaw [87], as shown in Table 3.

Testing Result of the Causal Relationship Model

As shown in Table 4, the effects of SCI and LGF on SCC depicted R-Square of 0.815 or SCI and LGF explained the variance of SCC by 82%. The effect of SCI on LGF portrayed R-square of 0.674 or SCI explained the variance of LGF by 67%. The effects of SCI, SCC, and LGF on SCP displayed R-square of 0.823 or SCI, SCC, and LGF explained the variance of SCP by 82%.

As shown in Table 5, hypotheses 1-10 were supported with the statistical significance at a level of P-value<0.001 – P-value<0.05. Such table showed C.R. (critical ratio) or T-Value of testing results of all hypotheses, except hypotheses on mediation effects as they were not calculated in AMOS. Testing results of hypothesis 1 described the T-value of 5.094. Testing results of hypothesis 2 described the T-value of 7.877. Testing results of hypothesis 3 described the T-value of 17.188. Testing results of hypothesis 4 described the T-value of 2.090. Testing results of hypothesis 5 described the T-value of 5.392. Testing results of hypothesis 1 described the T-value of 2.814. These T-values were meet the acceptable criterion of C.R. or T-value>1.96, as suggested by Henseler et al. [91].

Path analysis by structural equation modeling was used to test the 10 hypotheses comprising the proposed model

of the effects of SCI, LGF, and SCC on SCP, the effect of SCI on LGF and SCC, and the effect of LGF on SCC, including the mediating roles of SCC and LGF on the effect of SCI on SCP of auto-parts manufacturing firms in Thailand. The model fit analysis results were acceptable (Chi-square= 63.414; degree of freedom=44; P=0.59; relative chi-square=1.441; GFI=.971; AGFI=.940; TLI=.991; CFI =0.95; RMR=.008; RMSEA=.037). The results are presented in Figure 2.

Table 1. Testing results of the measurement model

	Items' no.	$\bar{x}$	SD	Interpret	1st order loading	α	Remarks
Supply Chain Performance							
Efficiency	5	4.23	0.64	High	(0.45-0.75)	0.86	Acceptable
Effectiveness	5	4.26	0.60	High	(0.55-0.84)	0.84	Acceptable
Supply Chain Collaboration							
Responsiveness	5	4.30	0.65	High	(0.64-0.80)	0.81	Acceptable
Reliability	5	4.22	0.65	High	(0.55-.0.65)	0.88	Acceptable
Resilience	5	4.44	0.55	High	(0.61-0.84)	0.87	Acceptable
Relationship	5	4.32	0.60	High	(0.60-0-71)	0.81	Acceptable
Logistics Flexibility							
Physical Supply Flexibility	6	4.26	0.52	High	(0.65-0.80)	0.85	Acceptable
Purchasing Flexibility	6	4.13	0.67	High	(0.68-0.84)	0.88	Acceptable
Physical Distribution Flexibility	6	4.11	0.72	High	(0.72-0.82)	0.86	Acceptable
Demand Management Flexibility	6	4.21	0.66	High	(0.64-0.75)	0.81	Acceptable
Supply Chain Integration							
Supplier Integration	4	4.21	0.60	High	(0.45-0.75)	0.83	Acceptable
Internal Integration	4	3.99	0.64	High	(0.61-0.71)	0.89	Acceptable
Customer Integration	4	4.12	0.59	High	(0.60-0.72)	0.87	Acceptable

Table 2. Reliability, convergent and discriminant validity

	CR	AVE	MSV	ASV
Supply Chain Performance (SCP)	0.837	0.520	0.491	0.476
Supply Chain Collaboration (SCC)	0.801	0.507	0.438	0.426
Logistics Flexibility (LGF)	0.843	0.525	0.476	0.464
Supply Chain Integration (SCI)	0.859	0.578	0.493	0.480

Notes: Threshold of reliability: CR>.70; Convergent validity: AVE>.50; Discriminant validity: AVE>MSV. CR = composite reliability; AVE = average variance extracted; MSV = maximum shared variance; ASV = average shared variance.

Table 3. Goodness of fit by 2nd order CFA

Index	P value	x^2/df	CFI	GFI	AGFI	RMSEA	Critical N	SRMR	Remarks
	>0.05	<2	>0.95	>0.95	>0.95	<0.05	>300	<0.05	
SCP	0.55	1.58	1.00	0.99	0.97	0.016	785	0.04	pass
SCC	0.69	1.25	1.00	0.98	0.96	0.000	622	0.02	pass
LGF	0.54	1.34	1.00	0.98	0.96	0.000	549	0.03	pass
SCI	0.72	1.66	1.00	0.99	0.98	0.023	568	0.04	pass

Notes: SCP: Supply Chain Performance, SCC: Supply Chain Collaboration, LGF: Logistics Flexibility, and SCI: Supply Chain Integration

Table 4. Total effects, direct effects, and indirect effects

DV	SCC				LGF				SCP			
IV	TE	DE	IE	S.E.	TE	DE	IE	S.E.	TE	DE	IE	S.E.
SCI	.877***	.557***	.320***	.075	.821***	.821***	-	.055	.888***	.536***	.352***	.101
SCC	-	-	-	-	-	-	-	-	.291**	.291**	-	.097
LGF	.375***	.375***	-	.062	-	-	-	-	.239**	.129**	.109**	.062
R^2	.815				.674				.823			
Chi-Square = 63.414; df =44; p-value = .059; Relative Chi-square =1.441; GFI = .971; AGFI = .940; TLI = .991; CFI = .995; RMR = .008; RMSEA = .037												

Note: TE: total effect, DE: direct effect, IE: indirect effect, S.E.: standard error

Table 5. Hypothesis testing results

Hypothesis	Path	(β)	T-Value	Results
H1	Supply Chain Integration → Supply Chain Performance	0.536***	5.094	Supported
H2	Supply Chain Integration → Supply Chain Collaboration	0.557***	7.877	Supported
H3	Supply Chain Integration → Logistics Flexibility	0.821***	17.188	Supported
H4	Logistics Flexibility → Supply Chain Performance	0.129**	2.060	Supported
H5	Logistics Flexibility → Supply Chain Collaboration	0.375***	5.392	Supported
H6	Supply Chain Collaboration → Supply Chain Performance	0.291**	2.814	Supported
H7	Supply Chain Integration → Supply Chain Collaboration → Supply Chain Performance	0.302**	2.802	Supported
H8	Logistics Flexibility → Supply Chain Collaboration → Supply Chain Performance	0.201**	2.798	Supported
H9	Supply Chain Integration → Logistics Flexibility → Supply Chain Performance	0.107**	2.049	Supported
H10	Supply Chain Integration → Logistics Flexibility → Supply Chain Collaboration	0.312***	5.083	Supported

Note: *** = p < 0.001, ** = p < 0.01, * = p<0.05; Threshold of acceptable hypothesis: T-value>1.96

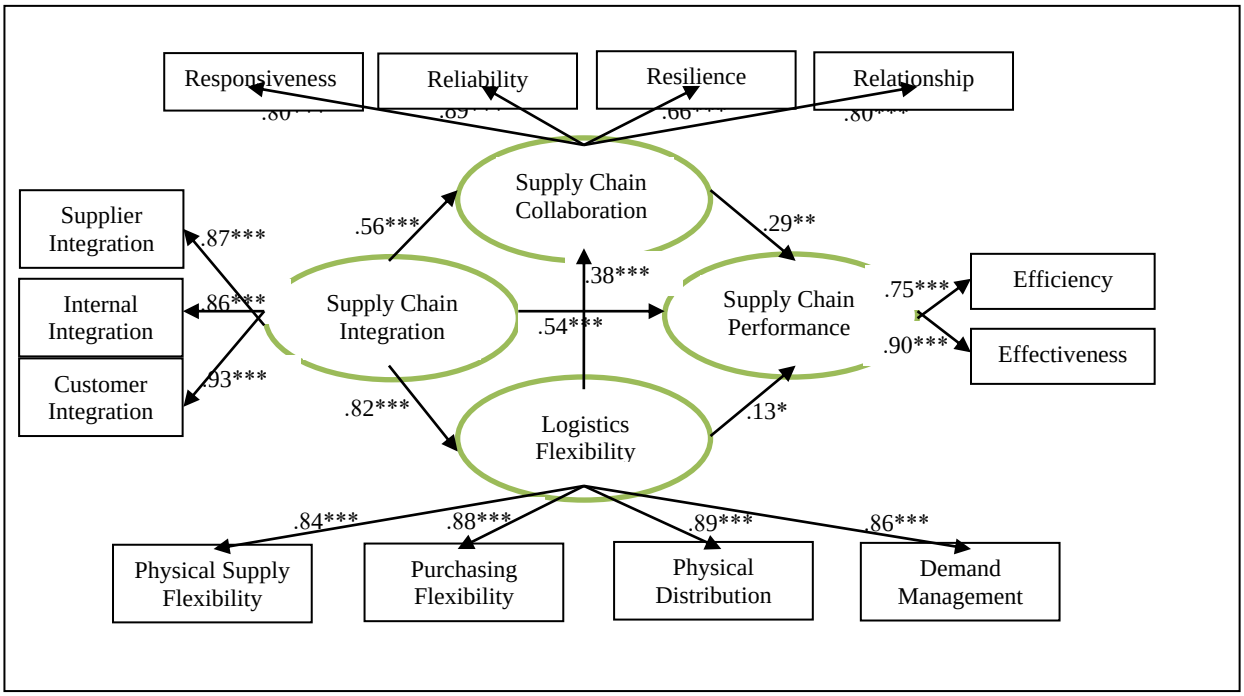

Figure 2. Structural equation modeling

5. Discussion and Conclusion

For the levels of SCI, SCC, LGF, and SCP of auto-parts manufacturing firms in Thailand, as the findings show that auto-parts manufacturing firms in Thailand have a high level of these variables. These may be caused by today firms' development in terms of information technology infrastructure [92] and collaborative management approaches among their supply chain partners, such as reliability [93, 94], relationship [95], resilience and responsiveness [94; 96], including the agility in logistics and supply chain management [92], and then these enhance SCP [47; 58 64], respectively.

For the findings on the direct positive effect of SCI, SCC, LGF on SCP, including the direct positive effect of SCI and LGF on SCC and SCI on LGF, they are in line with the past studies [as discussed in literature review. When the direct effect size of LGF towards SCP is considered, it depicts the lowest effect sizes in structural equation model. These may because if firms raise the flexibility in terms of physical supply, purchasing, physical distribution, and demand management, it impacts the increase of costs regarding coordination in the supply chain management activities. The coordination among supply chain members is difficult and often has problems, for example unsuccessful negotiation and termination of contract. These cause the auto-parts manufacturing firms to have transaction costs – negotiation costs and contracting costs – which affect overall supply chain efficiency, as conceptualized by Fink et al. [97]. However, LGF allows firms to perform effective order cycle time and perfect order fulfilment.

For the findings on the mediating roles of SCC and LGF on the effect of SCI and SCP, and the mediating role of SCC on the effect of LGF on SCP, they are in agreement with Hayes [68], regarding the linkage of the two sub-hypotheses allows to account for the mediating effect. As SCC has a higher mediation effect than LGF on the influence of SCI on SCP, LGF has a higher mediation effect on the influence of SCI on SCC than the impact of SCI on SCP, and SCC has a higher mediation effect on the influence of SCI on SCP than the impact of LGF on SCP, the supporting reasons are LGF causing costs, as discussed by Fink et al [97]. In increasing SCP, apart from the customer integration emphasis to improve supply chain integration, the enhancement of mediation effects is also important. For enhancing the mediating effect of SCC, the firms may pay attention on the reliability among supply chain partners by keeping the promises to each other. The companies, moreover, may sincerely concern common business succeeds and keep common best interests or benefits in mind. These are the way to increase mediating effect of supply chain collaboration since the trustworthiness or reliability in supply chain is the most important dimension in supply chain collaboration, as concluded in the previous part. Whereas, for developing the mediating effect of LGF, the firms may emphasize physical distribution flexibility by reorganizing the processes in the finished goods warehouse, such as packaging, labelling finished products, and picking materials to respond effectively to the situation that

multiple customer orders are required. The multiple transportation modes may be used flexibly to meet schedule for deliveries. These are the technique to intensify mediating effect of logistics flexibility since it is the most important dimension in supply chain collaboration, as summarized in the preceding part.

In conclusion, auto-parts manufacturing firms should develop an excellent SCI, SCC, and LGF. Furthermore, Thailand government sectors, such as Department of Primary industries and Mines, Department of Industry Promotion etc. should use the results of this study as the guidelines for holding logistics and supply chain management training programs, giving firms the depth advices in terms of logistics and supply chain management, and developing supply chain performance indicators and measurement system.

Further study should emphasize other factors outside logistics and supply chain management field that can improve SCP, such as happy workplace, transformational leadership, learning organization, and organizational commitment, as conceptualized by Phrapratanporn et al. [98], cultural intelligence, as suggested by Aunyawong et al. [99], corporate social responsibility, as studied by Tuan [100], lean practices, as revealed by Hotrawaisaya [101], marketing communication, as proposed by Sutduean et al. [102], information technology, as recommended by Sutduean et al. [103], and process strategies, as depicted by Mee-ngoen et al. [104] since these factors are quite new in supply chain management study, as reviewed by Shaharudin et al. [105], especially in the context of Thailand. Moreover, the comparative future study should be conducted in different ASEAN countries or cultures distinguished in automotive industry, especially in terms of manufacturing since these countries have the different political or government supports, strategic locations, infrastructures, qualities of human resources, and strong support industries under ASEAN Economics Community. The study, in addition, in different interesting industries related to automotive industry is necessary, such as Thai iron and steel industry.

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