Effects of a Supply Chain Collaboration Model on Competitiveness via Collaborative Advantages and Reduction of Supply Chain Disruption

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***Abstract*-Model of Supply chain collaboration model that affects on competitive advantage via collaboration advantage and reduction of supply chain disruption: a case study in Automotive Parts Manufacturing Industry in Thailand. The aims of this study were to investigate the mediating effects of collaboration advantage and reduce supply chain disruption on the relationship between Supply chain collaboration and competitiveness. Data were obtained from 282 manager in production division of small and medium-sized enterprises (SMEs) in automotive parts manufacturing industry in Thailand. Structural equation model (SEM) technique was employed for data analysis. The findings indicated that supply chain collaboration had significant positive effect on collaboration advantage and competitive advantage. Furthermore, collaboration advantage and reduce supply chain disruption had significant positive impact on competitiveness. On the other hand, supply chain collaboration had significant negative effect on reduce supply chain disruption. This is quite a surprising result. The discovery of the relationship between supply chain collaboration and competitive advantage in this field benefits for not only academic sector but also public and private sectors. The study suggests that organizations enable to improve their collaboration advantage, including process efficiency, offering flexibility and innovation, by developing either supply chain collaboration practices. This, in turn, enhances organizational performance in high competitive advantage.**

Keywords; *Supply chain collaboration, Reduction of supply chain disruption, Competitiveness, Automotive Parts Manufacturing Industry*

1. Introduction

Currently, business management is in an age of competition between various networks, and the success of businesses will increase along with the ability of the administrators in effective network integration of business relationships by companies creating competitive advantages via the collaboration of the members in the supply chain, which uses the benefits from resources and knowledge, coordination, the flow integration of products, and the exchange of information with the suppliers of production inputs and the customers. This is in accordance with the concept of supply chain collaboration (SCC), which refers to two or more independent companies that have created long-term relationships by jointly planning for work and operations in their supply chain in order to achieve their goals [42]. In this process, both companies will work together to share information, resources, knowledge, benefits and risks along with the decision making regarding various matters in order to achieve their mutual goals [50].

Based on the application of the concept of the supply chain in business operations as previously mentioned, it was found that the players in supply chains attempt to reduce costs by outsourcing, which is something that can lead to the risk of disruption in business [41] due to it being a relationship that is not stable, as the companies that provide outsourcing have risks in terms of the continuation of the outsourcing. This can cause the companies that outsource to need to find other customers in order to reduce the risk of the manufacturing businesses needing to use the services of the same outsource companies in production, but being unable to produce due to them being engaged by other customers [1]. This will cause the production process of businesses to be disrupted, which can not only cause delays in the shipping of goods or the providing of services but also cause the work of the members within the supply chain to fail, the sales to decrease, the costs to increase, and the business to be unable to recover [34].

As a result of the importance of these problems mentioned above, this research was conducted in order to create a supply chain collaboration model that is able to efficiently reduce disruption in supply chains and provide the collaborative advantages that will lead to the competiveness of companies, which is something that allows the organizations to gain the stable competitive advantages. Based on the study of the context of entrepreneurs of SMEs in Thailand's automotive parts manufacturing industry is one of the leading industries in the country, fastest growing in region [45] and leading car manufacturers in ASEAN countries [22]. Combined with the entrepreneurs of SMEs being the players in the supply chain that lack resources, especially in terms of

investment when compared with players in larger organizations, it was found that when disruption occurs in the supply chain, the people who are affected the most are the SME entrepreneurs that have insufficient working capital in their business activities, resulting in these entrepreneurs of SMEs being unable to continue conducting business activities. Eventually, this will have an effect on the other players in the supply chain. Therefore, the creation of networks within industries for collaborations that do not involve the exchange of information, various innovations, designs and inventions of new methods in production but instead focus only on investments will help to achieve the improvement of organizations, such as higher returns on investments, which are more beneficial than on-time deliveries, reduced expenses, etc.[33].

The objective of this research study is to investigate the supply chain collaboration model that has an effect on the collaborative advantages in terms of the reduction of supply chain disruption, which has an impact on the competiveness of companies. Thus, the knowledge that has a high value for the development of organizations within the business environment at present and in the future will be created as a basis and a guideline in the development of the process of collaboration in supply chains in order to reduce disruptions in the business operations of SMEs, so that they will be better able to continue to conduct business activities to create jobs, generate revenue and add value to increase the gross domestic product (GDP).

2. Literature Review

The Relational View theory was developed in order to explain that the competiveness of companies will increase along with the relational networks that the companies have in combination with the identification of the sources of the competitive advantages of organizations [13]. The theory is focused on strategic alliances and long-term relationships [6]. The Relational View theory mentions the mechanism of collaborative value creation between companies [7] which is the concept that all types of operations in organizations done by individual companies will not be able to achieve collaborative advantages, but these collaborative advantages will occur when businesses rely on or work together with other businesses, which is known as a relational network, through the sharing of information or resources with each other [33]. Businesses that are able to access and use the knowledge and the various abilities of other companies in relational networks will likely experience more success [55], due to it being difficult for competitors to be able to copy these special characteristics [31].

Relationships between supply chain collaboration, collaborative advantages, reduction of supply chain disruption, and competitiveness

The concept of supply chain collaboration is based on the idea of the collaborative advantages [9] with the objective to create value for customers with efficient production that results from collaboration between the manufacturers and the suppliers of raw materials, which is related to the search for products and the services that have good quality, are modern, are able to respond to the rapid changes in the environment [26], and are decrease of supply chain cost covering costs of process, inventory and production [36]. This is in accordance with the research of [56], [40], [54], [39] and [33] who found that the components of collaboration in supply chains, namely the sharing of information with each other, building knowledge, internal communications between members of the supply chain, coordinated setting of goals, planning and decison making, and joint measurement of the results of the operations of the supply chain, have a positive effect on the collaborative advantages.

Supply chain collaboration is able to improve the results of the overall operations of the supply chain [32]; [8]. Therefore, companies must collaborate and coordinate within strategic alliances in order for the operations in the supply chain to be both efficient and able to respond to the needs of the constantly changing markets [43]. Also, [46] found that the strategy of supply chain collaboration is resilient and able to help reduce expenses in the search for lower inventory levels and better relationships with customers, which provide companies with competitive advantages. This is in line with the work of [43], whose findings indicated that competitive advantages, such as the ability to create profitabilty and customer satisfaction, occur from collaboration in terms of information sharing, decision synchronization, and incentive alignments. Moreover, [17]; [21], and [30] also found that supply chain collaboration is able to produce faster delivery times and higher quality goods, which are factors that will help companies increase their ability to generate profitabilty and the satisfaction of customers.

In addition, various organizations must therefore currently make themselves capable of responding to various events quickly in order to prevent disruptions of the supply chain [25]. The method that is used in planning for this fast response is supply chain collaboration, which includes the duty to consider the situation in terms of the environment that helps organizations to be able to detect threats that can cause the work to be disrupted [35]. For example, in the work of [41], it was found that supply chain collaboration has a direct influence on the ability to detect early signs of disruption and increase the capability for recovery from negative impacts. Futhermore, it is also recommended that the alleviation of disruption in supply chains should first relate to creating an understanding of

the important members in the supply chain and create the need for collaboration in order to reduce the events that will cause disruptions. This is in accordance with the work of [44], [29] and [10] who found that collaboration between alliances in supply chains helps create resilience and reduce the risks from disruptions of the supply chain.

Therefore, when it occurs, collaboration between alliances in supply chains is able to have a positive effect on the collaborative advantages, resulting in increased efficency in the production process. Also, a decrease in the disruptions of the production process has a positive effect on the competiveness of companies. Therefore, the research hypotheses are as follows.

Research hypothesis 1: Supply chain collaboration has a positive influence on the competiveness of companies.

Research hypothesis 2: Supply chain collaboration has a positive influence on the collaborative advantages.

Research hypothesis 3: Supply chain collaboration has a positive impact on the reduction of supply chain disruptions.

Relationships between collaborative advantages, reduction of supply chain disruption, and competiveness

From the literature review, it was found that when companies gain advantages in collaboration, this has an effect that leads to the competiveness of companies as well. For example, in the research of [4] it was found that operations that result in good quality products have a direct positive impact on a comany's ability to compete by being able to improve the satisfaction of customers in aspects that are related to the services received as well as the ability to attract new customers and improve the image of company. This is in accordance with the work of [12] [14], [48], and [24], who found that the collaborative advantages have a significant relationship with the competiveness of a company.

In addition, reduction of disruptions of the supply chain can allow companies to gain a competitive advantage by improvement of the level of the satisfaction of the customers and providing the services that have good quality [23]. For example, [28] found that the model of the reduction of the risk of disruptions to the operations of a supply chain is able to build customer satisfaction and increase the ability to create profitabilty. This is in accordance with the research of [44] and [29], who found that the planning related to the reduction of the risk of disruptions is able to increase efficiency in creating profitabilty and customer satisfaction. Furthermore, the results of the research also showed that collaboration among organizations is a method that is able to increase resilience in the production process, which causes the risk of disruption of supply chains to decrease and results in competiveness.

Therefore, when companies gain the collaborative advantages and are able to reduce disruptions of their supply chain, it will have a positive effect on the competiveness of these companies. Therefore, the additional research hypotheses are as follows.

Research hypothesis 4: The collaborative advantages have a positive influence on the competiveness of companies.

Research hypothesis 5: Reduction of supply chain disruptions has a positive influence on the competiveness of companies.

Based on the review of the literature above, the research framework was therefore developed, as seen in Figure 1.

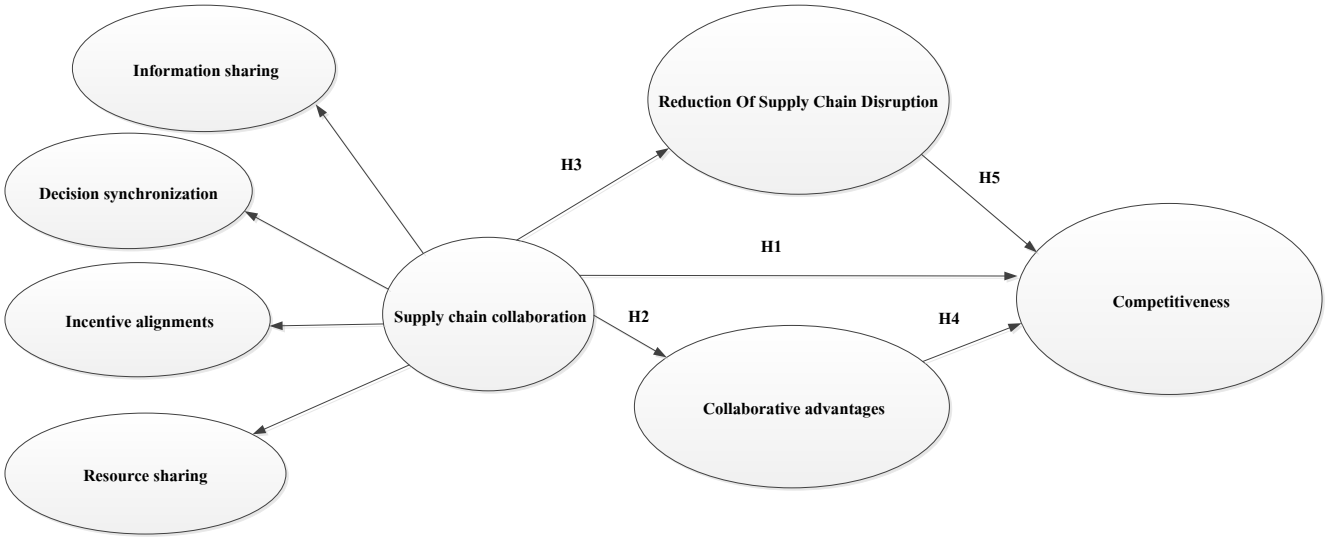

Figure 1 the Research Framework

3. Research Methodology

Sample and Data Collection was collected from managers in various departments that are related to supply chains, namely the purchasing departments, production departments, logistics departments and marketing departments of small and medium-sized enterprises in the automotive parts industry in Thailand. A total of 570 sets of a questionnaire were sent out by mail, and a total of 285 sets of completed questionnaires were received, which resulted in a rate of return of 49 percent of the total amount of questionnaires that were sent out. Moreover, there was a total of three sets of questionnaires that had missing data, leaving a remainder of 282 sets of the questionnaire that were complete. The general information of the respondents to the questionnaire found that the majority of the sample group were male, with an age between 35 – 44 years and an educational level of a bachelor's degree, working in the position of manager of a marketing department that performs the duties that are related to the logistics of small and medium-sized enterprises (SMEs) in the automotive parts manufacturing industry and are concerned with supply chain management in the production or assembly plants. Their work experience was between at least one year and the maximum length of 35 years, and the average length of time spent working was approximately 12 years. Regarding the businesses, they had total full-time staff ranging from 1.2 percent having five people to the maximum of 7.8 percent having 200 persons, and on average, the number of full-time staff was 93 persons.

Measurement variables in the research was developed by the researcher from the review of the related theories and the literature in order to determine the observed variables based on the characteristics of those indicated. The rating scale that was used was a 7-point Likert scale with opinions ranging from "the least" = 1 to "the most" = 7. The researcher performed the Exploratory Factor Analysis and checked the Reliability with the details as follows.

Supply chain collaboration is the process of long-term partnerships with the partners and customers in the supply chain, which occurs from working together by the joint setting of their goals in order to bring about the mutual gain of advantages, which will be more numerous than those that individual companies can receive alone, by the collaborative components in the supply chain. In this research, the components include the 4 dimensions that have the most significant effects on the collaborative advantages, which were applied from [33]. These include information sharing, decision synchronization, incentive alignments, resource sharing, which have a Cronbach's alpha of 0.91, 0.91, 0.91, 0.89, respectively. In addition, there was a total of 15 observed variables.

The collaborative advantages are the benefits that organizations receive over their competitors in the market via the collaboration of alliances in the supply chain. In this research, a total of 6 observed variables having a Cronbach's alpha of 0.94 were adapted from [56].

The reduction of supply chain disruption involves the cooperation with partners and customers in the improvement of the capability for the event visibility that will unexpectedly occur in the process of the supply chain. There was a total of 4 observed variables that were developed into questions from [34] having a Cronbach's alpha of 0.89.

The competiveness include the abilities of the supply chain to deliver value to the customers via a process that is modern with efficiency and resilience that is higher than that of the competing companies. There was a total of 4 observed variables that were developed into questions from [5] having a Cronbach's alpha of 0.93.

Data analysis was performed with the R system by checking the correlation coefficient of the variables, the Variance Inflation Factor (VIF), and the Tolerance value. From that, the confirmatory factor analysis was performed in order to check the convergent validity and discriminant validity. Moreover, an analysis was conducted on the Structural Equation Model in order to test the conceptual framework of this research.

4. Research Results

Analysis of the correlation coefficient, the VIF value, and the Tolerance value of the variables was conducted, and it was found that for every variable, there is a positive relationship in the same direction by the correlation coefficient of every pair having a value less than 0.80. Moreover, every variable has a VIF value less than 5.00 and a Tolerance value greater than 0.20 [18], which shows that each variable has few relationships. Therefore, no problems were found regarding multicollinearity.

The confirmatory factor analysis conducted by checking the convergent validity considered from the Composite Reliability (CR) value and the Average Variance Extract (AVE) found that every observed variable has a CR value greater than 0.70 [3] and has an AVE value greater than 0.50 [16]; [20], which are within the acceptable criteria. Therefore, every observed variable has the accuracy and consistency within the measurements. From that, the checking of the discriminant validity by considering from the square root of AVE (√AVE) found that every observed variable has a relationship value between variables that is less than (√AVE), which is an indication that each group of observed variables having differences in the measurement variable has no covariance problems, as seen in Table 1.

Table 1. Convergent Validity

Observed Variables	Factor Loading	α	CR	AVE
Information sharing (is)		.912	0.916	0.734
There is exchange of data related to the work plan between the company and the partners in the supply chain (is1).	0.853			
There is exchange of information about work procedures between the company and the partners in the supply chain conducted at appropriate times (is2).	0.903			
There is exchange of data that is trustworthy between the company and the partners in the supply chain (is3).	0.859			
There is exchange of data that is complete between the company and the partners in the supply chain (is4).	0.810			
Decision synchronization (ds)		.916	0.916	0.786
There is joint planning of promotional activities between the company and the partners in the supply chain (ds1).	0.911			
There is joint forecasting of the demand for goods between the company and the partners in the supply chain (ds2).	0.894			
There is arrangement of group and joint product lines between the company and the partners in the supply chain (ds4).	0.854			
Incentive alignments (ia)		.918	0.918	0.692
The criteria are created for the evaluation of the results of joint operations between the company and the partners in the supply chain (ia1).	0.828			
There are shared costs that result from operational errors between the company and the partners in the supply chain (ia2).	0.842			
There are equitable agreements to share the benefits between the company and the partners in the supply chain (ia3).	0.823			
There are shared responsibilities for risks that occur from operations between the company and the partners in the supply chain (ia4).	0.848			
Returns from collaboration with partners are worthwhile for the investments and risks that occur (ia5).	0.820			
Resource sharing (rs)		.899	0.900	0.750
There is coaching from the expert work teams between the company and the partners in the supply chain (rs1).	0.864			
There are personnel or work units that are responsible for coordinating the work between the company and the partners in the supply chain (rs2).	0.882			
There is the support of specific techniques in the operations between the company and the partners in the supply chain (rs3).	0.853			
Collaborative advantages (ca)		.944	0.942	0.730
Your company and partners in the supply chain are able to effectively offer various products and services to the market when compared with the same industry standards (ca1).	0.842			
Your company and partners in the supply chain are able to respond to the needs of customers by quickly providing products and services when compared with the same industry standards (ca2).	0.845			
Your company and partners in the supply chain are able to effectively respond to the customer demand for goods in different volumes when compared with the same industry standards (ca3).	0.893			
Your company and partners in the supply chain are able to respond well to the needs of customers when compared with the same industry standards (ca4).	0.893			
Your company and partners in the supply chain perform production of goods that is standardized when compared with the same industry standards (ca6).	0.827			
Your company and partners in the supply chain are able to manufacture goods in the volume that is appropriate for storage in the warehouses in order to respond to customers (ca8).	0.826			

Reduction of supply chain disruption (rscd)		.899	0.931	0.772
Your company has reduced the impacts from other internal factors, namely broken down machinery, power failures, and equipment that does not meet the requirements (rscd1).	0.839			
Your company has reduced the effects of the impacts resulting from the suppliers of production inputs, namely sudden fluctuations of production capacity, inconsistent quality of the products, lack of coordination, and low efficiency of delivery (rscd2).	0.910			
Your company has reduced the effects from the impacts from customers, namely inaccurate data that is related to the volume of ordering, sudden increases in demand, and unpredictable product specifications (rscd3).	0.917			
Your company has reduced the effects from the impacts from external problems, which include the effects of fluctuations of currencies, the rate of inflation, and customs duties (rscd4).	0.847			
Competitiveness (cn)		.936	0.939	0.795
Your company is able to deliver goods at the time that customers have ordered them (cn1).	0.906			
Your company provides delivery of goods that match the category that the customers have ordered (cn2).	0.914			
The volume of the goods that the customers receive is correct according to their customer needs (cn3).	0.936			
Your company is better able to provide goods according to the orders when compared with other companies in the same industry (cn4).	0.806			

Analysis of the Structural Equation Model was done with the R system for considering the consistency of the model with the empirical data. The results of the first analysis indicated that the structural model does not have consistency with the empirical data ($\chi2$ = 907.429, df = 368, $\chi2$/df = 2.465, p-value = 0.000, CFI = 0.933, TLI = 0.926, NFI = 0.893, RMSEA = 0.072, SRMR = 0.058, GFI = 0.915 and AGFI = 0.893). The researcher therefore conducted Model Modification by considering the index value MI (Modification Indices). After modifying the model, it was found that the second model has suitability and consistency with the empirical data with the $\chi2$ value = 336.798, df = 299, $\chi2$/df = 1.126, p-value = 0.065, CFI = 0.995, TLI = 0.994, NFI = 0.960, RMSEA = 0.021, SRMR = 0.034, GFI = 0.968, and AGFI = 0.950, as seen in Figure 2.

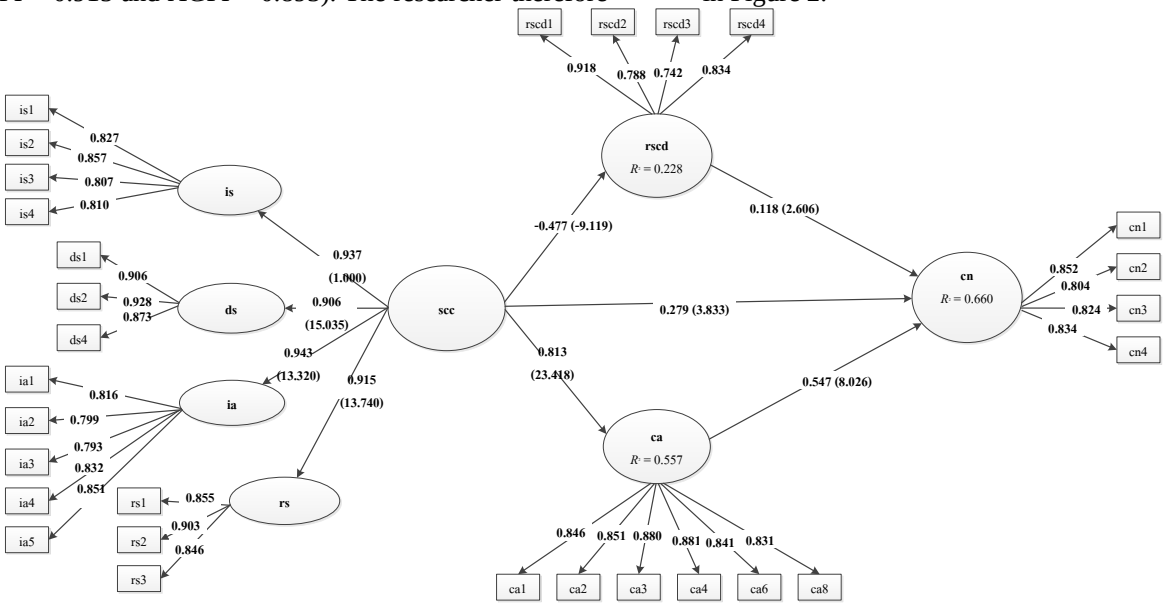

Figure 2 Analysis of the Structural Equation Model

From the hypothesis analysis, the results indicated that regarding Research hypothesis 1: Supply chain collaboration (SCC) has a positive influence on the competitiveness of companies (cn), the results of the

testing showed that supply chain collaboration has a significant positive influence on the competiveness of companies (β= 0.279, p < 0.001) (supported). With regard to Research hypothesis 2: Supply chain collaboration (scc) has a positive influence on the collaborative advantages (ca), the results of the testing indicated that the cooperation in the supply chain has a significant positive influence on the collaborative advantages (β = 0.813, p < 0.001) (supported). For Research hypothesis 3: Supply chain collaboration (scc) has a positive impact on the reduction of supply chain disruption (rscd), the results of the testing indicated that supply chain collaboration has a negative influence on the reduction of supply chain disruption (β = -0.477, p < 0.010) (not supported). Regarding Research hypothesis 4: The collaborative advantages (ca) have a positive influence on the competitiveness of companies (cn), the results of the testing indicated that the collaborative advantages have a significant positive influence on the competitiveness of companies (β = 0.547, p < 0.001) (supported). Moreover, for Research hypothesis 5: Reduction of supply chain disruptions (rscd) has a positive influence on the competitiveness of companies (cn), the results of the testing indicated that the reduction of supply chain disruptions has a significant positive influence on the competitiveness of companies (β = 0.118, p < 0.001) (supported).

Furthermore, the researcher performed variance testing of the Structural Equation Model that results from the influence of the control variable by setting the control variable in this research study as the size of the business, for which, in the variance testing of the model, the researcher used the technique of multigroup analysis [15]; [38], which is a technique of checking the variance of the Structural Equation Model when specifying the control variable by having the two steps of the process of variance testing as follows:

1. Variance testing of the model under the conditions of the structural equation analysis by not forcing the parameters to be equal at this stage in the analysis, and the chi-square value that does not have significance must be obtained.

2. Variance testing by increasing control of the weight of the component of each group to be equal, in which the results of the analysis differences of the Sig. of the chi-square value must not have significance or not be different, and the difference of the chi-square value between testing 2 and testing 1 must not have any statistically significant degree of independence.

2.1) a detailed summary of the results of the variance testing of the supply chain collaboration model according to the variable of size of the business is shown in Table 2.

Table 2 Summary of the results of variance testing of the supply chain collaboration model according to the variable of size of business

Model testing	χ^2	df	AIC	BIC	P	CFI
1. Prototype model	337.37	299	36686	37286	0.065	0.995
2. Prototype model, control variable	296.77	264	36954	39372	0.095	0.996
Differences of Models 2 and 1	40.606	35	P-value = 0.237			

From the structional equation analysis, Model 1, which is the prototype model, was presented. This is the model that has consistency with the empirical data by the index values χ2, df, RMSEA and CFI being within the acceptable criteria, which indicates the consistency of the model with the empirical data. Also, from testing the differences of the chi-square value with ANOVA, it was found that both models do not have differences.

5. Discussion and Conclusion

The findings can be summarized by stating that the collaborative advantages have the most significant effect on the competiveness, followed by supply chain collaboration and the reduction of supply chain disruption. Also, the finding in this research that has an outstanding feature is the result of the study that indicates that the abovementioned collaboration model can be used with both small and medium-sized businesses due to the results of the implementation of the model not being different.

Supply chain collaboration has an effect on the collaborative advantages and the competiveness due to the components of the collaboration, namely the information sharing, the planning and decision synchronization, the incentive alignments, and the resource sharing. These are regarded as the guidelines that can provide efficiency in the reduction of costs in the supply chain and the quest for high quality products and services as well as enhance the ability to rapidly respond, resulting in the businesses gaining the competitive advantages. However, supply chain collaboration in turn has a significant negative effect on the reduction of supply chain disruption, which is a new finding that differs from the expectations of the researcher, in which the first reason is that entrepreneurs who manufacture automotive parts in SMEs have low bargaining power. This makes their partners who enter the

input factors and the customers that purchase goods possibly not give much importance to the cooperation within the SME businesses due to the low purchasing volume, which means that they are not the main partner of the businesses and the integration of the ERP system, or another system such as informatics, is unable to coordinate smoothly. In addition, the second reason is that the partners of the business do not have sufficient potential or the data that is used in the exchange is not of sufficient quality, for example, the data that is unreliable or is out-of-date. When exchanging this data, it will result in operational errors or delayed production operations. Therefore, excessive reliance on partners may cause businesses to encounter risks that result from the disruptions or the mistakes of their own partners.

For the application of the results of this research study for practical use with regard to policies and implementation, the government sector and related work units should provide support to organizations to determine the policies related to collaboration between partners so as to create network connectivity in the supply chain in a vertical relationship in order to add value and reduce the costs for business groups. This will help to develop the level of the industrial sector and create value that will promote its firm and stable growth. Moreover, entrepreneurs will be able to apply each component of the collaboration model for practical use in the strategic planning of the supply chains of organizations in order to build capacity in the development of those organizations so that they will have strong and sustainable expansion.

6. Limitations and Future Research

In this study, the factors of collaboration in supply chains that were studied were limited to the sharing of information, decision synchronization, the incentive alignments and investments, and the sharing of resources. Thus, it may be possible that there are other variables that can have an effect on the competiveness of companies. As a result, the related research in the future should examine these additional factors of collaboration in the supply chain, such as joint knowledge management, communication with others via technology, etc., in these future research studies.

In addition, the results of the study show that collaboration with partners may have a negative impact on the reduction of disruptions of supply chains due to SME entrepreneurs having the opinion that overly relying on partners may negatively affect the production process if a partner does not perform as agreed. Therefore, the research in the future should conduct a examination of the factors that allow supply chain collaboration to increase stability, such as the creation of trust with partners, in order to achieve the ability to reduce disruptions in the supply chain.

The final limitation is that the sample group used for this study of the automotive parts manufacturing industry may not cover other industries. The research in the future should therefore study the high performance system layout with the sample groups in other industries in order to be able to explain the relationships that cover all industries.

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