Supply chain collaboration and firm performance in Thai automotive and electronics industries

Chawalit Jeenanunta · Yasushi Ueki ·
Thunyalak Visanvetchakij

Published online: 13 December 2013
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Abstract This paper examines factors that encourage firms in Thai automotive and electronics industries to enter into supply chain collaborations (SCCs) and relationships between SCCs and supply chain performance (SCP) using a questionnaire survey in 2012. The results of ordinary least squares regression show that firms that established a supplier evaluation and audit system, a system of rewards for high-performance suppliers and long-term transactions, with their supply chain partners under competitive pressure cooperate more closely with their partners along the supply chain with respect to sharing information and synchronizing decisions. Our two-stage least squares regressions indicate that SCCs that arise from competitive pressure, supplier evaluation and audit, and a system of rewards for high-performance suppliers and long-term relationships influence SCP, including on-time delivery, responsiveness to fast procurement, flexibility to customers' needs, and profit. These findings indicate that Thailand machinery industries have learned globally adopted SCM practices, and invested in tangible and intangible assets to realize potential benefits from costly SCC.

Keywords Supply chain collaboration · Supply chain performance · Automotive · Electronics · Thailand

C. Jeenanunta · T. Visanvetchakij
Sirindhorn International Institute of Technology, Thammasat University, 131 Moo 5, Tiwanont
Road, Bangkadi, Muang Pathum Thani 12000, Thailand
e-mail: chawalit@siit.tu.ac.th

T. Visanvetchakij
e-mail: thunyalakv@gmail.com

Y. Ueki (✉)
Institute of Developing Economies, 3-2-2 Wakaba Mihama, Chiba 261-8545, Japan
e-mail: yasushi_ueki@ide.go.jp

Introduction

Today, manufacturing firms must satisfy customers' needs for quick and on-time delivery of quality products at lower prices, even in unpredictable economic crises and amidst natural disasters. Firms in a supply chain collaborate with their partners in the chain to cope with such challenges in a more efficient way than they could do so individually. Thus, supply chain management (SCM) has been gaining in importance for firms to survive the global competition.

SCM and supply chain collaboration (SCC) are becoming essential for management practices for firms from Southeast Asia and other developing countries where manufacturing industries are agglomerated. Their internally available resources are so limited. Thus, they are dependent on external resources that are accessible through SCCs to achieve product improvements (Machikita and Ueki 2012). Practitioners in Southeast Asia are eager to gain a better understanding of how to participate in supply chains and how to reap benefits from SCCs. However, only a few studies have quantitatively investigated SCM and related practices in Southeast Asia, such as Malaysia (Chong and Ooi 2008; Ooi et al. 2012) and Thailand (Banomyong and Supatn 2011).

This paper examines the factors that encourage firms to enter into SCCs and relationships between SCCs and supply chain performance (SCP) at the firm level using a questionnaire survey within the Thai automotive and electronics industries. The research was conducted between January and February of 2012. Different from the previous studies that have examined direct relationships between factors that promote SCC-like trust among firms and operational or business performance at the firm level (Khan and Pillania 2008), we introduce such SCC factors as instrumental variables (IV). Our two-stage least squares (2SLS) regression model describes the relationship among SCC factors, SCCs, and SCP; and reduces the potential endogeneity bias in the association between SCCs and SCP. Our IV regressions verify that SCCs positively influence SCP, including on-time delivery, fast procurement, flexibility to meet customers' needs, and increasing profit.

This paper is structured as follows. The next section describes testable hypotheses. Then, we explain the dataset and the main variables for the regressions. Next, we present the empirical models and the results. The final section summarizes and discusses the findings.

Collaboration and performance

Formation of SCC

The strategic alliance and supply chain literature has investigated reasons why firms form inter-firm networks (Grandori and Soda 1995). One perspective highlights synergies between resources owned by two independent organizations (Eisenhardt and Schoonhoven 1996). Another important factor relates to transaction costs that prevent firms from obtaining resources efficiently through the market mechanisms (Chen and Chen 2003).

In addition to these structural elements, we must consider what motivates firms to make investments in developing alliances and SCCs. Among several motives, competition has been widely recognized as a fundamental factor to forming collaborations (Stuart 1998; Gimeno 2004). In particular, firms in vulnerable strategic positions are expected to show a higher propensity to form alliances to access additional resources that are indispensable to execute innovative technical strategies or to compete effectively (Eisenhardt and Schoonhoven 1996). For example, Hallgren and Olhager (2009) showed that competitive intensity of industry drives agile and lean manufacturing, which affects operational performance. However, they did not investigate how firms realize agile or lean manufacturing. As agile or lean manufacturing should be combined with a total supply chain strategy (Naylor et al. 1999), we can assume that competition encourages firms to enter into SCCs to improve physical and financial performance.

H1 Competitive pressures stimulate firms to build collaborative relationships.

Meanwhile, excessive competition may push firms to take opportunistic behaviors, especially in arm's length transactions. To avoid potential trouble, buyers may obligate their suppliers to accept audit or evaluation when they enter into agreements. Thus, supplier audit and evaluation can be considered a monitoring mechanism embedded in agreements to assure minimum technical requirements and to promote corporate social and environmental responsibility.

Although supplier audit and evaluation are documented and fed back to suppliers, such a process does not necessarily mean daily exchange of information or collaborations among supply chain partners. Even so, records of a suppliers' performance foster trust between the supplier and buyer (Dyer and Chu 2000), which may result in cooperation between the customer and supplier. For example, Heide and John (1990) found verification efforts significantly increase the level of joint actions in machinery industries. Therefore, we expect a supplier evaluation and audit can be the foundation or motivation for suppliers to form buyer–supplier collaborations.

H2 Supplier evaluation and audit encourage suppliers to enter into SCCs to accomplish customers' requirements.

Formation of SCCs will enable a buyer to give its suppliers competition, especially when the buyer holds a leading position in the supply chain or the suppliers have difficulty switching to new buyers. Such intra-supply chain competition among existing suppliers can motivate the suppliers in the supply chain to make proactive efforts to accomplish the buyer's requirements or to make better improvements than the buyer expects. Although the buyer in a position to lead the supply chain can make use of bargaining power, such a coercive power relationship can negatively affect its suppliers' commitment.

To mitigate such negative effects, the buyer could design a reward system in hopes of eliciting favorable reactions from the suppliers. If the suppliers expect benefits from the reward system, such as a continuous transaction with the buyer, the expected mutual benefits for the buyer and its suppliers will promote collaboration (Zhao et al. 2008).

H3 Reward systems for suppliers stimulate the formation of SCCs.

Although firms with coercive power may force their partners to collaborate in a competitive market, subordinate partnerships can be vulnerable to competition. Firms will take strategic joint actions to reinforce their entire supply chain toward the prospect of continued, trustworthy, and long-term transactional relationships (Heide and John 1990; Tomkins 2001; Prajogo and Olhager 2012). As Yeung et al. (2009) found trust influenced supplier integration in Chinese supply chains. Trust is crucial to effective collaboration among firms. If we assume that length and continuity in customer–supplier relationships fosters trust among supply chain partners (Dyer and Chu 2000), the following hypotheses can be examined.

H4 Long-term relationships stimulate formation of SCCs.

H5 Long-term relationships promote closer SCCs that require intense information exchange and coordination among firms.

Collaboration and performance

Both the SCM and the innovation literature have focused on the effects of inter-firm collaboration along a supply chain on business performance at the firm level. Among the various business performance indicators, firms place more importance on enhancing flexibility to be competitive and profitable and to mitigate risks in uncertain globalized business environments. SCM and SCC are considered key business practices to enhance flexibility.

Empirical evidence exists to support such perspectives. For example, Chen et al. (2004) verified that communication and long-term orientation in strategic purchasing are significantly related to customer responsiveness and financial performance. Sánchez and Pérez (2005) also found a positive relationship between superior performance in flexibility of capabilities and firm performance in Spanish automotive suppliers. Zhou and Benton (2007) illustrated that effective information sharing significantly enhances effective supply chain practices, including supply chain planning, just-in-time production, and delivery practices. As another example, Prajogo and Olhager (2012) found that information sharing significantly affected logistics integration, which influenced operational performance positively. Thus, we postulate that SCC improves flexibility in business management, resulting in increased profits in Thai automotive and electronics companies.

H6 SCCs improve process management.

H7 SCCs improve profits.

Data

Sampling

To examine the hypotheses empirically, we conducted a mail survey of Thai firms in the automotive and electronics industries (the main machinery industries in Thailand) in 2012. The questionnaire we designed included three parts. The first part

consisted of demographic questions, including capital structure, hierarchical position in the industries, the number of employees, etc. The second part related to innovation factors and achievements. The last part asked the respondents about SCCs.

The sampling frame consisted of 558 manufacturers listed by the Thai Auto Parts Manufacturers Association and 1,499 member firms of the Electrical and Electronics Institute. From these 2,057 firms, we selected ten firms for pre-test and an in-depth interview. We also mailed the questionnaire. As a result, we collected 195 valid responses from the 2,057 firms in both industries.

To examine the factors promoting SCCs and the effects of SCCs on operational and business performance exclusively in the automotive and electronics industries, we narrowly defined the observations from these industries by excluding respondents that did not answer the question on their place in the multi-tiered hierarchical production system of these industries. As a result, 160 of the observations were utilized for the econometric analysis.

Table 1 presents the summary statistics for the variables that we used for the econometric analysis. The summary statistics for the characteristics of the respondents, which were included as control variables in the regressions, indicate that the observations are not considerably biased to a specific group of the firms according to the sector, nationality, or size. More than half of the respondents were from the electronics industry. Some 54 % of them produce only electronic parts, components, and final products; 38 % of them manufacture only automotive parts or assembled cars. Only 8 % ship their products to customers in both the automotive and electronics industries. Although these sectors in Thailand are dominated by multinationals, especially Japanese firms, half of the respondents indicated they are wholly Thai-owned indigenous. The remaining half is foreign owned, composed of foreign-owned (27 %) and joint venture (23 %) firms. The firm size in terms of average annual sales in the period of 2007 through 2011 fell into six categories. About 38 % of the respondents were lower middle-sized firms that recorded the sales of 100–499.9 million Thai baht.

Collaboration promotion factors (CPF)

Regarding factors that promote SCCs, the respondents were asked to indicate on a five-point Likert scale their perception that (1) *competition is a factor in seeking innovations*, (2) *supplier evaluation and audit* is a factor that promotes SCCs, and (3) *rewarding high-performance suppliers* is a promotion factor. As an indicator of the level of trust the respondents placed in their supply chain partners, the dummy variable, *collaboration for more than 6 years*, was coded as “1” if they had any form of collaboration with their customers and/or suppliers for 6 years or longer. As shown in Table 1, the mean of the variable *competition is a factor in seeking innovations* is 3.93, which is higher than that of *supplier evaluation and audit* (3.49) and *rewarding high-performance suppliers* (2.73). The table also shows 79.0 % of the respondents had been collaborating for more than 6 years.

Table 1 Summary statistics

Variable	Mean	SD	Min	Max
Supply chain performance				
On-time production and delivery	3.82	0.98	1	5
Responsiveness to fast procurement	3.75	0.97	1	5
More flexibility to customer need	3.70	0.89	1	5
Profit increase	3.58	1.08	1	5
Supply chain collaboration				
Information sharing	12.78	3.55	4	20
Sharing information of manufacturing	3.31	1.05	1	5
Sharing information of warehouse level	3.02	1.02	1	5
Sharing information of processing	3.21	1.01	1	5
Sharing other information with supply chain member	3.23	1.04	1	5
Decision synchronization	13.18	3.91	4	20
Helping to solve operational problems	3.68	1.02	1	5
Making a decision in market planning	3.01	1.16	1	5
Planning to improve and develop product	3.24	1.14	1	5
Planning to improve and develop process	3.25	1.15	1	5
Collaboration promoting factor				
Competition is a factor to seek new innovation	3.93	1.00	1	5
Supplier evaluation and audit	3.46	1.07	1	5
Rewarding high performance suppliers	2.73	1.35	1	5
Collaboration for more than 6 years (dummy)	0.79	0.41	0	1
Company type (dummy)				
Foreign company	0.27	0.44	0	1
Joint venture	0.23	0.42	0	1
Domestic group company	0.11	0.32	0	1
Single domestic company	0.39	0.49	0	1
Average annual sales in 2007–2011 (dummy)				
Less than 50 million THB	0.11	0.32	0	1
50–99.9 million THB	0.19	0.39	0	1
100–499.9 million THB	0.38	0.49	0	1
500–999.9 million THB	0.14	0.35	0	1
1–2.9 billion THB	0.11	0.32	0	1
More than 3 billion THB	0.08	0.26	0	1
Sector (dummy)				
Automotive	0.38	0.49	0	1
Electronics	0.54	0.50	0	1
Both	0.08	0.27	0	1
Observations	160			

Source SIIT Thai Automotive and Electronics Industries Survey 2012

Supply chain collaborations

Varied forms of SCCs exist. In this paper, we focus on (1) *information sharing* and (2) *decision synchronization* with supply chain partners, assuming that the former is a fundamental practice for the respondents to establish a closer cooperation such as the latter.

The variable for *information sharing* is defined as the sum of the scores for the four items related to sharing information on (1) manufacturing, (2) warehouse, (3) processing, and (4) others, all of which were measured on a five-point Likert scale. The variable for *decision synchronization* was calculated in the same manner as *information sharing* by summing the scores for collaborations in (1) solving operational problems, (2) market planning, (3) planning product improvement and development, and (4) planning process improvement and development. The means, as shown in Table 1, for *information sharing* and *decision synchronization* are 12.78 and 13.18, respectively.

Supply chain performance

Four indicators for SCP at the firm level are introduced in this paper. As follows, three are for operational performance and one is for business performance: (1) on-time production and delivery, (2) responsiveness to fast procurement, (3) more flexibility to customers' needs, and (4) profit increases. All of these items were asked using a five-point Likert scale. Table 1 presents the mean for *on-time production and delivery* as 3.82, while that for *profit increases* is 3.58. This implies that improvements in production and delivery through SCCs do not necessarily lead to bigger profits, or there are suppliers that consider SCCs only a burden to secure orders from buyers.

Results

Relationship between collaboration promoting factors and collaboration

Using these variables, we examine the hypotheses by applying econometric approaches. Firstly, we performed the method of ordinary least squares (OLS) to estimate the regression of SCC on CPF, which was formulated as the following Eq. (1).

$$SCC_i = \alpha_1 + \beta_1 * CPF_i + \gamma_1 * x_i + u_i \quad (1)$$

The variables x_i are control variables for attributes of a respondent (i) such as company type, average annual sales in the period of 2007–2011, and sector, all of which are dummy variables.

Table 2 summarizes the result of the estimations. The dependent variable in columns 1–5 is *information sharing*, while that in columns 6–10 is *decision synchronization*. The four collaboration factors are included in the model individually before including all four independent variables as columns 5 and 10.

Table 2 Relationship between collaboration promoting factor and supply chain collaboration

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Information sharing									
Decision synchronization									
Collaboration promoting factor									
Competition is a factor to seek new innovation	1.55*** (0.25)			0.46 (0.29)	1.78*** (0.30)				0.37 (0.33)
Supplier evaluation and audit	1.93*** (0.22)			1.33*** (0.29)		2.40*** (0.23)			1.77*** (0.33)
Rewarding high performance suppliers		1.24*** (0.22)		0.45** (0.22)			1.48*** (0.21)		0.51** (0.21)
Collaboration for more than 6 years			1.70** (0.73)	0.67 (0.54)				2.41*** (0.74)	1.17** (0.56)
Company type	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Average annual sales in 2007–11	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	160	160	160	160	160	160	160	160	160
R-squared	0.253	0.396	0.275	0.105	0.438	0.264	0.481	0.120	0.523
F statistic	6.012***	12.41***	5.953***	1.949**	11.04***	5.719***	13.12***	6.728***	2.915***
									15.15***

Notes Robust standard errors in parentheses

*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$

The CPF are positively significant when included individually. The variables for *competition is a factor to seeking innovations*, *supplier evaluation and audit*, and *rewarding high-performance suppliers* are positively significant at the 1 % level irrespective of the dependent variables. The dummy variable for *collaboration for more than 6 years* is positively significant at the 5 % level when the dependent variable is *information sharing* (column 4) and at the 1 % level for the regression of *decision synchronization* (column 9).

When we regressed *information sharing* on all four variables and the control variables, *supplier evaluation and audit*, as well as *rewarding high-performance suppliers*, are positively significant at the 1 and 5 % levels, respectively (column 5). When *decision synchronization* is regressed on all these independent variables, *supplier evaluation and audit*, as well as *rewarding high-performance suppliers*, are also positively significant at the 1 and 5 % levels, respectively. Moreover, *collaboration for more than 6 years* becomes positively significant at the 5 % level (column 10).

The robustly significant impacts of *supplier evaluation and audit* and *rewarding high-performance suppliers* on the formation of SCCs indicates the design of supplier development and supply chain governance influences firm-level decision making regarding whether parties in a supply chain enter into collaborative relationships with their supply chain partners.

This difference in the significance level for *collaboration for more than 6 years* indicates that more complex inter-firm collaborations involving denser information exchange among the parties in supply chain-like *decision synchronization* are based on trust that would be fostered through long-term supply chain transactions and information exchanges. In contrast, a relatively simple *information exchange* might be necessitated in the standard SCM in these industries or incorporated into contracts closed before firms start business transactions.

Relationship between collaboration and performance (OLS)

To examine the relationship between SCCs and business performance, we use the OLS estimations to regress SCP on SCC formulated as Eq. 2.

$$SCP_i = \alpha_2 + \beta_2 * SCC_i + \gamma_2 * x_i + u_i \quad (2)$$

The control variables x_i are the same as those in the Eq. 1. There are four indicators for SCP, as explained in “[Supply chain performance](#)” section. One of the two indicators for SCCs, which are dependent variables in Eq. 1, is included in the estimation. Columns 1–4 in Table 3 present the results of the OLS estimations when the variable for SCC is *information sharing*, and columns 5–8 summarize the results of the regression of SCP on *decision synchronization*.

Table 3 shows that all the estimated coefficients on SCC are positively significant at the 1 % level. This result indicates a robust relationship between the measures for SCC and SCP. The R-squared values are increased for the regressions of *decision synchronization*, indicating that denser collaborative partnerships along a supply chain will improve firm performance.

Table 3 Effect of supply chain collaboration on supply chain performance (OLS)

	(1) Production and delivery	(2) Procure-ment	(3) Customer need	(4) Profit	(5) Production and delivery	(6) Procure-ment	(7) Customer need	(8) Profit
Supply chain collaboration								
Information sharing	0.12*** (0.02)	0.14*** (0.02)	0.11*** (0.02)	0.13*** (0.02)	0.14*** (0.02)	0.13*** (0.02)	0.11*** (0.02)	0.16*** (0.02)
Decision synchronization	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Company type	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Average annual sales in 2007–11	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	160	160	160	160	160	160	160	160
R-squared	0.26	0.32	0.29	0.26	0.36	0.34	0.32	0.39
F statistic	5.544***	7.184***	5.477***	5.695***	8.111***	8.119***	5.420***	9.418***

Notes Robust standard errors in parentheses

*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$

Table 4 Effect of supply chain collaboration on supply chain performance (2SLS)

	(1) Production and delivery	(2) Procure-ment	(3) Customer need	(4) Profit	(5) Production and delivery	(6) Procure-ment	(7) Customer need	(8) Profit
Supply chain collaboration								
Information sharing	0.25*** (0.04)	0.26*** (0.03)	0.23*** (0.03)	0.29*** (0.04)	0.20*** (0.03)	0.21*** (0.02)	0.18*** (0.03)	0.23*** (0.03)
Decision synchronization								
Company type	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Average annual sales in 2007–11	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	160	160	160	160	160	160	160	160
R-squared	0.046	0.143	0.093	0.031	0.295	0.248	0.215	0.324
Wald chi2	60.34***	101.4***	73.69***	86.49***	85.15***	114.9***	69.97***	120.4***
Tests of endogeneity								
Robust score chi2	13.16***	10.84***	13.19***	13.48***	9.01***	11.54***	13.28***	9.29***
Robust regression F	29.77***	23.37***	26.64***	28.67***	13.44***	19.15***	20.60***	13.12***
Test of overidentifying restrictions								
Score chi2	2.54	3.38	2.92	2.27	3.83	5.73	3.02	4.28
First-stage regression Robust F	22.28	22.28	22.28	22.28	35.96	35.96	35.96	35.96

Notes Instrumented: supply chain collaboration (information sharing, decision synchronization). Instruments: collaboration promoting factor (competition is a factor to seek new innovation, supplier evaluation and audit, rewarding high performance suppliers, collaboration for more than 6 years). Robust standard errors in parentheses

*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$

Relationship between collaboration and performance (2SLS)

Although we assume that more intense SCCs will cause better SCP or the dependent variable for Eq. 2 would not be determined jointly with the independent variable, a firm achieving better performance might be more likely to be selected as a collaboration partner. If the problem of reverse causality exists, variables are omitted, or there is measurement error in the variable for SCC, OLS will yield inconsistent and biased estimates.

To solve this problem of endogenous regressors, we perform 2SLS by running Eq. 1, which is shown in columns 5 and 10 in Table 2 as the first-stage auxiliary regression and running Eq. 2 as the second stage. Thus, in the 2SLS, the IV are the variables for the four collaboration-promoting factors (*competition is a factor in seeking innovations*, *supplier evaluation and audit*, *rewarding high-performance suppliers*, and *collaboration for more than 6 years*) and the instrumented variables are the variables for SCCs (*information sharing* and *decision synchronization*).

All the coefficients for the SCCs were estimated by 2SLS, as shown in Table 4, and are positively significant at the 1 % level. The coefficients that were estimated by 2SLS are larger than the OLS estimators in Table 3 were indicating that the results of OLS are biased. Score tests and regression-based tests of endogeneity reject the null hypothesis that the variables for SCCs are exogenous in all of the eight estimations for the regression of firm performance. The first-stage regression F statistics are larger than 20, indicating that the instruments are not weak (Stock and Yogo 2005). The tests of overidentifying restrictions do not reject the null hypothesis that the IV are valid. These results of post-estimation tests suggest the validity of the 2SLS estimators.

Conclusions

This paper had two objectives. Firstly, we attempted to identify motivations for firms to share information or synchronize decision making with their supply chain partners. Secondly, we examined if SCCs cause better SCP.

Table 2 shows that competitive pressure is significantly correlated with SCCs when the indicator is introduced into the regression individually (columns 1 and 6), but it is not significant when the four independent variables are used for the estimations (columns 5 and 10). The indicators for supplier evaluation and audit and reward system are positively significant at the 1 or 5 % level for all related estimations (columns 2, 3, 5, 7, 8, and 10). Thus, H2 and H3 are robustly supported. The indicator for long-term relationship is significant, as predicted from H4, when the indicator is introduced in the regression individually (columns 4 and 9). However, when the indicator is introduced in the regression model with the three other variables, the variable is significant only when we regressed decision synchronization on it. This differential result between information sharing (column 5 of Table 2) and decision synchronization (column 10) imply that long-term relationships with supply chain partners foster denser information exchange, which facilitates decision synchronization, as assumed in H5. Finally, Tables 3 and 4

provide robust associations between SCCs and SCP. Thus, H6 and H7 are supported.

We conclude that the results of the regressions provide evidence that support the hypotheses we tested. This indicates Thai automotive and electronics industries, of which development has been led by Japanese and Western multinationals, have learned globally adopted SCM practices. However, the relationship between SCC and SCP is not necessarily evident. For example, Flynn et al. (2010) found that neither customer integration nor supplier integration contributed significantly to business performance in Chinese manufacturing. Simple and routine information exchanges with business partner do not always directly contribute to improving operational or business performance (Devaraj et al. 2007). Zhang et al. (2009) found a positive association between buyer communication and suppliers' willingness to invest in technology, and the results of our study indicate that automotive and electronics industries in Thailand have invested in tangible and intangible assets to achieve effective exchanges of information and realize potential benefits from costly information exchanges.

In practice, SCCs between a buyer and a new supplier begin with an evaluation of the supplier's production (including quality, cost, and delivery), financial status, environmental operations, and other items prescribed in the buyer's procurement policy. The buyer conducts a supplier audit periodically to rank its suppliers according to their performance for a specific fiscal period. The buyer can use the scores to decide the volume of orders to be placed with its suppliers in the following fiscal year. High-performing suppliers can obtain a higher volume of orders from the buyer as a reward for their efforts, while the lowest-performing suppliers risk the possibility of losing the buyer's business. The buyer, threatening such penalty and allowing competition among its existing and potential suppliers, at the same time provides low-performing suppliers with training to improve production processes. In addition to the periodic audit, the buyer can conduct an unscheduled audit on randomly selected suppliers, or do so when defective products are shipped. All of these audit and after-audit processes will contribute to process improvements along the supply chain. In tandem with the supplier audit, the buyer holds periodic meetings with its suppliers to exchange information on sales forecasts; production planning; inventory level of raw materials, parts, components, and products; new product and process developments; and so on. Such daily or monthly information sharing also enables firms in the supply chain to improve operational performances.

It should be emphasized that these buyer–supplier relationships within the supply chain are not one time only. Although the buyer requires the suppliers to achieve a certain percentage of continuous cost reduction while fulfilling other requirements, their constant interactions under the demanding audit and reward system foster mutual understanding and build confidence among firms involved in the supply chain. These may result in facilitating complex collaborations that require decision synchronization along the supply chain and in creating operational and financial benefits.

The empirical findings from this paper imply that lead firms, as well as international first-tier suppliers in the automotive and electronics industries, make a strategic combination of supplier audit, reward system, and competitive pressure

among suppliers to optimize their supply chain operations and maximize profits. This situation is beneficial not only for lead firms, but also for lower-tier suppliers. Even though suppliers are under heavy pressure from their buyers to achieve continuous improvements, the latter also provides the former with technical assistance, training, and knowledge and skills necessary for achieving internationally competitive technical, operational, and managerial standards. SCCs can function as training schools for suppliers. This aspect of an international supply chain is important for firms in developing countries without competent trainers in their educational systems. Suppliers in developing countries will be able to learn by producing goods in an international supply chain, so that it will be worth making investments necessary for educable and potentially capable suppliers to enter into a global supply chain at any cost.

While our study contributes considerably to the SCM literature, especially for Southeast Asia, there are some limitations. Firstly, as our study uses cross-sectional data, we must further investigate the causal relationships between factors that encourage firms to collaborate with their partners, SCC, and performance. Secondly, we did not explore key differences in SCM between the automotive and electronics industries. These are opportunities for future research.

Acknowledgments This work was supported in part by Grants-in-Aid for Scientific Research (B) (no. 25380559) from the Ministry of Education, Culture, Sports, Science, and Technology of Japan. We would like to express our gratitude to Tomohiro Machikita for useful comments. All errors are our own. The views expressed in this paper are those of the authors and do not necessarily reflect the views of the organizations involved.

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