THESISES OF THE DOCTORAL (PhD) DISSERTATION

THE SIGNIFICANCE OF SHARING INFORMATION ON THE PERFORMANCE OF THE SUPPLY CHAIN AND THE VALUE OF INFORMATION SHARING FACTORS

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1. INTRODUCTION, OBJECTIVE, AND HYPOTHESIS DEVELOPMENT

Supply chain performance (SCPerf) is described by the extended activities of the supply chain to satisfy customers' requirements (Beamon, 1999). According to Afum et al. (2019), the performance of the supply chain is defined by the efficiency and effectiveness of the enterprise's entire supply chain (Afum et al., 2019; Sillanpää, 2015). It measures the outcomes of dimensions in an organization, including flexibility, quality, and the efficiency of improved processes (Voss et al., 1997).

Supply chain integration (SCIntg), supply chain collaboration (SCCol), and supply chain flexibility (SCFlex) are the main activities affecting the improvement of the performance of the supply chain (SCPerfIAs). SCIntg is known as the process integration in the supply chain (Hsin Hsin Chang et al., 2013). These processes connect the activities between an individual and its partners such as suppliers and customers in the supply chain (Hau L Lee & Whang, 2004; Näslund & Hulthen, 2012; Tan, 2001; David Zhengwen Zhang et al., 2006). SCCol is referred to as a connection between at least two individuals who work together with the same objectives such as gaining competition and getting higher profits (Simatupang & Sridharan, 2002). Responsibilities are shared between the companies participating in supply chain collaboration (Anthony, 2000). SCFlex is the supply chain's ability to respond quickly to market changes. Rapid responsiveness of the supply chain reflects the agility of both inside and outside of each company (Swafford et al., 2008). In the internal of an organization, flexibility reflects the dynamics of how a job is done and job completion time. In the external of an organization, the strong connection of each firm with its key suppliers and customers increases the success of rapid responsiveness and reduces potential and actual disruptions (Braunscheidel & Suresh, 2009).

Information sharing (IShar) is an information-sharing activity where high-quality information is exchanged between partners in the supply chain (Gang Li et al., 2006). According to Min et al. (2005), IShar seems to be a source of connectivity in the supply chain (Min et al., 2005). The connection is created by exchanging information supporting the activities of supply chain performance (SCPerfIAs) and supply chain performance (SCPerf). Particularly, IShar increases effective communication among supply chain members (Sundram et al., 2016). This not only increases collaboration but also increases

supply chain integration (Morash & Clinton, 1997). The exchanging information helps individuals understand their customer's needs and behaviour. As a result, individuals may actively plan to respond to the change in markets and customers' needs quickly (Shore, 2001). Therefore, IShar seems to be one of the key elements that help to increase resource utilization and productivity, as well as the quick response, contributing to the improvement of supply chain performance (Jauhari, 2009; Mourtzis, 2011; Tung-Mou Yang & Maxwell, 2011). However, some previous studies provide that it is not sufficient to confirm the effect of IShar on SCPerfIAs and SCPerf. For example, Kang & Moon (2015) reject the effect of IShar on SCPerf (Kang & Moon, 2015). Dwaikat et al (2018) point out that sharing information about inventory is not an important factor in increasing delivery flexibility (Dwaikat et al., 2018). Şahin & Topal (2019) present that the relationship between IShar and SCFlex is not supported (Hasan Şahin & Topal, 2019). Siyu Li et al. (2019) reject the impact of IShar on SCCol (Siyu Li et al., 2019). In some cases, some other studies indicate the effect of IShar on SCPerfIAs and SCPerf through mediators. For example, Chang et al. (2013) indicate that SCPerf is influenced by IShar through SCIntg (Hsin Hsin Chang et al., 2013). Therefore, the question is whether the exchanging of information has an influence on SCPerf and SCPerfIAs, and how strong is the impact? What are the relationships between IShar, SCPerf, and SCPerfIAs? What are mediators in the relationships between IShar and SCPerfIAs, between IShar and SCPerf, and between SCPerfIAs and SCPerf.

In another aspect, information transfer among members in the supply chain is affected by four main factors including information technology (InfT), trust (Trust), commitment (Comt), and environmental uncertainty (EnU). These factors' influence is confirmed by previous studies. Omar et al. (2010) confirm that technology has a positive impact on IShar (Omar et al., 2010). Technology linkage will help information flows to be transferred between supply chain partners efficiently (Newcomer & Caudle, 1991), and information flow is interrupted because of poor technology (Hoffman & Mehra, 2000). In addition, technical support may not be effective if each company is not willing to exchange information (Fawcett et al., 2009). Willingness to share information is used to refer to the attitude of exchanging necessary information with partners in an honest, enthusiastic, and trustworthy manner (Fawcett et al., 2007). According to Zaheer & Trkman (2017) and Wu et al. (2014), Trust and Comt are two key elements in the willingness for information transfer

(Wu et al., 2014; Zaheer & Trkman, 2017). The term trust is used to refer to the perceived reliability and honesty between partners (Erdogan & Çemberci, 2018). Comt represents the desire of individuals in a business relationship through a guarantee or agreement, promoting a lasting relationship (Hwee Khei Lee & Fernando, 2015). Finally, Şahin, & Topal (2019) indicate the impact of EnU on IShar (Hasan Şahin & Topal, 2019). EnU describes the difficulties of accurately predicting the future such as competitive uncertainty, changing technology, fluctuating demand, and supplier and customer uncertainty (Gupta & Wilemon, 1990). By contrast, some previous studies such as Jengchung V Chen et al. (2011); Üstündağ & Ungan (2020); Zhong et al. (2020), and so on also provide the rejection of hypotheses related to the impact of Comt, Trust, InfT, and EnU on IShar (Jengchung V Chen et al., 2011; Üstündağ & Ungan, 2020; Zhong et al., 2020). From there, a question arises whether the factors considered have an effect on IShar? How strongly do the factors consider influence IShar?

Based on the research questions, this study is formed to examine the connections between information sharing (IShar) and supply chain performance (SCPerf), between IShar and the activities of supply chain performance (SCPerfIAs) including supply chain integration (SCIntg), supply chain collaboration (SCCol), and supply chain flexibility (SCFlex), between SCPerfIAs and SCPerf, between IShar's factors and IShar, and between the factors of IShar. The aims of this research are to confirm the effect of IShar on SCPerfIAs and SCPerf and the impact of IShar's factors. Simultaneously, this research purposes to form the structure of the relationships between IShar, SCPerf, and SCPerfIAs and the structural relationships between IShar and the factors of IShar. Furthermore, it also is to evaluate the degree of the effect of IShar on SCPerfIAs and SCPer and the impact of each factor on IShar. From that, decision-makers can prioritize between activities/factors to consider and choose which activities/factors need to be taken to improve their IShar and SCPerf. Meta-analysis (MA) and Meta-analytic structural equation modeling (MASEM) are used in this study. MA is used to quantitatively study solutions by summarizing, analysing, and comparing results from the literature. MA is used to test the connections between two activities/factors. MASEM refers to the model merging MA and SEM. Hence, this method can reduce the limitations of both MA and SEM. Based on the results of MA, MASEM is used to determine the structure of the connections between activities/factors. In this study,

analysis models are computed by using correlation coefficients. These coefficients are gathered from 101 previous publications with a total of 23580 observations. Our results reaffirm the correlation between IShar and factors, the role of IShar on the supply chain activities and performance, especially on SCIntg and SCCol, and the positive impact of factors on the effectiveness of sharing information. The findings also suggest a dominant role for commitment (Comt) over trust (Trust), information technology (InfT), and environmental uncertainty (EnU) in information exchange. The conclusions in this study add value to the literature on the scope of information exchange in the supply chain. In addition, our study also highlights the appearance of many other activities/factors influencing IShar, SCIntg, SCCol, SCFlex, and SCPerf besides considered activities/factors.

The main objectives

1. To examine the correlation between activities/factors considered in this study
2. To identify the structure of the relationships in the set of IShar, SCPerf, and SCPerfIAs and the relationships in the set of IShar and the factors of IShar
3. To accurately determine the degree of the effect of IShar on SCPerf through:
   - Measuring the direct effect of IShar on SCPerf
   - Measuring the impact of IShar on SCPerfIAs including SCIntg, SCCol, and SCFlex
   - Measuring the influence of SCPerfIAs on SCPerf
4. To accurately evaluate the accurate influence of factors such as Comt, InfT, Trust, and EnU on IShar in the supply chain
5. Propose the key activities/factors for improving SCPerf and IShar, as well as the activities that should be prioritized for improvement of SCPerf and IShar

Hypothesis development

Two main hypotheses are tested in this study. First of all, the importance of information sharing (IShar) for the performance of the supply chain (SCPerf) is considered. The connection between IShar and SCPerf is described by the direct influence of IShar on SCPerf and the indirect impact of IShar on SCPerf through the activities of supply chain performance (SCPerfIAs). As a result, the connection between IShar and SCPerfIAs is determined. In addition, the study also examined the impact of components of SCPerfIAs on SCPerf. SCPerfIAs include SCIntg, SCFlex, and SCCol. The second main hypothesis is

that the influence of IShar's factors on IShar is also examined. The factors of IShar are trust (Trust), commitment (Comt), information technology (InfT), and environmental uncertainty (EnU). Therefore, the connection between each factor and IShar is evaluated. Finally, the relationships between information-sharing factors are presented. The research hypotheses are presented in Table 1.

Table 1: Hypothesis development

Hypothesis	Supporting literature
HI: There is a strong influence of IShar on SCPerf	
H1: SCPerf is directly affected by IShar	Sundram et al., (2020); Wai-Peng Wong et al., (2020); Zhong et al., (2020); Al-Doori, (2019); Swain & Cao, (2019); Thaiprayoon et al., (2019); Nugraha & Hakimah, (2019); Jermsittiparsert & Rungsrisawat, (2019)
H2: IShar strongly impacts SCIntg	Kong et al., (2021); Sundram et al., (2020); Sundram et al., (2018); Kang & Moon, (2016); Prajogo & Olhager, (2012); Koçoğlu et al., (2011)
H3: IShar strongly improves SCFlex	Hasibuan et al., (2020); Kim & Chai, (2017); Bargshady et al., (2016); Ye & Wang, (2013); Tarafdar & Qrunfleh, (2017); Huo et al., (2021)
H4: SCCol is strongly influenced by IShar	Hasibuan et al., (2020); Hove-Sibanda & Pooe, (2018); Dubey et al., (2018); Afshan et al., (2018); Panahifar et al., (2018); Brandon-Jones et al., (2014); Baihaqi & Sohal, (2013); Jao-Hong Cheng, (2011); Olorunniwo & Li, (2010)
H5: SCCol has a strong relationship with SCIntg	Yang Cheng et al., (2016); Ralston et al., (2015); Adams et al., (2014); Mubarik & Mubarak, (2020); Liu & Lee, (2018)
H6: SCCol has a strong relationship with SCFlex	Cirtita & Glaser-Segura, (2012); Mandal et al., (2016); Chan et al., (2017); Attia, (2016); Kumar et al., (2017); Chowdhury et al., (2019); Chan et al., (2012)
H7: SCCol directly influences SCPerf	Chowdhury et al., (2019); Hove-Sibanda & Pooe, (2018); Ju et al., (2016); Panahifar et al., (2018); Umam & Sommanawat, (2019); Yim & Leem, (2013)
H8: SCPerf is strongly impacted by SCIntg	Sundram et al., (2016); Phan et al., (2020); Huo, (2012); Woojung Chang et al., (2016); Christina WY Wong et al., (2015); Rajaguru & Matanda, (2019); Chen et al., (2019)
H9: SCPerf is strongly impacted by SCFlex	Liao et al., (2010); Chowdhury et al., (2019); Attia, (2016); Hsin Hsin Chang et al., (2019); Ibrahim &

Hypothesis	Supporting literature
	Ogunyemi, (2012); Vanpoucke et al., (2017); Christina WY Wong et al., (2017)
HII: IShar is strongly impacted by the factors of IShar	
H10: Comt directly affects IShar	Fu et al., (2017); Wu et al., (2014); Jia et al., (2014); Zailani et al., (2014); Zhong et al., (2020)
H11: Trust is strongly impacted by trust	Christina WY Wong, (2013); Vijayasarathy, (2010); Wu et al., (2014); Chowdhury et al., (2019); Yim & Leem, (2013); Lee & Fernando, (2015); Afshan et al., (2018)
H12: Comt has a strong correlation with InfT	Huo et al., (2015); Attia, (2016); Zailani et al., (2014); Zaheer & Trkman, (2017); Somjai & Jermsittiparsert, (2019); Idris & Mohezar, (2019);
H13: Trust has a strong effect on IShar	Zhong et al., (2020); Khan et al., (2018); Panahifar et al., (2018); Fu et al., (2017); Kulangara et al., (2016); Wu et al., (2014); Yina Li et al., (2014)
H14: InfT directly influences IShar	Sundram et al., (2020); Wai-Peng Wong et al., (2020); Fernando et al., (2020); Hendy Tannady et al., (2020); Kang & Moon, (2016); Zailani et al., (2014); Ye & Wang, (2013); Baihaqi & Sohal, (2013); Zelbst et al., (2012)
H15: InfT is strongly correlated EnU	Yunus & Tadisina, (2016); Ganbold & Matsui, (2017); Boon-itt & Wong, (2011); Wang et al., (2014); Erdogan & Çemberci, (2018); Abdelkader & Abed, (2016)
H16: EnU strongly affects IShar	Üstündağ & Ungan, (2020); Şahin & Topal, (2019); Siyu Li et al., (2019); Khan et al., (2018); Wiengarten & Longoni, (2018); Jia et al., (2014)

Source: Own study (2021)

The effect and linkages between IShar, SCPerf, SCPerfIAs, and the factors of IShar are theoretically modeled in three situations, which are shown in Figure 1. In Figure 1, situation 1 describes the hypothesis tests between two factors/activities. Then, based on the results of situation 1, the structures in situations 2 and 3 are formed. Structure 2 presents the complex relationships in the set of IShar, SCPerf, and SCPerfIAs. Structure 3 shows the relationships in the set of IShar and the factors of IShar.

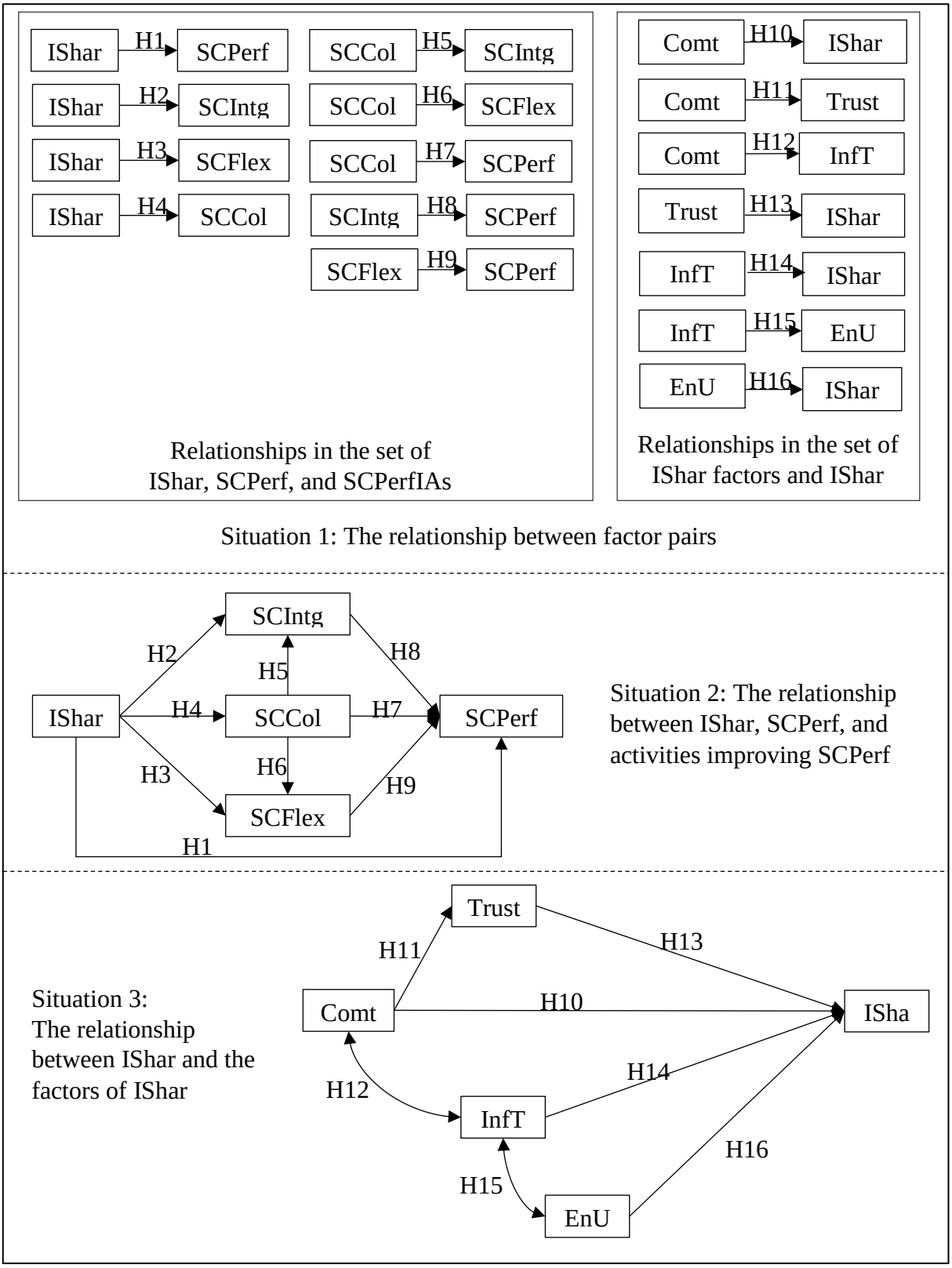


Figure 1: Concept models

Source: Own study (2021)

2. RESEARCH METHODS

Meta-analysis (MA) and meta-analytic structural equation modeling (MASEM) are used in this study. In which, MA is used to determine the relationship between two factors while the relationships among more than two factors are performed by MASEM.

2.1. Meta-analysis (MA)

The process of MA is started by transforming the values of Pearson's into Fisher's z scale. This step is performed due to the non-normal distribution of Pearson's (Quintana, 2015). Then, the specification of the MA model needs to be done before beginning further meta-analysis. The fixed-effect model and random-effect model are two main candidates for specifying the MA model. The difference between these two models is described by their assumptions of study homogeneity. The fixed-effect model assumption shows that the true effect size is unchanged in all studies. Under the random-effect model, the true effect size is assumed to be normal distribution and the effect size of each study is distributed about the average value of all true effect sizes (Borenstein et al., 2021; Cheung, 2015). The final step of the meta-analytic calculations is is to convert Fisher's z's back to Pearson's to report the average correlation and 95% CI.

To distinguish the MA model as a fixed-effect model or a random-effect model, the study heterogeneity is tested by the calculation of Q-statistic, I^2, and tau-squared (T^2). First of all, Q-statistic is the percentage of the overall heterogeneity that can be assigned to the true variation between studies (Quintana, 2015). The values of 0.1 or 0.05 are used as the criterion of statistical significance. Therefore, if the p-value is less than 0.1 or 0.05, the null hypothesis will be rejected. This indicates that all studies do not have the same effects (Higgins et al., 2003). Secondly, the I^2 statistic is likely to be due to actual differences in effect size, not to variance in studies (Borenstein et al., 2021). I^2 scale ranges from 0 to 100%, where the order of 25% is equivalent to the low, 50% is moderate, and 75% is the high (Higgins et al., 2003). Compared to Q-statistic, I^2-statistic has more advantages. The number of studies cannot directly influence the results of I^2 in the analysis, and confidence intervals (CIs) can also be calculated (Higgins et al., 2003; Quintana, 2015). Last but not least, the T^2 test is also used to estimate whether or not the heterogeneity in the studies

according to random-effects models (Hunter & Schmidt, 2004). The value of T^2 is equal to zero, which indicates no heterogeneity.

Besides using Q-statistic, I^2-statistic, and T^2 for testing heterogeneity, the Baujat plot and forest plot are also used to describe the disproportionate influence of studies on heterogeneity and the visualization of effect sizes and confidence intervals (CIs), respectively. Baujat plot indicates the excessive contributions of studies to heterogeneity and overall outcomes. In the Baujat plot, the horizontal axis represents study heterogeneity, and the vertical axis describes the effect of a study on the general outcome. If any of the studies are in the top right quadrant of the Baujat plot, their contribution is the most to the factors considered (Baujat et al., 2002).

Another important task of performing MA is the bias tests of selected publications. Publication bias is the phenomenon whereby studies with stronger effect sizes are more likely to be published and subsequently included in MA. The bias tests are applied, including a funnel plot, RCT, and ERT. Firstly, the funnel plot visually depicts the dispersion of individual studies. From this, the adversarial shape of the set of individual studies is estimated (Sterne & Harbord, 2004; Sterne et al., 2011). According to Egger et al. (1997), however, although potential publication bias may be visualized by the funnel plot, their explanations are subjective. Furthermore, the presence of asymmetry can come from various biases such as research quality, study size, or location bias (Egger et al., 1997). As a result, RCT and ERT are proposed to measure objectively publication bias (Borenstein et al., 2021). Both RCT and ERT are to evaluate the connection between effect estimates and sampling variances (Sterne et al., 2000). In these two tests, if the p-value is greater than or equal to 0.05, the funnel plot is symmetric; otherwise, it is not symmetrica (Begg & Mazumdar, 1994). ERT test is more suitable than the rank correlation test for smaller MA (not greater than 25 studies). In ERT, the funnel plot is non-symmetry when the p-value is less than 0.05 (Egger et al., 1997).

2.2. Meta-analytic structural equation modeling (MASEM)

MASEM is a combination of two research methods, including MA and structural equation modeling (SEM) (Budsankom et al., 2015). The process of performing MASEM includes four steps (Figure 2).

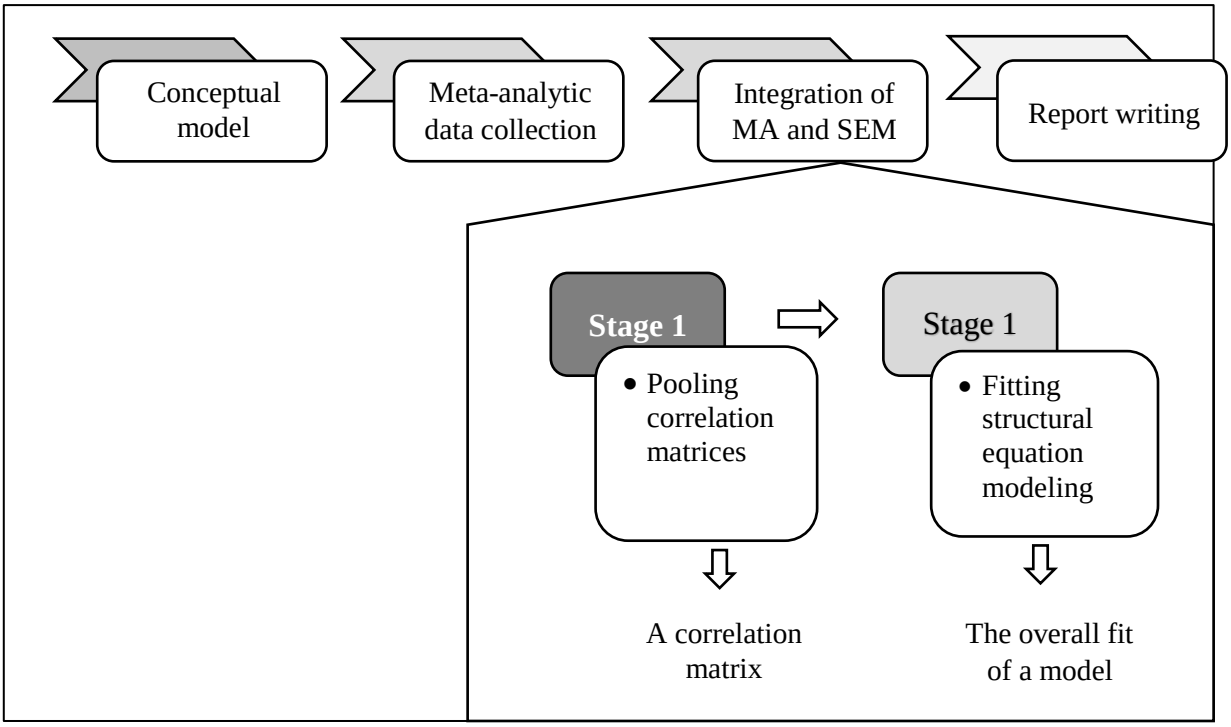


Figure 2: Process of performing meta-analytic structural equation modeling

Source: Own research (2021)

Step 1 is the conceptual model, and step 2 is the meta-analytic data collection. Both steps 1 and 2 are similarly performed as in the meta-analysis process. Then, integration of MA and SEM is the next step. Step 3 consists of two stages, including 1) pooling correlation matrices to a correlation matrix and 2) fitting structural equation modeling based on the pooled correlation matrix in stage 1. The final step is to write a report. In step 3, there are some indicators that need to be focused on, as follows:

- The ratio between Chi-Square χ^2 and df . This ratio is good and acceptable if it is less than 5 and 3, respectively.
- Root Mean square Error of approximation (RMSEA) is good if it is less than 0.07, is moderate if it lies between 0.07 and 0.1. By contrast, RMSEA is bad
- Non-Normed-fit index (Tucker-Lewis) (TLI) is good and acceptable if it is greater than 0.95 and 0.08, respectively
- Comparative fit index (CFI) is good and acceptable if it is greater than 0.95 and 0.09, respectively

3. MAIN FINDINGS OF THE DISSERTATION

3.1. The results of selecting publications

In this study, the publication selection process is performed based on the flow diagram of PRISMA 2020 (Page et al., 2021). This process includes three stages (Figure 3) that are identification, screening, and included.

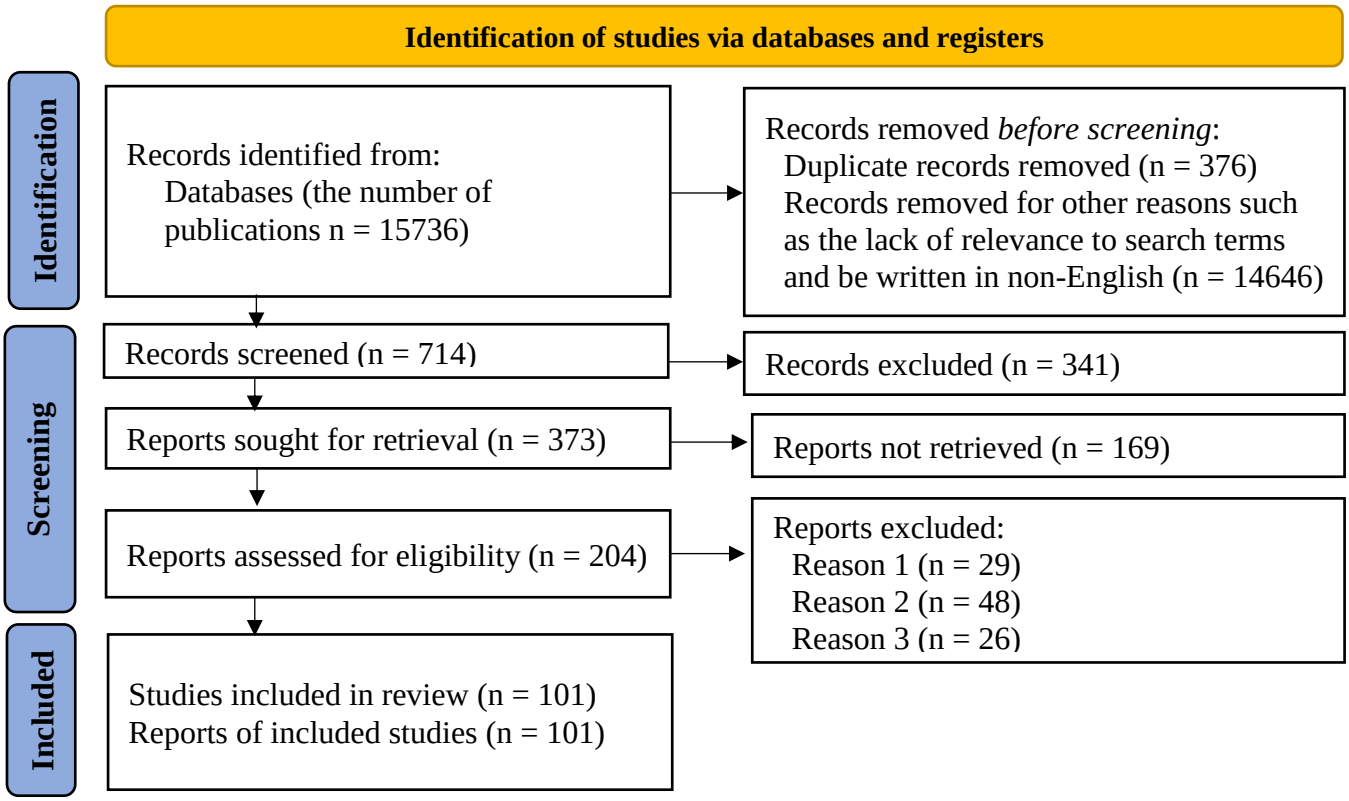


Figure 3: Publication selections

Source: PRISMA 2020 flow diagram (Page et al., 2021)

First of all, there are 15736 results found from a database on Google Scholar. In which, 376 results are duplicated and 14646 results lack relevance to our search terms or are written in a non-English language. As a result, 714 results are selected to continue the process of finding suitable publications. Next, 341 results are removed because they do not match our research field, or they only show the abstract and do not allow readers to download the full publication. Then, the abstracts of 373 articles are reviewed. Due to lacking connection with the requirements of a quality abstract or our research topic, 169 abstracts are gotten rid of 373 results. After that, the full articles of 204 remaining results are carefully reviewed, of which there are 103 results removed. Particularly, 29 items are removed because of lacking a description of the sample size. 48 results do not provide correlation coefficients. Both

sample size and correlation coefficients are missed in 26 results. Finally, 101 selections are found that adapt all requirements related to the research field, research topic, language, and necessary data. These 101 publications are used for calculation and further analyses in this study.

After selecting publications, the analysis and test of data are performed. Table 2 describes the summary of data collection, the heterogeneity of studies, publication bias tests, and the reliability of data. First of all, data are collected from previous studies belonging to the same field as our study. The studies included in the meta-analysis varied widely in sample sizes ranging from 939 to 9065. The obtained correlation coefficients of each relationship are in different ranges. For example, the correlation coefficients of the relationship between IShar and SCPerf range between -0.17 and 0.87. Another is the heterogeneity of studies. Testing the heterogeneity of studies is to determine the suitability of data with the fixed-effects model or a random-effects model. From that, a suitable model is selected for further analyses in this study. Q-statistic and I^2 are the main two indicators to determine the heterogeneity of studies in this study. The range of Q-statistic is from 23.2 to 788.8 and all of the p values for each Q-statistic is less than 0.001. In addition, all of the values of I^2 are greater than 75%. These indicate that the null hypothesis is rejected when 0.05 is the criterion for statistical significance. As a result, it is certain that heterogeneity may exist. Therefore, the random-effects model suits our analysis. Finally, the results of testing publication bias show that all of the p values of both two methods (ERT and RCT) are larger than 0.05. This means that publication bias does not exist in this study. In addition, the fail-safe number is computed. For each hypothesis, the fail-safe numbers differ from the sample size. For example, the sample size in the relationship between information sharing and supply chain performance is 9065 while the fail-safe number is 34085. Therefore, the reliability of the number of articles is determined.

Table 2: Summary of data collection and heterogeneity and publication bias tests

Relationship	Collected data				Heterogeneity			Publication bias		Fail-safe N
	k	N	r_{min}	r_{max}	Q	p-value	I^2 (%)	RCT (p)	ERT (p)	
IShar - SCPerf	44	9065	-0.17	0.87	788.8	p < 0.0001	94.9	0.19	0.99	34085
IShar - SCFlex	16	3919	-0.21	0.76	451.8	p < 0.0001	95.7	0.69	0.76	4326
IShar - SCCol	21	5410	0.22	0.90	407.4	p < 0.0001	95.3	0.19	0.39	22774
IShar - SCIntg	15	2885	0.26	0.84	203.1	p < 0.0001	92.2	0.25	0.12	6511
SCCol - SCIntg	7	1874	0.39	0.85	131.6	p < 0.0001	95.9	0.56	0.36	3098
SCCol - SCFlex	10	2522	-0.29	0.77	517.2	p < 0.0001	98.1	1.00	0.70	2122
SCCol-SCPerf	22	5146	0.02	0.91	699.8	p < 0.0001	96.7	0.18	0.33	13045
SCIntg - SCPerf	30	6699	0.09	0.87	631.6	p < 0.0001	96.2	0.12	0.28	19200
SCFlex - SCPerf	17	3601	0.18	0.91	413.2	p < 0.0001	95.0	0.48	0.16	8393
Comt - IShar	17	3793	0.09	0.82	337.9	p < 0.0001	95.1	0.17	0.22	5966
Comt - Trust	11	2811	0.22	0.72	156.0	p < 0.0001	93.6	0.22	0.16	3840
Comt - InfT	8	2041	0.06	0.73	156.2	p < 0.0001	95.9	0.37	0.55	857
Trust - IShar	22	5490	0.15	0.74	213.2	p < 0.0001	89.9	0.16	0.53	10181
InfT - IShar	21	4585	0.2	0.86	361.2	p < 0.0001	94.7	0.20	0.43	8794
InfT - EnU	4	939	-0.03	0.33	23.2	p < 0.0001	87.4	0.75	0.99	26
EnU - IShar	9	2132	-0.12	0.42	67.7	p < 0.0001	86.5	0.61	0.36	156

Source: Own research (2021)

3.2. The results of testing the relationship between the pairs of factors

3.2.1. The relationships in a set of IShar, SCPerf, and SCPerfIAs

Supply chain performance (SCPerf) reflects the entire capacity and capabilities of the supply chain (Afum et al., 2019; de Treville & Vanderhaeghe, 2003; Sillanpää, 2015). Supply chain flexibility (SCFlex), supply chain integration (SCIntg), and supply chain collaboration (SCCol) are referred to as the main elements significantly affecting SCPerf (Ataseven & Nair, 2017; Huam et al., 2011; Leuschner et al., 2013; Mandal et al., 2016; Umam & Sommanawat, 2019). IShar is one of the elements to create the connection between activities in the supply chain (Omar et al., 2010) and significantly contributes to increasing the performance of the supply chain (Rajaguru & Matanda, 2013). Thus, it is necessary to examine the relationships in the set of IShar and both the activities and performance of the supply chain. This is described by nine hypotheses from H1 to H9. The results of the relationships are clearly presented by the summary estimate of the correlation (Table 3).

Table 3: Summary of relationship between factors

Model	Hypothesis	k	N	Model results					
				r_c	CI.LB	CI.UB	SE	zval	p-value
1	H1: IShar ➔SCPerf	44	9065	0.51	0.42	0.60	0.05	10.8	p < 0.0001***
2	H2: IShar ➔SCFlex	16	3919	0.46	0.30	0.61	0.08	5.8	p < 0.0001***
3	H3: IShar ➔SCCol	21	5410	0.76	0.63	0.88	0.06	11.9	p < 0.0001***
4	H4: IShar ➔SCIntg	15	2885	0.69	0.56	0.83	0.07	10.1	p < 0.0001***
5	H5: SCCol ➔ SCIntg	7	1874	0.86	0.63	1.10	0.12	7.27	p < 0.0001***
6	H6: SCCol ➔ SCFlex	10	2522	0.48	0.20	0.77	0.15	3.30	p < 0.0001***
7	H7: SCCol ➔ SCPerf	22	5146	0.60	0.44	0.75	0.08	7.65	p < 0.0001***
8	H8: SCIntg ➔ SCPerf	30	6699	0.56	0.43	0.68	0.06	8.76	p < 0.0001***
9	H9: SCFlex ➔ SCPerf	17	3601	0.61	0.46	0.75	0.08	8.06	p < 0.0001***

*Source: Own research (2021). Note: ***p-value < 0.001, k is the amount of research, N is the number of sample size, r_c - the corrected correlation were computed (Hunter & Schmidt, 2004), (CI.LB, CI.UB) is confidence interval, SE is standard error, and zval is z-value*

In Table 3, there are some indicators of models such as k, N, CI.LB and CI.UB, SE, z-value, and p-value. In particular, k represents the number of studies, N is the sample size and the range between CI.LB and CI.UB is a confidence interval, SE is the standard error, and z-value and p-value. In nine models, although there is a difference in the number of studies and sample size between models, the variability of studies is quite low. Hence, the confidence interval and standard error of models are low. This indicates that sample means are closely distributed around the population mean. It is undoubted that the sample is representative of the population.

The indicators of models in Table 3 describe the difference in the degree of relationships. First of all, the effect of IShar on SCPerf is examined firstly because the entire strength and weakness of the supply chain are represented by SCPerf (Afum et al., 2019; de Treville & Vanderhaeghe, 2003; Sillanpää, 2015). The corrected correlation between IShar and SCPerf was 0.5 and the 99% credibility interval for the population correlation of IShar and SCPerf is [0.42, 0.58]. This result implies that assuming effect size correlations have a normal distribution, 99% of the values in the population correlation distribution are within the credibility interval (Hunter & Schmidt, 2004). The results provide further evidence for a positive correlation between information sharing (IShar) and SCPerf since 0 is not included in the credibility interval. As a result, it is undoubted that we conclude there is support for H1 – SCPerf is directly affected by IShar. Next, the relationships between IShar and SCFlex,

SCIntg, and SCCol are tested in turn. Similar to the result of SCPerf, IShar has a significant correlation with all three activities improving the performance of the supply chain. Their values of correlations lie on 99% confidence intervals excluded zero and negative values. Hence, hypotheses including H2, H3, and H4 are supported. IShar positively affects the flexibility, integration, and collaboration of the supply chain. Furthermore, the relationships between SCPerf and SCPerfIAs, between SCPerfIAs with each other are also examined in this study. The results show that H5, H6, H7, H8, and H9 are accepted at a p-value < 0.0001.

These results of testing H1 to H9 are consistent with previous studies' findings. For example, Hsin Hsin Chang et al. (2019) indicate that IShar directly affects SCPerf by reducing the bullwhip effect (Hsin Hsin Chang et al., 2019). According to Lummus et al (2005), IShar plays a key role in improving flexibility in the supply chain (Lummus* et al., 2005). Thanks to IShar, flexibility in production and distribution is increased to react quickly to changing market conditions (Long Wu et al., 2014). Fawcett et al. (2011) demonstrate that SCCol is directly enhanced by IShar (Fawcett et al., 2011). However, our study's results are contrary to the findings of some studies. For instance, Lin et al. (2010) indicated that the effect of SCIntg on SCPerf was not statistically significant (Lin et al., 2010). Tutuhatunewa et al. (2019) show that the effect of IShar on SCPerf is rejected with a p-value of 0.188 (Tutuhatunewa et al., 2019). Seo et al. (2014) concluded that there is no effect of customer integration on SCPerf (Seo et al., 2014). Chowdhury et al. (2019) results that there is a correlation between SCCol and SCPerf (Chowdhury et al., 2019).

3.2.2. The relationships in the set of IShar's factors and IShar

Based on the findings of many previous studies, commitment (Comt), trust (Trust), information technology (InfT), and environmental uncertainty (EnU) are four key factors significantly impacting information sharing (IShar). To examine the effect of these four factors on IShar and the relationships between the factors of IShar with each other, seven hypotheses are tested, including Comt directly affects IShar (H10), Trust is strongly impacted by Comt (H11), Comt has a strong correlation with InfT (H12), Trust has a strong effect on IShar (H13), InfT directly influences IShar (H14), InfT strongly affects EnU (H15), and EnU strongly affects IShar (H16). The results of the examination are shown in Table 4.

Table 4 shows the indicators of models, including k represents the number of studies, N is the sample size and the range between CI.LB and CI.UB is a confidence interval, SE is the standard error, and z-value and p-value. The variability of studies is different among the 7 models. In general, all seven models have low standard errors. This indicates that sample means are closely distributed around the population mean. It is undoubted that the sample is representative of the population.

Table 4: Summary of the relationship between four factors and IShar

Model	Hypothesis	k	N	Model results					
				r_c	CI.LB	CI.UB	SE	zval	p-value
10	H10:Comt ➔ IShar	17	3793	0.54	0.40	0.69	0.07	7.3	p < 0.0001***
11	H11 Comt ➔ Trust	11	2811	0.62	0.47	0.76	0.08	8.1	p < 0.0001***
12	H12: Comt ➔ InfT	8	2041	0.42	0.20	0.64	0.11	3.75	p < 0.0001***
13	H13: Trust ➔IShar	22	5490	0.50	0.41	0.58	0.04	11.5	p < 0.0001***
14	H14: InfT ➔ IShar	21	4585	0.53	0.40	0.66	0.07	8.1	p < 0.0001***
15	H15:InfT ➔ EnU	4	939	0.15	-0.04	0.33	0.09	1.57	p = 0.116
16	H16: EnU ➔ IShar	9	2132	0.17	0.05	0.29	0.06	2.8	p = 0.006**

***p-value < 0.001, and **p-value < 0.01

Source: Own research (2021). Note: r_c *- the corrected correlation were computed (Hunter & Schmidt, 2004)*

The effect of four factors on IShar and the relationships between the factors of information sharing is clearly presented in turn by the summary estimate of the correlation (Table 4). Firstly, the corrected correlation between Comt and IShar is 0.54 and the 99% credibility interval for the population correlation of commitment and information exchange is [0.40, 0.69]. This result implies that assuming effect size correlations have a normal distribution, 99% of the values in the population correlation distribution are within the credibility interval (Hunter & Schmidt, 2004). The results confirm a positive correlation between IShar and Comt because 0 is not included in the confidence interval. As a result, it is undoubted that we conclude there is support for H10. Similarly, the relationships of other factors (Trust, InfT, and EnU) and IShar are tested with the same process in turn. The results of models 13, 14, and 16 indicate that all of Trust, InfT, and EnU have a positive correlation with IShar. Their values of correlations lie on 99% confidence intervals excluded zero and negative values. Hence, all three hypotheses are accepted. Therein, H13 and H14 are supported at p-value < 0.001, and H16 is supported at p-value <0.01. In addition, the examinations of the

relationships between Comt and Trust, Comt and InfT, and InfT and EnU also show that H11 and H12 are accepted at p-value < 0.001 while H15 is rejected at p-value < 0.05.

Overall, our findings confirm the effect of each factor on information transfer in the supply chain. These results are compatible with many other earlier individual studies but they have also contrasted with some studies. For instance, the confirmation of the effect of Trust on IShar contrasts with the finding of Chen et al. (2011). Chen et al. (2011) indicate that there is no correlation between IShar and Trust (Jengchung V Chen et al., 2011). Similarly, Zhong et al. (2020) did not find a correlation between IShar and Comt (Zhong et al., 2020).

3.2.3. Correlation comparison

According to Zhu (2012 and 2016), the ranges of correlation coefficient are divided into five levels, including: 1) 0 – 0.19 : no correlation, 2) 0.2 – 0.39 : low correlation, 3) 0.4 – 0.59 : moderate correlation, 4) 0.6 – 0.79: moderately high, and 0.8 : high correlation, or report the correlation determinations, i.e., squared correlation coefficients (Zhu, 2012, 2016). Figure 4 shows the degree of correlation between the pairs of factors in the two groups. Overall, the correlation between most pairs of factors in both groups dispersed in the moderate correlation region. There are only a few pairs of factors located in the regions of high correlation, moderately high, and no correlation. Particularly, the pair of factors between SCCol and SCIntg has a high correlation while two pairs of factors: 1) EnU and IShar and 2) InfT and EnU lie in the group of no correlation. Two pairs of factors 1) IShar and SCCol and 2) IShar and SCIntg belong to the group which has a moderately high correlation. Other pairs of factors are scattered in the group of moderate correlation. When comparing differences in correlation between pairs of factors in each group, they are presented as follows:

- The relationships in the set of IShar, SCPerf, and SCPerfIAs scatter from the degree of moderate to high correlation. In which, the correlation between IShar and SCCol is highest at 0.76. By contrast, the lowest correlation belongs to the relationship pair between IShar and SCFlex (0.46).

- The relationships in the group of IShar and the factors of IShar concentrate on the degree of moderate correlation and no correlation. In which, two-factor pairs 1) EnU and IShar and 2) InfT and EnU lie in the group of no correlation. Other pairs have moderate correlation, of which the correlation between Comt and IShar is highest and the correlation between Comt and InfT is lowest.

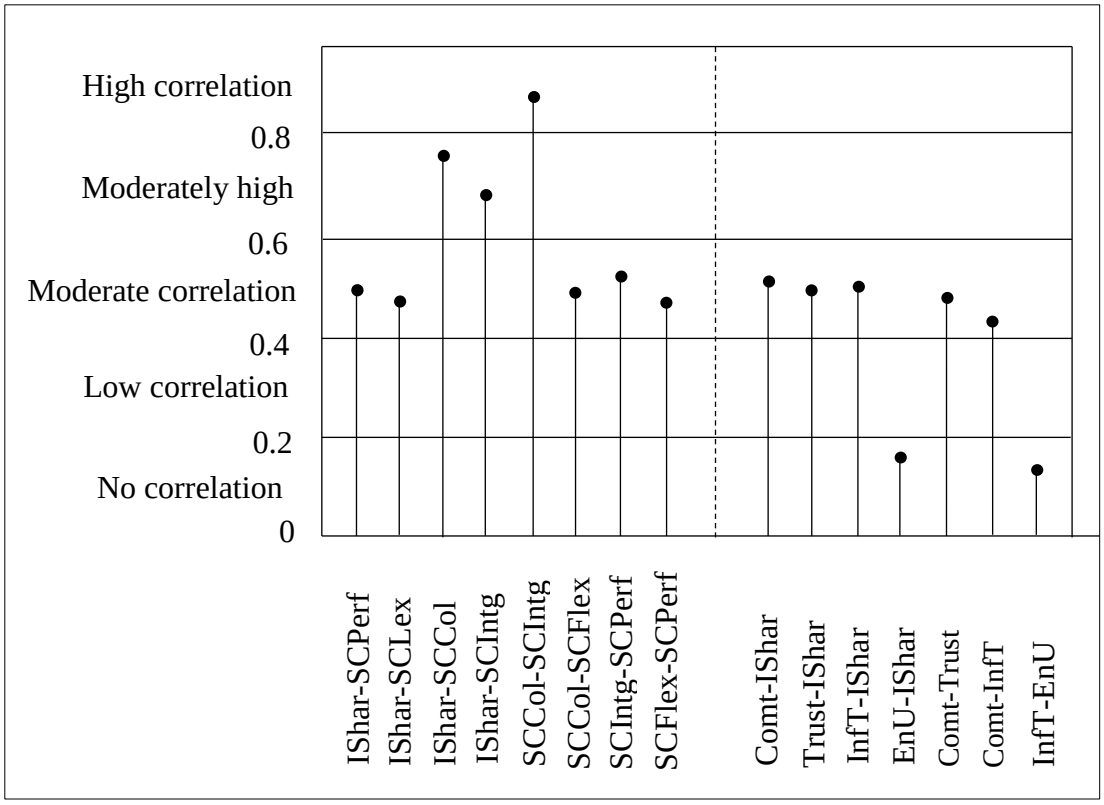


Figure 4: The degree of correlation between IShar, SCPerf, SCPerfIAs, and the factors of IShar

Source: Own research (2021)

3.3. The relationship structure between IShar, SCPerf, and SCPerfIAs

The set of relationships between information sharing (IShar), supply chain performance (SCPerf), and the activities of supply chain performance (SCPerfIAs) are considered simultaneously. Meta-analytic structural equation modeling (MASEM) is used to analyze these relationships. The relationship structure is described by situation 2 in Figure 1, including 1) the direct link between IShar and SCPerf, 2) the links between IShar and SCPerfIAs, and 3) the links between SCPerf and SCPerfIAs. They form nine hypotheses from H1 to H10. The results are presented as follows:

In stage 1 of MASEM, 67 correlation matrices with a sample size of 15835 are pooled into a meta-analytic correlation matrix containing correlation coefficients between all variables

in the hypothetical model. To pooling correlation matrices, a process of three steps is performed: 1) correlation coefficient converted to normal standard metric using Fisher's r-to-Z transform, 2) testing correlation homogeneity to select the fixed-effects model or random-effects model for analysis model, 3) transforming Fisher's Z-to-r correlation.

The results show that Q-statistic = 1732.553 and p-value < 0.001 and the range of I^2 from 0.72 to 0.96. These indicate that the null hypothesis is rejected when 0.05 is the criterion for statistical significance. As a result, there is no doubt about the presence of heterogeneity. Therefore, the random-effects model is suitable for the next analysis model. The results also present the correlation coefficients are statistically significant at a p-value of 0.001. This is pooled meta-analytic correlation matrix to implement the next steps in the process of MASEM (Table 5).

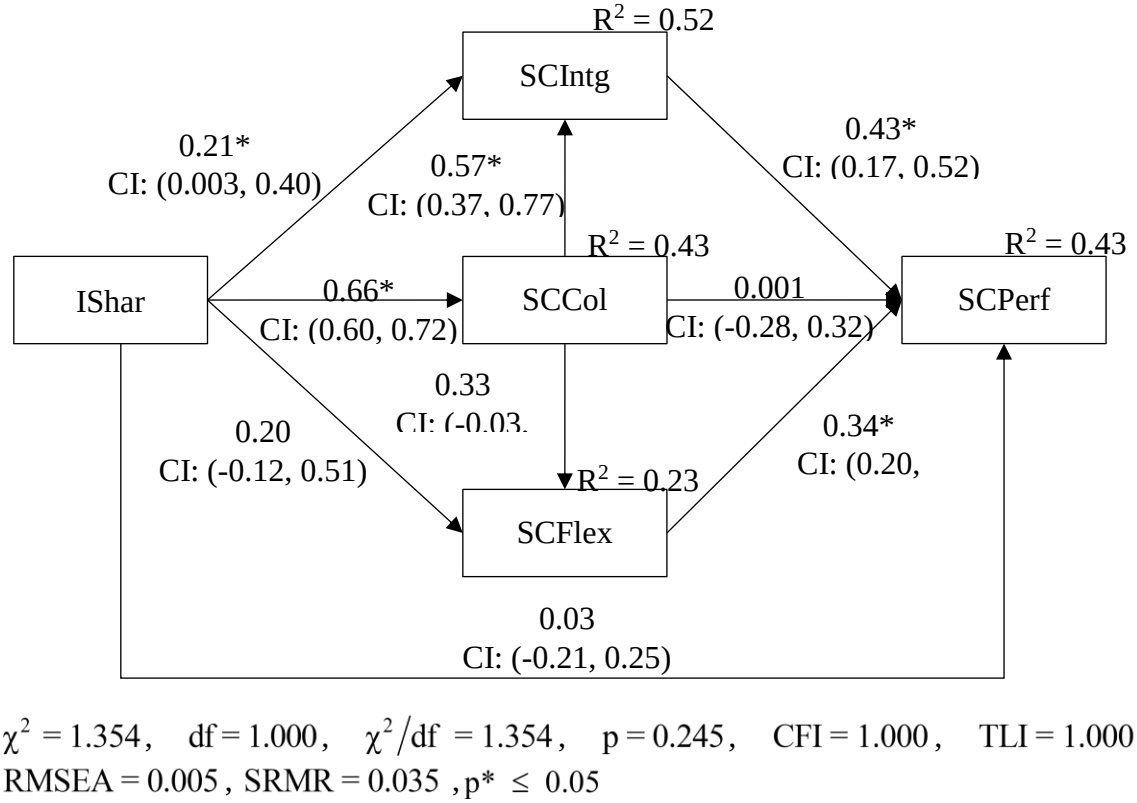
Table 5: The correlation matrix in the set of IShar, SCPerf, and SCPerfIAs

	IShar	SCPerf	SCIntg	SCCol	SCFlex
IShar	1	0.42***	0.58***	0.66***	0.41***
SCPerf	0.42***	1	0.57***	0.48***	0.50***
SCIntg	0.58***	0.57***	1	0.70***	0.43***
SCCol	0.66***	0.48***	0.70***	1	0.39***
SCFlex	0.41***	0.50***	0.43***	0.39***	1

*** is p-value < 0.001

Source: Own research (2021)

In stage 2, based on the pooled correlation matrix in stage 1, the structural model is fitted. The results show that the model fits well with the data from primary individual studies. In particular, TLI = 1.000, CFI = 1.000, SRMR = 0.035, RMSEA = 0.005 < 0.08, p-value = 0.245, and the ratio of χ^2 (1.354) to degrees of freedom (1.000) is less than the recommended value of 3.0 for the satisfactory fit of a model to data (Barbara M Byrne, 2013; Dragan & Topolšek, 2014; Hoyle, 2012). The structural equation model between IShar, SCPerf, and SCPerfIAs is shown in Figure 5, and the direct and indirect effects of factors are presented in Table 6.



$\chi^2 = 1.354$, df = 1.000, $\chi^2/df = 1.354$, p = 0.245, CFI = 1.000, TLI = 1.000, RMSEA = 0.005, SRMR = 0.035, p* ≤ 0.05

Figure 5: MASEM results of the set of IShar, SCPerf, and SCPerfIAs

Source: Own research (2021)

Figure 5 also shows the value of the coefficient of determination, denoted R^2. The range of R^2 values is between 0 and 1. According to Üstündağ & Ungan (2020), the rate of variance of a dependent variable is explained by independent variables (Üstündağ & Ungan, 2020). This conclusion is considered appropriate if the value of R^2 is greater than or equal to 0.1 (Falk & Miller, 1992). In Figure 5, the values of R^2 are higher than 0.1. It indicates a high degree of fit of the equation between the dependent and the independent variables.

According to Figure 5 and Table 6, all hypotheses are supported except for H1, H3, H6, and H7. Thus, the structural model is formed.

Table 6: Direct and indirect effects of factors in the set of IShar, SCPerf, and SCPerfIAs

Hypothesis	Variable		Direct effects			Indirect effects		
	Dependent	Independent	Est.	LB	UP	Est.	LB	UP
H1	SCPerf	IShar	0.03	-0.21	0.25	0.19	-0.01	0.34
H7	SCPerf	SCCol	0.001	-0.28	0.32	0.36	0.16	0.56
H9	SCPerf	SCFlex	0.34	0.20	0.47			
H8	SCPerf	SCIntg	0.43	0.17	0.52			
H6	SCFlex	SCCol	0.33	-0.03	0.69			
H3	SCFlex	IShar	0.20	-0.12	0.51	0.41	0.29	0.54
H5	SCIntg	SCCol	0.57	0.37	0.77			
H2	SCIntg	IShar	0.21	0.003	0.40	0.58	0.50	0.67
H4	SCCol	IShar	0.66	0.60	0.72			

Source: Own research (2021)

Table 6 presents the results of examining the direct and indirect influence of IShar on SCPerf, of IShar on SCPerfIAs, and of SCPerfIAs on SCPerf, as well as the internal effect between SCPerfIAs on each other, as follows:

First of all, the direct and indirect relationships between IShar and SCPerf are considered. In which, the indirect effect of IShar on SCPerf through three ways 1) SCIntg, 2) SCCol, and 3) SCFlex. The results provide that 0 is included in the confidence intervals of both the direct and indirect relationships. Therefore, there is not enough evidence to confirm that the more information is exchanged, the higher the performance of the supply chain. Besides, the results also have not enough evidence to conclude that all SCIntg, SCCol, and SCFlex are also not mediators in the relationship between IShar and SCPerf.

The next is consideration of the relationship between IShar and SCPerfIAs, including SCCol, SCIntg, and SCFlex. Particularly, SCCol is directly affected by IShar with an estimation of 0.66. This means that the more information exchanged between supply chain members, the higher the connection between members. For SCIntg, IShar has both direct and indirect effects on SCIntg with the estimations of 0.21 and 0.58, respectively. In which, SCIntg is indirectly influenced by IShar through SCCol. Hence, the more members in the supply chain enhance the exchange of information with each other, the more effective the integration in the supply chain will be. Besides, SCCol is a mediate activity in the relationship between IShar and SCIntg. For SCFlex, there is only an indirect effect of IShar on SCFlex through SCCol with the estimation of 0.41. In other words, SCCol is a mediator

in the relationship between IShar and SCFlex. By contrast, the result shows that the direct effect of IShar on SCFlex is not significant. This result does not have enough evidence to indicate that the change of SCFlex is directly decided by IShar.

Thirdly, the direct or indirect effects are found in the relationships between SCPerf and SCPerfIAs, including SCCol, SCIntg, and SCFlex. In particular, SCPerf is directly affected by SCIntg and SCFlex while the direct effect of SCCol on SCPerf is not significant. This indicates that the success of SCIntg and SCFlex significantly contributes to the high performance in the supply chain. In addition, the indirect effect of SCCol on SCPerf through SCIntg and SCFlex is significant. As a result, it is undoubted that SCIntg and SCFlex are two mediators in the relationship between SCPerf and SCCol.

Last but not least, the relationships between SCPerfIAs with each other are considered. The results show that SCCol has a direct impact on SCIntg but the direct effect of SCCol on SCFlex is not significant. In addition, the structure model only depicts the direct relationship between SCCol and SCIntg and between SCCol and SCFlex. Thus, there is no mediator in these relationships in this case.

3.4. The relationship structure between IShar and IShar's factors

Similar to the relationship structure between IShar, SCPerf, and SCPerfIAs, the structure of the relationships between information sharing (IShar) and the factors of IShar are examined using meta-analytic structural equation modeling (MASEM). The factors of information exchange include commitment (Comt), trust (Trust), information technology (InfT), and environmental uncertainty (EnU). The relationship structure is described by situation 3 in Figure 18, including 1) the links between information sharing factors with each other and 2) the links between information sharing factors and information sharing. The results are presented as follows:

In stage 1 of MASEM, 58 correlation matrices with a sample size of 13139 are pooled into a meta-analytic correlation matrix containing correlation coefficients between all variables in the hypothetical model. To pooling correlation matrices, a process of three steps is performed: 1) Correlation coefficient converted to normal standard metric using Fisher's r-to-Z transform, 2) testing correlation homogeneity to select the fixed-effects model or random-effects model for analysis model, 3) transforming Fisher's Z-to-r correlation.

The results show that Q-statistic = 741.7, p-value < 0.001, and the range of I^2 from 0.82 to 0.91. These indicate that the null hypothesis is rejected when 0.05 is the criterion for statistical significance. As a result, it is certain of the presence of heterogeneity. Therefore, the random-effects model is suitable for the next analysis model.

The pooled meta-analytic correlation matrix is described in Table 7.

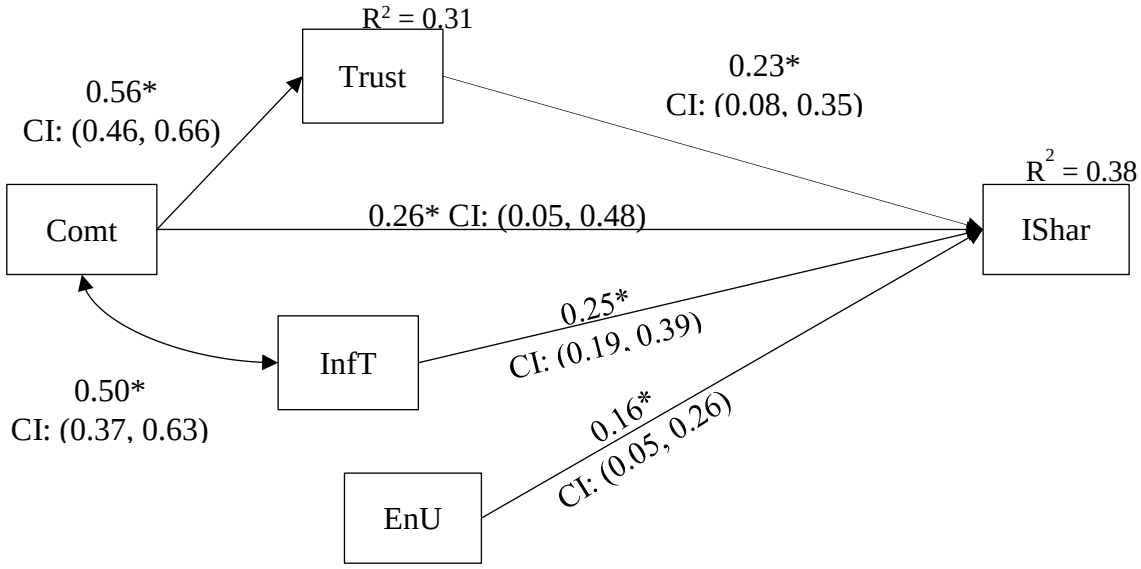
Table 7: The correlation matrix in the set of IShar and IShar's factors

	Trust	Comt	InfT	EnU	IShar
Trust	1	0.53***	0.39***	0.01	0.45***
Comt	0.53***	1	0.41***	0.11	0.52***
InfT	0.39***	0.41***	1	0.10	0.45***
EnU	0.01	0.11	0.10	1	0.16**
IShar	0.45***	0.52***	0.45***	0.16**	1

*** is p-value < 0.001 and ** is p-value < 0.01

Source: Own research (2021)

In stage 2, based on the pooled correlation matrix in stage 1, the structural model is fitted. The results show that the model fits well with the data from primary individual studies. In particular, TLI = 0.989, CFI = 1.000, SRMR = 0.066, RMSEA = 0.007 < 0.08, p-value = 0.169, and the ratio of χ^2 (6.438) to degrees of freedom (4.000) is less than the recommended value of 3.0 for the satisfactory fit of a model to data (Barbara M Byrne, 2013; Dragan & Topolšek, 2014; Hoyle, 2012). In addition, the coefficient of determination R^2 (0.38) in our structure model is greater than 0.1 (Falk & Miller, 1992). It indicates a high degree of fit of the equation between the dependent variable and the independent variables. The structural equation model between IShar and the factors of IShar is shown in Figure 6, and the direct and indirect effects of factors are presented in Table 8.



$\chi^2 = 6.436$, df = 4.000, $\chi^2/df = 1.609$, p = 0.169, CFI = 1.000, TLI = 0.989, RMSEA = 0.007, SRMR = 0.065, $p^* \leq 0.05$

Figure 6: MASEM results of the set of IShar and IShar's factors

Source: Own research (2021)

According to Figure 6 and Table 8, all hypotheses are accepted except H15. As a result, all four factors (Comt, InfT, Trust, and EnU) have a significant direct effect on IShar. In the words, the positive change of four factors positively affects IShar. Particularly, Comt has the highest effect on IShar with an estimation of 0.26. The effect of InfT is second-highest-ranking (0.25). The estimated effect of Trust is 0.23. Finally, the influence of EnU is weakest (0.16). Table 16 also shows that there are only Comt and InfT have both direct and indirect effects on IShar. Therein, the effect of Comt on IShar is through Trust and InfT, and IShar is affected by InfT through Comt. As a result, the effect of Comt on IShar is higher than the effect of Inf on IShar with the estimations of 0.51 and 0.39, respectively.

Table 8: Direct and indirect effects of factors in the structural model

Hypothesis	Variable		Direct effects			Indirect effects		
	Dependent	Independent	Est.	LB	UP	Est.	LB	UP
H10	IShar	Comt	0.26	0.05	0.48	0.51	0.41	0.63
H11	Trust	Comt	0.56	0.46	0.66			
H12	-	Comt ⇔ InfT	0.50	0.37	0.63			
H13	IShar	Trust	0.23	0.08	0.35			
H14	IShar	InfT	0.25	0.19	0.39	0.39	0.29	0.48
H16	IShar	EnU	0.16	0.05	0.26			

Source: Own research (2021)

3.5. Evaluation

3.5.1. The role of mediators

Information exchange (IShar), the performance of the supply chain (SCPerf), activities enhancing the performance of the supply chain (SCPerfIAs), and the factors of IShar are considered in this study. Therein, SCPerfIAs include the integration, collaboration, and flexibility in the supply chain denoted SCIntg, SCCol, and SCFlex, respectively. The factors of IShar consist of commitment (Comt), Trust (Trust), and information technology (InfT). Initially, based on previous studies, these elements form 16 relationship pairs that are equivalent to 16 hypotheses (Table 9).

Table 9: Hypothesis summary

Hypotheses	
HI: There is a strong influence of IShar on SCPerf	**HII: IShar is strongly impacted by the factors of IShar**
H1: SCPerf is directly affected by IShar	H10: Comt directly affects IShar
H2: IShar strongly impacts SCIntg	H11: Trust is strongly impacted by trust
H3: IShar strongly improves SCFlex	H12: Comt has a strong correlation with InfT
H4: SCCol is strongly influenced by IShar	H13: Trust has a strong effect on IShar
H5: SCCol has a strong relationship with SCIntg	H14: InfT directly influences IShar
H6: SCCol has a strong relationship with SCFlex	H15: InfT is strongly correlated EnU
H7: SCCol directly influences SCPerf	H16: EnU strongly affects IShar
H8: SCPerf is strongly impacted by SCIntg	
H9: SCPerf is strongly impacted by SCFlex	

Source: Own research (2021)

Figure 7 presents the difference in the results between testing the connection between two activities/factors and testing the connection between activities/factors in two structural sets. Firstly, there are 16 hypotheses presenting 16 connections between two activities/factors. They are divided into two groups: 1) group 1 includes from H1 to H9 and group 2 consists of H10 to H16. Next, two structures simultaneously describe the complex relationships between variables in two sets including 1) a set of IShar, SCPerf, and SCPerfIAs which contains 9 hypotheses from H1 to H9 and 2) a set of IShar and the factors of IShar covers 7 hypotheses from H10 to H14 and H16. Especially, H15 is excluded in the set of IShar and IShar's factors because H15 is unsupported in the first test.

Figure 7 also indicates the significant change in the relationships between factor pairs in the structural models when compared to the initial hypothesis tests between factor pairs. The relationship between IShar and SCFlex is an example. This relationship is supported when considered independently. However, it is not supported when considered concurrently with other paths departing from IShar such as IShar and SCIntg or IShar and SCCol. This indicates that the relationship between IShar and SCFlex may be affected by other relationships or elements. This finding is confirmed when the calculation of the indirect effect of IShar on SCFlex is performed. The result shows there is an indirect effect of IShar on SCFlex through SCCol. Similarly, the relationship between SCCol and SCPerf is unsupported in the structure model, but the indirect effect of SCCol on SCPerf is found through SCIngt and SCFlex. In the relationship between IShar and SCPerf, the undirect effect of IShar on SCPerf through SCIntg, SCCol, and SCFlex is unsupported. This may be explained that all three activities (SCIntg, SCCol, and SCFlex) may not be mediators in the relationship between IShar and SCPerf, or there may have one activity being a mediator between IShar and SCPerf but it is not strong enough to overwhelm the other effects on the relationship between IShar and SCPerf. This should be considered deeply in further studies.

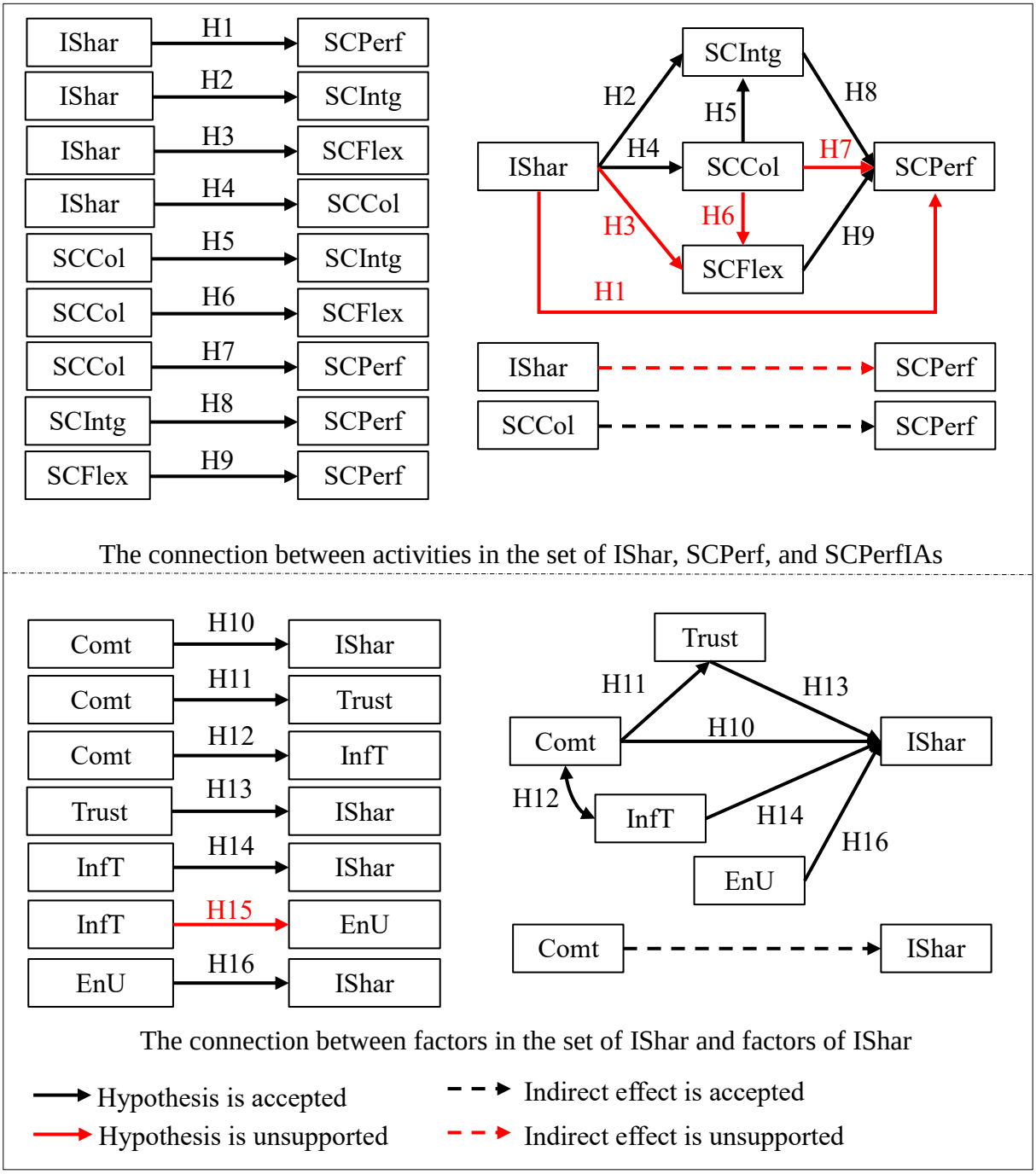


Figure 7: The difference in the results between testing the connection between two activities/factors and testing the connection between activities/factors in two sets

Source: Own research (2021)

From this comparison, a conclusion is proposed that mediators play an important role in the relationship between two factors. Therefore, researchers should consider mediators to be able to accurately determine the effect of one factor on another. Examining intermediaries in a relationship also helps businesses recognize that activity can have both a direct impact

on an activity under consideration and an impact on a third activity that makes an important contribution to the activity under consideration. From there, businesses can have more accurate assessments of the role of activities or can select important activities to focus on making effective and reasonable improvements.

3.5.2. The key activities in improving SCPerf

There are statistically significant relationships and mediators found in the results of testing hypotheses in the structural model of the set of information sharing (IShar), supply chain performance (SCPerf), and the activities of supply chain performance (SCPerfIAs) including supply chain integration (SCIntg), supply chain collaboration (SCCol), and supply chain flexibility (SCFlex). These results help provide a clear overview for the business to prioritize activities that need to be focused on to improve supply chain efficiency, as follows:

- For SCPerf, the determination coefficient (R^2) of SCPerf is 0.43. This value confirms that 43% of the variance of SCPerf is explained by IShar, SCIntg, SCCol, and SCFlex. Specifically, IShar, SCIntg, SCCol, and SCFlex are predicted to affect SCPerf (Figure 23). The results show that statistical significance is only found in the direct relationships between SCIntg and SCPerf and between SCFlex and SCPerf. Besides, the indirect effect of SCCol on SCPerf is also statistically significant. As a result, SCIntg and SCFlex are two activities directly affecting SCPerf and SCCol partially affects SCPerf through mediators such as SCIntg and SCFlex. On the other hand, based on the estimated effect (including direct and indirect effects) in the structural model, the degree of the effect of each activity on SCPerf is compared (Figure 8). Figure 8 shows that the degree of effect of SCIntg on SCPerf is the highest (0.43). The effect of SCCol on SCPerf is second-highest-ranking (0.36) even though its direct effect does not have statistically significant. Next, the impact of SCFlex is much higher than IShar but lower than the effect of SCCol. Finally, the influence of IShar on SCPerf is lowest at 0.22. Therefore, It can be asserted that SCIntg is the key activity that strongly influences SCPerf.

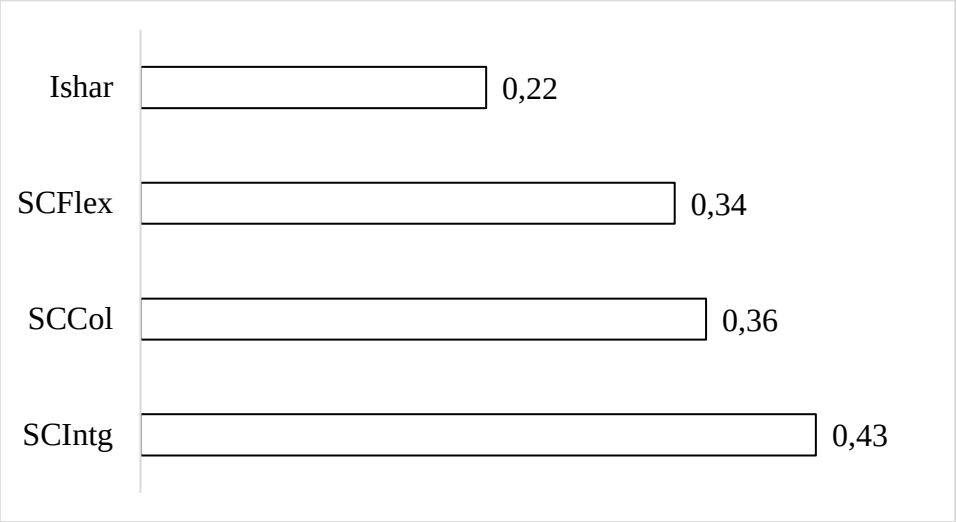


Figure 8: The estimated effect of activities on SCPerf

Source: Own research (2021)

- For SCIntg, the determination coefficient (R^2) of SCIntg is 0.52. This value confirms that 52% of the variance of SCIntg is explained by IShar and SCCol. The results of testing hypotheses present that the effect of both IShar and SCCol on SCIntg had statistically significant. Therefore, it is certain that both IShar and SCCol strongly affect SCIntg. Based on the estimated effect (including both direct and indirect effects), the effect of IShar on SCIntg of 0.79 is much larger than the impact of SCCol on SCIntg (0.57). Hence, IShar may be considered a more important activity of SCIntg.
- For SCCol, only IShar is suggested as a predictor variable in the equation of the relationship between IShar and SCCol. The results are found to be statistically significant in this relationship with a path coefficient of 0.66 and p-value < 0.001. In addition, the determination coefficient (R^2) of SCCol is 0.43. This value confirms that 43% of the variance of SCCol is explained by IShar. Therefore, it is certain that the positive change of IShar leads to a significant increase in SCCol.
- For SCFlex, IShar and SCCol are considered as two activities affecting SCFlex. The results that the direct effect of both IShar and SCCol on SCFlex are not statistically significant. However, it is statistically significant when examining the indirect impact of IShar on SCFlex, and SCCol is a mediator in the relationship between IShar and SCFlex. Furthermore, the determination coefficient (R2) of SCFlex is 0.23. This

value confirms that 23% of the variance of SCFlex is explained by IShar and SCCol. Hence, IShar and SCCol partially affect SCFlex.

In summary, the complex relationship structure of the set of IShars, SCPerfs, and SCPerfIAs confirms the role of SCPerfIAs in improving SCPerf, especially the SCIntg that has the strongest influence on SCPerf and contributes most significantly to the 43% variance of SCPerf. Besides, this structure also emphasizes the key role of IShar on SCPerfIAs and the important role of SCCol on SCIntg and SCPerf. Therefore, this study's results propose that prioritizing the implementation of two activities IShar and SCCol should be given more attention by decision-makers in improving SCPerf. Although neither IShar nor SCCol have the same direct effect on SCPerf as SCIntg, they contribute to 52% of the variance of SCIntg having the strongest direct effect on SCPerf. In some cases, if only one can be chosen because of some limitations such as resources or budget, decision-makers should prefer IShar's implementation or improvement over SCCol's. IShar directly affects SCCol, indirectly impacts SCFlex, and has both direct and indirect effects on SCIntg. As a result, it can conclude that IShar plays a key role in the activities improving SCPerf. According to Sundram et al. (2016), IShar increases effective communication among supply chain members (Sundram et al., 2016). This helps businesses capture information quickly to respond quickly to market and product changes. Simultaneously, it also strengthens relationships and long-term cooperation (de Mattos & Barbin Laurindo, 2015). According to Chiung-Lin Liu & Lee (2018) and Mandal et al. (2016), if information sharing is not performed, the collaboration will be broken between supply chain members. Consequently, SCIntg and SCFlex are affected significantly leading to a strongly reducing the performance of the supply chain (Chiung-Lin Liu & Lee, 2018; Mandal et al., 2016).

3.5.3. The key factors in improving IShar

Commitment (Comt), trust (Trust), information technology (InfT), and environmental uncertainty (EnU) are considered as four factors affecting IShar. Based on the hypothesis test between factor pairs, the structure of the set of IShar and the factors of IShar is formed. The results of testing the complex relationships in the structural model show that the effect of all four factors on IShar is statistically significant. All four factors explain 38% of the variance of IShar. Based on the estimated effect (including the direct and indirect effects) in

the structural model, the effects of Comt and InfT on IShar are much stronger than the effects of two remaining factors including Trust and EnU (Figure 9). Particularly, Comt affects IShar the most with an estimate of 0.77. This coefficient is the sum of Comt's direct and indirect effects on IShar, in which Comt's indirect effects on IShar is through Trust and InfT. InfT's influence on IShar is the second strongest with an estimate of 0.64. Similar to the Comt impact, the effect of InfT is calculated using both direct and indirect effects. In which, InfT's indirect influence on IShar is through Comt. The relationship between Trust and IShar is direct. Therefore, the Trust's impact on IShar is only a direct effect with an estimate of 0.23 lower than InfT. Similar to Trust, EnU only has a direct effect on IShar and this effect is lowest with 0.16.

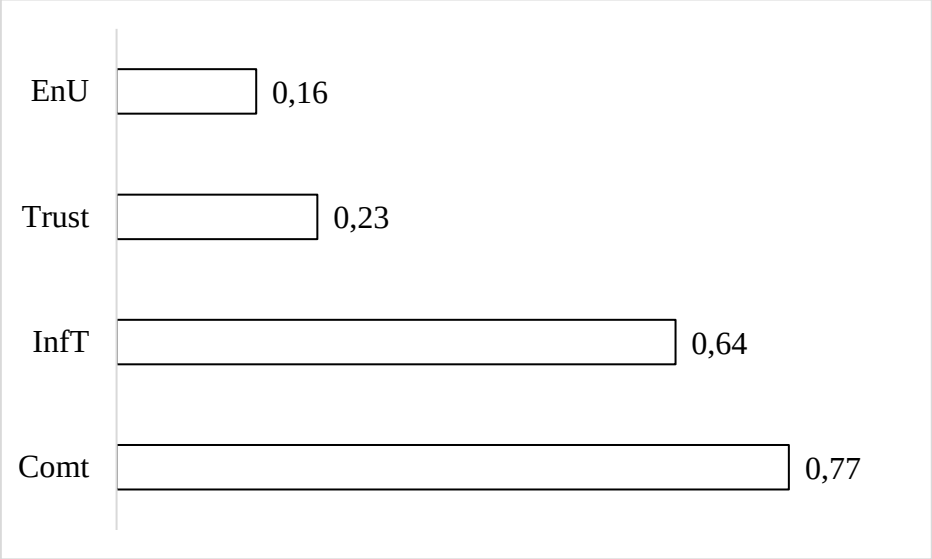


Figure 9: The estimated effect of factors on IShar

Source: Own research (2021)

In summary, Comt and InfT are two key elements in IShar and need more attention in improving IShar. In which, Comt should be given priority over InfT. Kwon et al. (2004) indicate that the information exchange disruption is significantly reduced thanks to an increase in commitment among supply chain members (Kwon & Suh, 2004). Comt contributes to increased trust between partners, leading to improved and strengthened long-term relationships in the supply chain (Mahmud et al., 2021; Maister et al., 2021; Rashed et al., 2010; Xiao et al., 2010).

3.5.4. The effect of other factors on SCPerf, SCIntg, SCFlex, and IShar

There are two structural models formed in this study and five dependent variables in these two structural models. Therein, supply chain performance (SCPerf), supply chain integration (SCIntg), supply chain collaboration (SCCol), and supply chain flexibility (SCFlex) are four dependent variables of the structural model of the collection information sharing (IShar), SCPerf, and the activities of supply chain performance (SCPerfIA). A dependent variable (IShar) is inferred from the structural model of the set of IShar and the elements of IShar. Each dependent variable is measured by some independent variables, as follows:

- SCPerf is measured by SCIntg, SCFlex, SCCol, and IShar.
- SCCol and IShar are used to measure SCIntg and SCFlex, respectively.
- IShar measures SCCol.
- IShar is measured by Comt, Trust, InfT, and EnU.

In each structural model, the value of the coefficient of determination (R^2) describes the percentage influence of the variables considered on the dependent variables. The value of R^2 ranges from 0% to 100% (Falk & Miller, 1992). Figure 10 shows that 43% of the change of SCPerf is affected by the change of SCIntg, SCFlex, SCCol, and IShar. Similarly, the change of SCCol and IShar impacts 52% of the change of SCIntg and 23% of the change of SCFlex. Especially, only IShar is an activity that is considered to affect SCCol, but it determines 43% of the change in SCCol. Last but not least, four factors including Comt, Trust, InfT, and EnU influence 38% of the variance of IShar.

On the other hand, the effect of other factors on dependent variables is measured by using 100% minus R^2. Figure 10 presents the effect rate of other random variables on five dependent variables including SCPerf, SCIntg, SCFlex, SCCol, and IShar. Overview, the influence of other variables on each dependent variable is greater than 50% except for the impact of other variables on SCIntg which is 48%. Particularly, the effect of other variables on SCFlex is largest with 77%. The influence of other factors on IShar is second-largest ranking with 62%. Ranked third is the rate of influence of other factors on SCPerf and SCCol with 57% for each activity. Finally, only 48% of the variance of SCIntg is contributed by other factors besides SCCol and IShar.

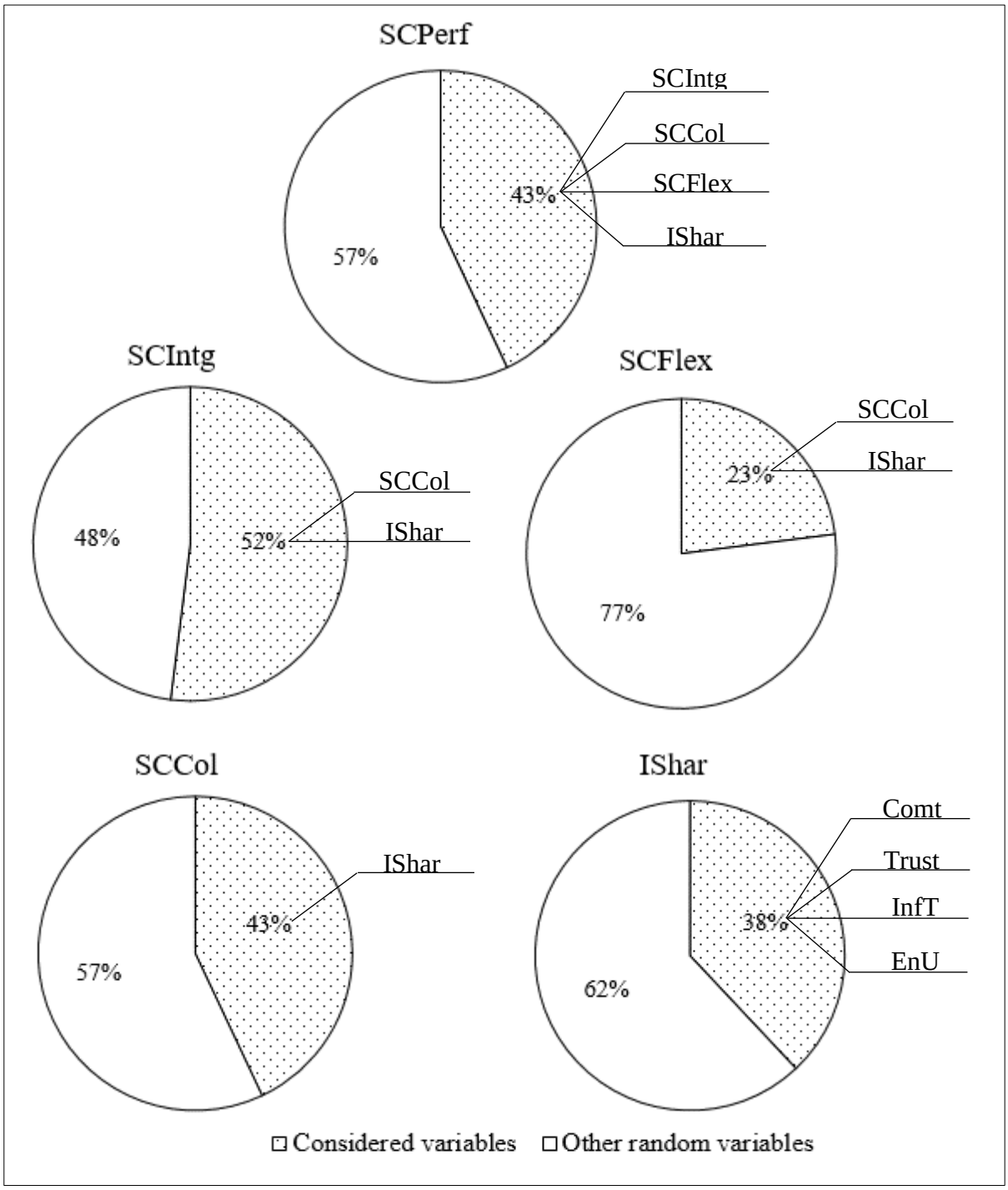


Figure 10: Percentage of other random variables' influence in SCPerf, SCIntg, SCFlex, SCCol, and IShar

Source: Own research (2021)

In summary, from the results in Figure 10, it is undoubted that considered activities/factors play an important role in SCPerf, SCIntg, SCFlex, SCCol, and IShar. Their positive change positively affects the change of the performance and the efficiency of activities enhancing the performance of the supply chain. However, there are still other factors/activities

affecting the change of SCPerf, SCIntg, SCFlex, SCCol, and IShar besides those considered factors/ activities. Therefore, this can be suggested as a research direction in the future. Researchers may find and determine the effect of other factors on SCPerf, SCIntg, SCFlex, and SCCol, as well as on IShar. The findings can be compared with those in this study to assist decision-makers in selecting key factors to help them improve their supply chains more efficiently.

4. CONCLUSIONS AND RECOMMENDS

Our study examines the influence of information sharing (Ishar) on operations enhancing the performance of the supply chain and evaluates the degree of the effect of factors on IShar simultaneously. Thus, considered activities/factors are divided into two groups. Group 1 consists of IShar, supply chain performance (SCPerf), and the activities of supply chain performance (SCPerfIAs) including supply chain integration (SCIntg), supply chain flexibility (SCFlex), and supply chain collaboration (SCCol). Group 2 is IShar and IShar's factors including commitment (Comt), trust (Trust), information technology (InfT), and environmental uncertainty (EnU). There are 16 hypotheses formed to describe the relationships between two activities/factors. Testing of 16 hypotheses is performed in two stages. Firstly, the relationships of the pairs of activities/factors are individually tested using meta-analysis. And then, based on the initial research results, the relationship structure between activities/factors is formed, including the relationship structures 1) between activities in the set of IShar, SCPerf, and SCPerfIAs and 2) between factors in the set of IShar and the factors of IShar. In particular, the relationships in structure 1 include the relationship between IShar and SCPerfIAs, between IShar and SCPerf, between SCPerfIAs such as between SCCol and SCIntg and between SCCol and SCFlex, and between SCPerfIAs and SCPerf. Structure 1 includes 9 hypotheses from H1 to H9. Next, the relationships in structure 2 are between IShar and IShar's factors and between factors such as between Comt and Trust and between Comt and InfT. Structure 2 consists of 6 hypotheses from H10 to H14 and H16. MASEM is used for both two relationship structures.

The results of individually testing the relationships show that there are 15 hypotheses accepted. They are from H1 to H14 and H16. H15 - InfT is strongly correlated EnU is unsupported. Therefore, H15 will be removed in testing the structure of the relationships in two sets in the next stage. 15 remaining hypotheses are still kept and are tested again in two structural models. The results of testing two structural models show that there are 10/15 hypotheses accepted. They are H2, H4, H5, H8, and H9 in structure model 1 and from H10 to H14 and H16 in structure model 2. In addition, the results also indicate the direct and indirect effects of these activities/factors on other activities/factors and the correlation relationship between two factors, as well as mediators in the relationships between two activities/factors.

Some conclusions are drawn from the results of this study. They are presented, as follows:

First of all, the findings of testing 16 hypotheses have confirmed the individual relationships between two activities/factors. These findings are consistent with many previous studies but they also contrast with the findings of some relevant studies. For example, Comt directly affects IShar (H10), which contrasts with the result of Zhong et al. (2020) who did not find a correlation between IShar and Comt (Zhong et al., 2020). However, other previous studies have the same finding as our study. Wu et al. (2014) demonstrate the positive effect of Comt on IShar (Long Wu et al., 2014). IShar can be delayed or slow if there is no commitment (Kwon & Suh, 2004).

Secondly, there is a difference between the test results of the relationship pairs independently and the results of the relationship test in the 2 structural models. For instance, in testing relationship pairs independently, the results show that SCCol directly affects SCPerf (H7). However, H7 is unsupported in the structure of the set of IShar, SCPerf, and SCPerfIAs. By contrast, the indirect effect of SCCol on SCPerf is indicated through SCIntg and SCFlex. Therefore, the role of intermediaries is introduced. They are important factors to accurately determine the effect of one factor on another. From there, businesses can have more accurate assessments of the role of activities or can select more important activities to focus on making effective and reasonable improvements.

Thirdly, the results display the key role of IShar on SCPerfIAs and the role of SCPerfIAs in improving SCPerf, as well as the important role of SCCol on SCIntg belonged to SCPerfIAs. Based on the evaluation of direct effects and influences through mediators, activities IShar and SCCol should be firstly prioritized when improving the performance of the supply chain. Both of these not only strongly connect to other activities of the supply chain, but also bring more benefits to the entire supply chain such as reduced lead time and bullwhip effect, increased flexibility, and satisfied end-customer needs (Gopal Kumar et al., 2017; Tian-Min, 2009). The performance of the supply chain will be significantly affected without sharing information and collaboration with the supply chain (Felix TS Chan et al., 2012). In some cases, due to the limitations of budget or resources, decision-makers should prefer IShar's implementation or improvement over SCCol's. Information exchange is critical to ensure that supply chain plans are executed seamlessly and in a way that

simultaneously increases collaboration and long-term relationships (de Mattos & Barbin Laurindo, 2015).

Fourthly, Comt and InfT are two key elements in exchanging information when compared to Trust and EnU. In which, Comt should be given priority over InfT if resources or budgets are limited. Comt affects both IShar and Trust (Maister et al., 2021; Xiao et al., 2010). Increasing commitment between individuals in the supply chain can foster trust among partners. This leads to significant improvements in the lasting connections in the supply chain.

Last but not least, there are still other factors/activities affecting the change of SCPerf, SCIntg, SCFlex, SCCol, and IShar besides those considered factors/activities. They account for a quite large percentage of each activity/factor. Particularly, the effect of other variables on SCFlex is largest with 77%. The influence of other factors on IShar is second-largest ranking with 62%. the rate of influence of other factors on SCPerf and SCCol with 57% for each activity. And, 48% of the variance of SCIntg is contributed by other factors. Therefore, researchers need to identify them to assist decision-makers in enhancing their supply chain efficiency.

Information sharing plays a key role in the activities enhancing the performance of the supply chain, especially the integration and collaboration of the supply chain (SCIngt and SCCol). Fawcett et al. (2011) indicate that collaboration in the supply chain becomes more effective because of effective information sharing (Fawcett et al., 2011). According to Müller & Gaudig (2011), sharing information increases the probability of expanding and building relationships (Müller & Gaudig, 2011). Thanks to information sharing, flexibility in production and distribution are increased to react quickly to changing market conditions (Wu et al., 2014). On the other hand, the integration and collaboration of the supply chain (SCIntg and SCCol) also are important activities contributing to the improvement of supply chain performance (SCPerf). According to Natour et al. (2011), SCCol is part of the success of SCIntg (Natour et al., 2011). SCCol strengthens long-term relationships between partners to increase the efficiency of the integration process (Mangan & Lalwani, 2016; Ken Mathu & Phetla, 2018). According to Flynn et al. (2010), Lau et al. (2010), and Ou et al. (2010), SCIntg is a great innovation in supply chain management and significantly contributes to firm performance (Flynn et al., 2010; Lau et al., 2010; Ou et al., 2010). SCIntg is one of the

possible tools to enhance the competitiveness of companies and bring about operational efficiency (Sundram et al., 2016). Therefore, the more and more effective the information sharing, the more positive the effect on integration and collaboration of the supply chain. This also contributes to the improvement of supply chain performance.

To be able to succeed in establishing or improving information sharing, commitment and technology are encouraged for managers or decision-makers. In particular, commitment should be the first priority if the business is limited by capacity and budget constraints. commitment has a significant impact on IShar and Trust (Maister et al., 2021; Xiao et al., 2010), as well as a correlation to technology (Mahmud et al., 2021). Extensively, the findings of this study provide a fundamental basis for the global supply chain to consider both commitment and technology to improve information exchange. A global supply chain is a network of many members dispersed across many different countries to provide goods and services (Meixell & Gargeya, 2005). Arnold et al. (2010) indicate the connection between Comt and IShar in the global supply chain (Arnold et al., 2010). Shore (2001) presents the influence of InfT on IShar in the global supply chain (Shore, 2001). However, the impact of each factor on IShar can be rearranged because of the difference between the global and local supply chain.

Some of the contributions found in our study are added to the literature in the scope of information exchange in the supply chain. Firstly, hypotheses regarding the effects of IShar on SCPerf and SCPerfIA and of SCPerfIA on SCPerf, as well as between members of SCPerfIA have been confirmed. Moreover, the impact of factors on sharing information is also reaffirmed. This has significant implications for supporting the findings of previous studies. Another contribution is that the study has indicated the important role of mediators in a relationship between two factors. Thirdly, the study has emphasized the significant effects of IShar and SCCol on the performance and activities enhancing the performance of the supply chain. Prioritizing improved information sharing should be considered. Similarly, Comt and InfT are confirmed as two key factors for IShar. Commitment should take precedence when building or improving information-sharing systems/networks. Finally, there is more than 50% influence of other factors on SCPerf, SCFlex, SCCol, and IShar. Individually, SCIntg has 48% influence from factors other than IShar and SCCol.

Besides the contributions of this study, there are some limitations found in our study. First of all, the data collection followed the structure of the meta-analysis method. They were selected from available articles relevant to our research topic. Although the publications are carefully selected, some articles may still be missing during the publication search. However, by using the fail-safe number test and publication bias test, the sample size in this study was sufficient for the results and conclusions to be reliable. In addition, only common activities/factors are selected for analysis models in this study. Therefore, it is necessary to determine other important factors.

Some suggestions are proposed to scholars. Firstly, finding the impact of other factors/activities on IShar, SCPerf, SCIntg, SCFlex, and SCCol is one of two research directions that can be performed in the future. These results can be compared to the results in this study to evaluate which activities/factors are the most important on IShar, SCPerf, SCIntg, SCFlex, and SCCol. This can help decision-makers to focus on improving key activities/factors and reduce resource waste to perform multiple activities/factors at the same time. Another is the consideration of mediators in the relationships. Researchers can determine mediators or evaluate their effect of them on the relationship between two factors. From that, the effect of one factor on another can be understood deeply through mediators. Finally, the results of the present study can be considered as valuable evidence of the important role of IShar for SCCol and the significant influence of Comt for IShar. This is a fundamental foundation for future researchers to expand the in-depth research about sharing information in the collaboration of the supply chain and the improvement of commitment to information sharing.

5. PRACTICAL APPLICABILITY OF THE RESULTS

Analysis of the research results shows that both direct and indirect effects of information sharing on supply chain efficiency are not statistically significant when other activities are involved structural model between information sharing and supply chain efficiency. However, information sharing have strongest impact on supply chain collaboration and supply chain integration while both supply chain collaboration and integration strongly affect supply chain performance. In addition, the result analysis also indicates the effect of all four factors (commitment, trust, information technology, and environmental uncertainty) on information sharing, in which commitment has the strongest effect on information sharing. From the present study results, their practical applicability are presented, as follows:

1. The current results show that supply chain collaboration strongly affects supply chain integration, supply chain significantly influences supply chain performance, and supply chain collaboration has an indirect effect on supply chain performance through supply chain integration. Our findings suggest that managers can take advantage of their existing collaboration in the supply chain to stimulate supply chain integration and consequently influence their supply chain performance level. In addition, managers can now determine which supply chain collaborations will potentially be more beneficial in enhancing supply chain integration. Greater benefits can be achieved if managers improve operations in information-sharing areas such as commitment, trust, information technology, and environmental uncertainty. Furthermore, if managers are considering investing in supply chain management, it is clear that managers should invest in both supply chain collaboration and supply chain integration to get the most benefit for supply chain performance. As a result, investment decisions should not be a stand-alone activity considering only collaboration or integration as supply chain integration mediates the relationship between supply chain collaboration and the performance of the supply chain. Managers are required to make this clear to top management for any budget allocation for the purpose of investing in supply chain management activities. In some cases, some difficulties such as resources or budget are prioritized in discussion and consideration, for example, for small and medium enterprises beginning to form their

supply chain, the supply chain collaboration should be prioritized for investment consideration first.

2. Information sharing does not have the direct effect on supply chain performance. The role of information sharing on supply chain performance only is described by its strong effect on two key activities of supply chain performance including supply chain integration and collaboration. Therefore, managers and researchers should be cautioned in assuming that information sharing is one of indicators measuring the performance of the supply chain. This theoretically contribution is rare in the past literatures. This information is very crucial, especially in the age of globalization where increasingly firms build or develop the information sharing system.
3. Information sharing strongly affects two key activities of supply chain performance, including integration and collaboration of the supply chain (SCIngt and SCCol). Fawcett et al. (2011) indicate that collaboration in the supply chain becomes more effective because of effective information sharing (Fawcett et al., 2011). According to Müller & Gaudig (2011), sharing information increases the probability of expanding and building relationships (Müller & Gaudig, 2011). Thanks to information sharing, flexibility in production and distribution are increased to react quickly to changing market conditions (Wu et al., 2014). Therefore, the effectiveness of sharing information can be considered as an measure indicator of the collaboration or integration of the supply chain in practice. In addition, due to the effect of information sharing on both supply chain collaboration and supply chain integration and the positive impact of supply chain collaboration on supply chain integration, information sharing is also considered as a mediator variable in the real model testing the relationship between supply chain collaboration and supply chain integration. Besides, all information sharing, supply chain collaboration, and supply chain integration should be received the investment of managers to improve supply chain performance because of the positive relationships between all three and supply chain performance (as in our analysis). In some cases, if only one can be chosen because of some limitations such as resources or budget, decision-makers should prefer information-sharing implementation first. Information sharing increases effective communication among supply chain members (Sundram et al., 2016) and strengthens

cooperation and integration between supply chain members (de Mattos & Barbin Laurindo, 2015).

4. All four factors including commitment, trust, information technology, and environmental uncertainty affect information sharing. Therefore, all four factors should be considered as a measure of the effectiveness of an information system in practice. According to Zhong et al. (2020), two states in building an information-sharing system are the level of willingness to share information and the quality of information sharing (Zhong et al., 2020). Managers can improve their commitment to foster goodwill from supply chain partners. Commitment can be improved by contracts with clear criteria between stakeholders. Trust and information technology enhances the quality of information sharing among supply chain members. Mutual trust is the driving force for managers to share important information. The higher the level of trust, the easier it is for important information to be shared. Information technology helps information be brought to the right place, to the right people, and to the right content quickly, accurately, and securely. Based on these, managers can reassess the level of trust between their partners and the techniques they currently use to share information. From there, the necessary improvements can be made to increase the efficiency of their information-sharing system. Finally, environmental uncertainty should be considered by managers when operating a real system. To transmit large volumes of information, sharing information through official information exchange systems is more effective than transferring information through social interaction. However, in some situations when demand is uncertain, it is more effective to share information through social interaction. Conversely, when demand is predictable, information sharing through social interaction is less effective. Siyu Li et al. (2019) indicates that it is more convenient to cooperate with customers in both operational and strategic aspects when sharing information through the company's official information system, but as unpredictable demand increases high, social interaction, such as face-to-face communication, will be more suitable for complex problem solving (Siyu Li et al., 2019). Therefore, managers can determine the level of uncertainty (may be based on the ability to forecast demand) to choose the appropriate method of information sharing.

6. MAIN CONCLUSIONS AND NOVEL FINDINGS OF THE DISSERTATION

Some major conclusions and the findings of novelty are highlighted, as follows:

1. The impact of one factor/ activity on another can be different in the individual relationships between two activities/factors and the structural associations between activities/factors in the same set. In an examination of the own link between supply chain collaboration (SCCol) and supply chain performance (SCPerf), for instance, SCCol has a significant direct influence on SCPerf with a correlation of 0.6. By contrast, in the structural connection of the set of information sharing (IShar), supply chain performance (SCPerf), and the activities of supply chain performance (SCPerfIAs), the direct impact of SCCol on SCPerf is not statistically significant. SCPerf is only indirectly impacted by SCCol with a correlation of 0.36 through supply chain integration (SCIntg) and supply chain flexibility (SCFlex). In addition, the comparison between two examinations (1- the individual connection between a pair of factors/activities and 2- the structure connection between activities/factors in the same set), presents mediators in a relationship between two elements and emphasizes the bridging role of mediators in relationships. This provides evidence that mediators should be considered when examining factor relationships.
2. The significance of IShar for SCPerf is highlighted because IShar is an essential element in two vital activities that mainly contribute to the efficiency of the supply chain. In the structure relationship of the set of IShar, SCPerf, and SCPerfIAs, SCIntg and SCCol are two activities with higher decision weight than SCFlex in improving SCPerf. Although IShar does not have a statistically significant contribution to the direct improvement of the performance of the supply chain, it is a key element affecting all activities enhancing the efficiency of the supply chain, especially SCIntg and SCCol. IShar is an indispensable part of the integration and cooperation process among supply chain members. In addition, the percentage of other activities/factors that affect on SCPerf, SCIntg, SCCol, and SCFlex is indicated accurately through the percentage of the variance R^2. For example, IShar and SCCol account for more than 50% of the variance of SCIntg. It may be certain that the success of SCIntg mostly comes from the contributions of IShar and SCCol but there are still contributions from

other factors. Thus, other activities should be considered in improving activities and the performance of the supply chain.

3. All 4 factors including commitment (Comt), information technology (InfT), trust (Trust), and environmental uncertainty (EnU), affect IShar in both two tests including the pair relationship test and the structural relationship test. Comt has the strongest effect on IShar with a correlation coefficient of 0.54 in the Comt-IShar relationship test and with an estimated coefficient of 0.77 (including both direct and indirect effects on IShar) in the structural examination of a set. Therefore, it is undoubted that Comt is a key factor in sharing information. In addition, structural relationship testing shows that there are other factors affecting IShar. This is described as a percentage of variance (R2) of IShar which is 0.38. Therefore, other factors need to be given more attention to improve information sharing.

7. SUMMARY

The present study examines the direct effect of information sharing (IShar) on supply chain performance (SCPerf) and the indirect impact of IShar on SCPerf through the activities of supply chain performance (SCPerfIAs) including supply chain integration (SCIntg), supply chain collaboration (SCCol), and supply chain flexibility (SCFlex). This study also determines and evaluates the influence of IShar's factors on IShar. In this study, there are five objectives including:

1. To confirm the correlation relationships between activities/factors considered in this study
2. To identify the structure of the relationships in the set of IShar, SCPerf, and SCPerfIAs and the relationships in the set of IShar and the factors of IShar
3. To accurately determine the degree of the effect of IShar on SCPerf through:
   - Measuring the direct effect of IShar on SCPerf
   - Measuring the impact of IShar on SCPerfIAs including SCIntg, SCCol, and SCFlex
   - Measuring the influence of SCPerfIAs on SCPerf
4. To accurately evaluate the accurate influence of factors such as commitment (Comt), information technology (InfT), trust (Trust), and environmental uncertainty (EnU) on IShar in the supply chain
5. Propose the key activities/factors for improving SCPerf and IShar, as well as the activities that should be prioritized for improvement of SCPerf and IShar

Two methods are used:

1. Meta-analysis (MA) is to examine the connection of each pair of two activities/factors
2. Meta-analytic structural equation modeling (MASEM) is to determine the suitability of relationship structures of two sets of activities/factors, including 1) set of IShar, SCPerf, and SCPerfIAs including SCIntg, SCCol, and SCFlex and 2) set of the factors of IShar and IShar

Five conclusions are drawn from the results of this study, as follows:

1. There is enough evidence to statistically confirm the correlation of 15 pairs of activities/factors except for the relationship between InfT and EnU.

2. The important role of intermediaries in the relationships between two activities/factors.
3. Two activities IShar and SCCol should be firstly prioritized when improving the performance of the supply chain. In which, IShar has more priority than SCCol.
4. Comt and InfT are two elements strongly affecting information exchange. In which, Comt should be given priority over InfT if resources or budgets are limited.
5. There are still over 50% of other factors/activities affecting the change of SCPerf, SCFlex, SCCol, and IShar besides considered factors/activities. For SCIntg, other activities/factors account for 48% of the variance of SCIntg.

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LIST OF ABBREVIATIONS

Comt	:	Commitment
EnU	:	Environmental uncertainty
ERT	:	Egger's regression test
InfT	:	Information technology
IShar	:	Information sharing
MA	:	Meta-analysis
MASEM	:	Meta-analytic structural equation modeling
RCT	:	Rank correlation test
SCCol	:	Supply chain collaboration
SCFlex	:	Supply chain flexibility
SCIntg	:	Supply chain integration
SCPerf	:	Supply chain performance
SCPerfIAs	:	Supply chain performance improvement activities
SEM	:	Structural equation modeling
Trust	:	Trust
TSSEM	:	Two-stage structural equation modeling

LIST OF PUBLICATIONS

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