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

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The aim of this dissertation is to obtain a doctoral (PhD) degree in the scientific field of „Management and Business”

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DECLARATION

I undersigned (name: Le Thi Diem Chau, date of birth: 24/07/1991) declare under penalty of perjury and certify with my signature that the dissertation I submitted in order to obtain doctoral (PhD) degree is entirely my own work.

Furthermore, I declare the following:

- I examined the Code of the Károly Ihrig Doctoral School of Management and Business Administration and I acknowledge the points laid down in the code as mandatory;
- I handled the technical literature sources used in my dissertation fairly and I conformed to the provisions and stipulations related to the dissertation;
- I indicated the original source of other authors' unpublished thoughts and data in the references section in a complete and correct way in consideration of the prevailing copyright protection rules;
- No dissertation which is fully or partly identical to the present dissertation was submitted to any other university or doctoral school for the purpose of obtaining a PhD degree.

Debrecen, …………………..

Le Thi Diem Chau

signature

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1. INTRODUCTION OF THE TOPICS AND OBJECTIVE

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), the collaboration of the supply chain (SCCol), and the flexibility of the supply chain (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 SCPerfIAs and 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 behavior. 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 activities to improve supply chain performance (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.

On 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 of 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 IShar and SCPerf, between IShar and SCPerfIAs including SCIntg, SCCol, and 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 evaluates 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. MA and MASEM are used in this study. MA is used to quantitatively study solutions by summarizing, analyzing, 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 Comt over Trust, InfT, and EnU in information exchange. The conclusions in this study add value to the literature in the scope of information exchanging 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

2. LITERATURE REVIEW

An overview of IShar in the supply chain is introduced in this chapter. It describes the various aspects of exchanging information in the supply chain through previous studies. Besides, this chapter also indicates the gaps between previous studies. From that, it is a fundamental foundation for forming our current research topic. As a result, this literature review consists of three contents, including 1) the steps of a literature review, 2) the definition and benefits of IShar in the supply chain, 3) the aspects of IShar in the supply chain, and 4) the gaps and current research direction.

2.1. Literature review process

According to Lune & Berg (2017), a literature review plays an important role in a study for a number of reasons. First of all, much information pertaining to a research topic is provided in the literature review. For example, different aspects of the research topic, problems resolved / unresolved by previous studies, or research directions that may be expanded in the future. These support researchers' knowledge to form a detailed topic and a methodology clearly. Another reason is that the literature review is considered to be effective evidence of the authors' understanding of their research topic to readers (Randolph, 2009). Based on the results of reviewing previous studies, unresolved points or points of further expansion are clearly indicated. These are very important for the formulation of research questions and the motivation of finding the answers to research questions. Thus, the reliability and integrity of the research topic's overall argument are increased (Berg et al., 2012). Wee and Banister (2016) also give similar confirmation about the usefulness of literature review for researchers. The value of a study is greatly increased when a well-structured and up-to-date literature review in a specific area is clearly displayed. For example, the research gaps are published clearly or the advantages and disadvantages of the methods used in the study are outlined/discussed distinctly. This useful information is significant support for those readers wishing to use the results of the study or research in the same field (Wee & Banister, 2016). A study is considered to be seriously flawed if it is omitted or misleading in the literature review (Boote & Beile, 2005).

According to Tranfield et al. (2003), a systematic literature review (SLR) is an effective approach used for identification, selection, and evaluation to clearly answer an established question (Tranfield et al., 2003). Unlike traditional narrative reviews, SLR adopts a clear, detailed, and specific process. In other words, it is described as a transparent and scientific process. Thus, bias is minimized during a document search (Mulrow, 1994). Following Chen & Huang (2020), Maskey et al. (2015), and Tranfield et al. (2003), the application of SLR in our study is briefly described in six steps as in Figure 1 (Ziyue Chen & Huang, 2020; Maskey et al., 2015; Tranfield et al., 2003).

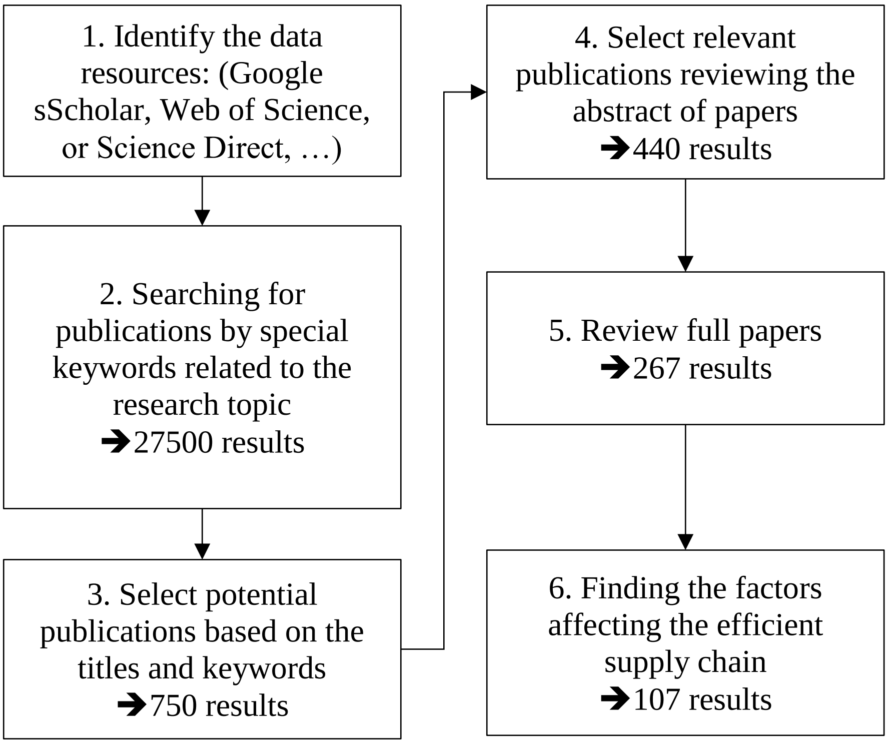


Figure 1: Steps of applying systematic literature review

Source: Own research (2021)

Based on the 27500 results of searching for terms related to information exchange and the supply chain on Google Scholar, there are 750 results selected because of the appearance of search terms in the titles or keywords. Then, the abstracts of these papers are reviewed to find 440 relevant publications. The criteria for selecting relevant publications consist of 1) papers written in English, 2) articles belonging to our study area, and 3) publications have to fully obtain the aims of the study, methods used to find solutions, and relevant conclusions. After that, 267 papers are selected and divided into three five groups based on the characteristics of problems of relevant publications. Finally, based on selected 107 articles, the important factors are identified that not only affect supply chain efficiency but also have a relationship with IShar.

2.2. The definition and benefits of IShar in the supply chain

IShar refers to good quality information exchange between collaborative partners working together in the supply chain (Gang Li et al., 2006). According to (Sun, S., & Yen, J., 2005), IShar in the supply chain describes the activities that useful knowledge is shared among partners to serve downstream customers effectively and efficiently. Thus, IShar may be contained knowledge transfer (Shuang Sun & Yen, 2005). The connection between partners in the supply chain seems to be created by exchanging information (Min et al., 2005).

Hou et al., 2014 divided information communication into internal IShar within firms and external IShar among firms in the supply chain (Huo et al., 2014). Internal IShar is represented by necessary supply chain information flows transferred among functions within a firm. External IShar indicates that supply chain information is exchanged between an individual and its partners such as suppliers and customers (Caixia Chen et al., 2019; Koufteros et al., 2007).

Many benefits are reaped by individuals but also for the entire supply chain through the exchange of information (Jingquan Li et al., 2001). According to Singh, H., Garg, R., & Sachdeva, A. (2018), there are 11 benefits of IShar to supply chain management. They relate to not only the improvement of productivity, visibility, and resource utilization, but also the reduction of inventory, bullwhip effect, cycle time, and supply chain cost (Singh et al., 2018). Lotfi et al. (2013) point out that IShar reduces the vulnerability of the supply chain (Lotfi et al., 2013). Gavirneni et al. (1999) show a 1-35% reduction in supplier costs by inventory information exchange (Gavirneni et al., 1999). Similarly, inventory costs and related costs are also significantly reduced because of IShar (Hau L Lee et al., 2000; Hau L Lee & Whang, 2004). Besides, Datta & Christopher (2011) indicate that the lack of information leads to an increase in Forrester's impact on the supply chain. Therefore, well-exchanging information between supply chain individuals has a significant effect on the reduction of uncertainty in the supply chain (Datta & Christopher, 2011). Furthermore, the efficiency of IShar increases the improvement of resource utilization (Mourtzis, 2011), the productivity of product and services (Tung-Mou Yang & Maxwell, 2011), and the quick response to the change in the market (Jauhari, 2009), as well as increasing social relationships (Hau L Lee & Whang, 2004). IShar is a critical factor that decides the sustainability of coordination in the supply chain (Mehmood Khan et al., 2018). For example, stakeholders would require relational mechanisms (e.g., trust) to reinforce their cooperation and mitigate the uncertainties arising from unanticipated events in the supply chain (Jie Yang et al., 2008). In addition, sharing information between participants in the supply chain also helps them to face and overcome the consequences of risks and disruptions that can occur to a business entity and can spread to the entire supply chain (Haobin Li et al., 2017). Based on quality information, firms avoid the risks and access the new changes in the business environment (Malhotra et al., 2007). For instance, Motorola seizes better the change in customer preference trends because of collaboration with retailers and sharing information between Motorola and retailers (Grover & Kohli, 2012). Therefore, IShar is an essential factor to increase mutual trust and improve relationships among supply chain members (Moberg et al., 2002).

2.3. A comprehensive picture of IShar in the supply chain

The comprehensive picture of exchanging information in the supply chain is described by the number of studies by Journal, the number of studies by year, keywords, characteristics of information exchanging problems, and methodology of information-sharing problems.

2.3.1. The number of studies by Journal

IShar in the supply chain has challenged many researchers in the past few decades. The searching words such as “information sharing” and “supply chain”, “information exchange” and “supply chain”, “information integration” and “ supply chain”, or “knowledge sharing” and “supply chain” are used to search for relevant articles between 2010 and 2021 on Google Scholar. Search results show that there are 267 selections to perform the analysis steps in our research. These selected publications are based on both the title and keyword of the publications containing the search terms and the in-depth analysis of abstract and complete content in articles. These 267 articles are published in 142 journals, of which 60% of previous studies (equivalent to 159 studies) are primarily published in 34 journals (Figure 2), and another 40% are published in 108 other journals (equivalent to 108 studies).

Figure 2 shows the statistics of the high-ranking journals where most relevant studies have been published such as “The International Journal of Production Economics”, “Computers & Industrial Engineering”, “European Journal of Operational Research”, and so on. In particular, these journals publish 102 studies, accounting for 38.2% of the total number of previous studies. Of which, 21 studies are published in “International Journal of Production Economics”, 13 studies are published in “Computers & Industrial Engineering”, 9 studies are published in “European Journal of Operational Research”, 6 publications are appeared in “Management Science”. Besides, 24 studies are published in “Production and Operations Management”, “International Journal of Operations & Production Management”, and “Industrial Management & Data Systems” with the number of studies of 8, 8, and 8, respectively. Similarly, 14 publications are equally separated by “Journal of Enterprise Information Management” and “International Journal of Production Research”. Finally, “International Journal of physical distribution & logistics management”, “Omega”, and “Supply Chain Management: An International Journal” published 15 studies, of which each journal published five studies.

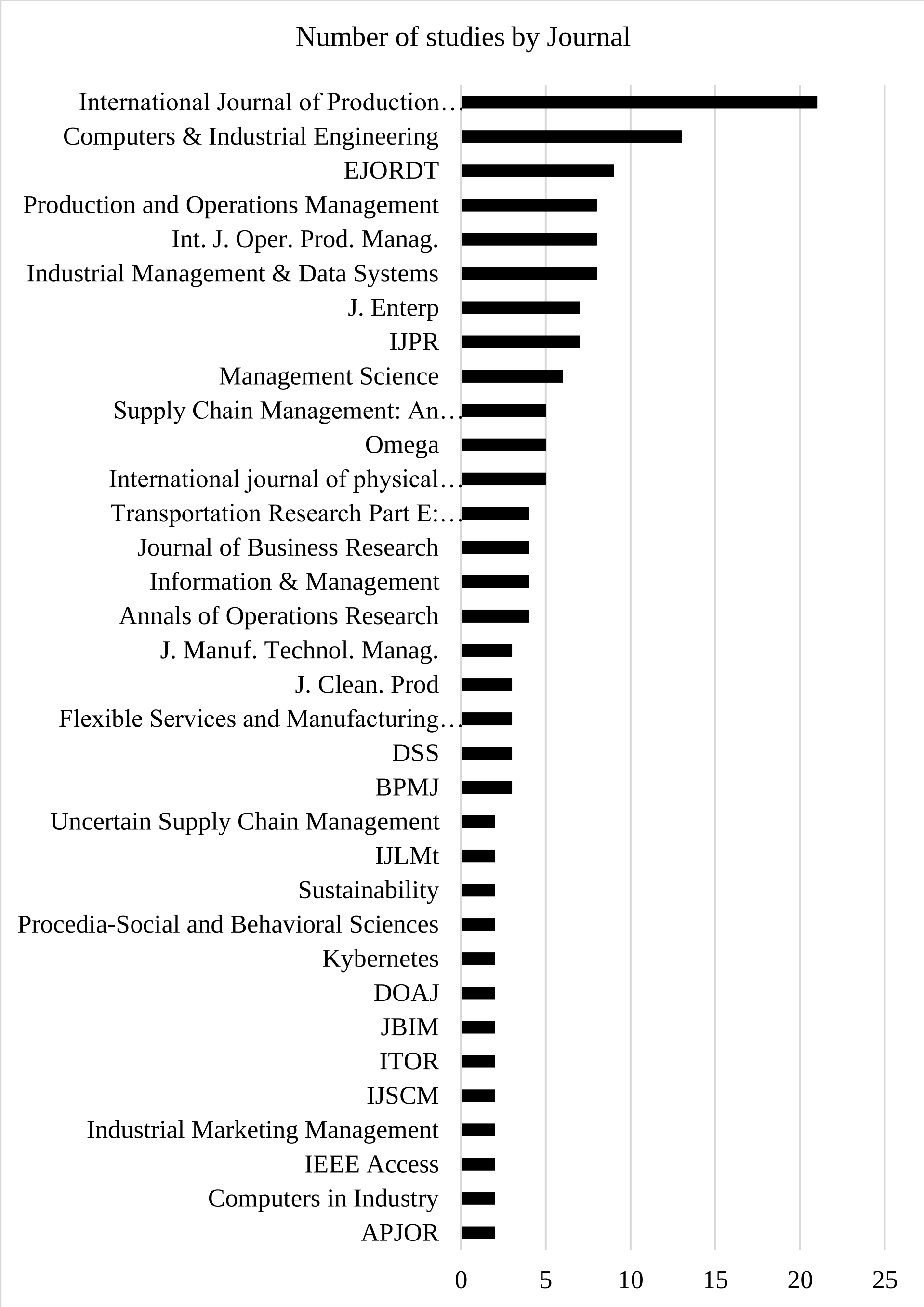


Figure 2: Number of studies by Journal

Note: Publications are published from 2010 to March 2021

Source: Own research (2021)

2.3.2. Number of studies by publication year

Figure 3 describes the number of publications in the area of IShar between the years 2010 and 2021. Overall, the number of articles published annually has a tendency to develop significantly over the past decade. Between 2010 and 2012, the number of publications increased significantly from fourteen publications to approximately 25 articles before dropping slightly to twenty-four in 2013. In the next six years, from 2013 to 2018, there was a slight fluctuation in the number of publications between the minimum value of 21 articles and the maximum number of publications of 24 articles. However, this fluctuation was also completed in 2018 before starting a period of strong growth. The number of publications increased significantly in 2019 with 26 articles and peaked at 38 publications by 2020.

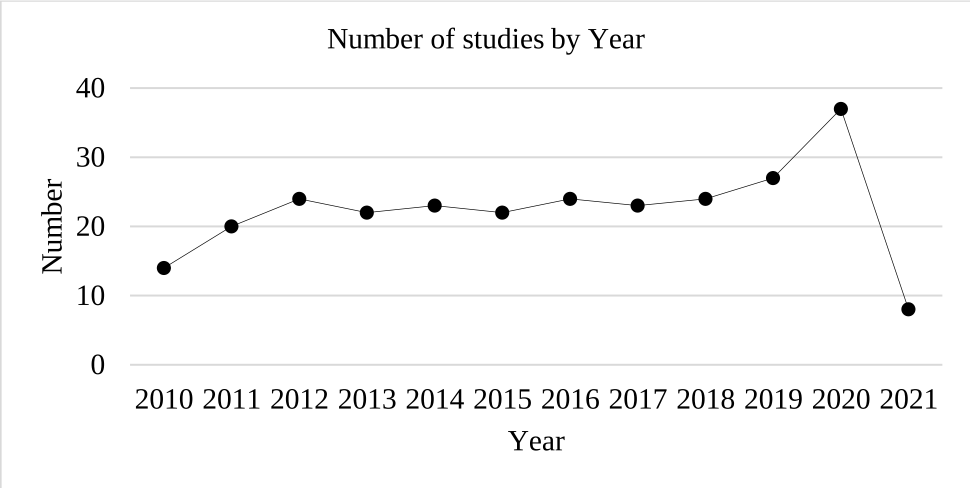


Figure 3: Number of studies by publication year

Note: Publications are published from 2010 to March 2021

Source: Own research (2021)

2.3.3. Keywords

In the scope of sharing information in the supply chain, there are 620 keywords appearing in 267 articles. However, only 18 keywords appear frequently in most previous studies besides two search words “information sharing” and “supply chain”. They are “supply chain performance”, “collaboration”, “bullwhip effect”, “relationship”, “information technology”, “trust”, “supply chain integration”, “supply chain flexibility”, “game theory”, “simulation”, “uncertainty”, “information quality”, “survey methods”, “structure equation modeling”, “blockchain”, “systematic literature review”, “sustainability”, and “commitment”.

Figure 4 shows the frequency of 18 popular keywords. As an overall trend of statistics, the frequency of these keywords appears more than 5 times. Keywords of “supply chain performance” and “collaboration” have the highest appearance frequency of over 20 times. The frequency of appearing from 10 to 20 times belongs to seven keywords as follows: “bullwhip effect”, “relationship”, “information technology”, “trust”, “supply chain integration”, “supply chain flexibility”, “game theory”. Finally, “simulation”, “uncertainty”, “information quality”, “survey methods”, “structure equation modeling”, “blockchain”, “systematic literature review”, “sustainability”, and “commitment” are the keywords with the lowest frequency of less than 10 but higher than 5.

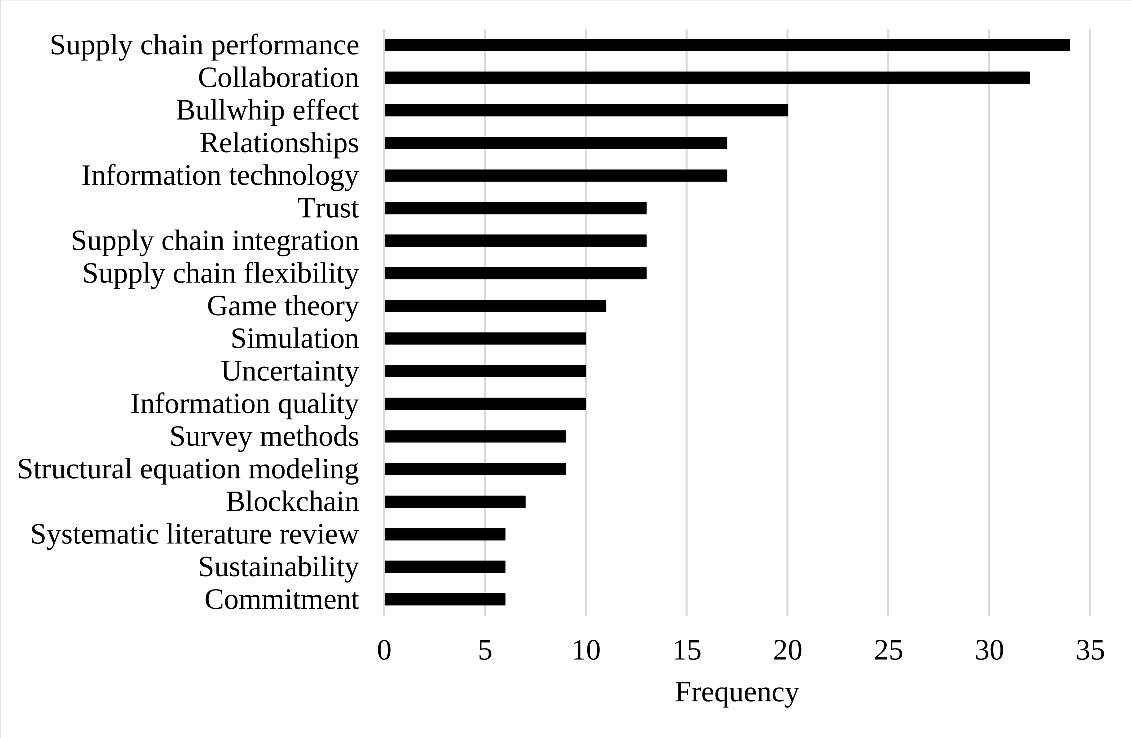


Figure 4: Popular keywords in previous studies

Note: other keywords have frequency less than and equal to 5

Source: Own research (2021).

2.3.4. Characteristics of problem

Based on the aims and problem description of 267 previous studies, the characteristics of the problem are divided into five groups by the authors. The groups consist of 1) information sharing and factors – IShar and factors, 2) information sharing value, 3) innovation in sharing information, 4) theory, and 5) others. The description of the characteristics of each group is as follows:

- Group 1 – IShar and factors:
  Group 1 is a rally of problems relating to relationships between IShar and activities/factors. The activities/factors include collaboration, commitment, information quality, information technology, trust, uncertainty, relation, flexibility, integration, the performance of the supply chain, big data, bullwhip effect, business performance, competition, cost efficiency, credit quality, financial performance, information availability, innovation, inventory efficiency, the magnitude of promotion, ordering policies, power, reciprocity, resource reliability, supply chain practice, sharing risks,

supply chain learning, supply chain network, time of promotion, truthful information, and so on. Solutions to articles in group 1 are to answer some questions, as follows:

- How the information sharing influences factors, or which factors affect information sharing. For instance, Tokar et al. (2011) investigate the influence of IShar on the efficiency of costs in the supply chain (Tokar et al., 2011). Olorunniwo & Li (2010) indicate the important effect of IShar on the performance of reverse logistics (Olorunniwo & Li, 2010). Du et al. (2012) determine that close relationships are one of the critical factors affecting the success of IShar in the supply chain (Timon C Du et al., 2012). Fernando et al. (2020) suggest that inventory efficiency is affected by sharing inventory information between manufacturers (Fernando et al., 2020). Chen et al. (2011) show the role of IShar in the connection of the supply chain. It positively affects both Trust and Comt of partners in the supply chain (Jengchung V Chen et al., 2011).
- Whether or not the mediating effect of IShar in the relationship between factors. For example, Ali et al. (2019) indicate that IShar is a mediator in the connection between network ties and credit quality in small and medium enterprises (Zulqurnain Ali et al., 2019).

• Group 2 – Information sharing value:

In this group, previous studies mainly focus on characteristics of problems, as follows:

- To minimize costs or maximize profits or benefits for each partner or/and overall supply chain. For example, Rached et al. (2015) determine an optimal model to minimize logistics costs when different types of information are shared between supply chain participants (Rached et al., 2015). Zhang et al. (2011) investigate the value of IShar by establishing cost-optimization models at suppliers (Sheng Hao Zhang & Cheung, 2011), or Jeong & Leon (2012) introduce an optimal coordination model, based on exchanging information with the nearest upstream member to maximize benefits (Jeong & Leon, 2012).
- To build the models of IShar under consideration of different parameters or new factors/ policies to perform improvements and assists businesses in making the decisions. The results of making a decision may be to find the right plans or increase competition in the market. For example, Feng (2012) applies the system dynamics method to establish the information-sharing model in the supply chain. In addition, Feng also simulates the IShar process when the parameters of the model are changed, and makes suggestions for improvements (Feng, 2012). Ali

et al. (2017) support decision-makers by performing two situations when running their optimal model. These situations consist of 1) performing a solution without demand sharing information, and 2) performing a solution with demand exchanging information. Based on the results, decision-makers may confirm whether or not they should share the information (Mohammad M Ali et al., 2017). Similarly, Liu et al. (2020) also evidence the benefits of exchanging information in the e-tailing supply chain through the results of a mathematical model. These results assist businesses in deciding whether or not to share information (Molin Liu et al., 2021).

– To determine the model of the relationship among members in the supply chain when they share information to assess benefits for each member and the whole system. This supports businesses in creating strong coordination with their partners via sharing information. For example, Esmaeili et al. (2018) use the Stackelberg game to model the relationship between retailers and warehouses. From there, the benefits of retailers and warehouses are determined when information is shared between them (Esmaeili et al., 2018). Similarly, Cheng (2011) models the relationship between manufacturer and retailer and proposes benefits to supply chain members when information is shared (Jao-Hong Cheng, 2011).

- Group 3 – Innovation in exchanging information:

  Articles in group 3 mainly use advanced solutions to increase the efficiency of IShar to create sustainable coordination in the supply chain. For example, Du et al. (2017) apply RFID and multi-agent simulation to effectively exchange information in the component industrial chain (Juan Du et al., 2017). Hasibuan et al. (2020) use a Blockchain system to share the information on product lifecycle in order to a contractual coordination model in the supply chain (Hasibuan et al., 2020). Vasilev et al. (2019) propose that ERP system is one of the effective tools for sharing information between upstream partners in the supply chain (Vasilev & Stoyanova, 2019). Or, Chen & Huang (2020) indicate that digital twins are an effective solution for information asymmetries (Ziyue Chen & Huang, 2020).

- Group 4 – Theory:

  Theoretical lenses, theory models, and concepts, relating to different aspects of sharing information in the supply chain, are explored by articles in group 4. Wilson (2010) defines the effect of trust, risk, benefits, and the closeness of the organization on IShar through a literature review (Wilson, 2010). Jonsson & Myrelid (2016) define the utilization and influence of information in the supply chain (Jonsson & Myrelid, 2016). Or, Sharma & Routroy (2016) defines concepts of information risks and determine various information risks in sharing information (Sharma & Routroy, 2016).

- Group 5 – Others

Analysis of the problem characteristics in 267 articles showed the difference in the number of studies among the 5 groups (Figure 5).

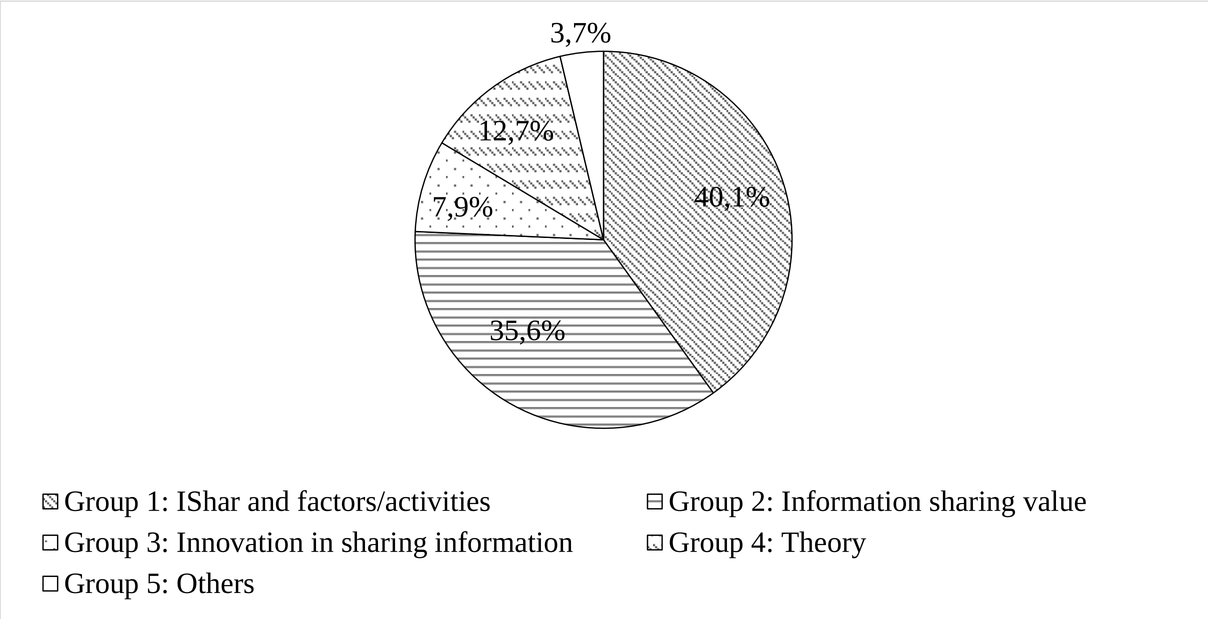


Figure 5: Ratio of five groups of articles (n = 267)

Note: Publications are published from 2010 to March 2021

Source: Own research (2021)

Overall, problems in groups 1 and 2 are of most concern in previous studies, while all three other groups account for less than a quarter of the pie chart. Groups 1 and 2 account for over 75% of the total number of previous studies. In which, the number of studies in group 1 is larger than group 2 by 4.5%. Group 1 takes 40.1%, and group 2 accounts for 35.6%. Next, the theory is interested in 12.7 % of previous studies. This percentage indicates that group 4 ranked third when compared with others. Finally, groups 3 and 5 account for 7.9 % and 3.7%, respectively. The detailed numbers of the previous studies are divided into 5 groups, shown in Table 1.

Table 1: Division of previous studies

Group	# of studies
1- IShar and factors/activities	107
2- IShar value	95
3-Innovation in sharing information	22
4- Theory	33
5- Others	10

Note: Publications published from 2010 to March 2021

Source: Own research (2021)

Figure 6 shows the change in study numbers among five groups from 2010 to 2021. Overall, groups 1, 2, and 4 have a tendency to develop significantly, while groups 3 and 5 tended to decrease by over 20 years. Between 2010 and 2012, the number of studies in groups 1 and 2 increased significantly from 6 to 11 studies and from 4 to 9 studies, respectively. Similarly, the study number in the theory group slightly increased from 3 to 4 studies. By contrast, the number of studies in groups 3 and 5 was unchanged during this period. In the next period from 2012 to 2017, the number of studies in all five groups fluctuates significantly. The largest fluctuation was the study number in group 1 with a maximum value of 11 studies in 2014 and a minimum value of 5 in 2015. The number of studies in group 5 fluctuated at the weakest, and its value is changed from 0 to 2 studies. Finally, in the recent five years from 2017 to 2021, the number of studies in most groups tended to increase significantly except for the number of studies in group 5. Particularly, group 1 leads in the number of studies with a maximum value of 16 studies in 2020. Groups 2, 3, and 4 rank in 2, 3, and 4, respectively. Similar to their ranking, their maximum values are 12, 8, and 2, respectively.

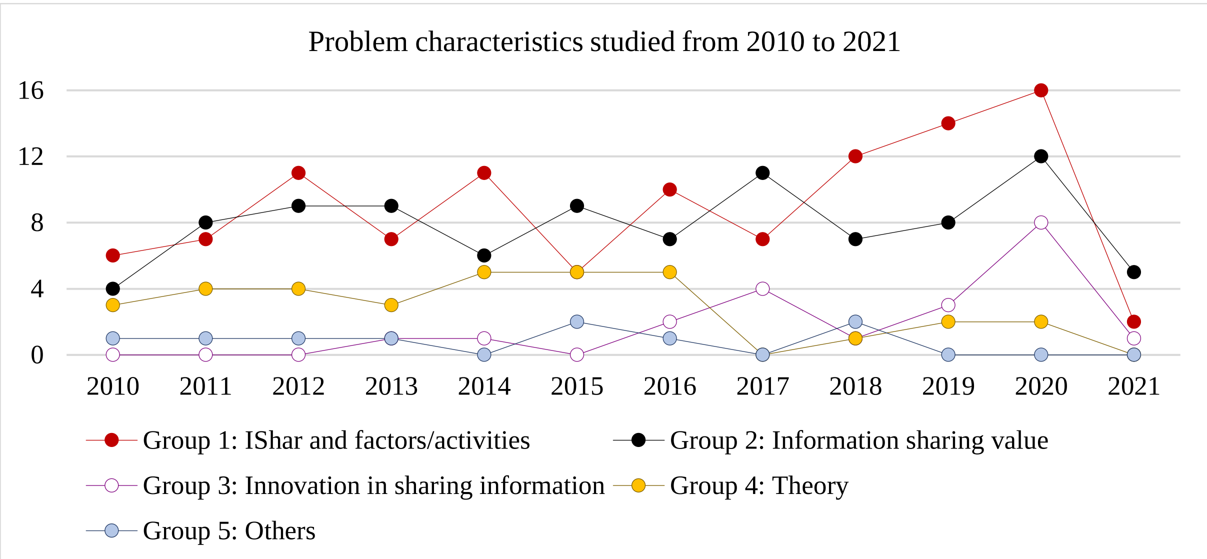


Figure 6: Problems studied over the 10 year period

Source: Own research (2021)

In conclusion, Figure 5, Table 1, and Figure 6 clearly describe the differences in authors' concern about characteristics of problems in the area of IShar, especially in the recent five years. During this period, the topics related to IShar and factors/activities that attracted the attention of scholars increased more and more. This conclusion is drawn by the number of studies continuously increasing year by year and the highest total number of studies when compared with other groups, as well as the growth rate when comparing the maximum and minimum values. Similarly, the group 4 – theory has received much attention from previous scholars. However, its attention is ranked only 4th when compared to the other four groups. The number of studies slightly increase from 2017 to 2019 and stabilized in the following year. Unlike groups 1 and 4, groups 2 and 3 dropped significantly from previous scholars' attention from 2017 to 2018 before slightly increasing in 2019 and picking up in 2020. Compared to the total number of studies, the ranking of group 2 is higher than group 3 with positions 2 and 3, respectively. However, the growth rate of group 3 is higher than that of group 2. This means that the innovation in sharing information seems to be an emerging topic.

2.4. The gaps between current study and previous studies

Based on the comprehensive picture of IShar in the supply chain, the IShar and activities/factors are a fundamental foundation to form the current direction. The process of finding research questions and the research gap is performed by carefully considering the detailed information of 107 previous studies in group 1. The detailed information includes factors/activities considered by most studies, the methodology used in previous studies, and the results of research articles. First of all, there are 9 factors/activities considered by most previous studies (Figure 7). They are "information sharing (IShar)", "supply chain performance (SCPerf)", "supply chain collaboration (SCCol)", "trust (Trust)", "information technology (InfT)", "supply chain flexibility (SCFlex)", "commitment (Comt)", "supply chain integration (SCIntg)", and "environmental uncertainty (EnU)". Overall, each factor is considered by a different number of previous studies. In particular, IShar and SCPerf attract more attention from scholars than others. In particular, there are 107 previous studies introducing IShar, and 50 previous studies considering SCPerf in their analysis and problems. By contrast, other factors only appear in less than 25 previous studies. Firstly, SCCol and Trust take 23 and 21 studies, respectively. Next, some factors accounting for the attention of under 20 previous studies but greater than 10 previous studies, are InfT, SCFlex, Comt, and SCIntg. Finally, there are 7 previous studies that paid more attention to the relationship between EnU and IShar.

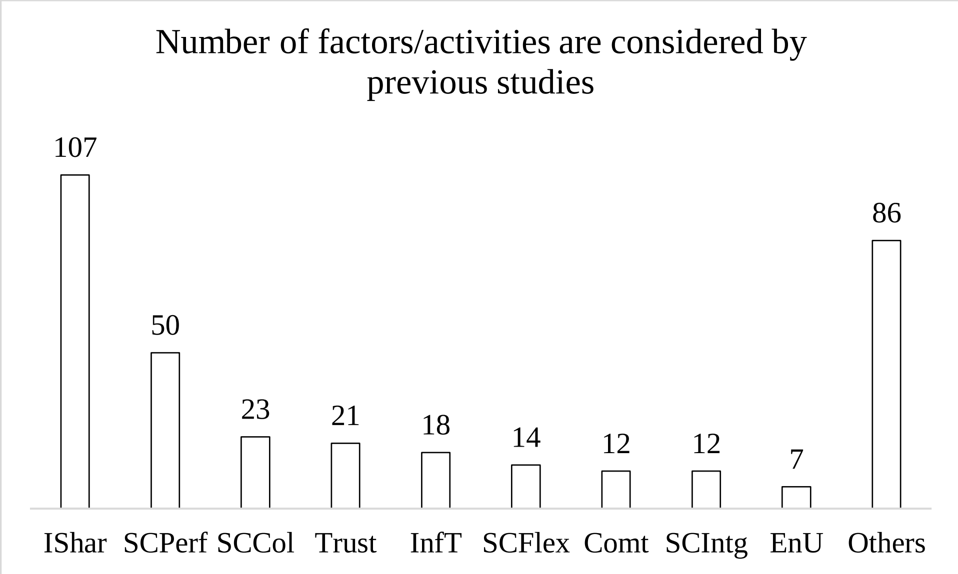


Figure 7: Number of factors have relationship with information sharing

Note: Publications are published from 2010 to March 2021

Source: Own research (2021)

Secondly, there are various methodologies used in previous studies, which are shown in Figure 8. The methodologies include analytic hierarchy process, Anova analysis, the research method of case study, data analysis, Delphi method, experiment model, factor analysis, interpretive structural model, mathematical model, the method of partial least squares, path analysis, qualitative research methodology, combination between quantitative and qualitative techniques, quantitative method, quasi-experimental approach, regression analysis, sentiment analysis approach, simulation, statistical analysis, and SEM. Overall, SEM is used in the majority of previous studies, while other methodologies are only applied in less than 25 previous studies. In particular, there are 51 relevant studies that use SEM to test hypotheses and analyze the relationships in their studies. Next, the application of analyzing regression is found in 14 previous studies. Finally, for the remaining methodologies, the number of previous studies applying them for solving the problems is less than or equal to 10 studies. For example, a mathematical model is appeared in 10 previous studies, or analyzing data is used in 4 relevant studies.

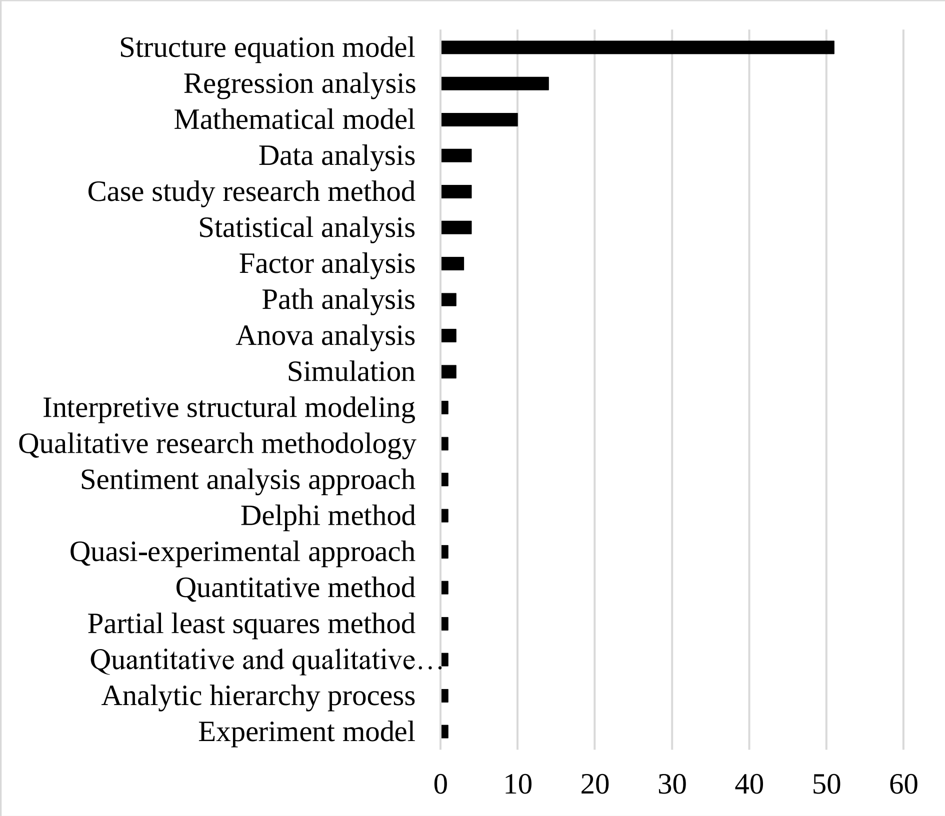


Figure 8: Methodology used in previous studies (n = 107)

Note: Publications are published from 2010 to March 2021

Source: Own research (2021).

Last but not least, the results of previous studies, focusing on the connection between IShar and factors/activities, are shown in Figure 9. Overall, there is a difference among the previous study numbers when considering the relationship between IShar and factors/activities. The relationship between IShar and SCPerf is investigated by approximately 40 previous studies. However, the relationships between IShar and others are only introduced in less than 15 but greater than 5 previous studies. In particular, the relationship between IShar and SCCol, between IShar and SCFlex, between IShar and Trust, between SCIntg and SCPerf, between SCCol and SCPerf, between IShar and SCIntg, between IShar and Comt, between SCFlex and SCPerf, and between IShar and EnU. Finally, fewer than 5 previous studies look at the relationships of information with each of the remaining factors.

On the other hand, the results in Figure 9 also show that almost all previous studies propose two types of results.

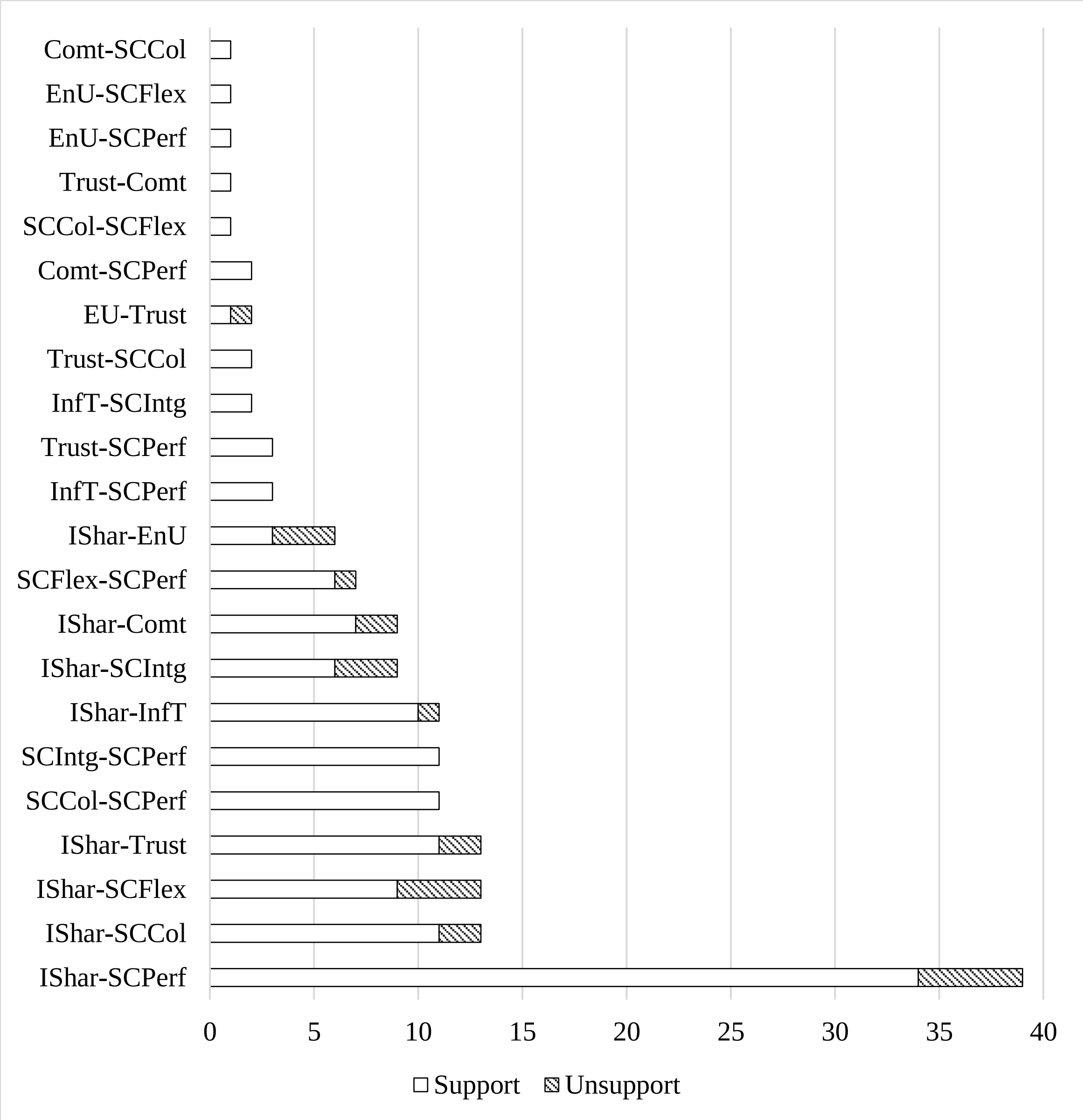


Figure 9: Relationship between IShar and factors/activities (n = 107)

Note: Publications are published from 2010 to March 2021

Source: Own research (2021)

In Figure 9, these two types of results are acceptance or non-acceptance of null hypotheses developed in each article. Almost null hypotheses are positive relationship between IShar and activities/factors. For example, the positive connection is found between IShar and SCPerf (Sundram et al., 2020), or IShar improves the influence of inner studying on flexibility performance (Huo et al., 2021)". Overall, there is a significant difference between the number of studies containing supported and unsupported null hypotheses in the relationship between IShar and each factor/activity. In almost the relationship between IShar and each factor/activity, the number of studies that accept the null hypothesis is extremely higher than the number of studies that do not accept the null hypothesis. For instance, 34 studies support the positive relationship between IShar and SCPerf while the non-acceptance of this positive relationship only accounts for 5 previous studies. Similarly, for the hypothesis of a positive relationship between IShar and SCCol, there are 11 studies that accept this hypothesis but only 2 studies reject the positive relationship between these two factors/activities.

In conclusion, the analyses from Figures 6, 7, 8, and 8 show the three most notable points. First of all, the relationships between IShar and 8 different factors/activities attracted the most attention from previous studies. These 8 factors/activities are SCPerf, SCCol, Trust, InfT, SCFlex, Comt, SCIntg, and EnU often appear. Besides, the structural equation model is the most popular method, is used to test the relationship between IShar and factors/activities in almost previous studies. Secondly, the results of the test were divided into two opposing groups. In particular, some studies give results that IShar positively affects each considered factor. For example, Wong et al. (2020), Hendy et al. (2020), and Zhong et al. (2020) accept the hypothesis about the positive relationship between IShar and SCPerf (Hendy Tannady et al., 2020; Wai-Peng Wong et al., 2020; Zhong et al., 2020). Hove-Sibanda & Pooe (2018), Dubey et al. (2018), and Brandon-Jones et al. (2014) confirm the influence of SCCol on IShar (Brandon-Jones et al., 2014; Dubey et al., 2018; Hove-Sibanda & Pooe, 2018). Or, Kong et al. (2021), Kang & Moon (2016), and Koçoğlu et al. (2011) support the positive correlation between IShar and SCFlex (Kang & Moon, 2016; Koçoğlu et al., 2011; Kong et al., 2021). On the contrary, the acceptance of the positive connection between IShar and individual factors/activities has been rejected by several other previous studies. For instance, Üstündağ & Ungan (2020) suggest that IShar has no positive relationship with supplier flexibility. This result is based on surveying 119 companies in Turkey (Üstündağ & Ungan, 2020). There is a rejection of the positive relationship between IShar and SCFlex (Baihaqi & Sohal, 2013; Hsin Hsin Chang et al., 2013). Or, Alzoubi & Yanamandra (2020), and Şahin & Topal (2019) do not accept the positive relationship between IShar and SCFlex (Alzoubi & Yanamandra, 2020; Hasan Şahin & Topal, 2019). Last but not least, 36.4% of relevant studies consider the relationship between IShar and SCPerf. 90% of considered factors/activities have a relationship with both IShar and SCPerf. Furthermore, SCPerf and its relationships seem to receive much attention from scholars besides the relationship between IShar and factors/activities. The fact is evident that the number of studies on the link between SCPerf and factors/activities ranks second only to IShar.

Therefore, some research questions are formed from the above analysis, as follows:

- Is there any influence between IShar and each considered factor/activity?
- Which factors/activities influence IShar, and vice versa?

- What element/activity is most important to IShar?
- Among the factors/activities under consideration, what are mediators between IShar and SCPerf? And, which mediators will be strongly influenced by IShar or have a positive influence on SCPerf?

In this study, the connection between IShar and factors/activities in the supply chain is continuously examined. The factors/activities involve SCPerf, SCIntg, SCFlex, SCCol, Comt, InfT, Trust, and EnU. This research purposes to determine the impact of IShar on SCPerf and the influence of IShar on SCPerfIAs. Simultaneously, this study also indicates mediators being bridges in the relationship between IShar and SCPerf and between IShar and SCPerfIAs, as well as between SCPerfIAs and SCPerf. Furthermore, the study also proposes the important factors affecting the efficiency of IShar in the supply chain. In addition, the mediators between factors are also presented. MA and MASEM are used to analyze data and test hypotheses in this study. In particular, MA is mainly used to explore the relationships between two factors/activities. MASEM is used to indicate the direct and indirect IShar on factors through the mediating factors and vice versa. The reasons and differences between MA, MASEM, and others are described in the next section. Data used in analysis methods are correlation coefficients. The correlation coefficients are gathered from relevant studies.

There are some differences between the current study and previous studies. First of all, the current study considers 9 factors/activities considered, while less than or equal to 5 factors/activities are proposed by previous studies (Table 2). The scope of considered factors/activities only contains IShar, SCPerf, SCIntg, SCCol, Comt, Trust, InfT, and EnU. Other factors/activities are ignored in this comparison and research. For instance, Sundram et al. (2020) investigate 4 factors/activities consisting of IShar, SCPerf, SCIntg, and InfT in their survey (Sundram et al., 2020). Or, Fernando et al. (2020) only consider IShar and InfT (Fernando et al., 2020). Üstündağ & Ungan (2020) mention four factors/activities including IShar, SCPerf, SCFlex, and EnU in their problem (Üstündağ & Ungan, 2020).

Another difference is the methodology and data used to analyze and solve the problems. The fact remains that there are different methods used in previous studies. However, the structural equation model and regression analyses are more popular than others (Figure 8 and Table 2). To perform the analysis of these two methods, data are mainly collected by surveys. Similarly, for the remaining methodology such as mathematical model, Anova analysis, path analysis, or simulation, the collection of data is performed by surveys, experiments, or numerical examples. Unlike the methodologies and the data collection methods in previous studies, our study proposes a new method that is not available in 107 previous studies. MA and MASEM are used in the current study. Both differences and benefits of MA and MASEM are shown in the next section. Data served for analyzing both two methods are collected from publications.

Last but not least, a complex relationship model contributes to the gap between the current study and previous studies. Many previous studies focus on investigating the direct relationship between two factors. For example, the relationship between IShar and SCPerf (Al-Doori, 2019; Hendy Tannady et al., 2020; Jermsittiparsert & Rungsrisawat, 2019). Some previous studies investigate more complex models. They test the relationship among three factors including the relationship between IShar and SCPerf, between IShar and SCCol, and between SCPerf and SCCol (Siyu Li et al., 2019; Tutuhatunewa et al., 2019). Unlike previous studies, our study examines the complex relationships in the set of IShar, SCPerf, SCIntg, SCCol, and SCFlex and the complex relationships in the set of IShar, Comt, Trust, and EnU. Both direct and indirect relationships are determined in our study.

Table 2: Factors and methodology by each study

Author	Year	Factor										Methodology	Data
		1	2	3	4	5	6	7	8	9	99		
Xue Chen et al.	2021	✓									✓	M	N-A
Kong et al.	2021	✓			✓						✓	SEM	S
Tang et al.	2021	✓									✓	M	E
Huo et al.	2021	✓				✓					✓	SEM	S
Sener et al.	2021	✓	✓					✓			✓	SEM	S
Üstündağ & Ungan	2020	✓	✓			✓				✓		SEM	S
Sundram et al.	2020	✓	✓		✓				✓			Multiple RA	S
Hasibuan et al.	2020	✓		✓		✓						SEM	S
Wai-Peng Wong et al.	2020	✓	✓						✓			SEM	S
Fernando et al.	2020	✓							✓		✓	SEM	S
Mabrouk	2020	✓				✓	✓	✓	✓		✓	ISM	S
Alzoubi & Yanamandra	2020	✓	✓			✓						PLSSEM	S
Yugang Yu et al.	2020	✓									✓	M	N-A
Hendy Tannady et al.	2020	✓	✓						✓			SEM	S
Pu et al.	2020	✓										RA	S
Huang & Wang	2020	✓									✓	M	N-A
van der Westhuizen & Ntshingila	2020	✓									✓	SEM	S
Qihui Yang et al.	2020	✓									✓	SEM	S
Zhong et al.	2020	✓	✓				✓	✓				SEM	S
Kenneth M Mathu	2019	✓		✓	✓				✓			Q	P
Al-Doori	2019	✓	✓									FA & RA	S
Sener et al.	2019	✓	✓								✓	SEM	S
Minnens et al.	2019	✓					✓	✓			✓	SA	S
Swain & Cao	2019	✓	✓	✓			✓	✓				SA	S
Thaiprayoon et al.	2019	✓	✓									SEM	S

Author	Year	Factor										Methodology	Data
		1	2	3	4	5	6	7	8	9	99		
Nugraha & Hakimah	2019	✓	✓									SEM	S
Hasan Şahin & Topal	2019	✓									✓	SEM	S
Tutuhatunewa et al.	2019	✓	✓	✓								SEM	S
Jermsittiparsert & Rungsrisawat	2019	✓	✓									PA	S
Siyu Li et al.	2019	✓	✓	✓						✓	✓	SEM	S
Zulqurnain Ali et al.	2019	✓	✓								✓	SEM	S
Teunter et al.	2018	✓									✓	M	N-A
Hove-Sibanda & Pooe	2018	✓	✓	✓							✓	SEM	S
Mehmood Khan et al.	2018	✓	✓				✓			✓	✓	SEM	S
Dubey et al.	2018	✓		✓		✓		✓				Multiple RA	S
Eckerd & Sweeney	2018	✓									✓	RA	S
Afshan et al.	2018	✓		✓			✓	✓			✓	SEM	S
Shahbaz et al.	2018	✓	✓									FA & RA	S
Sundram et al.	2018	✓	✓		✓				✓			SEM	S
Wiengarten & Longoni	2018	✓								✓	✓	SEM	S
Luu et al.	2018	✓									✓	RA	S
Chang-Hun Lee & Ha	2018	✓									✓	SEM	S
Panahifar et al.	2018	✓	✓	✓			✓					SEM	S
Raweewan & Ferrell Jr	2018	✓		✓								M	E
Fu et al.	2017	✓					✓	✓			✓	DA	S
Quandt et al.	2017	✓									✓	Si	E
Kembro et al.	2017	✓	✓				✓		✓			DM	I
Minkyun Kim & Chai	2017	✓				✓					✓	SEM	S
Tarafdar & Qrunfleh	2017	✓	✓			✓						SEM	S
Ayabakan et al.	2017	✓							✓		✓	QEA	S
Vikas Kumar et al.	2017	✓	✓		✓							CA	S
Galappaththi et al.	2016	✓		✓								Cs	S&I
Kumar et al.	2016	✓	✓			✓					✓	FA	S
Ya’kob & Jusoh	2016	✓	✓								✓	Multiple RA	S
Bargshady et al.	2016	✓				✓						QM	S
Kulangara et al.	2016	✓					✓				✓	SEM	S
Mettler & Winter	2016	✓									✓	SEM	S
Song et al.	2016	✓									✓	SEM	S
Kang & Moon	2016	✓	✓		✓				✓			PLS	S
Riley et al.	2016	✓									✓	Q-sorts & FA	S
Costantino et al.	2015	✓									✓	M	E
Chen Liu et al.	2015	✓	✓	✓							✓	SA	S
Gichuru et al.	2015	✓	✓									Q & QM	S
Chirchir et al.	2015	✓	✓		✓						✓	SEM	S
Denolf et al.	2015	✓									✓	Cs	S
Huo et al.	2014	✓	✓								✓	SEM	S
Brandon-Jones et al.	2014	✓	✓	✓							✓	Multiple RA	S

Author	Year	Factor										Methodology	Data
		1	2	3	4	5	6	7	8	9	99		
Badea et al.	2014	✓		✓								AHP	
Wu et al.	2014	✓	✓	✓			✓	✓			✓	SEM	S
Popovič et al.	2014	✓									✓	SEM	S
Jia et al.	2014	✓	✓					✓		✓	✓	RA	S
Hussain et al.	2014	✓	✓								✓	SA	S
Tung-Mou Yang & Wu	2014	✓							✓			DA	I
Yina Li et al.	2014	✓	✓			✓	✓				✓	SEM	S
Zhiqiang Wang et al.	2014	✓					✓			✓	✓	SEM	S
Zailani et al.	2014	✓					✓	✓	✓			SEM	S
Jraisat et al.	2013	✓	✓									DA	I
Tae-Ryong Kim & Song	2013	✓	✓	✓								DA	S
Ye & Wang	2013	✓				✓			✓		✓	SEM	S
Jao-Hong Cheng et al.	2013	✓									✓	SEM	S
Hefu Liu et al.	2013	✓	✓	✓	✓							Hierarchical RA	S
Hsin Hsin Chang et al.	2013	✓	✓		✓							SEM	I&E
Baihaqi & Sohal	2013	✓	✓	✓	✓				✓		✓	SEM	S
Timon C Du et al.	2012	✓									✓	SEM	S
Eckerd & Hill	2012	✓									✓	SEM	S
Ebrahim-Khanjari et al.	2012	✓					✓					M	E
Hall & Saygin	2012	✓	✓			✓					✓	Si	E
Zelbst et al.	2012	✓	✓						✓			SEM	S
Youn et al.	2012	✓				✓	✓					SEM	S
Peng et al.	2012	✓									x	PLSPA	S
Ibrahim & Ogunyemi	2012	✓	✓	✓								RA	S
Prajogo & Olhager	2012	✓	✓		✓				✓			RA	S
Chengalur-Smith et al.	2012	✓			✓						✓	FA	S
Schloetzer	2012	✓									✓	RA	S
Tokar et al.	2011	✓									✓	E	E
Jengchung V Chen et al.	2011	✓					✓	✓		✓	✓	RA & ANOVA	S
Kun Liao et al.	2011	✓	✓				✓					SEM	S
Piderit et al.	2011	✓	✓				✓		✓		✓	Cs	Cs
Özer et al.	2011	✓					✓					M	E
Jao-Hong Cheng	2011	✓		✓							✓	Ht	S
Koçoğlu et al.	2011	✓	✓	✓								SEM	S
Olorunniwo & Li	2010	✓	✓	✓								RA	S
Ren et al.	2010	✓									✓	M	E
Cai et al.	2010	✓					✓				✓	SEM	S
Tai & Ho	2010	✓										ANOVA	S
Pandey et al.	2010	✓	✓						✓		✓	SA	S
Kähkönen & Tenkanen	2010	✓		✓							✓	Cs	I
This study		✓	✓	✓	✓	✓	✓	✓	✓	✓		MASEM	Sd

1 – IShar, 2 – SCPerf, 3 – SCCol, 4 – SCIntg, 5 – SCFlex, 6 – Trust , 7 – Comt, 8 – InfT, 9 – EnU, 99 – Others, M – Mathematical model, SEM – structure equation model, RA – regression analysis, ISM – interpretive structural modeling, PLSSEM – partial least square structure equation model, Q – qualitative research methodology, FA – factor analysis, SA – statistics analysis, PA – path analysis, DA – data analysis, Si – simulation, DM – Delphi method, QEA – Quasi-experimental approach, CA – correlation analysis, QM – quantitative method, AHP – analytic hierarchy process, ANOVA – ANOVA analysis, Ht – hypotheses test, MASEM – Meta-analysis structural equation model, N-A – numerical analysis, S – survey, E – experiment, I – interviews, P – a non-probability sampling, Cs - case study, Sd – secondary data

Note: Publications are published from 2010 to March 2021

Source: Own research (2021)

3. METHODS

3.1. MA

3.1.1. Defination and difference of MA and other methods

MA is used to quantitatively study solutions by summarizing, analyzing, and comparing results from the literature (Lipsey & Wilson, 2001). According to Chalmer et al. (2002) and O'rourke (2007), meta analysis-based techniques are used very early by Rosenthal & Rubin (1978) and Schmidt & Hunter (1977) (Chalmers et al., 2002; O'rourke, 2007; Rosenthal & Rubin, 1978; Schmidt & Hunter, 1977). However, based on the research of Glass (1976), MA is known as a popular statistical technique (Glass, 1976). Then, MA attracts more attention from scholars, especially in the area of psychology. For example, based on the integrated analysis, Smith & Glass (1977) points out the effectiveness of psychological therapy and there is no difference when comparing the effectiveness of different types of treatments (Smith & Glass, 1977).

Today, the application of MA is widespread in many fields such as the educational sciences, social and medical sciences. In the areas of economics, finance, logistics, and supply chain, this statistical technique has gradually appeared in many previous studies (Bhosale & Kant, 2016). Leuschner et al (2013) collect data from 86 articles and use meta-analysis to find the relationship between SCIntg and various firm performance dimensions (Leuschner et al., 2013). Ataseven & Nair (2017) introduce the dimensions of SCPerf and integration. Then, they apply MA to investigate the relationships between dimensions of each other (Ataseven & Nair, 2017). Pakurár et al. (2020) find the importance of factors on the performance of the supply chain when applying meta-analysis to synthesize and analyze 35 relevant publications (Pakurár et al., 2020).

According to Glass (1976), MA has some differences when compared to "primary analysis" and "secondary analysis" (Glass, 1976). The difference between the three methods is shown in Table 3, as follows:

- For the term "primary analysis", is known as a methodology used by researchers to directly collect data from individual persons, companies, and so on. The collected data are analyzed to serve for finding solutions to the research questions (Card, 2015; Glass, 1976). According to Driscol (2011), the methods of collecting data may be interviews, online surveys, focus groups, or observations. Due to direct data collection in primary research, the data has high accuracy and is suitable for the demand of users. Besides, the data is controlled and used at the discretion of the individuals or organizations collecting it. However, conducting primary research is quite expensive and takes much time. Sometimes researchers need to use other methods besides primary analysis to solve the problem. Thus, the workload, time, and cost will maybe double (Driscoll, 2011).

- For the term “secondary analysis”, this method refers to using or analyzing the existing data, collected by other researchers. This method is intended to identify the original research question but uses better statistical techniques. Besides, it is also designed to answer new research questions but uses old data (Hui G Cheng & Phillips, 2014; Glass, 1976). According to Kiecolt et al. (1985) and Cheng & Phillips (2014), data in secondary research may be collected from sources such as online, archives from Government and NGOs, libraries, or Institutions of Learning. Due to the variety of data sources, researchers may save much time and reduce costs when applying secondary analysis. In addition, the secondary analysis also is very useful for scoping the study and determining the research gaps. However, the secondary analysis also has some disadvantages. It is difficult to determine the authenticity of the original data because of undirect data collection. Besides, the existing data may not be correlated with the research process or outdated data. Secondary analysis may not have the information advantage because the data is used by many people (Hui G Cheng & Phillips, 2014; Kiecolt et al., 1985).
- Unlike primary and secondary analysis, MA is a synthesis of results analyzed statistically from more than one study. Thus, MA has some highlighted differences in input data and inferred conclusions (Card, 2015). First of all, if raw data is needed for primary and secondary analysis, it is not required for a study using MA. Input data in MA were collected from many previous studies (Church, 2002). Another difference is conclusions. Following the characteristics of MA, input data are accumulated and summarized from studies researching in similar fields before performing further analysis and comparison. Therefore, it is undoubted that conclusions of studies that used MA are inferred from a sample of studies (Glass, 1976). This leads to that the estimates of results can be improved precisely and accurately. Due to the greater precision and accuracy of estimates, the statistical power is also increased in detecting the effects (Jak, 2015).

Table 3: Difference between MA, primary analysis, and secondary analysis

	Primary analysis	Secondary analysis	Meta-analysis
Definition	The term "primary analysis" is known as a methodology used by researchers to directly collect data from individual persons, companies, and so on. The collected data are analyzed to serve for finding solutions to the research questions (Card, 2015; Glass, 1976)	The term "secondary analysis" refers to using or analyzing the existing data, collected by other researchers. This method is intended to identify the original research question but uses better statistical techniques. Besides, it is also designed to answer new research questions but uses old data (Hui G Cheng & Phillips, 2014; Glass, 1976)	MA is described as a method quantitatively finding solutions by synthesizing and comparing the results of the empirical literature (Rosenthal & Rubin, 1978)
Research Methods	Some methods to collect data (Driscoll, 2011): • Interviews via telephonic or face-to-face • Online surveys • Focus groups • Observations	Secondary research methods include: • Online Data • Data from Government and Non-government Archives • Data from Libraries • Data from Institutions of Learning	The resutls of pubications • Mean • Binary data (risk ratio, odds ratios, and risk difference) • Correlation
Advantages	• Data is collected directly and accurately • Easily customizable according to the requirements of individuals, businesses, or organizations • Focus on the problem and find the solution to the problem • Collecting data is controlled • Is a time-tested method	• Easy access • Cost savings and it takes not too much time • Identify the research gaps is the fundamental foundation for a more systematic investigation • It is very useful for scoping the study, which serves for other field surveys	• Conclusions are inferened from a set of studies • The original data is non-obligatory • Save costs and time
Disadvantages	• It is quite expensive to conduct a primary analysis • Time-consuming • Sometimes it is necessary to use more than one method other than primary analysis to solve the problem. Therefore, it can double the time and cost of construction and implementation	• It is difficult to determine the authenticity of the original data • The existing data may not be correlated with the research process • It may not have the information advantage because the data is used by many people • It is possible that the data is out of date	• Selecting incorrect literature may provide erroneous conclusions

Source: Own study (2021)

On the other hand, the position of MA is also considered in the larger group of literature reviews because a literature review is also considered a synthesis of previous literature on a particular subject (Card, 2015). Figure 10 describes the difference between MA in a comprehensive literature review system, containing superordinate category, focus, and methods of synthesis. The fact remains that each type of research focuses on the special aspects of research direction. For example, the reviews of theories mainly focus on using theories to explain new phenomena or perspectives. Similarly, in research synthesis, methods pay more attention to research results. MA is one of these synthesis methods. Unlike other approaches in the same group; however, MA uses synthetic findings in relevant studies to make conclusions.

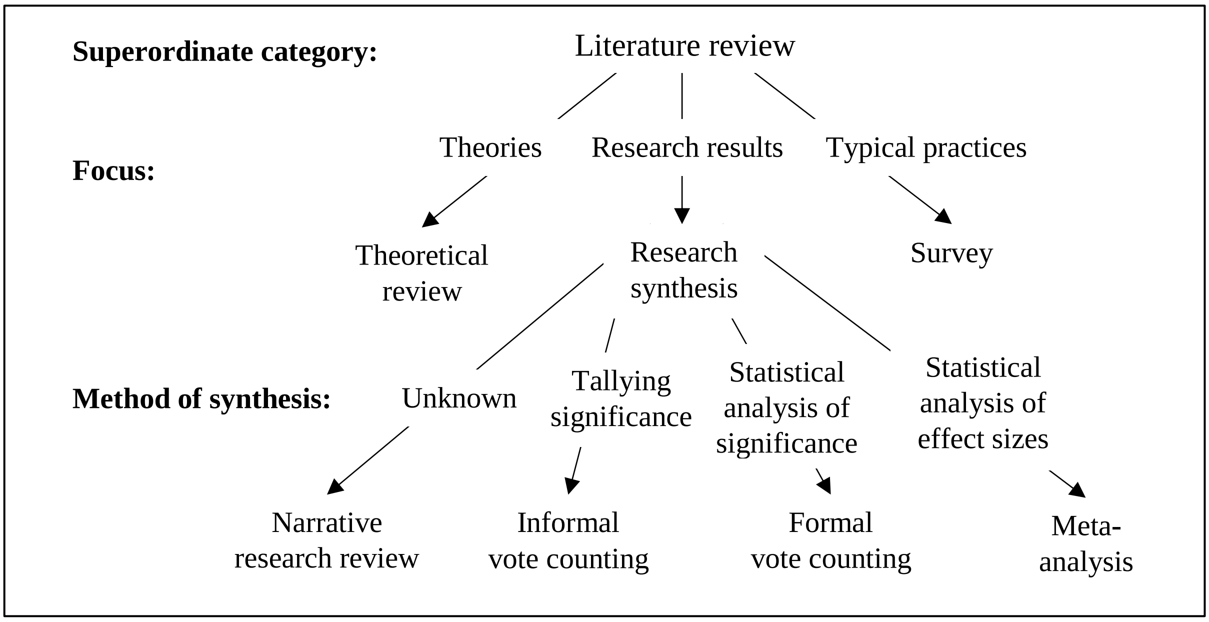


Figure 10: The relationship between MA and types of literature reviews

Source: Card, (2015)

3.1.2. The process of performing MA

According to Hedges & Cooper (2009), the process of performing a MA consists of five steps. They are the formulation of problems, finding studies, selecting suitable studies, analyzing the results of studies, and presenting findings (LV Hedges & Cooper, 2009). Field and Gillett (2010) introduce 6 stages to implement studies with MA. 6 steps include the literature search, publication selection criteria, effect size calculation, basic calculations of meta-analysis, advanced analysis, and report writing (Field & Gillett, 2010). Although there is a difference in the number of steps in both two studies, the process of performing meta-analysis is equivalent (Figure 11). In particular, steps 1 and 2, 3, 4, and 5 in Hedges & Cooper (2009) are equivalent to steps 1, 2, the next three steps (3, 4, and 5), and 6 in Field and Gillett (2010), respectively.

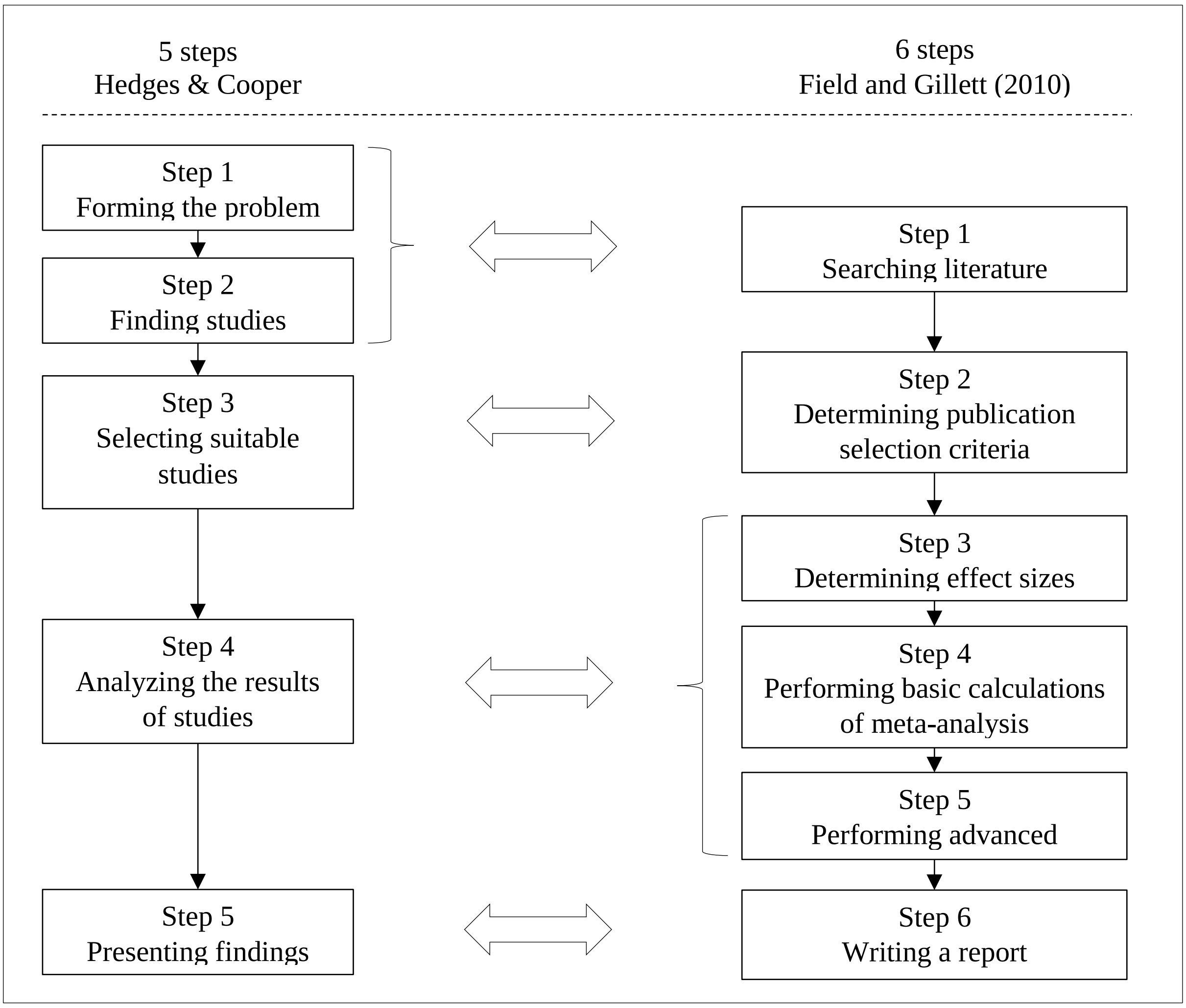


Figure 11: The process of performing MA

Source: Field & Gillett, (2010); LV Hedges & Cooper, (2009)

Following Hedges & Cooper (2009) and Field and Gillett (2010), the application of meta-analysis in our study is performed as follows:

- The first stage is to determine the research problem in our study. Based on the literature review section, the problem of the relationship between IShar and factors/activities in the supply chain is found. The factors/activities involve SCPerf, SCIntg, SCCol, SCFlex, Comt, Trust, InfT, and EnU. The purposes of the research are to develop and identify the validity of IShar affecting factors/activities, and the role of IShar on supply chain operations. Besides, the study also proposes the important factors affecting the efficiency of IShar. The aims of the study are to answer some research questions, including 1) Is there any influence between IShar and each considered factor/activity?, 2) What is the relationship between IShar and each factor/activity?, 3) Which factors/activities influence IShar, and vice versa?, 4) How is IShar affected by each factor, and vice versa?, and 5) What is the relationship among factors/activities?

- Finding and selecting studies are the next two stages. The process of these two stages is followed by 12 steps of searching the literature (Figure 12).

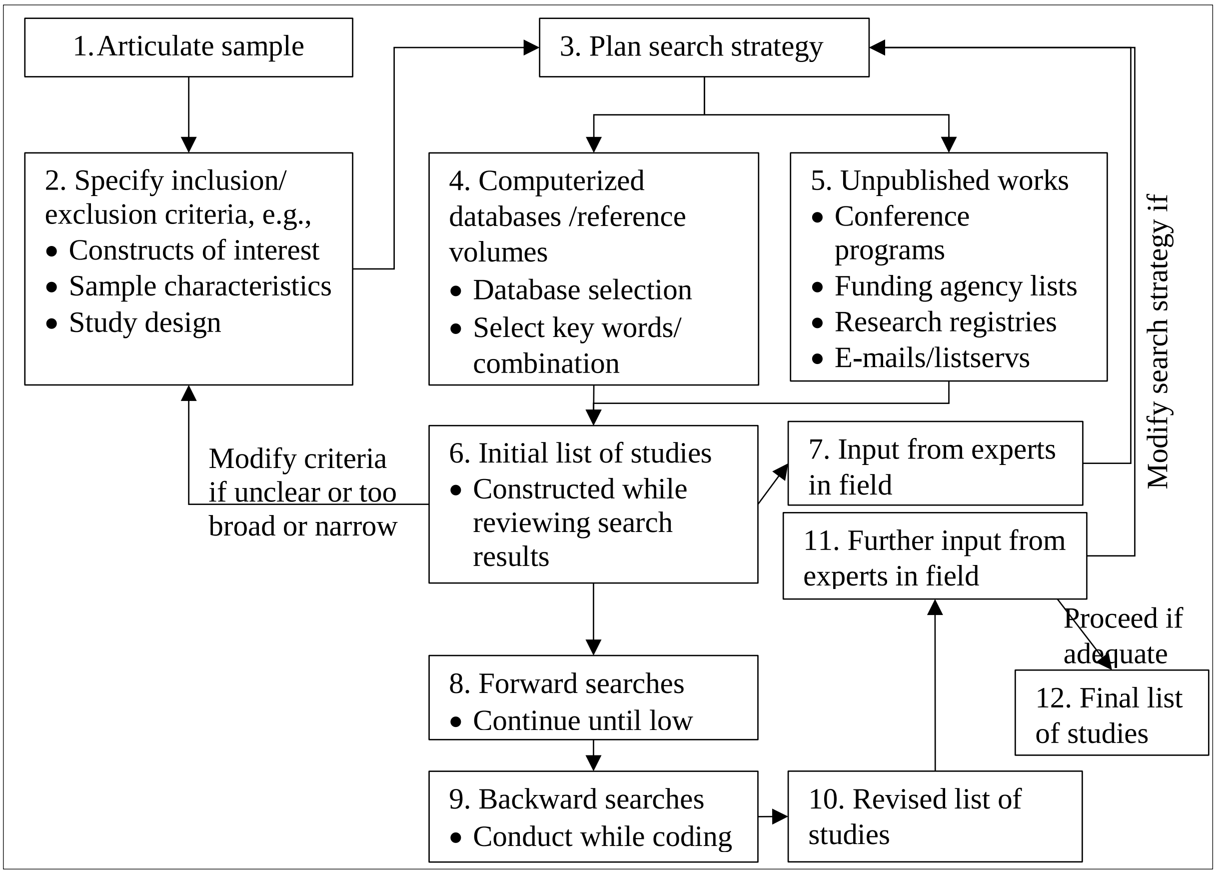


Figure 12: The process of find a literature

Source: p. 35, Card, (2015)

To find articles, keywords are used search terms on Google scholar such as "information sharing" and "supply chain performance", "information sharing" and "supply chain collaboration", and so on. The search results are reviewed by authors, and the selected publications base on some criteria such as:

- Their research fields belong to the field of information exchange in the supply chain
- Contain the number of samples/observations
- Have the attention of considered factors
- Include the correlation coefficient between at least two considered factors

- Effect size is calculated in this step. "An effect size is usually a standardized measure of the magnitude of observed effect" (Field & Gillett, 2010). Borenstein et al. (2011) indicate that the effect size is the basic unit of measurement in MA. It evaluates the strength of a relationship between two factors. Mean, risk ratio, odds ratios, risk difference, and correlation coefficients are used to compute the effect size (Borenstein et al., 2021). In our study, the values of effect sizes are used to describe the link between IShar and activities/factors. The effect sizes are measured by using correlation coefficients. Thus, this section mainly focuses on the functions of calculating effect sizes based on correlation. According to Card (2015) and Borenstein et al. (2011), some equations from (1) to (4) are used to find the effect sizes for studies, of which equations (2) and (3) are additional equations assisting the further calculation process. Firstly, in MA, the correlation coefficient is tranformed to Fisher's Z_r to implement analysis and comparison in MA (Function (1)). Then, the results are converted back to r for reporting (Function (4)) (Borenstein et al., 2021; Card, 2015). According to Hedges & Olkin (2014), the reason for the transformation process is that the sampling distribution r is skewed around a given population ρ. By contrast, the sample of Z_r is symmetry around a population Z_r. The symmetry of the sample of Z_r need to perform the comparison and combination of effect size across studies (Larry V Hedges & Olkin, 2014).

The value of Fisher's transformation of r:

$$Z_r = 0.5 * \ln\left(\frac{1+r}{1-r}\right) \quad (1)$$

r is the coefficient of the correlation between variables 1 and 2 in the study i

Variance of Z_r:

$$V_{Z_r} = \frac{1}{N-3}; \; N \text{ is the sample size of study} \quad (2)$$

Standard error SE_{Z_r}:

$$SE_{Z_r} = \sqrt{V_{Z_r}} \quad (3)$$

Changing Z_r to r:

$$r = \frac{e^{2Z_r} - 1}{e^{2Z_r} + 1} \quad (4)$$

- Analyzing MA is the next stage. According to Hedges and colleagues, fixed and random effects models are two important methods in MA. In the fixed-effect model, there is an important assumption that the true effect size is the same in all the studies. In some cases, if there are differences in the observed effects, the cause will be the sampling error. By contrast, there is a difference in true effect size from study to study in the random-effect model (Larry V Hedges, 1992; Larry V Hedges & Olkin, 2014; Larry V Hedges & Vevea, 1998).

Fixed-effect model:

The transformed effect size $\overline{Z_r}$:

$$\overline{Z_r} = \frac{\sum_{i=1}^{k} W_i Z_r}{\sum_{i=1}^{k} W_i} \tag{5}$$

W_i is the weight of study i and $W_i = N - 3$

The variance of the transformed effect size $V_{\overline{Z_r}}$:

$$V_{\overline{Z_r}} = \frac{1}{\sum_{i=1}^{k} W_i} \tag{6}$$

The estimated standard error of $\overline{Z_r}$, $SE_{\overline{Z_r}}$:

$$SE_{\overline{Z_r}} = \sqrt{V_{\overline{Z_r}}} \tag{7}$$

Lower and upper limitations (with 95%) for $\overline{Z_r}$:

$$LL_{\overline{Z_r}} = \overline{Z_r} - 1.96 * SE_{\overline{Z_r}} \tag{8}$$

$$UL_{\overline{Z_r}} = \overline{Z_r} + 1.96 * SE_{\overline{Z_r}} \tag{9}$$

To test the null hypothesis, the value of Z :

$$Z = \frac{\overline{Z_r}}{SE_{\overline{Z_r}}} \tag{10}$$

ρ - value is found in a one-tailed test and a two-tailed test, respectively:

$$\rho = 1 - \Phi\left(\pm|Z|\right) \tag{11}$$

$$\rho = 2\left[1 - \Phi\left(\pm|Z|\right)\right] \tag{12}$$

Random-effect model:

The between-studies variance:

$$\tau^2 = \frac{Q - df}{C} \tag{13}$$

$df = k - 1$ and k is the number of studies

$$Q = \sum_{i=1}^{k} W_i Z_r^2 - \frac{\left(\sum_{i=1}^{k} W_i Z_r\right)^2}{\sum_{i=1}^{k} W_i} \tag{14}$$

$$C = \sum W_i - \frac{\sum W_i^2}{\sum W_i} \quad (15)$$

The weighted mean:

$$\overline{Z_r} = \frac{\sum_{i=1}^{k} W_i^* Z_r}{\sum_{i=1}^{k} W_i^*} \text{; with } W_i^* = \frac{1}{V_{Z_r}^*} \quad (16)$$

The within-study variance:

$$V_{Z_r}^* = \frac{1}{N-3} + \tau^2 \quad (17)$$

The variance of $\overline{Z_r}$:

$$V_{\overline{Z_r}}^* = \frac{1}{\sum_{i=1}^{k} W_i^*} \quad (18)$$

The estimated standard error:

$$SE_{\overline{Z_r}}^* = \sqrt{V_{\overline{Z_r}}^*} \quad (19)$$

To test the null hypothesis, the value of Z^*:

$$Z^* = \frac{\overline{Z_r}}{SE_{\overline{Z_r}}^*} \quad (20)$$

ρ -value is found in a one-tailed test and a two-tailed test, respectively:

$$\rho^* = 1 - \Phi\left(\pm\left|Z^*\right|\right) \quad (21)$$

$$\rho^* = 2\left[1 - \Phi\left(\pm\left|Z^*\right|\right)\right] \quad (22)$$

- The final two steps are the goodness of study and report writing (Pakurár et al., 2020). Firstly, the goodness of study is a measure of a fail-safe number. The fail-safe number presents the value to reject the statistical significance of meta-analytic means (Fragkos et al., 2014). This measure is calculated by Equation (23) finding a fail-safe number (Rosenthal, 1978). In addition, publication bias is also tested using the funnel plot, the rank correlation test (RCT), and Egger's regression test (ERT) (Borenstein et al., 2021). 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). 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 symmetrical (Begg &

Mazumdar, 1994). Egger's regression test is more suitable than the rank correlation test for smaller MA (not greater than 25 studies). In Egger's regression test, the funnel plot is non-symmetry when the p-value is less than 0.05 (Egger et al., 1997). Last but not least, the results are written as a final report.

The fail-safe number, N_{fs} :

$$N_{fs} = \frac{\left(\sum_{i=1}^{k} Z_r\right)^2}{2.706} - k \quad (23)$$

3.2. SEM

SEM is known as a model of Linear Structural Relations which describes the relationship between latent variables. These relations are often built by linear regression equations and are described by path diagrams using arrows. Thus, SEM is used to test a hypothesis regarding the relationship between latent variables. Besides, SEM also measures the relationship between observed and latent variables in theoretical models (Figure 13). Observed variables are a set of variables that are measured directly by surveying, testing, or scale. Observed variables are used to identify latent variables (Nachtigall et al., 2003; Schumacker & Lomax, 2004).

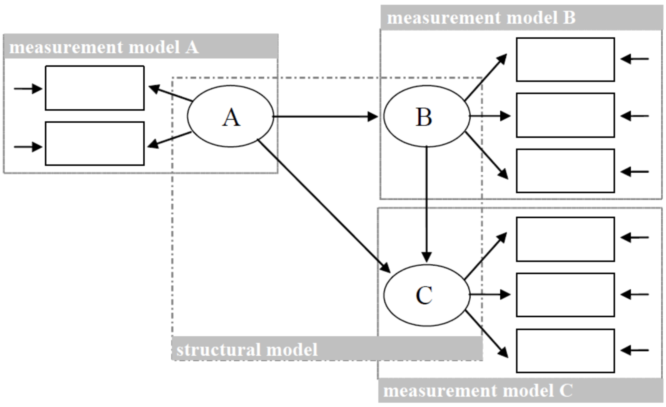


Figure 13: Structural equation modelling

Source: p.5, Nachtigall et al., (2003)

A brief development of SEM is shown in Figure 14. Firstly, Pearson (1938) introduces that the regression model is a predictive technique for the relationship between target variables (Y variable) and predictors (X variable). The regression model may be made in 1896 by Karl Pearson who found correlation coefficients. Correlation coefficients are used to calculate regression weights (Pearson, 1936). Some years later, correlation coefficients are used to determine a construct describing items that correlated or went together. This is a fundamental foundation for forming a factor analysis technique. The factor analysis is used to determine a two-factor construct for a theory of intelligence (Spearman, 1927). Then, the application of the factor analysis technique has been widely developed, is extended, and is known as the term "confirmatory factor analysis (CFA)". Confirmatory factor analysis is to tests the existence of a theoretical construct from a set of items (Goldberg, 1990; Jöreskog, 1969). Next, Sewell Wright proposes a path model that describes more complex relationships between observed variables. These relations are established through multiple regression equations, are solved based on correlation coefficients in the path model (Sewall Wright, 1918; Sewall Wright, 1934). Finally, the combination of the path model and CFA forms a structural equation model (Wiley, 1973).

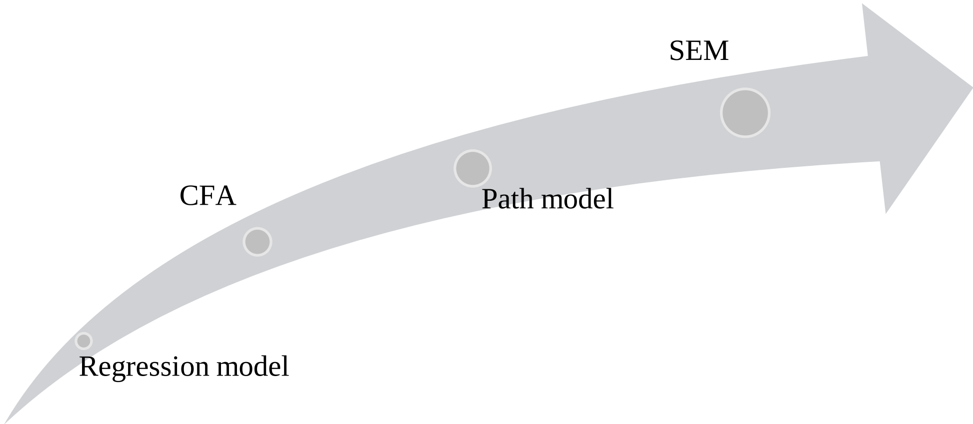


Figure 14: Development of structural equation modeling

Source: Schumacker & Lomax, (2004)

SEM is becoming more and more popular. It has become the preferred option among multivariate methods (Hershberger, 2003). According to Schumacker & Lomax (2004) and Nachtigall et al. (2003), some reasons play a key role in the popularity of SEM. First of all, SEM is more remarkable than basic statistical methods because of its flexibility. SEM can perform testing for theoretical relationships between multiple variables, while the number of independent and dependent variables is limited when they are tested by basic statistical methods. A regression model is illustrated as an example. In a regression equation, the correlation between two variables is not enough to test predictions using multiple variables. By contrast, the implementation of building and testing relationships between multiple variables is allowed by SEM. Another reason is measurement error. The error of measurement seems to be ignored by the statistical analysis of data. By contrast, it is explicitly measured when statistically analyzing data using structural equation modeling techniques (Nachtigall et al., 2003; Schumacker & Lomax, 2004).

3.2.1. The common process of building SEM

The application of SEM includes main two periods: 1) SEM framework and 2) application (Suhr, 2006; Weston & Gore Jr, 2006). The detailed process of applying SEM is shown in Figure 15. For the SEM framework, a conceptual model is the first step. The conceptual model consists of all the connections describing the interrelation and causal relations between indicator variables and constructs. Then, the hypotheses are defined to show the positive or negative relationships between the latent variables. In addition, questionnaire design and survey conduction are also performed. After that, the appropriate samples are selected to perform analyses in SEM, and indicator variables are defined for further steps. For the application of SEM, exploratory factor analysis (EFA), confirmatory factor analysis (CFA), SEM, and the calculation of model-fit indices are basic steps in a structural equation model. EFA and CFA are known as intermediate stages in modeling SEM. EFA is often applied to analyze the latent structures and provides a rough overview of the relationships between observed and latent variables. Based on analyzing exploratory factors, CFA is performed to confirm the factor structures in describing the loadings of the indicator variables on corresponding latent factors. CFA affects the measurement part of the SEM model. Next, interrelations between variables are estimated in SEM. Besides, causal relations between the treated variables are also found in SEM. Finally, the model's indices are calculated to check the model's suitability and the real data. In some cases, if the model performance is poor, some modifications will be made to the model (Barbara M Byrne, 2001; Dragan & Topolšek, 2014; Hoyle, 2012).

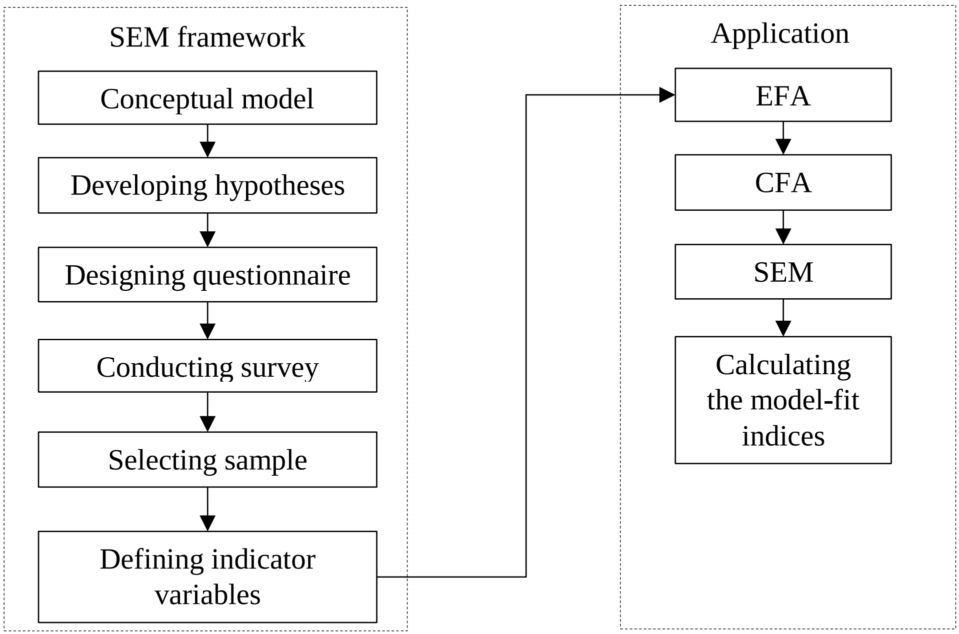


Figure 15: Steps of applying SEM

Source: Dragan & Topolšek, (2014)

3.2.2. The detailed process of SEM and the limited values of SEM application

According to Schumacker & Lomax (2004), on the other hand, SEM is also known as a quantitative test model, which contains the characteristics of path analysis and factor analysis (Jöreskog, 1970; Schumacker & Lomax, 2004). Thus, the measurement and structural models are two primary components of SEM (Weston & Gore Jr, 2006).

a) Measurement model

A measurement model is used to evaluate the degree of association of observed variables to determine the basic hypothesis structures. The hypothesized factors are formed from the observed variables and are latent variables in the measurement model. The latent variables are defined by researchers who select a suitable measure. Testing the measurement model is performed by factor analysis, including EFA and CFA. One notable consideration when performing these analyzes is the appropriateness of the data.

For EFA, the suitability of the data and analysis model is often tested by the Bartlett test of sphericity or the Kaiser-Meyer-Olkin (KMO) test. In the Bartlett test of sphericity, if the observed variables and a certain level have a significant correlation, EFA will be applied. To have this significant correlation, the correlation matrix is not equal to the identity matrix. In Kaiser-Meyer-Olkin (KMO) test, the strength of the intercorrelations must usually be the minimum value of 0.6, which allows for performing EFA. Another value of intercorrelations in the KMO test is shown in Table 4.

Table 4: Intercorrelation value in KMO

Intercorrelation value in KMO	Appropriateness
0.9	Marvelous
0.8	Meritorious
0.7	Middling
0.6	Mediocre
0.5	Miserable
<0.5	Unacceptable

Source: Barbara M Byrne, (2001); Dragan & Topolšek, (2014); Hoyle, (2012)

For CFA, the measure of this analysis method focuses on four indicators, including composite (construct) reliability (CR), average variance extracted (AVE), maximum shared variance (MSV), and average shared variance (ASV). Their suitable values to apply CFA are shown in Table 5.

Table 5: The measure of applying CFA

Measure	Acceptable threshold levels	Purpose
AVE	>0.5	Convergent validity
CR	>0.7 >AVE	Reliability Convergent validity
MSV	<AVE	Discriminant validity
ASV	<AVE	Discriminant validity

Source: Barbara M Byrne, (2001); Dragan & Topolšek, (2014); Hoyle, (2012)

b) Structural model

Structural models are used to the hypothesized relationships among latent variables. The relationship between latent variables can be described by three states, consisting of covariance, direct effects, and indirect effects. In particular, covariance refers to a non-directional relationship between independent latent variables. In the structure model, covariance is often described as double-headed arrows. Next, direct effects are described by single-directional arrows. These single-directional arrows show the direct impact of measured variables on latent variables. Besides, unidirectional arrows do not describe causal relationships between measured variables and latent variables unless researchers perform the analysis of longitudinal or experimental data. The strength of the relationships between the variables is represented by the coefficients that are generated, similar to the regression weights. Finally, an indirect effect indicates the presence of mediating one or more latent variables in the relationship between an independent latent variable and a dependent latent variable (Hoyle, 1995; Kaplan, 2008; Kline, 2015). The detailed steps in the structural model are shown in Figure 16.

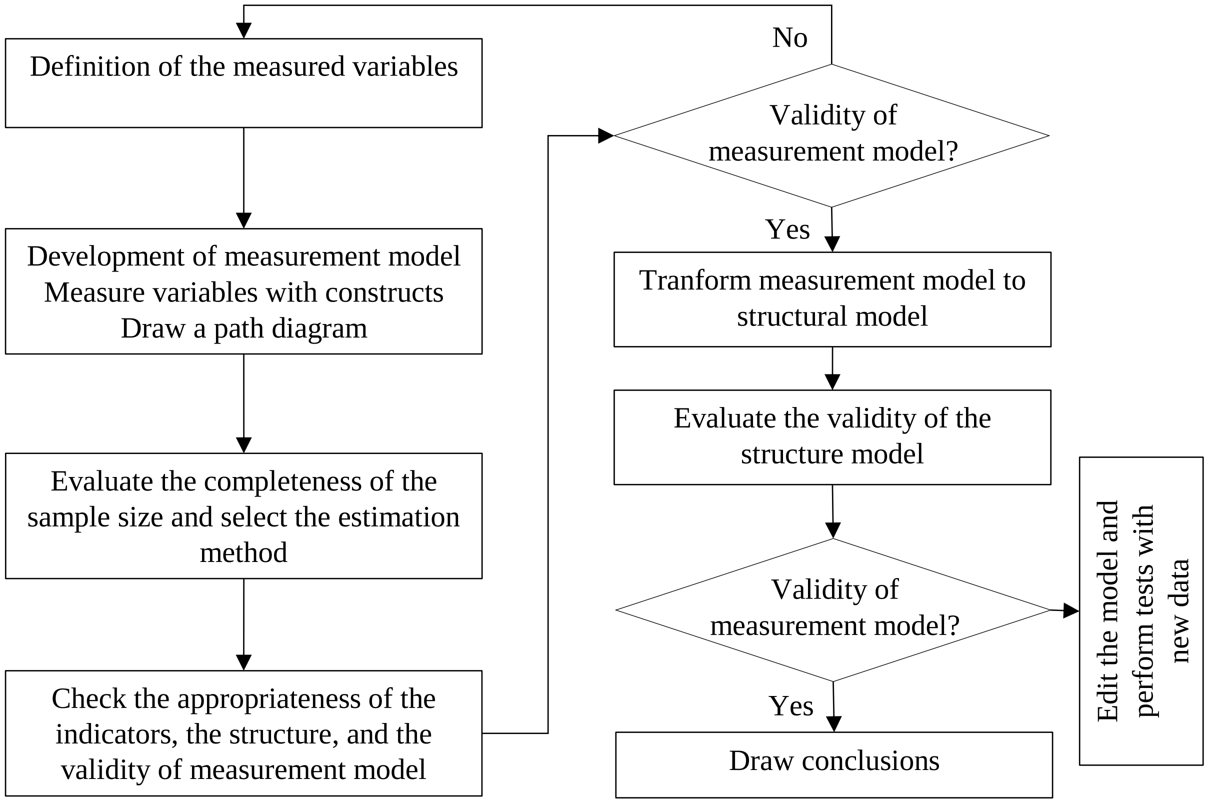


Figure 16: The detailed steps in the structural model

Source: Barbara M Byrne, (2001); Dragan & Topolšek, (2014); Hoyle, (2012)

The suitability of SEM model is evaluated by fit indices. These indicators include χ^2, $\left(\chi^2/df\right)$, RMSEA, ρ-value, GFI, RMR, SRMR, NFI, NNFI (TLI), CFI, PNFI . Table 6 shows the limit values of indicators.

Table 6: The fit indices in the process of SEM model testing and evaluation

Fit index	Acceptable threshold levels	Description	Type
χ^2	Low value relative to degrees of freedom with an insignificant ρ - value ($\rho > 0.05$)	Chi-Square χ^2 of the discrepancy between the sample and the fitted covariances' matrices	Absolute fit index
(χ^2/df)	Less than 3 is good Less than 5 is permissible	Relative Chi-Square χ^2 of the discrepancy	Absolute fit index
RMSEA	Less than 0.07 is good Between 0.07 and 0.10 is moderate Greater than 0.10 is bad	Root Mean square Error of approximation	Absolute fit index
ρ value (PCLOSE)	Greater than 0.50	Associated ρ -value for RMSEA (test of close fit)	
GFI	Greater than 0.95 is good Greater than 0.90 is acceptable	Goodness-of-fit statistic	Absolute fit index
RMR	Good models have small RMR	Root mean square Residual	Absolute fit index
SRMR	Less than 0.09	Standardized root mean square residual	Absolute fit index
NFI	Greater than 0.95 is good Greater than 0.90 is acceptable	Normed-fit index	Incremental fit index
NNFI (TLI)	Greater than 0.95 is good Greater than 0.80 is acceptable	Non-Normed-fit index (Tucker-Lewis)	Incremental fit index
CFI	Greater than 0.95 is good Greater than 0.90 is acceptable	Comparative fit index	Incremental fit index
PNFI	Greater than 0.50 is good	Parsimony normed fit Index	Parsimony fit index

Source: Barbara M Byrne, (2001); Dragan & Topolšek, (2014); Hoyle, (2012)

3.3. MASEM

MASEM is a combination of two research methods, including MA and SEM (Budsankom et al., 2015). The application of MA is to implement the synchronization and comparison of results from the empirical literature. SEM is used to test theoretical causal models (Cheung, 2008; Glass, 1976; Hunter & Schmidt, 2004). According to Bergh et al. (2016), MA typically assesses a theoretical model consisting of a bivariate correlation coefficient at a time. Consequently, it is unable for MA to perform the comparison between competing models containing multiple variables of predictors, mediators, and outcomes (Bergh et al., 2016). For example, meta-analysis can test the correlation between IShar and SCPerf. However, for a theory model including three factors such as IShar, SCPerf, and SCIntg, the relationship between three factors cannot be tested by MA simultaneously.

Unlike meta-analysis, SEM is so powerful in testing theory models including more than two factors (Bowen & Guo, 2011). As a result, the research findings of a research topic are also increased when using structural equation modeling. Therefore, many people can believe that their understanding of that topic is improved by using SEM. However, this may not be the case in general where study results are inconsistent despite SEM being used as the methodology (Cheung, 2015). In addition, it is extremely difficult for SEM to systematically compare different models which have a set of similar constructs. The reason for this is that each model is constructed with its own data and objective. It has been acknowledged that the statistical power of SEM in rejecting inaccurate models may not be high enough when the sample size is small. There may not be a direct comparison between findings supporting different models. Furthermore, it has also been found that when the proposed model fits the theoretical model well and the data, most researchers may not consider the necessity of comparing the alternative model (MacCallum & Austin, 2000). This bias in favor of the model being evaluated is confirmed to impede research progress (Greenwald et al., 1986). Thus, conducting more empirical studies is unlikely to reduce uncertainty around a particular topic if the findings from that study are inconsistent.

MASEM is “a quantitative synthesis technique that is used to synthesize correlation or covariance matrices and to fit structural equation models on the pooled correlation (covariance) matrix (Cheung, 2015)”. According to Jak (2015), MASEM uses information from multiple studies to test and explain relationships in a single model containing a set of variables. Besides, MASEM is used to compare several models built by different studies or theories (Betsy Jane Becker, 1992; Jak, 2015; Viswesvaran & Ones, 1995). By using MASEM, the overall fit of a model is provided to the researchers. Similarly, parameter estimates with confidence intervals are also found and standard errors are presented. MASEM improves the limitations of both MA and SEM. For SEM, large sample sizes are an important requirement. If samples are small, SEM's statistical power will be low and the models cannot be eliminated. For example, if there are several small sample studies investigating the same phenomenon, they can lead to very different final models. This leads to the same phenomenon but is described by different models. More flexible than MA and SEM, MASEM can make general conclusions about which model is most appropriate based on a combination of information from multiple primary studies. Moreover, MASEM can answer some unresolved research questions in primary research. It can even deal with models with a set of variables for which no major study covers all of their studies. For example, study 1 contains the correlations between two factors A and B. Study 2 describes the correlations between two factors B and C. Study 3 presents that factor A has a correlation with factor C. Although no study covers all variables, the correlation between all three factors can be found in a single model using MASEM (Bergh et al., 2016; Viswesvaran & Ones, 1995).

3.3.1. Steps to perform MASEM

According to Bergh et al. (2016), there are four steps to performing a MASEM (Figure 17) (Bergh et al., 2016). According to Figure 17, the specification and evaluation of the variables, models, and relationships are the first steps. This specification and evaluation are performed by researchers and are based on the research questions found in literature reviews. The detailed information on this process is shown in Figure 17.

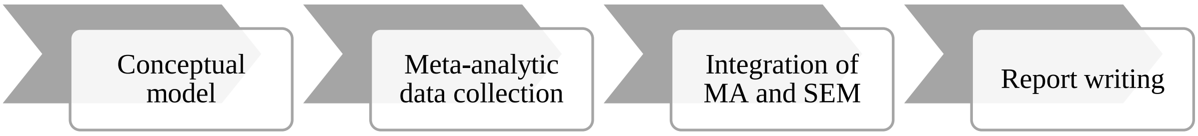


Figure 17: MASEM procedure

Source: Bergh et al., (2016)

The next step is the meta-analytic data collection which is to determine effect sizes. The calculation of the effect size is performed by using variable correlations. These correlation coefficients are collected from previous studies and then calculated based on the formulas in MA. In the case of effect dimensions collected from prior studies, transfer to a common standardized measure in primary studies must be performed before being synthesized. This is why the correlation coefficient is used for measuring the effect size instead of the regression coefficient (Bergh et al., 2016; Hunter & Schmidt, 2004). In this step, drawing out of effect size based on the sync of MA. The conclusions in this step include Pearson correlations (r) and standardized mean difference (g). They are used to describe the direction and magnitude of the relationship between two variables. In order to conclude the effect size of more complex variables, the effect size on a set of correlation matrices is used to create a pooled correlation matrix, which can then be analyzed using SEM (Budsankom et al., 2015).

The third step is the integration of MA and SEM based on a pooled matrix (Jak, 2015). This integration is described in a two-stage process. In the first stage, the homogeneity of correlation matrices is tested before pooling matrices. If there has a significant difference between the tested correlation matrices, a pooled correlation matrix will be formed. In some cases, without homogeneity, potential mediators may be used to explain differences between studies or a random-effects model may be used to average correlations. In the second stage, SEM is fitted using the pooled correlation matrix in stage 1(Cheung & Chan, 2005). According to Jak (2015), pooling correlation matrices is performed by the univariate approach, the generalized least squares (GLS) approach, and the Two-Stage SEM approach (TSSEM) are introduced (Jak, 2015).

- For the univariate method, the correlation coefficients are synthesized in a correlation matrix. Each correlation coefficient is an element in the correlation matrix. These elements are referred to as independent within studies. The correlation matrix is equivalent to the observed correlation matrix in SEM.
- GLS method is proposed by Becker (1992, 1995, 2000). GLS estimation is to correlation matrix and the asymptotic covariance matrix from independent studies (Betsy Jane Becker, 1992; Betsy Jane Becker, 1995; Betsy J Becker, 2000; Cheung & Chan, 2005). This indicates that both the sampling variances and the sampling covariances of each study are used to weigh the correlation coefficients (Jak, 2015).
- TSSEM: This approach will be introduced in the next section.

Last but not least, reported results should be subject to the meta-analysis reporting standards (MARS) (Budsankom et al., 2015). Final reports may be standardized, transparent, and applicable when followed by MARS (Aytug et al., 2012; Kepes et al., 2013). MARS clearly describes the methods for collecting studies, analyzing study's content, and constructor variables in the model.

3.3.2. Two stage structural equation modeling

There are two primary types of methods used to pool correlation coefficients in MASEM. They are univariate methods and multivariate methods, of which multivariate methods often include the GLS method and TSSEM. In our study, however, TSSEM is introduced clearly.

TSSEM is introduced by Cheung & Chan (2005). In stage 1 of TSSEM, the correlation coefficients are pooled by multigroup structural equation modeling (Cheung & Chan, 2005).

a) Stage 1: Pooling correlation matrices

An example is illustrated to explain the implementation process of MASEM. In this example, three factors A, B, and C are specified in three studies. Here, all three factors are found in study 1, study 2 present the correlation between factors A and B, and Study 3 show the correlation between factors B and C.

Let R_1, R_2, and R_3 are the correlation matrices in studys 1, 2, and 3, respectively. The values in the correlation matrix differing 1, are the correlation between two factors. The correlation matrices of the three studies look like this:

$$R_1 = \begin{bmatrix} 1 & & \\ 0.25 & 1 & \\ 0.66 & 0.45 & 1 \end{bmatrix},\ R_2 = \begin{bmatrix} 1 & & \\ 0.50 & 1 & \\ NA & NA & 1 \end{bmatrix},\ R_3 = \begin{bmatrix} NA & & \\ NA & 1 & \\ NA & 0.34 & 1 \end{bmatrix}$$

Next, multigroup structural equation modeling is used to estimate the population correlation matrix R of all p variables (p is three in the example above). Each study is then viewed as a group. The model for each group (study) is:

$$\sum_i = D_i \left(X_i R X_i^T \right) D_i \tag{24}$$

Whereas R is the $p \times p$ population correlation matrix with fixed 1's on its Diagonal, matrix X_i is the $p_i \times p$ selection matrix that accommodates smaller correlation matrices from studies with missing variables $\left(p_i < p \right)$, and D_i is a $p_i \times p$ diagonal matrix that accounts for differences in scaling of the variables across the studies.

b) Stage 2: Fitting structural equation models

In Stage 2, the structural model is fitted to the pooled correlation matrix, using weighted least squares (WLS) estimation. The weight matrix in the WLS procedure is the inversed matrix with asymptotic variances and covariances of the pooled correlation coefficients from Stage 1. This ensures that correlation coefficients that are estimated with more precision (based on more studies) in Stage 1 get more weight in the estimation of model parameters in Stage 2. The precision of a Stage 1 estimate depends on the number and the size of the studies that reported the specific correlation coefficient (Jak, 2015). In stage 2 hypothesized structural equation models can be fitted to R by minimizing the weighted least-squares fit function:

$$F_{WLS} = (r - r_{MODEL})^T V^{-1} (r - r_{MODEL}) \tag{25}$$

Where r is a column vector with the unique elements in R, r_{MODEL} is a column vector with the unique elements in the model implied correlation matrix $\left(R_{MODEL} \right)$, and V^{-1} is the inversed matrix of asymptotic variances and covariances that is used as the weight matrix.

4. HYPOTHESIS AND DATA SELECTION STRATEGY

In this section, the notions of SCPerf, the activities enhancing the supply chain efficiency (SCPerfIAs), IShar, and IShar's factors are firstly presented. SCPerfIAs include SCIntg, SCCol, SCFlex. IShar's factors are Comt, Trust, InfT, and EnU. Then, hypotheses between elements are built. They describe the role of IShar on SCPerf and SCPerfIAs, as well as the role of IShar's factors for IShar. Besides, they also introduce the relationships between SCPerf and SCPerfIAs, the relationships between SCPerfIAs, and the relationships between the factors of IShar. Finally, the strategy of selecting publications and publication bias tests are presented.

4.1. Definition

4.1.1. SCPerf

SCPerf is described by the extended activities of the supply chain to satisfy customers' requirements (Beamon, 1999). SCPerf is also defined as 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 (Voss et al., 1997). These dimensions mainly include flexibility, quality, and the efficiency of improved processes. Flexibility reflects the rapid response when a change in the market, product, and customer requirements happened, which is to meet customer satisfaction (Altiok & Ranjan, 1995; Cook & Rogowski, 1996; Gandhi et al., 2017; Hau L Lee & Billington, 1993; Newhart et al., 1993; Ma Ga Mark Yang et al., 2011), and increase competition (Flynn et al., 2010). Quality describes the level of meeting customer needs from products or services (Shatat & Udin, 2012). The effective improved processes are referred to as the results of improving the low inventory level (Gandhi et al., 2017), reducing costs, operation time, and lead time in the manufacturing process (Afum et al., 2019; Ambe, 2014; Sang M Lee et al., 2012; Qrunfleh & Tarafdar, 2014; Xu et al., 2016), increasing output production (Sezen, 2008), on-time delivery, accurate forecast (Gandhi et al., 2017; Qrunfleh & Tarafdar, 2014), and material and product accuracy (Wu et al., 2014).

4.1.2. SCIntg

SCIntg is proposed as the integration of supply chain processes (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). According to Leuschner et al. (2013), SCIntg is divided into three categories. They are the integration of information, operation, and relation (Leuschner et al., 2013). The integration of information refers to information technology coordination and support among supply chain partners. The integration of operation involves cooperation in joint activities between individuals in the supply chain. Relational integration describes that firms connect strongly with each other, and their connections are based on trust, commitment, and long-term orientation (Injazz J Chen et al., 2004; Ireland & Webb, 2007). Chang et al. (2016), Mackelprang et al. (2014), and Zhao et al. (2011) propose that SCIntg appears to be the collaboration and coordination in managing information, processes, and behaviors between the organization and its associated external organizations (Woojung Chang et al., 2016; Mackelprang et al., 2014; Zhao et al., 2011). According to Flynn (2010), Mackelprang et al., (2014), and Zhao et al., (2011), SCIntg consists of internal integration, supplier integration, and customer integration (Flynn et al., 2010; Mackelprang et al., 2014; Zhao et al., 2011). Internal integration refers to close internal relationships among functions (Trkman et al., 2006). Supplier and customer integration are described as external integration (Sundram et al., 2016). 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). In addition, dimensions of SCIntg also play a critical role in predicting the performance of the superior firms (Hefu Liu et al., 2013).

4.1.3. SCFlex

SCFlex refers to 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). For the internal of an organization, flexibility reflects the dynamics of how a job is done and job completion time. Internal structures and processes may be adjusted to rapidly and effectively respond to changes in the business environment (Reed & Blunsdon, 1998). According to Chan et al. (2017), flexibility in strategy and production are also the main factors to create organizational flexibility. The strategic and production flexibility is depicted by the speed of delivery, collaboration to work together, rapid response strategies, or IT integration (Alan TL Chan et al., 2017). For 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). Similarly, Agarwal et al. (2006) indicate that the synergies from inside and outside the supply chain in many different forms create the significant effect of rapid response (Agarwal et al., 2006).

4.1.4. SCCol

SCCol is known as a connection between at least two companies implementing works or projects together to increase their competitiveness and get higher profits (Simatupang & Sridharan, 2002). Responsibilities are shared between the companies participating in SCCol (Anthony, 2000). Supply chain members regularly meet and discuss with each other to create better work efficiency (Simatupang & Sridharan, 2005). Collaboration among members of the supply chain requires the availability of resources, appropriate expertise, commitment, trust, and implementation support from all levels of management. If the organizations do not believe in the claims of their supply chain partners, resources will not be added to the cooperation and cooperation will be disrupted (Xu et al., 2016). According to Natour et al. (2011), SCCol is part of the success of SCIntg (Natour et al., 2011). While SCIntg is known for the integration of business processes at all levels between supply chain partners to maximize profits, SCCol strengthens long-term relationships between partners to increase the efficiency of the integration process (Mangan & Lalwani, 2016; Ken Mathu & Phetla, 2018). In addition, SCCol is a prerequisite for achieving supply chain flexibility. It enhances coordination in actions such as resource planning to minimize any negative impact on supply chain operation (Mandal et al., 2016; Skipper & Hanna, 2009).

4.1.5. IShar

According to Gang Li et al. (2006), good-quality information exchanged among supply chain partners is known as IShar (Gang Li et al., 2006). IShar is one of the key principles of effectively managing the supply chain (Moberg et al., 2002). In particular, it contributes to increasing the efficiency of SCPerf (Le et al., 2021; Min et al., 2005). Thanks to IShar, the costs of suppliers are reduced from 1% to 35% (Gavirneni et al., 1999) such as inventory costs and associated costs (Hau L Lee et al., 2000; Hau L Lee & Whang, 2004). Besides, IShar also helps to increase resource utilization and productivity, as well as the quick response (Jauhari, 2009; Mourtzis, 2011; Tung-Mou Yang & Maxwell, 2011). Next, IShar is one of the basic criteria for both collaboration and integration of the supply chain (Morash & Clinton, 1997). It increases the effective communication among supply chain members (Sundram et al., 2016). Thus, it can be expected information-sharing processes can promote SCIntg and SCCol (Hsin Hsin Chang et al., 2013; Fawcett et al., 2011). For SCFlex, IShar is expected to the willingness of exchanging information on the strategy, operation, finance, and technique between supply chain members (Hasibuan et al., 2020). Thanks to IShar, individuals understand their customer needs and behavior. Thus, individuals can proactively plan to respond to changing market and customer needs quickly (Shore, 2001).

4.1.6. Trust

The term trust is used to refer to trustworthiness between participants in the supply chain (Maister et al., 2021). It is also a trustworthiness expectation that individuals bring to each other through the performance of obligations while cooperating with each other (Morgan & Hunt, 1994). Trust is two-way in ensuring honesty between members in the supply chain (Agarwal & Shankar, 2003). For example, customers trust on-time delivery and fair prices as agreed by suppliers. Similarly, suppliers also believe in completing payment as agreed by the customer.

4.1.7. Comt

Comt represents the desire of individuals in a business relationship, the purpose of maintaining and strengthening the relationship to promote the development of a long-term business relationship (Morgan & Hunt, 1994). Comt is the factor that helps stakeholders achieve trust and continuity of relationships (Allen & Meyer, 1990). According to Anderson & Weitz (1989), in a committed relationship, each member may be willing to give up temporary benefits in order to maintain the relationship for the long term (Anderson & Weitz, 1989). Similarly, in a supply chain, Comt is an agreement or promise formed during working together between the members of the supply chain (Hwee Khei Lee & Fernando, 2015). Proper fulfillment of Comt can help members achieve long-term relationships (Liang et al., 2007; Salam, 2011).

4.1.8. InfT

InfT is the activities that use devices such as computers, networks, and other devices to perform the creation, exchange, processing, and storage of electronic data. InfT is an essential part of supply chain activities especially information sharing (Omar et al., 2010). According to Rajaguru and Matanda (2013), the role of InfT is a system that connects information between individuals in the supply chain through technologies that support the exchange of information between members (Rajaguru & Matanda, 2013). In other words, InfT is described as the interconnection of information technology infrastructure (InfTI) between supply chain participants (Ye & Wang, 2013). InfT is the physical link that assists information exchange between participants (Zaheer & Trkman, 2017). Thanks to InfT, the speed of information transmission is increased. Besides, the information is transmitted to the place where it needs to be used more accurately and securely (Suhong Li & Lin, 2006). Therefore, the scope of IT is mainly focused on supporting and connecting information in the supply chain (Idris & Mohezar, 2019).

4.1.9. EnU

EnU is referred to as difficulties that are difficult to predict the future accurately (Beckman et al., 2004; Pfeffer & Salancik, 2003). EnU may be separated into 4 dimensions (Diem Le et al., 2021; Gupta & Wilemon, 1990). First of all, the uncertainty that comes from the competition can exist when a firm shows competitive strategies directly affecting its rivals' benefits in the market (Burgers et al., 1993). As a result, the firm may face unpredictable responses from competitors. Another dimension is that continuously and rapidly evolving technology plays a part in creating an uncertainty environment (Gharakhani et al., 2012; Suhong Li & Lin, 2006). The uncertainty of customer needs stems from unpredictable changes in consumer buying behavior (Paulraj & Chen, 2007; Szu-Yuan Sun et al., 2009). Finally, the uncertainty arises from the unpredictable change of suppliers in ensuring product quality and on-time delivery (Suhong Li & Lin, 2006).

4.2. Hypotheses

Two main hypotheses are tested in this study. First of all, the importance of IShar for 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 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, Comt, InfT, and 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 7.

Table 7: 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., (2017)
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 & 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 Comt	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 18.

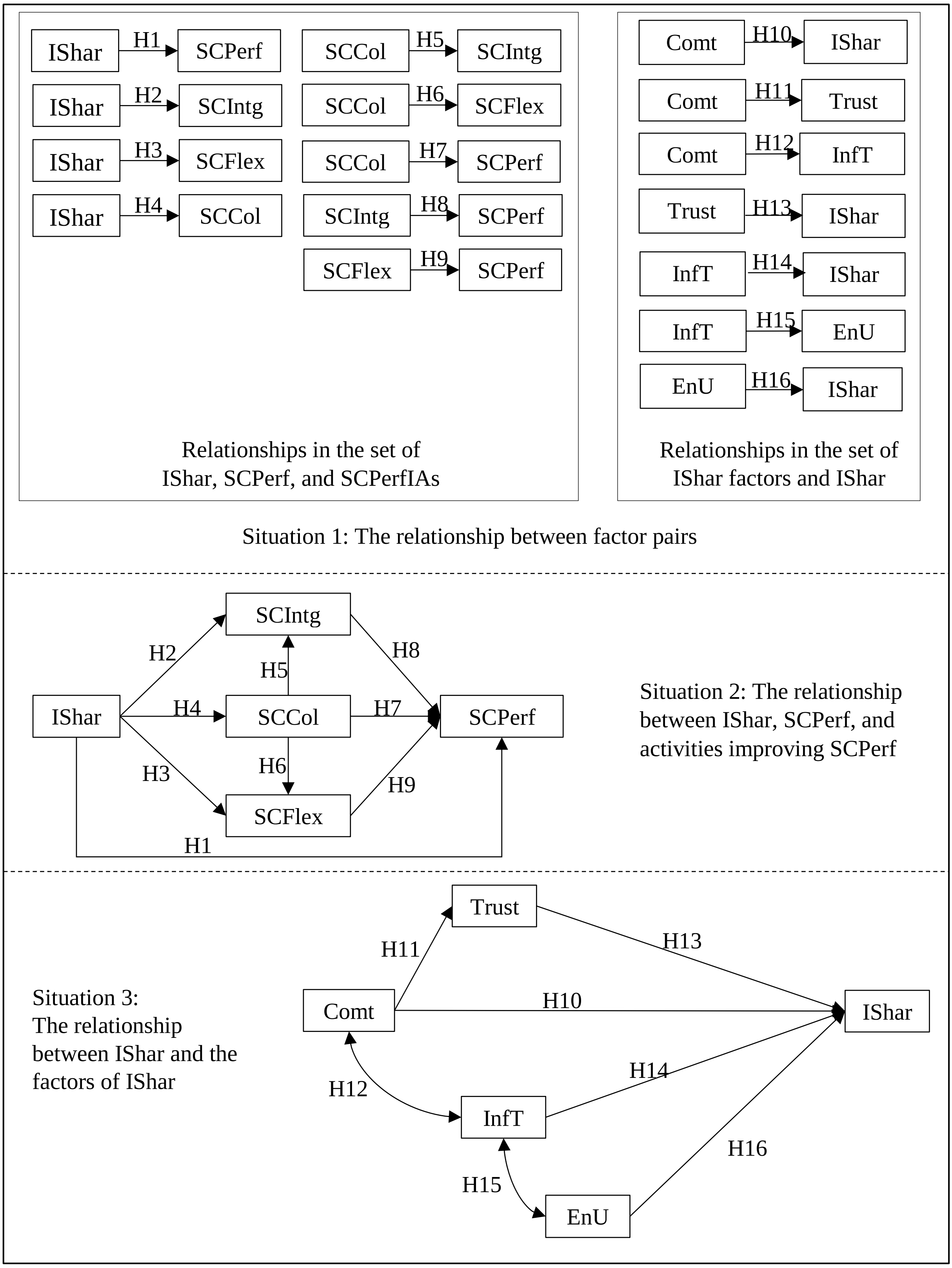


Figure 18: Concept models

Source: Own study (2021)

In Figure 18, 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.

4.3. The strategy of choosing publication and testing publication bias

Based on the systematic literature review, publications are found from 2010 to 2021 by searching relevant keywords on Google Scholar. For example, "information sharing" and "supply chain performance", or "information sharing", "commitment". Selecting a relevant paper for analysis models must base on some criteria.

- The research directions of publications must belong to the fields of sharing information in Logistics and supply chains.
- The contents of publications introduce the relationship between IShar and SCPerf, between IShar and SCPerfIAs, between IShar and the factors of IShar, between SCPerf and SCPerfIAs, between SCPerfIAs with each other, or between IShar factors with each other.
- Publications must provide correlation coefficients between two factors and clearly present the sample size
- All selected publications must be written in English

The process of reviewing publications is firstly started by considering the title and keywords in the articles. If the articles are duplicated and the keywords are not relevant to the research area of this study, they will be removed. Next, a thorough review of the abstracts in the articles is carried out. A suitable abstract includes the purposes of the study, the methods used to address the problems in the study, and the main conclusions drawn from the results of the study. In addition, the content of the abstract contains the problems related to the relationship between IShar, SCPerf, SCPerfIAs, and IShar factors. Last but not least, the full paper is reviewed. The content of the papers shows the methodology, data, problem description, results and analysis, and discussion.

According to Borenstein et al. (2021), in this study, the tests of rank correlation and Egger's regression are used to check publication bias (Borenstein et al., 2021). Both of them mainly assess the correlation between effect estimates and sampling variances. In which, Egger regression is more suitable for smaller meta-analyses (Egger et al., 1997; Sterne et al., 2000). The conclusion of the two tests is based on the p-value. Publication bias does not exist when the p-value is larger than 0.05. In addition, the funnel plot is also used in this study to test publication bias. It is a funnel plot that visually depicts the distribution of effects from individual studies (Sterne & Harbord, 2004).

Consequently, a total of 101 relevant individual studies with a total sample size of 23580 are involved in our study (Table 8). These studies fully provide necessary data for further analyses, including the sample size of each study and correlation coefficients between a factor couple.

Table 8: Data collection

#	Study	Year	N	r
1	Huo et al.	2021	213	IShar-SCFlex: 0.35
2	Zhong et al.	2020	421	IShar-SCPerf: 0.345; Trust-Comt: 0.22; Trust-IShar: 0.326; Comt-IShar: 0.093
3	Phan et al.	2020	536	IShar-SCPerf: 0.397; IShar-SCIntg: 0.261; SCPerf-SCIntg: 0.214
4	Üstündağ & Ungan	2020	119	IShar-SCPerf: 0.41; IShar-SCFlex: 0.44; SCPerf-SCFlex: 0.46; EnU-IShar: 0.10
5	Sundram et al.	2020	112	IShar-SCPerf: 0.71; IShar-SCIntg: 0.58; SCPerf-SCIntg: 0.78; InfT-IShar: 0.32
6	Hasibuan et al.	2020	388	IShar-SCCol: 0.57; IShar-SCFlex: 0.54; SCCol-SCFlex: 0.53
7	Alzoubi & Yanamandra	2020	132	IShar-SCPerf: 0.20; IShar-SCFlex: 0.46; SCPerf-SCFlex: 0.47
8	Raza et al.	2020	391	Trust-InfT: 0.469; Trust-IShar: 0.435; InfT-IShar: 0.358
9	Wai-Peng Wong et al.	2020	238	InfT-IShar: 0.66
10	Fernando et al.	2020	124	InfT-IShar: 0.50
11	Mubarik & Mubarak	2020	157	SCCol-SCIntg: 0.39
12	Wang et al.	2020	267	InfT-EnU: 0.26
13	Somjai & Jermsittiparsert	2019	220	IShar-SCPerf: 0.611; Comt-InfT: 0.731; Comt-IShar: 0.823; InfT-IShar: 0.764
14	Lyu et al.	2019	273	IShar-SCPerf: -0.07
15	Hsin Hsin Chang et al.	2019	204	IShar-SCPerf: 0.333; IShar-SCFlex: 0.377; SCPerf-SCFlex: 0.732; InfT-EnU: 0.332; InfT-IShar: 0.212; EnU-IShar: 0.19
16	Siyu Li et al.	2019	212	IShar-SCPerf: 0.3; IShar-SCCol: 0.7; SCPerf-SCCol: 0.31; EnU-IShar: 0.12
17	Chowdhury et al.	2019	274	SCPerf-SCCol: 0.213; SCPerf-SCFlex: 0.427; SCCol-SCFlex: 0.368; Trust-Comt: 0.376
18	Hasan Şahin & Topal	2019	203	IShar-SCPerf: 0.15; IShar-SCFlex: 0.13; SCPerf-SCFlex: 0.56; EnU-IShar: 0.23
19	Vankireddy & Baral	2019	80	Comt-IShar: 0.35
20	Idris & Mohezar	2019	177	Comt-InfT: 0.588; Comt-IShar: 0.534; InfT-IShar: 0.591
21	Afshan et al.	2018	166	IShar-SCPerf: 0.23; IShar-SCCol: 0.7; SCPerf-SCCol: 0.41; Trust-Comt: 0.69; Trust-IShar: 0.25; Comt-IShar: 0.22
22	Shahbaz et al.	2018	284	IShar-SCPerf: 0.726
23	Sinnandavar et al.	2018	110	IShar-SCPerf: 0.849
24	Wantao Yu et al.	2018	329	IShar-SCPerf: 0.405; IShar-SCIntg: 0.661; IShar-SCCol: 0.728; IShar-SCFlex: 0.683; SCPerf-SCIntg: 0.397; SCPerf-SCCol: 0.462; SCPerf-SCFlex: 0.468; SCIntg-SCCol: 0.763; SCIntg-SCFlex: 0.799, SCCol-SCFlex: 0.771
25	Al-Douri	2018	260	IShar-SCPerf: 0.679

#	Study	Year	N	r
26	Hove-Sibanda & Pooe	2018	350	IShar-SCPerf: 0.85; IShar-SCCol: 0.90; IShar-SCFlex: 0.90; SCPerf-SCCol: 0.91; SCPerf-SCFlex: 0.91; SCCol-SCFlex: 0.76
27	Dubey et al.	2018	351	IShar-SCCol: 0.63; IShar-SCFlex: -0.21; SCCol-SCFlex: -0.29
28	Sundram et al.	2018	248	IShar-SCPerf: 0.57; IShar-SCIntg: 0.57; SCPerf-SCIntg: 0.42; InfT-IShar: 0.81
29	Panahifar et al.	2018	189	SCPerf-SCCol: 0.79
30	Chiung-Lin Liu & Lee	2018	161	SCPerf-SCIntg: 0.662; SCPerf-SCCol: 0.631; SCIntg-SCCol: 0.847
31	Erdogan & Çemberci	2018	97	Trust-EnU: 0.202
32	Kwamega et al.	2018	162	Comt-InfT: 0.06
33	Wiengarten & Longoni	2018	485	EnU-IShar: -0.04
34	Sheko & Braimllari	2018	183	InfT-IShar: 0.198
35	Mehmood Khan et al.	2018	248	Trust-EnU: 0.24; Trust-IShar: 0.31; EnU-IShar: 0.31
36	Abdallah & Nabass	2018	294	SCIntg-SCPerf: 0.295
37	Ezgi Şahin et al.	2017	247	SCPerf-SCIntg: 0.108; SCPef-SCFlex: 0.322; SCIntg-SCFlex: 0.181
38	Atif et al.	2017	152	SCPerf-SCIntg: 0.806
39	Rockson et al.	2017	117	SCPerf-SCIntg: 0.464; SCPerf-SCFlex: 0.184; SCIntg-SCFlex: 0.434
40	Pradabwong et al.	2017	204	IShar-SCPerf: 0.5; IShar-SCCol: 0.483; SCPerf-SCCol: 0.653
41	Huo et al.	2017	361	IShar-SCPerf: 0.187; IShar-SCCol: 0.641; SCPerf-SCCol: 0.241; Trust-IShar: 0.472
42	Gandhi et al.	2017	125	IShar-SCPerf: 0.397
43	Vanpoucke et al.	2017	563	IShar-SCFlex: 0.13; InfT-IShar: 0.3
44	Vikas Kumar et al.	2017	60	IShar-SCPerf: 0.873; IShar-SCCol: 0.856; SCPerf-SCCol: 0.71
45	Zaheer & Trkman	2017	387	Trust-Comt: 0.599; Trust-InfT: 0.099; Trust-IShar: 0.413; Comt-InfT: 0.159; Comt-IShar: 0.432; InfT-IShar: 0.273
46	Cao et al.	2017	136	Trust-IShar: 0.56
47	Alan TL Chan et al.	2017	141	SCFlex-SCPerf: 0.618
48	Gunasekaran et al.	2017	205	Comt-IShar: 0.23
49	Attia	2016	153	IShar-SCPerf: 0.248; IShar-SCFlex: 0.662; SCPerf-SCFlex: 0.452; Comt-InfT: 0.592; Comt-IShar: 0.385; InfT-IShar: 0.413
50	Mandal et al.	2016	339	SCCol-SCFlex: 0.266
51	Ju et al.	2016	206	IShar-SCPerf: 0.72; IShar-SCIntg: 0.75; IShar-SCCol: 0.83; IShar-SCFlex: 0.69; SCPerf-SCIntg: 0.81; SCPerf-SCCol: 0.75; SCPerf-SCFlex: 0.75; SCIntg-SCCol: 0.79; SCIntg-SCFlex: 0.77, SCCol-SCFlex: 0.76
52	Xu et al.	2016	216	IShar-SCPerf: 0.46; Trust-IShar: 0.31
53	Sundram et al.	2016	156	IShar-SCPerf: 0.572; IShar-SCIntg: 0.573; SCPerf-SCIntg: 0.872
54	Xuan Zhang et al.	2016	320	IShar-SCPerf: 0.28; InfT-IShar: 0.28
55	Sundram et al.	2016	156	IShar-SCPerf: 0.572; IShar-SCIntg: 0.573; SCPerf-SCIntg: 0.872
56	Kang & Moon	2016	122	IShar-SCPerf: 0.46; IShar-SCIntg: 0.57; SCPerf-SCIntg: 0.56; InfT-IShar: 0.44
57	Yang Cheng et al.	2016	606	SCIntg-SCCol: 0.52; SCIntg-SCFlex: 0.17; SCCol-SCFlex: 0.14
58	Suhong Li & Lin	2016	196	Trust-Comt: 0.55; Trust-InfT: 0.11; Trust-EnU: -0.03; Comt-InfT: 0.15; Comt-EnU: -0.07; InfT-EnU: -0.03
59	Kulangara et al.	2016	357	Trust-IShar: 0.52

#	Study	Year	N	r
60	Yunus & Tadisina	2016	446	SCIntg-SCPerf: 0.297
61	Annan et al.	2016	199	SCIntg-SCPerf: 0.075
62	Kyung Kyu Kim et al.	2016	250	Trust-EnU: -0.2
63	Abdelkader & Abed	2016	36	InfT-EnU: -0.56
64	Chen Liu et al.	2015	361	IShar-SCPerf: 0.23; IShar-SCCol: 0.64; SCPerf-SCCol: 0.28
65	Alfalla-Luque et al.	2015	266	SCPerf-SCIntg: 0.437; SCPerf-SCFlex: 0.34, SCIntg-SCFlex: 0.27
66	Hwee Khei Lee & Fernando	2015	133	IShar-SCPerf: 0.63; IShar-SCIntg: 0.838; IShar-SCCol: 0.785; SCPerf-SCIntg: 0.665; SCPerf-SCCol: 0.627; SCIntg-SCCol: 0.801; Trust-Comt: 0.708; Trust-IShar: 0.584; Comt-IShar: 0.677
67	Shahzad Ahmad Khan et al.	2015	218	IShar-SCPerf: 0.25
68	Huo et al.	2015	617	Comt-InfT: 0.22
69	Shahzad Ahmad Khan et al.	2015	218	Trust-IShar: 0.15
70	Zhining Wang et al.	2014	228	IShar-SCPerf: 0.175
71	Jie Yang	2014	137	IShar-SCPerf: 0.25; IShar-SCCol: 0.36; IShar-SCFlex: 0.33; SCPerf-SCCol: 0.02; SCPerf-SCFlex: 0.44; SCCol-SCFlex: 0.01; InfT-IShar: 0.35
72	Wu et al.	2014	177	IShar-SCPerf: 0.26; IShar-SCCol: 0.43; SCPerf-SCIntg: 0.45; Trust-Comt: 0.22; Trust-IShar: 0.40; Comt-IShar: 0.39
73	Yina Li et al.	2014	272	IShar-SCPerf: 0.27; IShar-SCFlex: 0.30; SCPerf-SCFlex: 0.49; Trust-IShar: 0.36
74	Zailani et al.	2014	129	IShar-SCCol: 0.78; Trust-Comt: 0.63; Trust-InfT: 0.52; Trust-IShar: 0.58; Comt-InfT: 0.48; Comt-IShar: 0.68; InfT-IShar: 0.86
75	Adams et al.	2014	288	SCPerf-SCIntg: 0.505; SCPerf-SCCol: 0.487; SCIntg-SCCol: 0.569
76	Abdullah & Musa	2014	232	Trust-Comt: 0.724; Trust-IShar: 0.495; Comt-IShar: 0.573
77	Ying-Hueih Chen et al.	2014	226	Trust-IShar: 0.74
78	Zhiqiang Wang et al.	2014	272	Trust-InfT: 0.23; Trust-EnU: -0.15; Trust-IShar: 0.421; InfT-EnU: 0.004; InfT-IShar: 0.401; EnU-IShar: -0.12
79	Jia et al.	2014	225	Comt-EnU: 0.29; Comt-IShar: 0.55; EnU-IShar: 0.42
80	Nagarajan et al.	2013	75	SCCol-SCFlex: 0.63
81	Youn et al.	2013	141	IShar-SCPerf: 0.555; Trust-IShar: 0.467
82	Hsin Hsin Chang et al.	2013	108	IShar-SCPerf: 0.682; IShar-SCIntg: 0.756; SCPerf-SCIntg: 0.708
83	Aragón-Correa et al.	2013	164	IShar-SCPerf: -0.17; IShar-SCCol: 0.64; SCPerf-SCCol: 0.11; EnU-IShar: 0.26
84	Ye & Wang	2013	141	IShar-SCPerf: 0.52; IShar-SCFlex: 0.41; SCPerf-SCFlex: 0.52; InfT-IShar: 0.37
85	Hefu Liu et al.	2013	246	IShar-SCPerf: 0.45; IShar-SCCol: 0.62; SCPerf-SCCol: 0.46
86	Kalyar et al.	2013	61	Trust-IShar: 0.444
87	Yim & Leem	2013	420	Trust-Comt: 0.454; Trust-IShar: 0.288; Comt-IShar: 0.315
88	Min Zhang & Huo	2013	617	SCIntg-SCPerf: 0.46
89	Baihaqi & Sohal	2013	150	Tech-IShar: 0.46
90	Eckerd & Hill	2012	110	Comt-IShar: 0.691
91	Gharakhani et al.	2012	186	IShar-SCIntg: 0.28; InfT-IShar: 0.42
92	Cirtita & Glaser-Segura	2012	73	SCCol-SCFlex: 0.113

#	Study	Year	N	r
93	Ibrahim & Ogunyemi	2012	310	SCFlex-SCPerf: 0.52
94	Gharakhani et al.	2012	186	Tech-IShar: 0.42
95	Koçoğlu et al.	2011	158	IShar-SCIntg: 0.441; IShar-SCFlex: 0.331; SCIntg-SCFlex: 0.401
96	Hu et al.	2011	128	Trust-InfT: 0.477; Trust-IShar: 0.634; InfT-IShar: 0.576
97	Vijayasarathy	2010	276	Trust-Comt: 0.65
98	Cai et al.	2010	398	Trust-IShar: 0.715
99	Arnold et al.	2010	207	Comt-IShar: 0.76
100	Olorunniwo & Li	2010	65	IShar-SCPerf: 0.52; IShar-SCCol: 0.63; SCPerf-SCCol: 0.73

Note: Publications are published from 2010 to March 2021

Source: Own research (2021)

5. RESEARCH FINDINGS AND EVALUATIONS

IShar is described as a two-way exchange of useful information between supply chain participants (Gang Li et al., 2006). IShar seems to be a connection element in the activities of each member with other participants. Thus, IShar is one of the essential factors in promoting an efficient supply chain that meets the needs of customers (Damiani et al., 2011). According to many previous studies, there are eight most crucial activities/factors considered in the scope of supply chain information exchange, including SCPerf, Comt, Trust, InfT, EnU, and SCPerfIAs containing SCIntg, SCCol, SCFlex.

Firstly, this study made an examination related to the relationships between eight activities/factors. These eight activities/factors are divided into 2 groups: 1) the set of IShar, SCPerf, and supply chain performance improvement activities (SCPerfIAs) including SCIntg, SCFlex, and SCCol, and 2) the set of IShar and IShar's factors including Comt, Trust, InfT, and EnU. Based on previous studies, 16 hypotheses are formed to describe these relationships. Then, based on the results of testing 16 hypotheses, two structural models are formed to examine complex relationships in two sets. Finally, the evaluation of relationships between factor pairs and structural relationships in each set is performed. This examination is to determine the role of IShar on SCPerf and SCPerfIAs and the effect of SCPerfIAs on SCPerf, as well as the relationships between members in SCPerfIAs. In addition, important factors affecting IShar and the relationship between the factors of IShar are also indicated. All results of this study are presented from section 5.1 to section 5.5.

5.1. The results of selecting and testing publications

5.1.1. Publication choice

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 19) that are identification, screening, and included. 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.

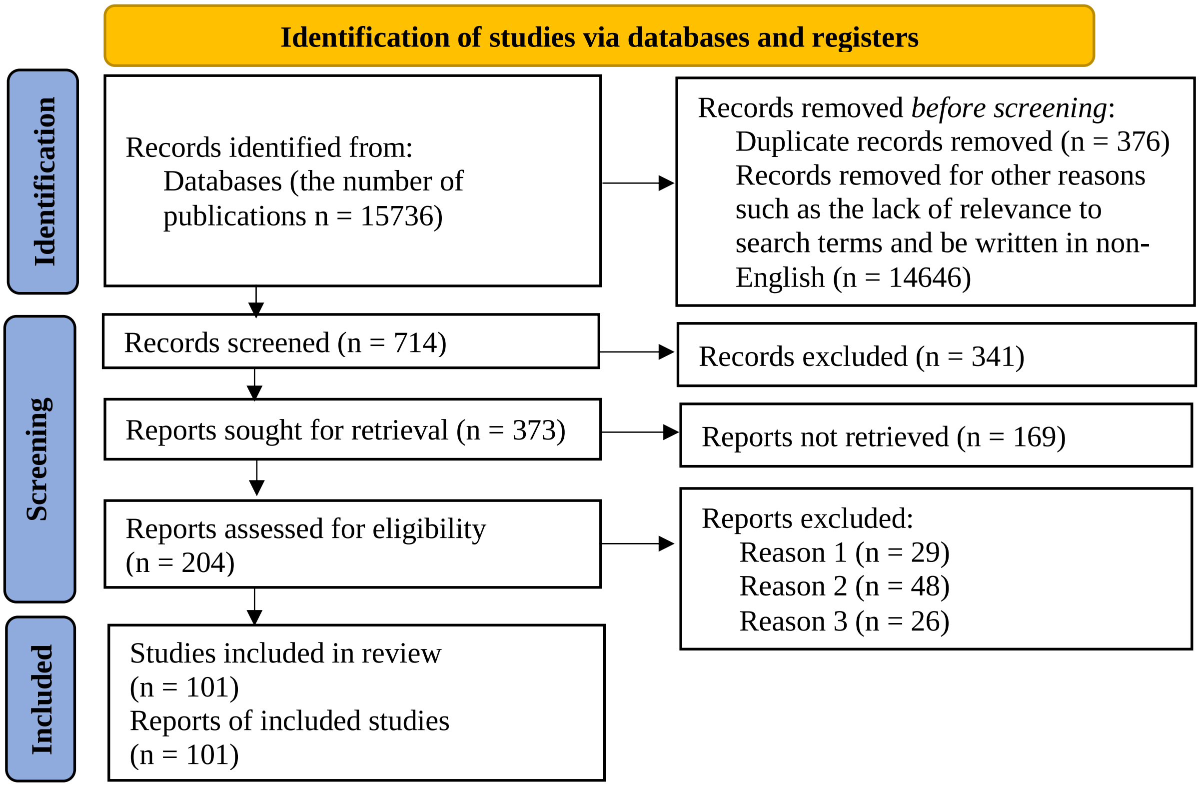


Figure 19: Publication selections

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

5.1.2. The tests of heterogeneity, publication bias, and fail-safe number

After selecting publications, the analysis and test of data are performed. Table 9 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 Q-statistic of 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.

All detail results of analyses are presented from section 5.1.2.1 to 5.1.2.16

Table 9: 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	94.8	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)

Table 10 presents the summary effect sizes for each relationship. Effect sizes range from 0.15 to 0.70. Each effect size is in its own confidence interval. The width of confidence interval (CIs) shows the diversity of publications. The greater the confidence interval, the more studies are comprised (Hunter & Schmidt, 2004).

Table 10: Summary effect sizes and confidence interval

Relationship	k	N	Summary (Confidence interval 95%)		
			r_0	CI.LB	CI.UB
IShar - SCPerf	44	9065	0.47	0.39	0.54
IShar - SCFlex	16	3919	0.43	0.29	0.54
IShar - SCCol	21	5410	0.64	0.56	0.71
IShar - SCIntg	15	2885	0.60	0.51	0.68
SCCol - SCIntg	7	1874	0.70	0.56	0.80
SCCol - SCFlex	10	2522	0.45	0.19	0.65
SCCol-SCPerf	22	5146	0.53	0.42	0.64
SCIntg - SCPerf	30	6699	0.50	0.41	0.59
SCFlex - SCPerf	17	3601	0.54	0.43	0.64
Comt - IShar	17	3793	0.50	0.38	0.60
Comt - Trust	11	2811	0.55	0.44	0.64
Comt - InfT	8	2041	0.40	0.20	0.57
Trust - IShar	22	5490	0.46	0.39	0.53
InfT - IShar	21	4585	0.48	0.38	0.58
InfT - EnU	4	939	0.15	-0.04	0.32
EnU - IShar	9	2132	0.17	0.05	0.28

Note: k is the amount of research, N is the sample size, r_0 *is observed correlation, (CI.LB, CI.UB) is confidence interval*

Source: Own research (2021).

5.1.2.1 The connection between IShar and SCPerf

The first results of the meta-analysis are the Fisher's z score transformation and the corresponding estimated sampling variance (The data used for this calculation are in Table 8). These results are calculated from 44 relevant studies with a total of 9065 samples and the range of their correlation coefficient is between -0.17 and 0.87. In particular, the values of Fisher's z range from -0.17 to 1.35, and the maximum and minimum sampling variances are 0.037 and 0.002, respectively.

Next, the study heterogeneity is tested by computing Q- statistic, I^2- statistic, and T^2 (Table 11). Table 11 shows that the estimated amount of total heterogeneity T^2 is 0.09, calculated using a restricted maximum-likelihood estimator (REML). I^2 statistic achieves 94.8 % computed by dividing between total heterogeneity and total variability. In other words, the actual differences in the population mean are 94.8%. This value lies in a range of confidence intervals of 95% from 92.5 to 96.9. In addition, the value of Q- statistic with degrees of freedom of 44 is 788.8 and the p-value of the heterogeneity test is less than 0.0001. This indicates that studies do not share a common effect size. In other words, data is suitable for the random-effect model.

Table 11: The heterogeneity tests of relationship between IShar and SCPerf

	Estimate	CI.LB	CI.UB
T^2	0.0912	0.0610	0.1558
T	0.3020	0.2470	0.3947
I^2(%)	94.8477	92.4909	96.9170
H^2	19.4087	13.3171	32.4362
Test for heterogeneity: df = 43, Q = 788.8425, p-value < 0.0001			

Source: Own research (2021)

Then, the disproportionate influence of studies on heterogeneity is presented in Figure 20. Figure 20 shows that there are four studies that lie on the top right quadrant of the Baujat plot, including 6- Lyu et al. (2019), 7- Sinnandavar et al. (2018), 15- Kumar et al. (2017), and 36- Hove-Sibanda & Pooe (2018). These four studies contribute the most to the connection between the two factors considered.

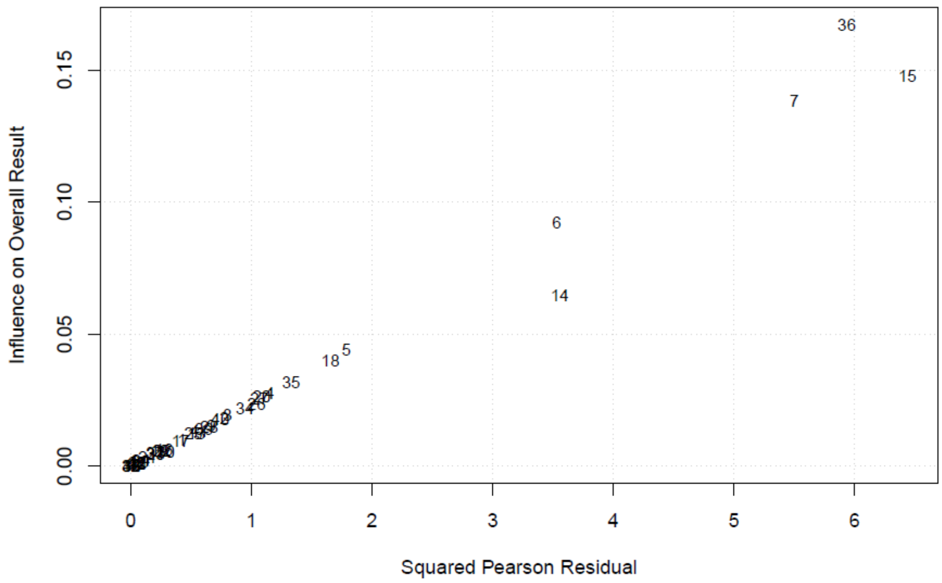


Figure 20: Baujat plot between IShar and SCPerf

Source: Own research (2021)

To test publication bias, the scatter of studies is observed in the funnel plot (Figure 21). In the funnel plot, studies seem to be equivalently spread on both sides of the centerline – the summary effect size. The distribution of studies creates symmetry, which proves that there is no publication bias. This conclusion is confirmed by two other tests: 1) the rank correlation test and 2) Egger's regression test. The p-values of Egger's regression test (ERT) and the rank correlation test (RCT) are 0.99 and 0.19, respectively. Both these values are statistically significant (greater than 0.05) so the conclusion of no publication bias is unchanged.

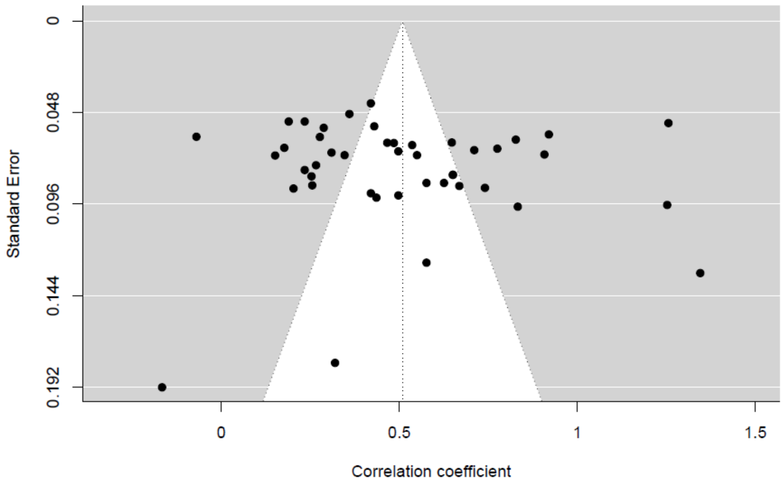


Figure 21: The funnel plot of correlation between IShar and SCPerf

Source: Own research (2021)

According to Rosenthal (1979), the calculation of the fail-safe number in the relationship between IShar and SCPerf is 34085.

5.1.2.2 The connection between IShar and SCIntg

The first results of the meta-analysis are the Fisher's z score transformation and the corresponding estimated sampling variance (The data used for this calculation are in Table 8). These results are calculated from 15 relevant studies with a total of 2885 samples and the range of their correlation coefficient is between 0.26 and 0.84. In particular, the values of Fisher's z range from 0.27 to 1.22, and the maximum and minimum sampling variances are 0.013 and 0.002, respectively.

Next, the study heterogeneity is tested by computing Q- statistic, I^2 statistic, and T^2 (Table 12). Table 12 shows that the estimated amount of total heterogeneity (T^2) is 0.0642, calculated using a restricted maximum-likelihood estimator (REML). I^2 statistic achieves 92.2 % computed by dividing between total heterogeneity and total variability. In other words, the actual difference in the population mean is 92.2%. This value lies in a range of confidence intervals of 95% from 85.3 to 96.9. In addition, the value of Q- statistic with degrees of freedom of 14 is 203.0637 and the p-value of the heterogeneity test is less than 0.0001. This indicates that studies do not share a common effect size. In other words, data is suitable for the random-effect model.

Table 12: The heterogeneity tests of relationship between IShar and SCIntg

	Estimate	CI.LB	CI.UB
T^2	0.0642	0.0314	0.1674
T	0.2534	0.1772	0.4092
I^2(%)	92.2199	85.2793	96.8653
H^2	12.8534	6.7931	31.9013
Test for heterogeneity: df = 14 Q = 203.0637 p-value < 0.0001			

Source: Own research (2021)

Then, the disproportionate influence of studies on heterogeneity is presented in Figure 22. Figure 22 shows that there are two studies lying on the top right quadrant of the Baujat plot, including 8- Phan et al. (2020), and 4-Lee & Fernando (2015). These two studies contribute the most to the relationship of the two factors considered.

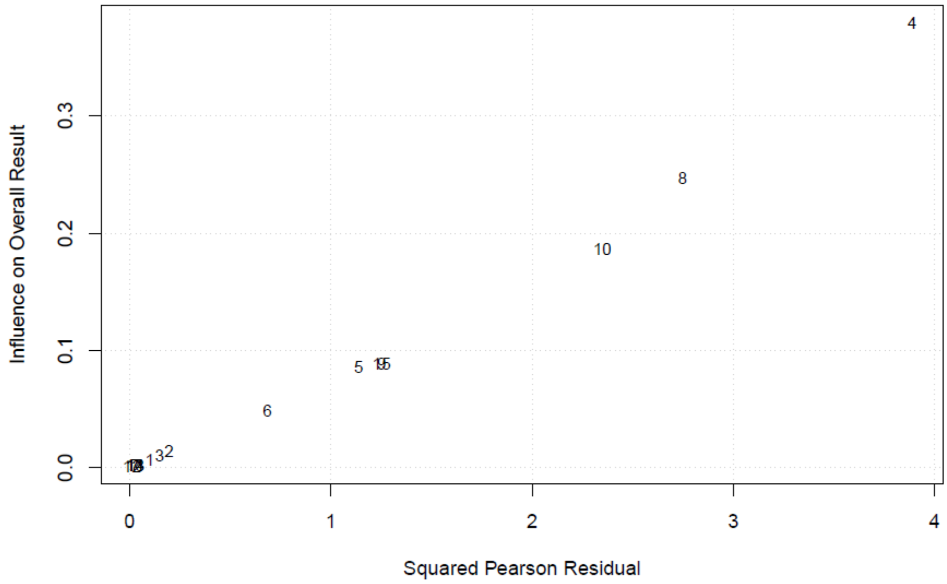


Figure 22: Baujat plot between IShar and SCIntg

Source: Own research (2021)

To test publication bias, the scatter of studies is observed in the funnel plot (Figure 23). In the funnel plot, studies equivalently spread on both sides of the centerline, which proves that there may be no publication bias. This conclusion is confirmed by two other tests: 1) the rank correlation test and 2) Egger's regression test. The p-values of Egger's regression test (ERT) is 0.1243 and the p-value of the rank correlation test (RCT) is 0.2527. Both these values are statistically significant (greater than 0.05) so the conclusion of no publication bias is unchanged.

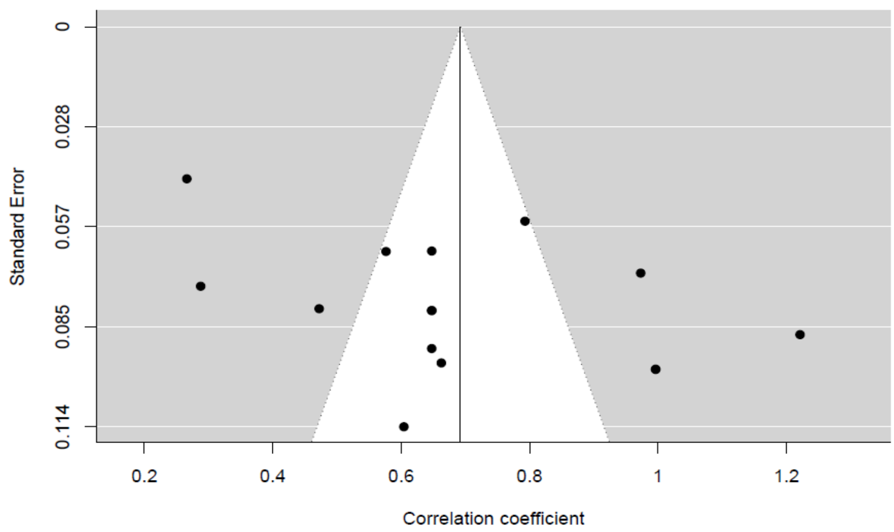


Figure 23: The funnel plot of correlation between IShar and SCIntg

Source: Own research (2021)

According to Rosenthal (1979), the calculation of the fail-safe number in the relationship between IShar and SCIntg is 6511.

5.1.2.3 The connection between IShar on SCFlex

The first results of the meta-analysis are the Fisher's z score transformation and the corresponding estimated sampling variance (The data used for this calculation are in Table 8). These results are calculated from 16 relevant studies with a total of 3919 samples and the range of their correlation coefficient is between -0.21 and 0.76. In particular, the values of Fisher's z range from -0.21 to 1.00, and the maximum and minimum sampling variances are 0.009 and 0.002, respectively.

Next, the study heterogeneity is tested by computing Q- statistic, I^2 statistic, and T^2 (Table 13).

Table 13: The heterogeneity tests of relationship between IShar and SCFlex

	Estimate	CI.LB	CI.UB
T^2	0.0943	0.0491	0.2275
T	0.3071	0.2215	0.4770
I^2(%)	95.7364	92.1160	98.1870
H^2	23.4542	12.6839	55.1574
Test for heterogeneity: df = 15, Q = 451.7934, p-value < 0.0001			

Source: Own research (2021)

The results in Table 13 show that the estimated amount of total heterogeneity (T^2) is 0.0943. I2 statistic achieves 95.7 % which is greater than 75%. The value of Q- statistic with degrees of freedom of 15 is 451.8 and the p-value of the heterogeneity test is less than 0.0001. Therefore, there was an occurrence of heterogeneity among the studies collected. In other words, the data fit the random-effects model.

Then, the disproportionate influence of studies on heterogeneity is presented in Figure 24. Figure 24 shows that there are two studies lying on the top right quadrant of the Baujat plot, including 13- Hove-Sibanda & Pooe (2018), and 14- Dubey et al. (2018). These two studies contribute the most to the relationship of the two factors considered.

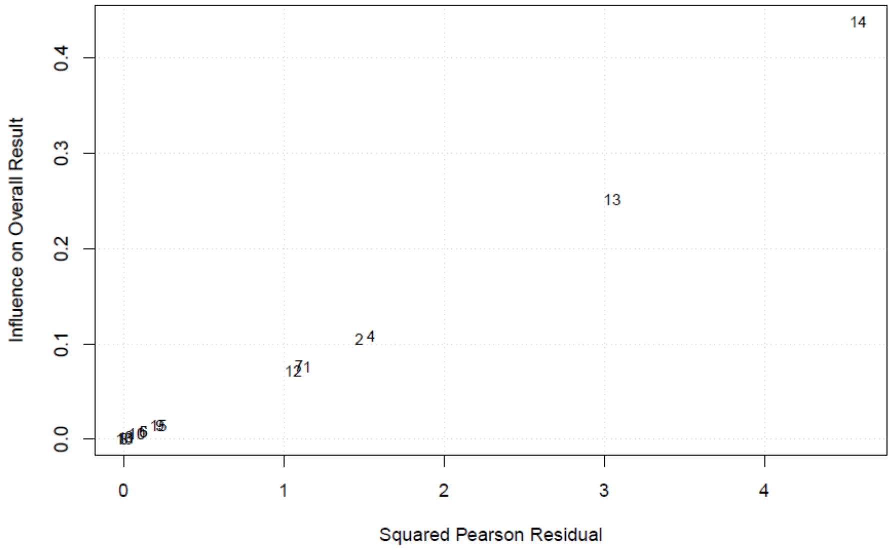


Figure 24: Baujat plot between IShar and SCFlex

Source: Own research (2021)

To test publication bias, the scatter of studies is observed in the funnel plot (Figure 25). In the funnel plot, studies equivalently spread on both sides of the centerline. Visually, therefore, there may be no publication bias. This conclusion is confirmed by two other tests: 1) the rank correlation test and 2) Egger's regression test. The p-values of Egger's regression test (ERT) and the rank correlation test (RCT) are 0.76 and 0.69, respectively. Both these values are statistically significant (greater than 0.05) so the conclusion of no publication bias is unchanged.

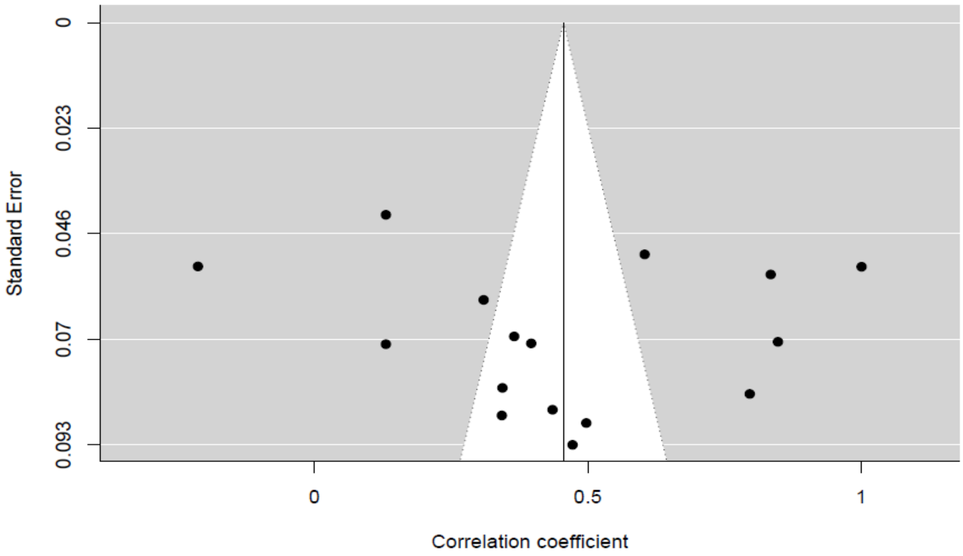


Figure 25: The funnel plot of correlation between IShar and SCFlex

Source: Own research (2021)

According to Rosenthal (1979), the calculation of the fail-safe number in the relationship between IShar and SCFlex is 4326.

5.1.2.4 The connection between IShar on SCCol

The first results of the meta-analysis are the Fisher's z score transformation and the corresponding estimated sampling variance (The data used for this calculation are in Table 8). These results are calculated from 21 relevant studies with a total of 5410 samples and the range of their correlation coefficient is between 0.22 and 0.90. In particular, the values of Fisher's z range from 0.22 to 1.47, and the maximum and minimum sampling variances are 0.017 and 0.002, respectively.

Next, the study heterogeneity is tested by computing Q- statistic, I^2 statistic, and T^2 (Table 14).

Table 14: The heterogeneity tests of relationship between IShar and SCCol

	Estimate	CI.LB	CI.UB
T^2	0.0799	0.0450	0.1756
T	0.2827	0.2121	0.4190
I^2(%)	95.2762	91.9034	97.7828
H^2	21.1692	12.3508	45.3055
Test for heterogeneity: df = 20, Q = 407.4479, p-value < 0.0001			

Source: Own research (2021)

The results show in Table 14 that T^2 is 0.0799, I^2 statistic achieves 95.3 % that is greater than 75%, and Q- statistic with degrees of freedom of 20 is 407.4 and the p-value of the heterogeneity test is less than 0.0001. Therefore, there was an occurrence of heterogeneity among the studies collected. In other words, the data fit the random-effects model.

Then, the disproportionate influence of studies on heterogeneity is presented in Figure 26. Study 17-Hove-Sibanda & Pooe (2018) lies on the top right quadrant of the Baujat plot. Therefore, this study contributes the most to the relationship between the two factors considered.

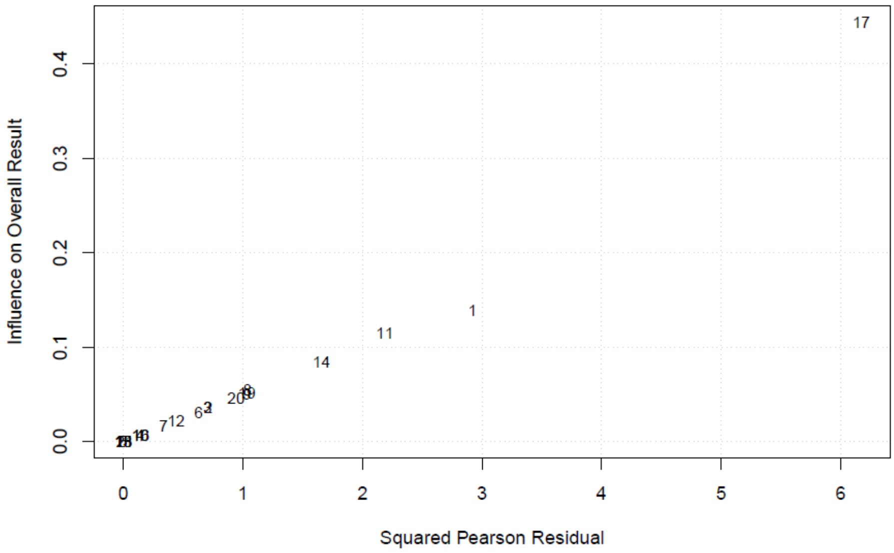


Figure 26: Baujat plot between IShar and SCCol

Source: Own research (2021)

To test publication bias, the scatter of studies is observed in the funnel plot (Figure 27).

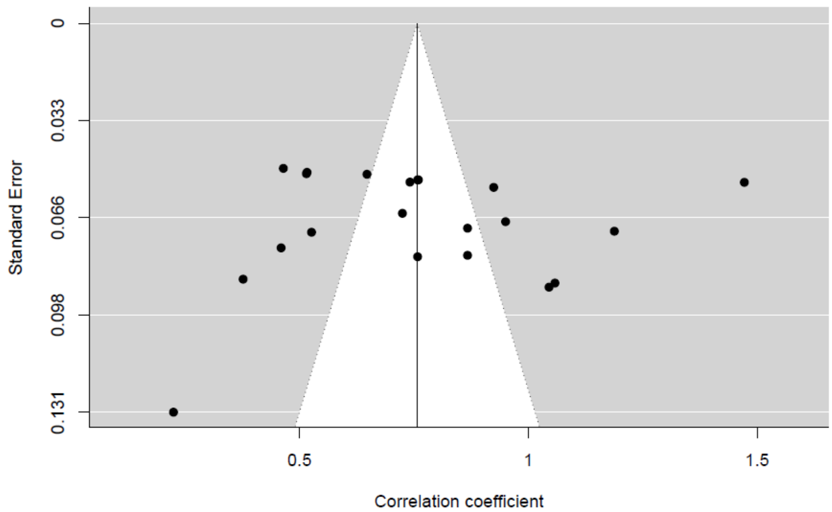


Figure 27: The funnel plot of correlation between IShar and SCCol

Source: Own research (2021)

In the funnel plot, studies equivalently spread on both sides of the centerline. Visually, as a result, there may be no publication bias. This conclusion is confirmed by two other tests: 1) the rank correlation test and 2) Egger's regression test. The p-values of Egger's regression test (ERT) and the rank correlation test (RCT) are 0.39 and 0.19, respectively. Both these values are statistically significant (greater than 0.05) so the conclusion of no publication bias is unchanged.

According to Rosenthal (1979), the calculation of the fail-safe number in the relationship between IShar and SCCol is 22774.

5.1.2.5 The results of examing the effect of SCCol on SCIntg

The first results of the meta-analysis are the Fisher's z score transformation and the corresponding estimated sampling variance (The data used for this calculation are in Table 8). These results are calculated from 7 relevant studies with a total of 1874 samples and the range of their correlation coefficient is between 0.39 and 0.85. In particular, the values of Fisher's z range from 0.41 to 1.25, and the maximum and minimum sampling variances are 0.002 and 0.008, respectively.

Next, the study heterogeneity is tested by computing Q- statistic, I^2 statistic, and T^2 (Table 15). The results show that T^2 is 0.0938, I^2 statistic achieves 95.9 % that is greater than 75%, and Q-statistic with degrees of freedom of 6 is 131.6 and the p-value of the heterogeneity test is less than 0.0001. Therefore, there was an occurrence of heterogeneity among the studies collected. In other words, the data fit the random-effects model.

Table 15: The heterogeneity tests of relationship between SCCol and SCIntg

	Estimate	CI.LB	CI.UB
T^2	0.0938	0.0361	0.4787
T	0.3063	0.1900	0.6919
I^2(%)	95.9110	90.0248	99.1712
H^2	24.4561	10.0249	120.6573
Test for heterogeneity: df = 6; Q = 131.6; p-value < 0.0001			

Source: Own research (2021)

Then, the disproportionate influence of studies on heterogeneity is presented in Figure 28. Studies 5-Mubarik & Mubarak (2020) and 7-Liu & Lee (2018) lie on the top right quadrant of the Baujat plot. Therefore, two studies contribute the most to the relationship between the two factors considered.

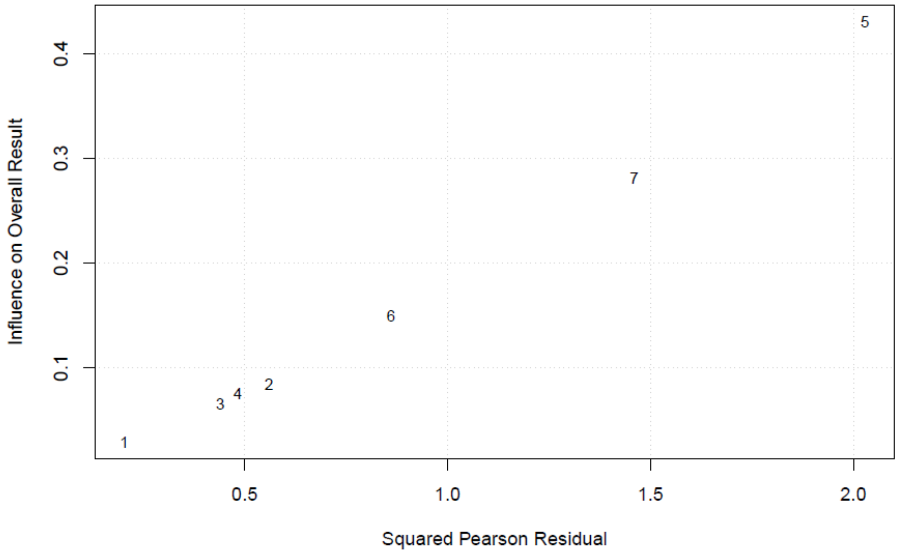


Figure 28: Baujat plot between SCCol and SCIntg

Source: Own research (2021)

To test publication bias, the scatter of studies is observed in the funnel plot (Figure 29). Visually, as a result, there may be no publication bias. This conclusion is confirmed by two other tests: 1) the rank correlation test and 2) Egger's regression test. The p-values of Egger's regression test (ERT) and the rank correlation test (RCT) are 0.36 and 0.56, respectively. Both these values are statistically significant (greater than 0.05) so the conclusion of no publication bias is unchanged.

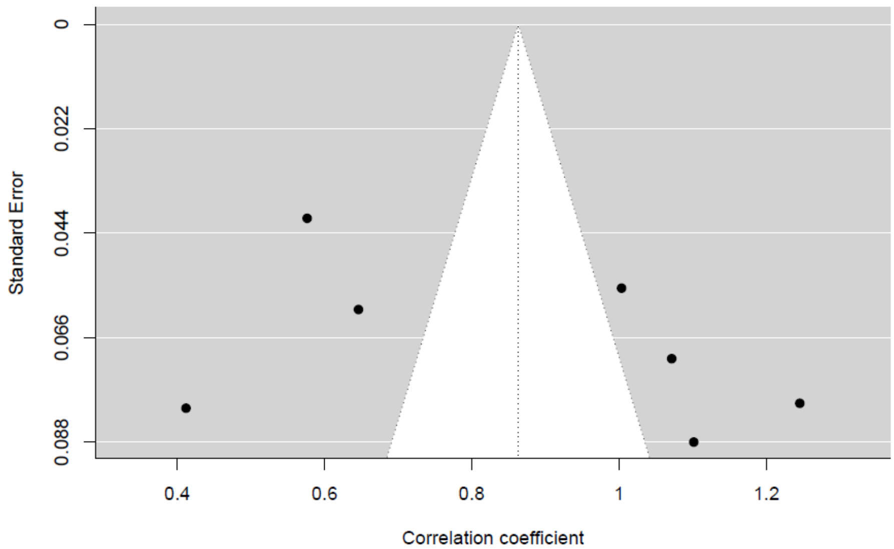


Figure 29: The funnel plot of correlation between SCCol and SCIntg

Source: Own research (2021)

According to Rosenthal (1979), the calculation of the fail-safe number in the relationship between SCCol and SCIntg is 3098.

5.1.2.6 The connection between SCCol and SCFlex

The first results of the meta-analysis are the Fisher's z score transformation and the corresponding estimated sampling variance (The data used for this calculation are in Table 8). These results are calculated from 10 relevant studies with a total of 2522 samples and the range of their correlation coefficient is between -0.29 and 0.77. In particular, the values of Fisher's z range from -0.30 to 1.02, and the maximum and minimum sampling variances are 0.003 and 0.014, respectively.

Next, the study heterogeneity is tested by computing Q- statistic, I^2 statistic, and T^2 (Table 16). The results show that T^2 is 0.2096, I^2 statistic achieves 98.1 % that is greater than 75%, and Q-statistic with degrees of freedom of 9 is 517.17 and the p-value of the heterogeneity test is less than 0.0001. Therefore, there was an occurrence of heterogeneity among the studies collected. In other words, the data fit the random-effects model.

Table 16: The heterogeneity tests of relationship between SCCol and SCFlex

	Estimate	CI.LB	CI.UB
T^2	0.2096	0.0962	0.7066
T	0.4578	0.3101	0.8406
I^2(%)	98.0771	95.9025	99.4218
H^2	52.0060	24.4050	172.9589
Test for heterogeneity: df = 9 Q = 517.17 p-value < 0.0001			

Source: Own research (2021)

Then, the disproportionate influence of studies on heterogeneity is presented in Figure 30.

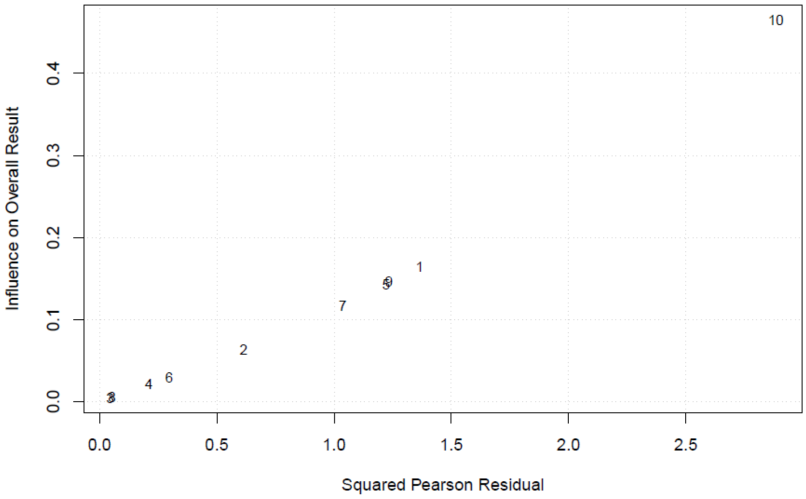


Figure 30: Baujat plot between SCCol and SCFlex

Source: Own research (2021)

In Figure 30, study 10- Dubey et al. (2018) lies on the top right quadrant of the Baujat plot. Therefore, this study contributes the most to the relationship between the two factors considered.

To test publication bias, the scatter of studies is observed in the funnel plot (Figure 31). In the funnel plot, studies equivalently spread on both sides of the centerline. Visually, as a result, there may be no publication bias. This conclusion is confirmed by two other tests: 1) the rank correlation test and 2) Egger's regression test. The p-values of Egger's regression test (ERT) and the rank correlation test (RCT) are 0.70 and 1.00, respectively. Both these values are statistically significant (greater than 0.05) so the conclusion of no publication bias is unchanged.

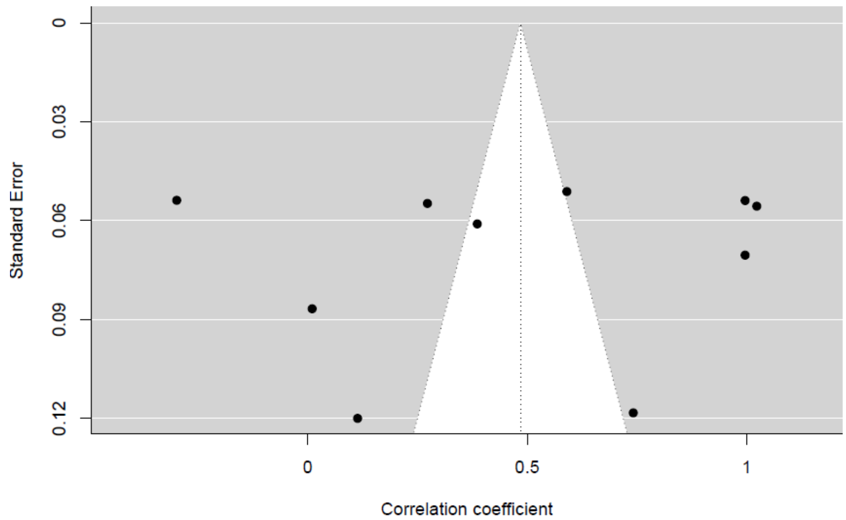


Figure 31: The funnel plot of correlation between SCCol and SCFlex

Source: Own research (2021)

According to Rosenthal (1979), the calculation of the fail-safe number in the relationship between SCCol and SCFlex is 2122.

5.1.2.7 The connection between SCCol and SCPerf

The first results of the meta-analysis are the Fisher's z score transformation and the corresponding estimated sampling variance (The data used for this calculation are in Table 8). These results are calculated from 22 relevant studies with a total of 5146 samples and the range of their correlation coefficient is between 0.02 and 0.91. In particular, the values of Fisher's z range from 0.02 to 1.53, and the maximum and minimum sampling variances are 0.002 and 0.018, respectively.

Next, the study heterogeneity is tested by computing Q- statistic, I^2 statistic, and T^2 (Table 17). The results show that T^2 is 0.1280, I^2 statistic achieves 96.7 % which is greater than 75%, and

Q- statistic with degrees of freedom of 21 is 699.8 and the p-value of the heterogeneity test is less than 0.0001. Therefore, there was an occurrence of heterogeneity among the studies collected. In other words, the data fit the random-effects model.

Table 17: The heterogeneity tests of relationship between SCCol and SCPerf

	Estimate	CI.LB	CI.UB
T^2	0.1280	0.0734	0.2655
T	0.3578	0.2708	0.5153
I^2(%)	96.6873	94.3587	98.3752
H^2	30.1867	17.7263	61.5443
Test for heterogeneity: df = 21, Q = 699.8416, p-value < 0.0001			

Source: Own research (2021)

Then, the disproportionate influence of studies on heterogeneity is presented in Figure 32. Study 15-Hove-Sibanda & Pooe (2018) lies on the top right quadrant of the Baujat plot. Therefore, this study contributes the most to the relationship between the two factors considered.

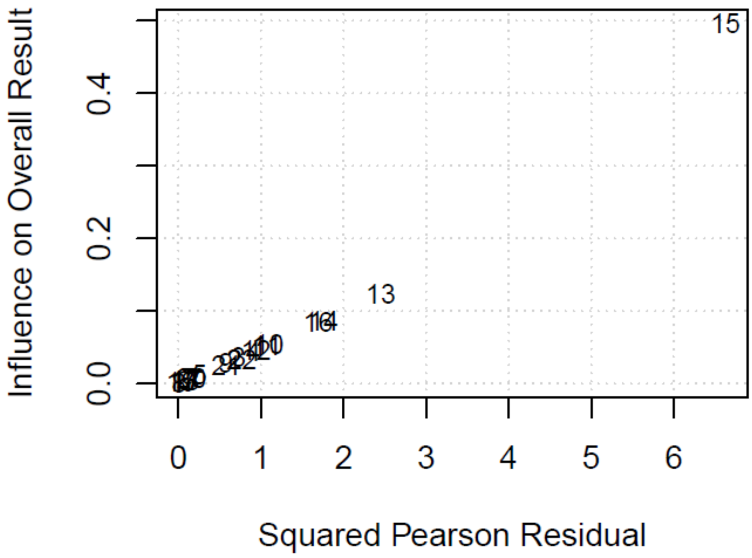


Figure 32: Baujat plot between SCCol and SCPerf

Source: Own research (2021)

To test publication bias, the scatter of studies is observed in the funnel plot (Figure 33). In the funnel plot, studies equivalently spread on both sides of the centerline. Visually, as a result, there may be no publication bias. This conclusion is confirmed by two other tests: 1) the rank correlation test and 2) Egger's regression test. The p-values of Egger's regression test (ERT) and the rank correlation test (RCT) are 0.33 and 0.18, respectively. Both these values are statistically significant (greater than 0.05) so the conclusion of no publication bias is unchanged.

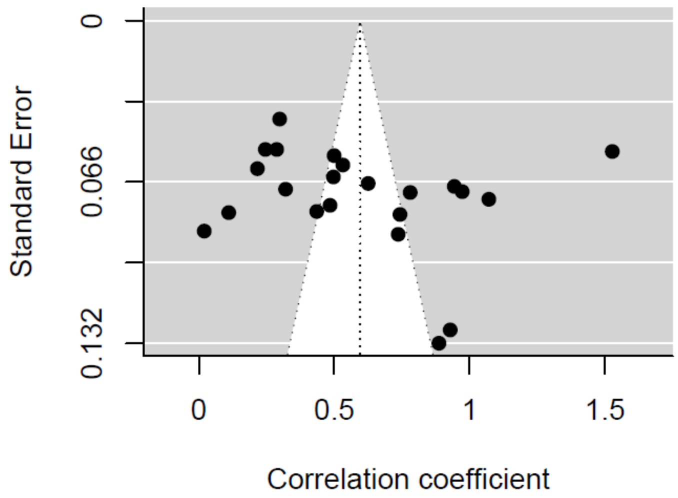


Figure 33: The funnel plot of correlation between SCCol and SCPerf

Source: Own research (2021)

According to Rosenthal (1979), the calculation of the fail-safe number in the relationship between SCCol and SCPerf is 13045.

5.1.2.8 The connection between SCIntg and SCPerf

The first results of the meta-analysis are the Fisher's z score transformation and the corresponding estimated sampling variance (The data used for this calculation are in Table 8). These results are calculated from 30 relevant studies with a total of 6699 samples and the range of their correlation coefficient is between 0.09 and 0.87. In particular, the values of Fisher's z range from 0.09 to 1.34, and the maximum and minimum sampling variances are 0.001 and 0.010, respectively.

Next, the study heterogeneity is tested by computing Q- statistic, I^2 statistic, and T^2 (Table 18).

Table 18: The heterogeneity tests of relationship between SCIntg and SCPerf

	Estimate	CI.LB	CI.UB
T^2	0.1150	0.0709	0.2140
T	0.3391	0.2663	0.4626
I^2(%)	96.1565	93.9140	97.8965
H^2	26.0176	16.4312	47.5405
Test for heterogeneity: df = 29; Q = 631.16; p-value < 0.0001			

Source: Own research (2021)

The results in Table 18 show that T^2 is 0.1150, I^2 statistic achieves 96.2 % that is greater than 75%, and Q- statistic with degrees of freedom of 29 is 631.2 and the p-value of the heterogeneity test is less than 0.0001. Therefore, there was an occurrence of heterogeneity among the studies collected. In other words, the data fit the random-effects model.

Then, the disproportionate influence of studies on heterogeneity is presented in Figure 34. Studies 24- Sundram et al. (2016) and 27- Pati et al. (2016) lie on the top right quadrant of the Baujat plot. Therefore, two studies contribute the most to the relationship between the two factors considered.

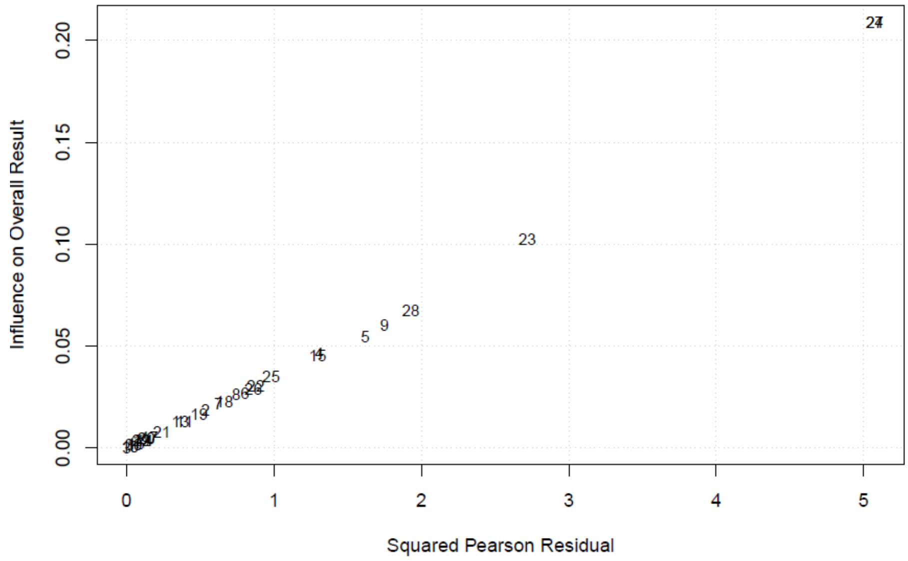


Figure 34: Baujat plot between SCIntg and SCPerf

Source: Own research (2021)

To test publication bias, the scatter of studies is observed in the funnel plot (Figure 35).

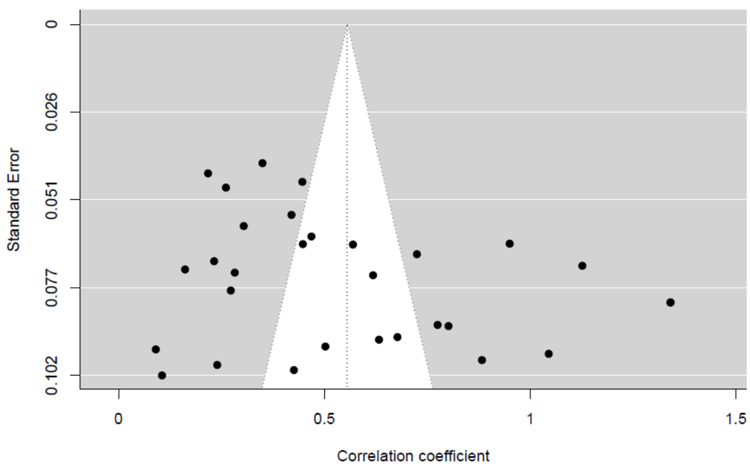


Figure 35: The funnel plot of correlation between SCIntg and SCPerf

Source: Own research (2021)

In the funnel plot, studies equivalently spread on both sides of the centerline. Visually, as a result, there may be no publication bias. This conclusion is confirmed by two other tests: 1) the rank correlation test and 2) Egger's regression test. The p-values of Egger's regression test (ERT) and the rank correlation test (RCT) are 0.28 and 0.12, respectively. Both these values are statistically significant (greater than 0.05) so the conclusion of no publication bias is unchanged.

According to Rosenthal (1979), the calculation of the fail-safe number in the relationship between SCIntg and SCPerf is 19200.

5.1.2.9 The connection between SCFlex and SCPerf

The first results of the meta-analysis are the Fisher's z score transformation and the corresponding estimated sampling variance (The data used for this calculation are in Table 8). These results are calculated from 17 relevant studies with a total of 3601 samples and the range of their correlation coefficient is between 0.18 and 0.91. In particular, the values of Fisher's z range from 0.19 to 1.53, and the maximum and minimum sampling variances are 0.003 and 0.009, respectively.

Next, the study heterogeneity is tested by computing Q- statistic, I^2 statistic, and T^2 (Table 19). The results show that T^2 is 0.0915, I2 statistic achieves 95.0 % that is greater than 75%, and Q-statistic with degrees of freedom of 16 is 413.2 and the p-value of the heterogeneity test is less than 0.0001. Therefore, there was an occurrence of heterogeneity among the studies collected. In other words, the data fit the random-effects model.

Table 19: The heterogeneity tests of relationship between SCFlex and SCPerf

	Estimate	CI.LB	CI.UB
T^2	0.0915	0.0482	0.2145
T	0.3025	0.2196	0.4631
I^2(%)	94.9882	90.8974	97.7982
H^2	19.9528	10.9858	45.464
Test for heterogeneity: df = 16 Q = 413.2 p-value < 0.0001			

Source: Own research (2021)

Then, the disproportionate influence of studies on heterogeneity is presented in Figure 36. Study 15- Hove-Sibanda et al. (2018) lies on the top right quadrant of the Baujat plot. Therefore, this study contributes the most to the relationship between the two factors considered.

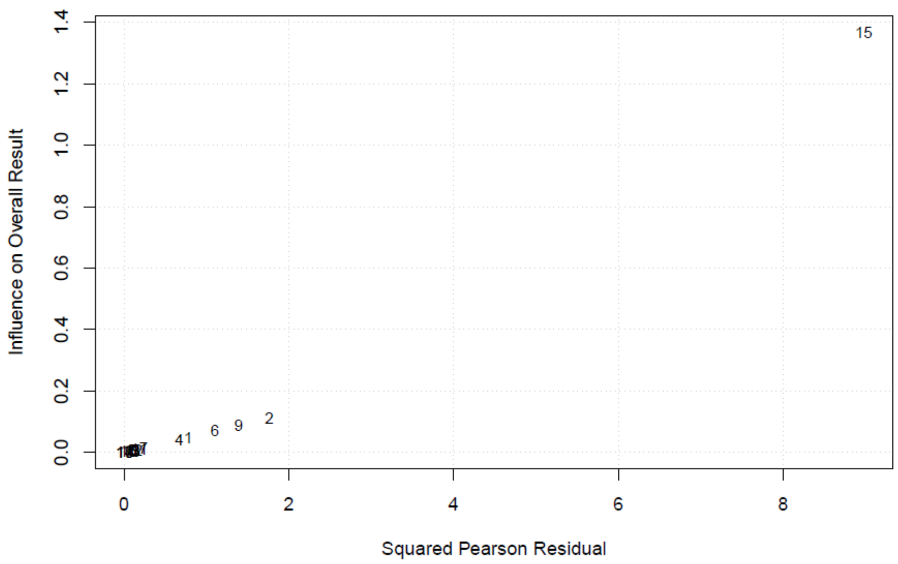


Figure 36: Baujat plot between SCFlex and SCPerf

Source: Own research (2021)

To test publication bias, the scatter of studies is observed in the funnel plot (Figure 37). In the funnel plot, studies equivalently spread on both sides of the centerline. Visually, as a result, there may be no publication bias. This conclusion is confirmed by two other tests: 1) the rank correlation test and 2) Egger's regression test. The p-values of Egger's regression test (ERT) and the rank correlation test (RCT) are 0.16 and 0.48, respectively. Both these values are statistically significant (greater than 0.05) so the conclusion of no publication bias is unchanged.

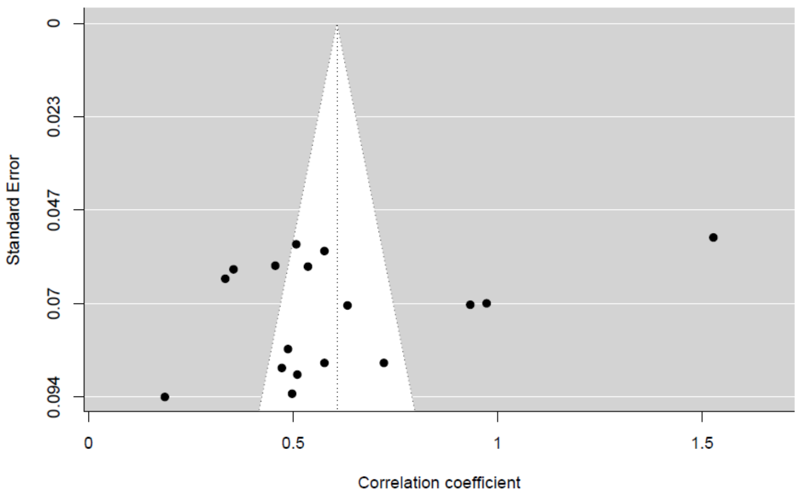


Figure 37: The funnel plot of correlation between SCFlex and SCPerf

Source: Own research (2021)

According to Rosenthal (1979), the calculation of the fail-safe number in the relationship between SCFlex and SCPerf is 8393.

5.1.2.10 The connection between Comt and IShar

The first results of the meta-analysis are the Fisher's z score transformation and the corresponding estimated sampling variance (The data used for this calculation are in Table 8). These results are calculated from 17 relevant studies with a total of 3793 samples and the range of their correlation coefficient is between 0.09 and 0.82. In particular, the values of Fisher's z range from 0.09 to 1.17, and the maximum and minimum sampling variances are 0.013 and 0.002, respectively.

Next, the study heterogeneity is tested by computing Q- statistic, I^2 statistic, and T^2 (Table 20). The results show that T^2 is 0.09, I^2 statistic achieves 95.1 % that is greater than 75%, and Q-statistic with degrees of freedom of 16 is 337.9 and the p-value of the heterogeneity test is less than 0.0001. Therefore, there was an occurrence of heterogeneity among the studies collected. In other words, the data fit the random-effects model.

Table 20: The heterogeneity tests of relationship between Comt and IShar

	Estimate	CI.LB	CI.UB
T^2	0.0891	0.0469	0.2118
T	0.2985	0.2166	0.4602
I^2(%)	95.0831	91.0547	97.8705
H^2	20.3380	11.1790	46.9600
Test for heterogeneity: df = 16, Q = 337.8845, p-value < 0.0001			

Source: Own research (2021)

Then, the disproportionate influence of studies on heterogeneity is presented in Figure 38. In Figure 38, study 3- Somjai & Jermsittiparsert (2019) lies on the top right quadrant of the Baujat plot. Therefore, this study contributes the most to the relationship between the two factors considered.

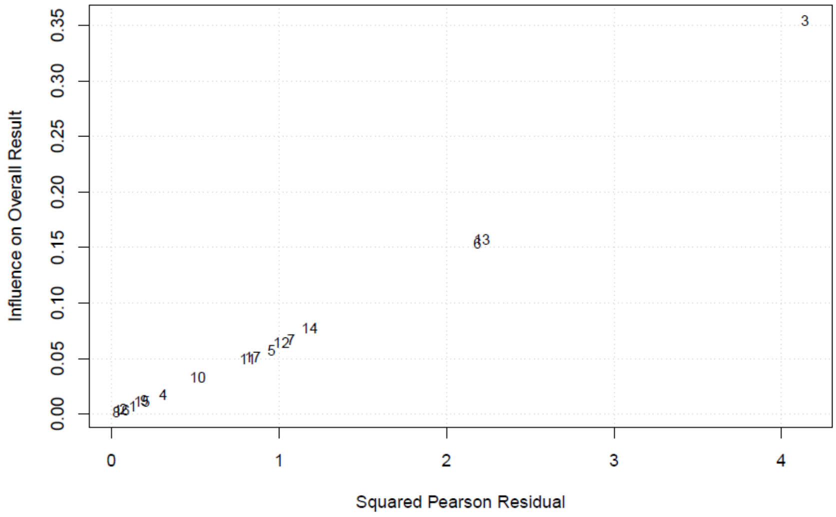


Figure 38: Baujat plot between Comt and IShar

Source: Own research (2021)

To test publication bias, the scatter of studies is observed in the funnel plot (Figure 39). In the funnel plot, studies equivalently spread on both sides of the centerline. Visually, as a result, there may be no publication bias. This conclusion is confirmed by two other tests: 1) the rank correlation test and 2) Egger's regression test. The p-values of Egger's regression test (ERT) and the rank correlation test (RCT) are 0.22 and 0.17, respectively. Both these values are statistically significant (greater than 0.05) so the conclusion of no publication bias is unchanged.

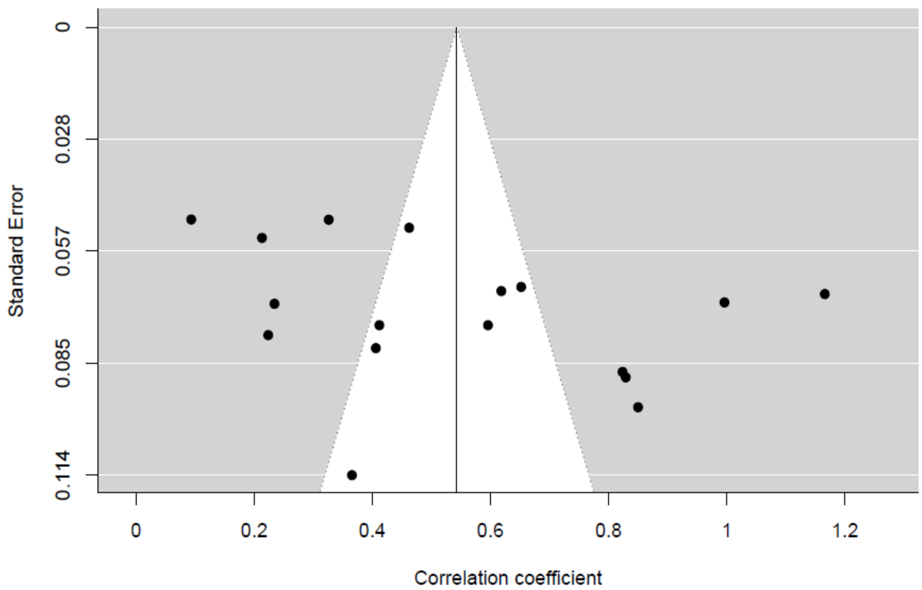


Figure 39: The funnel plot of correlation between Comt and IShar

Source: Own research (2021)

According to Rosenthal (1979), the calculation of the fail-safe number in the relationship between Comt and IShar is 5966.

5.1.2.11 The connection between Comt and Trust

The first results of the meta-analysis are the Fisher's z score transformation and the corresponding estimated sampling variance (The data used for this calculation are in Table 8). These results are calculated from 11 relevant studies with a total of 2811 samples and the range of their correlation coefficient is between 0.22 and 0.72. In particular, the values of Fisher's z range from 0.22 to 0.92, and the minimum and maximum sampling variances are 0.002 and 0.008, respectively.

Next, the study heterogeneity is tested by computing Q- statistic, I2 statistic, and T2 (Table 21). The results show that T^2 is 0.06, I^2 statistic achieves 93.6 % that is greater than 75%, and Q-statistic with degrees of freedom of 10 is 156.0 and the p-value of the heterogeneity test is less than 0.0001. Therefore, there was an occurrence of heterogeneity among the studies collected. In other words, the data fit the random-effects model.

Table 21: The heterogeneity tests of relationship between Comt and Trust

	Estimate	CI.LB	CI.UB
T^2	0.0589	0.0264	0.1907
T	0.2427	0.1624	0.4367
I^2(%)	93.5947	86.7484	97.9309
H^2	15.6120	7.5463	48.3308
Test for heterogeneity: df = 10 Q = 155.9949 p-value < 0.0001			

Source: Own research (2021)

Then, the disproportionate influence of studies on heterogeneity is presented in Figure 40. Studies 8- Zhong et al. (2020) and 10- Wuet al. (2014) lie on the top right quadrant of the Baujat plot. Therefore, these studies contribute the most to the relationship between the two factors considered.

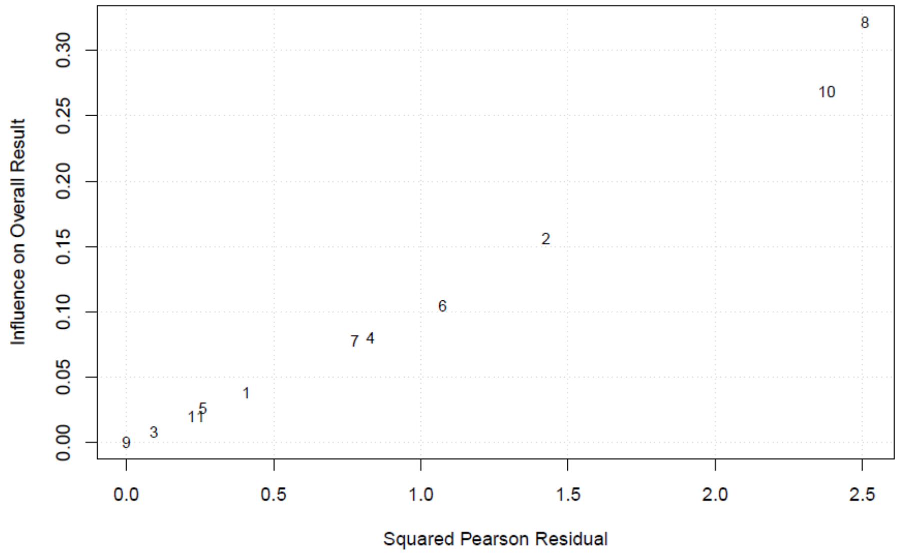


Figure 40: Baujat plot between Comt and Trust

Source: Own research (2021)

To test publication bias, the scatter of studies is observed in the funnel plot (Figure 41). In the funnel plot, studies equivalently spread on both sides of the centerline. Visually, as a result, there may be no publication bias. This conclusion is confirmed by two other tests: 1) the rank correlation test and 2) Egger's regression test. The p-values of Egger's regression test (ERT) and the rank correlation test (RCT) are 0.16 and 0.22, respectively. Both these values are statistically significant (greater than 0.05) so the conclusion of no publication bias is unchanged.

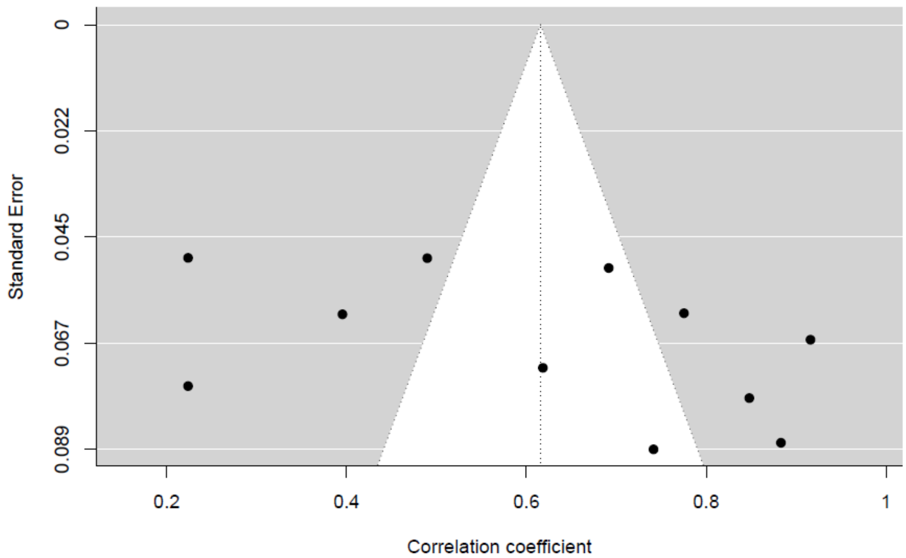


Figure 41: The funnel plot of correlation between Comt and Trust

Source: Own research (2021)

According to Rosenthal (1979), the calculation of the fail-safe number in the relationship between Comt and Trust is 3840.

5.1.2.12 The connection between Comt and InfT

The first results of the meta-analysis are the Fisher's z score transformation and the corresponding estimated sampling variance (The data used for this calculation are in Table 8). These results are calculated from 8 relevant studies with a total of 2041 samples and the range of their correlation coefficient is between 0.06 and 0.73. In particular, the values of Fisher's z range from 0.06 to 0.93, and the minimum and maximum sampling variances are 0.002 and 0.008, respectively.

Next, the study heterogeneity is tested by computing Q- statistic, I^2 statistic, and T^2 (Table 22). The results show that T^2 is 0.097, I^2 statistic achieves 95.9 % that is greater than 75%, and Q-statistic with degrees of freedom of 7 is 156.2 and the p-value of the heterogeneity test is less than 0.0001. Therefore, there was an occurrence of heterogeneity among the studies collected. In other words, the data fit the random-effects model.

Table 22: The heterogeneity tests of relationship between Comt and InfT

	Estimate	CI.LB	CI.UB
T^2	0.0969	0.0395	0.4164
T	0.3113	0.1989	0.6453
I^2(%)	95.8507	90.4094	99.0025
H^2	24.1006	10.4269	100.2473
Test for heterogeneity: df = 7; Q = 156.1593; p-value < 0.0001			

Source: Own research (2021)

Then, the disproportionate influence of studies on heterogeneity is presented in Figure 42. Study 2- Somjai & Jermsittiparsert (2019) lies on the top right quadrant of the Baujat plot. Therefore, this study contributes the most to the relationship between the two factors considered.

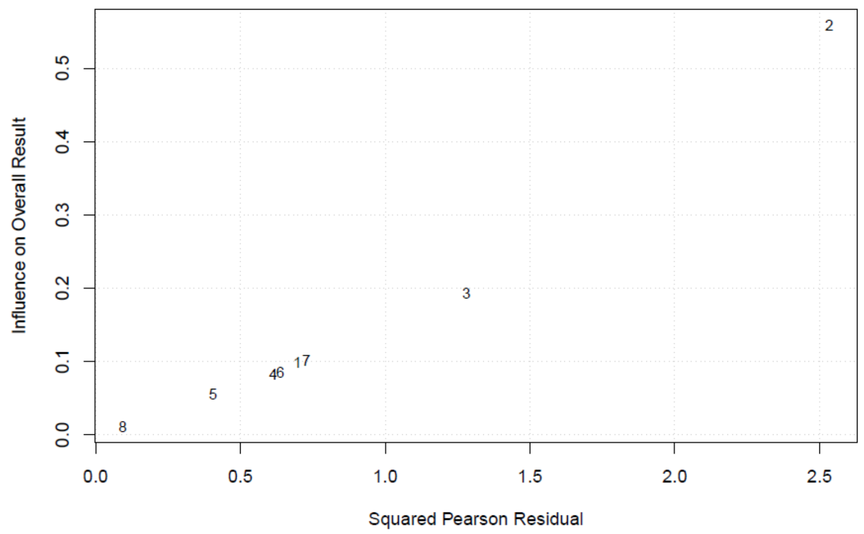


Figure 42: Baujat plot between Comt and InfT

Source: Own research (2021)

To test publication bias, the scatter of studies is observed in the funnel plot (Figure 43). In the funnel plot, studies equivalently spread on both sides of the centerline. Visually, as a result, there may be no publication bias. This conclusion is confirmed by two other tests: 1) the rank correlation test and 2) Egger's regression test. The p-values of Egger's regression test (ERT) and the rank correlation test (RCT) are 0.55 and 0.37, respectively. Both these values are statistically significant (greater than 0.05) so the conclusion of no publication bias is unchanged.

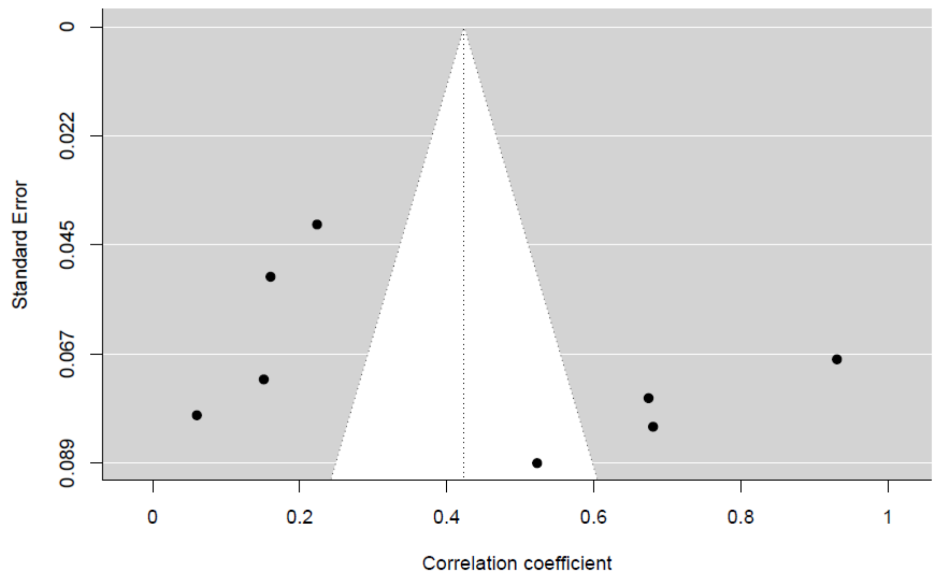


Figure 43: The funnel plot of correlation between Comt and InfT

Source: Own research (2021)

According to Rosenthal (1979), the calculation of the fail-safe number in the relationship between Comt and InfT is 857.

5.1.2.13 The connection between Trust and IShar

The first results of the meta-analysis are the Fisher's z score transformation and the corresponding estimated sampling variance (The data used for this calculation are in Table 8). These results are calculated from 22 relevant studies with a total of 5490 samples and the range of their correlation coefficient is between 0.15 and 0.74. In particular, the values of Fisher's z range from 0.15 to 0.95, and the maximum and minimum sampling variances are 0.017 and 0.002, respectively.

Next, the study heterogeneity is tested by computing Q- statistic, I^2 statistic, and T^2 (Table 23). The results show that T^2 is 0.04, I^2 statistic achieves 89.9 % that is greater than 75%, and Q-statistic with degrees of freedom of 21 is 213.2 and the p-value of the heterogeneity test is less than 0.0001. Therefore, there was an occurrence of heterogeneity among the studies collected. In other words, the data fit the random-effects model.

Table 23: The heterogeneity tests of relationship between Trust and IShar

	Estimate	CI.LB	CI.UB
T^2	0.0363	0.0193	0.0776
T	0.1905	0.1390	0.2786
I^2(%)	89.8622	82.5118	94.9903
H^2	9.8641	5.7182	19.9612
Test for heterogeneity: df = 21, Q = 213.1864, p-value < 0.0001			

Source: Own research (2021)

Then, the disproportionate influence of studies on heterogeneity is presented in Figure 44. Studies 6- Cai et al. (2010) and 13- Chen et al. (2014) lie on the top right quadrant of the Baujat plot. Therefore, these studies contribute the most to the relationship between the two factors considered.

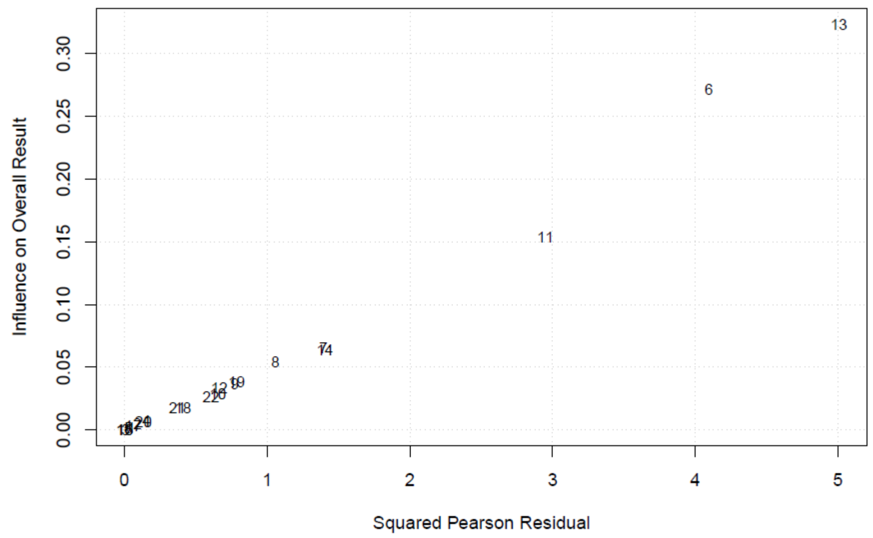


Figure 44: Baujat plot between Trust and IShar

Source: Own research (2021)

To test publication bias, the scatter of studies is observed in the funnel plot (Figure 45). In the funnel plot, studies equivalently spread on both sides of the centerline. Visually, as a result, there may be no publication bias. This conclusion is confirmed by two other tests: 1) the rank correlation test and 2) Egger's regression test. The p-values of Egger's regression test (ERT) and the rank correlation test (RCT) are 0.53 and 0.16, respectively. Both these values are statistically significant (greater than 0.05) so the conclusion of no publication bias is unchanged.

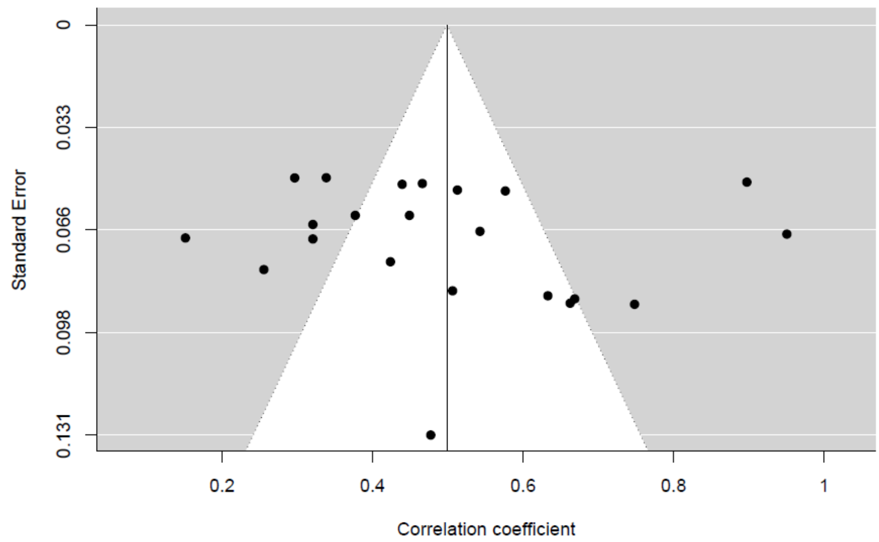


Figure 45: The funnel plot of correlation between Trust and IShar

Source: Own research (2021)

According to Rosenthal (1979), the calculation of the fail-safe number in the relationship between Trust and IShar is 10181.

5.1.2.14 The connection between InfT and IShar

The first results of the meta-analysis are the Fisher's z score transformation and the corresponding estimated sampling variance (The data used for this calculation are in Table 8). These results are calculated from 21 relevant studies with a total of 4585 samples and the range of their correlation coefficient is between 0.20 and 0.86. In particular, the values of Fisher's z range from 0.20 to 1.29, and the maximum and minimum sampling variances are 0.009 and 0.002, respectively.

Next, the study heterogeneity is tested by computing Q- statistic, I^2 statistic, and T^2 (Table 24). The results show that T^2 is 0.08, I^2 statistic achieves 94.7 % that is greater than 75%, and Q-statistic with degrees of freedom of 20 is 361.2 and the p-value of the heterogeneity test is less than 0.0001. Therefore, there was an occurrence of heterogeneity among the studies collected. In other words, the data fit the random-effects model.

Table 24: The heterogeneity tests of relationship between IShar and InfT

	Estimate	CI.LB	CI.UB
T^2	0.0839	0.0468	0.1810
T	0.2896	0.2163	0.4254
I^2(%)	94.6868	90.8594	97.4649
H^2	18.8209	10.9402	39.4469
Test for heterogeneity: df = 20; Q = 361.1755; p-value < 0.0001			

Source: Own research (2021)

Then, the disproportionate influence of studies on heterogeneity is presented in Figure 46. Studies 17- Sundram et al. (2018) and 19- Zailani et al. (2014) lie on the top right quadrant of the Baujat plot. Therefore, these studies contribute the most to the relationship between the two factors considered.

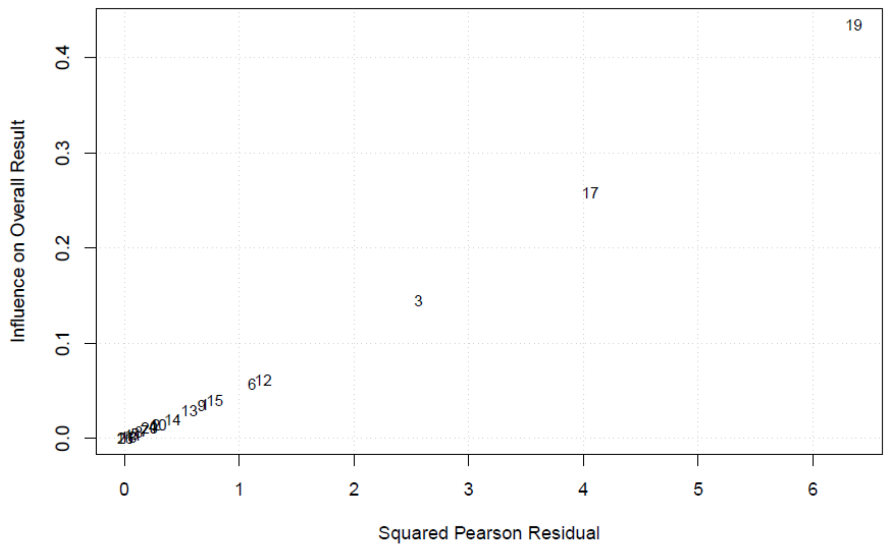


Figure 46: Baujat plot between InfT and IShar

Source: Own research (2021)

To test publication bias, the scatter of studies is observed in the funnel plot (Figure 47). In the funnel plot, studies equivalently spread on both sides of the centerline. Visually, as a result, there may be no publication bias. This conclusion is confirmed by two other tests: 1) the rank correlation test and 2) Egger's regression test. The p-values of Egger's regression test (ERT) and the rank correlation test (RCT) are 0.43 and 0.20, respectively. Both these values are statistically significant (greater than 0.05) so the conclusion of no publication bias is unchanged.

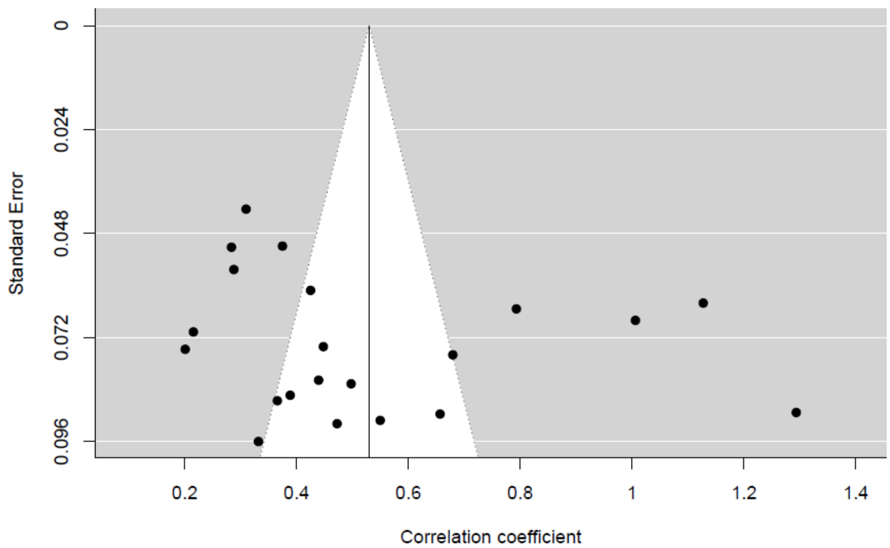


Figure 47: The funnel plot of correlation between InfT and IShar

Source: Own research (2021)

According to Rosenthal (1979), the calculation of the fail-safe number in the relationship between InfT and IShar is 8794.

5.1.2.15 The connection between InfT and EnU

The first results of the meta-analysis are the Fisher's z score transformation and the corresponding estimated sampling variance (The data used for this calculation are in Table 8). These results are calculated from 4 relevant studies with a total of 939 samples and the range of their correlation coefficient is between -0.03 and 0.33. In particular, the values of Fisher's z range from -0.03 to 0.35, and the minimum and maximum sampling variances are 0.004 and 0.005, respectively.

Next, the study heterogeneity is tested by computing Q- statistic, I^2 statistic, and T^2 (Table 25). The results show that T^2 is 0.03, I^2 statistic achieves 87.4 % that is greater than 75%, and Q-statistic with degrees of freedom of 3 is 23.2 and the p-value of the heterogeneity test is less than 0.0001. Therefore, there was an occurrence of heterogeneity among the studies collected. In other words, the data fit the random-effects model.

Table 25: The heterogeneity tests of relationship between InfT and EnU

	Estimate	CI.LB	CI.UB
T^2	0.0302	0.0067	0.4829
T	0.1739	0.0817	0.6949
I^2(%)	87.4304	60.5453	99.1076
H^2	7.9557	2.5346	112.0590
Test for heterogeneity: df = 3 Q = 23.1771 p-value < 0.0001			

Source: Own research (2021)

Then, the disproportionate influence of studies on heterogeneity is presented in Figure 48. Study 1-Chang et al. (2019) lies on the top right quadrant of the Baujat plot. Therefore, this study contributes the most to the relationship between the two factors considered.

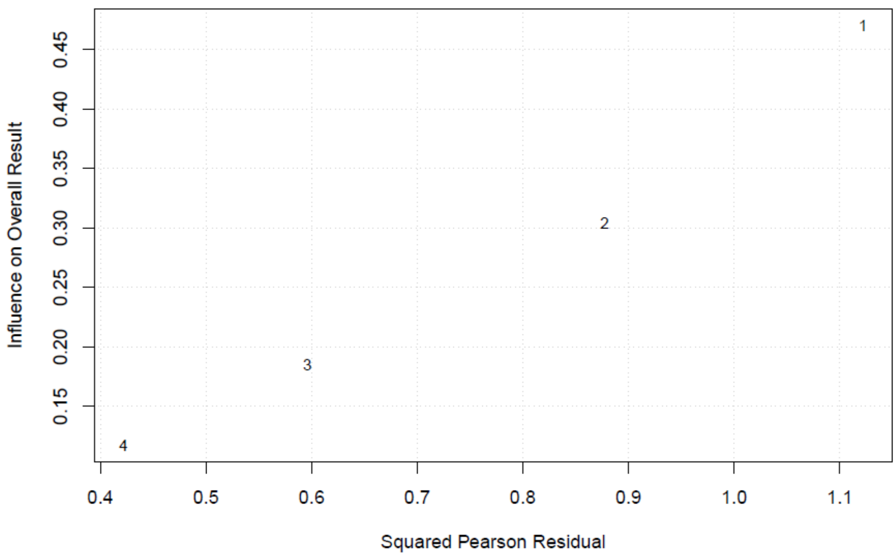


Figure 48: Baujat plot between InfT and EnU

Source: Own research (2021)

To test publication bias, the scatter of studies is observed in the funnel plot (Figure 49). In the funnel plot, studies equivalently spread on both sides of the centerline. Visually, as a result, there may be no publication bias. This conclusion is confirmed by two other tests: 1) the rank correlation test and 2) Egger's regression test. The p-values of Egger's regression test (ERT) and the rank correlation test (RCT) are 0.99 and 0.75, respectively. Both these values are statistically significant (greater than 0.05) so the conclusion of no publication bias is unchanged.

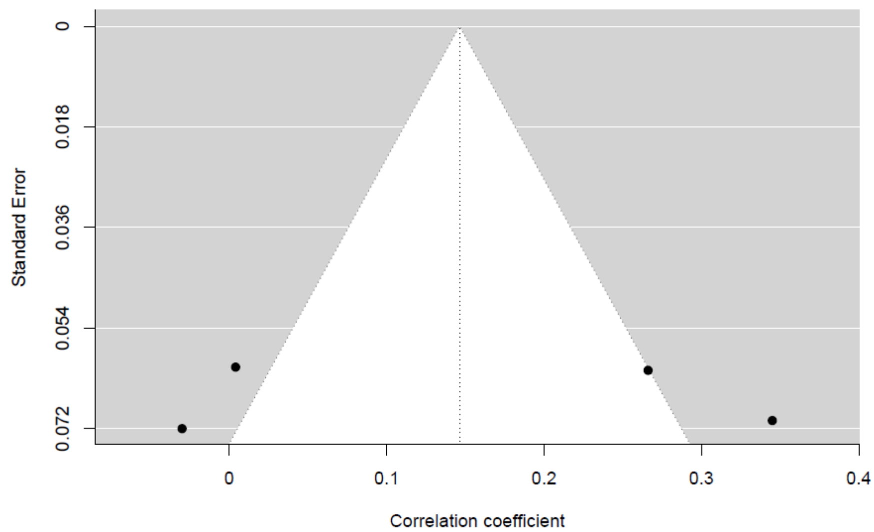


Figure 49: The funnel plot of correlation between InfT and EnU

Source: Own research (2021)

According to Rosenthal (1979), the calculation of the fail-safe number in the relationship between InfT and EnU is 26.

5.1.2.16 The connection between EnU and IShar

The first results of the meta-analysis are the Fisher's z score transformation and the corresponding estimated sampling variance (The data used for this calculation are in Table 8). These results are calculated from 9 relevant studies with a total of 2132 samples and the range of their correlation coefficient is between -0.121 and 0.42. In particular, the values of Fisher's z range from -0.122 to 0.45, and the maximum and minimum sampling variances are 0.04 and 0.002, respectively.

Next, the study heterogeneity is tested by computing Q- statistic, I^2 statistic, and T^2 (Table 26). The results show that T^2 is 0.03, I^2 statistic achieves 86.5 % that is greater than 75%, and Q-statistic with degrees of freedom of 8 is 67.7 and the p-value of the heterogeneity test is less than 0.0001. Therefore, there was an occurrence of heterogeneity among the studies collected. In other words, the data fit the random-effects model.

Table 26: The heterogeneity tests of relationship between EnU and IShar

	Estimate	CI.LB	CI.UB
T^2	0.0281	0.0103	0.1102
T	0.1677	0.1016	0.3320
I^2(%)	86.5484	70.2679	96.1857
H^2	7.4341	3.3634	26.2174
Test for heterogeneity: df = 8 Q = 67.6601 p-value < 0.0001			

Source: Own research (2021)

Then, the disproportionate influence of studies on heterogeneity is presented in Figure 50. Studies 3-Wang et al. (2014) and 9-Jia et al. (2014) lie on the top right quadrant of the Baujat plot. Therefore, these studies contribute the most to the relationship between the two factors considered.

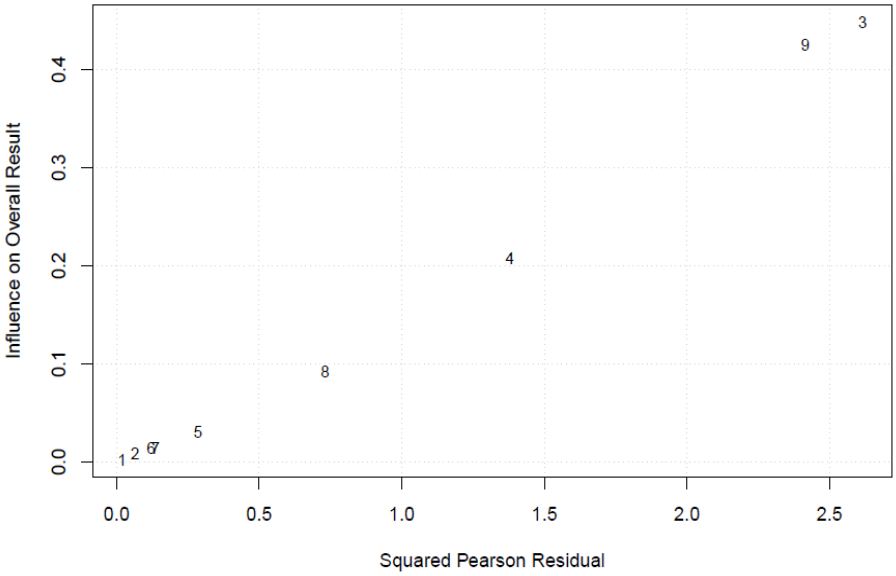


Figure 50: Baujat plot between EnU and IShar

Source: Own research (2021)

To test publication bias, the scatter of studies is observed in the funnel plot (Figure 51). In the funnel plot, studies equivalently spread on both sides of the centerline. Visually, as a result, there may be no publication bias. This conclusion is confirmed by two other tests: 1) the rank correlation test and 2) Egger's regression test. The p-values of Egger's regression test (ERT) and the rank correlation test (RCT) are 0.36 and 0.61, respectively. Both these values are statistically significant (greater than 0.05) so the conclusion of no publication bias is unchanged.

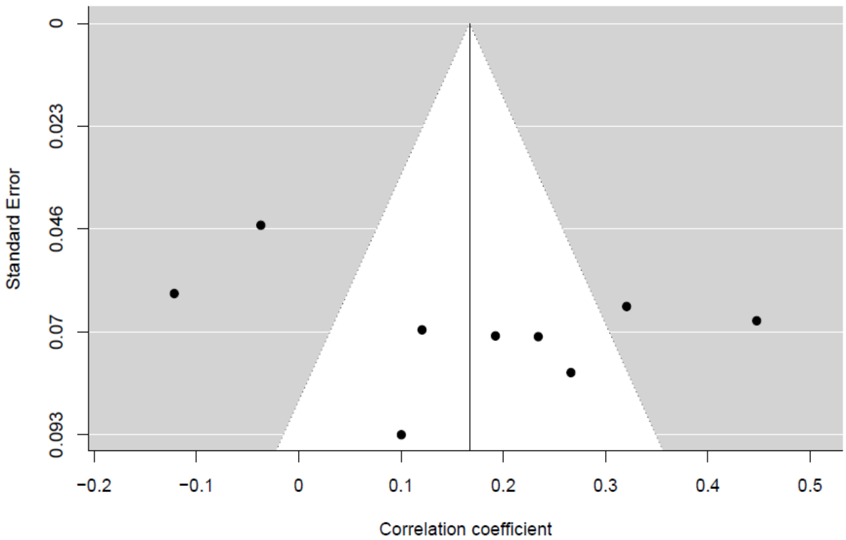


Figure 51: The funnel plot of correlation between EnU and IShar

Source: Own research (2021)

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

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

SCPerf reflects the entire capacity and capabilities of the supply chain (Afum et al., 2019; de Treville & Vanderhaeghe, 2003; Sillanpää, 2015). SCFlex, SCIntg, and 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 27).

Table 27: 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 27, 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 27 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 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).

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

Based on the findings of many previous studies, Comt, Trust, InfT, and EnU are four key factors significantly impacting 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 28.

Table 28 shows the indicators of models, including k represents the number of studies, N is the sample size, 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 28: 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 11). 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).

5.2.3. 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 52 shows the degree of correlation between the pairs of factors in the two groups.

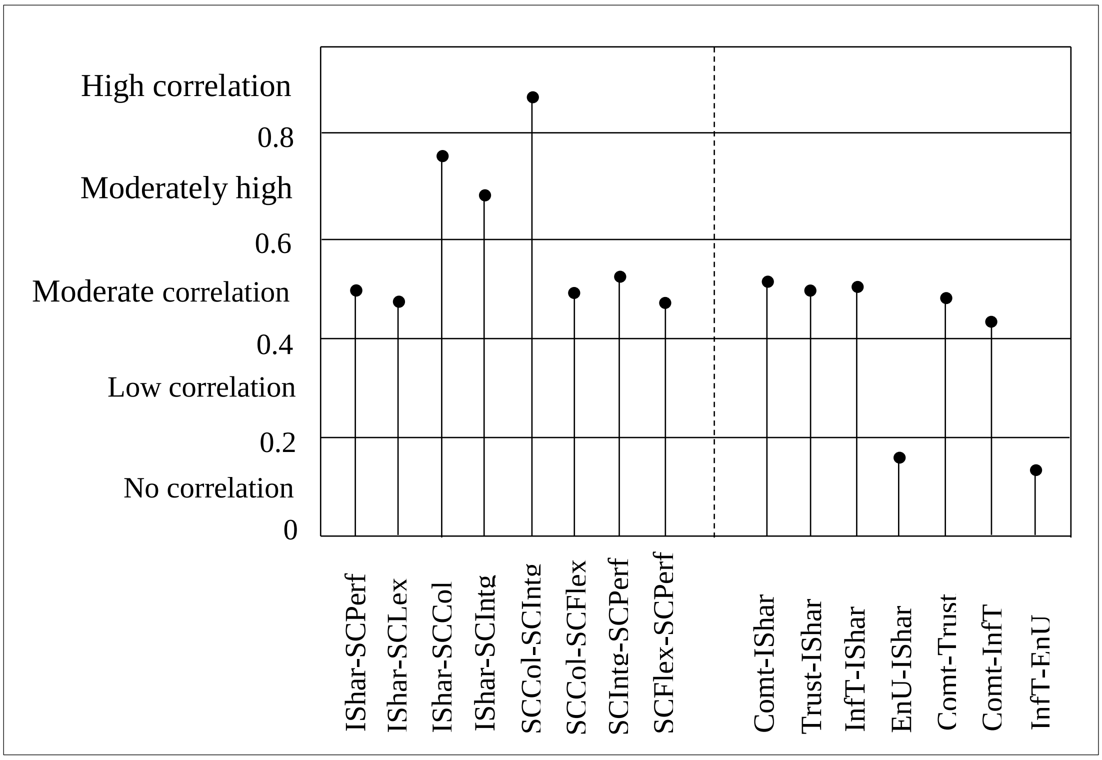


Figure 52: The degree of correlation between IShar, SCPerf, SCPerfIAs, and the factors of IShar

Source: Own research (2021)

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.

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

The set of relationships between IShar, SCPerf, and SCPerfIAs are considered simultaneously. MASEM is used to analyze these relationships. The relationship structure is described by situation 2 in Figure 18, 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 = 1732.6 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.

Table 29 presents the z statistic approximation coefficients with 95% confidence intervals. The results indicate that the correlation coefficients are statistically significant at a p-value of 0.001.

Table 29: The z statistic approximation coefficients in the set of IShar, SCPerf, and SCPerfIAs

Relationship	Est.	SE	LB	UB	zval	Pr (> |z|)
IShar-SCPerf	0.42	0.03	0.36	0.49	12.17	< 2.2e-16***
IShar-SCIntg	0.58	0.04	0.49	0.66	13.37	< 2.2e-16***
IShar-SCCol	0.66	0.03	0.60	0.71	21.62	< 2.2e-16***
IShar-SCFlex	0.41	0.06	0.28	0.53	6.31	2.74e-10***
SCIntg-SCPerf	0.57	0.05	0.46	0.67	10.76	< 2.2e-16***
SCCol-SCPerf	0.48	0.05	0.38	0.58	9.14	< 2.2e-16***
SCFlex-SCPerf	0.50	0.05	0.42	0.59	11.19	< 2.2e-16***
SCCol-SCIntg	0.70	0.05	0.59	0.80	13.61	< 2.2e-16***
SCFlex-SCIntg	0.43	0.09	0.25	0.61	4.77	1.85e-06***
SCCol-SCFlex	0.39	0.11	0.18	0.60	3.68	0.0002***

*** is p-value < 0.001

Source: Own research (2021)

From that, the pooled meta-analytic correlation matrix is determined to implement the next steps in the process of MASEM (Table 30).

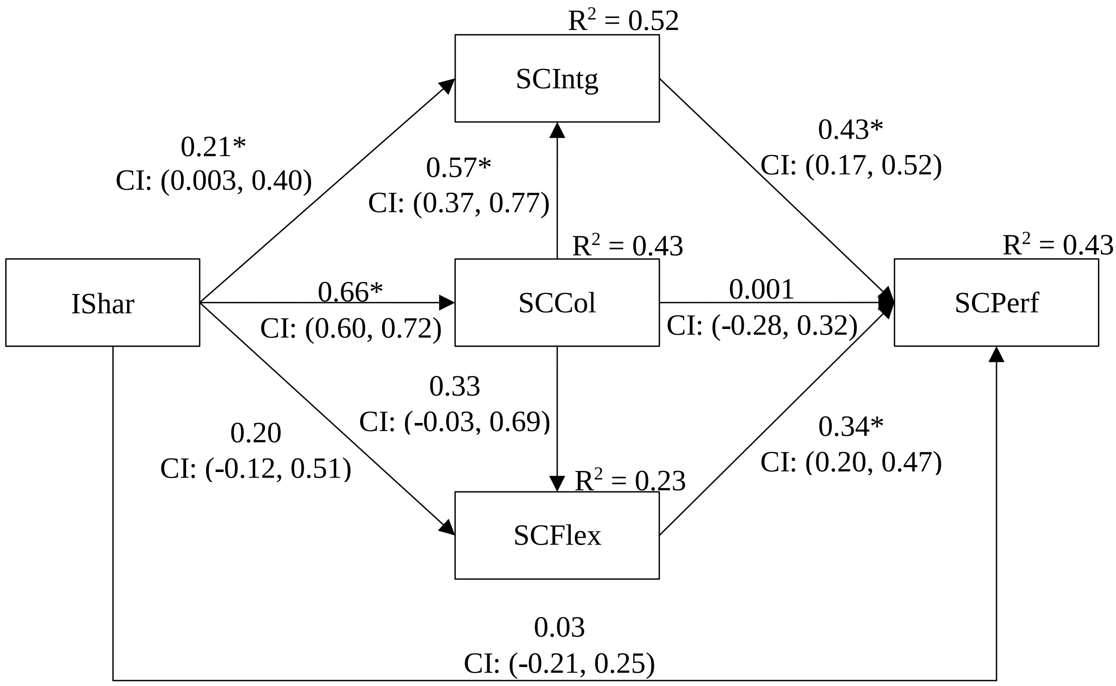
Table 30: The correlation matrix in the set of IShar, SCPerf, and SCPerfIAs

	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

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 53, and the direct and indirect effects of factors are presented in Table 31.

Figure 53 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 22, 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.



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

Figure 53: MASEM results of the set of IShar, SCPerf, and SCPerfIAs

Source: Own research (2021)

According to Figure 53 and Table 31, all hypotheses are supported except for H1, H3, H6, and H7. Thus, the structural model is formed. Table 30 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 with 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.

Table 31: 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)

5.4. 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 IShar and the factors of IShar are examined using MASEM. The factors of information exchange include Comt, Trust, InfT, and 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 $\text{Q-statistic} = 741.7$, $\text{p-value} < 0.001$, 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.

Table 32 presents the z statistic approximation coefficients with 95% confidence intervals. The results indicate that six correlation coefficients are statistically significant at a p-value of 0.001. They include the correlations between Comt and Trust, Trust and InfT, Trust and IShar, Comt and InfT, Comt and IShar, and InfT and IShar. Correlation between EnUand IShar has statistical significance at the p-value of 0.01. Finally, there are no correlations between Trust and EnU, Comt and EnU, and InfT and EnU.

Table 32: The z statistic approximation coefficients in the set of IShar and IShar's factors

Relationship	Est.	SE	LB	UB	Zval	Pr (> $\lvert z \rvert$)
Comt-Trust	0.53	0.05	0.42	0.63	9.92	< 2.2e-16***
Trust-InfT	0.39	0.06	0.26	0.51	5.99	2.08e-09***
Trust-EnU	0.01	0.08	-0.15	0.16	0.09	0.92
Trust-IShar	0.45	0.03	0.38	0.51	14.27	< 2.2e-16***
Comt-InfT	0.41	0.08	0.26	0.57	5.25	1.53e-07***
Comt-EnU	0.11	0.12	-0.13	0.35	0.89	0.38
Comt-IShar	0.51	0.05	0.41	0.62	9.55	< 2.2e-16***
InfT-EnU	0.10	0.09	-0.08	0.28	1.13	0.26
InfT-IShar	0.45	0.04	0.37	0.54	10.14	< 2.2e-16***
EnU-IShar	0.16	0.05	0.05	0.27	2.94	0.003**

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

Source: Own research (2021)

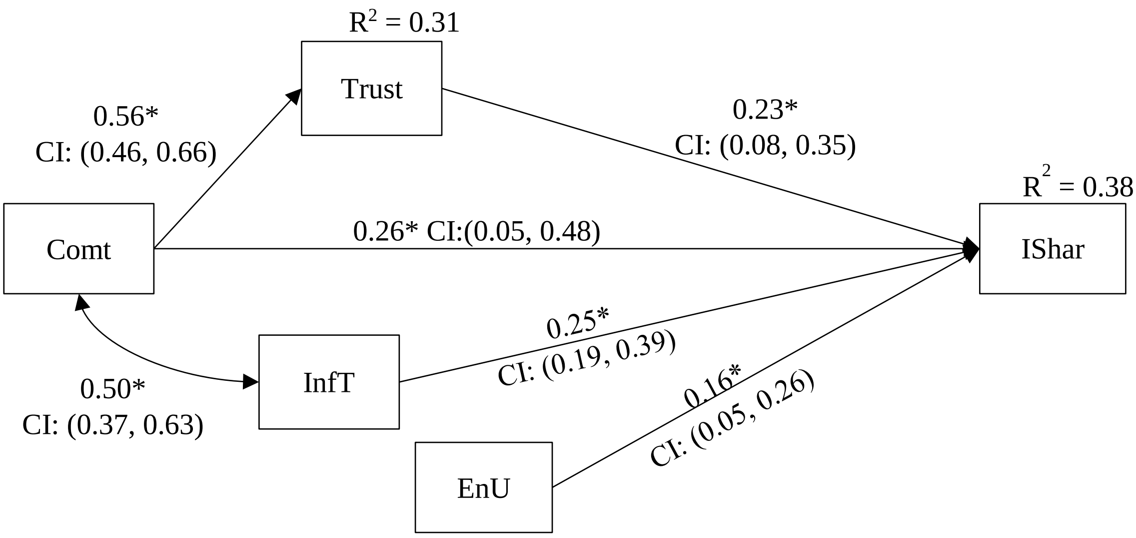
From that, the pooled meta-analytic correlation matrix is formed in Table 33, which is used in the next stage.

Table 33: 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

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 54, and the direct and indirect effects of factors are presented in Table 34.



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

Figure 54: MASEM results of the set of IShar and IShar's factors

Source: Own research (2021)

According to Figure 54 and Table 34, 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 34 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 34: 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)

5.5. Evaluation

5.5.1. 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 35).

Table 35: Hypothesis summary

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

Source: Own research (2021)

Figure 55 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 55 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 SCIntg 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.

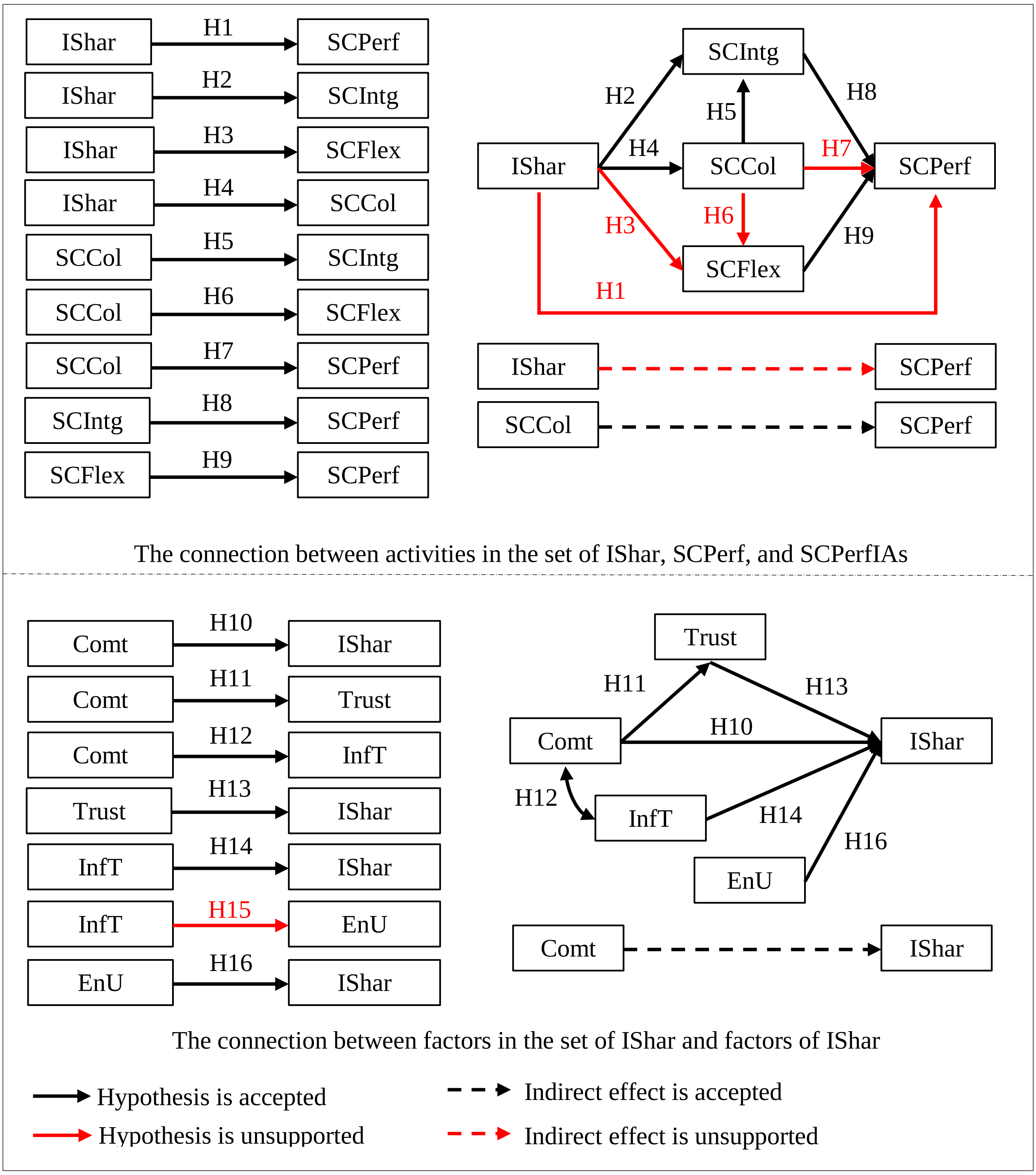


Figure 55: The difference in the results between testing the connection between two activities/factors and testing the connection between activities/factors in two sets

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.

5.5.2. 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 IShar, SCPerf, and SCPerfIAs including SCIntg, SCCol, and 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 (Table 30). As a result, SCIntg and SCFlex are two activities directly affecting SCPerf and SCCol partially affect 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 56).

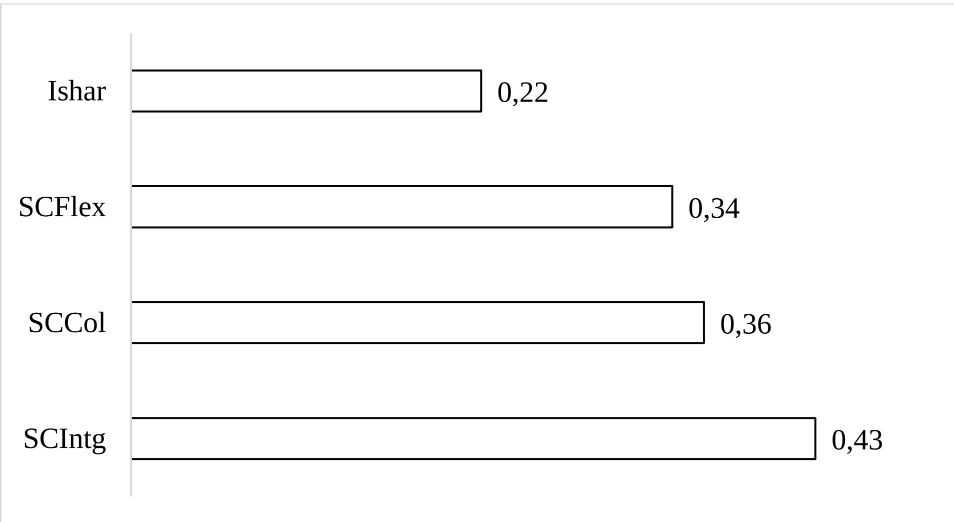


Figure 56: The estimated effect of activities on SCPerf

Source: Own research (2021)

Figure 56 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.

- 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 impact 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).

5.5.3. The key factors in improving IShar

Comt, Trust, InfT, and 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 57).

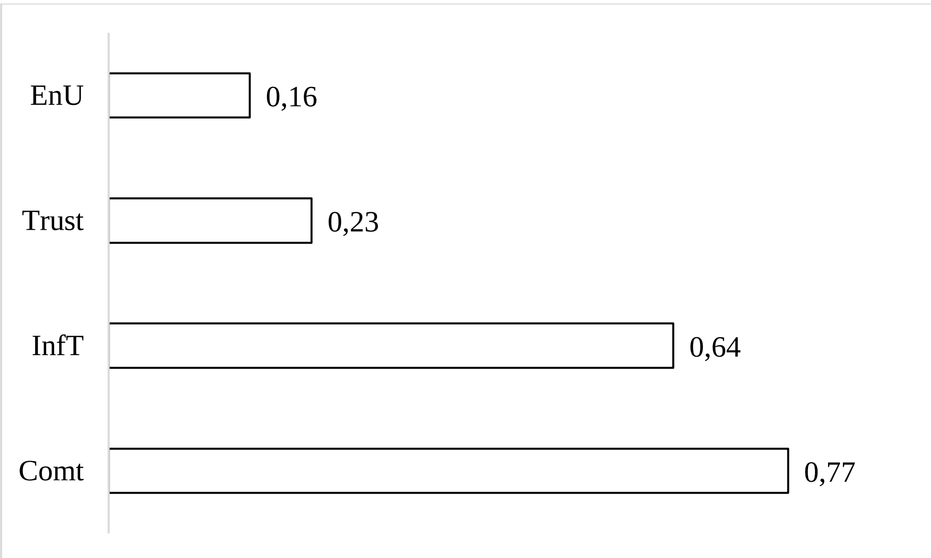


Figure 57: The estimated effect of factors on IShar

Source: Own research (2021)

Particularly, in Figure 57, 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.

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)

5.5.4. 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, SCPerf, SCIntg, SCCol, and SCFlex are four dependent variables of the structural model of the collection IShar, SCPerf, and 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 26 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 26 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.

In summary, from the results in Figure 58, 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.

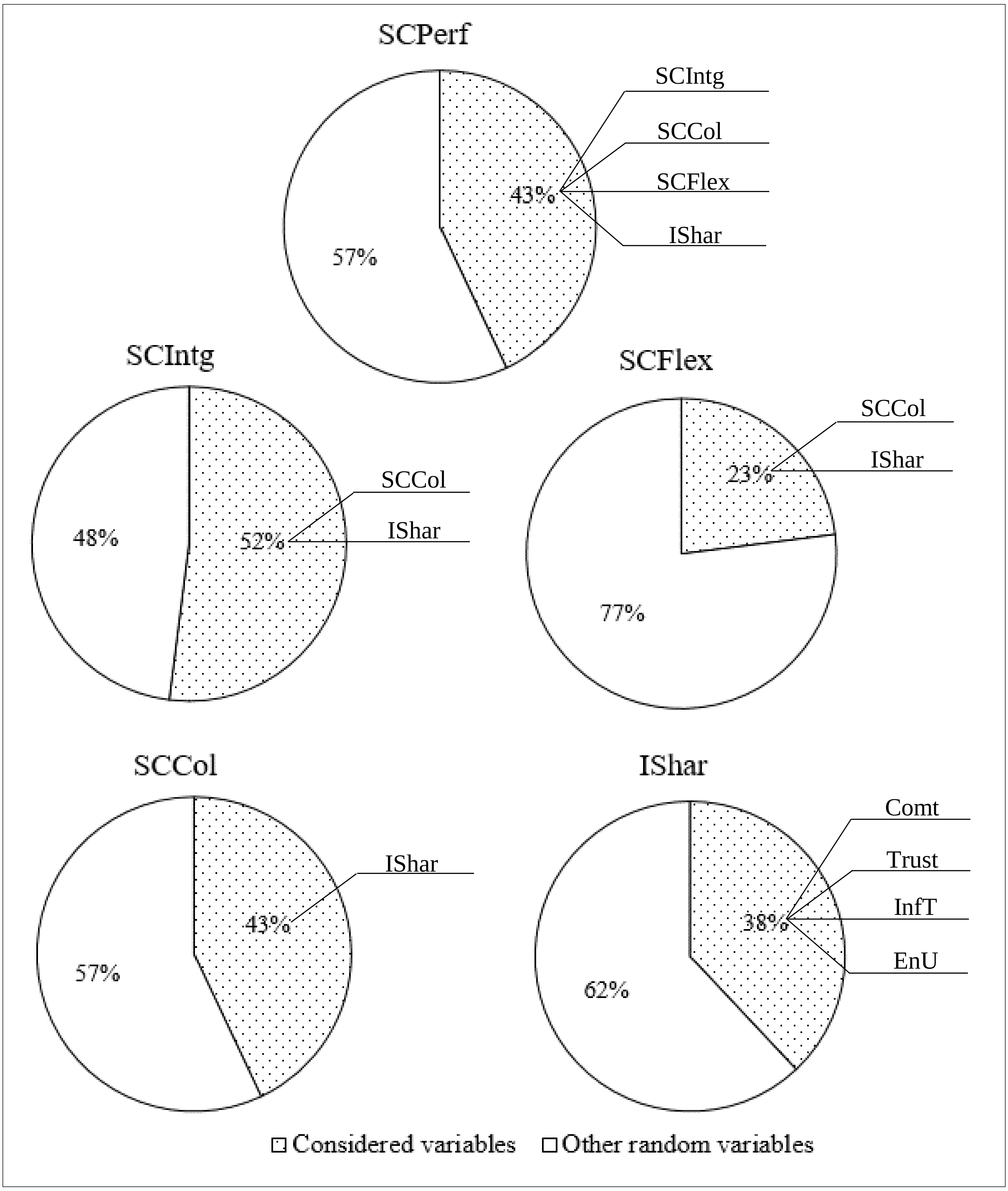


Figure 58: Percentage of other random variables' influence in SCPerf, SCIntg, SCFlex, SCCol, and IShar

Source: Own research (2021)

6. CONCLUSIONS AND RECOMMENDS

Our study examines the influence of 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, SCPerf, and SCPerfIAs including SCIntg, SCFlex, and SCCol. Group 2 is IShar and IShar's factors including Comt, Trust, InfT, and 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, 2005).

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 (SCIntg 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 exchanging 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.

7. 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 uncertainty, 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.

8. 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 SCCol and 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 IShar, SCPerf, and 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 SCIntg and 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 affecting 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 Comt, InfT, Trust, and 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.

SUMMARY

The present study examines the direct effect of IShar on SCPerf and the indirect impact of IShar on SCPerf through SCPerfIAs including SCIntg, SCCol, 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 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

Two methods are used:

1. MA is to examine the connection of each pair of two activities/factors
2. 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 PUBLICATION

#	Article title	Journal	Status	Journal ranking
1.	Le Thi Diem Chau, Nguyen Duc Duy, Pakurár, M., & Oláh, J. CLUSTERING ALGORITHM FOR A VEHICLE ROUTING PROBLEM WITH TIME WINDOWS. *Transport*, *37*(1), 17-27.	Transport	Published	Q2
2.	Diem Le, C. T., Pakurár, M., Kun, I. A., & Oláh, J. (2021). The impact of factors on information sharing: An application of meta-analysis. *Plos one*, *16*(12), e0260653.	Plos one	Published	D1
3.	Le Thi, Diem Chau; Judith, Olah; Miklos, Pakurar. (2021). Network interactions of global supply chain members. *Journal of Business Economics and Management*	JBEM	Published	Q2
4.	Le, T. D. C., Nguyen, D. D., Oláh, J., & Pakurár, M. (2020). Optimal vehicle route schedules in picking up and delivering cargo containers considering time windows in logistics distribution networks: A case study. *Production Engineering Archives*, 26(4), 174-184.	Production Engineering Archives	Published	Scopus
5.	Le, C. T. D., Buddhakulsomsiri, J., Jeenanunta, C., & Dumrongsiri, A. (2019). Determining an optimal warehouse location, capacity, and product allocation in a multi-product, multi-period distribution network: a case study. *International Journal of Logistics Systems and Management*, 34(4), 510-532.	IJLSM	Published	Q2
6.	Le T.D.C., Buddhakulsomsiri J., and Dumrongsiri A**.** Mathematical Model for Multiple Products Allocation of a Distribution Network, *PIM Journal*, (2017), Vol.9.	PIM Journal	Published	National journal
7.	Le N.Q.L., Le T.D.C., and Do N.H. A consideration of essential factors affecting on students who do not complete the bachelor program: A case study, *The International Conference on Logistics and Industrial Engineering(ICLIE)*, (2017).	ICLIE	Published	International Conference
8.	Le T.D.C. and Do N.H. Synchronization of furniture company packing operations with Kanban system, *Asia Pacific Industrial Engineering & Management Systems Conference*, (2015)	APIEM	Published	International Conference
9.	Le T.D.C., Le H.V.K., Le B.D., Le N.Q.L., and Do N.H. Design of a manufacturing supporting tool in furniture industry following a CDIO approach, *Science and Technology Development Journal*, (2015), Volume 18-K1	Science and Technology Development Journal	Published	National journal
10.	Tran M.C., Le T.D.C., Duong K.N., Huynh B.S.O., Phan T.N.T., Tran C.T., and Do N.H. An application of simulation in line balancing: A case study in Whittier Wood furniture Vetnam company, *Ho Chi Minh City of Technology*, (2014)	Ho Chi Minh City of Technology	Published	National journal

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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

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