The Effect Of The Covid-19 Pandemic On The Level Of Transparency With Lower-Tier Suppliers In The Supply Chain

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ABSTRACT

Transparency and information sharing between buyers and suppliers have not always been a high priority of organizations since business as usual did not require additional visibility. But the outbreak of the Covid-19 pandemic changed this perception. This thesis will research how organizations have improved their transparency with their suppliers beyond their direct, tier-1, suppliers as a result of the Covid-19 pandemic. A multiple case study approach was used by interviewing several representatives of organizations who had deep knowledge and insights into their Supply Chain. Four main ways of improving the level of transparency with the lower-tier suppliers were found during this thesis. Firstly, organizations prescribe specific suppliers and quality demands towards tier-1 and tier-2 suppliers to ascertain quality and specifications. Secondly, organizations started to question their suppliers about the risks in their Supply Chain more actively. Thirdly, organizations demanded to be informed by tier-1 suppliers if relevant issues or risks occur with their tier-2 suppliers. Fourthly, organizations have increased their level of digitalization, now having more time and cost-efficient communication with lower-tier suppliers. To ensure continuity and minimization of the effects of future Supply Chain disruptions, organizations should review their level of transparency, discuss the associated disruption risks and make adjustments where required with their lower-tier suppliers. The four main ways of improving the level of transparency with lower-tier suppliers, as will be presented in this thesis, could most certainly help organizations in this process to improve their transparency.

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Keywords
Supply Chain – Covid-19 – Transparency – Information Sharing – Multi-Tier Supply Chain – Disruption – Buyer-Supplier Relationships

1. INTRODUCTION

The Covid-19 pandemic had a lot of impact on the world over the past two years. The pressure on the global Supply Chain (SC) has increased immensely since the outbreak of the Covid-19 pandemic as can be seen in *Figure 1*. Buyer-supplier relationships across the SC changed as well with the way of dealing with future SC disruptions via contingency plans (Choi, Rogers, & Vakil, 2020). The Covid-19 pandemic is a disruptive event and we have seen it has a major impact on SC relationships. This means that 'business as usual' in SCs no longer works. Therefore SC mechanisms described in previous literature might work differently during or after this disruptive event. Some might become more effective as a result of the disruptive event, and some might become less effective. Take for example SC transparency. Kembro and Selviaridis (2015) have studied information sharing across a multi-tier (seven-tier) SC and found out that many of the studied organizations refrained from sharing information beyond their tier-1 suppliers (dyadic ties). Alicke, Barriball, & Trautwein, (2021), confirm this conclusion by finding out that only 21% of the responding organizations have visibility into the supply chain beyond their tier-1 suppliers, and only 2% beyond tier-2 suppliers. But during and after the Covid-19 pandemic this refrain from information sharing might not be the case anymore. This is because having transparency and visibility in lower-tiers of the SC is important to decrease supplier risk, as many of today's critical supply shortages, such as semiconductors, happen in these lower-tiers of SCs (Alicke, Barriball, & Trautwein, 2021). Therefore we know little about how the Covid-19 pandemic affects transparency improvement across SCs. This thesis is going to examine that.

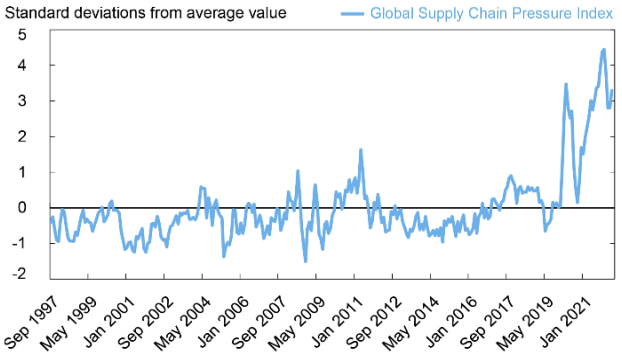

Figure 1. Global Supply Chain Pressure Index May 2022 (Federal Reserve Bank of New York, 2022)

The Covid-19 pandemic has opened eyes all over the world in almost every business sector. Heavy disruptions in SCs due to the pandemic, demands organizations to shift their focus on building resilience in the SC and create more transparency between buyers and suppliers to be better prepared for future disruptions in the SC (Mena, Humphries, & Choi, 2013; Alicke, Barriball, & Trautwein, 2021). This also means having more insight into lower-tier suppliers. Digitalization and the use of software can increase the level of transparency of organizations in the SC (Blecken, & Hellingrath, 2008). In what way the multiple tiers across SCs (can) interact and share critical information to prevent future disruptions, is vital in having an effective and proactive response to future disruptions (Choi, Rogers, & Vakil, 2020; Kembro, Näslund, & Olhager, 2017). How organizations share information and decide what information needs to be shared across multiple tiers, needs to be managed. Although this 'management of lower-tiers' related to disruptions is very important, little is known about it.

Many studies have been done about transparency in SCs. Some even do it in a disruptive setting (e.g. Tao, Lai, & Zhou, 2020). However, what is specifically missing is the connection between the transparency improvement of organizations in lower-tiers of the SC and disruptive events such as the Covid-19 pandemic. Transparency is very important during a disruption as we have seen from the major semiconductor shortages caused by the Covid-19 pandemic (Morgan, 2021). Studies about SC relationships have been done in mostly dyadic buyer-supplier relationships (Caridi et al., 2014; Autry et al., 2014). This dyadic approach to researching SCs is problematic. This is because the dynamics and complexity across multi-tier SCs are much different than in a dyadic buyer-supplier relationship (Kembro, & Näslund, 2014; Mena, Humphries, & Choi, 2013).

Several conceptual studies have analyzed the effects disruptions have on SCs (e.g. Sawik, 2017). Furthermore, there are conceptual studies about dyadic buyer-supplier relationships across SCs (e.g. Butt, Shah, & Ahmad, 2021). But few empirical studies have yet examined organizations' transparency improvement across multi-tier SCs as a result of the Covid-19 pandemic disruption. More empirically grounded studies of transparency improvement across lower-tier SCs as a result of the Covid-19 pandemic are clearly needed.

This thesis will research beyond the tier-1, dyadic buyer-supplier relationships in SCs. Results will be presented on how transparency improved in the lower-tier SC resulting from the Covid-19 pandemic. Therefore the Research Question that arises is: *"How do organizations improve transparency in their lower-tier Supply Chain and what is the effect on transparency during the Covid-19 pandemic?"*.

The purpose of this thesis is to close the research gap described above and further expand already existing knowledge. Research has been conducted into how organizations improved and changed transparency in their lower-tier SC and what the effects are of these transparency improvements/changes during disruptions. By doing so, this thesis contributes to the literature. Four main ways of improving transparency with lower-tier suppliers were found during this thesis. Firstly, organizations *prescribe specific suppliers and quality demands towards tier-1 and tier-2 suppliers* to ascertain quality and specifications. Secondly, organizations started to *question their suppliers about the risks in their SC more actively*. Thirdly, organizations *demanded to be informed* by tier-1 suppliers if relevant issues or risks occur with their tier-2 suppliers. Fourthly, organizations have *increased their level of digitalization*, now having more time and cost-efficient communication with lower-tier suppliers.

This thesis contributes to the literature by extending the already known knowledge, set by for example Choi, Rogers, & Vakil, (2020), and Tao, Lai, & Zhou, (2020), by finding out how organizations have increased their level of transparency with lower-tier suppliers because of the Covid-19 pandemic.

The remainder of this thesis is structured as follows. First, a summary and description of the used literature will be given. After, a chapter explaining the methodology will be provided. Chapter 4 will provide the results following from the research done. In chapter 5, a discussion and several implications of this thesis will be given, followed by a conclusion in chapter 6.

2. LITERATURE REVIEW

2.1 Multi-tier Supply Chain relationships

The past decades have seen trends towards outsourcing and global sourcing that have created longer and more complex Multi-tier Supply Chains (MSC) (Christopher, & Lee, 2004; Harland, Knight, & Lamming, 2005). MSC can be described as multiple single-level collaborations in a SC between buyers and

suppliers (Mena, Humphries, & Choi, 2013). With the growing complexity of SCs due to the increasing connectivity of SCs over the world, more-and-more organizations are increasingly extending their reach into the SC (Choi, & Linton, 2011).

There have been several studies that have emphasized the need for increased information sharing across multiple tiers in the SC (e.g. Caridi et al., 2010; Ogden et al., 2005). It has been shown that the effort of connecting the broader SC and sharing customer demand data upstream to other tiers in the SC, could be worthwhile to achieve higher efficiency and effectiveness in the SC (Mason-Jones, & Towill, 1999; Autry et al., 2014). It has also been shown that managers should establish consistent information sharing by involving the entire SC, whilst also working together collectively with timely and accurate information flows between multiple tiers in the SC (Melnyk et al., 2009). Working together collectively and sharing information across the SC, affects the buyer-supplier relationships in SCs.

Multi-tier Supply Chain relationships have already been examined in a three-tier SC study by Mena, Humphries, & Choi (2013). They found out that when there is a formal link between a buyer and the supplier's supplier (tier-2 supplier) and they are directly connected with each other, the visibility of members of the MSC strengthens the sense of interdependence among the members of the MSC. They studied the relationships in MSC but did not include any disruptive events as a cause of the link between members of the MSC or the information sharing. Furthermore, studies mainly focus on the effects that information sharing across multiple SC tiers has on sustainability and power position across the MSC, not so much on how they created or improved transparency (Tachizawa, & Wong, 2014; Wilhelm et al., 2016; Mena, Humphries, & Choi, 2013). This thesis will focus on how organizations improve transparency in their lower-tier SC and take into consideration the effects of a disruption, namely, the Covid-19 pandemic. It will be studied how organizations react to a disruptive event and change their communication and information sharing styles across the MSC. A link will be drawn between transparency improvement across lower-tiers in the SC and the effects of the Covid-19 pandemic.

The buyer-supplier relationships across Multi-tier Supply Chains have a big impact on the efficiency and effectiveness of the SC and are therefore very important (Melnyk et al, 2009). However, there has been a disruptive event in the past two years that affects the buyer-supplier relationships across MSC. Disruptions can have a major impact on buyer-supplier relationships, and this will be discussed in the next section.

2.2 Supply Chain Disruptions

In modern SCs, it has become a vital part of SC management strategy to manage the risk that comes with possible SC disruptions (Stecke, & Kumar, 2009). The risk of SC disruptions arises from the vulnerabilities of the interconnected flow of information, materials, and funds between a network of organizations (Bode, & Macdonald, 2017). These high-impact but low-probability disruptions and the resulting losses that might come with them, may threaten the financial state of organizations (Sawik, 2017). Disruptive events can be defined as unplanned or unanticipated events that cause problems and/or disrupt an activity or process. In SC this means a breakdown in the flow of goods and materials and their delivery to customers within a SC (Macdonald, & Corsi, 2013).

Multiple studies have studied the effects disruptions have on SCs (e.g. Ivanov, 2020; Craighead et al., 2007). It has been shown that before the Covid-19 pandemic, vital information was often not available or not accessible (enough) across SCs. This led to a reactive and uncoordinated response, leading to organizations getting hit full force by the unexpected increase or decrease in demand of goods due to the Covid-19 pandemic disruption. In contrast, the organizations that did invest in visibility and communication in their SC before the pandemic were better prepared for the disruption (Choi, Rogers, & Vakil, 2020). Further studies have shown that (the possibility of) disruptions may trigger a change in buyer-supplier relationships as the behavior of suppliers might change. To effectively deal with demand risks, as a result of possible disruptions, focal organizations have an incentive to have strong relationships with partners across the SC. These relationships enable organizations to be more efficient and effective in production (Walter et al., 2003). Such buyer-supplier relationships could lead to better information sharing and coordination across the SC which could decrease the risks disruptions bring to buyer-supplier relationships in the SC (Srinivasan, Mukherjee, & Gaur, 2011).

The effects of disruptions in SCs have already been examined across dyadic buyer-suppliers relationships in SCs (e.g. Sawik, 2017). This study was mainly focused on how to find and select primary and recovery suppliers in a SC before, during, or after a disruption happened. It was not studied how disruptive events influence the multiple tiers in the SC, beyond the direct, tier-1 suppliers. Meaning, how disruptive events affect suppliers beyond the dyadic tier-1 suppliers of focal organizations. Disruptions influence multiple suppliers across the SC and could therefore have major effects on focal organizations higher up the SC. Furthermore, studies about disruptions in SCs mainly focus on the viability and resilience of organizations towards disruptions, but not so much on how transparency across multiple tiers in the SC is improved as a result of disruptive events (Ivanov, 2018; Ivanov, 2020; Cimellaro, Reinhorn, & Bruneau, 2010). Although several authors have examined the effects disruptions have on the SC buyer-supplier relationship, crucial insights into how disruptions affect the improvement/change of transparency in the lower-tier SC of organizations are missing. In this thesis, a link will be drawn between transparency improvement across lower-tiers in the SC and the effects of a disruptive event, namely, the Covid-19 pandemic.

As mentioned in this section, it is very important to share critical information and have good communication across multiple tiers in the SC to be well prepared for when disruptive events happen. Transparency is needed to be well prepared for disruptions. Transparency in SCs will be discussed in the next section.

2.3 Supply Chain Transparency

Transparency has become more and more important in the past decades as governments, consumers, and other stakeholders are pressuring organizations (Batemen, & Bonanni, 2019). Transparency can be roughly described as the disclosure of information (Mol, 2015; Doorey, 2011). According to Martinez & Crowther (2008, p. 19), transparency means "that the external impact of the actions of the organization can be ascertained from the organization's reporting". Transparency is oftentimes seen as a way to serve principles of accountability, democracy, and participation (Mol, 2010). The definition of transparency that will be used in this thesis consists of two elements of SC transparency, namely, *visibility* and *disclosure*. Visibility means accurately identifying and collecting information from all links in your SC. Disclosure means communicating information with other tiers in the SC (Batemen, & Bonanni, 2019). In the findings of this thesis, the main focus will be put on the level of communication and information sharing across the SC.

Several studies have been done about information collection and information communication in SCs (e.g. Doorey, 2011; Egels-

Zandén, Hulthén, & Wulff, 2015). It has been shown that transparency can make complex SCs better to understand, and it helps different organizations in a SC to identify and minimize SC risks (Gardner et al. 2019). Also, the use of software can help organizations to improve their transparency (Blecken, & Hellingrath, 2008). Therefore, how organizations share and collect information, affects the buyer-supplier relationships in SCs (Wilson et al., 2017; Bilyea, & McInnes, 2016; Insight, 2016). It has also been shown that increased transparency is assumed to favor more emancipatory and demographic forms of governance, but greater transparency can also worsen already existing inequalities and empower the already powerful even more (Mol, 2015; Egels-Zandén, Hulthén, & Wulff, 2015).

The effects of transparency on SCs have already been studied extensively. Although, many studies have focused on transparency concerning sustainability in SCs as sustainable SCs have become an increasingly important factor for consumers and governments (Doorey, 2011). What is missing is the focus on the effect disruptions have on transparency across lower-tiers in SCs, instead of focusing on the effect sustainability has on transparency. Transparency in MSCs during disruptions is important because the disruption causes shortages and other difficulties further down the SC, which has a ripple effect further up the SC (Batemen, & Bonanni, 2019). Transparency in the MSC could decrease the effect disruptions have on MSCs, although this is often difficult to establish. This is because building trust with suppliers to share data could bring several challenges. It is difficult to predict where in the MSC the costs and benefits of this transparency will fall (Gaur, & Gaiha, 2020). Furthermore, studies have focused on transparency in food supply chains, some also researching further into the SC (tier-2 suppliers) (Trienekens et al, 2012; Mena, Humphries, & Choi, 2013). But in these studies, the link between transparency improvement/change in (multi-tier) SCs and the effects of disruptive events is missing. This link between transparency improvement/change in the lower-tiers of SCs and the effects disruptive events have on transparency will be researched in this thesis.

The next chapter will describe the methodology of how this thesis will figure out how organizations improved transparency in their lower-tier SC and what the effects are of disruptions.

3. METHODOLOGY

A multiple case study approach along with pre-interview surveys was chosen. The Research Question of this thesis is *"How do organizations improve transparency in their lower-tier Supply Chain and what is the effect on transparency during the Covid-19 pandemic?"*. The best way to answer this research question is by means of multiple case study approach and pre-interview surveys since a case study approach has proven to be an effective way of clarifying theory (Steenhuis, & de Bruijn, 2006; Dubois, & Araujo, 2007; Yin, 2009; Beverland, & Lindgreen, 2010; Gustafsson, 2017). This case study approach is especially suitable for creating an understanding of how buyer-supplier transparency changed in the lower-tier SC as a result of the Covid-19 pandemic (Yin, 2009). In addition, conducting a pre-interview survey can be an effective way in already gathering knowledge and insights into buyer-supplier relationships, also beyond tier-1 suppliers, which can be used and further elaborated on during the interviews (Meredith et al., 1989).

3.1 Case Selection

The unit of analysis in this research is the buyer-supplier relationship. Whilst selecting cases, it was aimed at identifying cases from which in-depth insights into the transparency between buyers and tier-1/2 suppliers could be gained. The characteristics of the interviewees and studied cases can be seen in *Table 1*. The main criteria were to find suitable cases where there already was some kind of transparency between buyers and suppliers before the Covid-19 pandemic started. This would allow observations of how transparency has changed due to Covid-19. Thus, cases were selected where transparency relationships between buyers and tier-1/2 suppliers were most likely to be already present in some way. Second, to allow observations of how transparency was affected by the Covid-19 pandemic, cases needed to be selected where their SC-relations had most likely been affected by the Covid-19 pandemic. Selecting cases that were not affected by the pandemic would not contribute to this study as this study researches the effects the Covid-19 pandemic had on buyer-supplier relationships regarding transparency in the lower-tier SCs. As almost every organization was (differently) affected by the pandemic over the past years, it was highly unlikely to find a case that was not affected by the pandemic (Craven et al., 2022). Though it still needed to be considered when selecting cases.

Interviewees were selected on the buyer side, and it was tried to also select cases on the supplier (tier-1/2) side as well, because the focus of this study is the relationship between buyers and suppliers beyond tier-1, regarding transparency in the lower-tier SC. Unfortunately, it was not achieved to interview tier-1/2 suppliers of the interviewed buying organizations (further explained in chapter 5.4). To ensure that the interviewees had sufficient knowledge about the relationship with suppliers and the level of transparency, interviewees were selected who are in the positions to be knowledgeable enough about the case in question (Crawford, 2005). To ensure that the interviewees were familiar with the terms and definitions used, these were explained in detail prior to the interviews using the definitions given in the literature section. This includes the definition of transparency, tier-1, and tier-2 suppliers.

In selecting cases, it was aimed at getting a perspective of how the transparency was before the Covid-19 pandemic and after the Covid-19 pandemic. This way, it could be observed how transparency in buyer-supplier relationships was or was not affected by the Covid-19 pandemic.

3.2 Data Collection

Data was collected through conducting interviews and pre-interview surveys. Eisenhardt & Graebner, (2007), state that interviews are a very efficient way of gathering rich, empirical data. Interviews were conducted with the buying organizations' executives and managers. The data collection was initiated prior to the interviews. A survey was sent out to the selected cases to already get a better understanding and insights into the transparency in the buyer-supplier relationships across multiple tiers in the SC. Furthermore, in the interviews more in-depth questions could be asked, partially based on the answers given in the survey. This allows the interviewer to ask more adequately, further elaborated questions based on the case (Meredith et al., 1989). The survey questions also gave the opportunity to minor quantitative data. The survey questions can be seen in *Appendix A* in Chapter 8.

The interviews were carried out between the 2nd of May 2022 and the 27th of May 2022 following the interview protocol as stated in *Table 2*. In total, six interviews were conducted. All the interviews were audio-recorded and transcribed. Each of these interviews had a duration of between 45-80 minutes. This gave the opportunity to further gain details about the buyer-supplier relationships. To lead the interviews, interview protocols were made beforehand. This interview protocol was used as a guide

Table 1. Case descriptions

Case name (C = Company) (S = Supplier)	Function interviewee	Role and responsibilities interviewee	Industry/Sector	Involvement in SC beyond tier-1 supplier before Covid (long arm)	Level of transparency before Covid
C1	Head Purchasing	External Purchasing	Yacht Building	Low	Low
C2	Supply Chain Logistics Manager	Logistics & External Purchasing	Chip Industry	Medium	Medium
C3 (S3A)	Procurement Liaison Officer	Project & Indirect Purchasing	Electronics	Very Low	Low
C3 (S3B)	Procurement Liaison Officer	Project & Indirect Purchasing	Electronics	Very Low	Low
C4 (S4A)	Tender Manager	Tender Process	Construction	Medium	Low to Medium
C4 (S4B)	Tender Manager	Tender Process	Construction	Low	Low
C5	Chief Financial Officer	Financial SC Risk Mapping	Agricultural Trade	Nonexistent	Low
C6 (S6A)	Owner	Communication & Management	Pulp & Paper	Low	Low to Medium
C6 (S6B)	Owner	Communication & Management	Pulp & Paper	Low	Low to Medium

Table 2. Interview protocol

Phase	Purpose
1. Introduction to subject and aligning interviewee with RQ	Introduce the goal of the interview and what this thesis is about. Explaining the definitions of the used concepts.
2. General information, responsibilities and role of interviewee, and the SC	Gathering general information about organization, its Supply Chain, and the interviewee
3. Tier-1 supplier-related questions, pre/post-Covid	Information about relationships with tier-1 suppliers and the impact of the Covid-19 pandemic
4. Tier-2/3 supplier-related questions, pre/post-Covid	Information about relationships with suppliers beyond tier-1 and the impact of the Covid-19 pandemic
5. Remaining questions and conclusion interview	Information about effects of Covid on SC in general. Concluding interview with interviewee

during the interviews (Jacob, & Furgerson, 2012). Semi-structured interviews were conducted as the primary data source (Newton, 2010). This gave the opportunity to clearly structured questions, but also some kind of flexibility during the interviews. The interviews were structured with general information in the beginning, followed by questions related to transparency with tier-1 suppliers and afterwards with tier-2/3 suppliers, to eventually conclude with questions related to the total effect of the Covid-19 pandemic. The topics and theories used in these interviews were developed from the literature.

The interview protocols were mostly identical across all cases, though, the semi-structured interviews and the surveys allowed a focus on issues specific to the case. In total, this amounted to four survey responses and six hours of conducted interviews.

3.3 Data Analysis

The data analysis began during the data collection process. The responses to the surveys were analyzed before the interviews took place. A content analysis consisting of several steps was conducted when the interviews were finished. First, to have better prior knowledge and deeper insights into the transparency in the buyer-supplier relationships, the answers to the surveys had to be analyzed. By analyzing the answers to the surveys, more case-specific questions could be asked where the interviewees could further elaborate on issues mentioned in the survey.

Second, all the interviews were transcribed manually. Transcribing interviews structures the interview conversations in a form more accessible to closer analysis and is in itself also already an initial analysis (Kvale, & Brinkmann, 2007). Transcribing the interviews ensures getting the response of the interviewees naturally in their own words, not a summarized version of the interview, writing down the parts I might find useful. Transcribing helps with avoiding inaccuracies and data loss (Bailey, 2008).

Third, summaries were made of the transcriptions of each interview. Each summary captures the main points of the interview in 2-3 pages. The summary focuses on the main content relevant to this research (Mershon, 2010). Based on this summary, along with the transcriptions, comparisons and conclusions will be drawn to answer the Research Question.

4. RESULTS

The findings of this thesis describe the improvement (if any) of transparency with the lower-tier Supply Chain (SC) due to the Covid-19 pandemic, as perceived by the interviewees from the studied cases. *Table 3* shows an overview of the case findings. In the sections below, first, the overall observations from the individual within-cases will be presented in section 4.1. Afterwards, the cross-case findings observed will be categorized and discussed in five sections regarding 1. *Transparency before Covid and initial reaction* (section 4.2), 2. *Digitalization and software usage* (section 4.3), 3. *Transparency of tier-1 suppliers about tier-2 suppliers* (section 4.4), 4. *Involvement in SC beyond tier-1 suppliers* (section 4.5), and 5. *Overall level of transparency after Covid* (section 4.6). From these five findings sections, the four main findings of this thesis were derived. These four main findings on how the studied cases have improved their level of transparency with their lower-tier suppliers because of the Covid-19 pandemic, will be mentioned and discussed in chapter 5.

4.1 Findings Per Case

4.1.1 Case C1

Before the Covid-19 pandemic struck, C1 had little to no big issues in their SC and therefore the focus on the importance of the SC had become less. The main suppliers of C1 are in the Netherlands so as soon as the pandemic began to have consequences in Europa, they realized quickly that they should bring into the picture how it could affect them. To get all the

Table 3. Overview case findings

Case name	Transparency before Covid-19 and initial reaction	Digitalization and software usage to increase transparency	Transparency of tier-1 about tier-2 suppliers before and after Covid	Involvement in SC beyond tier-1 supplier after Covid	Level of transparency after Covid
C1	No big issues in SC so focus on the importance of SC had become less, realization SC mapping is needed, dashboard set up, weekly Covid crisis meetings	[Medium] – Started usage of Power BI to share information, online expediting more time and cost-efficient	[Low → Medium] – Before Covid less reason to share information, issues in SC forced transparency among suppliers to pass on accountability	[Medium] – Product drawings and specifications sent to tier-2 suppliers, customer preferences communicated down the SC	[Medium to High] – Demanding information of tier-1's SC and possible risks, looking deeper into the SC, meetings with tier-1 suppliers discussing tier-2/3 suppliers
C2	Less pressure towards tier-1/2 suppliers in information sharing, implementation of Lobster program, chip shortages at suppliers	[Medium to High] – Implementation of Lobster program before Covid, online communication platform with tier-1/2 suppliers,	[Low → Medium/High] – Covid accelerated the use of the Lobster program and therefore the transparency, more insight into key tier-2 suppliers	[High] – Prescription of tier-2 suppliers to tier-1 suppliers, drawings sent to tier-2 suppliers, specified quality toward key tier-3 suppliers	[High] – Covid reinforced the goal towards more transparency, tighter contact with suppliers, weekly online meetings with tier-1/2 suppliers
C3 (S3A)	Projects were put on hold, less pressure on suppliers, C3 gets twice a week an overview of orders and delivery times from S3A	[Low to Medium] – Experimenting with Risk-Method Software to better monitor SC, resulting in better negotiation positions	[Low → Low] – No real change in view beyond tier-1, not demanded for as long as tier-1 complies with quality	[Low] – Involvement with tier-2 suppliers absent, only 'black-list' to forbid certain tier-2 suppliers	[Medium] – Growth in showing where delays and shortages are, new contact person at S3A to discuss order level and time
C3 (S3B)	Projects were put on hold, less pressure on suppliers (stagnation in supply and demand)	[Low] – No real software usage to improve transparency	[Low → Low] – No real change in view beyond tier-1, not demanded for as long as tier-1 complies with quality	[Low] – Involvement with tier-2 suppliers absent, only 'black-list' to forbid certain tier-2 suppliers	[Low] – Bad insight into delivery times and delays, no detailed information sharing about delays and shortages
C4 (S4A)	Quite some transparency due to the importance of S4A, shortages in supplies and employees	[Low to Medium] – Prior to Covid already usage of communication tools in SC (12Build), online communication was more efficient	[Low → Medium] – More transparent to share accountability and risks	[Medium] – More extensive questioning of key tier-2 (and a tier-3) suppliers, 'black-list' to forbid certain tier-2 suppliers	[Medium] – Improved relationship due to the importance of S4A, more risk questioning and communication towards S4A's SC
C4 (S4B)	No real insights as this SC had no real burdens, shortages in supplies and employees	[Low to Medium] – Prior to Covid already usage of communication tools in SC (12Build), communication online was more efficient	[Low → Medium] – More transparent to share accountability and risks	[Low] – Involvement with tier-2 suppliers absent, only 'black-list' to forbid certain tier-2 suppliers	[Low to Medium] – More communication and questioning of risks towards S4B's SC
C5	Problems in containerized transport started to occur a few months after begin Covid, not much transparency because of the trader position	[Low to Medium] – Not every business partner has good access to the internet, experimenting with Customer Portal for more insights customer	[Low → Low] – No real change, not demanded for as C5 is always flexible with its suppliers	[Nonexistent]	[Low] – Transparency is deliberately not wished for as sharing too much information could take away the trader position in the SC
C6 (S6A)	Postponed or canceled orders, no advertisements allowed briefly to prevent hoarding, constant contact with S6A, the interviewee was commercial director of S6A	[Medium] – Usage of CSM system already before Covid, fewer on-site visits during Covid	[Medium → Medium] – Not more transparent about suppliers, was already quite known, information sharing needed for explanation towards the market	[Low to Medium] – No real involvement besides quality demands, keeping an eye on key suppliers of S6A but no contact between	[Medium] – Improved consultation between C6 and S6A, searching for the reasons for problems, transparency needed to explain price increase to the market
C6 (S6B)	Orders were canceled or postponed, advertisements were not allowed for a short period to prevent hoarding, constant contact with S6B to discuss the impact	[Low] – No real software usage to improve transparency, fewer on-site visits during Covid	[Medium → Medium] – Not more transparent about suppliers, was already quite known, information sharing needed for explanation towards the market	[Low] - No real involvement besides quality demands	[Medium] – Improved consultation between C6 and S6B about pulp price and supply structure, transparency needed to explain price increase to the market

information acquired from their SC, they set up a dashboard, Power BI, where everybody could post signs from the SC about how the pandemic could affect them, and they used this dashboard for weekly Covid crisis meetings. Suppliers of C1 started to get delivery problems such as shortages and employee fallouts. This led to suppliers not always being able to deliver anymore. To manage the lower-tiers, C1 started to map where their suppliers exactly are located. They tried to find out if they are located in possible high-risk areas and if there are possible alternatives. The problems arising in the SC forced more transparency among suppliers to pass on their accountability. If they could show and explain to C1 why they are having issues, C1 would understand where the problems are and could act accordingly. C1 had a deeper look into the SC with strategic tier-2 suppliers. This is because the customer had certain demands for the end product and these demands needed to be communicated down the SC directly with the strategic tier-2 suppliers. Therefore, drawings and specific manufacturers were communicated with tier-1 and tier-2 suppliers. Due to the required switch towards an online and more digitalized world, expediting became much more time and cost-efficient. It was no longer needed to physically visit suppliers to put pressure and have insights on them *"Grab your laptop and show us around [via Teams] in the factory where our products are and who is working on them"*. C1 demanded more information and transparency from its tier-1 suppliers regarding possible problems and risks in the SC of tier-1 suppliers. C1 had meetings with tier-1 suppliers where they discussed the position and possible problems with tier-2 and tier-3 suppliers in their SC. The Covid-19 pandemic forced C1 to be more focused on the SC, also beyond its tier-1 suppliers.

4.1.2 Case C2

It was realized before the Covid-19 pandemic that C2 wished for more transparency with its tier-2 suppliers. Therefore, to manage the lower-tiers, they introduced a software program (Lobster) where tier-1 suppliers could post all information regarding the acquisition of supplies from tier-2 suppliers so that C2 has insight on this as well. This improved the transparency with tier-2 suppliers considerably. There were chip shortages in the industry C2 operates in, but because the monthly output quantities are very low and the lead time of an order is more than two years, C2 did not experience any production delays. Due to the Covid-19 pandemic, the use of the Lobster program accelerated, increasing the transparency and visibility into the SC. C2 operates in a very high-tech market "*… we are working on the edge of physics*". Therefore, certain tier-2 suppliers were prescribed towards tier-1 suppliers to ascertain the high quality demanded. They even specified certain quality standards towards a couple of key tier-3 suppliers for even more critical goods. Their 'long arm' therefore reached quite far into the SC and for this, transparency and information sharing are needed and thus demanded by C2. C2 had almost weekly meetings with tier-1 and tier-2 suppliers to discuss the expected delivery times, new delivery terms, etc. The pressure on tier-1 and tier-2 suppliers to share information and be more transparent, has forcefully been increased, since the outbreak of the Covid-19 pandemic.

4.1.3 Case C3 (S3A)

Before the Covid-19 pandemic, S3A delivered an overview of current orders and delivery times twice a week to C3, so there was already a certain level of openness and information sharing. The initial reaction to the Covid-19 pandemic was that suppliers of C3, like S3A, were expecting and experiencing delivery delays. At the same time, customers of C3 were putting projects on hold so there was less pressure on suppliers like S3A to deliver as there was a stagnation in supply and demand. S3A started to be more transparent and share extra information with C3 regarding order shifts due to delays and explaining which components in an order are missing for example. A new contact person on S3A's side was appointed where discussions about orders and delays could be discussed with the customers of S3A (e.g. C3). This new contact person for C3 improved the level of transparency and information sharing with S3A. There was no real lower-tier management by C3. Only being informed by S3A of their (lower-tier) SC. On the digitalization level, C3 had recently started to experiment with Risk-Method software where it is easier to monitor the SC and report where disruptions in the SC are. This way there was a greater insight into the SC of certain tier-1 suppliers (S3A) "*When a supplier says that they cannot deliver a certain good because the port of Shanghai is closed, but we see that they can also produce that same good in the US, we can counter their demand for force majeure by telling them to get their goods from the US*". The increased information sharing regarding orders by S3A as a result of the Covid-19 pandemic had a positive impact on the transparency between C3 and S3A.

4.1.4 Case C3 (S3B)

As what happened with many suppliers of C3, customer projects were put on hold and suppliers were experiencing delivery delays at the start of the Covid-19 pandemic. S3B was before the pandemic already quite withholding in sharing information regarding which components are experiencing delays or are missing. S3B was way less specific in specifying how much a certain order was delayed. On the digitalization level, S3B did not participate in the software experiment mentioned in 4.1.3, limiting the transparency between C3 and S3B. Apart from 'black-listing' certain suppliers and having quality demands, C3 was not involved in the SC beyond tier-1 suppliers. This is something C3 wishes to improve in the future "*From a risk management perspective, we certainly see that we are missing useful information and we are planning to improve this in the future*". C3 had bad transparency and insight into the delivery times and delays of S3B whereas S3A did share extra information regarding these aspects during the Covid-19 pandemic.

4.1.5 Case C4 (S4A)

The transparency with S4A before the Covid-19 pandemic was quite high due to the importance of this supplier for C4. There was a higher level of transparency with S4A needed than with S4B because of the high number of components and complexity of S4A's products. Due to the Covid-19 pandemic, production of certain supplies was brought to a halt and employee shortages occurred. With the outfall of supplies and employees, it became clearer for C4 to have more insight into the risks of S4A and its tier-2 suppliers. To manage the lower-tiers, there was more communication between C4 and S4A to discuss the possible risks of S4A's SC, also to share the accountability of S4A's SC with C4. This transparency was also more in demand for C4 to be able to better explain shortages and delays to its customers. Questions within C4 were being asked regarding the complexity of its SC "*Covid was an accelerator for the realization of the importance of a less complex SC*". The involvement and lower-tier management of C4 down the SC of S4A was certainly there. On-site visits with tier-2 suppliers were held and also certain quality demands were made towards tier-2 suppliers. They even had one supplier where they checked the quality and specifications of this product in person. As this was a raw material, the quality had to be checked and accounted for at the source. C4 also had certain suppliers on a 'black-list' which tier-1 suppliers were not allowed to source from.

4.1.6 Case C4 (S4B)

The importance of S4B's products was less than that of S4A's products and there were no real burdens in the SC. Therefore there was less reason for a high level of transparency and SC questioning between C4 and S4B before the Covid-19 pandemic. As with S4A, this changed due to the pandemic. Potential risks and shortages were communicated more between the two parties. C4 was questioning S4B more actively about its SC and tier-2 suppliers. S4B was also more willing to share information as this shares the accountability of S4B towards C4 and its customers. So S4B became more transparent about its SC. But C4 did not change its perspective in its involvement with tier-2 suppliers of S4B whereas C4 did have certain involvement in the SC beyond S4A. There was no direct communication in the SC beyond S4B, excluding the 'black-listing' of certain suppliers. So C4 did not have a certain level of lower-tier management of S4B's SC.

4.1.7 Case C5

The industry of C5 is the international trade market so they have lots to do with the containerized transport over the world. And this is exactly what was upside down in the first months of the Covid-19 pandemic. The containerized transport was not what it used to be. Ports we closed down so no containers could come in or out. This was a problem for the containerized transport as there is an organized rotation system with containers over the world. As a result of this, containers were not in the right place causing major problems like delays and planned schedules not working out anymore. As C5 mentioned, "*Before you planned something 10 times, it would come out 9 times. Now when you plan something 10 times, it would only come out 1 time, so there is continuous communication needed between buyers and suppliers*". There is little transparency up the SC in the international trade market as this could eliminate the purpose and position of the trader. On a digitalization level, C5 started experimenting with a custom Customer Portal where customers can see in the system of C5 where their containers are located exactly to stay updated on delivery times, but this was still very limited, and only for customers (not with suppliers). As C5 is an international trader, there is no real insight or involvement in the SC beyond tier-1 suppliers. C5 did not have a certain level of lower-tier management. It was for C5 also not demanded to know what suppliers are behind their tier-1 suppliers as they always had to be flexible with its suppliers.

4.1.8 Case C6 (S6A)

In the first period of the Covid-19 pandemic, it was forbidden in Belgian supermarkets to have advertisements to prevent the hoarding of (paper) products. This had a big impact on C6 as lots of orders were canceled or postponed. There was no real change in the relationship between C6 and S6A as the interviewee of C6 used to be a sales director of S6A. So there was already quite some involvement between C6 and S6A before the Covid-19 pandemic. What changed due to the Covid-19 pandemic was the emphasis on explaining why problems occur in the SC. This needed to be communicated more elaborately, also towards customers of C6 via the already existing online Customer Success Management program. The problems the pandemic brought with it, forced C6 to search for more information to be able to explain delays or other problems to its customers. This led to improved consultation and transparency between C6 and suppliers like S6A. But there was no real lower-tier management by C6. Only being informed by S6A of issues in their SC.

4.1.9 Case C6 (S6B)

The problems at S6B were bigger than at S6A because the supply of pulp and wastepaper to S6B almost came to a stop as S6B partially relied on the community to deliver wastepaper to the factory. C6 had to check almost weekly with S6B if they were able to get the pulp they needed to supply C6. The demand for pulp had risen extremely and therefore took the prices up with it. This led to very fluctuating pulp prices which meant that it was very hard to predict how much S6B, and therefore also C6, would be paying for their products. This led to improved consultation and transparency between C6 and suppliers. More transparency in the market was needed to explain what was happening in the market to customers. This was always the case in C6's market but was increased due to the Covid-19 pandemic as there were more problems and fluctuations in the market. There was no real lower-tier management by C6. Only being informed by S6B of problems in their SC.

4.2 Transparency Before Covid-19 and Initial reaction

Before the Covid-19 pandemic struck, multiple cases showed that business as usual was working rather smoothly with little or easy to solve issues in the SC. There was weakened attention and focus on the importance of the SC mentioned by for example case C1 "*At a certain moment of time, there are fewer issues in the supply chain and then your attention weakens, and other things become more important. … There was barely any reason to have full focus on the supply chain*". This view changed considerably when the Covid-19 pandemic struck. Projects were put on hold (C3+C6) and suppliers of all cases experienced certain shortages in their SCs. To discuss the possible impact of the Covid-19 pandemic on the SC, cases such as C1 and C6 had almost weekly Covid crisis meetings in the beginning phase of the pandemic. It was decided that organizations should map their SCs more in-depth when SC-related problems, such as shortages and delays, arise. Also looking if suppliers are in possible high-risk areas with certain restrictions. This included identifying possible alternative suppliers and changing the way they assess the performance of their SC to include continuity of production and not just cost savings. C5 mentioned that more flexibility with suppliers is needed to ensure the continuation of your production. Shortages and delays in the SC led to the realization of the importance of transparency in the SC again.

There even was a case, case C2, that was not satisfied with the level of information sharing of their tier-1 suppliers already before the Covid-19 pandemic struck. They had realized the importance of transparency beyond tier-1 suppliers in the SC and implemented a software program in their organization and SC to improve the transparency with tier-2 suppliers. Due to the Covid-19 pandemic, the use of this software program accelerated in usefulness, increasing the transparency and visibility into the SC. Compared to other cases like C3, they had the advantage of already having quite a certain level of information sharing about their tier-2 suppliers, and did not perceive any production delays. Other cases had also recognized the need to improve their level of digitalization and this will be discussed in the next section.

4.3 Digitalization and Software Usage

Because of the restrictions the Covid-19 pandemic brought, the studied cases have greatly improved the digitalization of the company. Of course, the use of online meetings (e.g. Zoom and Teams) instead of physical meetings had to be implemented to communicate with suppliers. But these online meetings also had further interesting advantages and possibilities. As on-site visits were not always possible anymore due to the restrictions, case C1 used this possibility of online meetings to switch their way of expediting towards a more efficient way. Instead of visiting the suppliers to see how production is going, it was now an option to have these meetings online. The supplier had to walk through the

factory or warehouse while in an online meeting and had to virtually show C1 where their products are exactly and who is working on them. This way, the pressure on suppliers is still being put but without having to visit the supplier yourself. This online expediting has made C1 more transparent in information sharing with its tier-1 suppliers "*We are now much more transparent in contact, in particular with tier-1 suppliers to see what exactly they are doing*". The digitalization of C1 has made expediting more time and cost-efficient.

It has been noticed that certain cases had started to experiment with certain software to increase the transparency with customers and insights into the SC. Case C3 S3A had recently started experimenting with a Risk-Method software to better monitor what is happening in the SC and where tier-1 suppliers have their suppliers (tier-2 suppliers). With this software, C3 had better insight into the SC of S3A. So when S3A for example reported that they cannot deliver a certain good because their supplier of product X in Shanghai could not produce this good, C3 can see in the system that S3A also has a supplier of product X in the US where it is possible to get supply from. This way C3 has better negotiation positions with S3A and others. Case C5 was experimenting with a custom Customer Portal to enable better insights from customers into the location of their ordered products. To be able to share this information with its customers, C5 needs certain transparency and information sharing from its suppliers. Thus, it can be seen that the importance of visibility and transparency has been recognized and acted on by C3 and C5 by experimenting with new software to enhance transparency (also towards customers).

4.4 Transparency of Tier-1 Suppliers About Tier-2 Suppliers

It has been noticed that the Covid-19 pandemic has had a mixed impact on the transparency and insight of tier-1 suppliers about their tier-2 suppliers in the studied cases. Cases like C1 and C2 gained insight into their SC beyond their tier-1 suppliers in the past two years. Case C2 had already implemented a software program to increase the transparency with tier-1 and tier-2 suppliers and the Covid-19 pandemic accelerated the use of this program, increasing the transparency and view into the SC. The same goes with case C4 where tier-1 suppliers were more transparent in sharing information of their tier-2 suppliers to share the accountability of the SC issues with C4. This phenomenon has been seen with multiple tier-1 suppliers of the studied cases.

Where information sharing concerning tier-2 suppliers between tier-1 suppliers and the buying organizations was not yet the case before the Covid-19 pandemic, it was in most cases implemented during the pandemic with the reason to share accountability. Cases like C6 S6A+B already demanded quite some information-sharing regarding tier-2 suppliers as explanation towards customers regarding price was already requested before the pandemic. It was with these cases already quite known what suppliers are behind their tier-1 suppliers. Furthermore, there was no real change in information sharing about tier-2 suppliers by tier-1 suppliers with cases C3 S3A+B and C5. C3 stated that "*As long as the right quality is being delivered by tier-1 suppliers, information about tier-2 suppliers is not demanded*". C3 did mention that this is something they wish to improve in the future. As C5 is in the international trade market, they always have to be flexible with tier-1 suppliers so vision in their tier-2 suppliers is not demanded.

If there was a change in transparency and insight of tier-1 suppliers about the tier-2 suppliers due to the pandemic, this change was minor. The reason for this minor change was in most cases to shift and explain the accountability towards the buying organization of tier-1 suppliers further down the SC.

4.5 Involvement SC Beyond Tier-1 Suppliers

The change in involvement in the SC beyond tier-1 suppliers varies greatly between the studied cases. The cases C3 S3A+B, C4 S4B, and C6 S6A+B had no real involvement in the tiers in the SC beyond tier-1 suppliers. They did however have certain quality demands of tier-2 suppliers towards their tier-1 suppliers. The suppliers of tier-1 suppliers had to comply with the demanded quality standards of certain products they are sourcing. Along with that, the buying organization had certain 'black-listed' businesses or countries which tier-1 suppliers were not allowed to source from. C6 S6A has no involvement in or contact with a certain key tier-2 supplier but kept an eye on the developments of this key tier-2 supplier. Apart from these involvements towards the suppliers of tier-1 suppliers, there were no other involvements with the above-mentioned cases.

However, cases like C1, C2, and C4 S4A had quite an extensive involvement in their SC beyond tier-1. The former two cases have such involvement that they sent specific drawings to key tier-2 suppliers to make products for their tier-1 suppliers. The latter case had more extensive questioning with key tier-2 suppliers and also one specific key tier-3 supplier. Case C2 goes a step further with prescribing certain key tier-2 suppliers to tier-1 suppliers and even prescribing certain quality demands to a tier-2 supplier for one key tier-3 supplier.

Cases that operate in very (customer) specific and high-tech markets, cases C1, C2, and C4 S4A, tend to already have more insight and involvement into the SC due to the specific and extreme importance of quality and customer demands. It is also therefore that only these cases have some sort of involvement and/or insight into tier-3 suppliers whereas this is absent in the remaining cases.

4.6 Overall Level of Transparency After Covid-19

As mentioned by C3 "*The Covid-19 pandemic was a wake-up call that you must have more control over your Supply Chain*", and this was by many of the studied cases the same case. It had been realized by cases C1, C3 S3A, C4, and C6, that more insight and information into the SC beyond tier-1 suppliers was needed. In general, more elaborate and in-depth conversations were held with tier-1 suppliers to discuss the possible risks and problems of the SC of tier-1 suppliers. Tier-2 suppliers became a bigger point on the agenda with these conversations. Cases like C1, C2, C3 S3A, C4, and C6 have more actively started to question tier-1 suppliers about the possible risks in their SC, demanding information about suppliers beyond their tier-1 suppliers. As C4 mentioned, "*Much more talks were held with tier-1 suppliers to discuss potential problematic products and alternatives in the Supply Chain*". They started to immerse themselves more in each other's problems and wanted to be informed well.

The Covid-19 pandemic was not for all cases the reason for a change in the level of transparency. C2 had already realized the importance of information sharing between different tier suppliers and had implemented the use of a software program to increase the transparency in their SC. The Covid-19 pandemic however did accelerate the use and efficiency of this software program, further improving the level of transparency of C2. Case C5 did not improve its level of transparency in any way. There were no extra information demands made towards the tier-1 suppliers regarding the possible risks of their tier-1 suppliers. Due to the international trader's position of C5, they always had to be flexible with sourcing tier-1 suppliers so getting

information from their tier-2 suppliers was never in the picture. Transparency between multiple tiers in the international trade market is also something that was deliberated not wished for as too much information sharing could take away the trader position in the SC, with being bypassed in the SC as a possible result.

Transparency with the lower-tier SC in all but one case has been improved in the past two years due to the Covid-19 pandemic. The Covid-19 pandemic was a wake-up call for many cases and a turning point in the realization of the importance of knowing your SC and having a certain transparency level with suppliers.

5. DISCUSSION & IMPLICATIONS

5.1 Key Findings

Several studies have researched transparency with lower-tier suppliers in the Supply Chain (SC), and also the effects of the Covid-19 pandemic on transparency in dyadic buyer-supplier relationships (e.g. Caridi et al., 2014; Tao, Lai, & Zhou, 2020). However, as discussed in chapters 1 and 2, it was found that no research had been done before with a connection between lower-tier SC transparency improvement and the Covid-19 pandemic. This research gap in the literature, was the inspiration for this thesis and eventually led to the Research Question of this thesis, *"How do organizations improve transparency in their lower-tier Supply Chain and what is the effect on transparency during the Covid-19 pandemic?*".

After having analyzed the collected data, it was found that eight out of the nine studied cases have in some way increased their transparency with their lower-tier suppliers in the SC since the outbreak of the Covid-19 pandemic. Of the eight cases, they improved their transparency with their lower-tier suppliers by four main interesting points which were derived from the five findings sections in chapter 4: 1 – *Prescribing certain suppliers and quality demands towards tier-1 and tier-2 suppliers*, the 'long arm' of the buying organization. 2 – *Actively questioning suppliers* about their SC risks and *discussing lower-tier suppliers with tier-1 suppliers*. 3 – *Demanding to be notified by tier-1 suppliers if there might occur relevant issues or risks with their tier-2 suppliers* (and/or further down the SC). 4 – *The improvement of the level of digitalization of organizations*, the more cost and time-efficient way of communicating and expediting with lower-tier suppliers.

As a result of the research done based on the Research Question and the findings that came out of this research, it is now known how and in what way organizations have improved their transparency with their lower-tier SC as a result of the effects of the Covid-19 pandemic. Therefore, the research gap described in the introduction was filled.

5.2 Implications For the Literature

As described in the introduction and literature review, no research has been done before with a connection between transparency improvement of organizations in lower-tiers of the SC and disruptive events like the Covid-19 pandemic (Autry et al., 2014; Kembro, & Näslund, 2014; Alicke, Barriball, & Trautwein, 2021). This thesis was the first to have a look into this 'black box' described as the research gap in the introduction and was the first to shine a light into this 'black box'. This thesis has three main contributions to the literature stated below.

First, previous studies have shown the importance of transparency during SC disruptions (e.g. Tao, Lai, & Zhou, 2020). In this thesis, it was found that transparency became a more crucial aspect for most organizations during a SC disruption, namely, the Covid-19 pandemic. This is in line with Tao, Lai, & Zhou, (2020) and Bateman, & Bonanni, (2019), but this knowledge is extended in this thesis by researching the level of transparency improvement with the lower-tier SC with the Covid-19 pandemic as the cause for this improvement. In most of the studied cases, it was found that organizations have increased their level of transparency and concern towards lower-tier suppliers in their SCs in several different ways. It is now known how organizations have increased their transparency with lower-tier suppliers via actively questioning suppliers and the digitalization of organizations to name a few. The possible issues and risks caused by the Covid-19 pandemic were found to be the reason for these changes. This extended knowledge to the literature about the transparency improvement with lower-tier suppliers due to the Covid-19 SC disruption was not yet known before and therefore this thesis has contributed to the existing literature.

Second, several other studies have shown the importance of transparency with lower-tier suppliers in the SC (e.g. Mena, Humphries, & Choi, 2013; Kembro, Näslund, & Olhager, 2017). In this thesis, it was found that information sharing with lower-tier suppliers improved the continuity of production of suppliers and therefore also the continuity of the buying organization. This is in line with studies by Kembro, Näslund, & Olhager, (2017), and Choi, Rogers, & Vakil, (2020), where they also found that information sharing with lower-tier suppliers helps with continuity of the production. This knowledge is extended by this thesis by researching how the level of transparency with lower-tier suppliers changed due to the Covid-19 pandemic. To contribute to the literature, it was found that one of the main reasons lower-tier suppliers have increased their level of information sharing, was to share and be able to explain their accountability, e.g. shortages and delays, to the buying organization. Informing and being able to explain to the buyer certain issues and/or problems in your production processes, helps in sharing the accountability of possible delays, most likely leading to less or no punishment or penalties set by the buying organization. Discussing possible risks and issues in the SC of lower-tier suppliers became a bigger point on the agenda of the buying organizations. By extending the research previously done about transparency with the lower-tier SC, now with the cause of the Covid-19 pandemic disruption, this thesis has contributed to the existing literature.

Third, it was found that the level of transparency with the lower-tier SC before the Covid-19 pandemic, when business was going as usual, was sufficient in most cases. As case C5 for example stated, "*contact with tier-1 suppliers was sufficient for us to get our orders in time*". This is in line with Ketchen Jr, & Craighead, (2021), where they state "*why change what made us successful?*". But during the Covid-19 pandemic, this was not the case anymore. In this thesis, it was found that more information sharing between buyers and (lower-tier) suppliers was clearly needed and was therefore also demanded for by buying organizations towards tier-1 and tier-2 suppliers. Even after the Covid-19 pandemic, this change in the buyer-supplier relationship will remain strategic in most cases and therefore needed and demanded for by buying organizations. It was found that the Covid-19 pandemic has better-prepared organizations for future SC disruptions such as the current Ukraine-Russia disruption, as case C4 stated "*Due to the Covid-19 pandemic, we now know better how our Supply Chain is mapped and this has already benefited us in the current Ukraine crisis*". These and other findings of this thesis have extended the already known knowledge of the current literature by connecting the transparency improvement in the lower-tier SC of organizations with the effects of the Covid-19 pandemic, and has therefore contributed to the existing literature.

5.3 Managerial Implications

There were several managerial implications. One of them was considered the most interesting by the studied cases and this was, firstly, the mapping of their SC. The mapping and actively questioning of suppliers in the SC gave organizations better insight into where their products in their SC come from and where possible higher risks and influences of the Covid-19 pandemic are. As a result of this, organizations can better anticipate these possible risks and allocation of products, giving them the chance to look for more low-risk suppliers (e.g. dual-sourcing), which improves the continuity and resilience of the organization. The Covid-19 pandemic was an eye-opener for most organizations for the importance of having mapped their SC and looking beyond the dyadic buyer-supplier relationships as tier-2 suppliers could also have a big effect on you. Actively questioning tier-1 suppliers about their SC was a key element in the change in the level of transparency in organizations. Organizations that have not done so yet, should do this in the future when disruptions in the SC, like the Covid-19 pandemic, happen.

Second, digitalization was considered very interesting and important as well for organizations. The digitalization of organizations and the way of communicating with suppliers, made expediting and communicating with suppliers more time and cost-efficient. Several cases have started to experiment with new software programs to improve their transparency and gain further insight into (lower-tier) suppliers in their SC. These developments will be further developed in the future, also after the Covid-19 pandemic has passed, better preparing organizations for future disruptions, and even already for new current disruptions in the SC (Ukraine-Russia crisis). The cases that have not implemented certain software to improve the mapping of their SC and therefore transparency and insights, should do this in the future to get a better grip on the lower-tier suppliers of their SC, which has proved to be very useful in the event of a disruption in the SC. Investing in SC mapping is expensive and much time and labor are required for this. The organizations that had invested in their SC mapping before the Covid-19 pandemic struck, were better prepared and knew exactly where their suppliers were located and which were at risk, allowing them to anticipate quicker and more adequately. But because SC mapping is so expensive, many companies still rely on human intelligence instead of software for SC mapping. This information collection via personal relationships is typically limited and anecdotal, leading to less accurately informed personnel (Choi, Rogers, & Vakil, 2020). Yes, it can be difficult and expensive to map your SC. But in the end, the value of having your SC mapped is greater than the cost and time you had to invest in it. Organizations should see the long-term benefits of investing in SC mapping software.

If organizations do not have sufficient insight into their lower-tier SC, they will be put on the backfoot when disruptions in the SC occur, leading to a bigger impact of this disruption on the organization in question. Therefore, it is advised to improve the level of transparency and information sharing with suppliers beyond tier-1, if not already done so, to ensure continuity and minimize the effects of future SC disruptions. The four main ways of improving the level of transparency with lower-tier suppliers, as presented in this thesis, could most certainly help with this process.

5.4 Limitations and Future Research

In the methodology, it was stated that it was aimed at interviewing multiple tier-1 and/or tier-2 suppliers to gain different insights about the improvement of transparency with the lower-tier SC of organizations as a result of the Covid-19 pandemic. Unfortunately, none of the interviewed buying organizations were willing or able to share and/or bring into contact their tier-1 and/or tier-2 suppliers to participate in this research, although having made it explicitly clear that information would be kept confidential. As a result of this, insights from tier-1/2 suppliers about the change in transparency with a buying organization because of the Covid-19 pandemic, have not been investigated in this thesis. The perspectives of tier-1/2 suppliers of this change in transparency with a buying organization are missing and could therefore be different than that of the buying organization's perspective, which should be researched further. As Pichert, & Anderson, (1977) and Clarke, & Davison, (2018), mention, perspective can determine the significance of information and ideas, and having different perspectives about a case will result in more information-rich research. Interviewing tier-1/2 suppliers of an interviewed buying organization was wished for prior to the data collection process but could unfortunately not be achieved.

Furthermore, most interviewees are working for organizations with an international supply chain and mainly work in the Netherlands but also in Germany. Cultural differences and perspectives between countries towards the Research Question in question were not covered in this research. As Beiser (2003) and Buil, & de Chernatony, (2012), mention, culture can have a great impact on the phenomena that you are researching, and that outcomes of studies might not be the same in each and every context (e.g. culture). Therefore, it could be possible that the improvement in transparency in the lower-tier SC due to the Covid-19 pandemic could be different in other countries that are for example (digitally) less developed than the Netherlands or Germany. This could have influenced the outcomes of this thesis.

To address the limitations described above, future research should more thoroughly research the perspective of lower-tier suppliers about how the transparency with the lower-tier suppliers of organizations improved due to the Covid-19 pandemic. Not only from the buying organization's perspective as this thesis has done. Secondly, future research should also focus on the nationality of the studied cases. Interviewees should be selected from more different nationalities. Improving these limitations will improve the validity of future research.

Possible future research that is not related to the limitations above, could be about how the communication and information sharing within an organization and with suppliers, has changed/improved during the Covid-19 pandemic, to ensure that there are always products on-shelf. How was the process of ordering products before, during, and after the Covid-19 pandemic? How was dealt with the extreme increase/decrease in demand? Researching how this process within an organization and with suppliers has changed due to the Covid-19 pandemic, would contribute to the literature.

6. ACKNOWLEDGEMENT

Throughout the writing of my thesis, I have received great support and assistance. First of all, I would like to thank my first supervisor, dr. Niels Pulles, for his extensive feedback and guidance throughout the whole process of writing my thesis. Next to that, I would like to thank all the interviewees who have participated in this thesis. Finally, I would like to show my appreciation for my friends and family, especially my girlfriend and dad, who helped keeping me motivated throughout the writing of my thesis and helped me with useful insights and ideas.

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8. APPENDIX

Appendix A. Survey questions

Question 1	How many individual supply chains do you have?
Question 2	How many tier-1 suppliers are part of these chains?
Question 3	**BEFORE COVID-19:** Of these tier-1 suppliers, which percentage (adding up to 100%) would fall into which category (stated below)? If possible, please use the perception you had of the categories before it became clear that your assumptions were (potentially) false due to Covid-19. - **Non-key supplier**; can be replaced by a competing supplier if needed, with limited impact to cost/quality/capacity; or redundant supplier already available - **Important supplier**; can be replaced by a competing supplier if needed, but with significant impact to cost/quality/capacity - **Key supplier**; hard or impossible to replace
Question 4	**BEFORE COVID-19**: Of these tier-1 suppliers, which percentage (adding up to 100%) would fall into which category (stated below). If possible, please use the perception you had of the categories before it became clear that your assumptions were (potentially) false due to Covid-19: A - (Almost) no transparency in tier-2 suppliers B - Some transparency in "key" tier-2 suppliers; no transparency in others C - Reasonable transparency in more than 50% of tier-2 suppliers, including all key tier-2 suppliers. D - (Almost) full transparency across all tier-2 suppliers
Question 5	**AFTER COVID-19**: Of your tier-1 suppliers, which percentage (adding up to 100%) would fall into which category (please compare with similar question PRE-COVID (Q4)): A - (Almost) no transparency in tier-2 suppliers B - Some transparency in "key" tier-2 suppliers; no transparency in others C - Reasonable transparency in more than 50% of tier-2 suppliers, including all key tier-2 suppliers. D - (Almost) full transparency across all tier-2 suppliers
Question 6	**DUE TO COVID-19**: Of your tier-1 suppliers, which percentage (adding up to 100%) would fall into which category with respect to the amount of disruption that you have experienced with these suppliers: A – (Almost) no disruption B – Some disruption (e.g., due to capacity/cost/quality/etc. – can be solved/absorbed with minimal impact or impact was short term) C – Significant disruption (not easy to solve or absorb easily – significant impact) D – Total disruption (e.g., drastic degradation in capacity/cost/quality or bankruptcy of tier-1 supplier)
Question 7	**AFTER COVID-19**: How much impact did the Covid-19 pandemic have on your revenue? (Percentage increase/decrease, if decrease please use negative sign)
Question 8	**AFTER COVID-19**: How much impact did the Covid-19 pandemic have on your gross margin? (Percentage increase/decrease, if decrease please use negative sign)
Question 9	Which measures (if any) have you taken to increase the transparency to tier-2 suppliers in your supply chains?
Question 10	If these changes in improved transparency would have been implemented before the Covid-19 pandemic, which % of the experienced impact could potentially have been prevented? Between: 0%-20% / 20%-40% / 40%-60% / 60%-80% / 80%-100%