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The role of personal relationships during supply chain disruptions

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Aim: Research on supply chain disruptions is most commonly conducted on the inter-organizational level of analysis. Although personal relationships in business-to-business relationships are generally considered important, the role of personal relationships during supply chain disruptions has been neglected in extant literature. Our study aims to fill this void by focusing on the role of personal relationships from the buyer perspective.

Design / Research methods: An embedded case study was conducted at manufacturer ASML on the role of personal relationships during seven supply chain disruptions. ASML is the world's leading supplier of machines for the semiconductor industry. The unit of analysis is a supply chain disruption due to a delay or interruption in supply caused by the supplier or a sub-supplier. A total of seven sub-cases were examined.

Conclusions / findings: We found that personal relationships facilitate communication, the building of trust, flexibility, mutual understanding and anticipating behaviors. The results indicate that personal relationships indeed can play an important role in advancing supplier performance and addressing supply chain disruptions.

Originality / value of the article: The lack of research into the role of personal relationships in handling supply chain disruptions is a notable omission and points to a gap in the current body of knowledge. This study contributes to current understandings and knowledge by being one of the first studies to specifically investigate the role of personal relationships in a context of supply chain disruptions.

Implications of the research (if applicable): The results of this study have important implications for practice. The recommendation for management is to make employees aware and train them to invest in personal relationships which lays the foundation for successful collaboration also on the inter firm level. Trust and communication can be reinforced by regular face-to-face meetings, team-building activities with counterparts and communication training for better personal skills. Regular communication and maintaining relationships in stable times can help to increase supply chain resilience.

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Limitations of the research: A limitation of this research is its focus on describing the role of personal relationships during different supply chain disruptions within a single focus organization. Another limitation of our study is the focus on supply chain disruptions that were successfully resolved. Further research could address these issues.

Keywords: personal relationships, supply chain disruptions, personal communication, proactive measures, reactive measures
JEL: L63, M5

1. Introduction

A supply chain disruption is defined as "the combination of an unintended and unexpected triggering event that occurs somewhere in the upstream supply chain, inbound logistics network, or sourcing environment, and a resulting situation that poses a serious threat to the company's normal business operations" (Bode, MacDonald 2017, p. 838). The COVID-19 pandemic created many unexpected risks and serious supply chain disruptions (e.g. Ivanov 2020).

Supply chain disruptions lead to significant delays, reducing the ability to meet customer demand and increasing operational costs (Xu et al. 2020). Logistics is essential for the continuity of a company and important for the success of the supply chain department. Supply chain disruptions are usually costly for companies as they have a significant negative impact on the operational and financial performance of the members of the supply chain and the supply chain in general (Xu et al. 2020). Due to the negative effects that disruptions have, it is prudent for businesses to put in place mechanisms to reduce the likelihood of disruptions occurring and manage them effectively (Asamoah et al. 2021).

Research on supply chain disruptions is most commonly conducted on the inter-organizational level of analysis (e.g. Wieland et al. 2016). Although there is a growing interest in personal relationships, academic studies largely neglect the role of personal relationships within buyer-supplier relationships (cf. Rood et al. 2018; Schorsch et al. 2017). Personal relationships refer to interpersonal bonds between managers of different firms, based on formal, business transactions (Porterfield et al. 2012). Supply chain management issues in the real world are often messy for which people's actions are necessary, although 'micro-human activities are invisible to (…) traditional SCM research' (cf. Tsvetkova 2021, 837). In our study we will focus on actions undertaken

by members of a supplier account team, specific aimed at solving a supply chain disruption.

The importance of personal relationships in business-to-business relationships is generally accepted. Several studies show that having strong buyer-supplier relationships (BSR) can increase the company's resilience, performance, and competitive advantage (Daugherty 2011; Fawcett et al. 2012; Mocke et al. 2016; Van Der Walt et al. 2021). Personal relationships are believed to cultivate trust and long-term stability (Yıldızhan et al. 2023; Qian et al. 2021), loyalty, reciprocity and mutual understanding (Gligor, Holcomb 2013), enhanced communication (Gligor, Autry 2012), improved knowledge sharing (Butt 2019), and ultimately improved organizational performance (Zhou et al. 2014). However, other studies have found negative consequences of personal relationships, for instance when managers use these relationships for personal gains and/or the personal loyalty of purchasing managers leads to unnecessarily costs and inferior quality (cf. Butt et al. 2019). In other words, a personal relationship may develop into personal loyalty which may be unbeneficial for the companies involved (e.g. Gligor, Holcomb 2013).

Limited research has focused on the role of personal relationships in supply chain disruptions (Rood et al. 2018; Van Der Walt et al. 2021; Van Staden et al. 2020). Especially in case of serious supply chain disruptions, parties tend to be more lenient towards each other, where weak personal relationships may easily lead to reduced business performance (Rood et al. 2018; Van Staden et al. 2020; Butt 2019). Other studies concluded that companies may benefit from relational governance, communication and collaboration, also on a personal level (e.g. Gelderman et al. 2023). The lack of research into the role of personal relationships within the context of supply chain disruptions is therefore a notable omission and points to a gap in the existing body of knowledge (Gligor, Esmark, 2015; Gedeon et al. 2009; Mocke et al. 2016; Rood et al. 2018).

Our research contributes to the body of knowledge by being one of the first studies to specifically investigate the role of personal relationships in a context of supply chain disruptions. The research focuses on the personal relationships between representatives of buying and supplying companies from the buyer side. The problem statement is: what is the role of personal relationships during supply chain disruptions

from the buyer's perspective? The problem statement has been investigated using an embedded case study within ASML, the world's leading supplier of machines for the semiconductor industry. In this high-tech setting, it is extremely important that everything runs successfully throughout the supply chain from start to finish, without delays. The unit of analysis is a supply chain disruption due to a delay or interruption in supply caused by the supplier or a sub-supplier. A total of seven sub-cases were examined.

2. Literature review

2.1 Supply chain disruptions

A supply chain disruption can be defined as "the combination of an unintended and unexpected triggering event that occurs somewhere in the upstream supply network, inbound logistics network or sourcing environment, and a resulting situation that poses a serious threat for the normal operations of the company" (Bode, MacDonald 2017, p. 838). Supply chain disruptions consist of any potential or actual, unexpected and unplanned event that affects the normal flow of goods or services (Craighead et al. 2007; Hendricks, Singhal 2003; Svensson 2000; Wagner, Bode, 2008).

Globalization and increasing international trade has led companies to expand their supply chains around the world in order to reach new markets, reduce production costs and improve their competitiveness (Bode, Wagner 2015; Ghadge et al. 2012). Globally, supply chains are under more pressure than ever due to major shifts in supply and demand and trends in stockpiling and panic buying among consumers (Addo et al. 2020; Prentice et al. 2021; Schleper et al. 2021; Tang 2006; Van Hoek 2021; Wong et al. 2020). As a result of this increased supply chain complexity, companies have become more vulnerable to disruptions, as in a global supply chain, all members depend on each other (Bode, Wagner 2015; Chopra, Sodhi 2004; Craighead et al. 2007; Gh

adge et al. 2012). A disruption at one company can also create a disruption at another organization (Van Der Walt et al. 2021; Wagner et al. 2009).

Disturbances are caused by human or natural events. Companies are affected by human factors (explosions, terrorism, war, loss of suppliers) or by natural phenomena

beyond their control (floods, earthquakes, tornadoes, etc.) (Katsaliaki et al. 2021; Singh, Singh 2019; Skipper, Hanna 2009). These factors can lead to disruptions that affect the global supply chain by creating uncertainty in both supply and demand (Nikookar, Yanadori 2021; Shahed et al. 2021). Disruptions can also have major financial consequences (Craighead et al. 2007; Porterfield et al. 2012; Xu et al. 2020). Research shows that listed companies that are affected as a result of a disruption experience a decline in stock market value and a decrease in sales (Hendricks, Singhal 2003). In 2000, for example, Ericsson suffered a loss of $400 million. as a result of a disruption in the supply of microchips due to a severe fire at sole supplier Philips (Huang, Wang 2017; Katsaliaki et al. 2021; Tang 2006; Trent 2022).

A recent disruption to the global supply chain was the grounding of the container ship The Ever Given in the Suez Canal in early 2021. The Ever Given is the largest cargo ship in the world and can carry up to 20,000 containers at a time. Due to strong gusts of wind, the ship came across the canal, where it then became stranded and could no longer resume its course on its own (Lee, Wong 2021). The Suez Canal is responsible for 13.5% of container shipments worldwide every year. This has impacted more than 400 other container ships, and the global impact has been between $15 billion and $17 billion.

As supply chains have become increasingly complex (Chowdhury et al. 2021), disruptions create a snowball effect with serious consequences for all supply chain participants, also referred to as the ripple effect (Ivanov et al. 2013). It is paramount that companies identify risks and focus on developing strategic solutions to quickly and effectively mitigate the impact of similar events (e.g. Asamoah et al. 2021; Chang et al. 2015; Dubey et al. 2019; Katsaliaki et al. 2021). Reviewing own resources help companies develop capacity buffers and process data (Brandon-Jones et al. 2014; Parker, Ameen 2018). Examples of investing in resilience include increasing safety stock, contracting with multiple suppliers, optimizing network structures, setting up supplier development programs and increasing supply chain visibility.

Companies are using a variety of measures to reduce disruptions, divided into reactive and proactive measures. Proactive measures can help with supply issues from suppliers or an internal reduction in capacity (Gelderman et al. 2023; Ivanov et al. 2017) providing short-term solutions to supply chain disruptions, whereas reactive

measures are more efficient in countering distribution problems and changes in demand (cf. Gelderman et al. 2023; Ivanov et al. 2017). The size of a company has an impact on the strategies used. Large companies use integrated strategies to avoid disruptions as much as possible (proactive), while small and medium-sized enterprises often use passive strategies that are reactive in nature (Thun, Hoenig 2011). Each type of disruption requires its own type of measure (Gelderman et al. 2023; Golan et al. 2020). Table 1 shows the different measures, divided into the categories of proactive and reactive.

Table 1. Proactive and reactive measures for handling supply chain disruptions

	Measures	**Sources**
Proactive	Multiple sourcing to increase independence	Tang (2006), Van Hoek (2020)
	Using digital tools for supply chain transparency	Ivanov (2021), Ruel et al. (2022)
	Mapping the supply chains of (sub-)suppliers	Ivanov, Das (2020)
	Using reserves, overcapacity and surplus suppliers	Chopra, Sodhi (2004)
	Building up stock buffers and increasing inventory	Vanpoucke, Ellis (2019), Van Hoek, Loseby (2021)
	Multiple sources through outsourcing or off-shoring	Manuj, Mentzer (2008)
	Sharing information throughout the supply chain	Rao, Goldsby (2009), Wagner, Bode (2008)
	Reshoring of production	Pettit et al. (2019), Van Hoek, Dobrzykowski (2021)
	Strengthening of collaborative supplier relationships	Golan et al. (2020)
	Including force majeure clauses in contracts	Gelderman et al. (2023)
Reactive	Quickly switching to other strategies (situational)	Ivanov, Das (2020), Zhu et al. (2016)
	Adopting a flexible attitude	Ambulkar et al. (2014), Chowdhury, Quaddus (2017)
	Building up stocks	Vanpoucke, Ellis (2019), Van Hoek, Loseby (2021)
	Searching for alternative suppliers	Schleper et al. (2021)
	Shifting to other markets	Schleper et al. (2021)
	Ensuring the supply of critical components	Van Hoek (2020)
	Repeated forecasting based on new data	Van Hoek, Loseby (2021)

2.2 Relationships at the personal level

THE ROLE OF PERSONAL RELATIONSHIPS DURING SUPPLY CHAIN DISRUPTIONS

Companies benefit from building and maintaining close, long-term relationships with suppliers and customers (Golicic, Mentzer 2006; Mentzer et al. 2000). Although it is generally accepted that business relationships are maintained by individuals within companies interacting with each other, most buyer-supplier studies focus on relationships and processes between companies. These elements can be *implicitly* linked to the interaction between individuals (Celuch et al. 2006; Gligor, Holcomb 2013; Golicic, Mentzer 2006). Studies on buyer-supplier relationships most commonly examine relationships "in isolation from the interactions (…) among people representing these organizations" (Qian et al. 2021, p. 32).

In our study we explicitly distinguish between individual relationships at the organizational and the personal level. Relationships on a personal level refer to relationships that develop on an individual level between individuals who do business, as opposed to relationships that exist on an individual level but are only company-specific (Grayson 2007). Personal relationships at the individual level are "grounded in the unique and irreplaceable qualities of partners, defined and valued independently of their place in public systems of kinship, power, utility, and esteem, and of any publicly defined status." In contrast to business relationships in which "the substitution of persons does not affect the shaping features of the relationship" (Silver 1990, pp. 1476–1477). There is an interaction between the personal and business relationships, in which the personal relationships take place on an individual basis between persons within the context of the organization in which they work (Gligor, Holcomb 2013).

Literature recognizes the importance of interfirm relationships (Golicic, Mentzer 2008), although the role of managers who develop personal relationships does not specifically emerge (Gligor, Holcomb 2013). Mapping social elements helps to better understand the role of the individual, dyadic interactions in buyer-supplier relationships (Celuch et al. 2006). The theoretical foundation for the inclusion of the benefits or interpersonal relationships can be found in the Social Exchange Theory (e.g. Homans 1961). SET is mainly concerned with factors that influence the development, maintenance and breakdown of interpersonal relationships (Downard et al. 2023). Personal relationships with a cooperative and reciprocal bond result in a certain level of interdependence (Adobor 2006; Mocke et al. 2016). Rood et al. (2018)

argue that this dependency increases in a context of supply chain disruptions. Managers who have personal relationships within representatives from other companies are believed to be more productive, engaged, and creative (Gligor, Holcomb 2013). Necessary conditions for establishing personal relationships are trust, continuous communication, information sharing, engagement, and mutual understanding (Nyaga et al. 2009; Porterfield et al. 2012; Van Der Walt et al. 2021; Wieland, Wallenburg 2013). Employees with inter organizational personal relationship are considered to be more reliable, loyal, and dedicated business partners (Adobor 2006; Van Staden et al. 2020). The benefits of personal relationships are: unique, acquired knowledge, improved communication throughout the supply chain and the ability to better understand each other, a higher degree of problem-solving, mutual trust and loyalty (Adobor 2006; Butt 2009; Chung et al. 2016; Gligor, Holcomb 2013; Mocke et al. 2016).

Social capital theory also recognizes the importance of personal relationships (Putnam 1995). Interactions between parties result in social capital which refers to the access to valuable resources made available through social relationships (Nahapiet, Ghoshal 1998). Trust, friendship, respect, and regular interactions are features of social capital (e.g. Gelderman et al. 2016). The interaction between parties where personal information is shared and where parties are honest with each other is established as the elements through which personal relationships are built and maintained, also known as social capital. With an increase in social capital, the risk of opportunistic behavior also increases. The exchange of personal information consists of extensive and repeated contact between parties, combined with affection and mutual sympathy. These bonds between individuals are responsible for establishing norms of trust and reciprocity (Granovetter 1973). The embeddedness of supply chain managers in their reference network was found to impact the resilience of their company (Nikookar, Yanadori 2022).

While developing relationships, participants look for ways to relate to each other, which makes them feel better about the relationship between them. Shared interests and the ability to get along with each other make it easier to trust the other party (Gligor, Holcomb 2013; Van Staden et al. 2020). Trust is also seen as the extent to which participants in the personal relationship are willing to adapt to the other

person's behavior. It removes some of the risks and difficulties because members can anticipate the potential behavior of the other person (Chung et al. 2016; Rood et al. 2018; Van Der Walt et al. 2021). This flexibility ensures that members can survive in unclear and unsafe operating conditions (Nyaga et al. 2009). Trust is the most important factor in building and maintaining a successful personal relationship (Knemeyer et al. 2003). Once members have shared interests and communication is honest and transparent, trust is developed (Gligor, Holcomb 2013; Van Staden et al. 2020; Van Der Walt et al. 2021).

Characteristic for personal relationships is the voluntary participation. Participants choose which personal information is shared and based on this, a connection is created. When sharing these interests and experiences, there is no obligation for the other party to share the same information. Based on these personal elements, participants are difficult to replace (Gligor, Holcomb 2013). The three most important dimensions of interpersonal relationships are personal credibility, personal attraction, and personal communication (cf. Wang et al. 2018).

2.3 Personal relationships during supply chain disruptions

Mutual trust in personal relationships helps in reducing business risks (Chung et al. 2016). Sharing information and market knowledge ensures that parties may be aware of external threats sooner and can thus respond to them sooner (Adobor 2006; Chopra, Sodhi 2004; Gligor, Holcomb 2013; Van Der Walt et al. 2021). This continuous flow of communication between parties, both good and bad news, provides real-time information, visibility, feedback, and open, honest communication (Rood et al. 2018). In a broader sense, this continuous flow of information provides flexibility, cohesion and alertness, allowing companies to act quickly and survive in difficult situations (Kahn et al. 2013; Wieland, Wallenburg 2013).

Mutual understanding, interests, mutual goals, and objectives between members can influence the success of the relationship (Gligor, Holcomb 2013). Rood et al. (2018) indicate that during a disruption, participants may receive extra support and favorable treatment from members with whom they have a personal relationship. Trust is also an important factor in relationships and provides guidance in an uncertain situation (Rood et al. 2018). Personal relationships support easier business operations

during a supply chain disruption, improving the performance of both the buyer and the supplier (e.g. Day et al. 2013; Nyaga et al. 2009; Mocke et al. 2016). To keep companies safe in a context of supply chain disruptions, it is important to maintain and actively use personal relationships (cf. Gligor, Esmark 2015).

3. Methodology

3.1 Method of research

This research is both qualitative and exploratory in nature. An embedded case study was conducted at ASML, which is the world's leading producer of lithography machines for the semiconductor industry. ASML is currently the top supplier of photolithography systems to the semiconductor industry. ASML dominates the global market for lithography equipment used in the semiconductor industry, with an overall market share of more than 80%. The headquarter is located in Veldhoven, the Netherlands. ASML employs more than 42,000 people from 143 nationalities and relies on a network of nearly 5,000 tier 1 suppliers. ASML has a worldwide customer base and over sixty service points in sixteen countries. ASML reports €27.6 billion net sales and €7.8 billion net income in 2023.

Cases in this study are situations in which suppliers have not been able to deliver according to the agreements made as a result of a disruption at the supplier or a sub-supplier, as a result of which the flow of goods to ASML was affected. This can be about some of the materials that the supplier provides, or the entire range. In such a situation, the materials (parts) in question are escalated internally, which means that from that moment on, more people, from different functions, become involved to address the situation. The precision mechanics and assembly (PMA) team was chosen for this study. This team is concerned with suppliers who process and supply mechanical parts, assemblies and sheet metal. The unit of analysis in this study is a supply chain disruption due to a delay or interruption in supply caused by the supplier or a sub-supplier. A total of seven cases/disruptions were investigated.

Four disruptions were caused by a lack of capacity of the supplier and/or a sub supplier (case 1, 2, 4 and 5). Underlying problems had to do with specifications resulting in a vendor lock in, with poor logistical performance and with severe quality

issues. Two disruptions were linked to an acute shortage of packaging materials (case 3 and 5). More specific, the company was confronted with unexpected shortage of the large wooden boxes, needed to transport modules and machines. In one situation the company had to deal with a sudden, strong increase in demand for raw materials.

3.2 Data collection

Data was collected through unstructured and semi-structured interviews and document analysis. The interviews were recorded in consultation with the interviewees so that they could be transcribed afterwards. The contact between ASML and its suppliers takes place through an (extended) SAT team (Supplier Account Team), where this team from the buying side has contact with a number of employees from the selling side (suppliers). A SAT team consists of professionals, performing tasks related to logistics, planning, buying, sourcing and quality. Members of the SAT team interact with suppliers on different topics. The size and composition of the team depends on the relationship, complexity and size of the supplier. ASML tries to approach the suppliers with one voice. Within the contact moments, the personal relationships are present to help with stakeholder management and better understanding the expectations of the other party. The mission of the buying side is material availability and the timely acquisition of information about situations that deviate from the normal. This aims to detect disruptions as early as possible in the chain in order to be able to address them as quickly as possible. Employees from the SAT team are interviewed.

Table 2 provides background information about the respondents. The Operational Supplier Coordinator is responsible for the day-to-day, operational contact with the suppliers of volume parts); the Logistics Supplier Manager has a more strategic role (i.e. the second escalation channel, above the OSC level); the Manager Q&L functions at the senior management dealing with the supplier landscape and the capabilities around QLTCS (i.e. quality, logistics, technology, cost price, sustainability); the Product Lifecycle Management Project Coordinator is responsible for certain modules and the start-up of new projects at suppliers; the Product Lifecycle Management Project Leader has a more strategic role, functioning as a team leader with PLM Project coordinators in his team; the Development & Engineering Project Leader is

responsible for the technical, development side of parts (i.e. a team leader with several quality engineers in his team).

Table 2. Background information about the respondents

Job title	Abbre-viation	Experience at ASML	In current function	Educational background
Operational Supplier Coordinator	OSC	2+ years	2 years	MSc in Engineering
Logistics Supplier Manager	LSM	9+ years	3 years	MSc in Organizational sciences
Manager Quality and Logistics	M Q&L	27+ years	13 years	MSc in Industrial Engineering
Product Lifecycle Management Project Coordinator	PLM - PC	5+ years	4 years	MSc in Supply Chain Management
Product Lifecycle Management Project Leader	PLM -PL	9+ years	3 years	MSc in Supply Chain Management
Development & Engineering Project Lead	D&E PL	6+ years	2 years	MSc in Mechanical Engineering

The interviews covered 7 disruptions in which respondents discussed the same disruption from different positions and management levels. The diversity in roles and levels of management provides a valuable perspective on the disruption, as each individual has been involved in dealing with the consequences and seeking a resolution of this disruption from their unique role and responsibilities. By combining respondents' inputs, a more comprehensive picture of the disruption and its impact on different aspects of business operations can be obtained. The perspective from different functions and management levels contributes to a deeper understanding of the challenges, decision-making processes and the contact that took place during the disruption.

The interviews were conducted at the company's headquarters in the Netherlands between May and July 2023. ASML is a multinational where the working language is English and where many knowledge workers from other countries work. Respondents have Dutch nationality, but mainly represent a corporate culture that is well established within ASML. Interviews typically lasted 60 to 90 minutes. All interviews

were recorded and transcribed. The outcome of the interviews was displayed and summarized in a data matrix. The transcripts were submitted to the respondents for information to increase reliability.

In addition to conducting interviews, a document analysis was carried out to gain insight into which measures or procedures are prescribed during escalations and what steps need to be taken. The various documents examined include presentations, manuals and a checklist regarding how to deal with and address escalations (disruptions) and internal reports that were updated weekly.

3.3 Data analysis

The cases are first analyzed separately (within-case analysis). They are then compared with each other through cross-case analysis. In order to systematically analyse and structure the data from the interviews a structured data matrix was used to derive a comprehensive overview of all measures taken during the disruptions and personal relationships involved. This matrix was structured to include all key variables related to measuring the influence of personal relationships during disruptions.

The data was systematically coded and entered into the respective cells of the matrix. This coding process involved identifying themes, patterns and measures taken while taking the personal relationships into account. The data from the matrix were integrated where each column contained responses of a different participant. This allowed for a better understanding of the connection between measures taken and the role of personal relationships. These patterns and connections across participants contributed to a nuanced analysis which not only accustomed a systematic exploration of the data but also provided a visually accessible overview of the measures and impact of the relationships.

3.4 Results

3.4.1 The focus organization and escalation levels

Within the ASML focus organization, there are several levels of escalation. These levels of escalation each require a different approach. An escalation starts at level L1 where the operational planners (OSCs) take the lead and try to resolve the situation, possibly with the help of the LSM. Depending on the degree of impact, it shifts to L2 or eventually L3. The greater the impact on ASML, the higher the escalation level and the more higher-level stakeholders are involved. These escalations are initiated to ensure output for the factories and the right service levels to the field (maintenance and repair of existing machines). This procedure is used when a situation arises where there is a shortcoming in supply and demand that needs to be addressed to ensure the availability of material. This deficiency arises when the expected delivery of items occurs on a date later than they are required at the factory or for service. The checklist provides an overview of actions that can be taken to resolve the gap between the demand and delivery date, including:

- speed up output supplier
- investigate bottleneck at supplier
- alternative resources/supply.

The presentations, manuals and checklist do not explicitly mention proactive measures that can be taken to prevent disruptions or reduce their impact. No attention is paid to proactively identifying and assessing potential risks in the supply chain, nor to implementing preventative measures to increase supply chain resilience. In contrast, the documents showed that these are primarily focused on dealing with supply chain disruptions in a reactive manner. They each describe specific steps and procedures that must be followed after a disruption has already occurred, with the aim of resolving it. This reactive approach consists of identifying the disruption, determining the possible causes, and taking measures to restore normalcy. The checklist supports this by offering various measures that can be taken depending on the cause. The focus here is mainly on managing the consequences of the disruption after they have occurred and not allowing them to escalate further.

3.4.2 Proactive measures

Respondents indicated that proactive measures were not considered in advance. Respondent 6: "I think that was the biggest problem." Respondents were mainly focused on the day-to-day operational management of the supply chain, which means that there was little room or no attention paid to looking ahead and taking preventive measures. However, all respondents indicated that ASML proactively shared information with the supplier. They emphasized that transparency is an important element in this supplier relationship. The Logistics supplier manager: "I think your level of transparency should be as high as possible. That contributes to a relationship. This contributes to looking ahead and working proactively. And I think that at ASML we are also convinced that this helps to be as transparent as possible."

A possible explanation for the absence of proactive measures, was expressed as follows.

"If there is no problem, you don't need it in such a situation. When it comes to reactive measures, you have to switch very quickly with the supplier to speed up the various steps in the normal process and get usable packaging back as quickly as possible. There were still a number of these transport crates almost ready at the supplier. This required some external cleaning steps, which normally takes 1.5 to 2 weeks." (Manager quality & logistics)

Some respondents pointed at the reactive culture within the organization, where action is only taken when a disruption occurs. There was talk of a tiger team being put together where the team is responsible for addressing and resolving disruptions.

"If it goes wrong, we'll dive right in, with a lot of people and then we'll ask 1001 questions to solve that. If you're in an escalation, you're just a tiger team and you have to get out of that escalation together and then it's important that you trust each other and everyone is on the same page." (Product lifecycle management project lead)

3.4.3 Reactive measures

Respondents indicated that several reactive measures were taken in all supply chain disruptions. In the first case, the product in question was critically examined. The D&E department made changes to make the production process easier and increase the output. Searching and finding a second supplier for the production of critical materials proved to be a difficult process and only viable in exceptional cases. Product lifecycle management project coordinator: "Setting up a second source is very complex, although this was done for a specific product, because company A did not have the appropriate capabilities. A dual source has been set up with company B". The Logistics supplier manager added: "Again, you have to invest much [in the relationship], in order to reap the benefits in the end. Especially at the start when onboarding a supplier, I think that's very important."

Respondents reported that adopting a flexible attitude was always an important element during disruptions. The Product lifecycle management project coordinator: "Every day there were new surprises that you had to deal with and adjust your plan towards. That was precisely the dynamic of this escalation. Continuous switching, continuous adjustment." Several respondents also indicated that during such a situation, a team from ASML would dive in completely to figure everything out. The product lifecycle management project coordinator: "As ASML, we are always very good at reactively setting up completely WIP trackers in one go and going all the way in-depth." The Product lifecycle management project leader stressed that production personnel was sent from ASML to the supplier to temporarily increase capacity. Since ASML is one of the largest employers in the region, it can be difficult for suppliers to hire suitable staff.

"We take a deep dive where we have walked through everything in a very structured way and make the combination of yes, what is going on logistically and how can D&E [development and engineering] help with that? So if there's a bottleneck somewhere, do we have to solve it logistically, more tools, more people? During the disruption, the entire chain was mapped out down to the last step." (Development & engineering project leader)

According to respondents, much attention was suddenly paid to this from above: “we received much unsolicited attention, but also unsolicited help.” We determined the priorities and what needs to be tackled first. These measures were selected on a subject-by-subject basis, but the cause was first investigated, because it was often not known at all. Much time was spent on the lessons learned because of the impact of supply chain disruptions. These solutions had to be presented all the way to the board. Whenever it was clear that the disruption implied an urgent problem that could not be handled through the normal processes, higher management got involved. “When you realize how big a problem is and that there’s really no other solution, ... then you don’t get it fast enough.” This had to be controlled from higher (management).

In case 4 a *containment* (temporary solution) was first provided so that the factory could get started and a structural solution was then worked on. It was of critical importance to act quickly and to share information throughout the chain. This kind of information is very important: “if a change takes place deeper in your process, you must at least report it [as a supplier].”

Overall, it was concluded that the reactive measures contributed positively to the situation. Problems were not been completely solved, but their size and complexity decreased. The Development & engineering project lead added: “I think there was a mix of problems here, so if you solve one thing, it didn’t immediately lead to success because it would fall into the shadow of another big problem.” The product lifecycle management project coordinator advised: “just keep switching gears to limit the impact.”

3.4.4 Personal contact during disruptions

The logistics supplier manager was responsible for mapping the entire production process. To clarify this, the following questions have to be answered: Which steps take place? How long do they last? Which (sub)suppliers are involved? How is that logistically arranged? Is that smart? How can we skip steps? Can we take extra steps to ensure that output increases? In the first case, there was daily contact with the operational and commercial director.

"I had a good click with my contact person. The supplier was located just around the corner, so I could easily go there instead of doing everything via calls. There was much trust, since we knew the operational director, the people below and the commercial director. When solving the problem, we had to go into the supply chain of this supplier. They could have said, "No, that is our responsibility and you may not interfere. The personal relationships really contributed to the solution, while ASML's name also helps." (Logistics supplier manager)

In the second case, the company felt the need to invest in trust and getting to know the supplier better. It appeared also important to demonstrate reliability, integrity and the potential added value to the supplier. The physical presence has contributed to resolving the situation. Personal contacts outside working hours also contributed to the trust and collaboration in searching for solutions.

"You also have to drink beer together in the evening after such a day, because they were very long days of work, also to do that team building piece together. In the end it is also about being a team that has to solve something. For example, it also helped that a PLM [product lifecycle management] colleague joined who exchanged Dutch beer with German beer from his counterpart. It may seem insignificant, but it does contribute to building a (personal) relationship. It is important that a lot is invested in the relationship in the beginning so that you can reap the benefits later. Furthermore, it is of course also very important that you do what you promise. Show that you have integrity, that you can be trusted, that you really bring something to the table and that you don't just come to ask questions." (Logistics supplier manager)

Trust was always mentioned as an important element for a successful relationship. The Product lifecycle management project coordinator was involved in the steering committee meetings with suppliers, internally reporting updates related to the disruptions, and coordinating with his team on the focus points. The contact with suppliers was entirely by telephone, which, according to the respondent, was described as easily accessible because people know how to find each other easily by phone. This has contributed to a solution: "I do think that problems would have been

greater if contact had been difficult." It was also mentioned that there was much old pain in the teams because of the presence of an escalation that ran for years. Obviously, the contact with the supplier did not always go smoothly: "There was quite a bit of friction between company A and ASML and that we didn't really feel that we were both working in the same direction." ASML employees were closely involved in the escalation in the past. There was therefore 'old pain' within the team. There were also a number of changes in the composition of the team, both at supplier A and at ASML. Even the original project leader was replaced. In the new situation, new team members have been appointed to important positions, only young, ambitious employees. That has helped the dynamics in the escalation enormously.

The Product lifecycle management project coordinator had daily meetings with the supplier to discuss the planning and progress of production: "How far along is this production and to what extent is this production? What do you need from me to ensure that it can really be in our factory on Thursday afternoon at 10:00 a.m. at the latest?" He was also involved in research into the move rate and output of this material and into the competence and capacity of the supplier. During this process, there was intensive contact with a select group of employees of the supplier. This has contributed to a solution, and is described by the Product lifecycle management project coordinator: "If you hadn't done it, it would undoubtedly have been an even bigger mess." However, because of this intensive contact, parties became less critical of each other which can be challenging at times.

The Development & engineering project lead is responsible for the technical design and to adapt specifications, whenever possible. In the first case, the mutual relationship had to be built, but this went fairly quickly as the supplier noticed that the respondent started working with an open mind and mutual goals. The respondent perceived that his involvement has contributed to a solution to the problem, although he also indicated that the business that ASML creates is of critical importance for suppliers.

"I don't know if it's necessarily the personal relationship or just the mere fact that that turnover is just so high. I think it does contribute to the fact that the extra step was indeed taken, if that personal relationship is good. The name ASML does play a

role in this. However, senior management was not on good terms with each other, partly because a second supplier was appointed because the quality at the original supplier was stagnating." (Development & engineering project lead)

The Manager of quality & logistics is responsible for the long-term strategy regarding the quality and logistical capacity of the supplier. This manager had to initiate investigations into the supplier's processes and improvement projects. During disruption 3, the respondent contacted the supplier's director, explained the problem, and reported that it needed to be resolved. The respondent indicated that they had not spoken to the contact person for three quarters of a year, but that they have spent much time building the relationship the year before. As a result, the director of the other company knew that when the Manager quality & logistics calls, something needs to be resolved. "Then he knows that he has to act first, then he has to ask and that is what he has done, so he has personally ensured that those outsourcing steps were greatly accelerated." As a result, the supplier did everything in its power to get these transport materials back to ASML as quickly as possible. This quick action and involvement of senior management has shortened the process to 1.5 days.

During disruption 4, the Logistics supplier manager was in a steering committee meeting with the director of the supplier and in the meeting it became clear that something was wrong and that a switch had to be made because the factory was at a standstill.

"The factory was really at a standstill and then the supplier also knew that he has to do something, because then it really helps if you drive it top-down. Because of the seriousness of the matter, the supplier has put the best technical person on the problem. A few days later, new usable parts were ready. I went to pick them up personally and then delivered them to the factory (ASML). This has to do with reciprocity, which means that you show that you want to put in that extra effort yourself. It is important that we both invest in the relationship. For example, if the supplier calls to inquire about invoices that have not yet been paid or if something is wrong administratively. Then you also have to make an effort to resolve it, to show that it is a reciprocal relationship." (Manager quality & logistics)

The supplier's organization in case 5 was fairly flat and very flexible. The Manager quality & logistics had a personal relationship with the director that goes back twenty years. They knew from each other what is needed and if something is requested, action must actually be taken. In this case, it immediately became clear that action had to be taken quickly. The supplier's director acted accordingly and kept a team working after closing time to process and deliver the crates.

"The supplier's director personally delivered the crates in the evening. He put them in the car himself, drove to our warehouse to deliver them in the evening. You don't do that kind of thing in the normal circuit, there are no bills, that's something that's just part of it and you really only do that when you have that relationship with each other to be able to do this." (Manager quality & logistics)

All respondents indicated that suppliers are more likely to share useful information and market knowledge during supply chain disruptions because of personal relationships. The relationships made it possible to communicate fast, effective and openly since the contact was based on trust and was easily accessible. Having a personal relationship during a supply chain disruption contributes to solving it: "Such a personal relationship, yes that just helps, you call people more easily. It's easier to share things with them. It's just not that you're facing someone you just don't know at all, but it's just a person you already know reasonably well and that helps." (Development & engineering project lead).

3.4.5 Cross-case analysis

The data showed that proactive measures aimed at identifying risks and preventing disruptions had not been taken prior to a disruption. Multiple respondents indicated that many of the disruptions were unpredictable, making it difficult to proactively prepare for them. All respondents indicated that they acted only reactively. We found that ASML is strong in reactive action and solving the disruption.

Table 3. The role of personal relationships and the impact on supply chain disruptions

Type of supply chain disruption	Causes	Response	Activities at a personal level	Impact on disruption
Lack of production capacity at the (sub)supplier	Strict specifications and a complex production process, resulting in too little output	Mapping the supply chain of suppliers and sub-suppliers	Daily communication with higher management	Obtaining trust and openness from the supplier, confirming the need for the help offered
		Sharing information throughout the chain	Telephone contact with counterpart	Quickly obtain up-to-date information due to accessible contact
		Mapping the supply chain of suppliers and sub-suppliers and ensuring delivery of critical parts	Frequent contact with a limited number of specific employees of the supplier	Those involved know exactly what they need from each other
		Sharing information throughout the chain	Frequent consultation with management at the supplier	An open and correct approach brought calmness and structure
	Logistical and quality problems at a sub-supplier	Mapping the supply chain of suppliers and sub-suppliers	Physically present at the supplier every week	Permission to visit the supplier's facilities and speak to employees, which was previously strictly prohibited
	Adjustments of sub-supplier's production process	Situational response and ensuring delivery of critical parts	Steering group meeting with the supplier	Immediately deploy the most qualified technical experts
	Received materials with incorrect labels	Situational response	Telephone contact with group lead and daily meetings	The project team came directly to ASML
Increase in raw materials demand	Extra demand for parts due to rejection	Situational response and repeated forecasts	Telephone contact with counterpart	Efficient processing of telephone requests and actively involved
Shortage of packaging materials	Incomplete transport of materials in the warehouse	Ensure delivery of critical parts	Telephone contact with the supplier's director	Outsourcing steps intensely accelerated and everything is done to deliver
	Damaged transport materials in the warehouse	Situational response		Keep a crew working after hours to process and deliver materials

The following reactive measures were most commonly taken, when ASML had to deal with a supply chain disruption: mapping the supply chain of suppliers and sub-suppliers, sharing information throughout the chain, ensuring the supply of critical components, situational action, and repeated forecasting. In addition, there was (daily) personal contact with one or more direct counterparts of supplying companies. The sharing of information was done in a reactive way through telephone conversations or face to face with direct counterparts or employees of a higher level. The status quo, the actions taken and the next steps were discussed in these personal contacts. Sharing information is important for determining the impact and addressing disruptions.

The results showed that the emphasis on transparency and open communication had important advantages in dealing with a supply chain disruption. Transparent and open communication ensured that all stakeholders were aware of the current status and the measures taken. These initiatives contributed significantly to building trust, which leads to faster and more efficient actions. It also ensured that stakeholders were more willing to work together on a solution. Personal relationships can improve communication between parties. What did play a role, according to the respondents, is the name ASML and the business that this entails. Table 3 shows the activities on a personal level by type of disruption. Respondents reported that personal relationships and mutual contact have contributed to solving disruptions. Because of personal relationships, suppliers were (more) willing to act directly outside the normal processes and work to minimize the impact.

3.4.5 Discussion

This study provides insight into the role of personal relationships during supply chain disruptions, building on research by Rood et al. (2018), Van Staden et al. (2020), and Van Der Walt et al. (2021). When stakeholders are too emotionally involved during a disruption, this can lead to irrational decision-making and weak personal relationships may lead to reduced business performance (cf. Rood et al. 2018; Van Staden et al. 2020). Personal relationships contribute to building trust, which ensures that risk information is actually shared between supply chain partners (cf. Van der Walt et al. 2021). We have derived propositions that may be helpful for further research.

Research has shown that the size of the company influences the strategies used (Thun, Hoening 2011). Large companies use strategies that try to prevent disruptions as much as possible (proactive). Contrary to previous findings, no evidence of proactive measures was found in our study. The absence of proactive measures in the analyzed documents and the cases can be attributed to several factors. It may be that the focus organization focuses primarily on reactive crisis management rather than a preventive approach. In addition, a lack of awareness about the importance of proactive risk management and resilience in the supply chain may contribute to the absence of such measures.

A striking finding in this study is that only a reactive approach was used to resolve disruptions. No actions are taken to proactively prevent it in the first place. One possible reason for this is that ASML operates in a very specific sector and the disruptions are difficult to predict. Further, due to the complex supply chain, proactively managing risk may be a challenging and costly approach, making people more likely to adopt a reactive approach. This reactive way of acting is in line with the results of Ivanov and Das (2020), who recommend timely and situational action to changing circumstances over proactively building up stocks and reserves. This is in contrast to recent research by Gelderman et al. (2023) which recommends addressing distribution issues with proactive measures.

Proposition 1. *Powerful companies may be inclined to rely on reactive measures to supply chain disruptions, which are more feasible/practical than proactive measures which are more challenging and costly.*

The trust and transparency are identified as important benefits of close relationships (e.g. Van Staden et al. 2020), which plays a crucial role in a supply chain context where acting quickly in the event of a disruption is essential (cf. Knemeyer et al. 2003; Nyaga et al. 2009; Rood et al. 2018; Van Der Walt et al. 2021; Van Staden et al. 2020). Our results indicate that personal relationships create trust and understanding between the parties, contributing to transparency about what they can ask and expect from each other. This finding is consistent with prior research (e.g. Chung et al. 2016; Rood et al. 2018; Van Der Walt et al. 2021). Apparently, buyers

and suppliers are able to anticipate about the behavior of the other party, due to personal trust in personal relationships. As a result, suppliers are willing to address the problem outside of normal business processes and do everything possible to minimize the impact (cf. Rood et al. 2018; Van Der Walt et al. 2021). The decisive role of interpersonal communication in resolving supply chain disruptions is in line with Qian et al. (2021) who found a significant impact of interpersonal communication on firms' propensity to maintain long-term relationships. In our study we found confirmation for the assumption that personal relationships can play an important role in advancing supplier performance and addressing supply chain disruptions.

Proposition 2. *Transparency and open communication which are essential to establish a personal relationship are at the same time the basis for effective reactive measures in case of supply chain disruptions.*

4. Conclusions and recommendations

The extant literature shows little research on the role of personal relationships during supply chain disruptions. In this (embedded) case study, we investigated this topic within a large manufacturing company. We found that only reactive measures were taken. This reactive approach is driven by having intensive contact with contacts at the supplier. Personal relationships made it possible to communicate quickly and effectively, build trust and work together to find solutions to disruptions. It has helped to better reflect the seriousness of the situation and has led to greater involvement and cooperation between the different stakeholders. The cases show that personal relationships create trust and understanding between the parties, so that they know what to ask and expect from each other. This study showed that communication and personal relationships contribute to addressing and resolving supply chain disruptions. They help form an understanding of the situation and share information quickly and efficiently.

The results indicate that personal contacts make a positive contribution to solving supply chain disruptions. The cases show that investing in the relationship at an early

stage is an essential aspect for building the relationship and the associated trust. The recommendation for management is to make employees aware and train them to invest in personal relationships which lays the foundation for successful collaboration also on the inter firm level. Trust and communication are reinforced by regular face-to-face visits/meetings, team-building activities with counterparts and communication training for better personal skills. Regular communication and maintaining relationships in stable times can help to increase supply chain resilience.

It has been concluded that transparent communication promotes addressing the disruption, supports sharing the latest status and keeping everyone involved informed. Technological developments could make more use of this by picking up certain signals at an earlier stage that could potentially lead to a disturbance. Here, it is possible to work towards a model that builds on previous knowledge and a situation where the supplier feels confident to share such signals in a timely manner and the subsequent approach from ASML does not feel like a punishment.

The research findings suggest that the focal company has room for improvement in addressing supply chain disruptions. The current reactive approach can lead to delays, higher costs and reputational damage. The organization could benefit from developing more proactive and strategic approaches to risk management, such as identifying potential disruptions, trying to better understand root causes of past disruptions, and investing in technologies and processes that increase supply chain resilience. In a world where supply chain disruptions are becoming increasingly frequent and complex, it is imperative that organizations rethink their reactive approach and work towards a more forward-looking and strategic approach to ensure operational continuity and competitiveness and detect disruptions earlier. This highlights the importance of integrating proactive measures into the analyzed documents and the broader supply chain management process.

Follow-up research can focus on an in-depth understanding of the elements of personal relationships and under which circumstances they are effective (or not) for resolving disruptions. Another promising avenue of future research is investigating the relationships between interpersonal and inter-organizational factors (cf. Qian et al. 2021), focused on the handling of supply chain disruptions.

A limitation of this research is that it has focused on describing the role of personal relationships during different supply chain disruptions within a single focus organization. The findings shed light on the approach and effectiveness of the response to the disruptions in this specific context. Further research could attempt to generalize the findings to a broader industry or group of different organizations, which will support external validity. It is likely that different outcomes with regard to identifying and addressing disruptions will emerge here. It can be interesting to compare the approaches of different organizations to share best practices. In the cases examined in this study, only the impact of the relationship on resolving the disruption was examined. The importance of personal relationships within the supply chain cannot be underestimated and deserves more attention in future research and practice-oriented applications. Another limitation of our study is the focus on supply chain disruptions that were successfully resolved. The study also focused on the positive impact of personal relationships. Future research could investigate the disadvantages of personal relations in a supply chain disruption context (cf. Rood et al. 2018) and/or the impact of conflicts on a personal level between representatives of buying and supplying companies (cf. Butt 2019).

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