Risk and Disruption Management in Buyer-Supplier Relationships

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Davide Vito Burkhart

Mannheim

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List of abbreviations

ANOVA	Analysis of variance
B2B	Business-to-business
B2C	Business-to-consumer
bn	Billion
CHF	Swiss Francs
CI	Confidence interval
COVID-19	Coronavirus disease 2019
DD	Disruption duration
df	Degrees of freedom
DF	Disruption frequency
DI	Disruption intensity
DPAS	Defense Priorities and Allocations System
EU	European Union
EUR	Euro
GBP	British pound (Sterling)
H	Hypothesis
Ind.	Industrial
M	Mean value
m	Million
MANOVA	Multivariate analysis of variance
MG	(Supplier) material group
MS	Mean squares
NL	National lockdown
OEM	Original equipment manufacturer
OLS	Ordinary least squares
P_0	Prior supplier performance
P_1	Posterior supplier performance
REML	Restricted maximum likelihood
RQ	Research question
SD	Standard deviation
SE	Standard error
SI	Strategic importance
SS	Sum of squares
UK	United Kingdom
USA	United States of America

1. Introduction

"I can accept failure. Everyone fails at something. But I can't accept not trying.
[…] Talent wins games, but teamwork and intelligence wins championships."
                                                        – Michael J. Jordan.

Managing business relationships is challenging. While research indicates, that a significant part of the variance in firm profitability is explained by the network of which the firm is a part (Kumar, Liu, & Zaheer, 2022), business partners do not always behave as expected (Wang, Kayande, & Jap, 2010). A firm may even be held responsible and experience boycotting by customers for not only its own, but also for its suppliers' (unsustainable) behaviors and other incidents upstream in the supply chain (Hartmann & Moeller, 2014).

Consequently, managing buyer-supplier relationships is a central part of addressing supply risks, that is to manage the probability of incidents associated with inbound supply from individual supplier failures or the supply market, and their outcome (Zsidisin, 2003). A key factor hereby is transparency, because a lack of information limits the ability of a firm to understand, monitor, and control critical processes (Kim & Davis, 2016). In a perfect world, firms would know every process and every actor in their supply chain. However, working with the first-tier supplier is often the only viable option, with the actual operations at the supplier factories and beyond remaining opaque (Choi et al., 2021; Sodhi & Tang, 2019; Villena & Gioia, 2018).

An effect way to handle supply risks for firms lies in pursuing collaborative supplier relationships. Those relationships face the lowest frequency of supply chain disruptions, through a higher level of transparency, better mutual perception of risks, collaborative actions taken, and ensuring the efficacy of business continuity plans (Revilla & Saenz, 2017). In that regard, supply chain disruptions are a particular manifestation of supply risks and refer to unintended and unexpected events, triggered in the network of suppliers or the sourcing environment, that disrupt the normal flow of goods and materials to a focal firm (Bode, Wagner, Petersen, & Ellram, 2011; Craighead, Blackhurst, Rungtusanatham, & Handfield, 2007).

While supply chain disruptions are associated with a negative impact on the operating and financial performance of firms (Hendricks & Singhal, 2003, 2005a, 2005b), disruptions also have the potential to change relationships. Since events rather than time

define the development stage of the buyer-supplier relationship (Vanpoucke, Vereecke, & Boyer, 2014), supply disruptions might lead to a premature termination of relationships. In particular, the disruption impact, an internal locus of causality (at the supplier), and dissatisfying or unfair resolution processes are related to an increased likelihood of pursuing alternatives of supply by the focal firm (Bode et al., 2011; Polyviou, Rungtusanatham, Reczek, & Knemeyer, 2018; Wang, Cheng, Craighead, & Li, 2022).

Putting the buyer-supplier relationship in the spotlight, this dissertation examines various risk and disruption management approaches, and their outcomes. Visualized in Figure 1.1 in multiple disruption profiles (Sheffi, 2005), the three overarching research questions (RQs) revolve around the normal course of business (prior to a disruption), a triggering event, as well as the consequences of the disruption (i.e., impact). This dissertation hereby provides novel insights in both, proactive and reactive risk management.
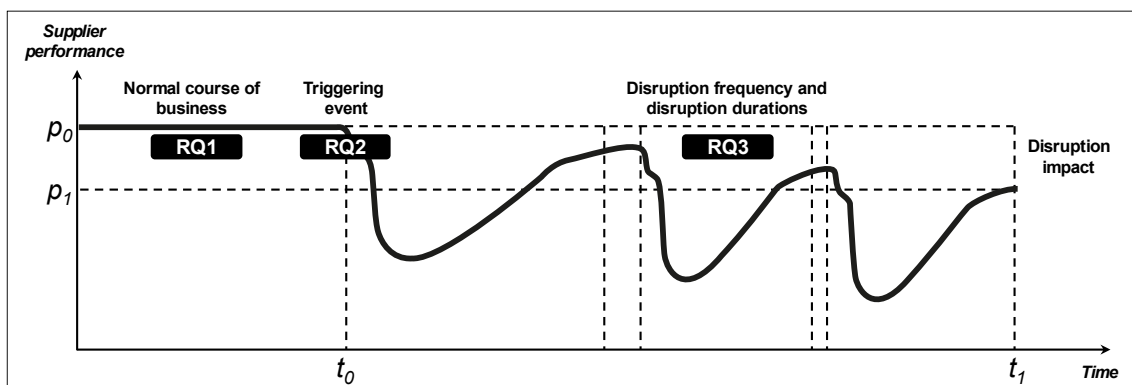
Figure 1.1 The research questions visualized in supplier performance disruption profiles (based on Sheffi & Rice, 2005)

In brief, the first research question aims to understand what approaches taken in practice are effective to induce the sharing of sensitive information, enabling transparency in the relationship, which eventually is crucial in disruptive situations. The second research question sheds light on force majeure events and declarations that can have many unintended consequences in the buyer-supplier relationship. Finally, the third research question scrutinizes the relationship of performance, disruptions, and their impact, with the individual supplier as the unit of analysis.

1.1. Research questions

1.1.1. Research question 1: Transparency in buyer-supplier relationships

Recent events, such as the outbreak of COVID-19 and its economic repercussions, had put especially globally connected companies in a difficult situation. As a first step in response to the pandemic, it was recommended that companies create transparency on multitier supply chains, including determining critical components, assessing interruption risk, and identifying likely tier-2 and onward risk (Alicke, Azcue, & Barriball, 2020). However, these recommendations for operations managers to strive for more detailed information about upstream and downstream operations in their supply chains, were not new (Sodhi & Tang, 2019).

Increased transparency in buyer-supplier relationships, which enables the selective exchange of sensitive information (Lamming, Caldwell, & Harrison, 2004), is also necessary to address increased consumer and societal awareness (Choi et al., 2021). Today's complex supply chains lack transparency, limiting managers' ability to monitor and control critical processes, including labor practices and sourcing of raw materials. As a result, only 1% of companies in a study of mineral supply chains could certify themselves as conflict-free, calling into question the "license to operate" of many companies (Kim & Davis, 2016).

One of the main reasons of missing transparency is that many buying firms keep their suppliers at arm's length, thus, typically work only with their first-tier suppliers and hold them completely responsible for the products and materials they supply. Consequently, firms often only have simple information about their suppliers, but the actual operations at the supplier factories and beyond remain opaque (Choi et al., 2021; Sodhi & Tang, 2019). On the other hand, suppliers are reluctant to share private and sensitive information with the buying company, including unpublished aspects of the firm's strategy, critical supplier or customer dependencies and inside management conflicts (Uzzi & Lancaster, 2003). In particular, the supplier fears information leakage (Hernandez, Sanders, & Tuschke, 2015; Ried, Eckerd, Kaufmann, & Carter, 2021) to competitors or opportunistic behavior by the buying firm in form of supplier switching or leveraging the information against the supplier (Klein & Rai, 2009).

Collaborating with suppliers is a crucial first step for companies to gather more information about the operations in the supply chain (Sodhi & Tang, 2019). Yet, a fundamentally different level of collaboration and transparency is required than has been

considered acceptable in the past, especially considering that supply chains are increasingly multi-tiered (Choi et al., 2021). Adopting a new theoretical lens with resource theory (E. B. Foa & Foa, 1980; U. G. Foa, 1971) from the interpersonal context, section two of this dissertation addresses the research question (Sodhi & Tang, 2019, p. 2956):

RQ1: *How do and how should companies collaborate with their suppliers to improve transparency?*

1.1.2. Research question 2: Force majeure in buyer-supplier relationships

In July 2022, Gazprom, Russia's state gas monopoly, has told customers in Europe in a letter that it cannot guarantee gas supplies because of "extraordinary" circumstances, and retroactively declared force majeure on supplies from June 2022. The letter was seen by the majority of EU countries as a retaliation for sanctions imposed on Russia over the war in Ukraine (Payne, 2022).

The term "force majeure" is French for *superior force* and is defined as an event that can be neither anticipated nor controlled, which results in preventing someone from performing or completing something that was agreed or officially planned to (*Black's Law Dictionary*, 2019). In the management literature however, force majeure issues have not received much attention and mostly appears at the intersection to contracting, as well as to characterize the locus of causality of (supplier) incidents and related disruptions. In this regard, studies indicate that the buying firm's dissatisfaction and the supplier's retention after a disruption depends on whether the supplier had control over the disruption (Polyviou et al., 2018; Primo, Dooley, & Rungtusanatham, 2007; Wang et al., 2022). In other words, if a supply disruption occurs which was due to a force majeure, the suppliers should communicate this fact with its customers to secure the retention after the disruption (Polyviou et al., 2018). Recent events however, including the COVID-19 pandemic, ongoing material shortages, and Russia's invasion in Ukraine, call into question the rationale of force majeure declarations. Therefore, the intentions and outcomes of force majeure claims, and the associated supply chain disruptions, may not be as straightforward as currently portrayed in the literature. Discussing its legal basis and investigating a unique dataset of force majeure letters, section three of this dissertation thus examines the following research question:

RQ2: *What are the intentions and outcomes of force majeure declarations in buyer-supplier relationships?*

1.1.3. Research question 3: Supplier performance and disruptions

Firms do not operate in isolation, they are typically embedded in interfirm networks where supply chain disruptions are inevitable (Craighead et al., 2007), and recent events suggest again that all supply chains carry some extent of risk. Supply chain disruptions are known to have a negative effect on firms' operational and financial performance (Hendricks & Singhal, 2005a; Papadakis, 2006), and repercussions for shareholder wealth (Hendricks & Singhal, 2003). While most would also argue that disruptions negatively impact supplier performance, the outcomes of disruptions at the level of the individual supplier remain largely unexplored. Reasons include that practitioners struggle to track direct disruption-related costs and instead focus on recovery efforts to ensure supply for their customers (Macdonald & Corsi, 2013).

In reaction to supply chain disruptions, the operations management literature focused on mitigation strategies, such as increasing stock levels and flexible sourcing strategies (e.g., Tang, 2006; Tomlin, 2006), as well as various preventive approaches. In practice, it is a great challenge for firms to predict supply chain disruptions and their course prior to their occurrence (Blackhurst, Scheibe, & Johnson, 2008). With preventive approaches firms aim to decrease the likelihood of disruptions; among those, effective ways are to simplify their supply chain complexity, which translates into reducing the size and spatial dispersion of the supply base (Bode & Wagner, 2015) or to pursue collaborative approaches with their suppliers (Revilla & Saenz, 2017). However, antecedents at the level of the individual supplier remain largely unexplored. While most would also argue that the occurrence of such disruptions is related to the performance of existing suppliers, little quantitative empirical evidence supports this assumption. Hence, investigating multiple facets of the relationship of supplier performance and disruptions, section four of this dissertation addresses the research question:

RQ3: *How are supplier performance, disruption frequency, and disruption duration interrelated?*

1.2. Outline of the dissertation

The three introduced research questions are addressed in the following main part of this dissertation. As displayed in Table 1.1, the first two sections adopted a mixed-method approach including a qualitative and an experimental part. The purpose of the qualitative studies was to elaborate the theoretical basis considering current developments and adapt the theory to the specific empirical context (Ketokivi & Choi, 2014). To complement the

qualitative studies, subsequent scenario-based experiments were utilized to observe the behavior of the respective target samples in controlled settings, limiting the influence of confounding external factors. To address the third research question, section four relied on several quantitative analyses of a unique panel data set of suppliers, their performance, and related disruptions. Further details on the foci, theories adopted, and methods applied in the three main sections of this dissertation are presented in Table 1.1. Finally, section five concludes the dissertation by providing a summary of the main findings along the three research questions, discussing limitations, and highlighting various avenues for future research.

Table 1.1 Overview of the research questions and outline of the dissertation

Section	2	3	4
Title	Transparency in buyer-supplier relationships: Analyzing resource exchanges for sensitive information	Force majeure or fake majeure? Exploring intentions and outcomes of force majeure declarations in buyer-supplier relationships	On supplier resilience: How supplier performance, disruption frequency, and disruption duration are interrelated
Research question	How do and how should companies collaborate with their suppliers to improve transparency?	What are the intentions and outcomes of force majeure declarations in buyer-supplier relationships?	How are supplier performance, disruption frequency, and disruption duration interrelated?
Theory / Literature	▪ Transparency ▪ Social exchange theory ▪ Resource theory	▪ Legal and managerial theories on force majeure ▪ Supply chain disruptions	▪ Supply chain disruptions ▪ Supplier resilience
Method	▪ Interviews ▪ Scenario-based experiment	▪ Case study ▪ Interviews ▪ Scenario-based experiment	▪ Regression analyses with panel data

2. Transparency in buyer-supplier relationships: Analyzing resource exchanges for sensitive information[1]

Co-author:

Christoph Bode
Endowed Chair of Procurement, Business School, University of Mannheim, Germany

Abstract

Enhancing transparency in buyer-supplier relationships is not only necessary to address increased consumer and societal awareness but also to tackle supply chain disruptions and shortages. We apply a mixed-method research design – including a qualitative study and an experiment – to investigate how firms do and should collaborate with their suppliers to increase transparency. Based on social exchange theory, the first study explores antecedents of "transparent" and "opaque" relationships, and tactics to induce the sharing of sensitive information. In line with resource theory, a sub-theory of social exchange theory, the second study suggests that the counterparts of buyers prefer to be reciprocated with information, money, or status resources when being asked for (sensitive) information. In this regard, our results reveal a slight bias in what works from buying firms' perspectives and what works at their counterparts (suppliers). That is, service resources (e.g., negotiation support and marketing support) might not enhance information sharing. Further, buying firms do not have to rely only on offering more business (money resource). Especially smaller firms, which seem to have fewer possibilities to offer (money resource) incentives or to rely on coercion, could use more status and information resources to induce sensitive information sharing. Finally, the popular "carrots and sticks" tactic (incentive with coercion) could have a negative effect on sensitive information sharing. This study contributes to research in buyer-supplier exchanges and transparency and provides valuable insights to practitioners on improving collaboration with their suppliers by firstly and empirically taking resource theory to the interorganizational context.

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[1]An earlier version (Burkhart & Bode, 2022) was finalist for the "ISM Best Paper in Supply Chain Management Award" of the Operations and Supply Chain Management Division of the Academy of Management at the 82nd Annual Meeting in Seattle, WA, in 2022.

2.1. Introduction

Over the last decades, supply chains have rarely featured in companies' earnings reports, besides occasional sidenotes regarding the benefits of low costs and lean inventories. In the current earnings season, however, supply chain issues are among the first problems mentioned by many firms, leading to massive losses for shareholders of firms experiencing supply chain "headwinds" ("Why supply-chain problems aren't going away," 2022). The seeds for the recent supply chain crisis were planted long before. Globalization and the imperative to reduce costs have led to complex and tightly coupled interorganizational networks that are vulnerable to disruptions (Bode et al., 2011). And the strategic management of interorganizational networks is crucial. A recent study suggests that more than 11 percent of the variance in firm profitability is explained by the network of which the firm is a part (Kumar et al., 2022). A key factor to manage those networks and the associated interorganizational relationships is transparency, because a lack of information limits the ability of a firm to understand, monitor, and control critical processes (Kim & Davis, 2016). Thus, enhancing transparency in interorganizational relationships is not only necessary to address increased consumer and societal awareness (e.g., labor standards) but is also decisive for the management of supply chains disruptions (Bode et al., 2011; Choi et al., 2021).

The attempt to strive for more detailed information about upstream and downstream operations in supply chains is not new (Sodhi & Tang, 2019). In buyer-supplier relationships missing transparency – enabling the selective exchange of sensitive information (Lamming et al., 2004) – originates in the fact that many buying firms typically work only with their first-tier suppliers and hold them responsible for the products and materials they supply. Consequently, firms often only have simple information about their suppliers, but the actual operations at the supplier factories and beyond remain opaque (Choi et al., 2021; Sodhi & Tang, 2019). Suppliers are reluctant to share private information with the buying firm, including unpublished aspects of the firm's strategy, critical sub-suppliers, and customer dependencies (Uzzi & Lancaster, 2003). Unlike public information, such as firm reports and regulatory filings, this private information is sensitive for the supplier, and sharing them with the buying firm is not without risks. The supplier could experience information leakage to competitors (Ried et al., 2021) and opportunistic behavior by the buying firm in the form of supplier switching or leveraging the information against the supplier (Klein & Rai, 2009).

Collaborating with suppliers is a crucial first step for buying firms to gather more information about the conditions upstream in their supply chains (Choi et al., 2021; Sodhi & Tang, 2019), but can take many forms in practice such as allocating various financial and non-financial resources across the relationship. Therefore, this paper addresses the research question "*How do and how should companies collaborate with their suppliers to improve transparency?*" (Sodhi & Tang, 2019, p. 2956). This question is then broken down into three sub-questions: (i) What are the antecedents of transparent buyer-supplier relationships?; (ii) Which information are regarded sensitive in buyer-supplier relationships?; and (iii) Which tactics work best to enhance sensitive information sharing in buyer-supplier relationships?

We apply a sequential, mixed-method research design, including a qualitative study and a scenario-based experiment. Building on social exchange and resource theory (E. B. Foa & Foa, 1980; U. G. Foa, 1971), the qualitative study elaborates on various hypotheses along with three thematic blocks – "antecedents," "sensitive information," and "tactics" – that refer to the three research questions highlighted above. Following, in study 2, we investigate the theorized buyer-supplier exchanges in a controlled setting by testing the key factors, including various incentives (i.e., resource classes), coercion, and dependence, with a scenario-based experiment. Our contributions include classifying sensitive information and the level of perceived vulnerability of their disclosure. We also gather empirically antecedents of transparent suppliers in more depth than initial conceptual studies (i.e., Lamming et al., 2004; Lamming, Caldwell, Harrison, & Phillips, 2001). Finally, while resource theory (E. B. Foa & Foa, 1980; U. G. Foa, 1971) is known in the social psychology discipline and has been partly applied to investigate interpersonal exchanges in organizational settings (e.g., Cropanzano & Mitchell, 2005; Flynn, 2003), our paper provides novel insights by firstly and empirically taking resource theory to the interorganizational context. In this regard, our results extend resource theory by analyzing interactions of resource exchanges with the use of coercion, as well as dependence as an important contextual factor. The sequential design and the mixed-method approach lend validity and robustness to our results (Boyer & Swink, 2008).

2.2. Conceptual background

2.2.1. Transparency in buyer-supplier relationships

The term "transparency" to describe a characteristic of an buyer-supplier relationship is an analogy from geology where transparent minerals transmit light, and the observer can see through them (Lamming et al., 2001). Recent events highlighted the necessity for many firms to increase transparency in their supply chains, and thus in their buyer-supplier relationships to understand sources of disruptions and strife for more resiliency. Due to rising societal awareness and changing preferences, firms are also pressured by consumers to increase transparency in their vertical relationships (i.e., suppliers) (Choi et al., 2021). While the origins of transparency in buyer-supplier relationships lie in what is now called "cost transparency" (Lamming et al., 2001), the term often serves as an umbrella for different characteristics of the relationship, such as "supply chain transparency," "supply chain visibility," "organizational transparency," and "technological transparency" (Hultman & Axelsson, 2007; Schnackenberg & Tomlinson, 2016). For the scope of our study, we treat transparency as a dynamic and manageable element of a specific relationship (i.e., dyad) (Lamming et al., 2001), which enables the bilateral exchange of selected sensitive information and tacit knowledge within the relationship (Lamming et al., 2004).

In practice, it is not trivial for buying firms to decide whether and how they should increase transparency in their supplier relationships, leading to different levels of transparency, from "opaque" or "translucent" to "transparent" relationships (Lamming et al., 2001). Although the literature does not suggest that transparency could or should be implemented in all relationships, the lack (presence) of it may be a significant factor in the failure (success) of the relationship (Lamming et al., 2004). Further benefits of transparency include reducing uncertainty in the relationship, providing stability while facing disruptions (Ellram & Krause, 2014), and increasing profitability for one or both parties (Lamming et al., 2004). One of the main reasons for missing transparency is that many buying firms keep their suppliers at arm's length. As a result, the buying firms typically work only with their first-tier suppliers and hold them responsible for the products and materials they supply (Sodhi & Tang, 2019). Consequently, firms often only have simple information about their suppliers, but the actual operations at the suppliers' factories and beyond remain opaque (Sodhi & Tang, 2019; Villena & Gioia, 2018). Working only with the first-tier suppliers is a viable strategic option, especially

considering that transparency over the supply chain goes through the supplier (Williams, Roh, Tokar, & Swink, 2013). Yet, this calls for a different level of collaboration that has been previously considered acceptable or necessary (Choi et al., 2021).

2.2.2. Sensitive information sharing

One of the key problems associated with transparency (i.e., the selective exchange of information or knowledge between buyer and supplier) is the sensitivity of the exchanges (Lamming et al., 2001). In line with recent research, we define "information as sensitive if it is perceived as risky for the discloser to reveal, in the sense that it makes the discloser vulnerable to experiencing negative consequences" (Mohan, Buell, & John, 2020, p. 1106). In this regard, negative consequences for the supplier include, for example, information leakage to competitors and opportunistic behavior by the buying firm in the form of supplier switching or leveraging information against the supplier (Klein & Rai, 2009; Ried et al., 2021).

While falling in the category of knowledge, for the scope of our study, we will focus on information as an *explicit* knowledge, which can be written down and be transmitted without loss of integrity, in contrast to know-how, which describes the *tacit* knowledge on how to do something (Grant, 1996; Kogut & Zander, 1992). In that regard, the operations management literature has given much attention to information sharing and the performance implications for buying firms and suppliers (Williams et al., 2013). There is, however, a lack of empirical studies investigating sensitive information sharing. Consequently, sensitive information sharing is often only implied in trust or as part of general information sharing (e.g., Cannon & Perreault, 1999; Heide & Miner, 1992). As sensitive information is typically kept secret, its disclosure is a continuously evolving practice and sometimes counterintuitive for practitioners (Ghoshal, Hao, Menon, & Sarkar, 2020). In practice, this could imply involving the other party in the early stages of product development, sharing cost information, discussing plans for future product development, or jointly forecasting supply and demand (Cannon & Perreault, 1999).

The intentional disclosure of sensitive information can further signal to the buyer that the supplier's motives and intentions are benevolent. This "signal of good faith" can invoke (calculative) trust-building processes (Doney & Cannon, 1997). In general, when firms know that they will benefit from this decision, they are more likely to share sensitive information (Romano & Formentini, 2012). On a conceptual basis, antecedents of sensitive information sharing are seen in long-term relationships with a certain level of

(bounded) collaboration, where incentives to abuse the information are absent (Lamming, Caldwell, Phillips, & Harrison, 2005). The exchange of sensitive information does not have to be symmetrical in the buyer-supplier relationship if the potential benefits of revealing its sensitive information are in balance with the information value for the receiver (Appleyard, 1996; Lamming et al., 2004).

2.2.3. Social exchange and resource theory

Social exchange theory is one of the major theoretical perspectives in social psychology (Cook & Rice, 2003). While initial interactions in a forming relationship are viewed as explorations, the interactions only continue if the experienced consequences meet the standards of acceptability (i.e., the relation of rewards and costs) that both individuals develop through their experience with other relationships (Thibaut & Kelley, 1959). Key concepts of the social exchange theory thus include costs, rewards, power, dependence (Emerson, 1976), rules, norms of exchange, and resources exchanged (Cropanzano & Mitchell, 2005). Although the foundations lie in the interpersonal context, the social exchange theory has been widely adopted by scholars researching organizational behavior (Cropanzano & Mitchell, 2005) and studying buyer-supplier relationships (e.g., Griffith, Harvey, & Lusch, 2006; Narasimhan, Nair, Griffith, Arlbjørn, & Bendoly, 2009). In line with the interpersonal context, some argue that the buying and the supplying firms will maintain the business relationship if it is beneficial. But if an alternative supplier can provide greater benefits, the buyer will switch suppliers.

One of the main dimensions of interorganizational exchange is the kinds and quantities of exchanged resources (Levine & White, 1961). Resource theory, as a sub-theory of social exchange theory, especially targets resources transacted through interpersonal encounters by classifying six types of resources: love, status, information, money, goods, and services (E. B. Foa & Foa, 1980). *Love* is defined as an expression of affection. *Status* is an expression of evaluative judgment denoting high or low prestige. *Information* includes advice or instruction but excludes those behaviors that could be classified as status or love. *Money* is any coin or standard exchange unit. *Goods* are tangible materials or products, and *services* involve activities that often constitute labor for the other party (E. B. Foa & Foa, 1980; U. G. Foa, 1971). The six resource types can be further classified by being more concrete or symbolic and more particularistic or universal. Services and goods involve the exchange of some tangible activity or object. Therefore, they are defined as concrete, while status and information are more symbolic

because they represent verbal or paralinguistic behaviors. As visualized in Figure 2.1, love and money are exchanged in both concrete and symbolic forms and therefore occupy intermediate positions. But love is exchanged in a highly particular way, and money in a universal way. Status and services are less particularistic than love but more particularistic than information and goods (U. G. Foa, 1971). Less particularistic and more concrete resources are more likely to be exchanged in the short run, and vice versa, highly particularistic and symbolic resources are exchanged more openly (Cropanzano & Mitchell, 2005). Further, resource classes proximal to each other on one or both dimensions appear more related and more likely to be substituted for another than distant resource types (Turner, Foa, & Foa, 1971). In other words, for example, goods are more likely be exchanged for other goods, services, or money, than for distant resource classes, such as information or love.
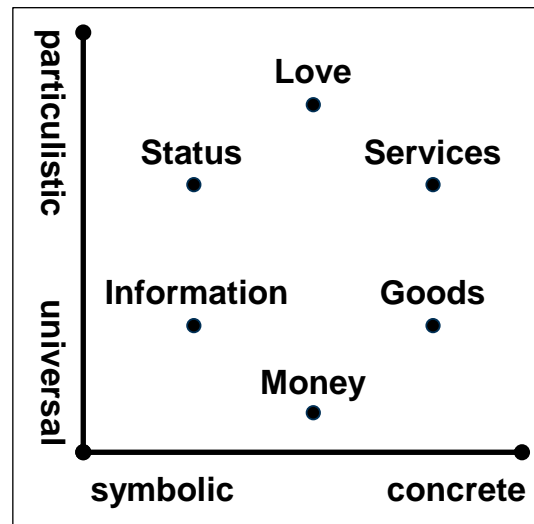
Figure 2.1 Plotted resource types (adopted from U. G. Foa, 1971)

Although, management researchers have long been adopting theories, which were originally developed in the interpersonal context, to investigate interorganizational relationships (Smith, Carroll, & Ashford, 1995), the application of the resource theory to investigate interorganizational exchanges is very limited. In a partial application of resource theory, status is a valuable exchange resource in buyer-supplier relationships because it brings actual advantages and symbolic value for other relationships (Hammerschmidt, Wetzel, & Arnold, 2018). Yet another study indicates that economic resources (money and service) have a stronger effect on interorganizational satisfaction than social resources (status) (Bolton, Smith, & Wagner, 2003).

We adopted resource theory for two main reasons. First, resource theory categorizes resources (or incentives) in a more concise and detailed manner than other common theories used to analyze buyer-supplier relationships, such as transaction cost economics or resource dependence theory. Second, resource theory provided good predictions for the probability of resource exchanges, which is described in the following two empirical studies.

2.3. Qualitative study

The main goal of the initial qualitative study is to elaborate theory and derive hypotheses. Unlike (inductive) theory generation, theory elaboration focuses on refining a general theory to approach an empirical context (Ketokivi & Choi, 2014).

2.3.1. Data collection and analysis

We utilized semi-structured interviews to gather context-rich empirical data (Eisenhardt & Graebner, 2007; Yin, 2009) and targeted manufacturing firms in European German-speaking countries (DACH-Area). To achieve a certain generalizability of the findings for the subsequent studies, our sampling strategy focused on obtaining a heterogenous set of firms from various industries and sizes. Another criterion was that the firm's supplier relationships should be actively managed. Therefore, we contacted interviewees with direct supplier contacts and sourcing responsibility (a managed spent). The interviews were conducted from August to November 2020 and ranged from 30 to 50 minutes. The interviewee and the firm were granted anonymity. Table 2.1 provides additional information on the ten sampled firms and interviewees.

Table 2.1 Participants of the qualitative study on transparency

Firm	Industry	Revenue	Employees	Informant		
				Position	Spent	Experience
MachineCo	Machinery & ind. Products	> 50 m EUR	< 500	Head of Procurement	18 m EUR	14 years
OpticsCo	Ind. Optics & sensors	< 200 m EUR	< 2,000	Head of Procurement	50 m EUR	22 years
PlantCo	Plant engineering	> 200 m EUR	< 2,000	Operational Project Procurement	74 m EUR	6 years
AerospaceCo	Aerospace / defense	< 5 bn EUR	< 10,000	Equipment Purchasing Manager	25 m EUR	15 years
DriveCo	Drive automation	< 5 bn EUR	> 10,000	Senior Global Category Manager	185 m EUR	31 years
AgriculturalCo	Agricultural machinery	< 5 bn EUR	> 10,000	Lead Buyer	300 m EUR	24 years
PowertoolCo	Power tools / construction	> 5 bn CHF	< 50,000	Global Supply Manager	275 m CHF	2.5 years
MedTechCo	Medical technology	> 10 bn CHF	< 50,000	Senior Global Category Manager	250 m CHF	13 years
AutomotiveCo	Automotive (supplier)	> 30 bn EUR	> 100,000	Senior Manager Program Purchaser	200 m EUR	17 years
CarCo	Automotive (OEM)	> 150 bn EUR	> 200,000	Buyer	150 m EUR	2 years

Note: Firms sorted by revenue. Revenue, employees, and procurement spent refer to the last full fiscal year.

The interview instrument was carefully designed before data collection and consisted of general questions about the firm and the interviewee as well as specific questions about sensitive information sharing. To elaborate the polar ends of transparency in the buyer-supplier relationships, we asked each interviewee to think of their supply base and characterize suppliers they consider willing or reluctant to share sensitive information on the buyer's request. The last set of questions focused on the tactics used by the interviewed buyers to induce the sharing of sensitive information. For this, we asked specifically whether coercion or incentives are used when suppliers are reluctant to share sensitive information. The full interview guideline can be found in the appendix. Extensive notes were taken during the interviews because the interviewees preferred not to be recorded as they provided useful real-life examples on this sensitive topic (Yin, 2009). The notes were carefully anonymized, summarized, and returned afterward to the interviewees to confirm their accuracy and completeness.

2.3.2. Results and hypothesis development

After data collection, we synthesized the data and structured the results along with the three themes "antecedents," "sensitive information," and "tactics," each addressing one

of the introduced research questions. The resulting hypotheses focus on the theorized buyer-supplier exchanges and are thus developed in the last section "tactics."

Antecedents

Overall, the results in Table 2.2 support the conceptual studies (e.g., Lamming et al., 2005) and highlight that long-term relationships with some degree of collaboration are more transparent. In turn, most interviewees report that opaque relationships – where suppliers are reluctant to share (sensitive) information and other ways of working together must be found (Lamming et al., 2001) – typically occur with suppliers of standard components or large suppliers where the counterpart changes often and the interactions have an economic focus.

Most of our interviewees highlight that their long-term suppliers are more transparent. In this vein, transparent long-term suppliers include suppliers which have conducted business with the buying firm for over 20 years (AerospaceCo) or even since the firm's foundation (PlantCo). Usually, collaborative behaviors – such as transparency – develop over time and past interactions improve communication between buyers and suppliers in several ways (Hoetker, 2005). In contrast, the relationship with suppliers accessed for "spot-buys" are usually opaque, mostly because suppliers are exchangeable (PlantCo, PowertoolCo).

Besides relationship length, the interviewees also reported that suppliers with a long-term orientation and willingness to stay in the relationship with the buyer are more transparent. Therefore, relationships with suppliers with (new) product development partnerships (MachineCo and AutomotiveCo) or with framework agreement partnerships (AerospaceCo) are considered more transparent. One interviewee even reported that transparency is part of the supplier management criteria that eventually affects new awarding (AgriculturalCo). This commitment presumes that the relationship is stable and will last long enough for the parties to realize long-term benefits (E. Anderson & Weitz, 1992). In this regard, one buyer reports that owner-managed suppliers are especially willing to take the risk and share sensitive information when they sense the necessity for a long-term relationship (AerospaceCo).

Table 2.2 Characteristics of transparent and opaque supplier relationships

Firm	Transparent relationships	Opaque relationships
MachineCo	▪ Suppliers with (new) development cooperation ▪ Buying firm makes a big part of the revenue / is under the top 10 customers ▪ Partnerships with mutual dependence	▪ Big suppliers
OpticsCo	▪ Partnership approach with most suppliers, as technological leadership is top priority	▪ Standard components suppliers
PlantCo	▪ Long relationship history in general long and more partnership like ▪ Component suppliers (complex products)	▪ Suppliers of norm parts, such as screws and nuts ▪ Suppliers where interaction is limited ▪ "Spot-buys" under framework agreements ▪ Sometimes also partnership suppliers ("established opacity over the course of the relationship")
AerospaceCo	▪ "Core suppliers" with longer relationships (more than 20 years) ▪ Special tool suppliers with framework agreement partnership ▪ Owner-managed suppliers ▪ Most suppliers in the business with suppliers of "flying parts" due to safety regulations	▪ Bigger suppliers, where communication occurs at lower hierarchical levels ▪ Contact persons change often
DriveCo	▪ Strategic partners ("A" suppliers) ▪ Suppliers who want more business, as transparency is part of the supplier management criteria which affects new awarding	▪ "B" & "C" suppliers, sometimes also with long lasting business relationships ▪ Suppliers with established opacity (for more than 20 years, but business works without problems)
AgriculturalCo	▪ Strategic partners and R&D cooperation ▪ Business philosophy matches with buying firm ▪ Partnership-like relationships ▪ Dependent suppliers	▪ Smaller family-owned firms ▪ Big firms, especially European subsidiaries of American firms, because of "rules and regulations" ▪ Standard products suppliers with almost no technological innovation
PowertoolCo	▪ Strategic partners (determined by innovativeness) ▪ Long-term suppliers ▪ Big part of business with buyer (dependent)	▪ "Spot-buys", because suppliers are exchangeable, and focus lies on price ▪ DACH-area supplier (cultural aspect)
MedTechCo	▪ Longer relationship history and more partnership-like ▪ Suppliers, where supply market is more competitive ▪ When supplier experiences own supply chain problems	▪ Monopoly or close to monopoly supplier ▪ No form of dependence on buyer ▪ Focused on pure economic exchange
AutomotiveCo	▪ Strategic partners with a long-term partnership ▪ Suppliers of complex components (e.g., control units) ▪ Suppliers with development partnerships (e.g., with simultaneous engineering) ▪ Market structure and competition can speed up the transparency in the relationship (instead of long-term partnership)	▪ Suppliers of standard components such as screws and nuts, which are easily exchangeable ▪ Less transparent suppliers do less business with buying firm
CarCo	▪ Suppliers with clear core competences (in general smaller suppliers) have more transparent relationships ▪ Often dependent on buyer	▪ Big suppliers, which often are less partnership-oriented

An important factor that most interviewees underscored is the power/dependence structure between buyers and suppliers. In the buyer-supplier context, dependence usually manifests in the amount of business with the counterpart. For example, a supplier is considered more dependent on a buying firm when that firm provides a larger fraction of its business (i.e., in the form of revenue) (Heide & John, 1988). Therefore, it is reported that suppliers are more transparent when they are dependent (CarCo), the buyer is a top ten customer (MachineCo), or the buyer makes up much of the business (PowertoolCo). When referring to transparent suppliers, one interviewee stated, *" […] revenue with the buying firm plays definitely a role"* (AgriculturalCo).

Sensitive information

As delineated above, information is defined as sensitive if the discloser makes itself vulnerable to negative consequences. The disclosure of sensitive information is an evolving practice (Ghoshal et al., 2020), and due to the limited literature on this topic, we wanted to understand which information is currently perceived as sensitive by the buying firms. The results are presented in Table 2.3, where the identified sensitive information is structured into four blocks: "commercial," "technological," "operational," and "network" information.

Commercial information includes typical sensitive information, such as cost structures, margins, and management strategies after mergers and acquisitions (DriveCo). Technological information includes technical features of products and components, know-how, and product and process innovations. Operational information, such as volumes and capacities, was mentioned by less than half of the respondents. In fact, one buyer states that they have no insight into a few of their supplier's production, namely special materials suppliers (AgriculturalCo). Finally, sensitive network information mostly includes the identity, location, volumes of the sub-suppliers, and the cooperation with other firms, especially competitors. The heterogeneous amount and type of information in Table 2.3 suggests that sensitive information can manifest in various forms, potentially means something different for every firm, and affects every buyer-supplier relationship.

Table 2.3 Sensitive information in buyer-supplier relationships

Firm	Commercial information	Technological information	Operational information	Network information
MachineCo	▪ Cost structures and calculations	–	–	▪ Identity of sub-supplier
OpticsCo	▪ Cost structures ▪ Optimization potentials	▪ Technical features of components ▪ Innovative processes and techniques	▪ Volumes and capacities	▪ Cooperation with other firms ▪ Sub-supplier (just core components)
PlantCo	▪ Cost structures and profits	▪ Technical processes and capabilities	–	▪ Sub-suppliers' identities, locations, and volumes
AerospaceCo	▪ Revenues, cost structures, margins, and profits	▪ Technical processes and capabilities (e.g., drawings)	–	▪ Sub-supply base structure, identities, locations, and volumes
DriveCo	▪ Margins and cost structures ▪ Business and management strategy	▪ Technology roadmaps (i.e., future products)	–	–
AgriculturalCo	▪ Cost calculations and product breakdowns	▪ Technical information on constructions, drawings, technical concepts, and designs	▪ Production processes (special materials suppliers)	▪ Identity and location of sub-suppliers
PowertoolCo	▪ Cost structures ▪ Optimization potentials	▪ Product and component innovations ▪ Innovative processes and used techniques	–	▪ Cooperation with other firms / competitors ▪ Sub-suppliers for direct materials
MedTechCo	▪ Cost structures and margins ▪ Investments in product lines	–	–	▪ Identity of sub-supplier and their volumes
AutomotiveCo	▪ Cost structures, value-added share, profits, and margins	▪ Technological capabilities	▪ Capacities and used machinery (type)	▪ Sub-supplier and sub-supply-base (identity, volumes, and sub-components
CarCo	▪ Cost structures ▪ Value-added share	▪ Used code and potential use of open-source codes (software)	▪ Working conditions (including sub-suppliers)	▪ Identity of sub-supplier/sub-contractors and locations of the facilities

Tactics

As for the prior results, the respondents stated that their motivation to attain higher levels of transparency is largest for supplier relationships that are between the polar ends (opaque and transparent). Especially with easily exchangeable and standard component suppliers, buyers see little need to increase transparency. But in new and important

relationships, in particular coercion and incentives are used to induce sensitive information sharing, as illustrated in our conceptual framework in Figure 2.2. In theory, rewards (incentives) and punishments can have similar effects on the recipient's decision but different patterns of cost and contexts in which they are most efficient (Oliver, 1980).
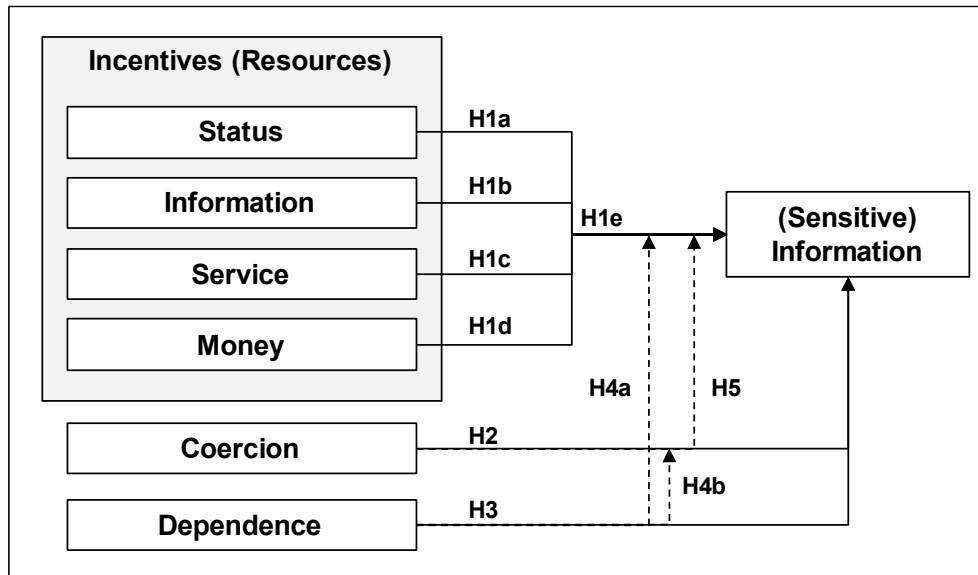
Figure 2.2 Conceptual framework of sensitive information sharing

In this regard, incentives can be defined as external stimuli that motivate future behavior and are important to effective supplier relationships and their development (Modi & Mabert, 2007; Terpend & Krause, 2015). Table 2.4 presents the use of incentives and their perceived effectiveness by the interviewees, structured in the resource categories of the resource theory (U. G. Foa, 1971).

Besides *love* and *goods*, we found incentives to induce sensitive information sharing out of every resource category. The three smaller firms – MachineCo, OpticsCo, and PlantCo (revenue < 300 M EUR) – use almost no incentives, implying that smaller firms have fewer opportunities or miss the ability to use them. As presented in Table 2.4, status incentives include top-management meetings with the supplier for better terms and conditions, such as less frequent cost engineering meetings (MedTechCo). Information incentives include benchmark opportunities in the form of disclosing other suppliers and sensitive information sharing, such as forecasts, data, or technology roadmaps. Service incentives include lean and six sigma trainings (AutomotiveCo), joint optimization projects (AgriculturalCo), and marketing support. For example, in the form of being listed as a reference customer in catalogs, websites, and fairs (PowertoolCo). Further service incentives are supported in negotiating with sub-suppliers for better volumes and prices

for the supplier or for problems with the supplier's supply base (CarCo). The last resource category is money incentives, which – in our interviews – related to additional business such as increased business volume or guaranteed margins. As indicated in Table 2.4, almost all firms use this kind of incentive, and most buyers assume that money incentives are the most effective way to induce sensitive information sharing. Unsurprisingly, various studies investigated the effect of money incentives in buyer-supplier relationships, for example, on the supplier's performance (Terpend & Krause, 2015), to reduce supplier's social and environmental violations (Porteous, Rammohan, & Lee, 2015) or implement open-book accounting (Romano & Formentini, 2012). Taken together, these observations led to the following hypotheses:

Hypothesis 1a. *Supplier sensitive information sharing is <u>positively</u> related to the use of a status incentive.*

Hypothesis 1b. *Supplier sensitive information sharing is <u>positively</u> related to the use of an information incentive.*

Hypothesis 1c. *Supplier sensitive information sharing is <u>positively</u> related to the use of a service incentive.*

Hypothesis 1d. *Supplier sensitive information sharing is <u>positively</u> related to the use of a money incentive.*

In line with our results, and as mentioned before, it is not assumed that the exchange of sensitive information needs to be symmetrical if the reciprocated incentive provides value for the supplier (Appleyard, 1996; Lamming et al., 2004). Further, our results in Table 2.4 reveal that the incentives show varying levels of effectiveness. In this regard, resource theory suggests that the satisfaction in an exchange with similar resource categories will be higher and more likely, and less preferred exchanges will result in lower satisfaction (Teichman & Foa, 1975; Turner et al., 1971). In particular, an information incentive might be more effective to induce (sensitive) information sharing. But there can also be a preference for a resource contingent on factors such as requested resources or institutional factors (Turner et al., 1971). As suppliers (and firms in general) are eager to increase their revenues and profits, this preference could be the money incentive. Taken together, these observations led to the following hypothesis:

Hypothesis 1e. *Use of information incentive and use of money have a stronger effect on sensitive information sharing than use of status incentive and use of service incentive.*

Table 2.4 Incentives and coercion used by the case firms, clustered applying resource theory

Firm	Status		Information		Services			Money		Coercion
	Better terms & conditions	Top-management meeting	Benchmark opportunity	Own sensitive information	Marketing support	Technical support & training	Negotiation support	Guaranteed margins	Greater business	Penalties & reduction of business
MachineCo									+	+
OpticsCo										
PlantCo			+							−
AerospaceCo		+	−	+					++	+
DriveCo		+		+					++	+
AgriculturalCo		+			+	+	+		++	+
PowertoolCo		+		++	+				+	
MedTechCo	+++		++			+	+			+
AutomotiveCo			−			++	+	++	++	++
CarCo				+			+		+++	++

Note: When ranking of the incentive's strength was possible by the informant, it is indicated by multiple signs (e.g., ++ > +). A minus significates a "no recommendation" by the informant.

Table 2.4 also highlights that most buyers use coercion to induce sensitive information sharing. In general, coercive power stems from the agent's expectation that the principal will punish him if he fails to conform to the influence attempt (French & Raven, 1959). For example, a buying firm could hint that it would take certain actions to reduce the supplier's profits if it did not comply with the buyer's requests (Brown, Lusch, & Nicholson, 1995). In this regard, the interviewees mentioned the use of penalties (e.g., unplanned cost calculation workshops), reduction of business, and termination of a contract when there is *"a gap to justifiable expectations of transparency"* (MedTechCo). They also mention that it has to be done to maintain credibility when the reduction of business or termination of a contract is hinted at ("not stopping halfway," AerospaceCo). Yet coercion must be used cautiously because it can have negative consequences for the relationship, (MachineCo) lead to frustration (DriveCo), or cause a loss of trust (AerospaceCo). Although some studies conclude that using coercive power is not beneficial (e.g., J. Chen, Zhao, Lewis, & Squire, 2016), interpersonal experimental results suggest that punishment power, if used consistently and contingently, can be an effective way to influence relationships (Molm, 1994). Taken together, these observations led to the following hypothesis:

Hypothesis 2. *Supplier sensitive information sharing is <u>positively</u> related to the use of coercion.*

As previously mentioned, when referring to transparent suppliers, one interviewee stated, "…revenue with the buying firm plays definitely a role" (AgriculturalCo). In line with social exchange theory, if the supplier depends on the buyer and only has the limited ability to achieve its goals outside the relationship, it will stay in the relationship at the expense of short-term benefits for future benefits (Emerson, 1962; Lambe, Wittmann, & Spekman, 2001). In other words, the supplier will be interested in maintaining a good relationship if the payoffs are high and there is a vested interest in sharing sensitive information (Dwyer, Schurr, & Oh, 1987; Lusch & Brown, 1996). Taken together, these observations led to the following hypothesis:

Hypothesis 3. *Supplier sensitive information sharing is <u>positively</u> related to supplier dependence (on the buyer).*

As mentioned above, incentives and coercion can have different strengths in different contexts (Oliver, 1980). Besides the direct effect of dependence in supply relationships, the interviewees implied that the supplier's dependence could influence the effectiveness of incentives and coercion. Thus, one buyer mentions that the use of

incentives is difficult with low supplier volumes (PlantCo). Other buyers noted that coercion works best when the buying firm accounts for large revenues at the supplier (e.g., AerospaceCo). Further, one interviewee stated that coercion is *"easier to use on dependent suppliers"* (AutomotiveCo). This is also in line with other studies emphasizing that one must consider the effect of coercive power use within a dependence structure (J. Chen et al., 2016; Molm, 1997). Taken together, these observations suggest the following interaction effects:

Hypothesis 4a. *The positive effect of incentives on supplier sensitive information sharing is stronger when supplier dependence is high than when supplier dependence is low.*

Hypothesis 4b. *The positive effect of coercion on supplier sensitive information sharing is stronger when supplier dependence is high than when supplier dependence is low.*

As coercion is seen as *"part of the game"* (AutomotiveCo), we also wanted to investigate their use together with incentives. This so-called "carrots and sticks" tactic was somewhat investigated in a related study (i.e., Porteous et al., 2015) but unfortunately without including any interaction effects. Both reward (incentive) and punishment powers are seen in the literature (i.e., social exchange theory) as potential ways to increase the benefits from an exchange. The main reason is that most exchange relations involve both forms, incentives, coercion, or a mix of both (Molm, 1994). In this regard, buyers report that coercion works best when there are new projects and thus new business on the line (e.g., CarCo). Taken together, these observations suggest the following interaction effect:

Hypothesis 5. *The positive effect of incentives on supplier sensitive information sharing is stronger when the use of coercion is high than when use of coercion is low.*

2.4. Experiment

2.4.1. Vignette development

Based on the results of the qualitative study and related literature, we evaluate the usual approaches taken in practice by investigating the effect of the identified incentives (*status*, *information*, *service*, *money*, and *no* incentive) and the effect of coercion (*low/high*) on the willingness to share sensitive information. As an important contextual factor for the tactics, we also considered the supplier's dependence (*low/high*) on the buying firm resulting in a total population of 20 vignettes.

Each scenario started with a short description of the prior defined role that the participants should assume (Rungtusanatham, Wallin, & Eckerd, 2011). The participants adopted the perspective of a senior customer service manager for a mid-sized manufacturer of bearing rotor systems (bearing description in the common module based on Cao, Niu, Xi, and Chen (2018)). In line with the results of the qualitative study, we described the general customer relationship as recent (5 years) and neither bad nor good ("In the past, your relationship with this customer has not always been easy but at the bottom line, you always got along well with them") as these are typically the relationships where the buying firm targets more transparency. The introductory module was followed by the description of the dependence on the customer and its use of coercion, which we mostly adapted from J. Chen et al. (2016). Lastly, we selected the incentives, which were mentioned most frequently by the case firms in the respective resource category (Table 2.4). Thus, the incentives consisted of a potential top-management meeting (status), insight into the product and demand forecasts (information), negotiation support with the suppliers (service), and greater future business (money). After designing the vignettes, we pre-tested them with ten doctoral students and two practitioners to ensure that the descriptions were believable and that the vignettes reflected the desired levels of the factors of interest (Rungtusanatham et al., 2011). A full description of all modules, factor levels, sources, and number of observations can be found in the appendix.

2.4.2. Sample and data collection

Participants were invited from March to June 2021 to participate in the self-administered online experiment. Considering that our analysis is at an interfirm level and to ensure that our sample has adequate experience to fully understand the context, we reached out to typical counterparts of buyers (e.g., people working in B2B marketing, sales, and product management) to test our derived hypotheses.

Ninety participants were self-recruited and received no financial compensation (besides a summary of the study's results). One-hundred fifty participants were recruited via the provider Prolific and received financial compensation of 1.50 GBP. The participants were pre-screened by approval rate (> 95 percent) and current employment sector (Palan & Schitter, 2018). The two participant groups were merged into one sample because they had a similar distribution of job functions, industry, and response time (differences in response time: $p = 0.24$). Further, the results were consistent when running the latter regression with each subgroup separately. The final sample consisted of 236

participants; four incomplete responses were dropped (participants did not provide their demographics data). The participants had an average work experience of 7.07 years (*SD* = 7.25), and 45.3 percent were females. Considering that every participant completed two randomly drawn scenarios (out of all 20 scenarios), we received *472 observations*. Further information on the participants can be found in Table 2.5.

Table 2.5 Sample characteristics of the sensitive information experiment

Variable	*n*	*%*
Function		
Marketing Manager	34	14.41%
Sales Manager	33	13.98%
Sales Agent / Assistant	45	19.07%
Product Manager	21	8.90%
Account Manager	20	8.47%
Supply Chain Manager	20	8.47%
Customer Service Manager	14	5.93%
Business Developer	13	5.51%
Brand Manager	7	2.97%
Marketing Assistant	5	2.12%
Other	14	10.17%
∑ 234		100%
Industry		
Consumer Products / Retail	52	22.03%
Telecoms / Media / Entertainment	28	11.86%
Automotive	24	10.17%
High Tech / Software	22	9.32%
Manufacturing	19	8.05%
Chemicals / Oil / Gas	13	5.51%
Public Sector	12	5.08%
Health Care / Life Sciences	11	4.66%
Industrial Products	10	4.24%
Travel / Transport / Logistics	8	3.39%
Other	37	15.68%
∑ 234		100%
Job location		
Germany	73	30.93%
UK	36	15.25%
Poland	23	9.75%
South Africa	22	9.32%
Italy	18	7.63%
Portugal	18	7.63%
USA	11	4.66%
Greece	8	3.39%
Switzerland	4	1.69%
Spain	4	1.69%
Other	19	8.05%
∑ 234		100%

2.4.3. Dependent variable

The dependent variable is the supplier's sensitive information sharing. We adapted an established construct (Siemsen, Roth, & Balasubramanian, 2008) that has been proven in

experimental studies and supplier-customer dyads (e.g., J. Chen et al., 2016). After reading the scenario, participants were asked to indicate their opinion on four statements considering the buyer's request for the mentioned sensitive information (production processes, future products, and identity of suppliers). To this end, they had to evaluate the items: "I have no intention to share this information with this customer" (reverse coded), "I am motivated to share what I know with this customer," "I really want to share this information with this customer," and "I mean to share this information with this customer." All items were scored on a 7-point rating scale (anchored at 1 := "strongly disagree" to 7 := "strongly agree"). Average variance extracted (0.67), coefficient alpha (0.89), and composite reliability (0.89) were above recommended thresholds (Fornell & Larcker, 1981; Hair, Black, Babin, Anderson, & Tatham, 2006).

2.4.4. Experimental checks

The experimental checks indicate that our scenarios were realistic and that all manipulations worked as planned. All checks were assessed by letting the participants reveal their opinion on several statements with a 7-point Likert-type scale (anchored at 1 = "strongly disagree" and 7 = "strongly agree"). We assessed the realism of the presented scenario with the statements, "The presented scenario is realistic" and "You could imagine yourself in a similar situation" from Dabholkar (1994). The mean score (M) across the two checks was high ($M_{realism} = 5.14$) and in the range of comparable prior studies (J. Chen et al., 2016; Hora & Klassen, 2013). We checked supplier dependence and coercive power with single items from J. Chen et al. (2016), which asked participants whether the firm is dependent on the customer or the customer is likely to use his coercive power in attempting to get its way. Results indicate that the mean score of the high dependence scenarios was significantly higher than those in the low dependence scenarios ($M_{dependence, high} = 5.33$, $M_{dependence, low} = 2.90$, $p = 0.000$). Similarly, the mean score of the high coercion scenarios was significantly higher than those in the low coercion scenarios ($M_{coercion, high} = 5.23$, $M_{coercion, low} = 4.66$, $p = 0.000$), which also was in the range of a comparable prior study (J. Chen et al., 2016). Finally, we developed a single item to assess the incentive manipulation by stating, "The customer offered an incentive together with the request." Results indicate that the grand mean of all scenarios with an incentive was significantly higher than those in the scenarios without an incentive offered by the customer ($M_{incentives} = 4.99$, $M_{no incentives} = 3.82$, $p = 0.000$).

2.4.5. Sensitivity sub-study and measure

Building on a recent scale of sensitivity (Mohan et al., 2020), we investigated how sensitive the identified information in study 1 was perceived (Table 2.3) and whether the manipulation in the experiment worked. After completing the two scenarios, participants were asked how vulnerable a firm would be by disclosing various information listed in Table 2.6. The results indicate that all information is perceived sensitive (i.e., that a disclosing firm would make itself vulnerable), with cost information and technological information showing the highest sensitivity. Additionally, compared to a similar study in the business-to-consumer (B2C) setting (Mohan et al., 2020), all comparable information is perceived more sensitive in the present study, meaning that the studied information is more sensitive in a B2B setting than in a B2C setting.

To control for the effect of the individual's sensitivity perception on the dependent variable (willingness to share information), we built a sensitivity measure by averaging the participant's responses over the information requested in the scenario (operational, technological, network information).

Table 2.6 Sensitivity sub-study results

Information	How vulnerable, if at all, would a firm be making itself if it disclosed to consumers…	B2B (study 2)		B2C (Mohan et al., 2020)	
		M	*SD*	*M*	*SD*
Cost	*…the detailed costs of the products it sells?*	3.70	1.06	3.28	1.11
Price	*…the prices of the products it sells?*	2.83	1.29	2.11	1.35
Technological	*…its future products including their technical features?*	3.70	1.24	–	–
Operational	*…its detailed production processes?*	3.48	1.12	2.59	1.17
Network	*…the identity of its suppliers/contractors?*	3.38	1.16	–	–

Note: The variables were assessed on a five-point response scale anchored at 1 = "not at all vulnerable" to 5 = "extremely vulnerable".

2.4.6. Results

We aimed for at least 20 observations per cell to ensure sufficient statistical power (Simmons, Nelson, & Simonsohn, 2011), although it has been argued that smaller samples might also be sufficient (Lonati, Quiroga, Zehnder, & Antonakis, 2018). On average, the treatment cells presented in Table 2.7 fulfill this condition ($M_{observations} = 23.60$, $SD = 4.89$, *Minimum* = 16, *Maximum* = 35). Figure 2.3 illustrates the mean scores of sensitive information sharing across the treatment groups.

Considering the continuous correlated multilevel data – as the respondents responded to two scenarios – we used linear mixed-effects regression to test the

hypotheses. Mixed effects incorporate both random and fixed effects in a linear expression with which the conditional mean of the response can be assessed. This approach allows us to model the participant as a random effect to account for the within-subject variance. Further, we considered all experimental treatments, interactions, and the sensitivity measure as fixed effects. Based on the interviews (study 1), we controlled for experience and gender, in addition to the beforementioned sensitivity perceptions. To scrutinize the presence of common method variance (participants completing two scenarios), we compared the mean values of the dependent variable between the first and second vignette but found no differences ($p = 0.490$). In line with current methodological recommendations (Luke, 2017), we fitted the model using a restricted maximum likelihood (REML) estimator and derived p-values using the Satterthwaite approximation. The results are shown in Table 2.8.

Table 2.7 Sensitive information sharing cell means, standard deviation, and number of observations

Factor manipulation			*M*	*SD*	Observations
Dependence	**Coercion**	**Incentive**			
Low	Low	(-)	2.92	1.48	24
Low	Low	Status	3.44	1.28	23
Low	Low	Information	3.62	1.22	18
Low	Low	Service	2.79	1.43	17
Low	Low	Money	3.61	1.35	22
Low	High	(-)	2.91	1.25	23
Low	High	Status	3.20	1.42	28
Low	High	Information	2.71	1.52	25
Low	High	Service	2.69	1.30	22
Low	High	Money	2.88	1.48	26
High	Low	(-)	3.86	1.24	35
High	Low	Status	3.93	1.45	31
High	Low	Information	4.20	1.65	20
High	Low	Service	3.54	1.50	21
High	Low	Money	3.87	1.22	29
High	High	(-)	3.98	1.59	25
High	High	Status	3.88	1.46	16
High	High	Information	3.93	1.08	28
High	High	Service	4.28	1.37	19
High	High	Money	3.81	1.50	20

First, the results indicate that of all the resource treatments, the information incentive has the largest effect on sensitive information sharing. Second, while the incentives of status (H1a: $\beta_{Status} = 0.575$, $p = 0.045$), information (H1b: $\beta_{Information} = 0.783$, $p = 0.010$), and money (H1d: $\beta_{Money} = 0.631$, $p = 0.031$) increase the willingness to share sensitive information, the service incentive has no statistically significant effect (H1c: $\beta_{Service} = -0.047$, $p = 0.879$).
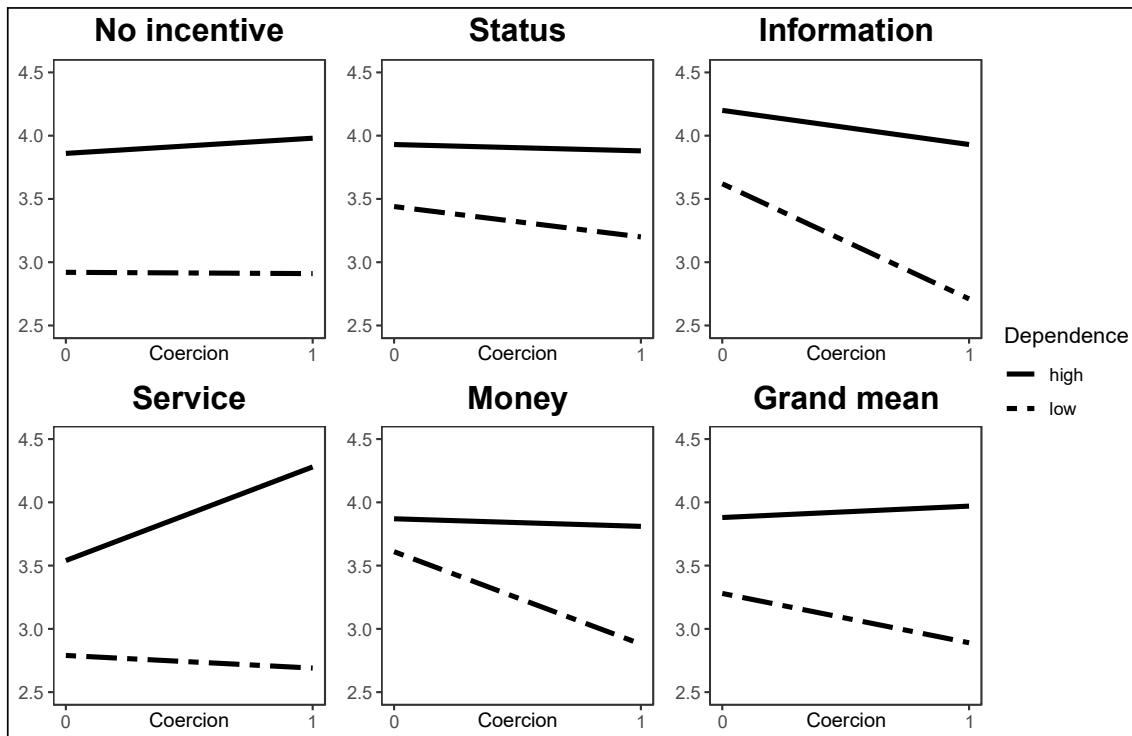
Figure 2.3 Sensitive information sharing mean scores per treatment group

A planned contrast analysis further revealed that for low levels of dependence and coercion, the incentives money and information have a stronger effect on the willingness to share information than status and service ($p = 0.046$), supporting the predictions of resource theory (H1e). Third, the results suggest no additional effect when using incentives with or without dependence, rejecting hypothesis 4a. Forth, the use of coercion alone has no statistically significant influence on the willingness to share information (H2: $\beta_{Coercion} = -0.334$, $p = 0.192$), yet this result changes in the presence of dependence (H4b: $\beta_{Dependence \times Coercion} = 0.482$, $p = 0.028$). As hypothesized, coercion requires some degree of dependence in order to become effective. Fifth, the direct effect of dependence not only reveals a significant effect (H3: $\beta_{Dependence} = 0.933$, $p = 0.000$) supporting hypothesis 3, but also shows the overall largest effect of all experimental treatment conditions. While dependence usually can not be changed quickly, it should be noted, however, that the degree of dependence is an important (contextual) factor considering sensitive information sharing. Sixth, the interaction of coercion with each of the four incentives ("carrots and sticks") has no significant effect at the five percent level, rejecting hypothesis 5. Yet, the use of the incentive "information" in conjunction with coercion shows a negative coefficient (H5: $\beta_{Information \times Coercion} = -0.658$, $p = 0.052$) that is only slightly over the threshold of $\alpha = 0.05$. This leads to the conclusion that the use of

coercion parallel to any form of dependence does not enhance sensitive information sharing and could even be detrimental when combined with an (information) incentive.

Table 2.8 Regression results of the sensitive information sharing experiment

Variables	β	SE	CI
Constant	4.304 ***	0.397	[3.540; 5.110]
Main effects			
Incentive (Resource)			
Status	0.576 *	0.287	[0.036; 1.133]
Information	0.783 **	0.301	[0.142; 1.362]
Service	− 0.047	0.307	[− 0.679; 0.527]
Money	0.631 *	0.291	[0.061; 1.209]
Coercion	− 0.334	0.255	[− 0.848; 0.178]
Dependence	0.933 ***	0.241	[0.475; 1.404]
Interactions			
Incentive × Coercion			
Status × Coercion	0.168	0.331	[− 0.518; 0.797]
Information × Coercion	− 0.658 †	0.337	[− 1.326; 0.032]
Service × Coercion	0.139	0.339	[− 0.502; 0.814]
Money × Coercion	− 0.046	0.328	[− 0.700; 0.611]
Incentive × Dependence			
Status × Dependence	− 0.281	0.327	[− 0.884; 0.353]
Information × Dependence	− 0.164	0.327	[− 0.762; 0.476]
Service × Dependence	0.151	0.339	[− 0.474; 0.808]
Money × Dependence	− 0.427	0.326	[− 1.080; 0.168]
Dependence × Coercion	0.482 *	0.219	[0.016; 0.913]
Controls			
Sensitivity	− 0.424 ***	0.088	[− 0.611; − 0.248]
Experience	0.024 *	0.011	[0.002; 0.046]
Gender	− 0.307 †	0.158	[− 0.628; 0.030]
Conditional R^2	0.597		
Marginal R^2	0.219		

Note: Restricted maximum likelihood (REML) estimator was used ($n = 472$). Dependent variable is "sensitive information sharing." *CI* refers to bootstrapped (1,000 reps) 95%-confidence intervals. "Low" dependence, "low" coercion, "no (-)" incentive and "female" served as the baseline categories. R^2 were calculated following Nakagawa and Schielzeth (2013). †$p < 0.10$, *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

Finally, we controlled for sensitivity, work experience (relevant work experience in years), and gender. The results not only suggest that our requested information are in fact sensitive, they further indicate that the more sensitive information is perceived, the less likely it is shared with the buying firm ($\beta_{Sensitivity} = -0.424$, $p = 0.000$). While the effect of gender was not statistically significant ($p = 0.053$), the effect of experience influenced the willingness to share information, indicating that less experienced counterparts of buyers may be more reluctant to share sensitive information.

2.5. Discussion

2.5.1. Theoretical implications

Using two empirical studies, we investigated the research question "*How do and how should companies collaborate with their suppliers to improve transparency?*" (Sodhi & Tang, 2019, p. 2956) and makes three main contributions to literature. We first investigate what information is considered sensitive in buyer-supplier relationships and our results reveal that the perceived sensitivity (i.e., vulnerability of disclosure) strongly influences its sharing. Second, we extend the literature on transparency in buyer-supplier relationships by elaborating conceptual studies and providing well-grounded findings on antecedents and tactics of sensitive information sharing. Third, we provide first support for resource theory in interorganizational relationships by clustering incentives in resource categories and our results indicate that the theory provides valid predictions for buyer-supplier exchanges for the respective resource categories. In this regard, we extend first applications of resource theory in the management research from intraorganizational (i.e., interpersonal) research (e.g., Flynn, 2003) to the interorganizational context. Further, we extend resource theory by analyzing interorganizational interactions of resource exchanges with the use of coercion, as well as dependence as an important contextual factor.

Building on the social exchange theory, both studies suggest that sensitive information in buyer-supplier relationships is shared on a long-term basis. As the disclosure of sensitive information is a continuously evolving practice (Ghoshal et al., 2020), we first investigated and structured information in study 1 that is currently regarded sensitive by the buyers in supplier relationships. As part of study 2, our results indicate that this information (including commercial, technological, operational, and network information) is also seen as sensitive by the counterparts (e.g., sales manager) at the supplier. In this regard, suppliers report that a firm makes itself the most vulnerable to negative consequences by revealing cost and technological information to the buyer. Compared to a recent marketing study (Mohan et al., 2020), our results reveal that all identified information is perceived more sensitive in the B2B context than in the B2C context. Further, study 2 also reveals that sensitivity perceptions play a role. The more information is seen as sensitive by the supplier, the less the motivation to share it with the buyer. We thus argue that the disclosure in the buyer-supplier relationship largely depends on the differences in the perceived sensitivity of the information.

Unlike current discussions on transparency (e.g., Sodhi & Tang, 2019), the qualitative study results suggests that buyers do not necessarily want transparency in every supplier relationship, such as standard component suppliers and easily exchangeable suppliers. Further, our results support conceptual studies (i.e., Lamming et al., 2005; Lamming et al., 2004) and reveal that in particular relationship length, commitment, and dependence are antecedents of transparent supplier relationships. While some studies argue that communication generally decreases as the relationship ages (e.g., E. Anderson & Weitz, 1989), most of our interviewees in fact highlight that their long-term suppliers are share more sensitive information. Usually, collaborative behaviors – such as transparency – develop over time and past interactions improve communication between buyers and suppliers in several ways (Hoetker, 2005). Beginning with a phase of initial explorative interactions (Thibaut & Kelley, 1959), continued relationships develop channels for relationship-specific communication and coordination routines (Singh & Mitchell, 1996). After passing those initial relationship stages, mature buyer-supplier relationships show higher adaptability and higher levels of reciprocity on both sides of the dyad (Hallen, Johanson, & Seyed-Mohamed, 1991). Thus, successful relationships evolve through a sequence of learning-reevaluation-readjustment cycles over time, including the willingness to make large, increasingly specific, and irreversible commitments (Doz, 1996; Vanpoucke et al., 2014). This commitment presumes that the relationship is stable and will last long enough for the parties to realize long-term benefits (E. Anderson & Weitz, 1992). In line with social exchange theory, suppliers will stay in the respective relationship if the relation of benefits and costs is like other relationships. Otherwise, it will switch to a customer (buyer), providing a better benefits-cost ratio (Lambe et al., 2001; Thibaut & Kelley, 1959). Given sufficient commitment and confidence in the relationship's stability, a supplier will be willing to make short-term sacrifices to maintain the relationship and capture future benefits (E. Anderson & Weitz, 1992; Lambe et al., 2001). In this regard, one interviewee reports that owner-managed suppliers are especially willing to take the risk and share sensitive information when they sense the necessity for a long-term relationship. The experimental study further reveals that the supplier's dependence (also mentioned as an antecedent by the buyers in study 1) is positively related to sensitive information sharing. While dependence usually can not be changed quickly, it should be noted, however, that the degree of dependence is an important contextual factor considering sensitive information sharing.

Both studies suggest that the exchange of sensitive information does not have to be symmetrical, as long potential benefits of revealing sensitive information is in balance with the value of the incentives for the receiver (Appleyard, 1996; Lamming et al., 2004). Our study further contributes to the literature of interorganizational exchanges by providing initial indications of the resource theory's validity in interorganizational relationships. Although incentives have been studied widely in the behavioral sciences at the individual or group level, incentives in interorganizational relationships have been mainly studied through analytical research (Terpend & Krause, 2015). Resource theory suggests that the satisfaction in an exchange with similar resource categories will be higher and more likely, and less preferred exchanges will result in lower satisfaction (Teichman & Foa, 1975; Turner et al., 1971). We clustered the mentioned buyer's tactics (i.e., incentives) in study 1 to the various resource categories and tested their effect with the buyer's counterparts in study 2. In line with the theory (Turner et al., 1971), suppliers prefer to be reciprocated with similar resources categories, which is visualized in Figure 2.1 by being close to each other on the two axes symbolic-concrete and particularistic-universal. Asking for (sensitive) information, a supplier thus prefers to be reciprocated with information, money, and status incentives, with information having the biggest effect of all resource treatments in study 2. Service incentives, being more concrete and more particularistic than information, had no significant effect on information sharing, bolstering the resource theory.

As mentioned before, while falling in the category of knowledge, for the scope of our study, we focused on information as an *explicit* knowledge which can be written down and be transmitted without loss of integrity (Grant, 1996; Kogut & Zander, 1992). In this regard, unlike a comparable experimental study revealing a negative relation to knowledge-sharing (without distinction of tacit and explicit knowledge) (J. Chen et al., 2016), our results suggest that coercion can increase sensitive information sharing in buyer-supplier relationships. This relationship is, however, only significant if the supplier is to some extent dependent on the buyer. Lastly, the results indicate that the tactic "carrots and sticks" – the use of coercion together with an (information) incentive – could have a negative effect on sensitive information sharing.

2.5.2. Managerial implications

Our contributions provide valuable insights to practitioners on improving collaboration with their suppliers by investigating both sides of the buyer-supplier relationship. Thus,

this study has five important and well-founded messages for managerial practice. First, we provide a benchmark of used incentives to induce sensitive information sharing for purchasing managers and test them in a controlled setting with the actual counterparts of the buyers. We reveal a slight bias in what works from buyers' perspectives and what works at the suppliers. In this regard, service incentives (e.g., negotiation support and marketing support) might not enhance information sharing. Second, buyers do not have to rely only on offering more business (money incentive). Especially smaller firms, which seem to have fewer possibilities to offer (money) incentives or coercion, could use more status and information incentives to increase transparency in their relationships. Third, coercion, while mentioned by most buyers in study 1, should be used cautiously. In this regard, our results indicate that coercion only works when the supplier is somewhat dependent on the buyer. Fourth, the popular "carrots and sticks" tactic (reported in study 1) could have a negative effect on sensitive information sharing. Lastly, the buyers report that coercion can harm the relationship and trigger opportunism. This is especially critical with the information incentive (e.g., own sensitive information sharing), as it could be leaked to other firms such as the buyer's other suppliers or competitors.

2.5.3. Limitations and future research

Although we strive for a high validity of our results with a sequential design and the mixed-methods approach, our paper has some limitations. In the qualitative study, we rely on ten interviewees and must trust their statements as we have limited insight into the firms and processes to further verify the responses. Further studies should, however, extent the initial sample and provide more generality of our findings. Additionally, the outcome of a scenario-based experiment depends, among other aspects, on the very specific choice of vignette factors and factor levels (Steiner, Atzmüller, & Su, 2017). As mentioned, we used the incentive as factor, which was applied the most in the respective resource category by the respondents in the qualitative study. Other incentives for the resource categories, such as guaranteed margins for the money incentive, might have yielded slightly different results.

Our two studies focused on coercion (mediated power) as the most common type of power exercised in buyer-supplier relationships (Hunt & Nevin, 1974) and incentives as a form of reward power. Future studies could research the influence of other power bases on sensitive information sharing, such as expert, referent, and legitimate power (French & Raven, 1959), as well as their combination with the identified resource

categories of resource theory (U. G. Foa, 1971). Additionally, we focused on the supplier's dependence on the buyer. Future studies could investigate whether there are different implications for transparent relationships if there is a mutual dependence (Emerson, 1962) or various levels of mutual dependence (Casciaro & Piskorski, 2005). Another avenue of future research could be to investigate the effects of cultural factors on buyer-supplier relationship transparency because study 1 indicates that European subsidiaries of American firms and DACH-area suppliers could be different in this regard. Finally, we see a big potential in further applying resource theory to investigate interorganizational exchanges. This paper provided first support for the validity of resource theory in interorganizational settings, but we focused on buyer-supplier relationships (as one form of interorganizational relationship) and information exchanges (at least as the main aim of the buying side here). Future research could, for example, investigate whether resource theory provides accurate predictions with interorganizational service or goods exchanges.

3. Force majeure or fake majeure? Exploring intentions and outcomes of force majeure declarations in buyer-supplier relationships

Co-author:

Christoph Bode
Endowed Chair of Procurement, Business School, University of Mannheim, Germany

Abstract

The management literature views "force majeure" claims in buyer-supplier relationships as purely exogenous (i.e., as consequences of external catastrophic events outside of human control). Yet, recent events indicate that force majeure declarations are increasingly used for purposes other than excusing non-performance due to unforeseeable and irresistible catastrophes. Applying a sequential mixed-method research design – consisting of an in-depth case study, followed by post-hoc interviews, and a scenario-based experiment – we investigate intentions and outcomes of force majeure declarations in buyer-supplier relationships. Contrary to the literature, our qualitative studies suggest that a force majeure declaration is often not the result of an exogenously triggered supply disruption and sometimes used as a cover or leverage for other issues in the business relationship. The subsequent experiment supports the findings of the qualitative studies and indicates that force majeure declarations can have unintended consequences, such as slowing down disruption response actions of the recipient (i.e., buyer) and increasing switching intentions. Our study contributes to the field of supply chain disruptions and communication, and presents important implications to operations managers on dealing with force majeure issues.

3.1. Introduction

The COVID-19 pandemic has created massive global and domestic disruptions in the supply chain, but has also revealed the interdependence between government, business, and the local community (Sheth, 2020). Many national governments followed the recommendations of the World Health Organization and issued legislative responses to the challenges caused by the pandemic. This uncertain environment led almost reflexively to many canceled or curtailed purchase orders by buying companies (Sherman, 2021). Predictably, studies suggest that the COVID-19 pandemic had a deleterious effect on the fulfillment of contractual obligations (Yas, 2021). The resulting performance shortfalls and supply disruptions were often dismissed with references to the pandemic as a force majeure. In that regard, communicating a disruptive situation that was truly not under the supplier's control to customers and consumers is in line with the pertinent management literature (Hartmann & Moeller, 2014; Polyviou et al., 2018).

In July 2022, Gazprom, Russia's state gas monopoly, informed its European customers by letter that it could no longer guarantee gas supplies because of "extraordinary" circumstances, and retroactively declared force majeure on supplies from June 2022. The letter added to fears in Europe that Moscow may not restart the Nord Stream 1 pipeline at the end of the maintenance period in retaliation for sanctions imposed on Russia over the war in Ukraine. Uniper, Germany's biggest importer of Russian gas, was among the recipients of this letter, and stated that it had formally rejected the claim as unjustified (Payne, 2022).

While the frequency of force majeure declarations (or claims) in business-to-business relationships will likely increase due to the heightened uncertainty and crises in the current business environment, not all claims will be justified. In addition to the numerous underlying motives for force majeure declarations, their implications in the business relationship are not certain either, from accepting the claim – up to rejecting, enforcing penalties, or dissolving the relationship. Yet, the management literature has not given much attention to force majeure issues – besides using the term to frame certain events as acts of God (i.e., "nobody's fault"). Hence, this empirical study examines the following research question: *"What are the intentions and outcomes of force majeure declarations in buyer-supplier relationships?"*

To answer the research question, this study applies a sequential mixed-method research design. After a discussion of its conceptual and legal basis, the sparse

management literature on force majeure in business relationships is reviewed. The qualitative studies – including an in-depth case study followed by post-hoc interviews – elaborate upon the literature and provide novel and detailed insights in current developments as well as underlying intentions on force majeure declarations. In the subsequent scenario-based experiment, several hypotheses focusing on the behavioral outcomes of force majeure declarations in buyer-supplier relationships are investigated. Although the case company received 43 force majeure declarations in a two-month time frame and 76.1% of the purchasing and supply managers in our experiment sample had experienced force majeure claims in the past, the topic has not received much attention in the management literature. Therefore, our study contributes to the intersection of legal issues, supply chain disruptions, and interfirm communication, and has important implications for operations managers contending with force majeure issues.

3.2. Conceptual background

The term "force majeure" is French for "superior force" and is defined as an event that can be neither anticipated nor controlled, and that results in preventing someone from performing or completing something that had been agreed upon or officially planned. The term refers to acts of nature and acts of people (*Black's Law Dictionary*, 2019). Among these extraordinary events are fire, flood, earthquake, storm, hurricane, or other natural disasters, the loss of electricity, cataclysmic loss, sabotage, arson, war, invasion, acts of hostility from foreign enemies, civil war, rebellion, revolution, military or usurped power, terrorist activities, nationalization, government sanctions, embargos, labor disputes and strikes, which in the appropriate context justify force majeure (Bishoff & Miller, 2009). Parties to a contract, such as manufacturers, suppliers, and sellers, can declare force majeure with the aim of protecting themselves due to their inability to perform under their (supply) contracts as they usually cannot be expected to consider and negotiate individual terms for the impact of such events. Declaring force majeure allows a delay for the period of inability to perform and an excuse for non-performance. Legal consequences thus include a suspension of the relationship or a termination, in which usually the debtor bears the consequences of the termination. In some cases, the parties may be compensated for the services already provided, depending on the duration of the force majeure event (Hagedoorn & Hesen, 2007).

According to the jurisprudence, such an event has to fulfill two conditions to be classified as force majeure: It has to be (i) beyond a party's reasonable control; and (ii) must make ongoing performance commercially impossible (Bishoff & Miller, 2009). In this regard, force majeure differs from economic hardship. Economic hardship is a situation in which the performance of a contract has become burdensome, but not impossible; force majeure means that the performance of obligations has become at least temporarily impossible (Maskow, 1992).

The most disputed issue of force majeure is the question what threshold events make the contractually agreed performance impossible. The first-place parties should look for this in the contract itself, where parties are free to negotiate and define which events they consider unexpected or uncontrollable and to determine the possible consequences (Bishoff & Miller, 2009). These contractual provisions are called "force majeure clauses" and aim to allocate the risk of loss if performance becomes impossible or impracticable due to force majeure events (*Black's Law Dictionary*, 2019). In practice however, these clauses have to be properly defined to work and eventually to stand in court (Yas, 2021). In that regard, although the COVID-19 pandemic had a massive global impact, there were almost no suitable force majeure clauses in place. The term "pandemic" seems completely absent from force majeure clauses drafted prior to the COVID-19 outbreak (Schwartz, 2020). Without a valid pandemic-related clause in place, the contract party seeking to be excused could cite the laws enacted in the pandemic or frame the pandemic as an "act of God" (Schwartz, 2020). Based on the law, the declaring party must prove that a government-issued lockdown or preventive directive, such as ordering people to stay home or business to temporarily stop operations, prevented or delayed the party from fulfilling contractual obligations. A higher cost or merely the difficulty to perform are usually not sufficient to declare force majeure (Yas, 2021). The same holds true for less restrictive orders or recommendations that fall short of being law. The line between significantly more expensive and impossible is, however, not yet defined and will be a difficult judgment for courts in the upcoming years (Schwartz, 2020). This will be especially relevant for multinational supplying companies which could have produced the contracted parts or components in their facilities out of country. Regarding the act of God provision, the question will be whether the COVID-19 pandemic will be viewed as unforeseeable and uncontrollable as other types of (natural) disasters, like hurricanes and earthquakes. On the one hand, some lawyers argue that pandemics have happened before, and scientists have warned about their recurrence. On

the other hand, other lawyers argue that this foreseeability does not matter as the same arguments hold true for hurricanes and fires which have happened before and will surely occur again, leading to an unclear outcome of the debate (Schwartz, 2020). Thus, from a legal perspective, the impact of the COVID-19 pandemic on contractual obligations has not yet been conclusively determined, and the outcome may vary by case, depending on its contextual and situational factors.

3.3. Literature review

Force majeure has not received much attention in the management literature. The concept is considered in research at the intersection to contracting, as well as to characterize the locus of causality of (supplier) incidents, and related disruptions. Considered a catastrophic risk (Wagner & Bode, 2006), an accident, such as an engine explosion, is regarded as force majeure if it is caused by a lightning strike and is therefore beyond the control of the one party (Hartmann & Moeller, 2014). Other reasons mentioned are natural but also "outside forces" which constitute nearby industrial human-made causes, including damage by cars, trucks, boats or other equipment, and intentional damage, such as vandalism. The underlying principle is, besides the uncontrollability, that the causes could not have been prevented with regular maintenance – such as corrosion (Park & Rogan, 2019).

In terms of supply chain disruptions, consumer reactions, such as boycotting, depend on the responsibility attributed to the focal firm, even when the incident occurred at a supplier factory. When an incident was caused by sloppy security systems in manufacturing (i.e., internal cause), the negative consumer reaction will be much stronger than if the incident was caused by an earthquake or other force majeure event (Hartmann & Moeller, 2014). In this regard, buying companies seem to react similarly to consumers, as other studies indicate that the buying firm's dissatisfaction and the supplier's retention after a disruption depends on whether the supplier had control over the disruption (Polyviou et al., 2018; Primo et al., 2007). In other words, if a supply disruption is caused by a force majeure, the suppliers should communicate this fact with its customers to ensure their retention after the disruption (Polyviou et al., 2018). In fact, these studies highlight the importance of well-developed communication strategies with customers and consumers in the event of an incident, especially if it is due to force majeure (Hartmann & Moeller, 2014; Polyviou et al., 2018). Yet, suppliers may even shoulder some

responsibility for disruptions triggered by force majeure, depending on procedural and interactional justice in the disruption recovery process (Wang et al., 2022). Some firms even deliberately exaggerate a force majeure event, such as sunken ships, to terminate a business relationship (Pressey & Selassie, 2007).

In terms of contracting, buying and supplying companies try to address force majeure events by including contract clauses (Egan, 2010; Mouzas & Blois, 2013). One study found that approximately 31% of transactions with suppliers of IT products and services included a force majeure component (i.e., clause) in the written contract terms governing the transaction (S. W. Anderson & Dekker, 2005). A force majeure clause could indicate that parties *"bear no liability for damages occurred as a result of war, political unrest, strikes, lockouts, and governmental interventions"* (Mouzas, 2016, p. 58). Extensions can include that *"parties have the obligation to contact each other immediately in case of obstacles and will negotiate the steps to be taken"* (Mouzas & Ford, 2006, p. 1252). These contract clauses tend to allow for more certainty of transactions and aim at reducing potential opportunistic behavior (Mouzas & Blois, 2013). In technology outsourcing, for example, the inclusion of force majeure clauses in contracts reduces the likelihood of contract terminations (Susarla, 2012).

3.4. Qualitative studies

The main objective of the qualitative studies is to elaborate the sparse management literature on force majeure issues in an appropriate empirical context (Ketokivi & Choi, 2014). Based on the results of case study and the post-hoc interviews, we derive several hypotheses to be tested in the subsequent experiment. In particular, the hypotheses address outcomes of the force majeure declarations in buyer-supplier relationships.

3.4.1. Sample and data collection

The basis of our explorative investigation is an in-depth case study of *MachineFirm*, including an analysis of a unique dataset of 43 force majeure declarations. We enriched the analysis of the coded force majeure declarations with supplier data (i.e., past performance and strategic importance), interviews, and data collected from analyzing protocols of weekly supply situation calls (i.e., disruption duration) with the heads of the logistics and purchasing departments of the focal buying firm. Utilizing multiple sources of data helps in triangulating observations and conclusions (Eisenhardt, 1989; Yin, 2009).

MachineFirm is a German business-to-business manufacturing company with subsidiaries in Europe, Asia and America, a total turnover of over 4 billion euro and more than 10,000 employees worldwide. One advantage of using one focal buying company is that relevant factors such as market position, corporate culture or supplier management policy are held constant over the entire sample, which should improve the internal validity of our findings (J. Chen et al., 2016; Subramani & Venkatraman, 2003).

While our initial findings are situationally grounded, we aimed for more generality by complementing the case study with several post-hoc interviews (Ketokivi & Choi, 2014). We targeted manufacturing firms with actively managed supplier relationships, and especially informants with direct supplier contacts and sourcing responsibility (a managed spend). For additional insights, we also reached out to (corporate) lawyers since the topic of force majeure is at the intersection of business and legal issues. All interviews took place in February and March 2022 and ranged from 25 to 75 minutes. The interviewees and firms were granted anonymity. Further details of the sample are shown in Table 3.1.

Table 3.1 Participants of the qualitative studies on force majeure

Firm	Industry	Revenue	Employees	Informant	
				Position	Experience
MachineFirm	Machine manufacturing	< 5 bn EUR	> 10,000	Lead Buyer I	26 years
				Lead Buyer II	3 years
				Supplier Management	12 years
				Contract Manager	22 years
BuildingFirm	Building materials	< 20 bn EUR	> 50,000	Head of Project Procurement	16 years
CarFirm	Automotive	< 30 bn EUR	> 30,000	Buyer	7 years
ChemicalFirm	Chemicals	> 50 bn EUR	> 100,000	Head of Global Indirect Procurement	26 years
PolymerFirm	Polymer materials	> 15 bn EUR	< 20,000	Category Manager	28 years
PowertoolFirm	Power tools / construction	> 5 bn CHF	> 30,000	Category Manager	27 years
ITFirm	IT products and services	< 500 m EUR	> 2,000	Head of Corporate Legal	28 years
LawFirm	Corporate law	−	< 10	Lawyer	34 years

3.4.2. Case study

Due to the increased uncertainty surrounding the outbreak of COVID-19, in February 2020 MachineFirm issued an initial letter to its production material suppliers requesting to be informed of any supply problems. Besides generally increased communication with its suppliers and other responses to the initial letter, MachineFirm received 43 force

majeure declarations in between February and April 2020. As depicted in Figure 3.1, almost half of the supplier's letters were received in calendar week 13. At the same time, the numbers of COVID-19 cases in Europe and beyond were increasing and the World Health Organization was warning that the pandemic was accelerating (BBC, 2020). The number of force majeure declarations during this two-month period was extraordinary, as a lead buyer recalls: *"Prior to the pandemic, force majeure declarations were rather rare, maybe once every five years"* (Lead Buyer I, MachineFirm).
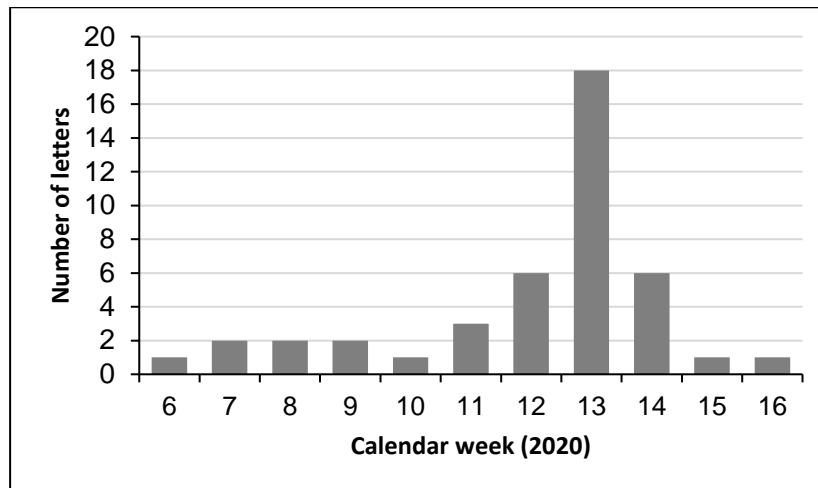
Figure 3.1 Force majeure declarations received per calendar week

In a first step, we analyzed the general characteristics of the force majeure declarations, such as the length of the letters, which ranged from half a page to 2 pages ($M = 0.81$, $SD = 0.30$). The letters were then coded in terms of the reasons they mentioned as force majeure. On average the letters gave 1.56 reasons ($SD = 0.91$) with a minimum of 0 and a maximum of 5. As displayed in Table 3.2, due to the initial circumstances of the pandemic, the reasons ranged from regulatory to operational (i.e., employees and transportation) to supply chain issues (i.e., suppliers and customers). Interestingly, not all reasons were directly attributed to the pandemic, but rather to its consequences. Therefore, most letters referred to government issues, such as national shutdowns and other official actions. Almost a third of the letters cited issues with their own suppliers, such as shutdowns at the suppliers' locations or resulting supply shortages; for example, one supplier briefly stated: *"We and our suppliers cannot operate in China."* Another category addressed operative issues such as employees in quarantine and production cessations to protect employee safety. Some declarations referred to the other party's customer decisions and their consequences for production planning. The least mentioned reasons were missing transport availability, for example, due to logistic service providers

that had shut down and missing transport vessels. Lastly, no specific reason was given in 18.6% of force majeure letters, and thus, these were mostly sent as an alert *"for possible delays in the future*." These letters were found to be inconclusive. As one contract manager simply states: *"From a legal perspective, a force majeure declaration without mentioning a reason is nonsense"* (Contract Manager, MachineFirm).

Table 3.2 Frequency of reasons in the force majeure declarations

Reason	*n*	*%*
Government	28	65.1%
Suppliers	14	32.6%
Employees	8	18.6%
Customers	6	14.0%
Transport	3	7.0%
Precautionary (no specific reason)	8	18.6%

The main underlying reason of force majeure declarations is to justify non-performance. To analyze the relationship of the declarations with supply disruptions, we enriched the dataset by including the disruption duration of the respective supplier. The disruptions were recorded by the heads of the logistics and purchasing departments in the protocol of their weekly supply situation calls. Surprisingly, of the 43 suppliers which issued force majeure declarations, only 10 could not fulfill their contractual obligations and were recorded as critical (i.e., supply disruption) in the protocol. For these suppliers, the supply disruption lasted on average 3.50 weeks ($SD = 1.75$).

Table 3.3 Correlations of disruptions and properties of the force majeure declarations

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1) Disruption duration	—							
(2) Letter length	0.28 †	—						
(3) Number of reasons	0.04	0.41 **	—					
(4) Government	0.12	0.10	0.07	—				
(5) Suppliers	0.28 †	0.45 **	0.67 ***	0.09	—			
(6) Employees	–0.16	0.01	0.10	-0.40 **	–0.20	—		
(7) Customers	–0.19	0.03	0.57 ***	-0.27 †	0.29 †	–0.02	—	
(8) Transport	–0.13	0.18	0.64 ***	-0.18	0.20	0.10	0.42 **	—
(9) Precautionary	0.02	0.11	0.37 *	-0.40 **	0.05	–0.08	0.15	0.34 *

Note: Pearson correlation coefficients are shown below the diagonal (n = 43). "Number of reasons" is the sum of reasons mentioned, "Disruption duration" is measured in weeks, and "Letter length" in pages; all other variables are dichotomous. †p < 0.10, *p < 0.05, **p < 0.01, ***p < 0.001

For a more detailed analysis, we computed the correlations of the disruptions with various properties of the force majeure declarations, displayed in Table 3.3. In line with the impression that in this case the declarations might not be a reliable indicator of supply disruptions, the first column shows that the correlations of the force majeure declarations'

properties with the disruptions are not large enough to be statistically significant at a 5% level. While being slightly over the threshold of $\alpha = 0.05$, the length of the letters and the stated reason of supply issues could be an indicator for a disruption (both $p = 0.07$). A follow-up analysis reveals, however, that even when the force majeure declaration is associated with a supply disruption, the time in between letter and disruption can vary greatly. As illustrated in Table 3.4, nine of the ten suppliers sent their force majeure declaration prior or simultaneously to the disruption. At first, this was perceived as positive, because the force majeure declarations and further communication helped as early warning, and *"showed that the supply chain issues were not limited to China"* (Supplier Management, MachineFirm). Yet, 40% of the letters in Table 3.4 were sent more than 20 weeks in advance of the disruption, which makes the allocation of the letter to the disruption difficult in practice. In particular, one lead buyer recalls: *"Smaller suppliers try to relate disruptions to force majeure declarations sent almost a year before; those suppliers often issue declarations which are not legally correct, maybe due to missing legal advice and less professional management"* (Lead Buyer II, MachineFirm).

Table 3.4 Time from letter to disruption and supplier characteristics

ID	Strategic relevance	Performance rating	Calendar week		
			Letter	Disruption	Δ
S01	A	C	8	12	4
S02	B	–	10	44	34
S03	A	C	11	46	35
S04	B	–	12	12	0
S05	A	C	12	21	9
S06	B	B	13	11	–2
S07	B	C	13	16	3
S08	D	C	13	17	4
S09	B	C	13	34	21
S10	B	C	15	46	31

Note: All variables refer to the year 2020. Strategic relevance / performance rating ranges from A (strategic supplier / performance > 90%) to D (supplier to substitute / performance < 50%)

In response to a force majeure declaration from a supplier, the letter is first reviewed by the legal department, and in most recent cases, the claims were not accepted, which was eventually communicated to the supplier in a formal response letter. Since the declarations are meant to excuse non-performance, there is no real deadline for when to respond. If the force majeure declaration is associated with a supply disruption, MachineFirm's main aim is to secure material availability to ensure business results and handle legal issues only with a lower priority in parallel. As the following quote illustrates: *"We always seek a solution with the supplier for example by allowing*

deviations with regard to [company-specific special requirements] or accepting supply from another plant. If this is not possible, we look for other solutions with the supplier, for example by the supplier granting a license to third parties who can manufacture. Only if all this fails, we try to get further without the supplier, that includes buying back spare parts from the market and buying from the competition" (Contract Manager, MachineFirm).

The behavior of the supplier before and after declaring force majeure varies substantially and often depended on the relationship history. The informants stated that collaborative suppliers usually announced a force majeure declaration before issuing the letter, while suppliers with a transactional and market-oriented way of interaction more often sent declarations without warning. However, this sets certain expectations and can make a negative impression, as following quote depicts referring to a supplier on a partnership level: *"When a force majeure declaration arrives without warning, it is perceived to some extent as an offense. This negative impression will be communicated directly in the next yearly meeting of buyer and key account manager"* (Lead Buyer II, MachineFirm).

After receiving a force majeure declaration, MachineFirm's first reaction is to work with the supplier to find a solution. Suppliers with a closer and more collaborative relationship usually accepted the support to recover from the disruption. More market-oriented suppliers, however, seemed to treat force majeure as an excuse for not fulfilling any contractual obligations and were reported to be less solution-oriented. While the existence of a force majeure declaration was less important than the behavior of the supplier during the disruption, legal discussions following the claim can accelerate tendencies that could include a termination of the relationship. Yet in general, long-term consequences, such as enforcing penalties and pursuing alternative sources, depended on MachineFirm's internal politics and future strategic importance.

In the event of a force majeure affecting a supplier, the supplier's decision to forego a force majeure declaration was perceived as positive. While a single force majeure declaration is not crucial for the future of the business relationship, the way it is handled – such as giving prior notice, behaving in a solution-oriented way, formulating the declaration as legally correct/justified, or even refraining from issuing a formal declaration – influences the perception at the receiving firm. Concluding, the preferred way of handling force majeure declarations and disruptions, is described in the following quote: *"Desirable is a quick communication of a disruption and a prior announcement*

that a force majeure declaration will arrive, with a clear and justified reason" (Contract Manager, MachineFirm).

3.4.3. Post-hoc interviews

We complemented the initial case study with several post-hoc interviews and structured the findings along reasons mentioned, intentions, outcomes, and context, such as timeline and relationship history. Table 3.5 summarizes the cross-case findings.

The reasons mentioned by the informants are quite varied from acts of nature, such as tsunamis and earthquakes, to acts of people, including strikes and accidents resulting in fires or explosions. However, there were also many force majeure declarations that failed to give specific reasons, only mentioning "possible delays in the future." Analogously to the case study, those precautionary declarations will likely have no consequences, because a force majeure claim will only be accepted when fulfilling obligations has become impossible (BuildingFirm). In the same vein, the interviewees report that the supplier's threshold for force majeure claims decreased, and that as a result, even minor problems are now called force majeure (PolymerFirm). This has led to an "almost inflationary use since the start of the pandemic" (ChemicalFirm) and a weaker association with supply chain disruptions. Further, most informants highlighted that force majeure declarations are increasingly used with intentions other than to excuse non-performance, including getting another production facility certified for free or even leveraging the situation for price increases (LawFirm). In contrast, some suppliers had massive delays even without an official force majeure declaration. Some of those could have issued a force majeure declaration but did not, which made a positive impression on the buying firm (BuildingFirm). In other cases, the informants stated that a force majeure declaration is often issued out of a supplier's desperation, with the impression – at least in the last years – that those suppliers might not have planned their own supply (i.e., material missing) and associated processes, such as machine maintenance, well (ChemicalFirm, PolymerFirm).

Table 3.5 Force majeure cross-case study results

Firm	Reasons	Context	Intention / Perception	Outcome
Machine-Firm	▪ Government orders ▪ Sub-supplier issues ▪ Transportation ▪ Quarantined staff *Pre-COVID-19* ▪ Floods ▪ Tsunami ▪ Fire ▪ Earthquake	*Timeline* ▪ Company issued an initial letter and asked to be informed in case of supply problems. ▪ Some suppliers announce force majeure declarations before, some in time with the first delivery problems. ▪ Up to 6 months in between letter and supply disruption. *Relationship history* ▪ Full spectrum of supplier relationships managed.	▪ When force majeure declaration arrives without prior announcement, it is perceived negatively – especially when supplier is not interested in finding a solution afterwards. ▪ Good impression when supplier nevertheless works on a solution with buyer and searches for alternatives. ▪ Partnership supplier relationships are more solution-oriented and market-oriented suppliers are more likely to take declaration as an excuse for not fulfilling any contractual obligations anymore. ▪ Force majeure declarations serve as indicator for less reliable suppliers. ▪ With precautionary declarations, in particular market-oriented suppliers, try to limit their responsibility and possible penalties in case of future disruptions.	*Short-term* ▪ Not immediately replying to the force majeure declaration. Examination with legal department and in most cases not accepted – with formal reply. ▪ On an operational level securing supply by searching alternative ways with disrupted suppliers, such as supply from other production facility or temporarily renouncing customization. *Long-term* ▪ Delivery contracts will be adapted on basis of the issue, now often there are no delivery times and quantities specified. ▪ In case of single source, searching for additional suppliers. ▪ Waiving penalties or sharing damage depending on relationship history, the supplier's financial situation, company politics, and strategic importance.
Building-Firm	▪ Specific reasons rarely mentioned ▪ Travel restrictions ▪ Government orders ▪ Sub-supplier issues	*Timeline* ▪ Force majeure declarations came without warning, sometimes even only mentioned in jour fix. ▪ In general force majeure declarations came after first supplier facilities had to be closed and delays became longer. *Relationship history* ▪ Partnership-like relationships are maintained with most suppliers.	▪ There were suppliers which had massive delays even without official force majeure declaration. Positive impression, when suppliers had the opportunity to claim force majeure but did not. ▪ Receiving a formal force majeure declaration is a small shock, because partnership-like relationships are maintained with suppliers. ▪ Desirable is to have a short notice prior to getting the letter.	*Short-term* ▪ Operational looking of ways to solve problems with suppliers. ▪ Sometimes force majeure declarations led to discussions and delays in the buyer's response, because legal issues had to be clarified ▪ Some force majeure declarations led to reciprocal declarations when timeline of project is affected. *Long-term* ▪ Limited possibilities to exchange supplier because long-term project work on facilities, and alternative suppliers will usually face the similar problems. ▪ When delay due to the COVID-19 pandemic, no penalties enforced (even without force majeure declaration). ▪ No further change in working with suppliers.

CarFirm	▪ Travel restrictions ▪ Border closures ▪ Production shutdown ▪ Floods ▪ Energy saving orders (China)	*Timeline* ▪ Force majeure declarations are previously announced via call or mail. *Relationship history* ▪ Close relationship, sometimes discussions but overall fair and cooperative.	▪ Since the COVID-19 pandemic, more force majeure declarations are received. ▪ No blame for force majeure declaration as suppliers do not claim it voluntarily. Yet, some suppliers try to establish a safety net with precautionary declarations, for possible advantages in future litigations.	*Short-term* ▪ More intensive collaboration, high-frequent communication with the supplier's supply chain management, sales, and even plant management. Developing and evaluating of alternative solutions with suppliers. Alternative suppliers not an option due to product complexity. ▪ Declarations were forwarded to legal department, first reaction was declining force majeure and emphasizing delivery obligation. *Long-term* ▪ No penalties enforced, because timely deliveries were reestablished as soon as production was reopened (after shutdown). ▪ Force majeure was officially never accepted by buyer. Yet, no supplier changes planned.
Chemical-Firm	▪ Quarantined staff ▪ Travel restrictions ▪ Facility burnt down	*Timeline* ▪ Force majeure declarations were announced previously (a few days before); no letter came unexpected. *Relationship history* ▪ Good and close supplier relationships.	▪ In the last two years (since the COVID-19 pandemic), the number of force majeure declarations increased to "almost inflationary use" ▪ Uncertainty increased with force majeure declaration, perception that supplier is at its limits and desperate. Perception that they did not plan well their own supply (material missing) or other underlying intentions present. ▪ Warning sign for buyer, could also significate supplier financial risk.	*Short-term* ▪ Primary aim was to continue business by working to find a solution with supplier, intensive communication and negotiations; alternative suppliers were not really an option because they suffered from the same problems (e.g., travel restrictions) ▪ Legally examined in parallel, by analyzing what was agreed in contract. Short delay of disruption response and support due to declaration. *Long-term* ▪ Consequences not depending on prior relationship, rather impact, strategic importance, and exchangeability. Reevaluating whole picture of supplier for future work relationship ▪ Reassessment of supplier financial and credit risks ▪ Eventually, just a minor proportion of force majeure claims were accepted. Never went to court.

Polymer-Firm	▪ Materials shortage ▪ Production failures (and resulting capacity problems) ▪ Snowstorm ▪ Defense Priorities and Allocations System (DPAS)	*Timeline* ▪ Received 46 force majeure declarations in one year. ▪ FM declaration came with or shortly after supply disruption. Allocation quotas for customers came 2-3 days later. *Relationship history* ▪ Full spectrum of relationships managed. Cooperative suppliers often warn earlier in case of problems (prior to formal declaration)	▪ Main underlying reason for the force majeure declarations is the demand surge after the shock of the COVID-19 pandemic. Suppliers did not perform maintenance sufficiently and postponed investments, which eventually led to many breakdowns in the ramp-up processes. ▪ Impression that suppliers have a lower threshold since the pandemic, even minor problems are called force majeure as an easy way out; overall more declarations. ▪ In general, all contracts have a force majeure clause and suppliers have to inform all customers simultaneously.	*Short-term* ▪ Purchaser first evaluates whether force majeure declaration seems legitimate, then analysis of existing contract as well as alternative supplies, and crisis meeting with supply chain management department. ▪ Supporting suppliers on an operational level difficult, because of strong vertical supply chain. Thus, alternative suppliers are preferred. *Long-term* ▪ On a strategic level, searching and creating more alternatives of supply. ▪ When force majeure issues are long-lasting, high pressure of internal stakeholders to look for alternative suppliers. ▪ However, "a lot has to happen until two big firms go to court over force majeure issues".
Powertool-Firm	▪ Snowstorm ▪ Sub-supplier issues ▪ Production facility explosion ▪ Floods / Hurricanes	*Timeline* ▪ Force majeure was claimed the same day as sub-supplier declared force majeure to supplier. ▪ Another letter came 10-12 days after explosion, with stating 8 weeks no supply. Eventually, a subsequent force majeure letter stated a delivery stop for all products of at least 4-5 months. *Relationship history* ▪ Long-term (>50 years) and collaborative relationships.	▪ No blame for supplier situation, force majeure was not declared voluntarily.	*Short-term* ▪ Establishing task force, frequent communication to suppliers, evaluating production capabilities, inventory, and market situation (e.g., products and alternative materials) *Long-term* ▪ Relationship outcome neither better nor worse. ▪ New contract concluded with liberal force majeure clauses. ▪ No legal prosecution due to wording of force majeure clause in contract; happy to be supplied at all. Using insurance would have been possible for, but lost revenue (damages) was lower than the insurance deductible.

ITFirm	▪ Strike	*Timeline* ▪ Communication of force majeure shortly after disruption (the latest with the not executed delivery). *Relationship history* ▪ Rather transactional relationships with suppliers and customers.	▪ Force majeure declaration sign of unreliability, customer expectation to have a business continuity plan or to be supplied by other location. ▪ No precautionary declaration to not unsettle the customer when the event eventually does not occur (de minimis principle).	▪ Reasons for force majeure declaration are to prevent negative reactions and penalties. Expectation that customer accepts declaration due to emergency situation. ▪ Litigation in court or arbitrary court depending on contractual agreements (can differ for each customer). ▪ Short supply chain (low vertical complexity) in the IT sector, when there is a (supplier-issued) force majeure declaration, the customer will probably switch the supplier.
LawFirm	▪ COVID-19 is not valid anymore as reason, because after two years firms should know it and plan with it (i.e., not uncontrollable). ▪ For supply shortages evidence necessary that specific (missing) material is cause of late delivery; easier when parts are customized for customer.	*Timeline* ▪ In case of a large gap (e.g., 30 weeks in advance) from force majeure declaration to supply disruption, reevaluation whether the circumstances still justify the previous statement.	▪ The term force majeure was often used wrong on purpose to give letter and reasons a legally justified impression of being in the right without having to bear the responsibility for the consequences of non-performance. ▪ Sometimes letters are vague on purpose to keep the customers. Precautionary letters (details missing about shortage, missing quantities and timeline) also utilized to test how severe the customer reacts (for latter determination of quotas). ▪ Further use of force majeure declarations with other intentions includes increasing pressure (e.g., in ongoing negotiations), managing (customer's) expectations in the issuer's favor, provoking an additional order of the customer, and getting an expedited certification process (sometimes even for free) for different production locations.	▪ Consequences depend on contractual agreements at the time of force majeure (e.g., obligations, quantities, deadlines) and clauses. Difficult to enforce in case of framework agreements, because quantities are not fixed. Consequences have to be defined contractually in the Anglo-American countries; for Western Europe rather matter of interpretation. ▪ Outcomes of force majeure litigations often kept secret, due to use of arbitration courts (choice of court depending on contractual agreements). ▪ Even if force majeure is accepted, the parties have to do their best to fulfill contractual obligations to the best possible extent, for example by using other production sites. ▪ Force majeure declaration by one party (buyer/supplier) can lead to a reciprocal force majeure declaration by the other party.

In the short-term response to a force majeure declaration, almost all interviewees relied on establishing task forces, communicating frequently with suppliers, and supporting suppliers in handling the issue, such as offering technical support and materials. In parallel, the force majeure declarations were usually forwarded to the buying firm's legal department (PolymerFirm, CarFirm). In case of supply issues, some force majeure declarations of suppliers had their sub-suppliers' force majeure declarations

attached to justify the own inability to perform (PowertoolFirm). These supply disruptions can inadvertently create disruptions at the receiving firm and trigger reciprocal force majeure declarations, and even ripple through other relationships of the buying firm and affect ongoing projects (e.g., interfirm R&D projects and project procurement activities) (BuildingFirm, LawFirm). Thus, force majeure declarations increased the likelihood that the recipient (buyer) will also declare force majeure in the dyad, to project partners, and along the supply chain. In this regard, receiving a force majeure declaration from a supplier likely increased the uncertainty about the supplier's performance, as the exact time frame of the disruption was often unknown, the disruption could exacerbate, and (in some industries) the allocation of remaining materials and products on the customers was ex-ante unclear (PolymerFirm, ChemicalFirm, BuildingFirm, ITFirm). Together with the legal examination, the presence of a force majeure declaration also had the potential to delay slightly the buying firm's response, including the support for the supplier in handling the disruption (ChemicalFirm, BuildingFirm).

In the long-term response to a force majeure declaration, most interviewees planned on keeping the suppliers which issued force majeure declarations and reported that relationship termination only occurred in cases of already poor performance ratings or existing plans to phase out the supplier. This is owed in part to the fact that securing supplies and business results is considered more important. Nevertheless, the interviewees planned on adapting contracts (PowertoolFirm), reassessing the supplier's financial risks (ChemicalFirm), or searching more alternatives of supply (PolymerFirm). While only a small proportion of force majeure claims have been accepted, force majeure issues were unlikely to be pursued in court; most companies have not filed suit (e.g., ChemicalFirm, CarFirm) and have rarely imposed penalties (MachineFirm).

3.4.4. Hypotheses development

The severity of a supply chain disruption is negatively related to the discovery speed (Craighead et al., 2007) and the total response speed to the disruption (Bode & Macdonald, 2017). Thus, to receive quick support to handle supply chain disruptions including force majeure events, suppliers should strive to shorten response time at the buying firm. Yet, when suppliers communicate a disruption and at the same time confront the buying firm with a force majeure declaration, our qualitative results suggest that possible response actions will be (slightly) delayed. This is mainly attributable to the

involvement of more people and departments (i.e., legal department) than usual, and associated discussions of the force majeure claim. In addition, the qualitative findings suggest that force majeure declarations are often issued by heavily distressed suppliers as a last resort; as a consequence, more support may be needed, and a different degree of involvement planned. Taken together, these observations led to following hypothesis:

Hypothesis 1. *A force majeure declaration is <u>negatively</u> related to the <u>speed of response actions</u> initiated by the receiver.*

A firm receiving a force majeure declaration will likely experience related disruptions in its supply chain. A force majeure declaration will usually be reviewed by the legal department, leading to additional efforts – in addition to finding ways to recover from the disruption. In the long run, this could affect the perceived cost-benefit ratio of the supplier relationship, resulting in the pursuit of other, more profitable relationships (Dwyer et al., 1987). Unsurprisingly, the qualitative findings indicate that that when a supplier is affected by force majeure and could issue a declaration to excuse the non-performance, but chooses not to do so, the buyer perceives this behavior as positive. In contrast, a force majeure declaration in addition to a supply disruption has the potential to reinforce negative perceptions, such as anger, which are also associated with supplier switching intentions (Polyviou et al., 2018). Taken together, these observations led to following hypothesis:

Hypothesis 2. *A force majeure declaration is <u>positively</u> related to <u>switching intentions</u> by the receiver.*

Since the parties to a contract are not obliged to invoke a declaration when experiencing force majeure, expectations would be that suppliers with a good relationship history, in the sense of interacting at a partnership level and being flexible in collaborating (Y.-S. Chen, Rungtusanatham, & Goldstein, 2019; Macneil, 1978), would forego a claim. In that regard, the qualitative findings suggest that suppliers with a good relationship history tend to not only announce force majeure declarations before issuing them, but often even waive a claim in the spirit of partnership. This behavior, and the whole history of working together, creates a shared identity with certain expectations. In buyer-supplier relationships, a belief-based expectation represents a stable anchor from which any deviation or incoherence can have a negative impact on preference (Wang et al., 2010). For instance, under normal circumstances, a supplier with an excellent historical performance is less likely to be terminated by the manufacturer. But if that supplier errs, the likelihood of being terminated increases to a greater extent than when a supplier with

a poor historical performance commits the same mistake (Bode et al., 2011; Y.-S. Chen et al., 2019). While the buyer expects errors from the poorly performing supplier, disappointing the high expectations of the supplier with excellent historical performance will be judged more harshly. Although a force majeure is not the supplier's fault, sending a formal declaration could be perceived as an error in a collaborative relationship (i.e., a deviation from expectation), and as a result delay response actions and increase switching intentions even more. Taken together, these observations suggest the following interaction effects, further qualifying the effects suggested by hypotheses 1 and 2:

> **Hypothesis 3a.** *The negative effect of a force majeure declaration on the <u>speed of response actions</u> initiated by the receiver is moderated by the prior relationship history; the better the prior relationship history, the larger the negative effect.*

> **Hypothesis 3b.** *The positive effect of a force majeure declaration on <u>switching intentions</u> is moderated by the prior relationship history; the better the prior relationship history, the larger the positive effect.*

3.5. Experiment

The hypotheses are tested using a scenario-based experiment that manipulated aspects of relationship history and communication behavior in a force majeure disruption. The experiment allows an investigation of the buyer's response behavior in a controlled setting without confounding factors leading to a high internal validity (Aguinis & Bradley, 2014).

3.5.1. Vignette development

Based on the results of the qualitative studies and related literature, we experimentally investigate the effect of a force majeure declaration on the disruption response while considering relationship history as an important contextual (i.e., moderating) factor. Adopting the common modules from Wang et al. (2022), the participants assume the role of a purchasing manager in charge of managing supplier relationships for a mid-sized manufacturing company. One of their important suppliers is Alpha, whose key seaport for raw materials has been struck by a tsunami.

The first vignette describes the relationship history with Alpha. The relationship was either *poor*, with "arm's length" interaction where the supplier is unresponsive to required changes in order quantities, or *excellent*, with a collaborative and flexible way of interaction (based on Y.-S. Chen et al., 2019; Macneil, 1978). While the qualitative studies indicated that force majeure declarations are increasingly used with other

intentions, for the experiment we excluded those ambiguities and framed the disruption due to an unequivocal act of nature (i.e., tsunami). This setting allows us to focus on the effect of a force majeure declaration. In both vignettes shown after the disruption, the supplier "states that they will do their best to resume operations as soon as possible." In one vignette the supplier issues a letter declaring force majeure (*yes*), in the other vignette the supplier specifically does not (*no*).

The manipulations of relationship history (*poor/excellent*) and force majeure declaration (*no/yes*) yielded a total of four scenarios, pre-tested with eleven doctoral students in operations management to ensure that the descriptions were believable and that the vignettes reflected the desired levels of the factors of interest (Rungtusanatham et al., 2011). Based on the feedback, no changes were made. A full description of all modules and factor levels can be found in the appendix.

3.5.2. Sample and data collection

From May to July 2022, we conducted a self-administered online experiment. In line with methodological suggestions of experimental research in operations management, we opted for a targeted sample of buyers and supply chain managers because our analysis is at an interfirm level and to ensure that our sample has adequate experience to understand the context (Eckerd, DuHadway, Bendoly, Carter, & Kaufmann, 2021).

The participants were self-recruited and received no compensation besides a summary of the study's results. By presenting each participant with a randomly drawn scenario, we obtained 134 complete responses with an average duration of 7 minutes. The participants had an average work experience of 14.9 years ($SD = 9.8$), 20.1% were females, and 76.1% have received at least one force majeure declaration from their interfirm partners (e.g., suppliers) in the past. Table 3.6 shows further sample characteristics.

Table 3.6 Sample characteristics of the force majeure experiment

Variable	*n*	*%*
Function		
Procurement Manager	45	33.58%
Buyer / Purchaser	21	15.67%
Senior Buyer / Purchaser	19	14.18%
Supply Chain Manager	16	11.94%
Vice President Procurement	14	10.45%
Chief Procurement Officer	6	4.48%
Supplier Management	6	4.48%
Supply Chain Consultant	3	2.42%
Other	4	2.99%
	∑ 134	100%
Industry		
Manufacturing	27	20.15%
Automotive	18	13.43%
Industrial Products	17	12.69%
Health Care / Life Sciences	16	11.94%
Consumer Products / Retail	13	9.70%
High Tech / Software	7	5.22%
Chemicals / Oil / Gas	5	3.73%
Travel / Transport / Logistics	5	3.73%
Public Sector	4	2.99%
Other	22	16.42%
	∑ 134	100%
Job location		
Germany	51	38.06%
USA	47	35.07%
Switzerland	10	7.46%
Liechtenstein	4	2.99%
Australia	2	1.49%
India	2	1.49%
Other	18	13.43%
	∑ 134	100%

3.5.3. Measures

Corresponding to our hypotheses, after the scenario we asked the participants to express their opinion on our two dependent variables: *immediate action* and *switching intention*. For immediate action we developed the following statement based on McKelvie, Haynie, and Gustavsson (2011): "If I were in the situation of the purchasing manager, I would immediately act to support Alpha in its disruption recovery efforts." For switching intention, we adopted following statement based on Wang et al. (2022): "If I were in the situation of the purchasing manager, in the long-term I would switch to a different supplier when my company has an opportunity." Both variables were scored on a 7-point rating scale (anchored at 1 = "strongly disagree" to 7 = "strongly agree"). We utilized the single-item measures as they have proven effective in past research (e.g., McKelvie et al.,

2011; Wang et al., 2022), are preferred by practitioners, and have similar predictive validity compared to multiple-item constructs (Bergkvist & Rossiter, 2007).

3.5.4. Experimental checks

The experimental checks indicate that our scenarios were realistic and that all manipulations worked as planned. All checks were assessed by letting the participants reveal their opinion on several statements with a 7-point Likert-type scale (anchored at 1 = "strongly disagree" and 7 = "strongly agree"). We assessed the realism of the presented scenario with the statements, "The presented scenario is realistic" and "You could imagine yourself in a similar situation" from Dabholkar (1994). The mean score across the two checks was high ($M_{realism} = 5.97$). We evaluated the manipulations of relationship history and force majeure declaration with two single items, by assessing the statements "Prior to the disruption, you had a really good relationship history with Alpha," and "Alpha issued a written letter declaring force majeure to you after the disruption." Results indicate that the mean score of the excellent relationship history scenarios was significantly higher than those in the poor relationship history scenarios ($M_{relationship, excellent} = 6.32$, $M_{relationship, poor} = 3.10$, $p = 0.000$). Similarly, the mean score of the force majeure declaration scenarios was significantly higher than those in the no declaration scenarios ($M_{FMdeclaration, yes} = 5.76$, $M_{FMdeclaration, no} = 3.39$, $p = 0.000$).

3.5.5. Results

In line with methodological recommendations, we aimed for at least 20 observations per cell to ensure sufficient statistical power (Lonati et al., 2018; Simmons et al., 2011). As presented in Table 3.7, summarizing the descriptive statistics, the treatment cells fulfill this condition. Figure 3.2illustrates the mean scores of our two dependent variables for the four treatment groups.

Table 3.7 Dependent variables cell means, standard deviation, and number of observations

Factor manipulation			Immediate action		Switching intention	
Relationship history	Force majeure declaration	Observations	M	SD	M	SD
Poor	No	35	6.23	1.00	4.71	1.76
Poor	Yes	34	5.65	1.74	5.00	1.67
Excellent	No	37	6.16	1.26	3.16	1.85
Excellent	Yes	28	5.71	1.68	4.18	1.85
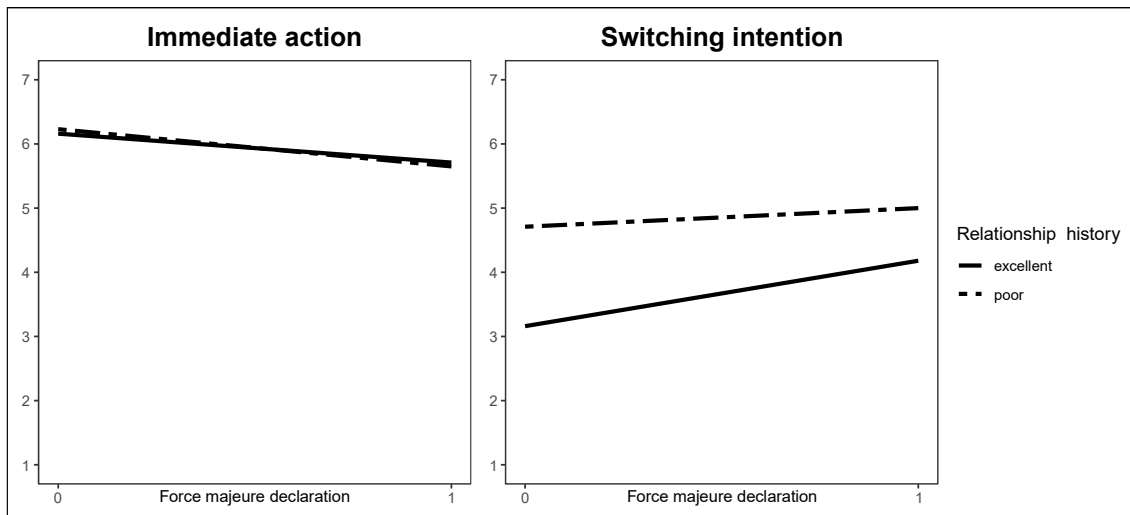
Figure 3.2 Dependent variables mean scores per treatment group

We tested the hypotheses using a multivariate analysis of variance (MANOVA); the results are shown in Table 3.8. While immediate action (i.e., response speed) is high in all four scenarios, the presence of a force majeure declaration has a statistically significant effect on the dependent variable ($p = 0.039$). This suggests that a force majeure declaration is likely to slow the disruption response of the recipient and thus provides support for hypothesis 1. The varying relationship history produced no statistically significant difference on immediate action, and neither did the interaction effect of the experimental treatments. Hence, the results indicate that buyers want to act quickly and find a solution with the supplier, independent of whether the supplier had a poor or excellent relationship history, thereby not supporting hypothesis 3a.

However, regarding switching intentions, the relationship history explains much of the variance in the dependent variable. The switching intentions are lower in both scenarios with excellent relationship history ($p = 0.000$), as illustrated in Figure 3.2. The lowest switching intentions were indicated with the supplier waiving a force majeure claim and an excellent relationship history. The presence of a force majeure declaration in the scenarios had a statistically significant effect on switching intentions ($p = 0.041$). This suggests that when buyers face a force majeure declaration, they are not only slightly delaying their response actions but also tend to switch suppliers more likely, providing support for hypothesis 2. The increase in switching intentions due to a force majeure declaration seems to be larger for suppliers with an excellent relationship history (Figure 3.2). Although the interaction effect in the MANOVA (Table 3.8) was not statistically significant, a planned contrast analysis revealed that the effect of a force majeure declaration on switching intentions is more pronounced with suppliers having an

excellent relationship history ($p = 0.024$), providing a partial support for hypothesis 3b. Further post-hoc analyses are reported in the next section.

Table 3.8 MANOVA results

Variables	Immediate action				Switching intention			
	df	SS	MS	F	df	SS	MS	F
Relationship history	1	0.02	0.02	0.01	1	52.72	52.72	16.62 ***
Force majeure declaration	1	8.88	8.88	4.33 *	1	13.45	13.45	4.24 *
Relationship history × Force majeure declaration	1	0.15	0.15	0.07	1	4.42	4.42	1.39
Residuals	130	266.68	2.05		130	412.28	3.17	

Note: SS refers to "sum of squares", *MS* refers to "mean square", and *df* refers to "degrees of freedom"; $n = 134$. †$p < 0.10$, *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

3.5.6. Quantitative post-hoc analysis

To receive a more profound understanding of the results and their robustness, we performed a post-hoc analysis by applying an alternative estimation approach. For this, we performed ordinary least squares (OLS) regressions for our two dependent variables *immediate action* and *switching intention*. Following comparable studies (e.g., Wang et al., 2022) we included years of work experience. In addition, we considered experience with force majeure declarations as a binary variable, as this might affect our dependent variables. The results are presented in Table 3.9.

Table 3.9 Regression results of the post-hoc analysis

Variables	Immediate action			Switching intention		
	β	SE	CI	β	SE	CI
Constant	5.64 ***	0.33	[5.00, 6.28]	4.50 ***	0.42	[3.68, 5.32]
Controls						
Work experience	0.03 *	0.01	[0.00, 0.06]	0.01	0.02	[–0.02, 0.05]
Force majeure experience	0.14	0.29	[–0.44, 0.72]	–0.24	0.38	[–0.99, 0.50]
Main effects						
Relationship history	0.00	0.24	[–0.49, 0.48]	–1.19 ***	0.31	[–1.81, –0.58]
Force majeure declaration	–0.51 *	0.24	[–0.99, –0.03]	0.64 *	0.31	[0.03, 1.26]
F	2.78 *			5.40 ***		
R^2	0.08			0.14		

Note: OLS regression was used ($n = 134$). Regression estimates (*β*) and standard errors (*SE*) refer to unstandardized regression coefficients. *CI* refers to bootstrapped (1,000 reps) 95%-confidence intervals. "Poor" relationship history and "no" force majeure declaration served as the baseline categories. The highest variance inflation factor (VIF) among the independent variables is 1.073. †$p < 0.10$, *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

The OLS regression results are consistent with our first analyses. Whereas relationship history has no effect on immediate action, it represents the largest (negative) influence on switching intention. As mentioned before, 76.1% of our sample has received at least one force majeure declaration from their interfirm partners (e.g., suppliers) in the past, which however had no statistically significant effect on our dependent variables. Only overall work experience had a small statistically significant positive effect on

immediate action ($p = 0.022$). That indicates that all else being equal, buyers with more experience will act faster to support the disrupted supplier.

Consistent with our first analyses, a force majeure declaration has a statistically significant negative effect on immediate action and a positive effect on switching intention. Including an interaction effect with relationship history in our switching intention regression equation again did not increase statistically significant the explained variance. Yet, the interaction effect might only be statistically significant at certain values of relationship history. A following floodlight analysis (Spiller, Fitzsimons, Lynch, & Mcclelland, 2013) in Figure 3.3 suggests a conditional relationship: when relationship history is good to excellent, the slope of the interaction effect (force majeure declaration) is statistically significant different from zero ($p < 0.05$). Providing partial support for hypothesis 3b, the analysis indicates that force majeure declarations might be perceived as even worse for suppliers with a good relationship history, leading to a greater increase in switching intentions.
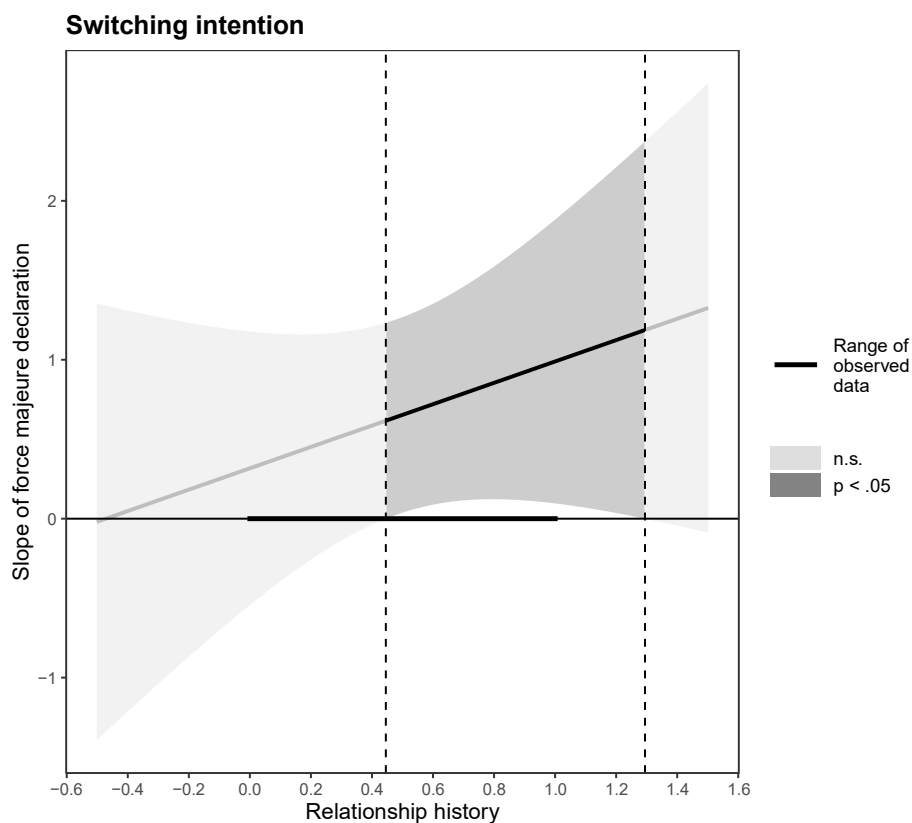
Figure 3.3 Johnson-Neyman plot of relationship history and force majeure declaration

3.6. Discussion

Despite the abundant literature on supply risk and disruptions, the related issue of force majeure declarations remained largely unaddressed. Based on qualitative studies, including a unique dataset of force majeure declarations, and a subsequent experiment, our findings provide novel insights for research and important implications to managers on responding to supplier force majeure declarations.

3.6.1. Theoretical implications

The pertinent management literature views force majeure as purely exogenous and in most cases attributable to an act of nature (e.g., Hartmann & Moeller, 2014; Polyviou et al., 2018; Wang et al., 2022). The findings of the qualitative study extend the reasons by considering developments arising from the COVID-19 pandemic, such as government orders, quarantine staff, travel restrictions, and border closures. In fact, government orders were the major reason (65.1% of letters) in the force majeure declaration dataset of our case study. In line with the literature, without a valid pandemic-related clause in the contract, companies usually tried to cite the consequences of the pandemic, namely government measures, which are covered by most standard force majeure clauses (Mouzas, 2016; Schwartz, 2020). While the implications of those reasons are similar to those of other acts of nature and people (forces majeures), the behavior regarding force majeure issues in buyer-supplier relationships has changed in the last years.

Due to the ongoing environmental uncertainty and the many ensuing supply chain disruptions, our findings suggest that the number of force majeure declarations issued in buyer-supplier relationships increased significantly. In that regard, past studies have not considered that a force majeure and a force majeure declaration have different implications, as also suggested by the findings of our experiment. The main purpose of force majeure declarations is to excuse non-performance, but the parties to a contract are not obliged to invoke them. Conversely, an event that (only) appears to be a force majeure provides an opportunity to issue a related declaration. For this reason, the relationship of force majeure declarations and supply chain disruptions is not as high as assumed by the literature; our case study indicates that only about 23.3% of the declarations resulted in a supply disruption in a sense that suppliers either did or could not deliver to the focal company as agreed. As a result, our results indicate that force majeure declarations are increasingly used with intentions other than to excuse non-performance, such as

increasing pressure in ongoing negotiations and managing the recipient's expectations in the issuer's favor.

Common ways for buying firms to respond to supply disruptions are to become less dependent on the respective supplier and look for alternatives (i.e., buffering), or to work more intensively with that supplier (i.e., bridging) (Bode et al., 2011). While research suggests that buffering will be less pronounced for supply chain disruptions due to force majeure (Polyviou et al., 2018; Wang et al., 2022), the behavior around claiming force majeure will also influence the relationship outcome. For the same disruption, the results of our experiment indicate that the presence of a force majeure declaration slows down the short-term disruption response and increases the long-term switching intentions. In line with the literature on expectation and behavior incoherence (e.g., Y.-S. Chen et al., 2019; Wang et al., 2010), the (positive) effect on switching intentions is stronger, when the relationship history was characterized by collaboration and flexibility. Even if the business relationship is maintained, the party declaring force majeure might face further unintended consequences, such as adapting contracts and a reassessment of the issuer's financial risks.

Finally, the qualitative findings reveal that force majeure declarations have the potential to cause ripple effects (Ivanov, Sokolov, & Dolgui, 2014) in supply chains, leading to further disruptions upstream and downstream. When force majeure is declared in an interfirm project, the declaring party is likely to face direct reciprocal force majeure declarations or even indirect claims from project partners affected by the recipient's reciprocal force majeure declaration.

3.6.2. Managerial implications

Our study has important messages for managers who are dealing with supplier force majeure issues. Recipients of force majeure declarations should be aware that not every claim will be justified and depends on individual and situational factors that make performance *impossible*; economic hardship alone is not sufficient. In addition, not every declaration is associated with a supply chain disruption, those "precautionary" letters with vague reasons and timelines usually aim at limiting responsibility and possible penalties in case of future disruptions. Further, force majeure declarations are increasingly used with other underlying intentions, including increasing pressure (e.g., in ongoing negotiations), managing (customer's) expectations in the issuer's favor, provoking an additional order of the customer, and getting an expedited certification process for

different production locations. When a force majeure declaration is associated with a disruption, the letter might not be final, and timelines communicated might not hold up. Recipients should be aware that if the issue is exacerbated, there will likely be follow-up force majeure declarations.

Firms affected by a force majeure should communicate this fact before declaring formally force majeure to their business partners, as an unannounced declaration will likely leave a negative impression. Further, the presence of a force majeure declaration might delay supportive actions of the recipient, because more people and departments (i.e., legal) will be involved. In addition, recipients might interpret a force majeure declaration as warning sign for further problems. In that regard, unintended consequences for the sender include adapting contracts, reassessing financial risks, and reciprocal force majeure declarations. Even if the disruption is caused by an obvious act of nature, the presence of a force majeure declaration is likely to increase the recipient's intentions to switch, or at least encourage them to seek more (customer/supply) alternatives. Potential senders should consider that this effect is even stronger, when a good business relationship was maintained with the recipient.

In summary, firms affected by a force majeure should communicate this fact to their business partners, but consider refraining from declaring formally force majeure, as this might bring unintended consequences; the counterpart will likely help, and in many cases even waive penalties.

3.6.3. Limitations and future research

There are some limitations that should be considered when interpreting the results, but also opportunities to extend this research. Due to the time frame of the qualitative studies, many force majeure declarations are at least to some extent connected to the COVID-19 pandemic. Further, the case study builds on a rather small set of letters ($n = 43$), all issued in early 2020. While this is a unique dataset, future research should try to assemble a larger dataset with force majeure declarations to enable the utilization of advanced statistical methods, such as logit regressions or mixed-effects regressions (e.g., in case of multiple declarations per supplier/customer). In that way, the relationship of reasons, time between declaration and disruption, as well as relationship outcomes could be investigated in more detail. In addition, such a dataset could provide more robustness to our findings, since for the experiment, we rely on the stated intentions (i.e., immediate action and switching intention) in response to the presented scenarios. Yet, research has

revealed that actual behavior likely differs from intentions (e.g., Manski, 1990; Morrison, 1979).

Further research opportunities include quantitative investigations (i.e., in experiments) of identified contextual factors, such as the effect of a prior announcement of the declaration on the short-term and long-term relationship outcome, for example, the extent to which a prior announcement weakens the delay of recipient's supportive actions and later switching intentions.

In particular, a more granular analysis of the intentions of potential senders of force majeure declarations constitutes an interesting future line of research. This could target understanding the threshold at which firms declare force majeure based on ambiguous events, and under which situational and behavioral circumstances. Similarly, future investigations could focus on the perceived intentions or suspicions of the recipient, and how these differ when they receive a force majeure declaration during ongoing price negotiations, or before an upcoming audit.

4. On supplier resilience: How supplier performance, disruption frequency, and disruption duration are interrelated

Co-author:

Christoph Bode
Endowed Chair of Procurement, Business School, University of Mannheim, Germany

Abstract

The negative effect of supply chain disruptions on financial performance is well documented and has been demonstrated again in recent crises. While most researchers would also argue that there is a link between an individual supplier's performance and supply chain disruptions, this assumption lacks quantitative empirical support. Based on three empirical analyses using panel data of 352 suppliers, we holistically investigate how supplier performance and disruptions are interrelated. In that regard, prior supplier performance is negatively related to the frequency and duration of disruptions, that is "bad performers" are associated with more and longer disruptions. Further, the higher the disruption intensity (*disruption frequency* × *disruption duration*), the larger the negative performance impact. For most of our sample, disruptions have a weaker negative performance impact on prior "good performers" than on prior "bad performers." These relationships also persist at a more granular level; an additional analysis reveals that disruptions have a negative effect in particular on supplier quality. This study brings important implications for practitioners and contributes to the literature on supplier resilience, as our analyses reveal that supplier performance does not only prevent disruptions, it also potentially mitigates (i.e., moderates) the latter supply disruption impact.

4.1. Introduction

"*When disasters occur, major business disruptions follow*" (Tang, 2006, p. 33).
Current geopolitical tensions, such as the Russian invasion of Ukraine, are adding to the pressure on strained supply chains, many of which are still struggling to recover from the negative effects of the COVID-19 pandemic. Its consequences, such as pervasive stockouts and delayed replenishments, are still observable. Supply chain risk management strategies of firms across almost all industries and countries were pushed beyond the limit by these variabilities in supply and demand (Dohmen, Merrick, Saunders, Stank, & Goldsby, 2022). Although supply chain management during a crisis has been studied extensively in the operations management literature, crises of this magnitude have not occurred recently (Shen & Sun, 2022).

Supply chain disruptions are known to have a negative effect on firms' financial performance and shareholder wealth (Hendricks & Singhal, 2003, 2005a, 2005b; Papadakis, 2006). While some supply chain disruptions might be unavoidable (Craighead et al., 2007), firms can try to limit their risk of occurrence or severity. In reaction to this, the operations management literature has dealt with mitigation strategies, such as increasing stock levels and flexible sourcing strategies (e.g., Craighead et al., 2007; Sheffi & Rice, 2005; Tang, 2006; Tomlin, 2006). However, antecedents and outcomes of disruptions at the level of the individual supplier remain largely unexplored, although academics have acknowledged that it is "useful to analyze the risk for each supplier" (Blackhurst et al., 2008, p. 153). In that regard, *supplier resilience* refers to the supplier's ability to detect and withstand disruptive events, and, if affected, to return quickly to normal operations (Choksy, Ayaz, Al-Tabbaa, & Parast, 2022; Rice & Caniato, 2003; Verghese, Koufteros, Polyviou, & Jia, 2022). While supplier resilience is related to the buyer's financial resilience (Durach, Wiengarten, & Choi, 2020) and to better buyer-relationships (Choksy et al., 2022), the interrelation of supplier performance and disruptions was not empirically assessed.

Like patients, we argue that suppliers were not all affected in the same way by disruptive events, such as the COVID-19 pandemic. In this regard, pre-existing conditions connected to a poor state of health (i.e., advanced age, obesity, and hypertension) were more likely to lead patients to develop severe disease courses (Wolff, Nee, Hickey, & Marschollek, 2021), and in addition, severe disease courses had a negative effect on long-term recovery compared to mild disease courses (Huang et al., 2021; Lucas et al., 2020).

Like COVID-19 affected patients differently (posterior performance) based on their state of health (prior performance) and the disease course (disruption intensity), we address the research question focusing on the individual supplier: *"How are supplier performance, disruption frequency, and disruption duration interrelated?"*

Based on three empirical analyses of panel data of 352 suppliers, our results suggest that supplier resilience is related to supplier performance in multiple ways. That is, prior supplier performance is negatively associated with disruption frequency and disruption duration (i.e., "bad performers" were the source of more and longer disruptions). The higher the disruption intensity (*disruption frequency $\times$ disruption duration*), the higher the negative impact on performance. For most of our sample, disruptions have a weaker negative performance impact on prior "good performers" than on prior "bad performers." On a more detailed level, our results also indicate that disruptions have a negative effect on supplier quality performance. Thus, our study makes a variety of contributions to the literature on supplier resilience by investigating supply chain disruptions on a supplier level and considering the impact of varying degrees of disruption frequency and duration. Our results extend the well-known disruption profile (Sheffi & Rice, 2005) by including multiple disruptions and by investigating the interrelations among performance, disruptions, and time. Like COVID-19 affected patients differently, our analyses reveal that supplier performance does not only prevent disruptions (i.e., reduce the probability), it also mitigates (i.e., moderates) the supply disruption impact.

4.2. Conceptual background and hypotheses

4.2.1. Supply chain disruptions

In the last two decades, supply chain disruptions have received ample attention by academics and practitioners. In supply chain risk management, disruption risks are distinguished from the normal supply-demand coordination risks, and relate to operational risks such as equipment malfunctions, unforeseen supply interruptions and human problems ranging from strikes to fraud, as well as risks arising from natural disasters, terrorism, and political instability (Kleindorfer & Saad, 2005). Thus, "supply chain disruptions are unplanned and unanticipated events that disrupt the normal flow of goods and materials within a supply chain" (Craighead et al., 2007, p. 132). Given that supply-side disruption risk factors are associated with greater impact on normal business

performance than customer-side factors (Bode & Wagner, 2015; Habermann, Blackhurst, & Metcalf, 2015), we focus here on risks that occur in the upstream supply chain. Those "supply disruptions" are unintended and unexpected events triggered in the network of suppliers, the inbound logistics network, or the sourcing environment and a consequential situation (e.g., supplier quality problems, delivery failures, supplier defaults, and plant fires), that significantly threatens or impairs the normal course of business operations of the focal firm (Bode & Wagner, 2015; Bode et al., 2011).

Global competition has created complex and tightly coupled inter-firm networks in which disruptions to material and information flows have become normal and unavoidable (Bode et al., 2011; Craighead et al., 2007). One way for firms to address supply side factors is by simplifying their supply chains (Bode & Wagner, 2015). Besides reducing the number of suppliers in the supply base, this includes striving for a less globally distributed supply chain. Sourcing from suppliers that are more distant from the firm leads to increased uncertainty (Zsidisin & Wagner, 2010), and longer lead times on the supplier side are significantly associated with more supply chain disruption risk factors (Habermann et al., 2015). Moreover, firms can decrease the occurrence of disruptions through building reliability into their supply chains by focusing on efficient processes, the elimination of failures, and by collaborating with their suppliers (Revilla & Saenz, 2017).

Initially, the supply chain disruption literature addressed mitigation strategies – reducing the impact of disruptions – such as increasing stock levels and flexible sourcing strategies (e.g., Craighead et al., 2007; Sheffi & Rice, 2005; Tang, 2006; Tomlin, 2006). More recently, academics focused on recovery efforts and relational outcomes of supply chain disruptions (e.g., Cheng, Craighead, Wang, & Li, 2020; Polyviou, Rungtusanatham, & Kull, 2022; Wang et al., 2022). Lastly, the COVID-19 pandemic with its resulting disruptions gave rise to studies investigating various phenomena in the context of the pandemic (e.g., Dohmen et al., 2022; El Baz & Ruel, 2021; Shen & Sun, 2022).

4.2.2. Supplier resilience and disruptions

Supplier resilience refers to the supplier's ability to withstand disruptive events and to return quickly to normal operations (Choksy et al., 2022; Rice & Caniato, 2003; Verghese et al., 2022). Supplier resilience is thus operationalized by the ability to detect, respond to, and recover from disruptive events (Ambulkar, Blackhurst, & Grawe, 2015; Durach et al., 2020). Yet, besides scrutinizing the relationship of supplier resilience and the

buyer's financial resilience (Choksy et al., 2022), the literature on supplier resilience focused mostly on influencing supplier resilience by the buying firm through, for example, customer benevolence and different leadership styles (Verghese, Koufteros, & Huo, 2019; Verghese et al., 2022).

In general, disruptions tend to follow a specific profile in terms of their effect on a firm's performance, whether measured by sales, production rate, profit, or another relevant metric (Sheffi & Rice, 2005). After a triggering event, performance will drop significantly until, during the recovery process, it converges to a steady level below, above, or similar to the pre-disruption performance. In practice, predicting supply disruptions poses great challenges (Blackhurst et al., 2008), although arguably "[p]rior to their actual occurrence, all crises send out a repeated train of early warning signals" (Mitroff, 2000, p. 102). While some disruptions, such as those triggered by earthquakes are almost impossible to predict, the likelihood of accidents, supply shortages, or human-centered issues such as labor strikes is also hard to determine (Sheffi & Rice, 2005). Supply chain managers themselves have an important role in predicting disruptions, as risks perceived from suppliers seem to be good indicators of supply disruptions (Zsidisin & Wagner, 2010). We will therefore argue that prior (bad) performance will act as an early warning signal (i.e., Mitroff, 2000) for supply disruptions. Suppliers that perform well, have better preconditions, by, for example, incorporating the latest technological advances in their operations and adhering to specified quality standards, which eventually result in a decreased likelihood of supply risk (Zsidisin & Ellram, 2003) through an improved ability to detect and respond to disruptions (Ambulkar et al., 2015). In turn, suppliers with incoming product problems, ineffective (labor) management and financial instability, will perform worse, and thus, represent significant supply risk sources with a higher frequency of disruptions (Wagner & Neshat, 2012; Zsidisin & Wagner, 2010). Taken together, these arguments lead to the following hypothesis:

Hypothesis 1. *Disruption frequency is <u>negatively</u> related to prior supplier performance.*

In addition to their frequency, the duration of disruptions is a critical determinant of the reaction of buying firms (Mehrotra & Schmidt, 2021). Suppliers that adopt professional supply chain management strategies and processes not only demonstrate increased supply chain performance, but also better management of supply risks (Wagner & Neshat, 2012; Zsidisin & Ellram, 2003). In terms of supplier resilience, those strategies and processes could hasten the detection of disruptions and initiation of countermeasures

(Ambulkar et al., 2015), resulting in less severe (Craighead et al., 2007) and shorter supply disruption at the buying firm. In this vein, practitioners report that when disruptions are well managed, customers never know that they have occurred (Macdonald & Corsi, 2013). As mentioned in the introduction, like COVID-19 patients in poor health and with pre-existing conditions (e.g., advanced age, obesity, cancer, and hypertension) were more likely to develop severe and longer-lasting disease courses (Dai et al., 2020; Wolff et al., 2021), suppliers with a good prior performance might more quickly fend off the disruption. Taken together, these arguments lead to the following hypothesis:

Hypothesis 2. *Disruption duration is <u>negatively</u> related to prior supplier performance.*

4.2.3. Supply disruption impact

Besides identifying risks and vulnerabilities, the assessment of risks is an integral part of supply risk management, and serves to reveal the potential harm to the firm from supply disruptions (Kleindorfer & Saad, 2005). Supply disruptions can impact firms financially, through the costs incurred as a result of the disruption, and in terms of services, as suppliers are not able to dedicate as much attention to satisfying customer demand as in a normal operating environment. Yet, practitioners (i.e., purchasers) struggle to track direct disruption-related costs and instead focus on recovery efforts (Macdonald & Corsi, 2013). Because if customer relationships are damaged, the impact of a disruption can be especially long-lasting (Sheffi & Rice, 2005). Thus it comes as no surprise that, a firm's dissatisfaction with a supplier increases with the impact of a disruption (Primo et al., 2007) which then affects the buying firm's reaction (Bode et al., 2011). Therefore, the impact of a disruption is important information that a firm interprets (Primo et al., 2007).
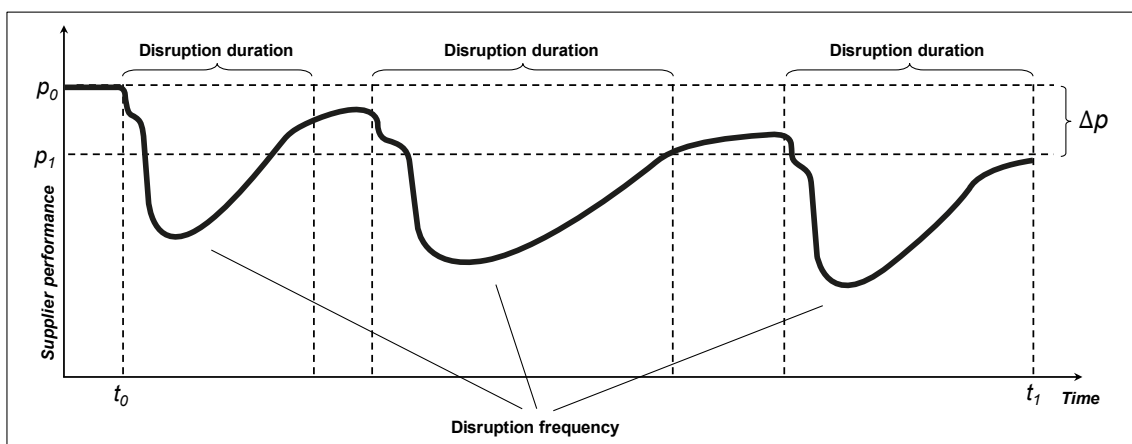
Figure 4.1 Multiple disruption profiles and supplier performance (based on Sheffi & Rice, 2005)

Frequent supply disruptions are related to a negative impact on the buying firm's plant operating performance, including cost performance and cycle times (Brandon-Jones, Squire, & Van Rossenberg, 2014). In general, firms try to recover quickly from disruptions to mitigate the effects of negative performance. Yet, the duration of a disruption duration is not only critical for the respective supplier, but also important information for determining the buying firm's mitigation of its own negative effects (Mehrotra & Schmidt, 2021). As shown in Figure 4.1, we argue that both the duration and the frequency of a disruption are detrimental to performance. Multiple supply disruptions, even short ones, might pile up (Figure 4.1), harming the supplier's internal and external processes, and lead to lasting problems with supplier quality, poor logistics performance, or fluctuations in capacity. In that sense, those consequences could be comparable to those caused by a single severe disruption. Therefore, we characterize disruption intensity as a measure of disruption severity over a period of time, which takes into account both the duration and the frequency of a disruption. Disruption intensity will have negative effects on supplier performance, just as severe cases of COVID-19 had a negative effect on long-term recovery (Huang et al., 2021; Lucas et al., 2020). Taken together, these arguments lead to the following hypothesis:

Hypothesis 3. *Posterior supplier performance is <u>negatively</u> related to disruption intensity.*

As mentioned before, higher performing (resilient) suppliers have processes that hasten the detection of disruptions and the initiation of countermeasures, resulting in less severe disruptions (Ambulkar et al., 2015; Craighead et al., 2007; Durach et al., 2020). Not only faster detection, but also predefined strategies for handling those disruptions are seen as more likely to be connected with recovery actions that lead to a positive perception of performance (Macdonald & Corsi, 2013). Even when higher performing suppliers are disrupted, the negative impact on performance will be weaker (i.e., due to a higher resilience / better recovery processes) than with lower-performing suppliers facing similar severe disruptions. Therefore, as illustrated in our conceptual framework shown in Figure 4.2, we argue that good prior supplier performance both prevents disruptions (i.e., reduces their probability), and mitigates (i.e., moderates) the impact of those disruptions. Taken together, these arguments suggest the following hypothesis:

Hypothesis 4. *The negative impact of disruption intensity on posterior supplier performance is moderated by prior supplier performance; the better the prior supplier performance, the less the impact.*
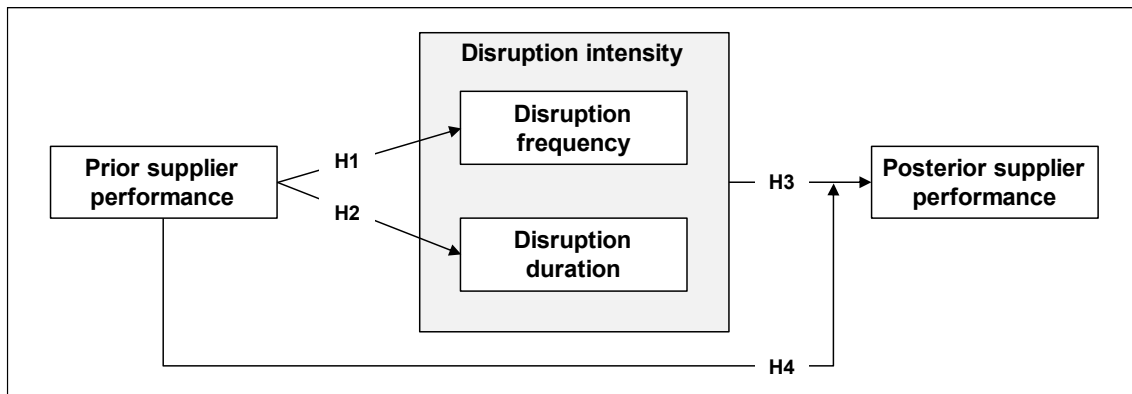
Figure 4.2 Conceptual framework of supplier performance and disruptions

4.3. Data and measures

4.3.1. Data collection

To examine the hypothesized relationships between supplier performance, disruption duration, and disruption frequency, we compiled a unique supplier panel dataset. The data stem from a heterogenous set of 352 suppliers, distributed worldwide and from various industries (Table 4.1), all of which supply to the same focal buying firm. The 352 suppliers are the firm's top suppliers, which collectively capture 80% of the direct spend, and thus are subject to annual performance evaluations. The buying firm is a German manufacturing (industrial machinery) business-to-business company with subsidiaries in Europe, Asia and America, a total turnover of over 4 billion Euro, and more than 10,000 employees worldwide. By focusing on the supplier base of one firm, we reduce the range of exogenous variations that could affect the variables of interest and ensure that factors such as market position, corporate culture, or supplier management policy are held constant over the entire sample, which should improve the internal validity of our findings (J. Chen et al., 2016; Subramani & Venkatraman, 2003). Relevant variables of the dataset include the supplier's location, material group, strategic importance, and the performance evaluation (from the perspective of focal buying firm) on costs, quality, and logistics over a two-year horizon (i.e., two data-points per supplier).

This panel data was complemented with data collected from analyzing protocols of weekly supply situation calls with the heads of the logistics and purchasing departments of the focal buying firm, and the statements of lead buyers. Between March 2020 and January 2021, 69 of the 352 suppliers were associated with a total of 109 disruptions varying in duration, which hit the focal buying firm. As previously defined, a disruption in the dataset refers to an unexpected event at the individual supplier and a

subsequent deviation of a magnitude severe enough to be discussed in the weekly supply situation calls. Although the reason of all of these supply disruptions could not be identified, Table 4.2 shows the frequency of selected recorded reasons from the supply situation calls, including sub-supplier issues, quarantined personnel, and missing steel with varying mean disruption durations.

Table 4.1 Supplier sample characteristics

Variable	*n*	*%*
Material group		
Machined/ Unmachined parts	65	18.47%
Weldments/ Springs / Knifes	63	17.90%
Hydraulics	38	10.80%
Power train/ Drivelines	33	9.38%
Electrics/ Electronics	33	9.38%
Tires/ Rims/ Bearings	25	7.10%
Power Pac	24	6.82%
Production materials/ Filters/ Belts	21	5.97%
Coatings/ Paintings/ Plastics	21	5.97%
Cabins	15	4.26%
Steel	14	3.98%
	∑ 352	100%
Country		
Germany	166	47.16%
France	48	13.64%
Italy	30	8.52%
Hungary	16	4.55%
India	11	3.13%
USA	9	2.56%
Netherlands	9	2.56%
Poland	8	2.27%
Czechia	7	1.99%
Slovakia	6	1.70%
Russia	6	1.70%
Belgium	6	1.70%
United Kingdom	5	1.42%
Türkiye	5	1.42%
Other	20	5.68%
	∑ 352	100%

Table 4.2 Selected reasons mentioned for supply disruption

Reason	*n*	*%*	Disruption duration (weeks)	
			M	*SD*
Sub-supplier issues	14	36.84%	3.79	2.96
Quarantined staff	9	23.68%	7.07	5.60
Production capacity issues	6	15.79%	7.60	13.15
Lockdown/ shutdown	4	10.53%	5.50	3.51
Transport issues	2	5.26%	9.25	10.25
Steel missing	2	5.26%	2.50	0.71

4.3.2. Measures

Dependent variables

The dependent variables of our empirical analyses are disruption frequency, disruption duration, and posterior supplier performance. *Disruption duration* (DD) is the amount of time (in weeks per supplier) a disruption took. *Disruption frequency* (DF) refers to the count of disruptions per supplier in the 11-month time window from March 2020 to January 2021. For disruptions to be considered separate events, there had to be an interval of at least two weeks of normal business operations between them to ensure that they are not directly related to the other. To measure *posterior supplier performance* (P_1), we use "supplier overall performance," a yearly index calculated as the arithmetic mean (unweighted average) of three supplier performance dimensions: costs, quality, and logistics, which also form the main part of the competitive priorities framework in operations management (e.g., Krause, Pagell, & Curkovic, 2001; Ward, McCreery, Ritzman, & Sharma, 1998). The cost performance dimension reflects, cost savings and development cost plans. Quality performance includes product quality in parts per million, supply quality, disturbance rates, and quality management systems. Logistics performance includes, for example, delivery time and quantity accuracy, and logistics disturbance rates. The performance indicators are based on reports from the ERP system and are compiled annually into the respective performance indices. All three supplier performance variables, and consequently overall supplier performance, are measured on a 0 to 100 scale, with 100 being the best score. For posterior supplier performance, we use the 2021 value of this index.

Independent variables

The independent variables of our empirical analyses are prior supplier performance and disruption intensity. For *prior supplier performance* (P_0) we use the 2019 value of the supplier overall performance index described above (i.e., the arithmetic mean of the dimensions costs, quality, and logistics). Finally, *disruption intensity* (DI) measures the disruption severity over a period of time for the supplier and was calculated as the product of disruption frequency and mean disruption duration (i.e., measured in weeks).

Control variables

We use several control variables for our empirical analyses: Strategic importance, material group, and national lockdown. *Strategic importance* (SI) refers to the importance

of the individual supplier to the focal firm, measured on a 4-point rating scale ranging from 1 = "supplier with no potential" to 4 = "strategic supplier." We included this variable as a control variable because strategic suppliers might allocate more resources and attention to the focal firm which might influence the frequency and duration of a disruption. In turn, when strategic suppliers are facing severe disruptions, the impact on performance might be stronger and more critical to the buying firm (Craighead et al., 2007).

The *national lockdown* (NL) variable aims at considering the effects of governmental decisions such as production shutdowns. While production facilities in many countries in our sample, like the UK, the USA, and Germany stayed open, other countries closed their non-essential shops, factories and other businesses for multiple weeks (e.g., 8 weeks in France and 3 weeks in India; Ahmed, 2020; Salaün & Lough, 2020) to slow the spread of COVID-19. With regard to disruption duration, the national lockdown variable is also measured in weeks, so we assigned the number of production shutdown weeks based on the country for each supplier. Countries where there was no production shutdown (e.g., UK, Germany) were assigned the value 0 for the national shutdown variable.

Finally, we included the *supplier's material group* (MG) at the focal firm as a control variable to consider, for example, industry effects and varying category strategies, which could influence the supplier's performance, and the frequency and duration of the disruption.

4.4. Analyses and results

Given that the hypotheses address three dependent variables (Figure 4.2), we report our results in three analyses: Analysis 1 investigates the effects of prior supplier performance on disruption frequency (Hypothesis 1); Analysis 2 scrutinizes the effects of prior supplier performance on disruption duration (Hypothesis 2); and Analysis 3 focuses on the impact of disruptions on the supplier's performance (Hypothesis 3) and the moderating effect of prior supplier performance (Hypothesis 4). As is common with longitudinal data, we faced minor issues with missing data. Although the focal buying firm meticulously measures supplier performance, for posterior supplier performance (P_1), 20 of the 352 suppliers were rated on their quality and logistics performance only, but not on their costs performance. Following methodological recommendations, we neither imputed the

missing values, nor list-wise deleted the data of the 20 suppliers, but calculated the overall performance based on two posterior supplier performance items (Newman, 2014). Table 4.3 presents the descriptive statistics and bivariate correlations for all dependent, independent, and control variables. Robustness analyses (e.g., regarding other approaches handling the missing data) are discussed at the end of this section.

Table 4.3 Descriptive statistics and correlations

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) Strategic importance	—						
(2) National lockdown	–0.10	—					
(3) Disruption frequency	–0.01	0.10	—				
(4) Disruption duration	0.01	0.03	0.45***	—			
(5) Disruption intensity	0.00	0.02	0.59***	0.93***	—		
(6) Prior supplier performance	0.19***	–0.22***	–0.19***	–0.13*	–0.12*	—	
(7) Posterior supplier performance	0.13*	–0.13*	–0.28***	–0.20***	–0.22***	0.56***	—
Minimum (*Min*)	1.00	0.00	0.00	0.00	0.00	40.72	39.12
Maximum (*Max*)	4.00	8.00	4.00	31.00	32.00	98.91	100.00
Mean (*M*)	3.37	1.96	0.31	0.78	1.07	80.42	79.87
Standard deviation (*SD*)	0.78	3.25	0.71	2.68	3.53	9.91	9.76

Note: Pearson product-moment correlation coefficients are shown below the diagonal ($n = 352$); *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$ (equals $|r| > 0.10$, 0.14, and 0.17, respectively).

4.4.1. Analysis 1 – Prior supplier performance and disruption frequency

Considering that the dependent variable at hand (*disruption frequency*, DF) takes on only non-negative discrete values, the first hypothesis is best investigated using count regression. The common starting point of a count regression is the Poisson regression, yet actual data usually has too much variability (i.e., overdispersion) to be represented by standard Poisson regression (Coxe, West, & Aiken, 2009). In our case, the mean value of our dependent variable is lower than its variance ($M_{DF}/\sigma_{DF} = 0.61$) and a subsequent likelihood ratio test (Cameron & Trivedi, 1986; Hilbe, 2011) revealed a statistically significant ($p < 0.001$) overdispersion in the data. To account for the overdispersion, we followed prior studies (e.g., Bellamy, Ghosh, & Hora, 2014; Bode & Wagner, 2015) and adopted a negative binomial model, in which it is assumed that there is unexplained variability between individuals having the same predicted value (Coxe et al., 2009). Further, a comparison of the predicted and actual probabilities indicated that the negative binomial model captures the probability mass better than the standard Poisson model, a zero-inflated negative binomial model, or a zero-inflated Poisson model (Bode & Wagner, 2015; Long & Freese, 2006). Therefore, we estimated the following two models:

$$lnE(DF_i|\cdot) = b_0 + b_1 SI_i + b_2 NL_i + \sum_{k=1}^{10} b_{3,k} MG_{k,i} + \varepsilon_i \tag{1}$$

$$lnE(DF_i| \cdot) = b_0 + b_1 SI_i + b_2 NL_i + \sum_{k=1}^{10} b_{3,k}\, MG_{k,i} + b_4 P_{0,i} + \varepsilon_i \qquad (2)$$

Following a hierarchical approach, we entered our control variables as a block in model 1, followed by the main effect variables in model 2. Based on likelihood ratio tests, the model fit increased and model 2 was statistically significant ($p < 0.05$). No indications for multicollinearity were found, zero-order correlations among the variables were relatively low, and variance inflation factors ($VIF_{max} = 1.77$) were below the commonly suggested thresholds for both models (Cohen, Cohen, West, & Aiken, 2003). Our results are reported in Table 4.4.

Table 4.4 Results of negative binomial regression

Variables	Model 1: Control variables			Model 2: Main effect		
	b	*SE*	*CI*	*b*	*SE*	*CI*
Constant	–0.36	0.67	[–1.64; 0.93]	2.56 *	1.11	[0.29, 4.93]
Controls						
Strategic importance	–0.06	0.16	[–0.37; 0.26]	0.03	0.16	[–0.29, 0.35]
National lockdown	0.06	0.04	[–0.02; 0.13]	0.04	0.04	[–0.04, 0.12]
Material group						
Electrics / Electronics	–0.32	0.50	[–1.30; 0.65]	–0.21	0.48	[–1.17, 0.75]
Cabins	–0.55	0.66	[–1.88; 0.74]	–0.67	0.66	[–1.99, 0.62]
Weldments/ Springs / Knifes	–1.00 *	0.47	[–1.93; –0.10]	–0.83 †	0.47	[–1.76, 0.07]
Machined/ Unmachined parts	–1.02 *	0.46	[–1.94; –0.13]	–1.04 *	0.46	[–1.95, –0.15]
Production materials/ Filters/ Belts	–1.42 †	0.74	[–3.05; –0.04]	–1.16	0.75	[–2.79, 0.22]
Steel	–1.41	0.88	[–3.42; 0.20]	–1.30	0.85	[–3.31, 0.29]
Hydraulics	–0.75	0.51	[–1.78; 0.25]	–0.65	0.51	[–1.68, 0.34]
Power Pac	–0.87	0.60	[–2.09; 0.29]	–0.92	0.60	[–2.13, 0.23]
Coatings/ Paintings/ Plastics	–1.38 †	0.70	[–2.84; –0.07]	–1.12	0.72	[–2.59, 0.20]
Tires/ Rims/ Bearings	–0.82	0.59	[–2.01; 0.32]	–0.68	0.58	[–1.87, 0.46]
Main effect						
Prior supplier performance				–0.04 **	0.01	[–0.07, –0.01]
–Log Likelihood	240.48			235.86		
Likelihood ratio (χ^2)	13.27			22.51 *		
$\Delta\chi^2$	—			9.24 **		
McFadden's Pseudo R^2	0.03			0.05		
Cragg–Uhler (Nagelkerke) Pseudo R^2	0.05			0.08		

Note: Negative binomial regression was used ($n = 352$). Dependent variable is *disruption frequency* (count of disruptions in a 11-month period). "Power train / Drivelines" served as the baseline material group. Table shows regression estimates (*b*), standard errors (*SE*) and bootstrapped (1,000 reps) 95%-confidence intervals (*CI*). †$p < 0.10$, *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

The results of model 1 indicate that various material groups have a statistically significant influence on disruption frequency. Including our independent variable prior supplier performance in the full model 2, suppliers of the material group "machined/unmachined parts" were still statistically significant less often disrupted than the other material groups ($b_{3,4} = -1.04, p < 0.05$). Further, prior supplier performance has a statistically significant negative effect on the frequency of disruptions ($b_4 = -0.04, p < 0.01$). That means, that better performing suppliers are less often disrupted, and poorly performing suppliers are more often disrupted. Figure 4.3 shows the

corresponding plot and suggests that the relationship between supplier performance and disruption frequency is not constant. A performance increase could be especially beneficial at poorly performing suppliers as the frequency of disruptions increases disproportionately with decreasing supplier performance.
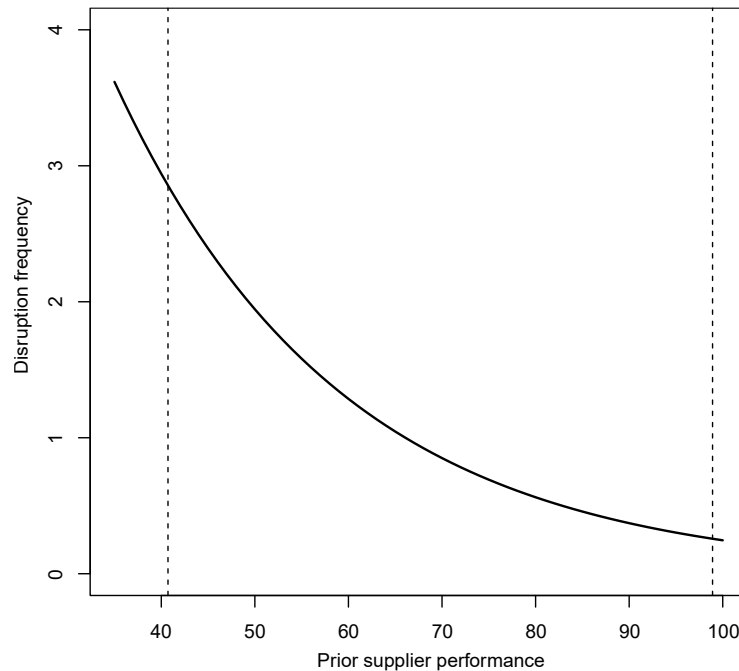
Figure 4.3 Direct effect of prior supplier performance on disruption frequency

Note: Dashed lines indicate the minimum and maximum values of the prior supplier performance. "Power Train / Drivelines" served as the baseline material group; all other control variables were kept at their mean.

Given that our regression results in Table 4.4 cannot be interpreted directly as marginal effects (Hoetker, 2007), we additionally computed the marginal effects of prior supplier performance on disruption frequency using the delta method. In this regard, the marginal effect of a predictor is the expected rate of change in the dependent variable as a function of the change in the specified predictor, with the values of the other predictors (i.e., control and independent variables) held at some constant value (Hilbe, 2011).

Table 4.5 Marginal effect of prior supplier performance on disruption frequency

Variable		Unstandardized (change per 1 unit)		
		$\delta y/\delta x$	*SE*	*CI*
Prior supplier performance	Marginal effect at mean	−0.011 **	0.004	[−0.018, −0.004]
	Average marginal effect	−0.013 *	0.005	[−0.023, −0.003]

Note: Table shows marginal effects (based on estimates of Model 2) calculated using the delta method, standard errors (SE), and bootstrapped (1,000 reps) 95%-confidence intervals (CI). *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

As shown in Table 4.5, the (unstandardized) marginal effect of prior supplier performance on disruption frequency is −0.013. While this might not seem much on an

individual supplier basis, each percent difference in performance of the whole 352 supplier sample relates to an average of 4.58 disruptions in the 11-month time frame. Taken together, the results of our first analysis provide empirical support for the first hypothesis.

4.4.2. Analysis 2 – Prior supplier performance and disruption duration

In our second analysis, the dependent variable is *disruption duration* (DD), and we investigated whether prior bad performing suppliers are linked to longer disruptions. Considering the continuous correlated multilevel data – as some suppliers in our sample were source of more disruptions (Table 4.3) with various durations – we opted for a linear mixed-effects regression. Mixed-effects regressions incorporate both random and fixed effects in a linear expression with which the conditional mean of the response can be assessed (Luke, 2017). This approach allows us to model the independent variable and the control variables as fixed effects in addition to the supplier as a random effect to account for the within-subject variance. Thus, we estimated (each) disruption duration with the following model (indices: j = disruption; i = supplier):

$$DD_{j,i} = \gamma_0 + \gamma_1 SI_i + \gamma_2 NL_i + \sum_{k=1}^{10} \gamma_{3,k} MG_{k,i} + \gamma_4 P_{0,i} + u_i + \varepsilon_{j,i} \tag{3}$$

Consistent with methodological recommendations (Luke, 2017), we fitted the model using a restricted maximum likelihood (REML) estimator and derived *p*-values using the Satterthwaite approximation. The results are presented in Table 4.6.

Overall, the mixed-effects model explains 16% of the variance in each disruption duration. While the results do not suggest statistically significant influences of the supplier's strategic importance or material group, there is a statistically significant effect of prior supplier performance on our dependent variable. In this regard, every additional percent in prior supplier performance decreases each disruption duration and thus supports Hypothesis 2 ($\gamma_4 = -0.04, p < 0.05$). That means on average a 25% difference in individual supplier performance relates to one week of disruption duration for every disruption. Finally, the effect of the duration of the national lockdowns (i.e., production shutdowns) on disruption duration was not statistically different from zero, maybe due to pre-existing inventory for the relevant weeks of the shutdown or a possible delivery from a different location.

Table 4.6 Results of mixed effects regression

Variables	Model 3		
	γ	*SE*	*CI*
Constant	3.35 [*]	1.49	[0.51, 6.37]
Controls			
Strategic importance	0.13	0.21	[–0.29, 0.55]
National lockdown	0.00	0.05	[–0.10, 0.10]
Material group			
Electrics / Electronics	0.15	0.70	[–1.20, 1.49]
Cabins	–0.22	0.91	[–2.05, 1.60]
Weldments/ Springs / Knifes	0.83	0.62	[–0.37, 2.04]
Machined/ Unmachined parts	0.02	0.61	[–1.19, 1.28]
Production materials/ Filters/ Belts	0.24	0.85	[–1.47, 2.00]
Steel	–0.57	0.97	[–2.47, 1.40]
Hydraulics	0.36	0.70	[–1.04, 1.81]
Power Pac	0.26	0.79	[–1.33, 1.78]
Coatings/ Paintings/ Plastics	–0.23	0.83	[–1.93, 1.35]
Tires/ Rims/ Bearings	1.25	0.78	[–0.21, 2.82]
Main effect			
Prior supplier performance	–0.04 [*]	0.02	[–0.07, –0.01]
Conditional R^2	0.16		
Marginal R^2	0.03		

Note: Restricted maximum likelihood (REML) estimator was used (*observations* = 392, *groups* = 352). Dependent variable is *disruption duration* (duration of a single disruption). "Power Train / Drivelines" served as the baseline material group. Table shows regression estimates (*γ*), standard errors (*SE*) and bootstrapped (1,000 reps) 95%-confidence intervals (*CI*). R^2 were calculated following Nakagawa and Schielzeth (2013). †$p < 0.10$, *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

4.4.3. Analysis 3 – Disruption intensity and posterior supplier performance

Now, we investigate the relationship between disruption intensity and posterior supplier performance (P_1) and ask whether prior supplier performance (P_0) moderates this relationship. As our panel data only includes two observations per supplier, we applied a pooled ordinary least squares (OLS) regression with our supplier panel data to test our predictions (Hypotheses 3 and 4) (Baltagi, 2005; Baltagi & Griffin, 1997). There are discussions whether including a lagged dependent variable as an independent variable is appropriate in an OLS regression, as they can suppress the explanatory power of other independent variables (Achen, 2000). In turn, other studies encourage including lagged dependent variables in OLS regressions to address residual serial correlation, which is common in time series data (Keele & Kelly, 2006). In case the relationships analyzed are to some extent dynamic, OLS regressions with a lagged dependent variable provides estimates that are superior to other models or estimators (i.e., general least squares) even in the case of (minor) residual auto correlation (Keele & Kelly, 2006). Eventually, we estimated the following models with an OLS estimator in hierarchical order:

$$P_{1,i} = \beta_0 + \beta_1 SI_i + \beta_2 NL_i + \sum_{k=1}^{10} \beta_{3,k}\, MG_{k,i} + \varepsilon_i \tag{4}$$

$$P_{1,i} = \beta_0 + \beta_1 SI_i + \beta_2 NL_i + \sum_{k=1}^{10} \beta_{3,k}\, MG_{k,i} + \beta_4 P_{0,i} + \beta_5 DI_i + \varepsilon_i \tag{5}$$

$$P_{1,i} = \beta_0 + \beta_1 SI_i + \beta_2 NL_i + \sum_{k=1}^{10} \beta_{3,k}\, MG_{k,i} + \beta_4 P_{0,i} + \beta_5 DI_i + \beta_6 P_{0,i} \times DI_i + \varepsilon_i \qquad (6)$$

As shown in Table 4.7, control variables were entered in model 4, followed by the main effect variables in model 5, and the interaction effect in model 6. While the control variables in model 4 already explained about 13% of the variance of the dependent variable, including the independent variables in model 5 significantly increased the explained variance by 29% ($p < 0.001$) and enhanced the model fit. However, including the interaction term in model 6 did not improve the explained variance compared to model 5 in a statistically significant way ($p > 0.05$). We found no indications of multicollinearity as zero-order correlations and variance inflation factors of the included variables were low ($VIF_{max} = 1.27$), and thus, below the commonly suggested thresholds (Cohen et al., 2003).

In model 5, we investigate the direct effect of disruption intensity on posterior supplier performance. Our results reveal that disruption intensity has a negative impact on posterior supplier performance. The longer and more often a supplier is associated with a disruption, the larger the impact on its posterior performance, supporting Hypothesis 3 ($\beta_5 = -0.47, p < 0.001$). Unsurprisingly, prior supplier performance – as a lagged dependent variable – has a statistically significant influence on posterior supplier performance ($\beta_4 = 0.52, p < 0.001$). Further, the supplier performance of various material groups, including "Power Pac," "Coatings/Paintings/Plastics," and "Tires/Rims/Bearings" deteriorated in the two-year time frame with the largest negative impact for steel suppliers ($\beta_{3,6} = -8.10, p < 0.001$).

As mentioned above, the inclusion of the interaction effect did not improve the explained variance in a statistically significant fashion. While the direct effect of prior supplier performance on the dependent variable remains statistically significant different from zero, the results in Table 4.7 indicate that the direct effect of disruption intensity and the interaction effect are not statistically significant ($p > 0.05$). Yet, this does not necessarily mean that there is no interaction effect present; the interaction effect (and the resulting slopes) might only be statistically significant at certain values of prior supplier performance (Brambor, Clark, & Golder, 2006). A following floodlight analysis (Spiller et al., 2013) illuminating the entire range of prior supplier performance in Figure 4.4 reveals that there is in fact a conditional relationship: When prior supplier performance is inside the interval [54.09; 86.38] (covering 68% of the sample), the slope of disruption intensity is statistically significant different from zero ($p < 0.05$). The results even indicate

that high performing suppliers ($P_0 > 86\%$) might not be affected at all by disruptions in their relevant performance metrics at the focal firm. The plotted regression surface of model 6 in Figure 4.5 supports this relationship, the slope of prior low performing suppliers facing severe disruptions is much steeper than the slope of high performing suppliers. Taken together, for 98.9% of the sample ($P_0 \in [54.09; 98.91]$), prior supplier performance moderates the influence of disruption intensity on posterior supplier performance up to statistically insignificance of the interaction with disruption intensity, resulting in partial support for hypothesis 4.
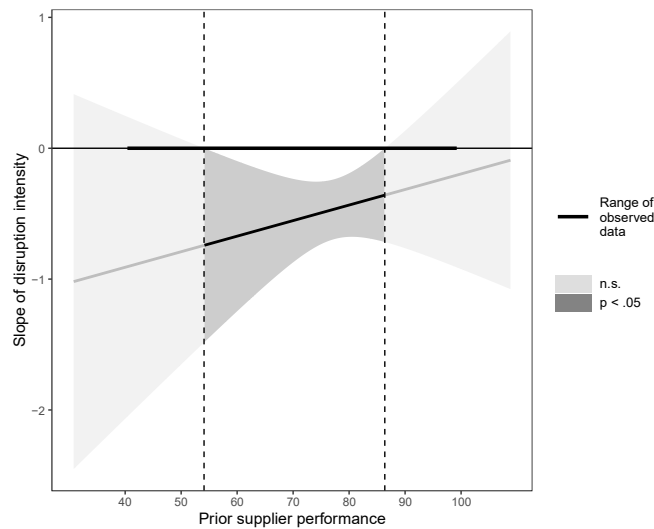
Figure 4.4 Johnson-Neyman plot of prior supplier performance and disruption intensity
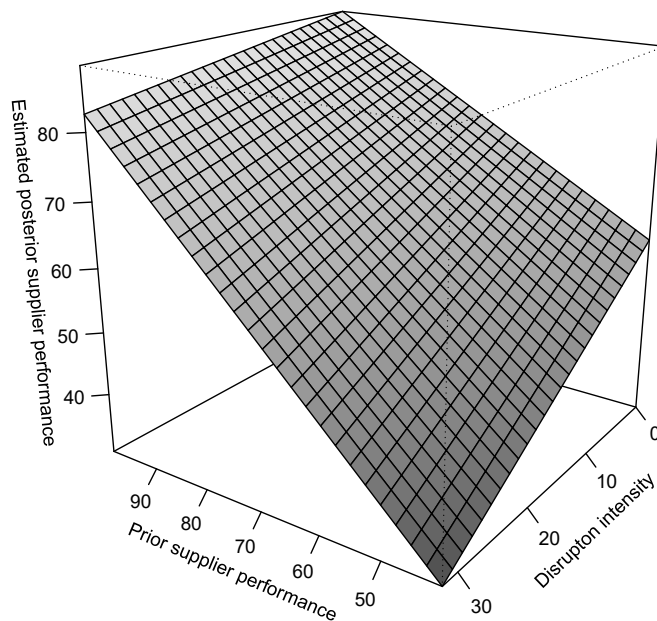
Figure 4.5 Moderating effect of prior supplier performance on disruption intensity

Note: "Power Train / Drivelines" served as the baseline material group; all other control variables were kept at their mean.

Table 4.7 Ordinary least squares regression results of supplier performance

Variables	Model 4: Control variables			Model 5: Main effects			Model 6: Interaction effect		
	β	SE	CI	β	SE	CI	β	SE	CI
Constant	76.02 ***	2.80	[70.5, 81.53]	38.78 ***	3.92	[31.06, 46.5]	39.52 ***	4.04	[31.57, 47.47]
Controls									
Strategic importance	1.48 *	0.64	[0.22, 2.75]	0.34	0.54	[-0.72, 1.39]	0.36	0.54	[-0.70, 1.41]
National lockdown	-0.30 †	0.16	[-0.6, 0.01]	0.03	0.13	[-0.23, 0.29]	0.03	0.13	[-0.23, 0.29]
Material group									
Electrics / Electronics	1.25	2.29	[-3.25, 5.74]	0.79	1.87	[-2.88, 4.46]	0.69	1.87	[-2.99, 4.37]
Cabins	-3.53	2.90	[-9.23, 2.17]	-3.46	2.37	[-8.12, 1.19]	-3.49	2.37	[-8.15, 1.17]
Weldments/ Springs / Knifes	1.41	2.00	[-2.52, 5.33]	-0.66	1.64	[-3.89, 2.57]	-0.65	1.64	[-3.89, 2.58]
Machined/ Unmachined parts	-2.17	1.99	[-6.08, 1.74]	-3.05 †	1.62	[-6.24, 0.15]	-3.04 †	1.63	[-6.24, 0.16]
Production materials/ Filters/ Belts	4.05	2.59	[-1.05, 9.15]	0.65	2.13	[-3.55, 4.84]	0.64	2.13	[-3.56, 4.83]
Steel	-7.71 **	2.96	[-13.54, -1.87]	-8.10 ***	2.42	[-12.87, -3.34]	-8.16 ***	2.42	[-12.93, -3.40]
Hydraulics	3.74 †	2.21	[-0.61, 8.09]	2.30	1.81	[-1.26, 5.86]	2.27	1.81	[-1.29, 5.83]
Power Pac	-4.49 †	2.50	[-9.41, 0.42]	-4.16 *	2.04	[-8.18, -0.15]	-4.12 *	2.04	[-8.14, -0.10]
Coatings/ Paintings/ Plastics	-1.64	2.59	[-6.74, 3.47]	-6.39 **	2.15	[-10.62, -2.17]	-6.36 **	2.15	[-10.59, -2.13]
Tires/ Rims/ Bearings	-4.50 †	2.46	[-9.34, 0.33]	-5.05 *	2.01	[-9.00, -1.09]	-5.24 *	2.03	[-9.22, -1.25]
Main effects									
Prior supplier performance				0.52 ***	0.04	[0.44, 0.61]	0.52 ***	0.05	[0.42, 0.61]
Disruption intensity				-0.47 ***	0.12	[-0.70, -0.24]	-1.39	1.20	[-3.75, 0.98]
Interaction effect									
Prior supplier performance × Disruption intensity							0.01	0.02	[-0.02, 0.04]
F	4.15 ***			17.62 ***			16.47 ***		
R^2	0.13			0.42			0.42		
ΔR^2	—			0.29			0.00		
F of ΔR^2	—			86.02 ***			0.59		

Note: OLS regression was used ($n = 352$). Dependent variable is *posterior supplier performance*; "Power Train / Drivelines" served as the baseline material group, reported estimates (β) and standard errors (*SE*) refer to unstandardized regression coefficients. *CI* refers to bootstrapped (1,000 reps) 95%-confidence intervals. †$p < 0.10$, *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

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4.4.4. Post-hoc analyses and robustness checks

As mentioned at the beginning of this section, we performed additional analyses to ensure the robustness of our results by testing (1) a sub-sample, (2) different measures for our dependent variables, (3) alternative estimation approaches, and (4) alternative dependent variables.

First, following methodological recommendations (Newman, 2014), we neither imputed the missing values, nor list-wise deleted the data of the 20 suppliers with missing posterior cost performance values. Yet, for our robustness check, we list-wise deleted those suppliers (leading to a sample of $n = 332$) and performed the three analyses of this section. Besides slightly differing coefficient values and model fits, we obtained qualitatively similar results.

Second, regarding the count of disruptions, we earlier stipulated that there had to be at least two weeks of regular performance between disruptions for those disruptions to be considered separate events. In further analyses, we required either one or three weeks of regular supplier performance between disruptions. The results for our three analyses are consistent with our original results.

Third, supplementary OLS regressions for the first two analyses (negative binomial count regression and mixed-effects regression) produce consistent results in terms of the coefficients' signs and statistical significance. The computed alternative models 1_{alt}, 2_{alt}, and 3_{alt} were all statistically significant ($p < 0.05$) and explained 5%, 13%, and 7% of the variance in the respective dependent variable (disruption frequency and disruption duration).

Finally, in additional analyses, we investigated the relationships of supplier performance and disruptions on a more granular level. Following the same procedure as in analysis 3 and focusing on prior and posterior supplier quality, the results presented in Table 4.8 reveal that disruption intensity has a statistically significant negative effect on supplier quality performance (model 5a, $p < 0.01$). Again, prior performance moderates this relationship, especially suppliers with a prior good quality performance ($> 80\%$; Figure 4.6) seem to be barely affected by disruptions in their quality performance (Figure 4.7), while the impact on prior bad performer is detrimental. Compared to the other performance dimensions in the dataset (i.e., cost and logistics), the negative effect of disruptions was the largest for supplier quality performance.

Table 4.8 Ordinary least squares regression results of supplier quality performance

Variables	Model 4a: Control variables			Model 5a: Main effects			Model 6a: Interaction effect		
	β	SE	CI	β	SE	CI	β	SE	CI
Constant	81.19 ***	4.93	[71.49, 90.88]	48.51 ***	5.58	[37.54, 59.48]	50.03 ***	5.67	[38.88, 61.17]
Controls									
Strategic importance	0.37	1.13	[-1.86, 2.60]	-0.28	1.00	[-2.24, 1.67]	-0.30	0.99	[-2.26, 1.65]
National lockdown	-0.24	0.28	[-0.78, 0.30]	0.21	0.25	[-0.27, 0.70]	0.21	0.25	[-0.27, 0.69]
Material group									
Electrics / Electronics	1.00	4.02	[-6.91, 8.90]	1.96	3.52	[-4.97, 8.88]	1.95	3.51	[-4.96, 8.86]
Cabins	-8.26	5.10	[-18.28, 1.76]	-7.91 †	4.46	[-16.68, 0.87]	-7.85 †	4.45	[-16.61, 0.91]
Weldments/ Springs / Knifes	-1.98	3.51	[-8.89, 4.93]	-1.74	3.07	[-7.78, 4.31]	-1.41	3.08	[-7.46, 4.65]
Machined/ Unmachined parts	-6.47 †	3.50	[-13.34, 0.41]	-5.57 †	3.06	[-11.59, 0.46]	-5.30 †	3.06	[-11.33, 0.72]
Production materials/ Filters/ Belts	6.49	4.56	[-2.48, 15.45]	1.19	4.03	[-6.73, 9.11]	1.48	4.02	[-6.44, 9.40]
Steel	-9.84 †	5.21	[-20.09, 0.41]	-11.66 *	4.57	[-20.65, -2.68]	-11.46 *	4.56	[-20.44, -2.49]
Hydraulics	4.30	3.89	[-3.35, 11.95]	3.65	3.40	[-3.04, 10.35]	3.55	3.40	[-3.13, 10.24]
Power Pac	-9.68 *	4.40	[-18.33, -1.03]	-7.19 †	3.86	[-14.78, 0.40]	-6.46 †	3.88	[-14.10, 1.18]
Coatings/ Paintings/ Plastics	-11.90 **	4.56	[-20.87, -2.93]	-14.89 ***	4.00	[-22.77, -7.01]	-14.52 ***	4.01	[-22.40, -6.64]
Tires/ Rims/ Bearings	-4.86	4.32	[-13.36, 3.65]	-6.04	3.79	[-13.50, 1.43]	-6.41 †	3.80	[-13.88, 1.06]
Main effects									
Prior quality performance				0.45 ***	0.05	[0.35, 0.54]	0.42 ***	0.05	[0.33, 0.52]
Disruption intensity				-0.70 **	0.22	[-1.13, -0.27]	-2.77 †	1.45	[-5.63, 0.08]
Interaction effect									
Prior quality performance × Disruption intensity							0.03	0.02	[-0.01, 0.07]
F	3.16 ***			11.08 ***			10.51 ***		
R^2	0.10			0.32			0.32		
ΔR^2	—			0.21			0.00		
F of ΔR^2	—			52.78 ***			2.08		

Note: OLS regression was used ($n = 352$). Dependent variable is *posterior supplier quality performance*; "Power Train / Drivelines" served as the baseline material group, reported estimates (β) and standard errors (*SE*) refer to unstandardized regression coefficients. *CI* refers to bootstrapped (1,000 reps) 95%-confidence intervals. †$p < 0.10$, *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

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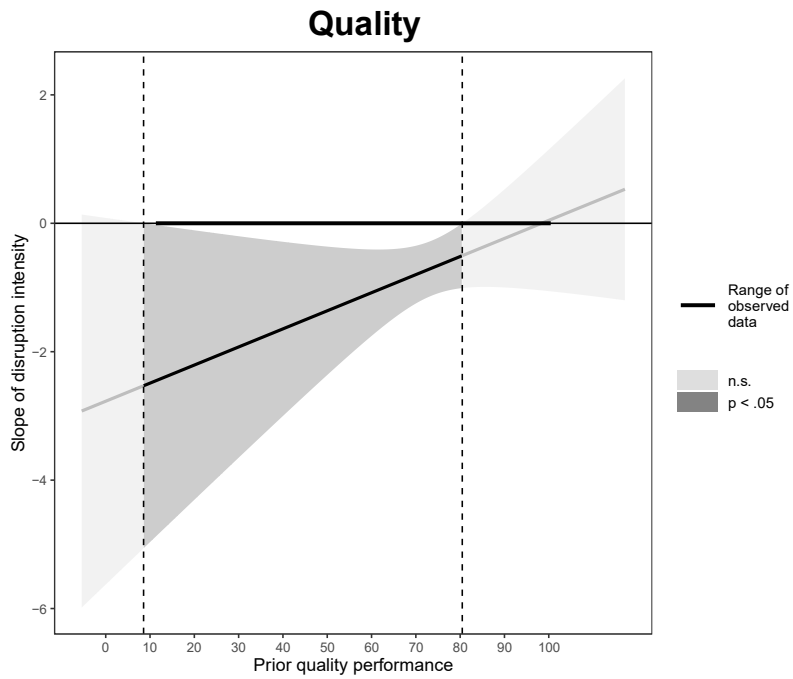
Quality

Figure 4.6 Johnson-Neyman plot of prior supplier quality and disruption intensity
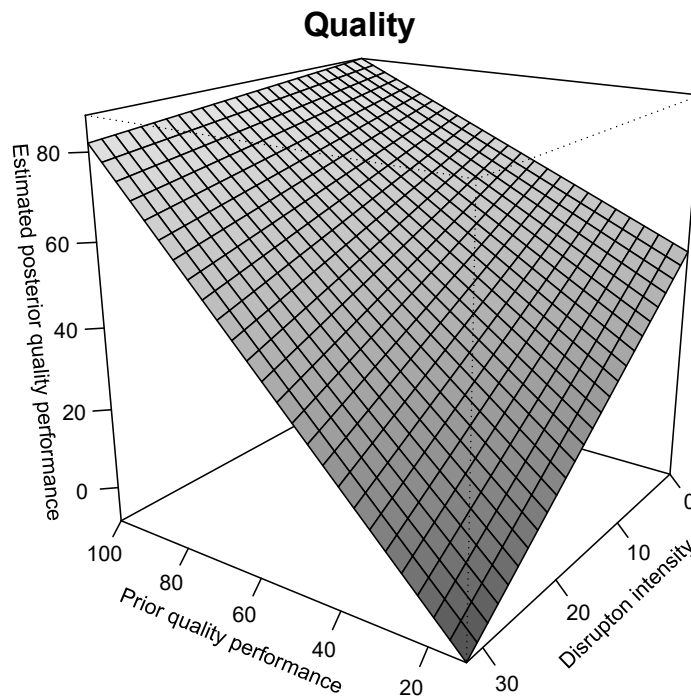
Quality

Figure 4.7 Moderating effect of prior supplier quality on disruption intensity

4.5. Discussion

By investigating the interrelation of supply disruptions and supplier performance, this study contributes to a better comprehension of supplier resilience. In essence, intuition

holds that disruptions hurt supplier performance, yet prior supplier performance plays a significant role in this relationship, even before the disruption occurs. The results of our three empirical analyses support our predictions and have several important theoretical and managerial implications.

4.5.1. Theoretical implications

Our results extend the literature on the antecedents of supply chain disruption frequency. While supply chain disruptions are seen as unavoidable (Craighead et al., 2007), firms can try to limit the risk of experiencing disruptions, such as reducing supply chain complexity (Bode & Wagner, 2015) and promoting a high interorganizational orientation (Revilla & Saenz, 2017). Taking the individual supplier as the unit of analysis, the results of our first analysis reveal that prior supplier performance has a statistically significant effect on disruption frequency; the better the supplier's performance, the less prone it is to disruptions. While the marginal effect of a 1% difference in performance for a single supplier does not have a huge impact on the individual disruption frequency, considering the full sample of 352 suppliers, the average marginal effect of 1% difference in the whole supply base performance already relates to 4.58 disruptions in the observed 11-month time frame. Suppliers which perform well, might have better preconditions, by, for example, incorporating the latest technological advances in their operations, adhering to specified quality standards, or a better management (Zsidisin & Ellram, 2003). Thus, our results suggest that (bad) prior supplier performance acts as an early warning signal (Mitroff, 2000) for disruptions.

In addition, the results extend the literature addressing antecedents of supply chain disruption duration. Disruption duration is not only critical for the respective supplier, but also important information for determining the buying firm's response to mitigate its own negative effects (Mehrotra & Schmidt, 2021). Yet, it is a great challenge for firms to predict supply disruptions and their course prior to their occurrence (Blackhurst et al., 2008). The results of our second analysis suggest a statistically significant influence of prior supplier performance on disruption length; the higher the prior supplier performance, the less the disruption duration. On average a 25% difference in individual supplier performance is associated with one week of disruption duration for every disruption. This indicates that supplier performance is related to the supplier's ability to recover from a disruption. The results of our first two analyses indicate that supplier

development programs, focusing on improving supplier performance, could significantly influence the frequency and duration of disruptions.

While the negative effect of supply chain disruptions on a firm's financial performance is well known (Hendricks & Singhal, 2003, 2005a, 2005b), our paper provides quantitative empirical evidence for the negative impact of disruptions on the individual supplier performance. To account for disruption severity, we introduce disruption intensity as the product of both disruption frequency and disruption duration. The assumption is that not only the disruption duration and frequency is detrimental to performance (Brandon-Jones et al., 2014; Sheffi & Rice, 2005). Multiple supply disruptions – even short ones – can pile up, negatively influence the supplier's internal and external processes, and eventually hurting the supplier's performance registered at the buying firm (e.g., supplier quality issues, poor supplier logistics performance, or capacity fluctuations). The results of our third analysis reveal that disruption intensity does have a negative influence on posterior supplier performance; the longer and more often a supplier is disrupted, the larger the impact on its performance. Additional analyses reveal that this relationship persists on a more granular level; disruptions significantly hurt the supplier's posterior (i.e., future) quality performance. Our results are particularly relevant, as it is difficult for practitioners to quantify the costs of supply disruptions (Macdonald & Corsi, 2013).

For most of our sample, our results also suggest that the negative influence of disruptions on posterior supplier performance is moderated by prior supplier performance. Disruption intensity has a weaker negative performance impact on prior good performing suppliers than on suppliers with a prior poor performance. This relationship also persists on a more granular level; suppliers with a history of good quality performance ($> 80\%$) seem unaffected by disruptions in their quality performance, while the impact on prior bad performers is detrimental. Therefore, our results have important implications for the quality performance of suppliers facing disruptions.

Finally, our paper extends the disruption profile (Sheffi & Rice, 2005) and the literature on supplier resilience by analyzing multiple disruptions of various durations and their impact on performance. Besides investigating the effect of supplier resilience on the buyer's financial resilience (Choksy et al., 2022), the literature on supplier resilience rather focused on influencing supplier resilience through several customer management styles including benevolence and leadership (Verghese et al., 2019; Verghese et al., 2022). The results of our three analyses reveal that the key variables of the disruption

profile – prior performance, disruption (recovery) duration, and posterior performance – are not independent from each other. Rather, there is a path dependency determined by prior performance. Thus, in summary, our analyses reveal that in terms of supplier resilience, good supplier performance does not only reduce the likelihood of disruptions but also mitigates the impact of supply disruption on supplier performance.

4.5.2. Managerial implications

Geopolitical tensions are putting more pressure on supply chains, which are still recovering from the COVID-19 pandemic. Yet not every company (i.e., supplier) was affected to the same degree by the events of recent years. Just as COVID-19 affects patients differently (posterior performance) based on their state of health (prior performance) and the disease course (disruption intensity), our study sends four important messages for practitioners regarding the management of their suppliers.

First, our findings aid managers to allocate and prioritize their supply risk management efforts. Risk management tends to focus on strategically important suppliers, but our results indicate that managers should not overlook underperforming suppliers. While these suppliers are an issue for the buying firm, they are also prone to more and longer disruptions. Our results suggest that this relationship is not linear, so practitioners should consider phasing out the poorest performing suppliers. Where eliminating or switching the supplier is not possible, practitioners should either try to develop those suppliers to elevate their performance, or rely on redundancies, perhaps by building up safety stocks, or adopting a multi sourcing approach (e.g., Sheffi & Rice, 2005; Tomlin, 2006).

Second, disruptions are detrimental to supplier performance; the longer and more often a supplier is disrupted, the larger the impact, especially on its quality performance. While this negative effect is less pronounced for resilient, good performing suppliers (*performance* > 80%), disruptions worsen the posterior performance of suppliers that are already underperforming. Practitioners should be aware of this relationship and consider supporting a supplier in its disruption recovery efforts to limit the duration of a disruption, and thus the negative impact on the supplier's future performance.

Third, our results indicate that supplier programs addressing an improvement of the overall performance of the supply base can be also beneficial regarding supply chain disruptions. As our first analysis suggests, while the marginal effect of a 1% difference in performance for a single supplier does not have a huge impact on the individual

disruption frequency, considering the full supplier sample, the average marginal effect of 1% difference in the performance of the supply base makes a significant difference in the frequency of supply disruptions at the focal firm in the observed time frame. Thus, practitioners should consider implementing programs to enhance the performance of the whole supply base.

Finally, our study highlights the importance of supplier performance measurement systems in disruptive times, such as the COVID-19 pandemic. Without measuring performance at the supplier level, managers cannot track performance before and after the disruption to estimate the impact on relevant performance metrics (i.e., cost, quality, and logistics), and initiate appropriate countermeasures.

4.5.3. Limitations and future research

The reported results are based on a panel dataset of obtained from the supplier base of a single buying firm. As highlighted above, by focusing on a supplier base of one focal buying firm, we reduce the influence of some not included variables by keeping market position, corporate culture or supplier management policy constant over the entire sample (Subramani & Venkatraman, 2003). This leads to a high internal validity of our findings, but our results might vary, for example when investigating a company with a different market position or approach to supplier management. In addition, our sample is biased toward European suppliers, which constitute more than two-thirds of our data. Further and due to the time frame of the panel data set, we focus on supply disruptions, which are at least to some extent connected to the COVID-19 pandemic.

In summary, we acknowledge some limits of our dataset, yet, it is difficult to obtain (extensive) datasets in supply chain risk research (Sodhi, Son, & Tang, 2012), especially containing sensitive information such as the individual supplier performance on costs, quality, and logistics dimensions. Future studies should – if possible – extend the initial sample to provide more generalizable findings. Further, the interrelations of supplier performance programs and disruptions (i.e., frequency and duration) should be examined in more detail, as our first analysis suggests that every 1% increase in the whole supply base performance could make a difference.

Additional research opportunities include investigating prevention and mitigation strategies for supply disruptions at the supplier level, such as the influence of a supplier's disruption orientation (e.g., Stekelorum, Gupta, Laguir, Kumar, & Kumar, 2022), or its

business continuity tactics (e.g., Dohmen et al., 2022), influencing the (negative) performance impact of disruptions.

5. Conclusion and outlook

5.1. Summary

Although buyer-supplier relationships have received ample attention in management research in the last decades, this dissertation aimed at investigating contemporaneous issues and relevant gaps in the risk and disruption management of buyer-supplier relationships. The first section provided a brief overview of the significance of buyer-supplier relationships in supply risk and disruption management, and introduced the three main research questions. The three main sections revolved around proactive risk approaches taken in the normal course of business, as well as reactive approaches and outcomes of triggering events and related disruptions. The dissertation findings pertaining to the research questions are highlighted below, followed by a summary of the contributions to academia and managerial practice.

5.1.1. Research questions

Transparency in buyer-supplier relationships

To address the research question "*How do and how should companies collaborate with their suppliers to improve transparency?*" (Sodhi & Tang, 2019, p. 2956), the study adopted a sequential mixed-method research design, including 10 semi-structured interviews followed by a scenario-based experiment with 472 observations. Building on social exchange and resource theory, the qualitative study gathered information which is perceived sensitive (grouped into commercial, technological, operational and network information), elaborated antecedents of "transparent" and "opaque" supplier relationships as well as tactics to induce the sharing of sensitive information. The findings highlight that long-term relationships with some degree of collaboration are more transparent. In turn, opaque relationships – where suppliers are reluctant to share (sensitive) information – typically occur with suppliers of standard components or large suppliers, where the counterpart changes often and the interactions have an economic focus.

In relationships where a higher degree of transparency is targeted, buyers mostly rely on offering money incentives (i.e., more business), service incentives (e.g., negotiation support and marketing support), and the use of coercion. Yet, the scenario-based experiment with 234 buyer counterparts (i.e., B2B marketing and salespeople) revealed that service incentives did not enhance sensitive information sharing. Further,

buying firms do not have to rely only on offering more business (money resource); status and information incentives proved to be effective as well. Further, coercion had no direct effect on the willingness to share sensitive information, the results indicate that it might only be effective when the supplier is dependent on the buyer. Finally, the popular "carrots and sticks" tactic (incentive with coercion) could have a negative effect on sensitive information sharing. In summary, the results provide a substantially refined understanding of how firms induce transparency in their relationships over time by resource exchanges and in various contexts.

Force majeure in buyer-supplier relationships

To address the research question "*What are the intentions and outcomes of force majeure declarations in buyer-supplier relationships?*", the study applied a sequential mixed-method research design, consisting of an in-depth case study including 43 force majeure declarations, 4 interviews, and additional data, followed by 7 post-hoc interviews, and a scenario-based experiment with 134 participants. Building on its legal background, the qualitative studies confirmed the main purpose of a force majeure declaration being to excuse non-performance in case of an unforeseeable event that results in making fulfilling contractual obligations impossible. Yet, the findings also revealed that a force majeure declaration is often not associated with a supply disruption and was also used as a cover or leverage for other issues, such as increasing pressure in price negotiations or triggering additional orders, in the business relationship. Even when a force majeure declaration was associated with a disruption, the time in between the event and the declaration varied strongly, with some letters being sent up to 30 weeks prior to the disruption.

Regarding outcomes of the force majeure declarations, the qualitative studies suggest that the main aim of the receiving (buying) firm was to secure supply and to find a solution together with the supplier. The force majeure declarations were investigated in parallel by the legal department and were seen as not crucial for the overall business relationship, but had the potential to accelerate plans, such as phasing out a supplier or evaluating a second source, in case of single source supply. The subsequent experiment provided further support for the findings of the qualitative studies and indicated that force majeure declarations can have unintended consequences. Those included slowing down disruption response actions of the recipient (i.e., buyer) and increasing switching intentions, which was even more pronounced for suppliers with a good relationship history. In summary, the results suggest that the current uncertain environment entails

many force majeure declarations, that these are used increasingly with other intentions than only to excuse non-performance, and that they can result in several unintended outcomes for the business relationship.

Supplier performance and disruptions

To address the research question "*How are supplier performance, disruption frequency, and disruption duration interrelated?*", the study relied on three quantitative analyses based on a panel dataset of 352 suppliers. The results of the first two analyses suggest that prior (i.e., pre-disruption) supplier performance correlates with disruption frequency and duration, that is, poor performing suppliers were associated with more and longer disruptions. Based on our dataset, a 25% difference in supplier performance is related to one week of disruption duration. Further, each percent difference in performance of the whole 352 supplier sample relates to an average of 4.58 disruptions in the observed 11-month time frame. Regarding post-disruption implications, the third analysis indicates that disruptions in fact hurt supplier performance. The more and the longer (i.e., high disruption intensity) a supplier was disrupted, the larger the negative impact on performance. Prior supplier performance moderates this relationship, disruptions of the same intensity had a weaker negative performance impact on prior "good performers" than on prior "bad performers". Additional analyses revealed that these relationships are even more pronounced for the supplier's quality performance, that is, intense disruptions especially affect negatively the supplier's quality.

In summary, the results suggest that with regard to supplier resilience, the key variables of the disruption profile, such as prior performance, disruption (recovery) duration, and posterior performance are not independent from each other. In fact, the study indicates that there is a path dependency determined by the prior performance, which should be considered for an effective supply risk and disruption management.

5.1.2. Major academic contributions

The findings of this dissertation contributed to the literature in various ways, with implications for buyer-supplier relationships and related risk and disruption management issues, but also implications for their general interaction.

Through a higher level of transparency, (collaborative) buyer-supplier relationships not only face the lowest frequency of supply chain disruptions (Revilla & Saenz, 2017), but also address the increased consumer and societal awareness (Choi et

al., 2021). Conceptualizing transparency as a manageable element of an interorganizational relationship which enables dyadic sensitive information sharing, the findings indicated that the more information is seen as sensitive by the supplier, the less the motivation to share it with the buyer. In general, information is perceived more sensitive in the B2B context than in the B2C context, with cost and technological information as the most sensitive.

Further, this dissertation analyzed resource exchanges for information by adopting a novel combination with resource theory (E. B. Foa & Foa, 1980; U. G. Foa, 1971). While resource theory is well-known in social psychology and has been (partly) applied to investigate interpersonal exchanges in organizational settings (e.g., Flynn, 2003), this dissertation provided new insights by firstly and empirically taking resource theory to the interorganizational context, as well as extending the theory by incorporating coercion and dependence. In line with the theory (Turner et al., 1971), suppliers prefer to be reciprocated with similar resources categories, characterized by the two dichotomous properties *symbolic-concrete* and *particularistic-universal*. Asked for (sensitive) information, a supplier thus preferred to be reciprocated with information, money, and status incentives, with information having the biggest effect of all resource treatments. Service incentives, being more concrete and more particularistic than information, had no significant effect on information sharing, bolstering the resource theory. In summary, results indicated that the theory provides valid predictions for buyer-supplier exchanges in the respective resource categories.

While the negative effects of supply chain disruptions on the financial performance of firms were well documented (Hendricks & Singhal, 2003, 2005b), the findings of this dissertation revealed that they also hurt supplier performance. By analyzing multiple disruptions of various durations and their impact on performance, this dissertation further extended the well-known disruption profile (Sheffi & Rice, 2005). The results of three analyses revealed that the key variables of the disruption profile – prior performance, disruption duration, and posterior performance – are not independent from each other. With regard to supplier resilience, a significant antecedent of supply disruption duration and frequency was prior supplier performance. Introducing *disruption intensity* to characterize the disruption severity over a period of time, the results revealed that the more often and longer a supplier was disrupted, the higher the negative impact on posterior performance. The results further suggested that prior supplier performance moderates this relationship, eventually indicating a path dependency in the disruption

profile determined by prior performance. In summary, contributions to supply risk and disruption management literature consisted in revealing that good supplier performance not only reduced the likelihood of disruptions but also mitigated the impact of supply disruption on supplier performance.

Finally, one source of disruptions are force majeure events, which the pertinent management literature viewed as purely exogenous and in most cases attributable to an act of nature (e.g., Hartmann & Moeller, 2014; Polyviou et al., 2018; Wang et al., 2022). This dissertation not only extends the addressed reasons to various acts of people, arising from the COVID-19 pandemic, but also contributed to the literature by investigating firstly the behavioral intentions and outcomes of force majeure declarations in buyer-supplier relationships. In that regard, past studies have not considered that a force majeure and a force majeure declaration have different implications. The findings of this dissertation further revealed that force majeure declarations are increasingly used with intentions other than to excuse non-performance, such as increasing pressure in ongoing negotiations and managing the recipient's expectations in the issuer's favor.

While research suggested that buffering (Bode et al., 2011) will be less pronounced for supply chain disruptions due to force majeure (Polyviou et al., 2018; Wang et al., 2022), the results of this dissertation indicated that the presence of a force majeure declaration slows down the short-term disruption response and increases the long-term switching intentions. Finally, the positive effect on switching intentions was stronger, when the supplier had an excellent relationship history. This result further supported the stream of literature dealing with expectation and behavior incoherence (e.g., Y.-S. Chen et al., 2019; DeCampos, Fawcett, & Melnyk, 2022; Wang et al., 2010).

5.1.3. Major implications for practice

The findings of this dissertation provide several important recommendations for managers on both sides of the buyer-supplier relationship. In particular, implications for prioritizing and executing their supply risk management efforts are summarized below.

Transparency in interfirm relationships is beneficial for both, proactive and reactive risk management approaches. Investigating how firms *do* and *should* collaborate with their interorganizational partners to increase transparency in the relationship, a slight bias in what works from buying firms' perspectives and what works at their counterparts (suppliers) was revealed. In this regard, service resources (e.g., negotiation support and marketing support) did not enhance information sharing. Further, buying firms do not

have to rely only on offering more business (money resource). Especially smaller firms, which seemed to have fewer possibilities to offer (money resource) incentives or to rely on coercion, could use more status and information resources to induce sensitive information sharing. In turn, the popular *carrots and sticks* tactic (incentive with coercion) did have a negative effect on sensitive information sharing.

Regarding further proactive risk management approaches, managers tend to focus on strategically important suppliers. Yet, the findings of this dissertation revealed that poor performing suppliers were related to more and longer disruptions. Managers should thus not overlook underperforming suppliers. Once a supplier is disrupted, it should be closely monitored or given support for recovery, because the more intense the disruption, the larger the negative impact on the supplier's performance – in particular on quality performance.

The ongoing uncertain environment entailed many supply chain disruptions which were due to a force majeure or, in some cases, only framed like it. Thus, recipients of force majeure declarations should consider that claims are only justified when contractually agreed performance has become impossible. Some force majeure declarations were even sent with other underlying purposes than to excuse non-performance, such as increasing pressure in ongoing negotiations or aiming to trigger additional orders.

Finally, firms affected by or source of supply chain disruptions due to force majeure – that are potential senders of force majeure declarations – should rather communicate this fact to their business partners and refrain from sending a formal letter. Those force majeure declarations have the potential to slow response actions and increase switching intentions. In that regard, business partners are likely to support the affected party anyway and, in most cases, will refrain from enforcing penalties.

5.2. Limitations

Some limitations should be noted when interpreting the results and recommendations of this dissertation. The major aspects related to the sampling procedure, the time frame, and the methods used are discussed below.

The articles presented in section 2 and 3 of this dissertation apply a sequential mixed-method approach, which should lend a high validity and robustness to the results (Boyer & Swink, 2008). Yet, the qualitative studies and the two experiments rely on self-

recruited samples. For this reason, there could be a self-selection bias present, which can be characterized as a specification error (Heckman, 1979). For example, an affinity for supply risk topics could have led to a higher willingness in participating in the experiment of section 3, resulting in a higher ratio of experience with force majeure issues than the overall population. A perfectly random sampling or a possible correction on basis of the knowledge of the overall population of purchasers and supply managers is however difficult. Future studies could further validate the results by following another sampling approach (e.g., larger sample, different countries, and cultures), or adopting a different methodology.

In a similar vein, there could be an issue with social desirability regarding the samples of the qualitative and experimental studies of section 2 and 3. For example, the informants in section 2 could have been tempted to attest a higher transparency in their interfirm relationships than established. Addressing this issue to some extent, those sections aimed at disguising the research purpose, as well as applying multiple methods, and assuring anonymity (Nederhof, 1985; Ried, Eckerd, & Kaufmann, 2022). Further, the experiments in section 2 and 3 rely on stated intentions of the participants. As research has revealed that actual behavior can significantly differ from stated intentions (e.g., Manski, 1990; Morrison, 1979), follow-up studies should adopt different methodologies to lend the findings more robustness.

Finally, due to the time frame of this dissertation, the findings are at least to some extent connected to the COVID-19 pandemic. Especially the results of the case study, the post-hoc interviews, as well as the major reasons mentioned for the supply disruptions in section 4 are associated with direct and indirect consequences of to the COVID-19 pandemic. While the COVID-19 pandemic affected most firms worldwide, future research should investigate to what extend the main findings and examined relationships hold in other crises.

5.3. Future research

This dissertation addressed three research questions revolving around risk and disruption management in buyer-supplier relationships. While the management of buyer-supplier relationships has received significant attention by research in the last decades, some promising avenues for future research are described in the following, beyond addressing the discussed limitations above.

Research suggests that collaborative buyer-supplier relationships will face the lowest levels of supply risks, among other mechanisms, through a higher degree of transparency (Revilla & Saenz, 2017). This link seems intuitive, yet the direct relationship between transparency in the supplier relationship and the properties of supply disruptions, such as frequency, duration, and impact, have not been empirically investigated. Future research could address this gap, for example by investigating if a disruption in a transparent relationship will last shorter. In the same vein, the process of disruption discovery (at the buying firm) should be examined in more detail. The interviewees in section 3 mentioned that they noticed supply disruptions in various ways, mostly differing in terms of timing and media. While this observation is in line with literature (Macdonald & Corsi, 2013), the implications of the discovery stage beyond the disruption impact (Bode & Macdonald, 2017) provides future research opportunities.

The informants in section 2 reported that cultural factors might play a role regarding the transparency of supplier relationships, as European subsidiaries of American firms and some DACH-area suppliers were especially reluctant to share sensitive information. A recent study also revealed that the culture of the supplier moderates the relationship between buyer power and supplier shirking (Skowronski, Benton Jr., & Handley, 2022). As the informants in section 2 often rely of (coercive) power, the interplay with transparency and culture could be addressed in future research. In addition, cultural aspects might also influence the handling and behavioral outcomes of force majeure declarations, as well as the beforementioned disruption discovery.

Further, this dissertation firstly and successfully adopted resource theory (E. B. Foa & Foa, 1980; U. G. Foa, 1971) to the interorganizational context to analyze resource exchanges for information. In this regard, incentives, services, or social values could be clustered in resource classes with the theory predicting the outcome exchanging them with resources of an interfirm partner. As this dissertation focused on buyer-supplier relationships and the goal of information exchanges, future research should investigate whether the theory provides valid predictions for other types of interorganizational relationships, such as alliances and franchises, and for other resource classes, such as service or goods.

Finally, issues revolving force majeure, related declarations, and disruptions provide various potentials for future research. The findings of this dissertation revealed that force majeure declarations are increasingly issued with other intentions than only to excuse contractually agreed non-performance. A more thorough examination of

intentions could provide a framework for analyzing situations and contexts in which declarations are likely to be sent with other intentions, such as increasing pressure in ongoing negotiations or getting an expedited certification for another facility. In that vein, the trade-off of penalties and negative consequences for the relationship could be investigated in an analytical way (e.g., game-theoretic). Regarding the outcome of force majeure issues, the findings of this dissertation suggest that force majeure issues were unlikely to be pursued in court as most companies have not filed suit. By means of analyzing archival data of court rulings on force majeure disputes in buyer-supplier relationships, the main factors and their potential thresholds for filing suit could be scrutinized in future studies. In conclusion, this dissertation addresses the issue of force majeure and related declarations in buyer-supplier relationships in more detail than previous management research, and I particularly look forward to further research in this area.

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Appendices

Appendix A: Transparency in buyer-supplier relationships

Interview questionnaire

Background information
- Company history, no. of employees, products, revenue, procurement volume, etc.
- What is your position? How many years have you been in this position?

Questions about supplier relationships
- Considering your current suppliers, are there one or more suppliers which offer always and large amounts of information in contrast to other suppliers? Even sensitive information?
- On the other hand, are some suppliers reluctant to share sensitive information (on request/when you need it)? Which information?
- How does your company react to this behavior?
- How is the relationship in general between your company and these suppliers?
- Do these suppliers make a large part of their revenue with your company?

Questions about tactics
- Does your company use incentives to gather sensitive information from the supplier?
- Which incentives? Which are stronger and weaker incentives in your opinion?
- Does your company hint that they would make things more difficult for the supplier (e.g., fines, reduction of business, and termination of contract) to gather sensitive information?
- Does the relationship with the supplier influence the chosen actions?
- Did you experience some consequences for the relationship?

Description of the vignettes

Common module	You are a senior customer service manager for a mid-sized manufacturer of technical components. One of your firm's main products is a special type of bearing rotor system which is needed by manufacturers in various industries. The rolling bearing rotor system consists of various sub-components (e.g., inner ring, outer ring, cage, and ball) and is the kernel of many rotating machines, such that it has the potential to affect the performance of the whole machine. You have many customers, one of whom you have supplied for more than 5 years. In the past, your relationship with this customer has not always been easy but at the bottom line, you always got along well with them. The business interactions between you and this customer are described below. Assume all scenario descriptions are accurate and trustworthy. After reading the scenario, please indicate to what extent you would go along with the customer's request.	

	Low	**High**
Dependence	This customer **is not very important**. The orders from this customer are less than 10% of your turnover and there are many alternative customers of the same scale. It is likely that you will be able to **compensate** the defect of this customer without significant losses.	This customer is **very important**. The turnover is almost half of your business and there are very few, if any, alternative customers of the same scale. It is unlikely that you will be able to compensate the defect of this customer without significant losses.
Use of coercion	If you failed to comply with this customer's requests, it **would not reduce orders right away**. Instead, it would point out the issues and give you some time to improve. During this period, it would also follow up and give feedback **with patience.**	This customer has often made it clear that it **would reduce orders** if you did not comply with their requests. You are fully aware that if you cannot meet their requests, they would **move these orders to your competitors.**

Common module	Recently, the customer is trying to understand the business of his suppliers better. Therefore, the customer would like to know more about your firm and asks for deeper insights in your **production processes** (e.g., used machines) and **future products** (i.e., technology roadmap) as well as the **identity of your suppliers**.

Incentive	**(–) Status**	**Information**	**Service**	**Money**
	(–) The customer guarantees that if you comply with the request, his management will **invite your top-management**, which will boost the **internal perception of your firm at the customer**.	The customer guarantees that if you comply with the request, he will offer your firm **insight in their product and demand forecasts**.	The customer guarantees that if you comply with the request, he will help you achieving **better conditions in negotiations with your suppliers**.	The customer guarantees that if you comply with the request, your firm could expect **more business** by being prioritized in the awarding process.

Common module	The situation represents an opportunity to elevate the relationship with this customer. However, at the same time, if you offer to share that information, there is also a risk that this information may be exploited by the buying firm or leaked to other suppliers, that is, your competitors. In such a situation, how would you most likely react?

Appendix B: Force majeure in buyer-supplier relationships

Interview questionnaire

Background information
- Company history, no. of employees, products, revenue, procurement volume, etc.
- What is your position? How many years have you been in this position?

Questions about force majeure and supplier relationships
- Did you receive force majeure declarations in the last years from your suppliers? How many?
- Did the respective suppliers not fulfil his agreed obligations prior, after, or with the release of the force majeure letter?
- What were the reasons mentioned?
- Were there other ways with which suppliers communicated disruptions?
- What were the consequences of the letters? (short-term, long-term, legal?)
- How was the relationship with these suppliers before the pandemic? Did their behavior change your perception of these suppliers?
- Do you plan to work more closely with these suppliers, or do you plan to search for alternatives?
- Did the behavior of your suppliers regarding force majeure issues change in the last years?

Description of the vignettes

Common module	Imagine you are a purchasing manager for a midsized manufacturing company in Germany that makes telecommunication equipment. You have worked with the company for the last 5 years, and a major part of your responsibility in the company is to manage supplier relationships. Any disruption in the supply chain would cause substantial harm to the company. In general, you have been pleased with the performance of all of the suppliers since your arrival at the company.	
	Poor	**Excellent**
Relationship history	One of your suppliers is Alpha, which supplies important parts for your telecommunication equipment. In the past, the relationship with Alpha was sometimes difficult, the interaction was at "arm's length", and rather focused on the economic exchange. Further, Alpha has not been very flexible nor very responsive to unexpected, last-minute changes in order quantities and order delivery schedules.	One of your suppliers is Alpha, which supplies important parts for your telecommunication equipment. In the past, the relationship with Alpha was excellent, the interaction was on a partnership level, and rather focused on collaboration. Further, Alpha has been very flexible and very responsive to unexpected, last-minute changes in order quantities and order delivery schedules.
Common module	Alpha recently informed you about a disruption, which will delay delivery of raw materials by a few weeks. The disruption was caused by an act of nature: a major tsunami affected the key seaport Alpha has used to receive its raw materials. As a result, Alpha had to halt production of parts used in your newly developed telecommunication equipment. Unfortunately, given limited resources, Alpha had little capability to obtain raw materials from alternative sources.	
	No	**Yes**
Force majeure declaration	Alpha mentions to you that they do not plan to issue a Force Majeure ("superior force") declaration. Alpha further states that they will do their best to resume operations as soon as possible.	You receive a letter from Alpha where they state that they do not see any other option than to declare Force Majeure ("superior force") under the applicable agreements with your company and that they bear no responsibility for possible delays or other impacts due to the tsunami. Alpha further states that they will do their best to resume operations as soon as possible.

Curriculum vitae

Academic employment

10/2019 – 04/2023   **Research Associate**

University of Mannheim, Mannheim, Germany
Endowed Chair of Procurement, Operations Management Area

05/2022 – 07/2022   **Visiting Researcher**

Colorado State University, Fort Collins, Colorado, USA
Department of Supply Chain Management
on invitation by Prof. Dr. John R. Macdonald

01/2019 – 09/2019   **Research Intern and Working Student**

University of St. Gallen, St. Gallen, Switzerland
Institute of Supply Chain Management

Education

10/2019 – 03/2023   **Doctoral Studies in Business Administration (Dr. rer. pol.)**

University of Mannheim, Mannheim, Germany
Advisor: Prof. Dr. Christoph Bode

10/2015 – 09/2019   **Master of Science in Industrial Engineering (M. Sc.)**

Technical University Darmstadt, Darmstadt, Germany

03/2017 – 07/2017   **Semester Abroad**

Universidad Católica Argentina, Buenos Aires, Argentina

10/2012 – 09/2015   **Bachelor of Science in Industrial Engineering (B. Sc.)**

Technical University Darmstadt, Darmstadt, Germany