Available online at www.centmapress.org

Int. J. Food System Dynamics 15 (5), 2024, 467-485

DOI: https://dx.doi.org/10.18461/ijfsd.v15i5M2

INTERNATIONAL JOURNAL ON FOOD SYSTEM DYNAMICS

A supply chain resilience framework for pandemic disruptions in general trading companies

Anton Sukoco[a], Iwan Vanany[b], and Jerry Dwi Trijoyo Purnomo[c]

[a] *Department of Technology Management, Institut Teknologi Sepuluh Nopember, Surabaya, Indonesia*
[b] *Department of Industrial and Systems Engineering, Institut Teknologi Sepuluh Nopember, Surabaya, Indonesia*
[c] *Department of Statistics, Institut Teknologi Sepuluh Nopember, Surabaya, Indonesia*
7032211001@mhs.its.ac.id; vanany@ie.its.ac.id (corresp. author); jerry@statistika.its.ac.id

Received December 2023, accepted June 2024, available online September 2024

ABSTRACT

In general trading companies, COVID-19 pandemic disruptions impacted their supply chain performance and their business. The ability to respond effectively to pandemic disruptions using supply chain resilience framework is needed. This research proposed supply chain resilience framework for pandemic disruption in the general trading companies that is used to assess the relationship between pandemic disruptions and supply chain capabilities. This research employs an empirical approach with a qualitative research method using review literature, rigorous in-depth interview with 12 informants in 5 companies are founded pandemic disruption factors and supply chain capability factors. Indonesian general trading company was used as case study to determine probability value of pandemic disruptions factors, sub-dimension, and dimension using Bayesian Network approach and assess the relationship between pandemic disruption factors and supply chain capability factor. Top three pandemic disruptions factors based on Bayesian Network analysis are (1) meeting order, (2) customer visit, and (3) mobility. The assessment results of supply chain resilience framework in case study indicated that a vital factors of supply chain capability are (1) upscaling competency in absorptive capability, (2) internal and external collaborations and (3) financial management in adaptive capability. The practitioners can be better prioritizing supply chain capabilities for pandemic disruptions using this proposed supply chain resilience framework. This study also providing valuable insight for the managerial implication to understand government direction and promote communication and collaboration (internal and external) amongst their supplier and customers.

Keywords*: Supply chain resilience, pandemic disruptions in supply chain, general trading company.*

1 Introduction

The Coronavirus Disease 2019 (COVID-19) pandemic began in December 2019, first reported by the Wuhan Municipal Health Commission from a pneumonia cluster area in Hubei province. On March 11, 2020, the World Health Organization (WHO) declared COVID-19 a global pandemic (WHO, 2020). The effect is enormous, impacting not only health but also the economy. The economic impacts include a 'global economic shutdown' and financial market anomalies characterized by currency crashes (Song & Zhou, 2020). Overall, the economic impact of the COVID- 19 pandemic on the global economy is greater than the impact of the global financial crisis in 2008.

Based on data from the Central Statistics Agency (BPS) (2021), the Indonesian economy in 2020 experienced a growth contraction of minus 2.07 percent compared to that of 2019. From the National GDP data based on several business fields, in 2020 the growth rate of several business fields experienced a recession in the first quarter to the second quarter. The 3rd quarter and the 4th quarter showed an improvement of GDP in all business fields, although in that quarter, the GDP growth rate still showed a negative value. Then, in the second quarter of 2021, the National GDP of all business field components is positive.

The trend of GDP contraction in several businesses in Indonesia shows the consequences and impact of COVID-19. König d Winkler (2021)provide empirical evidence of the relationship between COVID-19 and the economic crisis, showing how the government's restrictive policies reduced GDP growth not only in the same quarter but also in the following quarter.

Companies strive to improve their supply chain management to remain competitive in the business ecosystem (Tan et al., 2002; Pinder & Harlos, 2001). Decisions of global supply chain management are often based on trade-off considerations, i.e. between efficiency and vulnerability (Mizgier et al., 2013). Vulnerabilities in the supply chain must be addressed to avoid risks that would result in unfavorable outcomes and unproductive customer service (Jüttner & Maklan, 2011).

Disruptions in the supply chain can lead to other disruptions and even failure of the supply chain system (Cai & Luo, 2020). Identifying potential disruptions is necessary to predict problems that will occur and determine appropriate strategies to address them (Manuj & Mentzer, 2008; Ivanov & Dolgui, 2020). Proactive policymakers prevent such disruptions by developing risk identification and mitigation strategies (Asadzadeh et al., 2020; Shahed et al., 2021)

When supply chain vulnerabilities are faced with potentially pervasive disruptions, one of the steps which should be taken is managing those vulnerabilities and the uncertainty that comes along with them (Pettit et al., 2013).Therefore, there is a need for supply chain resilience models to anticipate and mitigate the impact of pandemic-related vulnerabilities and uncertainties, as well as in-depth studies on the assessment, prediction, prevention and management of supply chain disruptions (Ivanov & Dolgui, 2020).

Supply chain disruptions have been of interest to researchers and practitioners. Discussions on supply chain vulnerability and resilience began in 2001, initiated by Heft-Neal et al (2008) and Hosseini and Ivanov (2020). The concept of supply chain vulnerability (SCV) was then introduced by discussing supply chain vulnerability and classifying the specific risks associated with supply chains (Daultani et al., 2019).

Based on a review of previous research, this study's gap is establishing a supply chain resilience framework in trading companies by considering the vulnerabilities and uncertainties. This framework should also incorporate a dimensional analysis and disruption factors to accommodate the impact of the COVID-19 pandemic disruptions. The scope of this research is more focused on pandemic disruptions and supply chain capability in general trading companies. Therefore, this research aims to build a supply chain resilience framework for general trading companies to manage vulnerabilities and uncertainties in the supply chain, especially due to the COVID-19 pandemic. The framework is developed based on risk management literature and resilience and considers the fundamental causes of risk in supply chain based on the actual COVID-19 pandemic conditions from general trading companies.

Based on the research background, the formulated research questions are as follows:

RQ1: How can pandemic-related disruptions in the supply chain be identified in the general trading companies?

RQ2: How can general trading companies foster their supply chain capabilities to respond to pandemic disruptions in the supply chain?

RQ3: Assessed using a Bayesian network approach, what is the probability of each pandemic disruption in the supply chain?

RQ4: How does the supply chain resilience framework perform in general trading companies in managing the pandemic disruptions, especially in the context of pandemic disruptions?

This research aims to identify disruptions in the supply chain of the general trading companies and their capabilities to deal with disruptions in the supply chain during the COVID-19 pandemic. In addition, this study aims to determine the

probability of each disruption in the supply chain using a Bayesian network approach. With this, a supply chain resilience framework is built to assist general trading companies in managing pandemic disruptions, especially in the context of COVID-19 pandemic.

2 Literature Review

2.1 Supply Chain Disruptions and Risks

The COVID-19 pandemic has affected the entire world and imposed uncertainty in almost all sectors, including the business world. General trading firms are not an exception. They experience disruptions such as supply and demand instability. A resilient supply chain system is needed to deal with and thrive in an unstable environment. Companies must thus comprehend their supply chain risk management systems to reduce the risks. In addition, they must understand disruptions caused by force majeure, such as the COVID-19 pandemic. According to Ivanov (2021) the COVID-19 pandemic caused unprecedented disruptions that significantly influenced the global supply chain system. COVID-19 pandemic also affects the safe food shopping behaviors, hand hygiene, and online food delivery (Soon et al., 2022) .

Risks are typically related to potential incidents that might impede business processes. Risks in supply chains are categorized based on the likelihood to occur and the effects (Heckmann et al., 2015). Kim and Wagner (2021) define supply chain risks as the likelihood and consequences of unforeseen macro- and/or micro-level occurrences or situations that negatively influence certain supply chain components and can result in operational, tactical, or strategic failure. Another type of uncertainty is the risk associated with supply chains. The source of uncertainty is described as a function of the disruption distribution. Meanwhile, Mark and Shen (2012) and Sawik (2014) define risks as disruptions.

According to Vanany, et al (2021) , three dimensions of extraordinary disruptions in a supply chain system are supply, production, and demand disruptions. The beginning of disruption in supply is the depletion of raw materials and spare components needed to produce commodities (Paul & Chowdhury, 2021). During the COVID-19 pandemic, many supplier countries were affected, so the supply of raw materials and spare components declined. The commodities that the market demands also shifted during the pandemic, which disrupted a company's productivity (Paul & Chowdhury, 2021). The productivity of businesses producing various goods throughout the COVID-19 era can be compared.

Unlike other disasters, such as floods, earthquakes, and other natural disasters, which cause instantaneous disruptions in the supply chain system, the COVID-19 pandemic is an extraordinary event that has a successive impact on the supply chain system (Ivanov, 2021). Viewed from the impact factor perspective, mega disruptions like the COVID-19 pandemic have both long- and short-term effects coupled with uncertainty. The impact is pervasive and simultaneous in supply, demand, and logistics. Anticipating the recovery factor for COVID-19 is difficult due to the difficulty of using the disruption scale and the temporal element involved in running and not running the supply chain system (Hosseini & Ivanov, 2020).

2.2 Supply Chain Resilience

The expanding role of the global supply chain and the growing link between suppliers and manufacturers result in dependency between businesses in the supply chain and increasing supply chain complexity. In a stable and supportive business environment, supply chains can remain efficient. However, interruptions and hazards during the actualization process are always present (Blackhurst et al., 2005; Wagner & Bode, 2006; Christopher et al., 2011). Firms must comprehend the rapidly changing business environment and continually adapt to changes to survive. They have to go through the adaptation phase before being ready to react to sudden and unpredictable disruptions. Mitigating the impact of disruptions brought about by changes includes acting rapidly (Criaghead et al., 2007; Manuj & Mentzer, 2008; Chowdury & Quaddus, 2017; Dabhilkar et al., 2016).

Supply chain resilience is the ability to anticipate unforeseen events and respond to and recover from disruptions (Ponomarov & Holcomb, 2009), which can be achieved by maintaining the continuity of connections between supply chain elements and the structure's control and functionality. According to Holling (2001), resilience is the ability of a system to withstand perturbations while continuing to function and be under control. Viewpoints on resilience in the literature vary depending on the areas of study. Past studies have discussed the transdisciplinary and multifaceted characteristics of 'resilience' as a concept (e.g., (Ponomarov & Holcomb, 2009; Bhamra et al., 2011; Ponis & Koronis, 2012; Spiegler et al., 2012)

Resilience is a fundamental, active, and value-generating element (Ivanov, 2021). To create a resilient supply chain, companies need to be able to define and seize opportunities, identify and mitigate problems, and reorganize their supply chain and resource base for renewal (Maijanen & Jantunen, 2014). Achieving supply chain resilience requires a company to create internal competencies, such as the capability to identify disturbances (Mohammed et al., 2021). A company needs to continuously improve its capability to evaluate, explain, and reconfigure a company's activities. In

addition to this, it also needs to build and implement robust resilience in the supply chain, anticipatory resilience in handling crises, and adaptive resilience in decision-making (Flynn et al., 2021)

2.3 Supply Chain Capability

Ivanov and Doulgi (2020) developed the idea of supply chain capability in the context of the supply chain system, which consists of three steps for addressing supply chain interruptions: recognizing the effect, adapting, and reforming. In other words, they broke down capability into three stages: absorptive, adaptive, and restorative.

Absorptive capability is the ability of a system to absorb or tolerate the impact of disturbances and reduce the negative effects of disturbances with a relatively low degree of effort (Biringer et al., 2013). Adaptive capability is the degree to which a system can adjust and attempt to overcome disruptions by enacting non-standard operating procedures without recovery activities (Ivanov & Dolgui, 2020). Restorative capability is a system's capability to recover quickly and effectively from disturbances that are too great for adaptive or restorative capability to handle (Biringer et al., 2013).

2.4 Potential Supply Chain Disruptions and Risks at General Trading Companies

Risks exist in every industry sector, including general trading companies. Three supply chain risk elements that the supply chain of general trading companies' faces is operational, external, and network risks. According to the Basel Committee on Banking Supervision (2006), operational risk is the possibility of suffering a loss due to subpar or ineffective internal procedures, personnel, and systems or because of uncontrollable outside factors. Meanwhile, network risk results from ownership, an individual supplier's strategy, and a supplier's network (Knight et al., 2020). Lastly, external risks are occurrences or events brought on by outside sources, such as the weather, earthquakes, politics, policies, and market forces (Wagner & Bode, 2006).

3 Research Design

The phase of this research consists of third phases. In the first phase, determining pandemic disruptions factors and supply chain capability for general trading companies are conducted with two stages such as review the previous literatures related and interview with some informants in several companies with in-depth interviews methods. In the second phase, developing Bayesian Network Model for pandemic disruptions factors are conducted with three stages such as calculating the prior probability value of each disruption factors, constructing the Bayesian Network structure, and calculation the conditional probability nodes. In the third phase, development supply chain resilience framework for the pandemic disruptions in general trading companies are conducted. In phase two and three, implementation of proposed supply chain resilience framework for pandemic disruptions in general trading companies was conducted in company C to validate the applicability of the proposed supply chain resilience framework. The following sub-sections describe these three phases in more detail.

3.1 Phase 1: Determining Pandemic Disruptions and Supply Chain Capability Factors

In the review literature stage, a few previous articles related for three dimensions of supply chain disruptions (supply, operations, demand dimension) for pandemic in general trading companies that investigated the pandemic disruption factors for general trading companies have been reviewed. A literature review was also conducted to determine supply chain capabilities that are relevant to pandemic disruption factors in supply chains that affect general trading companies. Because the number of pandemic disruptions factors and supply chain capabilities the related and specified for the general trading companies is a few factors in previous literatures, therefore, we conducted interview with in-depth interview to find and determine related pandemic disruption factors and supply chain capability for general trading companies.

In the in-depth interviews stage, before the interviews were conducted in person or via Zoom meeting, open questionnaires were distributed to 12 informants in 5 companies to understand the questions from this research. Questions that needed to be understood were explained by phone and WhatsApp. During the 1.5-2-hour interview, recording was done for 12 informants to be processed with qualitative research software. Data processing for qualitative content analysis of recordings from in-depth interviews has been carried out using qualitative research software. Qualitative research software is established qualitative research tools that are used to conduct qualitative data analysis (Peters & Wester, 2007; Woods et al., 2015). Content analysis is easier to synthesized using qualitative software that open-ended textual data (ie., recorder to text) to better observe patterns and trends (Kuckartz, 2014)

Three steps of content analysis using qualitative software have been conducted. First, the recorder results of the in-depth interviews were entered into qualitative software and numbered in chronological stages of disruptions in the supply chain. Second, categorization is carried out on disruptions factors that severely impact the supply chain system by representing the disruptions factors through nodes and visualization of disruptions factors has been founded. Finally,

the results of content analysis using qualitative software based on in-depth interviews recorder have been confirmed with informants of this study.

The Case Studies

This research uses a multi-case studies approach involving past study reports. The use of the multi-case study method also allows the examination of data and the understanding of the similarities and differences between the cases studied. A multi-case study selects several similar cases as the object of research. According to Yin (2003), multiple case studies aim to replicate findings in several cases and draw comparisons. This research uses 5 companies as multiple case studies to determine the disruptions factor in each dimension. Creswell and Poth (2017) recommend the number of cases is 4 or 5 cases. As for the number of informants/interviewees used in this study, there were 12 informants to determine the disruptions factors that have an impact on the operational performance of the supply chain of trading companies. Guest et al (2006) stated that 12 interviewees should be enough to achieve data saturation. Creswell and Creswell (2017) suggested 10-50 informants as being sufficient depending on the type and research question of the study.

The 5 companies selected as cases in this study are companies that have experienced the impact of disruption due to the COVID pandemic and the products traded are obtained from abroad (import) or sent abroad (its type is import products or export products). There are 2 types of five general trading companies in this study, namely Single Agent Brand Holders (ATPM) and brand holder distributors. The five companies have good performance in Indonesia with the revenue range of USD 1,150,000 and USD 945,153,562 annually. The company profiles as case in this study are shown in Table 1.

Table 1.
Profiles of companies as case in this study

Company	Revenue (USD)	Market Share	Number of Branch	Type of Business	Number of Employees
Company A	1,200,195	8%	1	Brand Distributor	20
Company B	180,029,250	30%	15	Brand Distributor	600
Company C	140,022,750	18%	8	Brand Distributor	297
Company D	945,153,562	15%	8	Brand Distributor	4,846
Company E	1.150.000	8%	1	Brand distributor	25

The 12 informants of this research have been selected to have experience ranging from 7 - 22 years with the positions of president director, operational director, senior manager and branch manager. The screening questions show that all informants of this research have also understood and been involved in supply chain operations during the COVID-19 pandemic. Semi-open questionnaires were distributed to informants/interviewees to first understand what to ask for each type of supply chain disruptions and supply chain capabilities. The profile of informant in this study are shown in Table 2.

Table 2.
The profile of informants in this study

Company	Informants	Education	Duration of Work	Position
A	I01	Undergraduate	10 years	Operational Directors
	I02	Undergraduate	8 Years	Branch Manager
B	I03	Undergraduate	13 Years	Branch Manager
	I04	Undergraduate	10 Years	Branch Manager
	I05	Undergraduate	10 Years	Branch Manager
C	I06	Undergraduate	10 Years	Branch Manager
	I07	Undergraduate	10 Years	Branch Manager
	I08	Undergraduate	22 Years	Senior Manager
D	I09	Undergraduate	15 Years	Branch Manager
	I10	Undergraduate	14 Years	Branch Manager
E	I11	Graduate	10 Years	President Director
	I12	Undergraduate	7 Years	Senior Manager

3.2 Phase 2: Developing Bayesian Network Model for Pandemic Disruptions Factors

In this phase, the Bayesian Network method was conducted with three stages to determine the effects values of pandemic disruption factors each dimension of supply chain in this study. The first stage, secondary data was collected

from events for each pandemic disruption factor at company C as a case study because the existing secondary data has been recorded well and three informants in company C are willing to be interviewed again. The second stage, constructing the Bayesian Network structure of the case to see the causal relationship of each variable/node. The arrow from one node to another illustrates that the former influences the latter. Nodes that are influenced by other nodes have posterior probabilities, while nodes that are not influenced and are independent have prior probabilities. Finally, conditional probability, or the probability of nodes that have been influenced by other nodes, is calculated. This research uses calculation validation in the form of the Bayesian software. The results of the conditional probability assessment calculation are declared valid when the manual calculation and the application show the same results.

3.3 Phase 3: Developing Supply Chain Resilience Framework and Implementation in 1 Case

Development supply chain resilience framework for the pandemic disruptions in general trading companies are conducted. Validation of the proposed supply chain resilience framework was also carried out at Company C, whose performance was quite significant in reducing the Company's performance and there were efforts to improve supply chain capabilities to reduce the impact of the COVID pandemic. In addition, Company C has completed secondary data and is willing to collect the required primary data. The branch managers at Company C are also willing to provide input and validate so that the proposed supply chain framework is even better.

4 Results

4.1 Pandemic Disruptions Factors in Supply Chain for General Trading Companies

Supply chain effectiveness is related to sales and service levels, as well as supply chain cost efficiency (Ivanov, 2021). At the same time, achieving planned performance can be hampered by environmental disruptions. The COVID-19 pandemic becomes an external disruption which damages the supply chain network massively and thoroughly. This is called supply chain disruption by (Ivanov & Dolgui, 2020)

Based on the review previous literature, pandemic disruptions in the supply chain consist of three dimensions and six sub-dimensions. The first is the supply dimension with the sub-dimension of inbound logistics. The second is the operational dimension with two subdimensions: operational and outbound logistics. The third is the demand dimension with three subdimensions: marketing, sales, and service. The disruptions in the three dimensions are almost similar across the companies. We use in-depth interviews to identify the supply chain disruptions factors for each dimension and sub-dimensions. Furthermore, the results of the recorded in-depth interviews were processed with qualitative research software to determine the supply chain disruptions. Table 3 shows the pandemic disruptions factors results in supply chain for general trading companies using qualitative research software.

The following analyses pandemic disruption factors for each dimension of supply chain disruptions.

4.11 Pandemic Disruption Factors in Supply Chain for Supply Dimensions.

The four disruptions to the inbound logistics supply dimension are shipping costs, principle items prices, availability of goods in manufacturing and delivery time. Shipping costs increased drastically due to restrictions on shipping goods. The scarcity of goods and the increasing demand for goods causes the price of principal goods to increase dramatically. Availability of goods in manufacturing is disrupted due to the disrupted outbound manufacturing system by the mobility restrictions, which result in limited human resources in the production process. Delivery time is disrupted because deliveries were delayed due to restrictions to reduce the spread of COVID-19 pandemic. In-depth interview results show that the availability of goods factor was stated as a pandemic disruption factor by 9 informants, principle items prices and delivery time factors by 8 informants, and shipping costs by 5 informants (see Table 3).

4.12 Pandemic Disruption Factors in Supply Chain for Operational Dimension

Operations dimension consists of two sub dimensions, namely operational sub-dimension with three (3) pandemic disruptions factors and pandemic outbound sub-dimension with two (2) disruptions factors. The operational sub-dimension with several disruptions identified, some of which are the main activities in the company's business processes such as assembly, meeting order, and pre-delivery check factor. The assembly disruption factor was caused by the lack of supporting parts to assist the assembly process. The meeting order disruption factor was caused by being unable to conduct face-to-face or direct meetings. The pre-delivery check disruption factor arises due to the limited manpower to check goods, so the process takes longer.

In-depth interview results show that the meeting order factor was stated as a pandemic disruption factor by 9 informants, assembly and pre-delivery check factors by 8 informants (see Table 3).

The outbound sub-dimension with two pandemic disruptions that arise due to COVID-19 pandemic, namely disruptions to delivery times experienced by all sample companies and disruptions to forward availability experienced by three sample companies. Disruptions in forward availability arise due to mobility restrictions, so only a few goods delivery services were available. This has a cascading effect on the next disruption, namely the delivery time of goods to consumers, which takes longer or does not match the time the trading service company promises. In-depth interview results show that the forward availability factor was stated as a pandemic disruption factor by 9 informants and delivery time factors by 8 informants (see Table 3).

Table 3.
Pandemic disruptions factors result in supply chain for general trading companies using qualitative research software

Interview Protocol – References	Pandemic Disruptions Factors	I1	I2	I3	I4	I5	I6	I7	I8	I9	I10	I11	I12	Total
1. SUPPLY DIMENSION														
How and what are the impacts of COVID 19 on the Inbound Logistics process? [1]	1 Shipping logistic cost	P			P		P			P			P	5
	2 Principle items prices	P		P		P		P	P	P	P	P		8
	3 Availability of goods	P	P	P	P	P		P	P	P		P		9
	4 Delivery time	P	P	P		P	P		P		P		P	8
2.1 OPERATIONS DIMENSION: Operational sub-dimension														
How and what are the impacts of COVID 19 on operations in trading services companies? [2]	1 Assembly	P	P	P		P	P		P		P		P	8
	2 Meeting order		P	P	P	P		P	P	P	P		P	9
	3 Pre-delivery check	P	P	P	P		P	P	P			P		8
2.2 OPERATIONS DIMENSIONS: Outbound sub-dimension														
How and what are the impacts of COVID 19 on the logistics Outbound process? [3]	1 Forward availability	P	P	P		P	P	P		P	P	P		9
	2 Delivery time	P	P	P	P		P	P	P				P	8
3.1 DEMAND DIMENSION: Sales sub-dimension														
How and what is the impact of Covid 19 on sales activities? [4]	1 Visit		P	P	P	P		P	P		P		P	8
	2 Inquiry	P	P	P	P		P			P	P	P		8
3.2 DEMAND DIMENSION: Service sub dimension														
How and what are the impacts of Covid 19 on after-sales service activities? [5]	1 Manpower	P		P	P	P		P	P			P		7
	2 Mobility	P	P	P	P		P	P		P	P		P	9
3.3 DEMAND DIMENSION: Marketing sub dimension														
How and what is the impact of Covid 19 on marketing activities? [6]	1 Pricing	P		P	P	P	P		P		P	P		8
	2 Product seminar	P	P	P			P	P	P	P		P	P	9
	3 Exhibition	P	P	P	P	P		P			P		P	8

[1] (Vanany et al., 2021), (Liu et al., 2021), (Ivanov & Dolgui, 2020)

[2] (Ivanov & Dolgui, 2020), (Vanany et al., 2021), (Cai & Luo, 2020)

[3] (Cai & Luo, 2020), (Hosseini & Ivanov, 2020), (Ba & Bai, 2021)

[4] (Asadzadeh et al., 2020), (Hosseini & Ivanov, 2020), (Ba & Bai, 2021)

[5] (Cai & Luo, 2020), (Hosseini & Ivanov, Bayesian Networks for Supply Chain Risk, Resilience and Ripple Effect Analysis: A Literature Review, 2020), (Ba & Bai, 2021)

[6] (Liu et al., 2021), (Ba & Bai, 2021), (Cai & Luo, 2020)

4.13 Pandemic Disruption Factors in Supply Chain for Demand Dimension

Demand dimension consists of three sub-dimensions (3), namely sales sub-dimensions with two (2) pandemic disruptions factors, service sub-dimensions with 2 pandemic disruptions factors, and marketing sub-dimension with 3 pandemic disruption factors. In the sales sub-dimension, two factors are affected by the pandemic disruptions in supply chain such as visit and inquiry. The visit disruption factor is illustrated by the decrease in the frequency of the sales team going to the field to do a marketing campaign. This is due to social restrictions during the COVID-19 pandemic. Inquiry disruption factor is a common problem in the sales dimension and inquiry disruption factor occurs when there is a considerable decrease in the company's interaction with prospective buyers. In-depth interview results show that visit and inquiry factor was stated as a pandemic disruption factor by 8 informants (see Table 3).

In service sub-dimension, two factors are affected by pandemic disruption in supply chain such as manpower and mobility factor. The decreased labor to carry out maintenance is the manpower factor. The mobility disruption factor was caused by social restrictions that reduced labor movement on duty. In-depth interview results show that the manpower factor was stated as a pandemic disruption factor by 7 informants and mobility factor by 9 informants (see Table 3).

In marketing sub-dimension, three factors are affected by pandemic disruption in supply chain such as pricing, product seminar, and exhibition. Pandemic disruption also appeared in the pricing factor, with a decrease in margins caused by price changes in manufacturing and increased logistics costs. The aim was to keep the product's price in the market unchanged to remain profitable and still be accepted by the market. The product seminar factor was completely stopped due to the government's regulations to reduce crowds to prevent the spread of COVID-19 pandemic. Disrupted exhibitions factor occurred due to social distancing, the requirement to avoid gathering, and the formation of crowds. In-depth interview results show that the product seminar factor was stated as a pandemic disruption factor by 9 informants and pricing and exhibition factor by 8 informants (see Table 3).

4.2 Bayesian Network Model for Pandemic Disruptions in General Trading Company

Bayesian Network is a probabilistic model that represents causal relationships between random variables in a system. The model consists of nodes that represent variables and edges that represent causal relationships between those variables. Each node has a conditional probability distribution that shows how a variable is affected by other variables in the network.

The Bayesian Network structure in Figure 1 shows the relationship between each disruption in each dimension. The disruptions (colored blue) potentially impact all business processes, i.e., inbound logistics, outbound logistics, operations, marketing, service, and sales, which will then impact the entire supply chain during a pandemic.

To discover the risks in the supply chain, the Conditional Probability Assessment (CPA) value of each activity in the company needs to be determined. First, the prior probability of each disruption is subtracted by the disruption. Then, the CPA of the business processes is calculated. Finally, it will be known whether the supply chain is disrupted or not during a pandemic. CPA is one of the methods used in the Bayesian Network to calculate the conditional probability of a variable on other variables in the network. CPA is formulated as follows.

$$\mathrm{CPA} = \sum_{\mathrm{i}=1}^{\mathrm{n}} (\text{ Prior Combination}) \prod_{\mathrm{i}=1}^{\mathrm{n}} \text{Prior Probability}$$

4.21 Calculation of Prior Probability of the Pandemic Disruptions Factors

Prior probability is obtained through secondary data from 1,710 companies, stating whether or not disruptions exist in a particular process. In this study, code Y (yes) or 1 is given as an indication of disruption, while code N (no) or 0 is given as an indication of no disruption in the process. Table 4 shows the recapitulation of the observation results for each disruption.

The probability value is obtained from the number of Yes and No divided by the total observations. For example, the prior probability value regarding the availability of goods is as follows.

$$\mathrm{P(D1 = Yes)} = \frac{1305}{1710} \approx 0{,}7362$$

$$\mathrm{P(D1 = No)} = \frac{405}{1710} \approx 0{,}2368$$

Other values are obtained in the same way. This prior probability value is used as a reference in determining the CPA for each business process.

4.22 CPA Calculation on Sub Inbound Logistics, Operations, Marketing, and Services

The CPA calculation was conducted using the Bayesian Network software and manually. Disruptions assessed by the CPA calculation are classified into four: small (<25%), moderate (25%-50%), significant (51%-75%), and very significant (>75%). First, inbound logistics is influenced by the availability of goods (D1), the purchase price (D2), the delivery time of goods from within (D3), and the shipping costs (D4). Inbound logistics is in the supply dimension, as shown in Table 4. The result of the manual calculation is 0.2041. This result shows that with D1 to D4 factors, the probability of disruption in inbound logistics is 20.41% (small disruption). The calculation results with Bayesian Network software also show the same results as shown in Table 5.

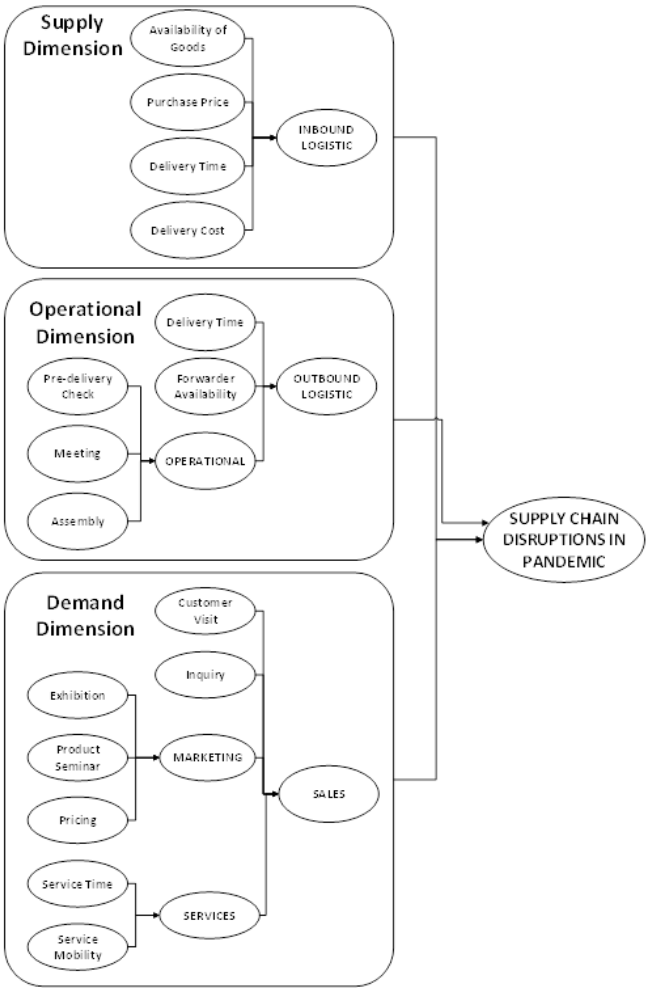

Figure 1. Structure of Bayesian Network for Supply Chain Pandemic Disruption in General Trading Companies

Table 4.
Recapitulation of pandemic disruption observations

No	Disruption code	Description	Observation Results		Chances	
			Yes	No	Yes	No
1	D1	Availability of Goods	1305	405	0.7632	0.2368
2	D2	Purchase Price	1304	406	0.7626	0.2374
3	D3	Delivery Time	1333	377	0.7795	0.2205
4	D4	Shipping Cost	1084	626	0.6339	0.3661
5	D5	Delivery Time	1434	276	0.8386	0.1614
6	D6	Forwarder availability	1140	570	0.6667	0.3333
7	D7	Pre-delivery checking	1434	276	0.8386	0.1614
8	D8	Meeting	1550	160	0.9064	0.0936
9	D9	Assembly	1434	276	0.8386	0.1614
10	D10	Customer visit	1550	160	0.9064	0.0936
11	D11	Inquiry	1115	595	0.6520	0.3480
12	D12	Exhibition	1434	276	0.8386	0.1614
13	D13	Product seminar	1434	276	0.8386	0.1614
14	D14	Pricing	1333	377	0.7795	0.2205
15	D15	Service personnel	1434	276	0.8386	0.1614
16	D16	Mobility of service personnel	1550	160	0.9064	0.0936

Bayesian Network results round the numbers, which is 20%. This is the same as the result of manual calculation, at 20.41%. As such, the calculation is valid. The inbound logistics is disrupted, but the scale is relatively small. In detail, the availability of goods (D1), purchase price (D2), delivery time (D3), and shipping costs in inbound logistics are disrupted, with delivery time (D3) being the most often disrupted at 78% (very significant), followed by availability of goods (D1) and purchase price (D2) at 76% (very significant), and finally shipping costs (D4) at 63% (very significant). In this case, if inbound logistics is disrupted, the first factor that should be checked is the delivery time (D3), which is the most disrupted.

Second, the operational process is influenced by the pre-delivery checking (D7), the price meeting (D8) and the assembly (D9). The result of the manual calculation on the operational dimension is 0.5364, which means that with the pre-delivery check, meeting, and assembly factors, the possibility of disruption in operations is 53.64% (significant disruption). The calculation results with the Bayesian Network software show the same results, with a rounded percentage of 54%, so the calculation is declared valid. It can be concluded that operations are disrupted on a significant level. The sources of disruption are the pre-delivery checking (D7), the meeting (D8), and the assembly (D9) with a very high probability. The meeting (D8) poses the most significant disruption during the pandemic at 91%, followed by the pre-delivery check (D7) and assembly (D9) at 84% (also very significant).

Third, the marketing process is influenced by the exhibitions (D12), the product seminars (D13), and the promotional awards (pricing) (D14). The result of the manual calculation is 0.4374, indicating that with the factors of exhibitions, product seminars, and pricing, the occurrence of disruption in marketing is 43.74%, which is a moderate disruption level. The calculation results of the Bayesian Network software also show the same results as shown in Table 5, rounded at 44%. As such, the calculation is declared valid. It can be concluded that marketing is moderately disrupted at less than 50%. The disruptions of the marketing are the exhibition (D12) and the product seminar (D13) at 84% (moderate) and the pricing (D14) at 78% (moderate).

Fourth, the service process is only influenced by the service personnel (D15) and the service personnel mobility (D16). Service is in the same dimension as Service, namely the demand dimension. The result of the manual calculation is 0.6488, indicating that, with service personnel and labor mobility factors, the possibility of disruption in the service process is 67.35% (significant disruption). The calculation result with the Bayesian Network software also shows the same results as shown in Table 5, rounded at 67%. As such, the calculation is declared valid. The service process is significantly disrupted, with the probability between 50% and 75%. The above 60% disruption is significant, caused by power mobility (D16) at 91% (very significant) and service power (D15) at 85% (very significant).

4.23 CPA Calculation on Outbound Logistics and Sales

The CPA calculation was performed using the Bayesian Network software and manually. The CPA calculation shows that the disruptions can be classified into four: small (<25%), moderate (25%-50%), significant (51%-75%), and very significant (>75%). The CPA calculation of outbound logistics and sales requires other business processes. Outbound logistics is influenced by operations, and sales are influenced by marketing and services. The CPA manual calculation result is 0.2997, which means that, with the factors of delivery time (D5), forwarder availability (D6), and operations (OP), the disruption in outbound logistics is at 22.97%. The results of calculations with Bayesian Network software also show the same results, as shown in Table 5, rounded at 23%. As such, the calculation is declared valid. Outbound logistics experiences a small disruption with a probability of less than 50%. The biggest disruption comes from the delivery time (D5) at 84% (very significant), followed by the forwarder's availability (D6) at 67% (significant), and operations at 54% (significant).

Meanwhile, sales are influenced by four factors: the consumer visit (D10), the inquiry (D11), the marketing (MK) and the services (SVC). The result of the manual calculation is 0.1345, which shows that, with the customer visit (D10), inquiry (D11), marketing (MK), and service (SVC) factors, the disruption in sales is at 13.45%. The calculation results using the Bayesian Network software also show the same results, as shown in Table 5, which is rounded at 13%. As such, the calculation is declared valid. Sales see a small disruption with a probability of less than 25%. The biggest disruption comes from customer visits (D10) at 91% (very significant), followed by inquiry (D11) at 65% (significant), service at 65% (significant), and marketing at 44% (moderate).

4.24 CPA Calculation on the Supply Chain

In the final stage, the supply chain's disruption probability is calculated, which is directly influenced by inbound logistics, outbound logistics, and sales. The result of the manual calculation is 0.0618, indicating a disruption in all factors, and the causal relationship of each factor in the supply chain is 6.18%. The calculation results using the Bayesian Network software also show the same results, as shown in Table 5, rounded to 6%. As such, the calculation is declared valid. It can be concluded that the supply chain experiences a small disruption below 25%.

The factors with the largest percentage of disruption are the services at 65% (significant), operations at 54% (significant), and marketing at 44% (moderate). These three factors come from the operational and demand dimensions. During a

pandemic, the factor that contributes the most to the disruptions in the supply chain is the service process consisting of service personnel (D15) and personnel mobility (D16), the company operations consisting of pre-checking (D7), meetings (D8), and assembly (D9), and marketing consisting of exhibitions (D12), product seminars (D13), and pricing (D14).

Table 5.
Probability calculation

Dimension	Pandemic disruptions sub-dimension and factors	Yes	No
		6%	**94%**
Supply Dimension	*Inbound Logistics*	20%	80%
	1. Logistic cost factor	63%	37%
	2. Price of Principal Goods factor	76%	24%
	3. Delivery Time	78%	22%
	4. Goods Product Availability	76%	24%
Operational Dimension	*Operational*	54%	46%
	1. Assembly	84%	16%
	2. Meeting order	91%	9%
	3. Pre-Delivery Check	84%	16%
	Outbound Logistics	23%	77%
	1. Forwarder Availability	67%	33%
	2. Delivery Time	84%	16%
3. Demand Dimension	*Sales*	13%	87%
	1. Customer Visit	91%	9%
	2. Inquiry	65%	35%
	Service	65%	35%
	1. Manpower	84%	16%
	2. Mobilities	91%	9%
	Marketing	44%	56%
	1. Pricing	78%	22%
	2. Product Seminar	84%	16%
	3. Exhibitions	84%	16%

4.3 Supply Chain Capability for Pandemic Disruption in General Trading Company

Supply chain capability is a concept introduced by Ivanov and Doulgi (2020) who proposed three stages to deal with disruptions in the supply chain: initial impact, adaptation stage, and restorative stage. In other words, supply chain capability consists of absorptive, adaptive, and restorative capability. The results of in-depth interviews show that general trading companies try to carry out business processes when the supply chain system is disrupted due to COVID-19 pandemic. These efforts are described in the stages of supply chain capability as outlined by Ivanov and Dolgui (2020). Qualitative research software was conducted with the X-axis representing factor capability and the Y-axis representing the number of capabilities factor in the company.

Table 6 shows five supply chain capability taken at the absorptive stage. The first is the inventory strategy of stockpiling goods and procuring local goods to maintain supply and meet predicted market demand. The deployment of response teams to quickly deal with the COVID-19 pandemic was done in three companies, although the implementation varied, such as whether or not emergency teams were formed. Then, employment was managed by limiting the number of employees working in the office and at home. Two companies performed the step. Next is following government directives and protocols in handling COVID-19. Similarly, two companies implemented this strategy. Finally, upscaling competencies means providing technology training to workers to support the company's business processes. Only one company implemented this strategy.

At the adaptive capability stage, as shown in Table 6, there are three strategies implemented by general trading companies. Communication and collaboration were established and maintained with stakeholders involved in business processes and the health sector to sustain business activities while maintaining safety amid the COVID-19 pandemic. All five companies performed the step. While internal and external information is shared by building and maintaining

relationships between companies and customers. Three companies implemented this strategy. In addition, finances are managed by extending customer payment terms, implementing 'cash before delivery', and implementing extended maturities to manufacturers. Three companies implemented the strategy.

Table 6.
The results of supply chain capability factors using qualitative research

Interview Questions/References	Supply Chain Capability Factors	I1	I2	I3	I4	I5	I6	I7	I8	I9	I10	I11	I12	To-tal
A Absorptive capability														
1) What is the supplier separation strategy during COVID-19 pandemic,2) what is the supplier selection strategy during COVID-19?3) Explain, what is the inventory position when COVID-19 pandemic occurs? [1]	1. Government Directives (A1)	P				P		P		P		P	P	6
	2. Upscaling competency (A2)				P		P		P		P		P	5
	3. Managing Manpower (A3)		P	P		P	P		P		P	P		7
	4. Response team to quickly (A4)	P	P	P		P		P		P		P		7
	5. Inventory strategy (A5)	P	P	P	P	P	P	P		P		P		9
B Adaptive Capability														
1. Is there an alternative route during covid 19?, 2. is there a backup supplier during covid 19? 3. how is communication with suppliers during covid 19, explain? [2]	1 Communication and collaboration (B1)	P		P	P		P	P	P	P	P	P		9
	2 Internal and external (B2)	P	P	P		P	P		P	P		P	P	9
	3 Finance management (B3)	P	P	P	P	P		P		P			P	8
C Restorative capability														
1) What is the facility recovery process during COVID-19 Pandemic? 2) What is the process of labor recovery during COVID-19 pandemic? 3) What is the process of technology recovery during COVID 19 pandemic? [3]	1 Manpower restoration (C1)	P				P		P	P		P	P	P	7
	2 Facilities restoration (C2)	P	P	P	P	P	P	P		P		P	P	10
	3 Technology restoration (C3)	P	P	P	P	P	P		P		P	P	P	10
	4 Related diversification (C4)				P	P	P		P		P	P	P	7
	5 Extended warranty (C5)				P	P	P	P			P	P	P	7

[1] (Hosseini et al., 2019; Hosseni & Barker, 2016; Yildiz & Yayla, 2015; Yoon et al., 2018);

[2] (Hosseini et al., 2019; Torabi et al., 2015; Wang et al., 2016; Levalle & Nof, 2014); [3] (Hosseini et al., 2019; Hosseni & Barker, 2016)

Five strategies were implemented at the restorative capability stage. Labor restoration was carried out by one of the trading service companies. It was downsized to reduce the burden of labor costs. Facility restoration was carried out by all trading service companies. This was done by building supporting facilities and health restrictions, such as hand washing stations, automatic temperature measuring devices, and partitions on work desks to reduce the spread of COVID-19 pandemic. Technology restoration was carried out by all trading service companies in this study. This was done through education on the use of technology and the construction of technological support facilities to support business processes. Finally, diversification and extended warranty were implemented by one company. The company seeks to diversify products to meet customer demand, and the trading service company provides an extended warranty to provide convenience for customers.

4.4 Supply Chain Resilience Framework

The supply chain disruptions and supply chain capability obtained from the qualitative research software and Bayesian Network analysis are used to develop the supply chain resilience model for trading companies. Based on the results of the assessment of the application of the supply chain resilience framework in the case study, a series of efforts are needed to deal with disruptions in the supply chain system, which are described in Figure 2.

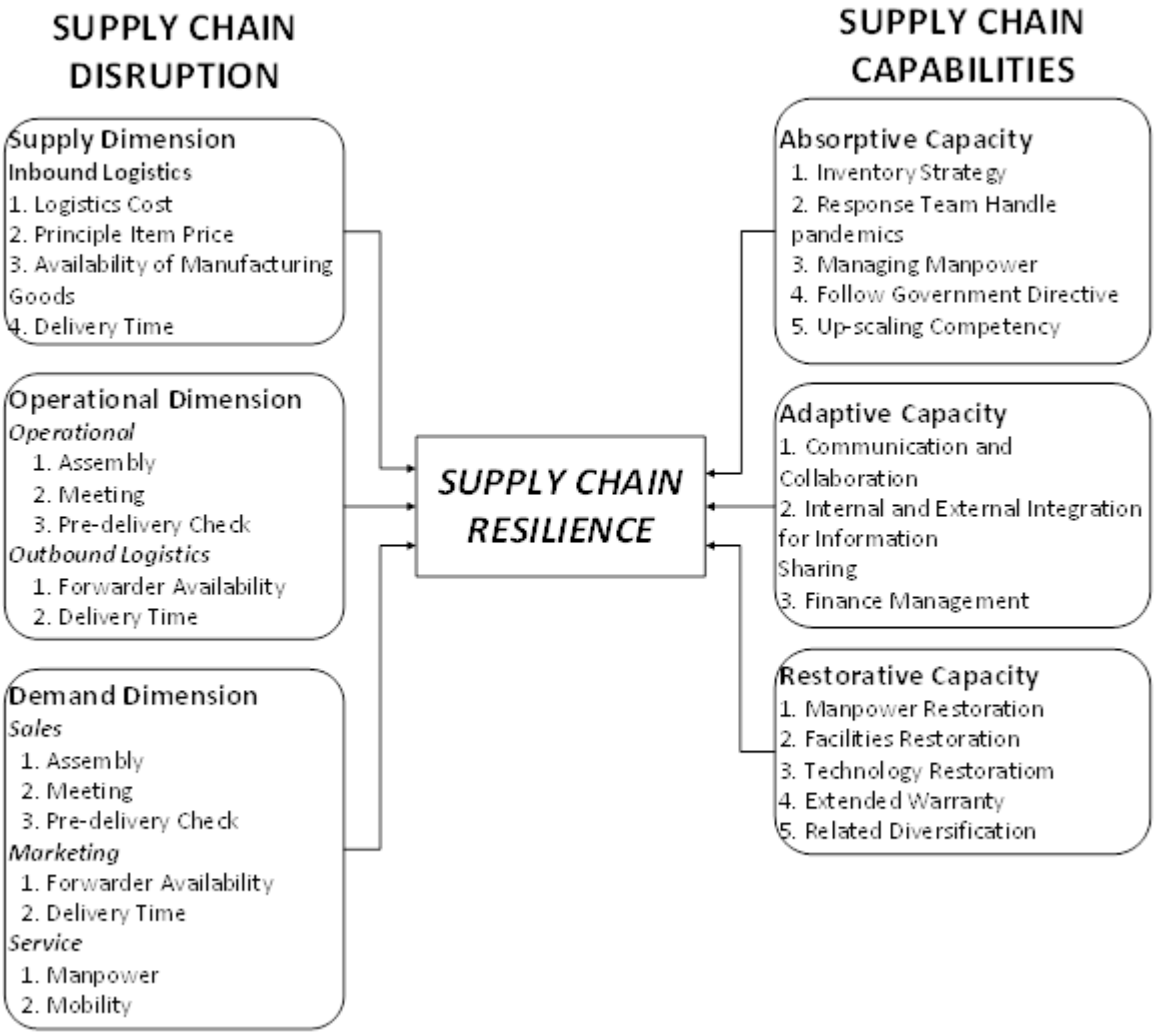

Figure 2. Supply chain resilience framework for pandemic disruption in general trading companies

4.5 Application of the Supply Chain Resilience Model in one Company

The supply chain resilience model was applied to one of the trading companies that served as the case study. The company is a trading company in Indonesia that operates as a brand holder distributor and has good performance. The process of applying the supply chain resilience model was carried out by one of the practitioners who was a deputy director having more than 15 years of work experience and a Master of Business Administration Educational background. The application of the supply chain resilience model was carried out to strengthen each aspect of the supply chain resilience model.

The questionnaires were given to and crosschecked with practitioners to see the results of the application of the supply chain resilience framework for pandemic disruption in the general trading company. The application is represented by a scale of 1 to 5. A value of 1 means low, 3 means moderate, and 5 means significant. The Assessment results of the supply chain resilience framework for pandemic disruption in the general trading company can be seen in Table 7.

The following describes the results of the assessment in company C.

4.51 Absorptive Capability

There are several efforts to deal with disruptions that occur in the supply chain system, including following government direction. This became the first step to handle COVID-19, with a total assessment result of 41 points. The next is an inventory strategy to maintain the stock of goods to meet the market demand, with a total assessment result of 33 points. The next step is managing manpower in a duty roster to support the company's business processes, with a total assessment result of 33 points. Furthermore, companies also formed a response team to quickly handle the pandemic, with a total assessment result of 21 points. Finally, upscaling competency to improve employee technological capabilities to support business processes when experiencing disruption, with a total assessment result of 8 points.

Table 7.
The Assessment results of the supply chain resilience framework for pandemic disruption in the general trading company

	Supply Chain Capability												
	Absorptive					Adaptive			Restorative				
Supply Chain Disruption	**A1**	**A2**	**A3**	**A4**	**A5**	**B1**	**B2**	**B3**	**C1**	**C2**	**C3**	**C4**	**C5**
Supply Dimension													
nd Logistics													
1. Logistic cost					5	5	3	3					
2. Price of Principal Goods					5	5	3	5					
3. Delivery Time					5	5	3	5					
4. Goods Availability					5	5	3	5					
Operational Dimension													
tional													
1. Assembly		5	5	5			1	1		3	3	5	1
2. Meeting order		5	5	5			1	1		1	3	5	5
3. Pre-Delivery Check		5	5	5			1	1		3	3	5	1
und Logistics													
1. Forwarder Availability					3		3	3			3		
2. Delivery Time					5		5	3			3		
Demand Dimension													
1. Visit	1	5	5				3	1			1		5
2. Inquiry		1	1				1	1	3		1		3
e													
1. Manpower	1	5	5	3			3	3	3	3	1		
2. Mobilities		5	1	3			3	3	3	1	1		
eting													
1. Pricing					5	5	3	3	3				3
2. Product Seminar	3	5	3				1	1					5
3. Exhibitions	3	5	3				1	1					5
Total of capability	8	41	33	21	33	25	38	40	12	11	19	15	28
Ranking of Capability	12	**1**	4	7	4	6	**3**	**2**	10	11	8	9	5
Total of dimension types	**136**					**103**			**85**				
Dimensions Ranking	1					2			3				

4.52 Adaptive Capability

Several strategies are implemented by trade service companies in responding to COVID-19 pandemic. One of them is communication and collaboration with relevant parties in the business processes so that company activities can be sustained, with a total assessment result of 40 points. Internal and external information sharing is done by building and maintaining relationships between companies and customers, with a total assessment result of 38 points. Finally, finance management to keep finances stable when disrupted by the COVID-19 pandemic has a total assessment result of 25 points.

4.53 Restorative Capability

Trade service companies also put in restorative efforts in responding to COVID-19 disruption. Among them is technology restoration, carried out through education on the use of technology and building technology support facilities to sustain

business processes. The total assessment result was 28 points. Product diversification is adjusting products in demand during the COVID-19 pandemic. The total assessment result was 19 points. Next, facilities restoration is done by building facilities to support business processes during the COVID-19 pandemic, with a total assessment result of 15 points. Meanwhile, extended product warranty for customers has a total assessment result of 12 points. Finally, manpower restoration or company downsizing to reduce operational costs shows a total assessment result of 11 points.

Based on the assessment of the model application in case studies in general trading companies, there is a sequence of efforts to be implemented to handle disruptions in the supply chain system of trading service companies, illustrated as follows (see Figure 3).

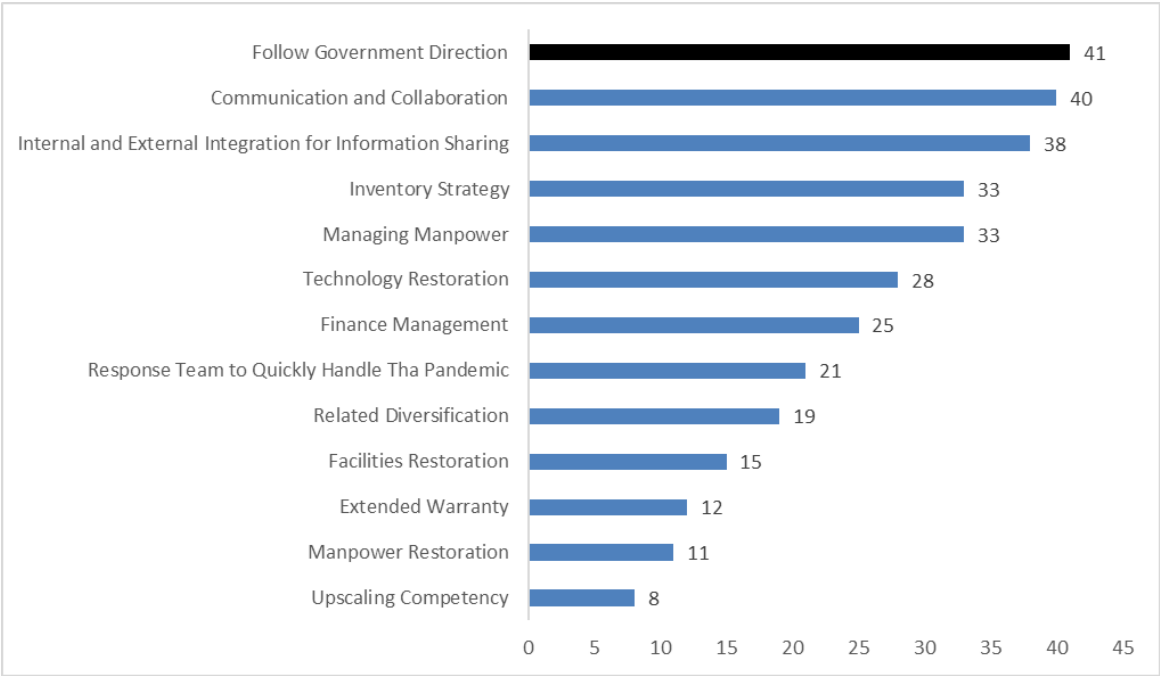

Figure 3. Efforts to handle disruptions in general trading's supply chains

Three supply chain capability factors or strategies can be implemented by trade service companies to deal with disruptions. These factors include following government directions, communication and collaboration, and internal and external integration for information sharing. Following government direction means following government regulations in handling the pandemic and implementing rules in the company's business processes. Communication and collaboration mean building and establishing communication with parties supporting the business processes during the COVID-19 pandemic. Internal and external integration for information sharing means building and maintaining communication with customers to maintain trust.

5 Conclusions

The results of this study show that there were pandemic disruptions in the supply chain for the general trading companies. Efforts that can be made to deal with these disruptions are described in supply chain capability. The analysis of supply chain disruptions and supply chain capability is represented by a resilience model for general trading companies. The findings also generate theoretical and practical implications that provide information to relevant stakeholders.

The COVID-19 pandemic is a phenomenon that can cause major disruptions to the supply chain system, leading to a major impact on business processes. This makes trading service companies work based on the concept of supply chain capability proposed by Ivanov and Doulgi (2020). The business concept is in accordance with the business processes of trading companies (Porter, 1985). This research provides empirical evidence with real case scenarios. In addition, the resilience model concept put forward in this study can provide insights into trading companies. Finally, the supply chain resilience model offers new strategies for similar research.

5.1 Managerial implications

The findings of this study have managerial implication for practitioners in the general trading companies, enabling them to pandemic disruption and supply chain capabilities factor in general trading supply chain. This research provides practical managerial directions through the proposed supply chain resilience framework. The proposed framework can be implemented to handle disruptions that arise in the supply chain system of a trading company. Practitioners or company managers can use this research as a guide to understand disruptions and determine the strategies to be applied in real cases. By utilizing this study, a manager of a trading company can be better prepared to face disruptions similar to COVID-19 pandemic in the future.

5.2 Future research

The proposed supply chain resilience framework for pandemic disruption in the general trading companies has limitations. However, the proposed supply chain resilience framework is easy to apply to any general trading companies. Firstly, the dimensions of pandemic disruption in supply chain and efforts to maintain supply chain capability are interrelated. However, further exploration of external aspects is needed to see how they affect the supply chain system in trade services companies.

Secondly, the limitation of this study is the proposed supply chain resilience framework for pandemic disruption and supply chain capabilities factor are identified from the results of in-depth interviews with Indonesian's general trading companies. The characteristics of disruption handling of trading companies in other countries may be different. Therefore, future research can benefit from a deeper exploration of supply chain resilience framework in general trading companies in several countries to develop a more general supply chain resilience framework.

References

Asadzadeh, A., Pakkhoo, S., Saeidabad, M. M., Khezri, H., and Ferdousi, R. (2020). Information technology in emergency management of COVID-19 outbreak. *Informatics in Medicine Unlocked,* **21**(11): 100475. https://doi.org/10.1016/j.imu.2020.100475.

Ba, S., and Bai, H. (2021). Covid-19 pandemic as an accelerator of economic transition and financial innovation in China. *Journal of Chinese Economic and Business Studies,* **18**(4): 1-8. https://doi.org/10.1080/14765284.2020.1855394

Bhamra, R., Dani, S., and Burnard, K. (2011). Resilience: The Concept, a Literature Review and Future Directions. *International Journal of Production Research,* **49**(18): 5375-5393. https://doi.org/10.1080/00207543.2011.563826

Biringer, B., Vugrin, E., and Warren, D. (2013). *Critical Infrastructure System Security and Resiliency* (1 ed.). Boca Raton: CRC Press. https://doi.org/10.1201/b14566

Blackhurst, J., Craighead, C. W., Elkins, D., and Handfield, R. (2005). An Empirically Derived Agenda of Critical Research Issues for Managing Supply-Chain Disruptions. *International Journal of Production Research,* **43**(19): 4067-4081. https://doi.org/10.1080/00207540500151549

BPS. (2021). *Ekonomi Indonesia 2020 Turun sebesar 2,07 Persen (c-to-c).* Retrieved from https://www.bps.go.id/id/pressrelease/2021/02/05/1811/ekonomi-indonesia-2020-turun-sebesar-2-07-persen%E2%80%93c-to-c-.html

Cai, M., and Luo, J. (2020). Influence of COVID-19 on Manufacturing Industry and Corresponding Countermeasures from Supply Chain Perspective. *Journal of Shanghai Jiaotong University (Science),* **25**(4): 409-416. https://doi.org/10.1007/s12204-020-2206-z

Chowdury, M., and Quaddus, M. (2017). Supply Chain Resilience: Conceptualization and Scale Development Using Dynamic Capability Theory. *International Journal of Production Economics,* **188**(4):, 185-204. https://doi.org/https://doi.org/10.1016/j.ijpe.2017.03.020

Christopher, M., Mena, C., Khan, O., and Yurt, O. (2011). Approaches to Managing Global Sourcing Risk. *Supply Chain Management: An International Journal,* **16**(2): 67-81. https://doi.org/10.1108/13598541111115338

Creswell, J. W., and Creswell, J. D. (2017). *Research Design : Qualitative, quantitative, and mixed method approaches.* Newbury Park: Sage.

Creswell, J. W., and Poth, C. N. (2017). *ualitative Inquiry and Research Design Choosing among Five Approaches.* Thousand Oaks: SAGE Publications.

Criaghead, C., Blackhurst, J., Rungtusanatham, M., and Handfield, R. (2007). The Severity of Supply Chain Disruptions: Design Characteristics and Mitigation Capabilities. *Decision Sciences,* **38**(1): 131-156. https://doi.org/10.1111/j.1540-5915.2007.00151.x

Dabhilkar, M., Birkie, S. E., and Kaulio, M. (2016). Supply side resilience capability as practice bundles: a critical incident study. *International Journal of Operations and Production Management,* **36**(9): 948-970. https://doi.org/10.1108/IJOPM-12-2014-0614

Daultani, Y., Cheikhrouhou, N., Pratap, S., and Prajapati, D. (2019). Designing Forward and Reverse Supply Chain Network for Refurbished Products. *Proceedings of the 9th International Conference on Operations and Supply Chain Management.* Vietnam.

Flynn, B., Cantor, D., Pagell, M., Dooley, K. J., and Azadegan, A. (2021). From the Editors: Introduction to Managing Supply Chains Beyond Covid-19 - Preparing for the Next Global Mega-Disruption. *Journal of Supply Chain Management,* **57**(1): 3-6. https://doi.org/10.1111/jscm.12254

Guest, G., Bunce, A., and Johnson, L. (2006). How Many Interviews Are Enough? *Field Methods,* **18**(1): 59-82. https://doi.org/10.1177/1525822X05279903

Heckmann, I., Comes, T., and Nickel, S. (2015). A critical review on supply chain risk – Definition, measure and modeling. *Omega,* **52**: 119-132. https://doi.org/https://doi.org/10.1016/j.omega.2014.10.004

Heft-Neal, S., Otte, J., Pupphavessa, W., Roland-Holst, D., Sudsawasd, S., and Zilberman, D. (2008). *Supply Chain Auditing for Poultry Production in Thailand.* Pro-Poor Livestock Policy Initiative.

Holling, C. (2001). Understanding the Complexity of Economic, Ecological, and Social Systems. *Ecosystems,* **4**: 309-405. https://doi.org/https://doi.org/10.1007/s10021-001-0101-5

Hosseini, S., and Ivanov, D. (2020). Bayesian Networks for Supply Chain Risk, Resilience and Ripple Effect Analysis: A Literature Review. *Expert Systems with Applications,* **161**: 113649. https://doi.org/10.1016/j.eswa.2020.113649

Hosseini, S., Tajik, N., Ivanov, D., Sarder, M., Barker, K., and Khaled, A. A. (2019). Resilient Supplier Selection and Optimal Order Allocation Under Disruption Risks. *International Journal of Production Economics,* **213**(3): 124-137. https://doi.org/10.1016/j.ijpe.2019.03.018

Hosseni, S., and Barker, K. (2016). A Bayesian Network Model for Resilience-Based Supplier Selection. *International Journal of Production Economics,* **180**: 68-87. https://doi.org/10.1016/j.ijpe.2016.07.007

Ivanov, D. (2021). Supply Chain Viability and the COVID-19 Pandemic: A Conceptual and Formal Generalisation of Four Major Adaptation Strategy. *International Journal of Production Research,* **59**(12): 3535-3552. https://doi.org/10.1080/00207543.2021.1890852

Ivanov, D., and Dolgui, A. (2020). A digital supply chain twin for managing the disruption risks and resilience in the era of Industry 4.0. *Production Planning and Control,* **32**: 775-788. https://doi.org/10.1080/09537287.2020.1768450

Ivanov, D., and Dolgui, A. (2020). Viability of intertwined supply networks: extending the supply chain resilience angles towards survivability. A position paper motivated by COVID-19 outbreak. *International Journal of Production Research,* **58**(10): 2904-2915. https://doi.org/10.1080/00207543.2020.1750727

Jüttner, U., and Maklan, S. (2011). Supply chain resilience in the global financial crisis: An empirical study. *Supply Chain Management: An International Journal,* **16**(4): 246-259. https://doi.org/10.1108/13598541111139062

Kim, S., and Wagner, S. M. (2021). Examining the Stock Price Effect of Corruption Risk in the Supply Chain. *Decision Sciences,* **52**(4): 833-865. https://doi.org/https://doi.org/10.1111/deci.12487

Knight, L., Meehan, J., Tapinos, E., Menzies, L., and Pfeiffer, A. (2020). Researching the Future of Purchasing and Supply Management: The purpose and potential of scenarios. *Journal of Purchasing and Supply Management,* **26**(3): 100624. https://doi.org/10.1016/j.pursup.2020.100624

König, M., and Winkler, A. (2021). COVID-19: Lockdowns, *Fatality Rates and GDP Growth*, **56**: 32-39. https://doi.org/10.1007/s10272-021-0948-y

Kuckartz, U. (2014). *Qualitative Text Analysis: A Systematic Approach* (1 ed.). SAGE Publications Ltd. https://doi.org/10.1007/978-3-030-15636-7_8

Levalle, R. R., and Nof, S. Y. (2014). Resilience by Teaming in supply network formation and re-configuration. *International Journal of Production Economics,* **160**: 80-93. https://doi.org/10.1016/j.ijpe.2014.09.036

Liu, X., Barenji, A. V., Li, Z., Montreuil, B., and Huang, G. Q. (2021). Blockchain-based smart tracking and tracing platform for drug supply chain. *Computers and Industrial Engineering,* **161**(5): 107669. https://doi.org/10.1016/j.cie.2021.107669

Maijanen, P., and Jantunen, A. (2014). Centripetal and Centrifugal Forces of Strategic Renewal: The Case of the Finnish Broadcasting Company. *JMM International Journal on Media Management,* **16**(3-4): 139-159. https://doi.org/10.1080/14241277.2014.982752

Mak, H.-Y., and Shen, M. (2012). Risk diversification and risk pooling in supply chain design. *IEE Transactions,* **44**(8): 603-621. https://doi.org/10.1080/0740817X.2011.635178

Manuj, I., and Mentzer, J. T. (2008). Global Supply Chain Risk Management. *International Journal of Physical Distribution and Logistics Management,* **38**(3): 192-223. https://doi.org/10.1108/09600030810866986

Mizgier, K. J., Jüttner, M. P., and Wagner, S. M. (2013). Bottleneck identification in supply chain networks. *International Journal of Production Research,* **51**(5): 1477-490. https://doi.org/10.1080/00207543.2012.695878

Mohammed, A., Jabbour, A. B., and Diabat, A. (2021). COVID-19 pandemic disruption: a matter of building companies' internal and external resilience. *International Journal of Production Research,* **61**(2): 1-22. https://doi.org/10.1080/00207543.2021.1970848

Paul, S. K., and Chowdhury, P. (2021). A production recovery plan in manufacturing supply chains for a high-demand item during COVID-19. *International Journal of Physical Distribution and Logistics Management,* **51**: 104-125. https://doi.org/10.1108/IJPDLM-04-2020-0127

Peters, V., and Wester, F. P. (2007). How Qualitative Data Analysis Software may Support the Qualitative Analysis Process. *Quality and Quantity,* **41**(5): 635-659. https://doi.org/10.1007/s11135-006-9016-8

Pettit, T. J., Croxton, K. L., and Fiksel, J. (2013). Ensuring Supply Chain Resilience: Development and Implementation of an Assessment Tool. *Journal of Business Logistics,* **34**(1): 46-76. https://doi.org/10.1111/jbl.12009

Pinder, C. C., and Harlos, K. (2001). Employee Silence: Quiescence and Acquiescence as Responses to Perceived Injustice. *Research in Personnel and Human Resources Management,* **20**: 331-369. https://doi.org/10.1016/S0742-7301(01)20007-3

Ponis, S. T., and Koronis, E. (2012). Supply Chain Resilience: Definition Of Concept And Its Formative Elements. *Journal of Applied Business Research,* **28**(5): 921-929. https://doi.org/10.19030/jabr.v28i5.7234

Ponomarov, S. Y., and Holcomb, H. (2009). Understanding the Concept of Supply Chain Resilience. *International Journal of Logistics Management,,* **20**(1): 124-143. https://doi.org/10.1108/09574090910954873

Porter, A. (1985). The Berlin West Africa Conference of 1884-1885 Revisited: A Report. *Journal of Imperial and Commonwealth History,* 14(1): 83-92.

Sawik, T. (2014). On the robust decision-making in a supply chain under disruption risks. *International Journal of Production Research,* **52**(22): 6760-6781. https://doi.org/https://doi.org/10.1080/00207543.2014.916829

Shahed, K. S., Azeem, A., Ali, S. M., and Moktadir, M. A. (2021). A supply chain disruption risk mitigation model to manage COVID-19 pandemic risk. *Environmental Science and Pollution Research*, 1-16. https://doi.org/10.1007/s11356-020-12289-4

Song, L., and Zhou, Y. (2020). The COVID-19 Pandemic and Its Impact on the Global Economy: What Does It Take to Turn Crisis into Opportunity? *China and World Economy,* **28**(4): 1-25. https://doi.org/https://doi.org/10.1111/cwe.12349

Soon, J. M., Vanany, I., Wahab, I. R., Sani, N. A., Hamdan, R. H., and Jamaludin, M. H. (2022). Protection Motivation Theory and consumers' food safety behaviour in response to COVID-19. *Food Control,* **138**: 109029. https://doi.org/https://doi.org/10.1016/j.foodcont.2022.109029

Spiegler, V., Naim, M. M., and Wikner, J. (2012). A control engineering approach to the assessment of supply chain resilience. *International Journal of Production Research,* **50**(21): 1-26. https://doi.org/10.1080/00207543.2012.710764

Supervision, B. C. (2006). Basel II: International Convergence of Capital Measurement and Capital Standards: A Revised Framework. Retrieved from https://www.bis.org/publ/bcbs128.htm

Tan, K.-C., Lyman, S. B., and Wisner, J. D. (2002). Supply Chain Management: A Strategic Perspective. *International Journal of Operations and Production Management,* **22**(6): 614-631. https://doi.org/10.1108/01443570210427659

Torabi, S., Baghersad, M., and Mansouri, A. (2015). Resilient supplier selection and order allocation under operational and disruption risks. *Transportation Research Part E: Logistics and Transportation Review,* **79**(12): 22-48. https://doi.org/10.1016/j.tre.2015.03.005

Vanany, I., Ali, M. H., Tan, K. H., Kumar, A., and Siswanto, N. (2021). A Supply Chain Resilience Capability Framework and Process for Mitigating the COVID-19 Pandemic Disruption. *IEEE Transactions on Engineering Management,* **71**: 1-15. https://doi.org/10.1109/TEM.2021.3116068

Wagner, S. M., and Bode, C. (2006). An empirical investigation into supply chain vulnerability. *Journal of Purchasing and Supply Management,* **12**(6): 301-312. https://doi.org/https://doi.org/10.1016/j.pursup.2007.01.004

Wang, G., Gunasekaran, A., Ngai, E., and Papadopoulos, T. (2016). Big data analytics in logistics and supply chain management: Certain Investigations for research and applications. *International Journal of Production Economics,* **176**: 98-110. https://doi.org/10.1016/j.ijpe.2016.03.014

WHO. (2020). *Coronavirus disease (COVID-19) advice for the public*. Retrieved from https://www.who.int/emergencies/diseases/novel-coronavirus-2019/advicefor-public

Woods, M., Paulus, T. M., Atkins, D. P., and Macklin, R. (2015). Advancing Qualitative Research Using Qualitative Data Analysis Software (QDAS)? Reviewing Potential Versus Practice in Published Studies using ATLAS.ti and NVivo, 1994-2013. *Social Science Computer Review,* **34**(5): 597-617. https://doi.org/10.1177/0894439315596311

Yildiz, A., and Yayla, Y. (2015). Multi-criteria decision-making methods for supplier selection: A literature review. *The South African Journal of Industrial Engineering,* **26**(2): 158-177. https://doi.org/10.7166/26-2-1010

Yin, R. K. (2003). Designing Case Studies. In *Qualitative Research Methods* (pp. 359-386). SAGE.

Yoon, J., Narasimhan, R., and Kim, M. K. (2018). Retailer's sourcing strategy under consumer stockpiling in anticipation of supply disruptions. *International Journal of Production Research,* **56**(10): 3615-3635. https://doi.org/10.1080/00207543.2017.1401748