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Master of Science in Logistics and Transport Management

Port Conflict Supply Chain Disruptions

A case study in an attempt to investigate the Gothenburg port-labour conflict from a manufacturing perspective

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Abstract

Scholars have addressed various supply chain disruptions that negatively affect companies in terms of operations and financial performance (Sodhi & Tang, 2012; Lam & Su, 2015; Blackhurst, Craighead, Elkins & Handfield, 2005), while few have studied in-depth port centric supply chain disruptions. In recent years, the likelihood of port conflicts has increased leaving serious consequences behind. By combining previous research and the paper qualitative analysis, the authors attempted to investigate the 2016 port-labour conflict that has arisen between the APM terminals and one of the labour unions in Port of Gothenburg in April 2016, which followed strikes, lockouts and other industrial actions. The port is of a strategic importance in the region that connects 70 percent of the Scandinavian businesses, therefore the conflict has affected various industries leading many companies to take mitigation initiatives, which usually generate costs as well as affects productivity. The negative effects were observed through conducting a case study addressing the conflict from a forestry manufacturing perspective. The forestry industry was involved since it requires a considerable capacity and weight that usually becomes an issue during a supply chain disruption. Eleven companies were involved and through comparing the results from both forestry manufacturers and logistics providers, the primary, secondary and tertiary consequences and mitigation strategies/initiatives were determined. The contributions have focused on revealing implications for both theory and practice in linkage to the research topic. In other words, it aimed to bridge the theoretical gap and provide insights for practitioners to efficiently overcome a Port Conflict Supply Chain Disruption

Keywords: Port-Labour Conflict, Supply Chain Disruption, Mitigation Strategies, Export, Forestry industry

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Abbreviations

APMT: APM terminals

PCSD: Port Conflict Supply Chain Disruptions

PoG: Port of Gothenburg

SCRD: Supply Chain Related Disruptions

TEU: Twenty-foot Equivalent Unit

Terminology

Agile system: refers to a supply chain's ability to quickly react to a changing customer demand (Cerasis, 2016)

Efficiency: It is a term that can be quantified or calculated utilizing the ratio of appropriate output to sum input. It aims to curtail the waste of resources such as assets, effort and time while achieving the desired goals (Investopedia, 2018a).

Lean system: refers to a manufacturing approach that is capable to minimize the waste (Techopedia, 2018)

Productivity: a term that enable do more in less time (Investopedia, 2018b)

Resiliency: The ability to recover quickly to the previous satisfactory performance after a certain issue (Cambridge Dictionary, 2018).

Redundancy: additional resources allocated to a task that exceeds the minimum requirements to perform it (Merchant & Van der Stede, 2007).

Supply Chain Optimization: is the implementation of methods and operations to ensure the ideal movement of goods within a production and transport supply chain. This encompasses the ideal placement of inventory with the nodes of a supply chain while maintaining optimal functioning costs (Quora, 2018).

1 Introduction

This chapter will provide the reader with a background of the paper and introduce some of the problems that manufacturers deal with during a supply chain disruption. It will also provide insights in respect to the research problem as well as the research purpose, questions and delimitations.

1.1 Background

Globalization has enabled businesses to enter new markets that expanded supply chains more than ever (Stecke & Kumar, 2009). Meanwhile, this expansion increased the complexity of supply chain operations, thus raised the vulnerability of supply chain disruptions (Stecke & Kumar, 2009). Not to mention that companies strive for increased efficiency through implementing agile and lean production systems, which has led to decreased redundancy in the logistics networks (Stecke & Kumar, 2009). True that supply chain developments accelerate growth but it also engenders serious risks, manifested in supply chain disruptions (Blackhurst et al., 2005). Such disruptions are leading to considerable consequences such as increased costs and worsened productivity (Lam & Su, 2015; Martin Associates, 2014). A disruption can also impact relationships with various stakeholders (Porterfield, Macdonald & Griffis, 2012). Sources of the so-called supply chain disruptions are embodied in natural and manmade disasters. Manmade disruptions; port conflicts in particular, have become likely frequent and leaving perilous effects (Stecke & Kumar, 2009). Between 2007-2013 only, around 30 port conflicts took place around the world leaving tremendous losses (Lam & Su, 2015; Martin Associates, 2014).

For the time being, ports act as an essential node in supply chains as it allows the movement of commodities between various locations, linking the producing and consuming markets together (Lam & Su, 2015). The importance of ports has even increased, as it became critical factor in maintaining the continuity of businesses (De Langen, 2006). Therefore, any unforeseen disruptive events in this substantial supply chain node would negatively affect companies' performances in linkage to cost-efficiency and productivity.

Mentioning port disruptions, a conflict has occurred at the container terminal that is managed by the APM terminals (APMT) at the Port of Gothenburg (PoG). As shown in figure 1, the port is a critical logistics node since its location allows to reach 70 percent of the Scandinavian businesses and connect the major Nordic capitals altogether such as Copenhagen, Stockholm and Oslo within a 500 km radius (Port of Gothenburg, 2018a). The conflict exacerbated in summer 2016 between one of the two labour unions at the PoG which is known as Section 4 and Gothenburg APMT (SVT Nyheter, 2018).

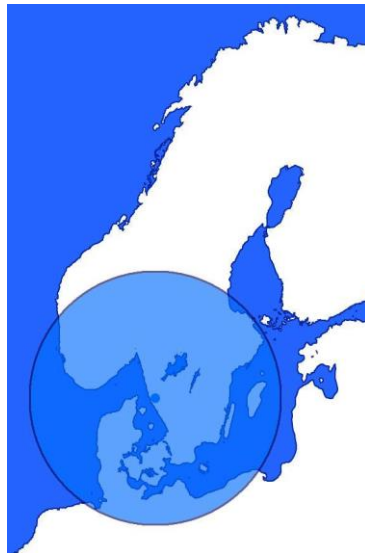


Figure 1: Port of Gothenburg coverage within 500 km radius (source: authors)

1.2 Research Problem

Due to several uncertain factors, after APMT took over the operations in 2012, the volumes dramatically decreased in the container terminals from 900 000 TEUs in 2012 to roughly 800 000 TEUs in 2015 (Port of Gothenburg, 2017a). Accordingly, the CEO of Gothenburg APMT resigned in 2015 (Transportnet, 2015), where the new CEO and the labour union Section 4 did not come along with each other. The conflicting interests has led to weaken the power of Section 4, which made the latter apprehensive (SVT Nyheter, 2018). In April 2016, Section 4 with its members decided to strike (Göteborgs-Posten, 2016). Section 4 was able to strike since they have not signed any collective bargain agreement with Gothenburg APMT. The Swedish law states that labour unions are able to strike if they are not committed to any collective bargain agreements with their employers (MBL, 1976; SVT Nyheter, 2018). APMT had already signed an agreement with the Transport Workers Union that is part of the Swedish Trade Union Confederation (For more information regarding the port conflict, the reader is referred to figure 2). By that, APMT found it unnecessary to write a separate agreement with Section 4 (SVT Nyheter, 2018).

According to De Langen (2006), a collective bargain agreement could be used to diminish a labour conflict. However, the existent collective bargain agreement in the Gothenburg container terminal is fruitless since the union possessing the agreement; Transport Workers' union, does not represent the majority of the dockworkers and could not therefore offer industrial peace (SVT Nyheter, 2018). Section 4 represents 85 percent of the dockworkers, while the Transport Workers' Union represents only 15 percent (Arbetsmarknadsnytt, 2017). Thus, the conflict is unique since most of the Swedish ports have even distribution of members between unions (Arbetsmarknadsnytt, 2017). In response to the strike, Gothenburg APMT triggered a lockout that reduced the working hours (SVT Nyheter, 2018) (The reader is referred to figure 2 for more information regarding the conflict).

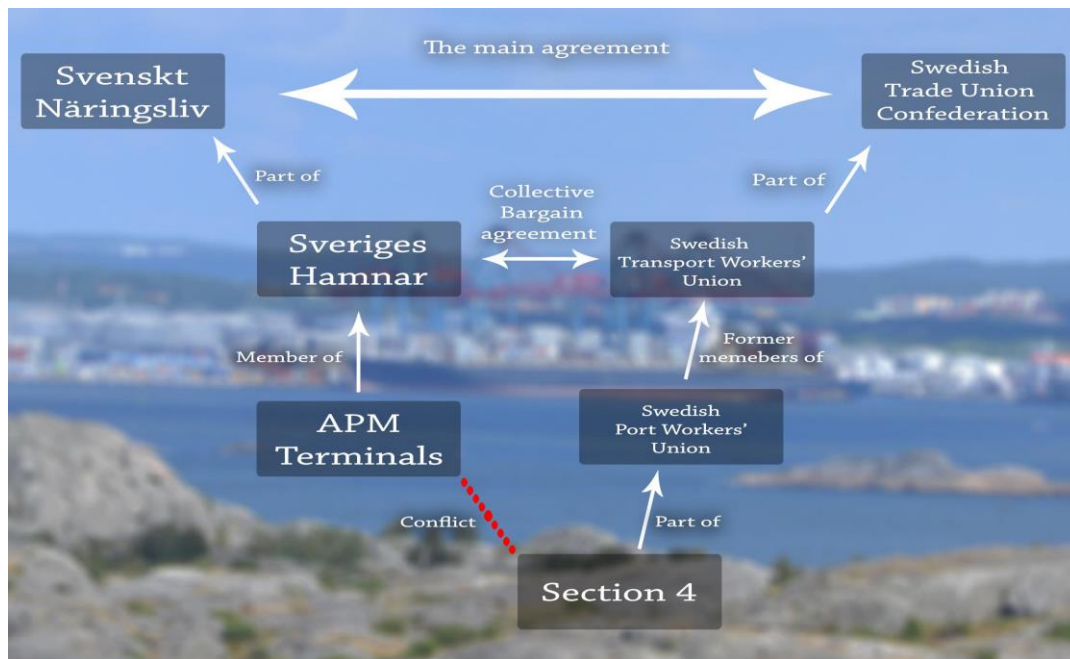


Figure 2: brief and simplified depiction of the actors involved in Gothenburg port-labour conflict (source: authors)¹

Correspondingly, customers of APMT were negatively affected and thus many of them have re-routed their shipments to other Swedish/European ports (Sveriges Radio, 2017). Specifically, 25 percent of 478 Swedish companies have been affected by the conflict, where 51 percent of them have taken initiatives to mitigate the impacts (Svenskt Näringsliv, 2017). The severity of the conflict became palpable to an extent that the Swedish government had to act towards the conflict by trying to alter the Swedish labour legislation (Port of Gothenburg, 2017b).

The port conflict has generated various losses for Swedish industries especially manufacturers such as Stora Enso, SKF and Volvo and they were compelled to change their transport routes (Sveriges Radio, 2017). Not an exception, the conflict affected manufacturers in the forestry industry (Alt.nu, 2017). Forestry products require huge capacity and weight (Yliskyla-Peuralahti, Spies & Tapaninen, 2011), which became a challenge after APMT lowered its capacity level due to a shortage in labour force (SVT Nyheter, 2018). Hence, the conflict has restrained many forestry manufacturers to move their shipments to and from Sweden (Port of Gothenburg, 2017c).

¹ The conflict was triggered between the APMT and Section 4. Section 4 is part of the Swedish Port Workers' union, which was founded by former members of The Swedish Transport workers' union. The APMT is a member of the Swedish ports' trade association (Sveriges Hamnar). The latter has written a collective bargain agreement with the Swedish Transport workers' union (SVT Nyheter, 2018). The Transport Workers' Union is a part of the Swedish Trade Union Confederation (LO). LO has a central main agreement written with the Confederation of Swedish Enterprises (Svenskt Näringsliv), stating that collecting bargain agreements in Sweden should only be written between sub-organizations of LO and Svenskt Näringsliv. The bargain agreement at Gothenburg APMT is written according to this order where Sveriges Hamnar, as a sub organization to Svenskt Näringsliv, has written an agreement with Transport Workers' Union (LO, 2018; SVT Nyheter, 2018). For more information regarding the conflict, the reader is referred to SVT Nyheter (2018).

From a logistics perspective, manufacturers seek always developing advanced supply chain models that as previously mentioned making supply chains vulnerable to disruptions (Cranfield University, 2002). These models constitute of modern approaches such as focused factories and centralized distribution, outsourcing and reduction of supply base in face of volatile demand and lack of visibility/control procedures. These models exist in the Swedish forestry-manufacturing sector that always requires continuing outbound flow (Cranfield University, 2002).

In a subsequence of these models, manufacturing-oriented supply chains suffer from considerable effects during a disruption. The effects as articulated by Zvejnieks (2015) are:

- (1) *Manufacturing costs* engendered from adapting production to lower/higher velocity.
- (2) *Inventory costs* of hiring new physical spaces due to shortage in capacity near the interrupted supply chain node.
- (3) Increased *transportation costs* since a disruption change suddenly the frequency of shipments transported and transportation distances.
- (4) *Increased replenishment lead times* due to higher inventories that lead to slacken a production velocity.
- (5) Increased *labour costs* due to overtime shifts that are used to ensure the continuity of business operations.
- (6) *Impacted Relationships* between business partners, as a disruption underlies a tendency to put the blame on each other.
- (7) A disruption complicates the processes of delivering products to all customers, thus affect *customer loyalty*.

1.3 Research purpose and questions

Proceeding from the above mentioned, this paper explores Port Conflict Supply Chain Disruptions (PCSD) from a manufacturing supply chain perspective, through involving several forestry manufacturers and logistics providers. The forestry industry represents a significant part of the Swedish businesses, generated 125 billion Swedish crowns in 2017 (export only). Not to mention that the industry is the largest transport buyer in Sweden with approximate expenditure of 25 billion Swedish crowns during 2017 (Skogsindustrierna, 2018). The logistics providers involved are operating international shipments for various manufacturers including the forestry industry.

The investigation has initially aimed to reveal the primary, secondary and tertiary PCSD consequences and how the severity of port conflicts differs among manufacturers located differently. Also, the paper attempts to evaluate the performance of the supply chain mitigation strategies implemented by manufacturers to handle a PCSD. Though, the authors propose various initiatives in linkage to the consequences and initiatives investigated. Identifying the consequences and strategies aimed to provide insights for

researchers and practitioners to better understand a PCSD, thus improve the efficiency and resiliency of a supply chain. In particular, the paper aimed to motivate researchers develop accurate PCSD models. Meanwhile improve the performance of manufacturers (exporters) to handle a PCSD.

In order to fulfil the research purpose, four research questions were developed:

- (1) From a supply chain perspective, what are the primary, secondary and tertiary consequences the port conflict generates on manufacturers (forestry manufacturers in particular)?*
- (2) Does the severity level of a port conflict supply chain disruptions differ among manufacturers located differently?*
- (3) What supply chain mitigation strategies do manufacturers (forestry manufacturers in particular) implement in order to handle a port conflict supply chain disruption. Can the strategies successfully resolve the disruption?*
- (4) How has the port conflict influenced manufacturers' future strategies (forestry manufacturers in particular)?*

To answer the questions above, the paper started with a literature review of the consequences engendered from a Supply Chain Related Disruptions (SCRD) and the supply chain mitigation strategies, which were compared later with the empirical findings gathered through eleven interviews². The first theoretical theme in respect with SCR D consequences attempt to answer research questions (1) and (2). The second theme mainly answer research question (3), but also enabled the authors to answer question (4). The insights gained from questions (3) and (4) facilitated to recommend relevant mitigation initiatives.

To attain the desirable results, a case study methodology was adopted to compare the situation during the conflict between the forestry industry and clients of logistics providers, in relation to the research questions.

The paper outcome is expected to shrink the gap observed in respect with port conflicts. Scholars have often studied supply chain disruptions in a comprehensive context rather than separately investigating each source of disruptions (See Table 1 on page 9). Therefore, the authors exploited the SCR D knowledge to investigate Gothenburg APMT-labour conflict, in order to reveal a PCSD framework.

² The companies involved are representative of the industries under investigation (See table 3 on page 25).

On a practice level, PCSD are unavoidable, where managers are usually unprepared to handle such disruptions (Stecke & Kumar, 2009). Correspondingly, the paper allows managers to employ relevant mitigation initiatives/measures that would improve their awareness/preparedness of a PCSD, thus alleviate the impacts.

1.4 Delimitations

The paper target mainly Swedish forestry companies operating manufacturing supply chains that have distributors, retailers, wholesalers and customers located overseas (See figure 3). The Swedish forestry industry was studied since 80 percent of the forestry products were exported overseas in 2016 and large forestry volumes were shipped through the Gothenburg APMT (Skogsindustrierna, 2018; Port of Gothenburg, 2018b). It was also obtained that the forestry industry is one of the largest export segments within the container terminals (Port of Gothenburg, 2018c). Despite our focus on the forestry manufacturers, but the results would be applicable to other industries that export internationally, through the APMT.



Figure 3: Studied supply chain node (source: authors)

Further, a unilateral study was conducted that focuses on one segment. Thus, the paper discloses particular insights. To minify this delimitation, three logistics providers operating international shipments were involved in order to gain a holistic view of the PCSD. Yet, more sufficient data is needed to thoroughly understand a PCSD, thus it is recommended to perform similar studies within other industries.

True that some of the results apply for both importers and exporters, but most of the companies involved were manufacturers exporting forestry goods such as sawmill, paper and pulp products. Therefore, the results are more applicable for outbound-flows and conducting studies of inbound supply chains is a requisite.

Finally, during June 2017, a cyber-attack occurred at AP Moller-Maersk causing problems for Gothenburg APMT. Specifically, the attack made the company operate manually for a few weeks, thus the capacity levels decreased (DI, 2017; SvD, 2017) The authors were aware of the attack and understood that it caused extra inefficiencies beside the port conflict for manufacturers. However, this study focused on port conflict supply chain disruptions so the cyber-attack is not considered. In order to ensure that the respondents

were bounded to the port conflict, they were always steered during the interviews to get relevant data to the research topic.

2 Theoretical Framework

The theoretical framework provides an overview of previous research in linkage to the topic being investigated at hand. Specifically, the chapter reviewed the sources of supply chain related disruptions (SCRD), consequences of SCRD and supply chain mitigation process and strategies.

2.1 Sources of Supply Chain Related Disruptions (SCRD)

Scholars summarize modern supply chains as [...] *“the supply network is inherently vulnerable to disruptions, and the failure of any one element in it could cause the whole network to fail”* (Blackhurst et al., 2005, p. 4068).

As mentioned in the previous chapter, nowadays goods are being produced further away from where the market exists and the importance of efficient logistics and transport facilities has therefore increased. Efficiency in this matter means that goods should be transported and handled quickly at the lowest cost possible (Blackhurst et al., 2005). Lean and agile approaches are therefore adopted to define the modern logistics. For instance, transport cost, stock levels and distribution should be respectively minimized, low and efficient (Lumsden, 2012). Hence, the increased distances and advanced technologies making supply chains vulnerable to disruptions.

Snyder et al. (2016) stresses that supply chain disruptions have existed since the emergence of supply chains. Thus, SCRD are not contemporary, as this field has interestingly evolved especially in the latter eras (See figure 4).

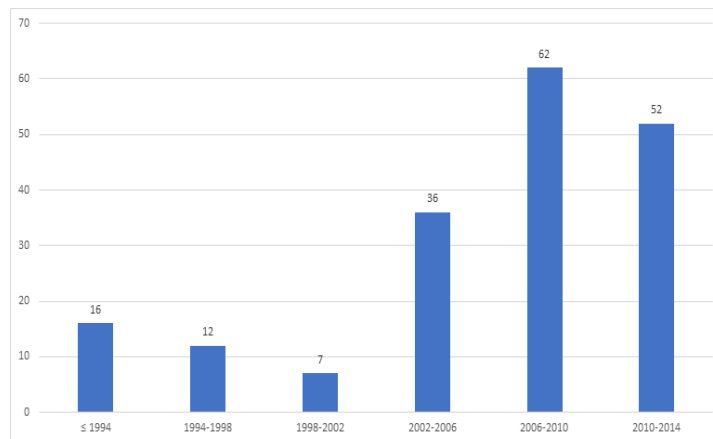


Figure 4: Histogram of literature development related to SCRD (Snyder et al., 2016, p 90)

Notwithstanding the foregoing, scholars have often studied disruptions in a collective context rather than separately investigating each source of disruption (See Table 1). Therefore, the authors employ the SCRD knowledge to construct new theories in respect with port conflict supply chain disruptions.

Reference	Title
Blackhurst et al. (2005)	An empirically derived agenda of critical research issues for managing supply-chain disruptions
Wilson (2007)	The impact of transportation disruptions on supply chain performance
Simchi-Levi, Kaminsky, & Simchi-Levi, (2008)	Designing and Managing the Supply chain
Oke & Gopalakrishnan (2009)	Managing disruptions in supply chains: A case study of a retail supply chain
Yliskyla-Peuralahti et al. (2011)	Transport vulnerabilities and critical industries: experiences from a Finnish stevedore strike
Porterfield et al. (2012)	An Exploration of the Relational Effects of Supply Chain Disruptions
Lam & Su (2015)	Disruption risks and mitigation strategies: an analysis of Asian ports
Loh & Thai (2015)	Cost Consequences of a Port-Related Supply Chain Disruption
Zvejnieks (2015)	Forestry Supply Chains - Preparing for the unpredictable
Snyder et al. (2016)	OR/MS models for supply chain disruptions: a review
Loh et al. (2017)	Portfolio of port-centric supply chain disruption threats
Maghsoudi et al. (2018)	Coordination of efforts in disaster relief supply chains: the moderating role of resource scarcity and redundancy

Table 1: Reviewed literature related to port-strike centric supply chain disruptions (source: authors)

According to Jüttner, Peck & Christopher (2003), sources of SCRCD fall majorly into three categories: environmental risk sources, organizational risk sources and network-related risk sources (See figure 5). Environmental risk sources are unforeseen events such as accidents (i.e. fire), social and political events (i.e. protests or terrorist attacks) or natural disasters (i.e. hurricanes). Network related risk sources emerge from low synergies between business partners. Organizational risk sources are bounded within supply chains and are resulted from labour related issues (i.e. strikes), production breakdown (i.e. machine stoppage) or IT system disintegration.

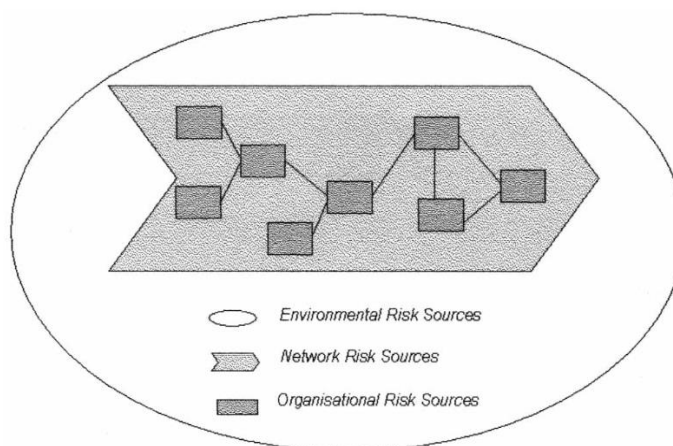


Figure 5: Supply chain risk sources (source, Jüttner et al., 2003, p 202)

2.2 First Theme: overview of the consequences related to supply chain disruptions

SCRD such as port conflicts are categorized under organizational risk sources, which have low occurrence probability but generate severe consequences in case occurred (Loh et al., 2017). For instance, the US West coast lockout in 2002 caused a shutdown in 29 ports, where 90 percent of the US companies could not move their shipments to/from the country. Despite that some companies have pre-planned the disruption, but they still had to face severe financial and operational consequences (Wilson, 2007). Also, Yliskyla-Peuralahti et al. (2011) illustrate the Finnish port strikes that forced 70 percent of the Finnish forestry exporters to stop/slacken their production, generating around \$4 million losses per day. The Finnish strikes if lasted for longer time, a lot of companies would have declared bankruptcy.

Through scrutinizing several quantitative and qualitative scientific studies in linkage to SCRDR, the authors have observed that such disruptions are usually engendering tangible and intangible consequences. The authors address these consequences below that have evoked problematic dilemmas for both scholars and practitioners (Simchi-Levi et al., 2008). The tangible consequences are mainly embodied in *financial performance, inventory management, distribution network and information sharing* while the intangible consequences are *supplier/customer relationship* and *customer value* (See figure 6 on page 12).

2.2.1 Tangible consequences

Financial performance: Blackhurst et al. (2005) discuss that recovering an SCRDR takes at least 50 trading days. The failure in any logistics node across a supply chain interrupts the material flow, thus generates financial losses that accounts on average between \$50-100 million per day. The financial losses are usually engendered from production disruption, high inventory, lack of capacity, increased labour costs, increased lead times and loss of business scope (Zvejnieks, 2015). In 1996, the manufacturer General Motors experienced 18 days labour-centric supply chain disruption that generated in total \$900 million losses in one quarter (Blackhurst et al., 2005).

Inventory level: Although manufacturers strive to be responsive through having redundant inventory, but meanwhile prevent excess inventories. In this matter, SCRDR weaken manufacturers to deliver in the same frequency due to the interruption in the product flow. Thus, inventory levels might severely increase and could lead to slacken/stop production until inventories are rebalanced (Simchi-Levi et al., 2008).

In addition, when retailers/customers feel threatened to stockout after a disruption occurred, they place bigger orders to manufacturers/suppliers. The demand level might slightly change in the downstream, while atrociously changes in the upstream, which possibly generate the so-called bullwhip effect. The severity of the bullwhip effect

increases as the demand goes across the supply chain toward the upstream tiers (Wilson, 2007).

Distribution Network: It is commonly known that distribution networks connect business actors altogether (Simchi-Levi et al., 2008). Sellers and buyers are usually connected by various transportation modes that ensure the delivery of shipments. For instance, maritime transport enables the shipping flow internationally and even globally, thus ports are seen as a significant enabler in the network. However, SCRD block the typical flow and therefore delivery times increase. Hence, disrupted distribution networks can lead to direct and indirect consequences that affect manufacturers and their customers/suppliers (Blackhurst et al., 2005; Loh et al., 2017).

Information sharing: Sharing information can enhance the performance of business actors through augmenting the ability to track products as well as enabling better visibility across the supply chain. Information sharing underlies many other benefits ranging from discovering to recovering an SCRD. Not to mention that it enables strengthening the relationship with stakeholders, through reflecting positive co-operative intentions (Simchi-Levi et al., 2008; Loh et al., 2017). However, Blackhurst et al. (2005) claims that some stakeholders monopolize critical information due to the conflicting interests, which might lead to mistrust. Consequently, an SCRD potentially diminish current/future business scope (Loh et al., 2017).

2.2.2 Intangible Consequences

Customer/Supplier Relationship: SCRD are capable to influence the relationship in both B2B and B2C environments (Porterfield et al., 2012). Depending on the severity of the disruption, customers and suppliers potentially lose the ability to maintain the same business scope with each other and thus lose future opportunities (Porterfield et al., 2012).

Also, Porterfield et al. (2012) discuss that SCRD affect the credibility of the value chain, as it would take long time to reconstruct trust. For instance, business actors in B2C environments are usually not able or willing to co-operate in order to resolve a supply chain disruption. The lack in contribution would change the perceptions of the affected actors toward each other, where in some extreme cases they lose each other.

Customer loyalty: With the increased commercial competition, companies are not only chasing operational and financial optimization, but also constructing values for customers, the value that maintain and increase customer loyalty (Loh et al., 2017).

In order to construct such values, companies establish efficient transport chains to deliver the right services and products to the right place at the right time. While SCRD create hinders to meet the customer expectations due to increased delivery times (Simchi-Levi et al., 2008).

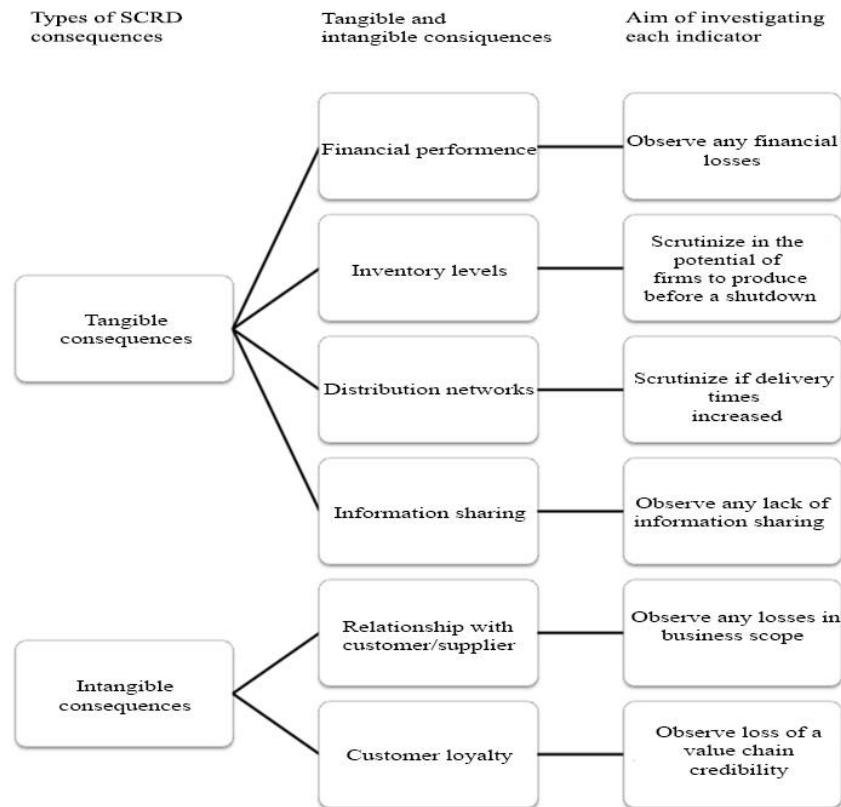


Figure 6: Summary of the first theme (source: authors)

2.3 Second Theme: supply chain mitigation process and strategies

In response to the consequences mentioned above, companies launch strategic initiatives that aim to mitigate a supply chain disruption (Tang, 2006). Although, the reviewed literature impose that managers have to consider the risk drivers when implementing a mitigation strategy. In more detail, managers have to consider the trade-offs that could underlie unforeseen losses (Tang, 2006). This theme identifies the role of mitigation strategies and discloses some initiatives that companies often consider when handling an SCRD. The initiatives are adapted below following the supply chain relief process. Various scientific sources were reviewed and summarized in table 2.

Reference	Title
Jüttner et al. (2003)	Supply chain risk management: Outlining an agenda for future research
Tang (2006)	Perspectives in supply chain risk management
Stecke & Kumar (2009)	Sources of Supply Chain Disruptions, Factors That Breed Vulnerability, and Mitigating Strategies
Micheli, Mogre & Perego (2013)	How to choose mitigation measures for supply chain risks
Lam & Su (2015)	Disruption risks and mitigation strategies: an analysis of Asian ports
Schmitt et al. (2015)	Centralization versus decentralization: Risk pooling, risk diversification, and supply chain disruptions
Maghsoudi et al. (2018)	Coordination of efforts in disaster relief supply chains: the moderating role of resource scarcity and redundancy

Table 2: Reviewed literature in linkage to supply chain risk management process and strategies (source: authors)

To understand the role of mitigation strategies, the authors involved an approach developed by Jüttner, Peck & Christopher (2003). The approach explains the four substantial and interlinked divisions of supply chain risk management (See figure 7).

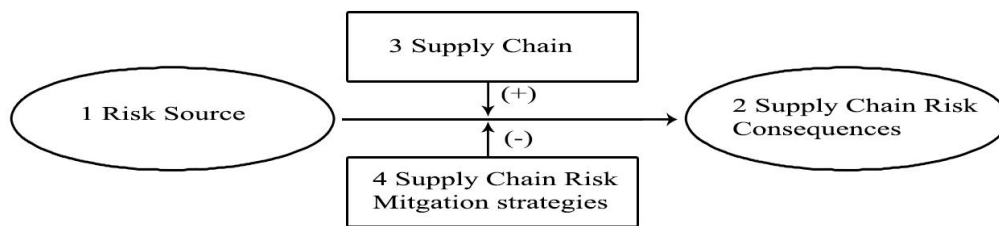


Figure 7: Divisions of supply chain risk management (source: Jüttner et al., 2003, p.201)

From this approach, the terms supply chain vulnerability and supply chain risk management can be determined. Supply chain vulnerability is linked to risk sources that outbalance the performance of mitigation strategies and thus generate counteractive supply chain consequences. The consequences jeopardize manufacturers to achieve their strategic goals as explained under 2.2. Thus, the supply chain risk management approach identifies the probable sources of risks and suggests potential actions to prevent a supply chain from high vulnerability (Jüttner et al., 2003). In other words, a risk mitigation strategy is “[...] the identification and management of risks for the supply chain, through a coordinated approach amongst supply chain members, to reduce supply chain vulnerability as a whole” (Jüttner et al., 2003, p 201).

Moreover, companies follow three-phase supply chain relief process that encompasses various mitigation initiatives, when experiencing an SCR. The phases are *disruption discovery*, *disruption recovery* and *supply chain redesign* (Blackhurst et al., 2005).

2.3.1 Disruption discovery

Scholars stress that information sharing in this stage is crucial in order to answer the following question “*what are the current needs and issues in industry?*” (Blackhurst et al., 2005, p. 4072). It was further discussed that the faster the information sharing regarding the emergence of disruptions, the lower the impacts would be. Although, companies should consider a cost-benefit analysis before establishing supply chain information systems in order to ensure that the benefits would exceed the costs (Blackhurst et al., 2005).

It was also discussed that in traditional supply chains, retailers receive orders from customers, where retailers send the information in form of orders to the warehouse, and the latter send the information in form of orders to the supplier. In this regard, supply chains that adopt traditional information systems have higher probability to generate the bullwhip effect across a supply chain. In contrast, a supply chain that adopted advanced information systems enable sharing information directly between the customer and the supplier. In this case, the supplier can receive the data faster and more accurate before producing. Hence, the severity of a disruption differs due to the implemented information system (Wilson, 2007).

2.3.2 Disruption recovery

First and foremost, to make disruption recovery possible, companies should have robust relationships with stakeholders across a supply chain (Loh & Thai, 2015). This would make business actors willing to carry out their partial responsibility to recover a disruption (Porterfield et al. 2012).

In this stage, companies implement various initiatives in the aim of improving their supply chains’ efficiency and resiliency. It initially relocates resources to alternative routes in the supply chain until the SCRD is resolved (Blackhurst et al., 2005).

There are five supply chain mitigation strategies companies frequently consider during an SCRD (See figure 8). The strategies are: *avoidance; control; co-operation; flexibility; and postponement* (Yliskyla-Peuralahti et al., 2011).

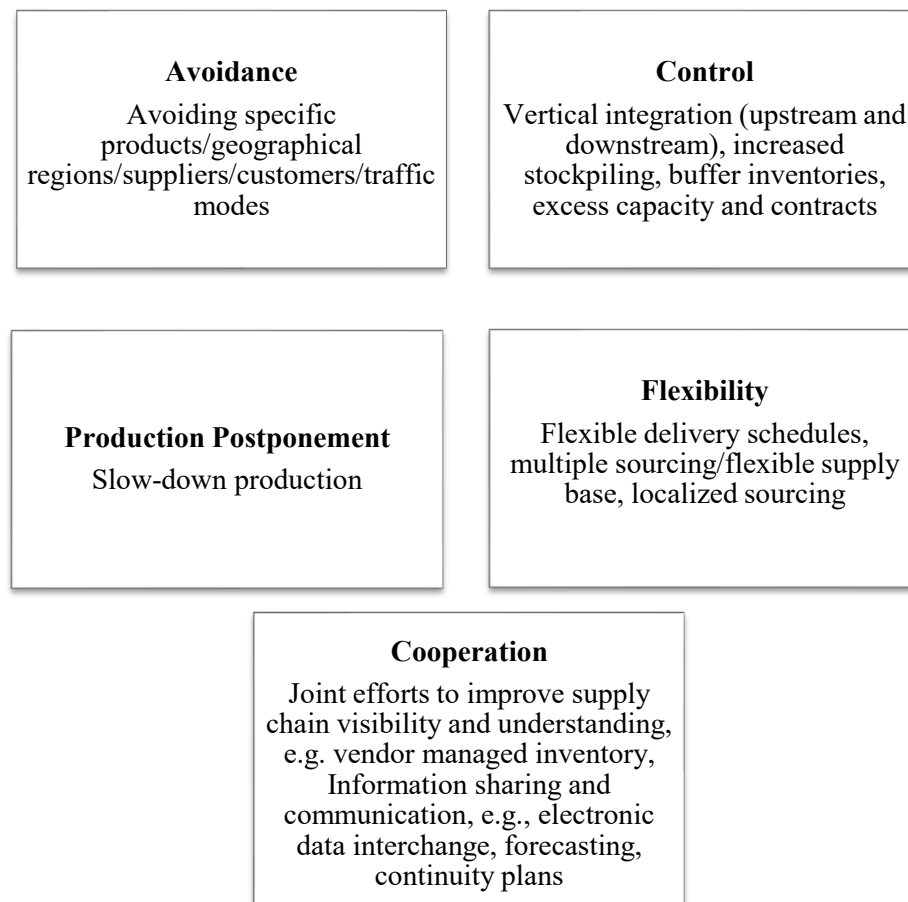


Figure 8: summary of the supply chain mitigation strategies (Yliskyla-Peuralahti et al, p. 225, 2011)

Avoidance: Avoidance is convenient when the risks are associated with certain product markets or geographical locations. In more detail, avoidance can be associated with regional markets and/or customer and supplier locations, where a company attempts to prevent certain links if it seems to be inaccessible (Jüttner et al., 2003).

Control: companies might have to simultaneously prepare for various disruptions, therefore initiating control plans can reduce risks. Such initiatives are quite common between manufacturers and customers, which are basically manifested in vertical integration, increased stockpiling, use of buffer inventory or maintaining excess capacity in production (storage, handling, transport), and finally forming contractual requirements with customers aiming for committing the latter to a certain risk sharing process as well as certain business scope (Jüttner et al., 2003).

Cooperation: co-operation involves joint arrangements rather than unilateral efforts to distribute evenly the severity of the unanticipated risks. In more detail, the joint arrangements involve several business actors that collaborate in order to improve the supply chain visibility as well as understand their supply chain model, through sharing significant information in respect to risk sources (Jüttner et al., 2003).

Flexibility: Flexibility initiatives aim to improve the responsiveness of supply chains. Postponement plans are an example that attempts to rationally slacken the decision-making process of delivering commodities to certain locations, while other convenient routes are being established. Postponement plans are less reliant on forecasts while it attempts to meet the substantial customer needs. Finally, multiple sourcing strives to dole out the risks on all the involved stakeholders, while local sourcing usually implies shorter lead times (Jüttner et al., 2003).

Production Postponement: this strategy is applicable for companies operating multiple production lines, which is common in modern supply chains (Tang, 2006). As shown in figure 9, K is a common stage for both production lines. Though, commodities start to split up due to the need of different operations or components.

Postponement production initiatives propose either to extend stage K which is the point of differentiation through standardizing components, (sub)assemblies and product design, or postpone and/or re-sequence operations (Tang, 2006). This would enable operational easiness to deal with a disruption.

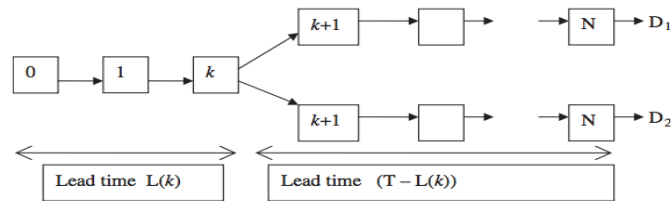


Figure 9: Production postponement system (source: Tang, 2006, p. 471)³

2.3.3 Supply chain redesign

When redesigning a supply chain, it is significant to re-plan in a comprehensive context. In detail, supply chains have to be fully optimized since partial optimizations would lead to sub-optimizations across a supply chain, where disruptions can be left unresolved (Blackhurst et al., 2005).

Moreover, Blackhurst et al. (2005) claims that it is important to question the nature of the environment where the company exists. In case it is a stable environment then traditional supply chain optimization models would be convenient since those models able to operate in static environments. However, if the environment is dynamic, then the supply chain optimization models should be also dynamic in order to adapt to a changing environment.

³ *N: processing stages, *0: dummy stage, *K: point of differentiation, *Total lead time of the whole manufacturing process, *L(k): lead time from stage 0 to stage k (Tang, 2006)

2.3.4 Supply Chain Mitigation Trade-offs

When overcoming a supply chain disruption, there are various factors to consider since several risks affect multiple performance indicators. In order to make the supply chain relief process more systematic, Micheli et al. (2013) have designed a quantitative decision support system. This system aimed at minimizing the overall risk profile of a supply chain operating under budget constraints. A company can have a set of mitigation initiatives that are combined in one policy. Hence, this formulation or as also known *linear programming model* is appropriate when measuring the suitability of certain mitigation initiative/set of initiatives (Micheli et al., 2013).

3 Methodology

In this chapter, the methods implemented will be explained and defended. The chapter also includes a visualization of the actors involved in the study. Finally, an evaluation of the research quality was administered.

3.1 Research Paradigm: Interpretivism

The research paradigm of a scientific paper follows a philosophical frame outlining how the research should be delivered (Collis & Hussey, 2013). There is usually two research paradigms that are adopted by researchers to complement a certain study: Positivism and Interpretivism (Yin, 2014).

Positivism exploits the existence of grounded theories in order to measure a certain phenomenon. Positivism approaches are used to explore theories through the gathered empirical findings. It was discussed that positivism is associated with quantitative approaches (e.g. statistical analysis), since it is capable to quantify a reality (Weber, 2004; Collis & Hussey, 2013).

Interpretivism was evolved and aspired from the positivism paradigm, where interpretivism is believed to affect the environment underlying this paradigm (Collis & Hussey, 2013). As articulated by Weber (2004), the events that cannot be measured by numerical analysis should be interpreted in order to simplify the complexity of a certain phenomenon, which is believed can be fulfilled by the interpretivist approach. Thus, the interpretations are usually addressed following qualitative methods.

Because of the requirements of this paper, the positivist paradigm was not appropriate to fulfil the purpose of the research. As mentioned earlier, the phenomenon under investigation is quite new and almost no numerical data was available to conduct a quantitative study. Therefore, the interpretivist approach was adopted and various interpretations were outlined in the end of the paper.

3.2 Research approach

As previously mentioned, the forestry industry was studied since it is a critical segment transporting through Gothenburg APMT, and one of the largest Swedish industries (Port of Gothenburg, 2018c; Skogsindustrierna, 2018). In addition, forestry products require huge capacity, the reason the forestry products stand in need for reliable flows (Yliskyla-Peuralahti et al. 2011). In the time that Gothenburg APMT-labour conflict disrupted supply chains, it generated various negative consequences making the forestry industry one of the most affected industries in Sweden (Port of Gothenburg, 2017c).

Though, the investigation involved three international logistics providers located in Gothenburg that deal with various types of industries, including the forestry, aiming for comparing the insights of both forestry industry and logistics providers. All logistics

providers used Gothenburg APMT as a substantial logistics node (except SCA Sourcing & Logistics; distant company).

Further, the paper attempts to reveal basic research since the final product is expected to enhance the awareness of academicians as well add knowledge to the existing one (Collis & Hussey, 2013). Since no external party (i.e. organization, company) promised to apply directly the propositions in this paper, it confirms that this research is basic where its benefits outranks the need for practitioners (Adams, Khan, Raeside & White, 2007). Yet, a subsequent contribution of this paper is manifested in providing practical insights for managers through evaluating the current supply chain mitigation strategies implemented by the companies involved, and then try to develop initiatives in order to improve the preparedness of manufacturers during a PCSD.

Also, a research usually adopts a logic that identifies the flow of the paper (Collis & Hussey, 2013). There are two types of research logics: deductive and inductive. Deductive research means that a theoretical framework is developed and will be examined by certain empirical findings, thus a certain research problem can be deducted from generic derivations. It also involves particular data that is relevant to the employed theories. However, in inductive research, the theories are concluded from the empirical findings and observations that are validated by the theoretical framework. The final outcome relies on an individualistic observation (Collis & Hussey, 2013). Hence, this paper follows an inductive logic through exploiting the theoretical framework to approve the empirical findings. In detail, the lack of knowledge observed in the PCSD field is expected to be filled by adopting the SCRD knowledge that will be validated by the empirics, in order to construct new theories in linkage to PCSD.

3.3 Research Composition

The research topic was developed together with a supervisor at the School of Business, Economics and Law at the University of Gothenburg that expressed her interest in investigating the Gothenburg APMT-labour conflict. Thus, the paper addresses the situation faced by various Swedish commercial actors during the conflict. This could be attained through adopting the qualitative approach and methods; case study, that is associated with the interpretivist paradigm (Yin, 2014).

Qualitative approach: There are two types of research approaches: quantitative and qualitative. Quantitative methods employ numerical data and statistical analyses to attain the research outcomes. On the contrary, qualitative methods utilize descriptive data and then interpret/analyze the data (Collis & Hussey, 2013). Qualitative methods allow to explore new approaches that is lacking either in the research or practice fields. This is usually accomplished through using some unique qualitative methods such as interviews, observations and text analysis (Yin, 2014). The uniqueness of such methods is its ability to conduct detailed and robust explanations allowing smooth understanding of the phenomenon under investigation, which is often not possible in quantitative studies

(Collis & Hussey, 2013). Since the research paradigm is interpretivist, there would be no intention to use any quantitative methods and/or numerical data. Thus, the authors conducted eleven semi-structured interviews; face-to-face, phone and email interviews between February 28th and March 28th, 2018. The interviews enabled instituting new theories, investigating certain event and assessing different substitutes, which correspond with the research purpose (Sreejesh, Mohapatra & Anusree, 2014; Yin, 2014).

The qualitative approach also allows identifying the root causes of a certain event and the consequences/initiatives enclosing with it (Adams et al., 2007). Not to mention that current and complex phenomenon can be simplified and understood, through collecting accurate and large amount of data (Yin, 2014). To do this, the interview questions were developed using “how” and “what” to allow deep conversations (Adams et al., 2007). The interviews were performed to gain insights from distinct parties in order to scrutinize the situation per se. Hence, this study adopted a qualitative approach to gather all information needed to attain the desirable results. Further, the authors conducted a case study to interpret the dilemmas faced by manufacturers during the port conflict. Thus, semi-structured interviews were performed to observe distinct/similar approaches with the theoretical framework, which revealed in the end a framework that is exclusively linked to port conflict supply chain disruptions. It is worth to mention that qualitative studies have some drawbacks manifested usually in low reliability versus high validity (Collis & Hussey, 2013). Many respondents in the study decided to remain confidential, the thing that might has influenced the transparency of the revealed information.

Case Study: A case study methodology allows investigating a certain phenomenon (Yin, 2014). In detail, case studies enable exploring dilemmas that already exist, which influence in a way certain parties (Adams et al., 2007). Therefore, this method was selected since it serves the research purpose; constructing a holistic view of a certain segment. Yin (2014) further discuss that case studies are suitable when the research questions are complex, since the distinguishment in the findings allow in-depth interpretations which is critical in this study. However, case studies are usually limited to certain scope, which is believed to limit wide validations (Collis & Hussey, 2013).

Since port conflict supply chain disruptions are complex events as expressed by Lam & Su (2015), adopting a case study methodology was believed to be suitable. Specifically, the complexity of the disruption increases on manufacturers as the conflict exacerbate or last for longer time (Martin Associates, 2014).

Research Subject & Case Analysis: the study aimed at observing the similarities and differences between the forestry industry and the clients of the logistics providers, through classifying the empirical findings into three main sections: PCSD consequences, mitigation strategies and future mitigation strategies. In respect with the companies’ future strategies, it was crucial to gain some insights of what is mostly debated within manufacturers (forestry manufacturers in particular), in order to propose relevant

recommendations. Further, the arguments in the analysis were either confirmed by literature or rejected, where the latter led to new explorations within the field under investigation. Meanwhile, some analyses sections were supported with quotations from the interview manuscripts to enhance the clarity of the core-arguments. Hence, the case analysis enabled the authors to put their focus on certain event (Yin, 2014). In other words, it allowed for a deep understanding of the PCSD engendered by the Gothenburg APMT-Labour Conflict.

Major focus was turned to the forestry manufacturers with an eye opened on other industries. In detail, the analysis focused on detecting how the port conflict affected forestry-export manufacturing supply chains and how the companies managed to resolve the disruption. The forestry segment was chosen since it is predominantly producing and exporting goods from Sweden, which correspond with one of the research purposes; investigating manufacturers operating international manufacturing supply chains. Further, involving some logistics providers enabled the authors to inspect the status of various manufacturing clients (forestry manufacturers in particular) using Gothenburg APMT. The major interest to involve logistics providers was to detect how the clients of logistics providers were affected from the port conflict, how they have dealt with the port conflict and how the conflict influenced their future strategies. Another reason for involving the logistics providers was that companies today outsource logistics services more than ever (Sheikh & Rana, 2012), and so this would have allowed gaining insights how other industries were affected.

Comparing the data between various parties enabled constructing new theories (Yin, 2014). By cross checking the material gathered throughout the data collection phase, the research purpose could be fulfilled (Collis & Hussey, 2013). The methods are believed has revealed the primary, secondary and tertiary consequences of the port conflict as well as the most frequent mitigation initiatives implemented by manufacturers.

Moreover, the paper encompasses a distant forestry manufacturer that is located far away from Gothenburg; SCA Sourcing & Logistics AB (See figure 10 on page 22). Involving this company aimed to answer the second research question that reveals whether the location play a role during a PCSD or not. The company mainly provides logistical services for SCA but also offer small and large companies variety of transport solutions within the Swedish Northern region (Norrland). Thus, the outcomes of the company represent SCA and other distant manufacturers in Sweden. The main motivation behind this is the lack observed in literature in respect to the factors associated with the vulnerability of a PCSD. Therefore, the authors believed that involving this company would contribute in terms of theory and practice to better understand a PCSD.

Finally, the data analysis phase followed certain criteria, where the data were first summarized, interpreted and finally analyzed (Yin, 2014). In more detail, the results were first summarized in tables (See table 4, 5 and 6, in chapter 4). This released easiness during

the analysis by gaining some preliminary insights. Thereafter, the empirical findings were briefly described from different perspectives (logistics perspective, industrial perspective and commercial perspective). The analysis section focused on comparing the mentioned above perspectives with the theoretical framework, where several contradictions/similarities were observed.

3.4 Data Collection

Data sources included both primary and secondary. The primary sources are embodied in semi-structured interviews administered on-site and through multiple cold communication tools. The secondary sources include websites and previous works accomplished by scholars.

3.4.1 Primary sources

The primary sources constitute of eleven semi-structured interviews, which followed an interview guide of open-ended questions (See full interview guide under Appendix 2, 3 & 4). All interviews were recorded on the respondents' permission.

For the authors' convenience, conducting some phone interviews was more time-efficient since some of the companies were located far from the authors' residency (See figure 10). Before the interviews, the authors sent out the questions by email to respondents in order to give them time to prepare themselves and make sure he/she was capable to answer the questions (Collis & Hussey, 2013).

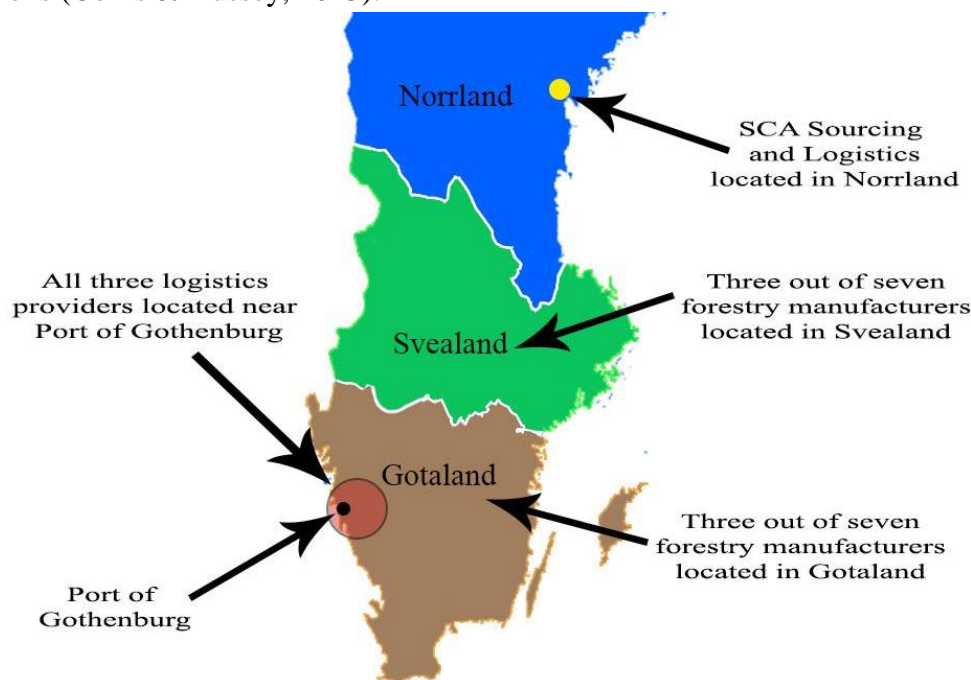


Figure 10: location of the interviewed forestry manufacturers and logistics providers in Sweden (source: authors).⁴

⁴*Six forestry manufacturers are located within Gotaland and Svealand regions; Southern Sweden

*Three Logistics providers are located within Gothenburg region; Southern Sweden

*SCA sourcing & Logistics represent distant manufacturers and located in Norrland; Northern Sweden

Semi-structured interview: The semi-structured interviews imply both flexibility and accuracy during the data collection process, which are needed to conduct an exploratory case study (Sreejesh et al., 2014). The interviews were on average 30 minutes, where respondents followed the interview guide explicitly, with possibility of further relevant discussions.

Also, scholars recommend such type of interviews when involving senior positions within a particular field of the researchers' interest (Sreejesh et al., 2014); respondents held senior positions of range 12-25 years (See Table 3 on page 25). Meanwhile, such interviews require researchers to be aware of relevant theoretical concepts/models to enable good interaction (Sreejesh et al., 2014). Therefore, many scientific sources were reviewed in linkage to the research problem, which enabled the authors to in-depth understand the topic before conducting the interviews.

Interview guide: The authors developed three versions of the interview guide; forestry manufacturers, logistics providers and industrial organization (For more information regarding the aim and literature referral of each interview question, the reader is referred to Appendix 1). Slight changes were made on the guides according to the operational nature. Though, the interview questions aimed at fulfilling the research purposes manifested in gaining insights of 1) the company operations, 2) PCSD consequences and 3) PCSD mitigation strategies. The questions were based on literature during the development of the paper theoretical framework (Yinn, 2014).

As recommended by Collis & Hussey (2013), one trial interview was conducted to open room for improvements. The trial interview led to modify the interview guide once. The modifications are believed have made the questions more relevant to the research purpose.

3.4.2 Secondary Sources

Secondary sources encompass information that is gathered in the past and available for a certain audience or the public (Yin, 2014). Such sources are usually retrieved from books, articles, journals and websites that is accessible through offline libraries or online sites (Collis & Hussey, 2013). In this paper, various secondary sources were utilized such as peer-reviewed articles, scientific books and websites that enabled to establish an overview of the research problem. It also enabled constructing the theoretical framework as well as the research methodology.

Specifically, the background and literature sections employed some peer-reviewed and academic journals that are of relevance to the research topic and scope. The journals were qualified by several academic institutions such as ELSEVIER, The International Journal of Logistics Management, Centre for Maritime Studies, The Asian Journal of Shipping and Logistics, International Journal of Production Research etcetera. The sources were mostly retrieved from the offline/online databases of the University of Gothenburg and

Google Scholar. By using these sources and the authors' knowledge, the reliability and relevance of the data is deemed to be high. As shown under chapter 1 and 2, the secondary data helped achieve a clear understanding of the port conflict in Gothenburg as well as revealed clarified theoretical framework of PCSD in respect to its consequences and the strategies accompanied by such disruptive events. This enabled the authors to smoothly interpret the empirical findings and thus contributed into robust and relevant conclusions.

One challenge with secondary sources is controlling the data being imported if they are of good quality, accuracy and relevance to the research topic and scope (Yin, 2014). Therefore, a process of source criticism and control was administered that enabled fulfilling the desired research quality.

3.5 Sample Method

The adopted sampling methods were both natural and snowball. Natural sampling since the respondents should carry relevant expertise and knowledge with the research topic. Fortunately, respondents were familiar with supply chain disruptions/management on a strategic level. They were running senior positions such as supply chain manager, chief of purchasing, production manager, logistics manager, etcetera (See table 3). While, snowball sampling since the authors requested from all respondents to provide further contacts, where in this way five other interviews were accomplished (Collis & Hussey, 2013).

Furthermore, the target sample constitutes of companies that are located in/near Gothenburg region to ensure they use Gothenburg APMT (See figure 10 on page 22). In detail, the selected companies enjoyed three main characteristics developed by the authors, but also inspired by literature: 1) operating international manufacturing supply chains 2) experiencing a PCSD resulted from Gothenburg APMT-labour conflict and 3) running mitigation strategies to resolve the disruption. Hence, the benchmarks aimed at conforming the data to the research purpose, through involving a representative sample.

Seven interviews with forestry manufacturers were performed, while three others with logistics providers transporting cargos for manufacturers and one interview with industrial organization that represents the forestry industry locally and abroad (Skogsindustrierna). Five companies decided to remain confidential, thus named them Company A, B, C, D and E (See table 3).

Name	Respondent (position & years of experience)	Company type	Method	Date	Duration of interview	Company description (size & markets)
F.H Bertling AB	Position: Director Years of experience: 30	Logistics provider	Face-to-face interview	20/03/2018	24 minutes	Size: large Market: Greece and overseas
Balltorps Tanktransport	Position: company owner, and partly managing the logistics operations Years of experience: -	Logistics provider	Telephone interview	28/03/2018	14 minutes	Size: small Market: Europe and overseas
Logistics provider A	Position: Manager customer service Years of experience: 12	Logistics provider	Face-to-face interview	19/03/2018	50 minutes	Size: large Market: Asia, Canada and US
Skogsindustrierna	Position: Market Analyst-Wood Years of experience: 17	Industrial organization	Telephone interview	21/03/2018	27 minutes	Industrial organization, represent forestry industry
BillerudKorsnäs	Position: logistics and supply chains Years of experience: 30	Forestry	Telephone interview	15/03/2018	34 minutes	Size: large Market: 10% export, UK and overseas
SCA Sourcing & Logistics AB	Position: President, Sourcing & Logistics Years of experience: 25	Forestry & Logistics provider	Telephone interview	28/03/2018	25 minutes	Size: Large Market: Scandinavia (25%) and rest overseas
Wallnäs AB	Position: Market Manager Years of experience: 17	Forestry	Telephone interview	29/02/2018	53 minutes	Size: medium Supply chain: Europe, China, India and North Africa
Forestry B	Position: Chief of production planning and logistics Years of experience: 20	Forestry	Telephone interview	14/03/2018	20 minutes	Size: medium Market: China, Japan and Southeast Asia
Forestry C	Position: Customer service Years of experience: -	Forestry	Telephone interview	27/03/2018	16 minutes	Size: Large Market: Worldwide 40% of production is being shipped through Gothenburg
Forestry D	Position: Logistician Years of experience: 15	Forestry	Telephone interview	27/03/2018	24 minutes	Size: medium Market: Europe, North Africa, Iran, China and Japan
Forestry E	Position: CEO Years of experience: -	Forestry	e-mail	20/03/2018		Size: medium Market: only inbound through Gothenburg APMT

Table 3: Summary details of the interviewed companies and respondents

3.6 Validity and Reliability

3.6.1 Validity

Construct validity ensures that a research has revealed the yielded results (Farquhar, 2012), through establishing a consistent theoretical framework followed by empirical data that enable forming relevant conclusions with the research problem (Farquhar, 2012). Therefore, this paper encompasses a relevant and detailed literature consisted of two main themes that were employed to examine the final conclusions.

Moreover, the substantial goal of *internal validity* is disclosing a holistic view of the research problem, to enhance the quality of the paper (Farquhar, 2012). This could be achieved through involving various parties that provided collective insights regarding the port conflict. This method enabled to strengthen the results through observing the similarities and differences between the different parties, while constantly observing contrasts/contradictions between the empirical data and literature (Farquhar, 2012). Hence, internal validity was managed.

To attain sufficient *external validity*, it is significant to have a representative sample that can reveal relevant data to the research problem (Bryman & Bell, 2013; Yin, 2014). The authors have therefore selected companies enjoying three main characteristics (See characteristics under 3.5), which assured the relevance of the target sample with the research problem. The sample could add value to the paper through gaining the representatives' insights from both forestry and logistics industries. Specifically, the huge business scope of the interviewed companies allowed rational conclusions that supposedly enhanced the external validity of the instituted theory, within the manufacturing sector. Likewise, the respondents that were interviewed possess advanced experience of average 21 years. The respondents held strategic positions whom deeply understand their companies' logistics/supply chain. In sum, the target sample included both representative companies within each industry as well as appropriate respondents within the companies.

However, due to time limitation, the forestry manufacturers in particular were investigated allowing limited validation for populations experiencing a PCSD with manufacturing-oriented supply chains. Thus, the core advantage of the paper is to provide insights for academicians to in-depth investigate in the future various types of supply chains when experiencing port related disruptions.

3.6.2 Reliability

The reliability of a research refers to what extent a future study would attain similar results (Farquhar, 2012). To do this, the authors have first disclosed the sources of all the material employed in the paper especially in literature. All scientific sources were categorized and visualized under each theoretical theme. Second, the companies' details were also summarized in table 3, excluding the confidential respondents. To assure high transparency, the authors are opened to provide future researchers with the interview manuscripts upon request.

In addition, the reliability also displays the certainty of the research outcomes. However, the reliability in interpretivism is not of great importance, but it is critical to provide understandable interpretations throughout the analysis (Collis & Hussey, 2013), therefore several quotations were imported directly from the interview manuscripts to elaborate what is meant by each observation. Yet, there is no guarantee that the research outcomes would be repeated or will have the same accuracy level as in this study. Future researchers might enjoy different circumstances (i.e. longer time span, availability of more data etcetera) that allow drawing different outcomes.

3.6.3 Generalizability

Generalizability refers to the extent that the outcomes of a study can be used/applied in other cases. Usually, the results in interpretivism can be generalized to other cases if the analysis possesses the critical features and synergies of the studied phenomenon (Collis & Hussey, 2013). To do this, in-depth understanding of the research problem is crucial in respect to its context and actions. Therefore, a one-month preparation was performed to assure that the project problem is fully understood. The investigation focused on manufacturing supply chains, but it is though assumed that the results can be generalized on 1st tier supply chains (Suppliers) that move goods to manufacturers. This assumption is based on the fact that the logistics providers revealed insights about all actors that produce goods and ship internationally. Yet, one can assume that the results are more applicable for actors that are located within the European Union since they are committed to fairly similar policies, thus the situation might be different for actors located far away from Europe or at least operate under totally different legislative systems.

3.7 Division of roles

Practically, the authors evenly worked on this paper where both had areas responsible for. The authors agreed on this way because it was believed to make the work more productive. However, the different parts of the paper were reviewed together throughout the whole process, which enabled the authors to adjust the paper, as both felt involved and up to date. Hence, it was believed that the following technique has strengthened the eventual outcomes, while the paper was always opened for modifications and improvements.

3.8 Limitations

Adopting an exploratory-case study methodology generates a trade-off embodied in low reliability versus high validity (Collis & Hussey, 2013). Specifically, the study focused at simplifying the interpretation and analysis of data. This usually enhances validity more than reliability, through conducting concrete qualitative interpretations and analysis methods, instead of a numerical investigation (i.e. statistical analysis). Not to mention that qualitative studies require a long time to find convenient respondents and collect data (Collis & Hussey, 2013).

Further, respondents might not be aware of other external factors that influence certain performance (Collis & Hussey, 2013). It was therefore necessary to involve several companies within each industry to achieve robust assumptions.

It could be also difficult to understand an event if the authors do not possess knowledge about its history (Collis & Hussey, 2013). Therefore, the authors have first established a detailed background of the port conflict before progressing with the rest of the paper.

3.9 Ethics and Confidentiality

When conducting a research, it is important to consider some ethical principles in order to protect the integrity of the respondents (Bryman & Bell, 2013). One important principle is to get approval from the respondents on how to use the data. To do this, it is crucial that the respondents are well informed about the purpose of the study. The respondents should also give a consent on the method used to save the observation i.e. audio recording (Bryman & Bell, 2013). Thus, the authors always asked for permission to record the interviews as well as ensured to inform the respondents about the attempts of this study before the interviews either by email or phone. Some companies rejected to participate, the thing that was always respected and understood by the authors.

Another principle is confidentiality meaning that researchers should treat the gathered personal data with care and make sure that no unauthorized people get access to the data (Bryman & Bell, 2013). In other words, sensitive information of a person or an organization should not be shared without permission. Also, if a respondent has chosen to remain confidential, then no names should be revealed. They should be instead identified unclearly and other characteristics such as location have not been depicted or provided precisely (Bryman & Bell, 2013). The authors have therefore been concerned about confidentiality and asked the respondents before the interviews if they would like to remain confidential. Those wanted to remain confidential have been named unclearly: Logistics provider A and Forestry manufacturer B-E. Also, the map depicting the location of companies was designed in a way that does not reveal the exact location of any company, however, it just shows the regions where the companies are positioned; Gothenburg region, Gotaland, Svealand and Norrland.

Finally, in order to attract more companies to participate in this study, all respondents were promised to be provided with the results after the paper is published on the official website of the University of Gothenburg (GUPEA). The thing that was agreed on with the supervisor at the School of Business, Economics and Law.

4 Empirical findings

This chapter reveals and visualizes the empirical findings from three distinct perspectives: logistics, industrial and manufacturing. A holistic visualization of the findings was performed in the tables below.

The gathered empirical findings were divided into three main parts: The first part includes the findings collected from logistics providers. The second part implies the industrial findings that were employed to construct a holistic view of the whole forestry industry during the disruption. The last part includes the forestry manufacturers. To avoid overlapping the findings, the authors created three different tables (See tables 4, 5 and 6), which briefly imply the key findings. The material was further explained, interpreted and analyzed in the next chapter (chapter 5).

The tables were then divided into three subparts: The first subpart includes the PCSD consequences in linkage to Gothenburg APMT-labour conflict. It specifically includes several tangible and intangible indicators (same as tangible and intangible consequences), to briefly reveal some preliminary insights of the major consequences the companies experienced. The indicators were recognizable by respondents and openly discussed during the interviews. The second sub-part entails the supply chain mitigation strategies the companies have implemented to handle the disruption. Some companies have considered variety of initiatives while others have not, due to limited awareness. The last sub-part shows the future strategies the companies might consider in the future, which also supported the recommendations chapter (chapter 6).

Company	PCSD consequences	Implemented PCSD supply chain risk management strategies	Future strategies/plans in linkage to PCSD
Balltorps Tanktransport	<p>Financial performance: severely affected (rerouting costs)</p> <p>Inventory level: no opinion</p> <p>Distribution network: considerably affected (rerouting delays)</p> <p>Information sharing: no opinion</p> <p>Relationship with customer/supplier: no opinion</p> <p>Customer loyalty: considerably affected (lost customers)</p>	None	Flexibility: advanced rerouting plans

F.H Bertling AB	<p>Financial performance: severely affected (rerouting costs, excess capacity costs and extra labour costs)</p> <p>Inventory level: severely affected Distribution network: severely affected (delivery delays between 1-5 weeks)</p> <p>Information sharing: considerably affected (not that actors became reluctant, however intensified the information sharing to keep the clients up to date)</p> <p>Relationship with customer/supplier: with clients not affected/ with companies end customers slightly affected</p> <p>Customer loyalty: not affected</p>	<p>Cooperation: joint efforts with clients, other logistics providers and suppliers</p> <p>Flexibility: rerouting plans</p> <p>Control: contractual requirements</p>	<p>Flexibility: advanced rerouting plans</p> <p>Avoidance: avoid certain transportation mode</p>
Logistics provider A	<p>Financial performance: severely affected (rerouting costs, redesigning supply chains and document closing costs)</p> <p>Inventory level: moderately affected (redistribution of inventory, shortage in excess capacity)</p> <p>Distribution network: Moderately affected (delivery delays between 6-8 days)</p> <p>Information sharing: moderately affected</p> <p>Relationship with customer/supplier: moderately affected (uncertainty)</p> <p>Customer loyalty: Considerably affected (lost customers)</p>	<p>Cooperation: joint efforts with clients, other logistics providers, information sharing and communication</p> <p>Control: contractual requirements, risk sharing</p>	<p>Flexibility: advanced rerouting plans</p> <p>Avoidance: avoid certain transportation mode</p> <p>Control: contractual requirements</p>

Table 4: Summary empirical findings from logistics providers

Organization	PCSD consequences	Implemented PCSD Supply chain risk management strategies	Future strategies/plans in linkage to PCSD
Skogsindustrierna	<p>Financial performance: considerably affected</p> <p>Inventory level: considerably affected</p> <p>Distribution network: considerably affected</p> <p>Information sharing: no opinion</p> <p>Relationship with customer/supplier: slightly affected</p> <p>Customer loyalty: no opinion</p>	<p>Flexibility: rerouting plans</p> <p>Cooperation: information sharing and communication</p>	<p>Flexibility: advanced rerouting plans</p>

Table 5: Summary of empirical findings from forestry industrial organization

Company	PCSD consequences	Implemented PCSD Supply chain risk management strategies	Future strategies/plans in linkage to PCSD
BillerudKorsnäs	<p>Financial performance: severely affected (rerouting costs, reproduction, postponement and leasing new equipment)</p> <p>Inventory level: severely affected (shortage in excess capacity)</p> <p>Distribution network: severely affected (delivery delays of 2 weeks)</p> <p>Information sharing: severely affected</p> <p>Relationship with customer/supplier: severely affected (outbound delivery delays)</p> <p>Customer loyalty: severely affected</p>	<p>Cooperation: Joint efforts with other logistics providers, information sharing</p> <p>Flexibility: rerouting plans</p>	<p>Flexibility: advanced rerouting plans, flexible delivery schedules</p> <p>Control: higher excess capacity, contractual requirements</p>
SCA Sourcing & Logistics AB	<p>Financial performance: Not affected</p> <p>Inventory level: Not affected</p> <p>Distribution network: Not affected</p> <p>Information sharing: Not affected</p> <p>Relationship with customer/supplier: Not affected</p> <p>Customer loyalty: Not affected</p> <p>Other: Could not move some specialized goods</p>	<p>Flexibility: minor rerouting some small affected volumes to other Swedish ports</p> <p>Avoidance: not considering Gothenburg APMT before the strike (risky option), since the conflict has been there since long time ago</p> <p>Cooperation: Cooperate with market agents to receive information about the conflict beforehand</p>	<p>No data (satisfied with current strategy)</p>

Wallnäs AB	<p>Financial performance: Slightly affected (rerouting costs, increased port charges)</p> <p>Inventory level: Not affected</p> <p>Distribution network: Moderately affected</p> <p>Information sharing: Not affected</p> <p>Relationship with customer/supplier: slightly affected (with suppliers improved, however companies' end customers considerably affected)</p> <p>Customer loyalty: Not affected</p>	<p>Flexibility: rerouting plans, delivery postponement</p> <p>Avoidance: avoid certain markets</p> <p>Production</p> <p>Postponement: slow down production</p> <p>Cooperation: joint efforts with outsourced consultancy company</p>	<p>Flexibility: advanced rerouting plans</p>
Forestry B	<p>Financial performance: considerably affected (increased transportation costs)</p> <p>Inventory level: slightly affected</p> <p>Distribution network: severely affected</p> <p>Information sharing: considerably affected</p> <p>Relationship with customer/supplier: considerably affected (uncertainty)</p> <p>Customer loyalty: slightly affected</p>	<p>Flexibility: rerouting plans, delivery postponement</p> <p>Cooperation: information sharing</p>	<p>No data</p>
Forestry C	<p>Financial performance: considerably affected (increased transportation costs)</p> <p>Inventory level: slightly affected</p> <p>Distribution network: severely affected</p> <p>Information sharing: considerably affected</p> <p>Relationship with customer/supplier: considerably affected (uncertainty)</p> <p>Customer loyalty: slightly affected</p>	<p>Flexibility: rerouting plans, delivery postponement</p> <p>Cooperation: information sharing</p>	<p>No data</p>

Forestry D	<p>Financial performance: considerably affected (increased transportation costs, increased port charges)</p> <p>Inventory level: considerably affected (redistribution of inventory).</p> <p>Distribution network: considerably affected (delivery delays of 1 month)</p> <p>Information sharing: considerably affected</p> <p>Relationship with customer/supplier: moderately affected (uncertainty)</p> <p>Customer loyalty: Moderately affected</p>	<p>Flexibility: rerouting plans, delivery postponement</p> <p>Cooperation: information sharing</p> <p>Control: contractual requirements, risk sharing</p>	<p>Flexibility: advanced rerouting plans</p>
Forestry E	<p>Financial performance: no data</p> <p>Inventory level: no data</p> <p>Distribution network: slightly affected</p> <p>Information sharing: no data</p> <p>Relationship with customer/supplier: no data</p> <p>Customer loyalty: no data</p>	<p>Flexibility: rerouting plans, delivery postponement</p>	<p>No data</p>

Table 6: Summary of empirical findings from forestry manufacturers

4.1 Implications from logistics perspective

As previously mentioned, involving the logistics providers aimed at gaining insights of how the forestry manufacturers were affected, but also keep an eye opened on other industries.

The logistics providers were acting as mediators between their clients (Swedish forestry manufacturers and other industries; will be referred as clients) and the clients' customers. One common problematic challenge was to deliver the clients' cargos on time to the customers, which was not possible due to the conflict at Gothenburg APMT. The clients had in most cases to face long delays, extra costs, capacity shortage etcetera. Subsequently, customers located worldwide were sometimes dissatisfied, due to their inability to receive their shipments on time and thus not be able to meet the demand. In addition, many clients have lost customers and therefore their customer loyalty has been negatively affected.

Surprisingly, information sharing between the clients and their customers has improved. The clients have intensified their information chains to keep their customers up-to-date regarding the port conflict. Some clients interpreted intensifying the information flow as frustration, while others found it crucial to retain their business scope.

In addition, some logistics providers were not able to smoothly implement flexible initiatives due to some geographical and infrastructure constraints. For example, they saw that rerouting to other Swedish/European ports would threaten their competitiveness on the short-term. This had either tied up their clients or enforced them to use other logistics providers.

Regarding the mitigation strategies, both logistics providers and their clients were opened to cooperate together but had one common issue manifested in low preparedness level. A few companies had minor back-up plans to reroute, but still could not prevent considerable consequences. The clients have mostly implemented flexibility, co-operation and control strategies.

Most clients have discovered the conflict fairly quickly. However, only a few clients have been proactive towards the disruption, meaning that they have not prepared any plans in beforehand. This imposes that the disruption recovery phase was quite challenging, the reason that some companies had to face severe losses.

Consequently, one can assume that the Swedish companies have experienced considerable negative consequences that have led to raise the companies' awareness of such disruptive events. In this matter, companies have expressed keen interest in developing advanced mitigation strategies to better avoid and overcome a PCSD in the future. The future strategies mentioned were flexibility and control.

4.2 Implications from forestry industrial perspective

According to the Forestry Industrial Organization (Skogsindustrierna), many forestry companies were affected by the port conflict either directly or indirectly. Directly since companies were not able to transport their commodities through Gothenburg APMT, and therefore were not able to reach their customers. Indirectly by receiving increased port charges due to labour shortage at the APMT.

In response, most of the forestry companies were implementing flexibility strategies embodied in rerouting plans. Moreover, no considerable collaboration between the industrial organization and the forestry companies was observed to overcome the disruption. The collaboration was limited to sharing information regarding the occurrence of the port conflict as well as providing some theoretical knowledge in respect with supply chain recovery.

However, the respondent mentioned that companies expressed their interest in developing advanced flexibility models in order to rapidly reroute cargoes to other ports, in case a similar situation as the labour conflict would occur again.

4.3 Implications from a manufacturing perspective (forestry industry)

The severity of the disruption was generally varying amongst the forestry manufacturers. However, they commonly received high recovery costs generated from longer transportation routes and capacity shortage.

Inventory levels have been moderately affected as a few forestry manufacturers have experienced unbalanced inventories. In contrast, distribution networks witnessed severe perturbations embodied majorly in delays from longer transportation detours and inefficient logistics setups that led to higher congestion rates at port gates.

Unexpectedly, none of the forestry manufacturers revealed that their information sharing was negatively affected, on the contrary improved due to the necessity of frequent interactions. Although, some manufacturers mentioned that their relationship with customer/suppliers has been affected to different extents. Last but not least, the customer loyalty was not considerably affected. Companies could maintain their customers despite their relationships were worsened.

Furthermore, flexibility initiatives were again most dominant since almost all forestry manufacturers had either rerouted to other ports or postponed delivering the shipments to their customers in i.e. Asia, North Africa, Middle East and North America.

Co-operation initiatives were second dominant, where manufacturers considered various joint efforts to handle the disruption. They have majorly intensified the information chains with their end-customers, logistics providers, market agents, market analysts, forwarding agents and consultancy firms.

Regarding the avoidance initiatives, a few manufacturers have re-targeted their markets that were potentially accessible by various transportation modes. Control initiatives were also considered by some manufacturers who committed their stakeholders to collaborate on resolving the disruption as well as gain excess capacity. One manufacturer who could maintain balanced inventory levels has considered postponement production initiatives.

In respect with the future strategies, forestry manufacturers are now aware of such disruptive events. Accordingly, they are either developing the current strategies or introducing new efficient strategies. Keen interest was reflected in implementing advanced flexibility initiatives. Control strategies were also considered, so that manufacturers won't lose any of their business scope.

Hence, manufacturers intending to improve their preparedness to better handle such disruptions in the future, but also aware of the trade-offs that would be engendered to attain efficient and resilient supply chains.

5 Data analysis

Among the implications revealed by respondents, various similarities and differences in the PCSD consequences, PCSD mitigation strategies and future PCSD strategies/initiatives were observed, thus discussed in detail below.

5.1 Similarities

The similarities below reveal the common PCSD consequences, PCSD mitigation and future strategies experienced or considered by the majority of manufacturers.

5.1.1 PCSD consequences of the port conflict

Generally, many manufacturers have received various consequences from the conflict that affected their productivity and efficiency. This corresponds with Porterfield et al. (2012) who state that supply chain disruptions underlie various in-efficiencies and restrain the commercial productivity i.e. limit price competitiveness and reliability. Basically, the manufacturers who experienced severe losses were located fairly close to Gothenburg APMT, where the severity was fading, as companies were located far from Gothenburg.

“It has affected the forestry manufacturers quite much especially the companies located near Gothenburg. From about one year ago, one-third of the forestry manufacturers were struggling from the conflict since they had to reroute to other ports. A certain time, it made some manufacturers cost-inefficient and unproductive” - Forestry Industrial Organization

Financial performance: the financial losses were widely mentioned among the respondents, where it was assumed to be severely/considerably affected. This goes along with Blackhurst et al. (2005) who state that companies' financial performance is very vulnerable to supply chain disruptions. The losses were basically generated from rerouting costs (using longer transportation routes), reproduction of commodities and excess capacity costs (redistributing volumes to new logistics facilities near other Swedish/European ports). Some other indirect costs were also observed such as higher congestion taxes. Forestry respondents in particular generally expressed that the financial losses were severe, because they often prioritized their reliability on costs, meaning that they tried to fulfill their promises regardless the costs.

“We are talking about millions. The conflict generated severe financial losses since we had to reroute to other Swedish/European ports. Sometimes we had to reproduce the affected commodities because of delays. Also, the lead times were longer and thus we had to pay higher congestion taxes as indirect costs. However, most we cared about is our reliability and to deliver to customers on time” - Billerudkorsnäs

Inventory levels: The inventory levels were moderately affected according to both logistics providers and forestry manufacturers. Two major dilemmas were prohibiting: unbalanced customer demand and shortage in capacity. These dilemmas have led to slacken production at certain times that underlined long-term issues for companies.

Behind that, some overseas customers as discussed by Wilson (2007) have placed bigger orders for the manufacturers after the conflict occurred, which was assumed to unbalance the inventory levels especially in the upstream.

“Of course companies have shifted some of their inventories somewhere. The companies have not lowered their inventory levels, but for sure had to redistribute it. It was challenging for manufacturers especially the ones operating internationally. They had, for example, to slow down their production in order to keep their factories working while meeting their unstable customer demand” - Logistics Provider A

“It was very challenging to access new warehouses and redistribute our commodities due to the shortage in capacity, the reason why our inventory levels dramatically increased” - Billerudkorsnäs

Distribution networks: most companies have established permanent intermodal connections to Gothenburg APMT such as rail, road and feeder transport. When the conflict occurred, huge volumes were rerouted to other Swedish/European ports. Subsequently, this underlined major modification in supply chains, which impacted the companies’ distribution networks. Specifically, the conflict engendered longer delivery times (delivery delays ranged between one-six weeks), due to longer routes and capacity shortage. The impacts mentioned above can be associated with Blackhurst et al. (2005) and Loh et al. (2017) who mentioned that SCRD negatively affects transport networks and generate delivery delays.

“This was a major problem for the Swedish manufacturers and it was extreme at some companies. For us, our delivery times increased six to eight days” - Logistics Provider A

“We had to drive trucks down to Hamburg and Rotterdam in order to reach our destinations” - Balltorps Tanktransport

“We have rerouted to other Swedish ports which generated delivery delays of average one month” - Wallnäs AB

Information sharing: respondents revealed a contradicting approach to what Blackhurst et al. (2005) and Loh et al. (2017) stated; that business actors become reluctant to share information during an SCRD. On the contrary, respondents expressed all business parties’ willingness to share information. Although, the intensified information chains have generated some negative effects such as labour frustration to continuously update the customers about the disruption. Subsequently, this has engendered increased labour costs due to the overtime shifts. Since all respondents agreed on this approach, information sharing will not be discussed under differences.

“I do not think our clients’ customers have changed the way they shared information because the latter had always to be up-to-date of the situation in Gothenburg on regular basis.” - Logistics Provider A

“It (information sharing) has been affected in the sense that it was booming. The performance of our staff has been affected but was crucial during the difficult times to keep all of our parties’ interest, through having the information system working.” - FH Bertling AB

“Our information chain became better and thus could strengthen the relationship with some customers. However, the conflict generated frustration for our staff since they had to contact frequently our international customers to inform them about the situation in Gothenburg.” - Wallnäs AB

Relationship with customer/supplier: the relationship between manufacturers and logistics providers has improved since they have established joint efforts to cope with the disruption as well as relied on the latter’s transport solutions. However, the clients of logistics providers received a lot of complaints from overseas customers due to delivery delays, thus clients’ relationship with customers has been moderately affected.

Similarly, manufacturers’ relationship with their customers has been considerably affected. The customers were dissatisfied because of delivery delays especially the ones located overseas i.e. China. Hence, some respondents expressed their inability to maintain the same business scope with some customers especially in B2C environments, the approach that match with Porterfield et al. (2012).

“There has been a lot of frustration among our clients of course, but the crucial thing was to properly explain for them that the conflict is not our fault. Thus, we strengthened the relationship with our clients in the sense that they relied on our ability to find solutions. However, it has been much more difficult for our clients to explain for their customers in Brazil, China and South Africa. I can assure you that this conflict has mostly affected the Swedish manufacturers and Gothenburg APMT.” - FH. Bertling AB

“Some customers of the Swedish forestry manufacturers were dissatisfied and wanted their commodities to be delivered on time. The whole situation was shocking for some customers who could not understand what is happening.” - Forestry Industrial Organization

Customer Loyalty: clients of logistics providers could not maintain the credibility of their value chains i.e. uncertain delivery times. The reason the customer loyalty was moderately/slightly affected. The port conflict has limited the ability of some manufacturers to fulfill their promises to the customers, thus their value chains became inefficient. This corresponds with Simchi-Levi et al. (2008) who state that an SCRD create hinders to maintain the customer loyalty. In addition, it was confirmed that large manufacturers are more exposed to lose customers than medium-small companies since large manufacturers were usually indirectly connected with their end-customers.

“It basically depends on the scope of the supply chain, where the more the company is internationalized the more the customer loyalty would be affected. Big companies such as BillirudKorsnäs would have lost many customers because they are internationally spread, where

they could not establish robust relationships with their customers.” - Wallnäs AB

Finally, most of the forestry manufacturers and clients were having a tricky situation: whether they will return to Gothenburg APMT or not. Respondents have mostly answered yes but not like before, which means that the companies are now aware of the conflict and its consequences. Therefore, they have permanently rerouted some of their volumes to other Swedish/European ports. This is because of two major factors that have been severely affected by the disruption which are manifested in cost efficiency and productivity.

More specifically, manufacturers have mostly faced severe financial losses and disrupted distribution networks that were problematic to cope with. The risk today if companies returned to Gothenburg APMT, whether this conflict would exacerbate again or not. A similar disruption would imply similar consequences but would even threaten some manufacturers to maintain their competitiveness.

“I think many manufacturers have resolved the disruption in a way, however, I’m not sure that all of them would recover from the losses.” - Balltorps Tanktransport

“...companies had to face severe costs to reroute to other ports and returning back again to Gothenburg APMT would add extra costs. Returning to the port now depends if APMT can reconstruct a reliable image. In terms of productivity, the scope of losses depends basically on where the company located. If they are near other Swedish ports, I do not think their productivity would be affected and vice versa.” -Logistics Provider A

“We have returned to Gothenburg APMT already and it required a lot of transport costs when we rerouted again. The major reason was that our favored transporters and forwarding agents are based in Gothenburg. It was also more expensive to ship through ports other than Gothenburg APMT.” - Forestry C

5.1.2 PCSD mitigation strategies/initiatives

Supply chain relief process: To begin with, the responsible party of handling the disruption was sometimes turned to the logistics providers, sometimes each company owns responsibility, while the dominant group was whom jointly worked with their partners to find prompt solutions. In detail, some manufacturers have outsourced logistics providers to fully handle their operations, therefore the service providers were responsible to overcome the disruption. In some other cases, companies had in-house potentials, thus the latter were independently responsible to face the disruption. Finally, the dominant group initiated joint efforts with logistics providers, forwarding agents and market agents. Hence, the above observed groups can be called: *Outsourcing - Joint efforts - In-house* (In-house and outsourcing groups will be explained further under differences since joint efforts group was the only dominant among respondents)

When the supply chain relief process was mentioned amongst respondents, only a few reflected awareness of the chronological order of the process and thus can be assumed that the companies' preparedness to handle a PCSD was insufficient. Specifically, manufacturers have not established separate divisions of their initiatives among the different phases of the process, rather it was random and spontaneous. Although, the initiatives implemented especially in the disruption recovery phase were overlapping with the given theoretical framework, thus the authors created different divisions to simplify the analysis in relation to literature.

Disruption discovery: companies have realized the crucial role of information sharing across a supply chain. Therefore, both manufacturers and clients have established rich information chains with their market agents, markets analysts, logistics providers (train operators, road shippers), forwarding agents, consultancy firms that were all based in Gothenburg. This strengthens what Blackhurst et al. (2005, p. 4072) stressed, that information sharing is critical to recognize "*the current needs and issues in industry*".

"We have close coordination with our expertise to help our clients, as we are involving several parties in our discussions such as Gothenburg APMT, in order to find potential solutions ... when the strike settled in September, we have been closely monitoring every information flow. We are in close contact with the shipping lines that are operating through Gothenburg APMT...The information sharing enabled us to react faster." - FH Bertling AB

"We have moreless daily discussions with our service providers, so within minutes and sometimes hours we get informed about any emergent event." - Billerudkorsnäs

Although, logistics providers have played the substantial role in discovering the disruption as mentioned by both forestry manufacturers and the service providers themselves, since the latter possess the transport solutions and in close communication with the Port of Gothenburg on daily basis. It is also worth to mention that manufacturers have not pre-planned the discovery phase since they had these informant connections with Gothenburg in beforehand. Hence, disruption discovery happened spontaneously, but it could help companies discover the disruption quickly.

Supply chain recovery: respondents have basically mentioned flexible, co-operative and some control initiatives. Other types of initiatives such as avoidance and production postponement were poorly considered and thus will be discussed under differences.

Flexibility: manufacturers suddenly had to face the disruption which generated a major issue: how to deliver to customers on time? In the time that manufacturers strived to reach their customers one way or another, in order to maintain their reliability and competitiveness.

Because all logistics providers were based in Gothenburg, they could not be flexible to implement rerouting plans since they were committed to contractual agreements with Gothenburg APMT. Also, logistics providers usually invest largely in constructing their logistical facilities such as warehouses, handling equipment, head offices etcetera. Therefore, the interviewed logistics providers were to some extent tied up and had to continue operating through the APMT, whether they are losing or not. This dilemma enforced many clients to shift their volumes, through other logistics providers, to different Swedish/European ports. The clients have mostly considered flexibility initiatives such as rerouting models and delivery postponement plans similarly to the ones discussed by Jüttner et al. (2003).

“We are trying to reroute but that is not easy since some of our customers have already disappeared and now moving their cargoes to other ports. Since then, we have been trying to find other efficient alternatives.” - Balltorps Tanktransport

Despite that these initiatives enabled many companies to reach their customers, however, the new routes were often longer. The reason the companies had either to afford the extra costs or increase the transportation prices on the customers, which sometimes was inconvenient for the latter. Besides the extra costs, the conflict delayed the manufacturers' delivery schedules to reach the customers, especially the ones located overseas since deep-sea transport is a prerequisite.

Generally, all the different perspectives and trade-offs mentioned above goes along with Blackhurst et al. (2005); Loh & Thai (2015) and Porterfield et al. (2012) whom mentioned that robust relocation models of shipments and strong business relations are critical in order to outpace the disruption in the least damages possible. The trade-offs were majorly embodied in risk management versus total cost of supply chain management.

Hence, flexibility initiatives enabled forestry manufacturers and clients of logistics providers to potentially move their commodities from their yards, thus prevent their factories from a shutdown. However, the initiatives have generally created a major trade-off of increased costs.

“We have had established connections with other Swedish ports such as Gävle, since it was the best alternative for us. We don't see any problems when it comes to rerouting as it works well, it is just a matter of extra costs because of shortage in capacity.” - Forestry B

No differences were observed between forestry manufacturers and clients of logistics providers in terms of flexibility, therefore will not be considered under differences.

Co-operation: respondents have shown a keen interest in initiating joint efforts, to be the second dominant between the strategies implemented. The co-operation initiatives were basically shaped in intensifying the information chains between forestry

manufacturers/clients and their brokers or markets agents etcetera. Information sharing was highlighted by Jüttner et al. (2003) who mentioned that it enables resolving an SCRD faster.

Another co-operation initiative was mentioned is close interactions with customers to explain the situation, while trying to find potential solutions to deliver the shipments. Last but not least, many efforts were observed between forestry manufacturers and their market analysts to evaluate the reliability of other Swedish/European ports in the aim of avoiding similar disruptions, since the striking labour union Section 4 at Gothenburg APMT is also existent within other Swedish ports. The initiatives mentioned correspond Loh et al. (2017) and Porterfield et al. (2012) who stated that co-operation with customers/suppliers are crucial to prevent losing certain business scope.

“We co-operated with our logistics providers that are located outside and inside Sweden. We also received some collaboration from the market analysts that helped us evaluate the reliability of other Swedish/European ports in order to prevent similar disruptions.” - Billerudkorsnäs

Control: these initiatives were fairly considered by forestry manufacturers. Control strategies were seen more important for logistics providers who tried to commit their clients to a certain business scope, the thing that was not convenient for their clients. It was not convenient in the sense that companies wanted to remain flexible, by rerouting to other ports, using other logistics providers.

The control initiatives were observed in common among a couple of respondents. Through these initiatives, companies basically attempted to gain excess capacity in order to store the goods before it is shipped. Also, some contractual requirements were considered to distribute the losses across the supply chain, so all stakeholders take a partial responsibility of resolving the disruption. The control initiatives go along with Jüttner et al. (2003).

“We have formed many agreements with our clients to retain certain volumes, however, they are not satisfied since we are not able to fully operate. The reason they are asking to re-negotiate the current agreements. Behind this, companies want to be more flexible by being able to smoothly reroute to other ports and shift some of their volumes” - Logistics Provider A

“We share some risks with our business partners because these disruptions are uncertain and out of our control. So, to not afford all of the consequences, we did establish accurate pre-risk-sharing plans” - Forestry D

Supply chain redesign: Both the clients and forestry manufacturers have redesigned their supply chains involving new modifications ranging from new routes to redesigning the information chains with stakeholders.

Although, one can indicate from the key-findings that manufacturers have mostly implemented partial optimizations to their supply chains. Meaning that companies have not fully left Gothenburg APMT in order to maintain an operative route with the largest port in Scandinavia. Companies expressed that true sub-optimizations would put some risks on the table such as running out of capacity, but leaving Gothenburg APMT is hard due to its convenient location and unique operations. This contradicts with what Blackhurst et al. (2005) have stated regarding the necessity of comprehensive supply chain optimizations.

“We moved 50% of our cargoes through Gothenburg APMT during the worst period of the conflict, since the port enjoys very competitive location and offering us good deals. However, we would not fully return to APMT as before and we will keep some cargos moving through other Swedish ports in order to prevent the consequences we experienced.” - BillerudKorsnäs

Moreover, in linkage to Blackhurst et al. (2005), companies have mostly considered dynamic supply chain models since the environment underlying disruption was regularly changing (various logistics setups). The dynamic models enabled companies to be adaptive to the disruption.

5.1.3 PCSD future strategies/initiatives

In general, the preparedness level to handle a PCSD was assumed to be low as noticed at both logistics providers and forestry manufacturers. Despite that the conflict has been emerging since 2012, however, companies have not expected the conflict to exacerbate this way. Therefore, companies have not pre-planned the disruption as supposed, so that some of them experienced severe losses. However, companies now are more aware of such disruptive events and in response developing advanced mitigation strategies following the supply chain relief process, which is believed to make supply chains more efficient and resilient.

“We were not prepared to face the disruption as supposed but will be next time. We have now implemented rerouting logistics models to other Swedish ports such as Norrköping and Helsingborg that are ready to be applied in case any further disruption would occur...” - Wallnäs

Specifically, both clients and companies have expressed their interest in either developing their current implemented strategies or introducing new strategies. In this regard, flexibility initiatives were again most mentioned by respondents. The flexibility initiatives focused mostly on developing advanced logistics rerouting models/plans. Some manufacturers also considering flexible delivery times means they would move their shipments overnight to several destinations to avoid generating high congestions, thus reducing delivery costs. In addition, some companies have employed more agents or currently in close communication with brokers that are based in several ports, in order to act faster in case Gothenburg APMT or Section 4 intended any new industrial action.

Unexpectedly, control initiatives were second dominant among future strategies. Seemingly, some companies have lost some of their business scopes especially with the overseas customers. In response, they are trying to form new contractual requirements to commit their customers with them. Moreover, forestry manufacturers had a major challenge in accessing more capacity, since it was lacking at other Swedish ports. Therefore, companies are trying to temporarily lease storage facilities near the ports i.e. warehouses. Some manufacturers are also considering hiring bulk ships as a warehouse in the sake of retaining the excess capacity, thus avoid the factories from a shutdown. However, excess capacity initiatives are costly due to a shortage in supply, in the time that most Swedish companies are demanding more capacity.

“Many of our shippers have disappeared and rerouted to other ports. Several ports have received higher volumes such as Halmstad, Helsingborg, Norrköping, Stockholm and Gävle. All of them have recently increased their capacity and want to build more.” - Balltorps Tanktransport

“The problem is we have huge volumes and any shift would lie extra costs anyhow. Even if we would improve our strategies, we still have to face some extra costs because of the contractual requirements that we have to commit in order to get access to capacity” - BillerudKorsnäs

5.2 Differences

The differences below reveal the distinct PCSD consequences, PCSD mitigation and future strategies experienced or considered by some manufacturers.

5.2.1 PCSD consequences

Financial performance: In terms of financial performance, only one difference was observed. The costs of the disruption were severe at manufacturers who were very reliant on Gothenburg APMT, especially those had larger intercontinental proportions shipped through the port. On the contrary, manufacturers that had other alternatives than APMT were slightly affected.

“We were not that affected in terms of costs, since our deliveries to India and China are not so big, while our target market is Europe that is accessible by various transport modes” -Wallnäs

Inventory level: The inventory levels dramatically increased in certain times, thus were moderately affected at most manufacturers. However, a few companies revealed that they were heavily impacted. They had their shipments blocked at Gothenburg APMT and therefore the inventories increased in the yards.

“We had some volumes stored at Gothenburg APMT that was problematic to move it somewhere else” -Forestry D

Distribution network: Distribution networks were differently affected. Those were heavily impacted are manufacturers operating international supply chains. However, a few others were slightly affected because of two main facts. The first fact manifested in

operating small-medium supply chains that usually underlies lower complexity. The second fact is that a few manufacturers have jointly pre-planned some mitigation strategies with their partners, allowing them to modify the delivery network quickly. Specifically, they have initiated sophisticated deliveries with some Swedish ports in order to reroute faster. Therefore, they could deliver the goods in relatively reasonable time.

The respondent from the forestry industrial organization revealed a similar approach, where he stated that the larger the supply chain the higher the complexity, thus the more impacts. This confirms what Porterfield et al (2012) stated that larger supply chains are more vulnerable to disruptions.

“Large forestry manufacturers faced severe problems, generated from a high supply chain complexity. “- Forestry Industrial Organization

Relationship with customers/suppliers: As previously mentioned, some manufacturers had their relationships with customers/suppliers negatively affected, while others have improved. Only a few had robust initiatives that allowed them to deliver in relatively good time. These manufacturers had previous connections in place with different Swedish ports before the conflict occurred, allowing them to rapidly reroute during the disruption. Subsequently, their customers have not noticed any interruptions in such challenging situation, thus their relationships get improved.

“We adopted robust solutions before the disruption occurred, therefore our customers were very satisfied of our delivery times and wanted to widen their business scope with us.” - Forestry B

Customer loyalty: Unlikely to clients of logistics providers who lost customers, some manufacturers could retain their business scope and even increase it, since they trusted each other to find prompt solutions. This corresponds with Simchi-Levi (2008) who stated that customer loyalty is based on trust.

Last but not least, forestry manufacturers and the clients expressed an interest to return to Gothenburg APMT in case the conflict is resolved (not in full capacity). However, a few companies were more skeptical as they would consider other permanent routes. Those companies were most concerned about the uncertainties in the conflict. Also, the respondent from the forestry industrial organization revealed that some companies might not be able to return to the APMT, since they have already made huge investments on alternative routes.

5.2.2 PCSD mitigation strategies/initiatives

Supply chain relief process: When it comes to relieving the supply chain, the majority revealed they initiated joint efforts with their partners. However, there were a few others who handled the disruption differently from the majority. Some of them were trying to recover individually (in-house), while others handed the full responsibility to other actors (outsourcing). According to the respondents and Tang (2006), owing in-house potentials

aim to avoid exposing sensitive data, so to retain a competitive advantage. In contrast, some clients of logistics providers have outsourced their logistics services and thus the responsibility was fully turned to an external party. The major reason for outsourcing was that companies were fairly small and therefore wanted to reduce their logistics expenditure, while focusing on their core competencies.

Disruption discovery: Moreless, most of the manufacturers had good information chains that enabled them to discover the disruption quickly. However, a few companies put extra effort such as employing an external *artificial intelligence agent*, aiming for discovering the disruption before it occurs. Another company developed a system that discovers whether the company is able to deliver or not, to certain locations. In case not, the system directly provides alternative routes to other ports (The system's functionality might overlap with recovering the disruption, but it initially aims to discover disruptions). Besides these exceptional examples, no one seemed have installed any artificial intelligence systems that were discussed by Wilson (2007).

"We have implemented some discovery intelligence agents that are owned by our service providers, so discovering the disruption was not a problem." -Billerud Korsnäs

Supply chain recovery

Co-operation: The only difference observed in terms of co-operation was the scope of the vertical integration with stakeholders/business partners. Specifically, some manufacturers have co-operated on a daily basis while others on weekly basis.

Control: The control initiatives were common among the clients of logistics providers. In contrast, they were less common within the forestry industry, as only one company implemented a control strategy aiming for sharing the risks with stakeholders. Clients of logistics providers were trying to share the risks since they were sometimes committed to Gothenburg APMT, thus they have considered control initiatives.

Avoidance/Production Postponement: Other differences that some forestry manufacturers have considered were avoidance strategies aiming for preventing certain markets that were challenging to reach during the disruption i.e. Asian markets. Moreover, one forestry manufacturer has implemented some postponement initiatives in order to slacken production, thus balance the inventory levels.

"We could slightly slacken our production speed to prevent our yards to be filled up...we also avoided some Asian markets during the disruption, and sold the excess volumes to nearby markets such as Denmark and Holland, which were accessible by road transport" - Wallnäs

Supply chain redesign: Although that most of the forestry manufacturers had to some extent redesign their supply chains, however only a few were interested in doing collective adjustments, due to the underlying costs of such one-big investment.

“We might fully move the shipments through other ports even if another conflict has occurred” - Wallnäs

5.2.3 PCSD future strategies/plans

Clients of logistics providers and forestry manufacturers were mostly focusing on developing rerouting logistics models/plans, through adopting advanced information systems. In other words, the systems would rapidly observe a supply chain disruption and quickly reroute their shipments to other ports.

Some other clients were considering moving their commodities using RoRo shipping as an alternative transport mode. For instance, the RoRo terminal in Gothenburg can receive large quantities and offer various direct deliveries to different destinations (Port of Gothenburg, 2018d). This alternative would be considered if the conflict was not resolved.

5.3 The case of SCA

SCA Sourcing & Logistics AB is a logistics provider for the parent company SCA (forestry manufacturer), but also provides shipping services for wide variety of customers (small-medium manufacturers) within the Swedish Northern region (Norrland). Their initial market is Europe, meanwhile manages overseas destinations across the world. The company has a very robust transport network that constitutes of marine terminals in different strategic locations within Europe such as Helsingborg, Dublin, Lisbon etcetera (SCA, 2018). As previously mentioned, the company was involved to inspect if the conflict affected distant companies, by that, the second research question would be answered. The company is located in Northern Sweden far away from the PoG (See figure 10 on page 22). The respondent from SCA revealed certain insights of how the second largest forestry manufacturer (Largest Companies, 2018) in Sweden has been affected by the conflict, but also provided other insights about their clients within the same region; Norrland.

The insights revealed by SCA were much different from manufacturers close to Gothenburg. SCA was almost not affected as it is located up-north Sweden. They just had to reroute some specialized cargoes that needed customized handling services, which were potentially provided by Gothenburg APMT. SCA has even widened its business scope since many customers relied on their operations and ability to deliver the products.

Further, SCA could prevent the consequences experienced by other Swedish manufacturers due to three major factors. First, SCA has not established substantial connections with Gothenburg APMT, due to the company's location (Northern Sweden). The company used Gothenburg APMT in exceptional cases especially when they received competitive offers, which could compensate the shipping costs to Gothenburg. Other than that, the company majorly operated their outbound flow through other adjacent Swedish ports such as Skövde and Helsingborg. The respondent further mentioned that most of the

distant manufacturers and other distant industries that are in contact with, relied on adjacent ports instead of Gothenburg APMT.

Second, SCA was aware of the conflict at Gothenburg APMT. The company had advanced measures to evaluate the reliability of each port, thus they noticed the conflicting interests at the APMT long time ago. Subsequently, they have prevented the APMT and sent only minor shipments, while kept the essential shipments moving through other ports. Finally, SCA owns various logistical modes/facilities, which made it easier for them to have excess capacity as well as move their own/clients' shipments using their feeder systems.

“It is more expensive to use Gothenburg APMT because it is a distant port and therefore the inland transportation costs are high...We were aware of the conflict in beforehand through our anticipatory measures... we are operating our own container feeder vessels, where we basically received higher volumes that caused minor frustration...the effectiveness of the transport solutions depend on the location of the company, and if any company has been moving marginal volumes through the APMT, they would have received marginal losses.” - SCA Sourcing & Logistics

5.4 Summary of analysis

To sum up the analysis (See figure 11 on page 50), it is now clear as revealed by respondents that some of the consequences and mitigation strategies were quite common among manufacturers. The primary consequences were mostly embodied in impacted financial performance and disrupted distribution networks. In contrast, other consequences such as inventory levels, relationship with customers/suppliers and customer loyalty were varying in their severity levels, which represent the secondary and tertiary consequences. Interestingly, information sharing and relationship with partners have improved, due to their interest in jointly relieving the supply chain. Moreover, it was noticed that the tangible consequences were overlapping with the intangible ones. For instance, delivery delays were irritating customers, thus affecting relationships with stakeholders as well as affecting customer loyalty. One other general consensus observed in respect to consequences is that larger and dynamic supply chains underlies higher severity, thus increase the vulnerability of port conflict supply chain disruption (PCSD).

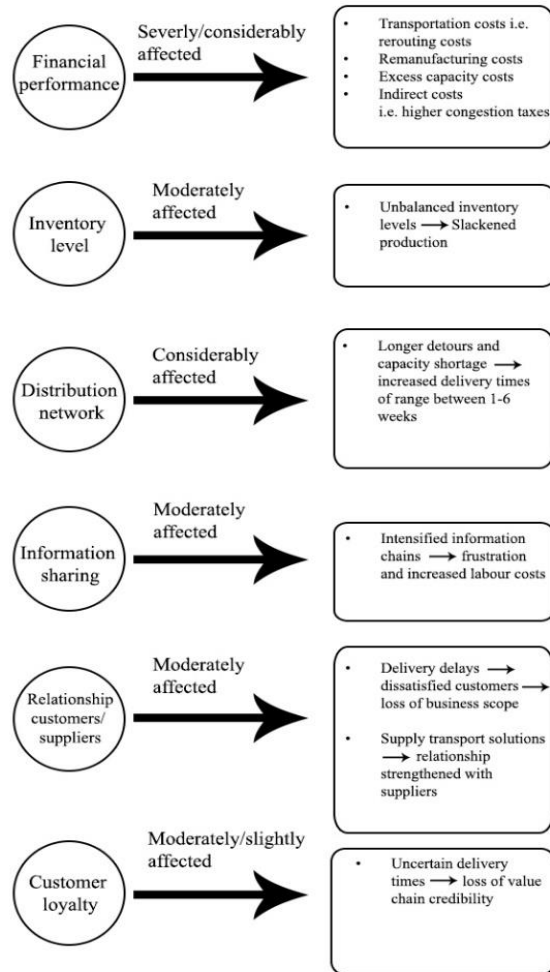
In respect to mitigation strategies, the manufacturers' potential/preparedness to handle a PCSD was generally low. This is initially because manufacturers who have not experienced similar events in the past would ignore preparing for something irrelevant. Most forestry/other manufacturers have implemented typical rerouting plans (flexibility strategies), initiated joint efforts (co-operation strategies) and formed some contractual agreements (control strategies). In contrast, manufacturers poorly considered avoidance and postponement production initiatives.

The conflict has indeed influenced the manufacturers' future strategies. Although, some companies decided to pursue their current methods without considering any future alterations, while others have shown a keen interest in improving their preparedness to

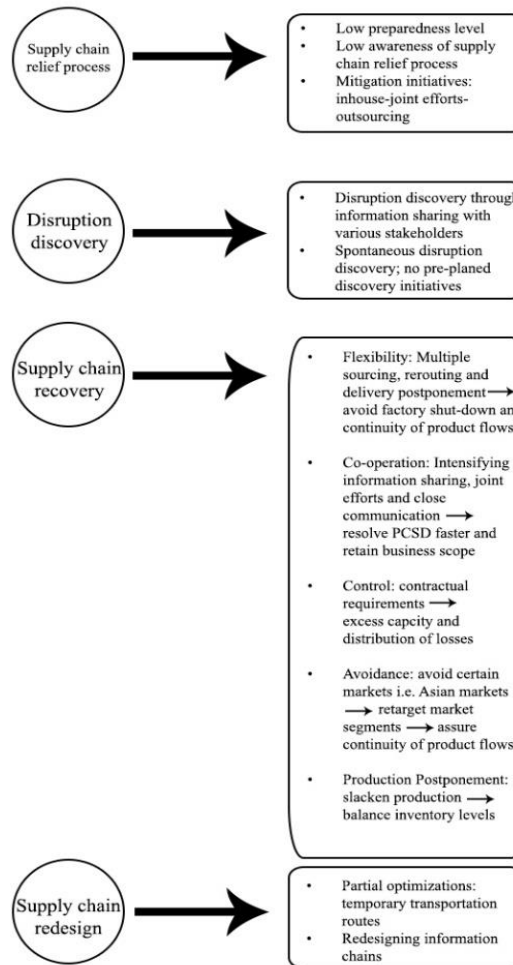
better handle similar disruptions in the future. Some of the mentioned suggestions were developing flexibility, control and avoidance strategies.

Regarding the distant manufacturers, one can assume that SCA enjoyed several factors that made them able to prevent the losses experienced by manufacturers/other industries close to Gothenburg APMT. These factors are embodied in: their distant location from the conflicting node, previous awareness of the conflict and the ownership of various logistics facilities. Yet, the respondent further revealed that even distant companies who were not enjoying the same factors could manage the disruption better than companies located near Gothenburg since they were not dependent in large extent on the port. Hence, distant companies have higher ability to maintain their efficiency and productivity, since they can easily reroute.

PCSD consequences



Mitigation strategies/initiatives



Future strategies and trade-offs

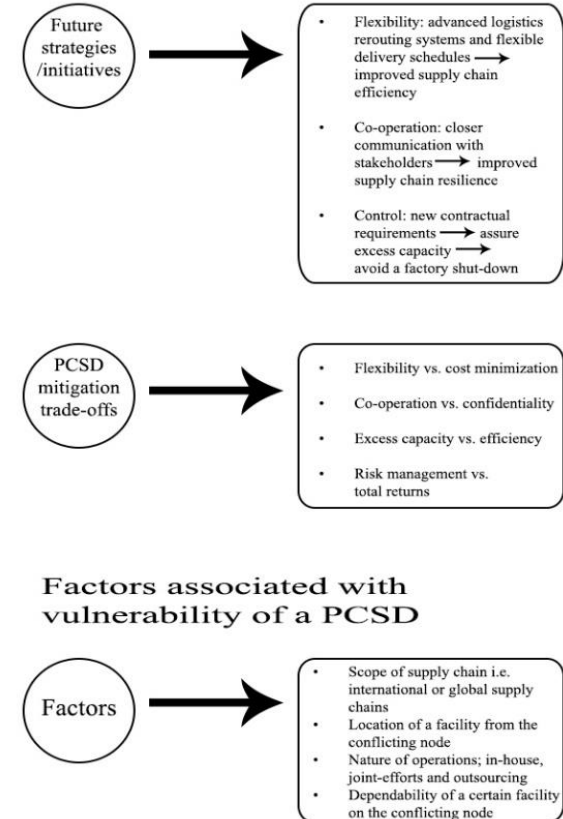


Figure 11: summary of key findings

6 Recommendations

In this chapter, multiple mitigation initiatives were developed based on the study key-findings. The initiatives adapt with the supply chain relief process in order to allow better implementation of each initiative.

In essence, the port conflict has engendered undesirable commercial losses. The disruption was met by low preparedness that has exacerbated the severity of the disruption, especially when it comes to financial performance and distribution networks. Moreover, it was noticed that selecting a convenient mitigation strategy depends in large extent on several factors such as the nature of operations (inhouse, joint efforts, outsourcing), location, process and market features. These factors created a challenge to identify the strategy that best fits a company. Correspondingly, through following the same supply chain relief process and through the aspiration of the future strategies discussed above, the following part addressed various PCSD initiatives in the aim of improving a supply chains' efficiency and resiliency. The initiatives were briefly explained due to page limitation. Therefore, the reader is referred to the sources accompanied with each initiative for further interest.

6.1 Disruption discovery

Despite that most manufacturers have discovered the port conflict quickly, however, this was spontaneous as previously discussed. The foresight of disruptions as addressed by Tang (2006) would provide sufficient time for companies to pre-plan initiatives, thus be able to mitigate the consequences. Specifically, most of the discovery tools utilized by companies were fairly traditional especially at medium-small companies i.e. brokers and market agents. Only BillerudKorsnäs employed automated information systems that could quickly discover a disruption. In response, advanced discovery initiatives were discussed below: visibility, capacity and predictive analysis systems.

Visibility: Improved visibility across a supply chain enhances efficiency, through identifying the weakened/threatened areas. As a result, managers can start preparing some initiatives to be implemented once a disruption occurs. However, despite the enormous benefits of supply chain visibility, the costs should be calculated and compared with the benefits in order to prevent severe trade-offs. (Blackhurst et al., 2005)

Capacity: Capacity was a problematic issue for manufacturers that has led sometimes to severely increase the inventory levels. Manufacturers had mostly leased inconvenient storage facilities due to the limited supply in capacity, especially near Gothenburg region. For this, Stecke & Kumar (2009) propose forecasting tools that continuously measure the availability of convenient capacity within different geographical areas. This would prevent a product flow to be interrupted or a manufacturing facility to be closed (Blackhurst, 2005).

Predictive analysis systems: Understanding supply chains are today essential in order to enable efficient product flows (Blackhurst, 2005). In this regard, predictability tools such as transportation event management systems enable observing probable problems at each supply chain node. The systems should acquire past disruptions if existed to better give reliable information. It compares the patterns of past experiences with current news/search engines and send warning signals to the logistics managers. Employing these search agents are very beneficial in situations such as strikes that usually takes time to occur (Blackhurst, 2005). However, these systems need to be further developed since they do not accurately anticipate the problems, and therefore it is crucial to employ people specialized in analysing the warning signals. Hence, more high-tech-solutions in supply chains are needed in conjunction with human intervention (Blackhurst, 2005).

6.2 Disruption recovery

Basically, manufacturers have not established delicate measures of the frequency and the probable consequences of a supply chain disruption. However, they are now eager to consider rigorous supply chain initiatives aiming to better recover from a PCSD. As briefly mentioned before, the major ambition behind these initiatives is to improve two major supply chain areas: First, efficiency that would make it possible to mitigate operational hazards despite the re-occurrence of severe disruptions. Second, resiliency that enables a company to remain functioning under a disruption and recover rapidly. The recovery initiatives will be discussed below including the mitigation strategies discussed in the literature.

Flexibility: These initiatives as previously mentioned were widely discussed among respondents. The major challenge observed was the pace to reroute/alter shipments flow to other logistical hubs within Sweden/Europe. In linkage to these issues, the authors propose two initiatives that enable manufacturers reroute faster and remain their excess capacity.

Flexible supply base: Not considering more than one logistics provider can increase the severity of disruptions (Stecke & Kumar, 2009). Normally, a disruption in one geographical area weakens a service provider to operate, while others located far from the disruption enjoy higher capability and capacity. In other words, it is recommended to establish flexible supply base that would ensure the continuity of the product flow through rapid rerouting, thus be able to prevent volatile inventory levels (Stecke & Kumar, 2009).

Flexible transportation modes: Logistics managers should be aware of other available transport modes such as air, land and sea transportation. As discussed by Logistics Provider A, RoRo shipping would be very convenient for forestry products and other various industries; Gothenburg RoRo terminals offers a variety of competitive logistics operations, packages and sufficient capacity (Port of Gothenburg, 2018d). Manufacturers should also be aware of alternate routes that are essential to quickly alter supply chains after a disruption occur (Stecke & Kumar, 2009), which was lacking at most companies.

Co-operation: The major incentive behind co-operation initiatives is to maintain the same level of customer service (Stecke & Kumar, 2009). During the conflict, the affected manufacturers recognized new competition manifested in delivering products to the customers on time while others are failing. Maintaining the level of service can be achieved through increased collaboration between different actors in the supply chain (In the case of Gothenburg, the collaboration was majorly observed between suppliers/manufacturers and manufacturers/customers). Although, manufacturers were generally reliant on traditional collaboration tools/methods/channels to share information. Therefore, the authors suggested some advanced co-operation solutions aimed at improving the visibility of the whole supply chain as well as the transportation network.

Improved supply chain visibility: Companies operating international supply chains are most vulnerable to a supply chain disruption. This is reasonable since the more supply chains are internationalized the more complexity would underlines. The complexity as stressed by Stecke & Kumar (2009) is mostly embodied in losing visibility. It is therefore necessary for companies to have both vertical and horizontal collaboration. The vertical collaboration aims to share realistic solutions through various information channels. While the horizontal collaboration deploys forecast softwares that measure the effects of any sudden change within the supply chain. The softwares include I2, ViewVelocity and Celarix that provide improved visibility of supply chains (Stecke & Kumar, 2009).

Improved transportation visibility: It was widely debated by respondents that transportation networks got severely affected from the port conflict since it interrupted a substantial transportation node. In this matter, promptly sharing information with all business actors about the occurrence of the disruption and providing alternate routes enable logistics managers to improve their supply chain resiliency. Hence, vehicles can be quickly rerouted, manufacturers can be able to prevent the bullwhip effect and orders can be better fulfilled (Stecke & Kumar, 2009).

Control: Control initiatives were fairly mentioned among respondents. Manufacturers have majorly involved contractual requirements and risk sharing agreements with their business partners.

Redundant/flexible capacity: a main issue observed in this regard was manifested in the manufacturers' potential to access new storage facilities (excess capacity) near other ports or near their firms. As discussed by Stecke & Kumar (2009), shortage in capacity during a disruption can be resolved through managing different manufacturing facilities with flexible/redundant capacity. Owning multiple facilities at distant locations reduce the scope of simultaneous severity, thus mitigate the operational risks engendered by a PCSD. In other words, disruptions at specific geographical areas can be mitigated through intensifying the production velocity at other stable facilities (Stecke & Kumar, 2009).

Contractual requirements: Jüttner et al. (2003) and Miller (1992) suggest increasing the contractual requirements with all external/internal stakeholders aiming for reducing the scope of uncertainties from a PCSD. Without contracts, some stakeholders might not be willing to coordinate in order to prevent the landed extra costs, which would lead in the end to a partial recovery (Tang, 2006).

Lobbying: Manufacturers can also consider lobbying that aims to influence the lawmakers to modify the laws. The Swedish government is currently considering a law modification that appeals to limit the influence of labour unions, through forming collective bargain agreements with one labour union, where all other unions at a certain workplace should be committed to the collective agreement (Port of Gothenburg, 2017b). Hence, lobbying is an effective way to control external risks (Allaire & Firsirotu, 1989; Miller, 1992).

Reliable transporters: Furthermore, manufacturers should also consider forming agreements with reliable transporters that are qualified to recover disruptions quickly. Reliable transporters are usually able to operate in fairly acceptable lead times during a disruption, because of their efficient custom systems (Stecke & Kumar, 2009). Rationale selection of transporters is significant since they are a critical actor in a supply chain and so they can provide more stability of the product flow during a disruption (Stecke & Kumar, 2009). Finally, purchasing commercial transport insurances is another option that can mitigate the losses during a disruption (Stecke & Kumar, 2009).

Avoidance: *Avoiding certain markets:* Some forestry manufacturers have been able to avoid certain markets that were difficult to reach during the conflict i.e. Asian markets and have instead delivered to nearer markets. This enabled the continuity of the product flow, through retargeting the market segments. In this regard, Jüttner et al. (2003) further state that avoiding certain suppliers that are seen uncertain would prevent many risks. Specifically, avoiding Gothenburg APMT as a logistics operator for a certain time would reduce supply chain uncertainties. A potential alternative would be RoRo shipping instead of Liner shipping. One drawback with RoRo shipping is that it might not be equally cost efficient as containers.

Influence customer choice: manufacturers can also influence the customer choice (Stecke & Kumar, 2009). For instance, manufacturers experiencing a disruption can offer compensations such as delivery discounts so to incentivize customers to buy the products that the manufacturers capable to produce and deliver to a certain location (Tang, 2006).

Production postponement: According to Lee (1996) and Tang (2006), standardizing components enable various efficiencies in inventory, administration and transportation. The core idea of this initiative is the *make to order system*, where certain standardized components are easily stored in a warehouse until the company receives an order. The components are then converted into finished products. This initiative can reduce inventory costs by balancing the inventory levels. However, this approach can lead to higher stock

levels and so generate extra costs (Lee, 1996). Moreover, standardizing processes allow manufacturers to directly adapt their current production plans/models into different plants that enable the continuity of production in multiple locations (Tang, 2006).

6.3 Supply chain redesign

Respondents poorly considered this phase of the supply chain relief process. None of them has established collective supply chain optimizations. The major factor behind the poor consideration is assumed to be cost, since such initiatives can affect the companies' financial performance on the long-term (Blackhurst et al., 2005). Therefore, the authors recommend two areas that managers have to be aware of in order to improve the efficiency and resilience of supply chains or the phase of supply chain redesign.

First, logistics managers have to deepen their understanding of supply chains and how it is vulnerable to a PCSD. This would enable managers to observe the trade-offs of each initiative the company would take (Blackhurst et al., 2005). Apparently, the trade-off between cost and flexibility was frequently mentioned, especially by manufacturers operating global supply chains. Thus, a clear perception of supply chains would offer an understanding of the transportation costs needed to maintain a supply chain efficiency and resiliency during a disruption (Blackhurst et al., 2005). Further, respondents were mentioning some hidden costs generated from the lack of visibility, inventory buffers and environmental charges. These hidden costs were not identified by the current supply chain models implemented by manufacturers and were not sufficient to provide calculations of the total landed costs from the disruption. Hence, Blackhurst et al. (2005) stresses that deep understanding of supply chain concepts/tools/methods can facilitate to better inspect trade-offs and measure the total costs of the mitigation policies.

Second, it was observed that the supply chain optimization models implemented by most companies were static to some extent (except SCA and Billarud Körsnäs). Specifically, companies have majorly employed traditional models such as statistical analysis, control theory models and supply chain modelling although the companies were/still operating dynamic supply chains. Blackhurst et al. (2005) argues that such optimization models are least effective in dynamic environments and therefore there is a need for more advanced optimization tools that better fit in dynamic environments.

6.4 Handling trade offs

This paper has recommended several initiatives with the aim of mitigating the consequences from a PCSD. However, almost all initiatives generated trade-offs. Thus, mitigation strategies on one hand resolve complex issues but on the other hand consume resources (Stecke & Kumar, 2009). Specifically, excess capacity generates extra costs, contractual agreements minimize profits and improved transportation networks engender complex distribution chains. For this reason, the authors recommend companies to develop a cost-benefit analysis measures to ensure the suitability of the implemented initiatives. In other words, managers should consider balancing the costs with the benefits

that are necessary to avoid uncertain losses. Subsequently, the authors propose the linear programming formulation suggested by Micheli et al. (2013). This formulation was initially developed to support managers take rational decisions in order to implement optimal policies (a policy is a set of mitigation initiatives) taking into account budget constraints.

As explained by Micheli et al. (2013), this formulation can involve single/several initiatives that form a collective policy (π), and so the formula calculates the sum costs of all initiatives considered by the management (c_π). The decision variable is defined as x_π and represents the chosen policy. This formulation can assist companies to find a suitable strategy, where the benefits of the initiative/initiatives are identified simultaneously with costs. When mitigating the uncertainties within a supply chain, reducing one risk might lead to other risks; therefore this formula is beneficial as it enable managers to minimize the overall risk profile of the supply chain. Due to page limitation, the reader is referred to Micheli et al. (2013) to in-depth understand how the proposed formulation can be applied.

However, the formulation has two drawbacks. First, when redesigning the supply chain, it is recommended to make collective calculations of the risks and costs. While this formulation assume that a risk source can impact only one indicator meaning for example that a disruption can just impact the financial performance, with least consideration of other indicators. This study has revealed that several indicators has been affected by the port conflict as well as multiple indicators are interrelated with each other. Therefore, collective assumptions are necessary which is not offered by the formulation. Another challenge is that the severity level and the likelihood of a risk source is assumed by a manager that might not possess sufficient experience to understand such disruptive events (Micheli et al., 2013). Hence, developing a suitable mitigation policy is a complicated decision since every company operates differently. Therefore, each company has to identify the nature of their supply chains in order to find convenient solutions to handle a disruption (Stecke & Kumar, 2009).

7 Conclusions

This chapter briefly summarizes the paper in linkage to the research questions. The chapter also includes implications for theory and practice, potential future research and the paper key message.

In conclusion, this paper attempted to identify the primary, secondary and tertiary PCSD consequences, current/future PCSD mitigation strategies and propose advanced mitigation initiatives to better handle such disruptive events in the future. This attempting has aimed to provide researchers and practitioners with theoretical insights and guidance to improve the performance of manufacturing-oriented supply chains before and during a PCSD.

To fulfil the above purpose, an exploratory case study was conducted. The study involved both forestry manufacturers and logistics providers, in order to investigate the similarities and differences in the data collected through eleven semi-structured interviews. This methodology helped the authors obtain the key findings as well as introduce valid and reliable theories in linkage to the research topic. The authors could also gain some insights from the findings that helped proposing relevant recommendations.

7.1 General observations in linkage to the purpose and research questions

In respect to the key findings, the paper has revealed approaches that some match while other contradict with the given theoretical framework. Most importantly, the four research questions/purpose were answered/fulfilled and will be briefly discussed below concerning the PCSD consequences, factors associated with the vulnerability of supply chains, PCSD current/future mitigation strategies and future propositions. Some findings were not discussed in literature, thus it is assumed that unplanned contributions were added.

Research questions:

- (1) From a supply chain perspective, what are the primary, secondary and tertiary consequences the port conflict generates on manufacturers (forestry manufacturers in particular)?*
- (2) Does the severity level of a port conflict supply chain disruptions differ among manufacturers located differently?*
- (3) What supply chain mitigation strategies do manufacturers (forestry manufacturers in particular) implement in order to handle a port conflict supply chain disruption. Can the strategies successfully resolve the disruption?*

(4) How has the port conflict influenced manufacturers' future strategies (forestry manufacturers in particular)?

Firstly, the primary, secondary and tertiary PCSD consequences were determined. The port conflict has essentially affected the financial performance and distribution networks of manufacturers. The financial losses are manifested in transportation costs, remanufacturing costs, excess capacity costs and indirect costs i.e. higher congestion taxes. As a supply chain gets interrupted, likely distribution networks get disrupted, as it takes a long time to recover. The inoperative transport networks engendered longer delivery delays of three to four weeks on average. The secondary consequences include the unbalanced inventory levels that have been moderately affected since the product flow was interrupted at certain locations. Accordingly, manufacturers had to take two actions: either employ new capacity facilities or slacken their production velocity, where both initiatives were costly. As a secondary effect, the delivery delays have made some customers dissatisfied, thus the relationship with customers was negatively affected. On the contrary, relationship with suppliers i.e. logistics providers have improved since manufacturers relied on their suppliers to jointly overcome the disruption. Last but not least, the tertiary consequences include customer loyalty that was moderately/slightly affected, where some manufacturers lost a certain business scope with their overseas customers. Further, manufacturers agreed that information sharing has improved with their stakeholders during the conflict. Yet, the intensified information chains underlined extra labour costs, which was a problematic dilemma to deal with.

It is worth to mention that the tangible and intangible consequences were sometimes overlapping. For instance, delivery delays have made customers irritated and therefore manufacturers lost some of their business scope, thus distribution network effects were overlapping with relationship with customers. The primary, secondary and tertiary consequences of the port conflict were determined and hence the first research question was answered (See figure 12).

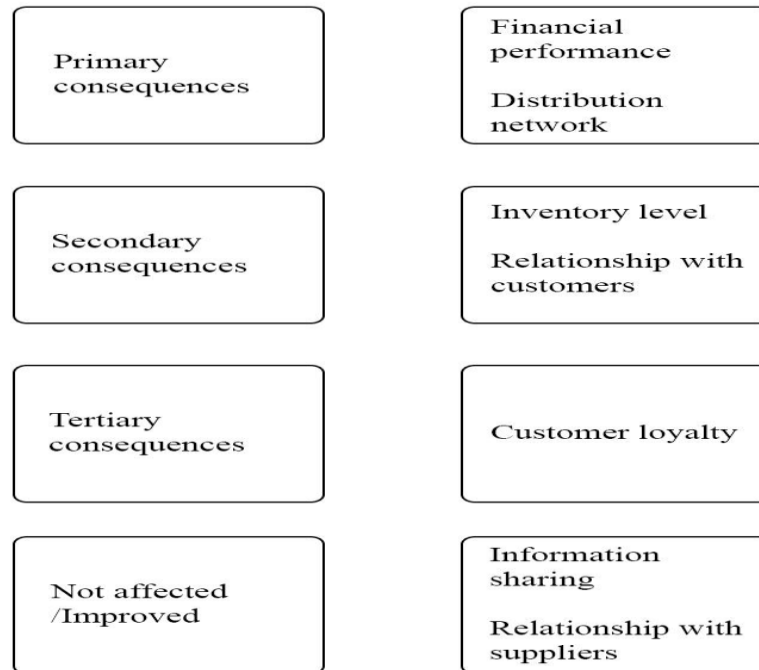


Figure 12: summary of primary, secondary and tertiary consequences (Source: authors)

Secondly, the vulnerability of port conflicts is associated with four factors: scope of a supply chain, location of a facility, nature of operations (inhouse-joint-outsourcing) and the dependability of certain manufacturer on the conflicting node. Specifically, medium-small manufacturers could adapt better to the disruption due to the lower complexity of their operations. Distant companies were able to reroute faster to other adjacent ports. In-house dependability increased the severity of the consequences, since such manufacturers fully handle a disruption and vice versa. Indeed, less reliant facility on a conflicting node would prevent experiencing marginal losses. Hence, the initial attempt of involving SCA was fulfilled through answering the second research question concluding that the distance of a facility from the conflicting node plays a role in the severity level of a PCSD. Unexpected factors were also observed (i.e. severity level is associated with nature of operations) that were not discussed in literature, thus further contributions were revealed.

Thirdly, the supply chain mitigation initiatives were generally random and unorganized. In this matter, manufacturers have not been aware of the supply chain relief process. They were rather initiating randomly cost-efficient solutions without a comprehensive awareness of the process that could improve the resilience of supply chains. It is significant to mention also that the supply chain redesign phase was the least developed area, due to the manufacturers' interest in implementing partial supply chain optimizations. Hence, the manufacturers preparedness level was not sufficient to handle a PCSD as they focused more on improving supply chain efficiency instead of resiliency. This can be associated with Stecke and Kumar (2009) who state that manufacturers

usually underestimate disruptions, which might explain why they seldom devote their resources to develop mitigation initiatives in a proactive manner.

In relation to the third research question, flexibility, co-operation and control initiatives were widely considered by manufacturers (forestry manufacturers in particular). However, these initiatives were contingent rather than pre-planned, thus some initiatives were assumed to be ineffective.

Finally, the conflict has raised the awareness of manufacturers to develop their supply chains' efficiency and resiliency. Therefore, they are considering advanced flexibility, control and avoidance initiatives. Yet, there is low awareness of accurate measures in respect to supply chain assessment and impacts of a particular disruption. Also, more focus was turned into improving efficiency than resiliency, since most respondents mentioned developing efficient routing models that aim to reduce costs and time. Thus, it can be anticipated that manufacturers were considering short-term solutions more than long-term. To conclude the fourth research question, the conflict has influenced manufacturers to develop/pre-plan strategies to handle a PCSD, as they were mostly considering advanced flexibility, control and avoidance initiatives.

The authors proposed various advanced initiatives that aim majorly to improve the efficiency and resiliency of supply chains in linkage to the current/future strategies implemented by manufacturers. In general, the propositions aim to involve more technology in supply chains i.e. artificial discovery and recovery agents, with the intervention of human to quickly recover a PCSD. Although, anticipating a disruption, its impacts and employing convenient policies is a complicated task that each company have to consider. Meaning that managers have to understand their supply chains, how it can be affected by such disruptions and what mitigation initiatives best fit the supply chain. In this regard, the authors proposed a Decision Support System (Linear programming) that constitutes of a formulation allowing managers to evaluate the benefit of each mitigation policy. This can avoid manufacturers from unforeseen trade-offs. In linkage to the paper key findings, the trade-offs are embodied in:

- (1) Flexibility versus cost minimization (i.e. flexible supply base versus decreased cost efficiency)
- (2) Co-operation versus confidentiality (i.e. information sharing versus exposing sensitive data)
- (3) Excess capacity versus efficiency (i.e. leasing new capacity facilities versus price competitiveness)
- (4) Risk management versus total returns (i.e. mitigation initiatives versus total cost of supply chain management)

7.2 Implications of findings for theory and practice

This paper contributes to academia by narrowing the gap in research through separately investigating port conflicts. The results depicted in figure 11 (on page 50) provide insights for researchers to further investigate port conflict supply chain disruptions in terms of consequences and mitigation initiatives. True that PCSD are only partial part of disruptions, however, they are becoming more frequent (Stecke & Kumar, 2009), thus more studies are needed to better understand such disruptive events. Some results have also confirmed what was indicated by previous studies such as the effects of globalization that is increasing the vulnerability of supply chain disruptions. Last but not least, the paper reveals some information about manufacturers located in Sweden that potentially might be interested to be involved in further studies.

As articulated earlier in this paper, PCSD are unavoidable. Accordingly, forestry manufacturers do not perform enough to handle a PCSD as indicated by this paper. Therefore, the study has revealed insights for practitioners that can enhance their understanding of a PCSD. Specifically, it attempts to raise the awareness of practitioners to pre-plan a PCSD before it occurs, thus mitigate the consequences. It also provides propositions on how to prevent unforeseen trade-offs that can worsen the disruption rather than resolving it. However, these implications apply the most for forestry manufacturing-oriented supply chains (export) since the latter was the unit of analysis of this study. Although, it is assumed that some results can be generalized on other industries since the information revealed by logistics providers were not always limited to forestry manufacturers but encompassed all Swedish industries.

7.3 Future research

Current awareness of a PCSD has been increasing over recent years by a series of disruptive events impacting the Swedish manufacturers and the business environment. The authors believe that this is an academic responsibility to further investigate these events as a significant topic of basic research. In this regard, the authors introduce some suggestions of potential future research and are as follows:

First, unilateral investigations of PCSD consequences such as financial performance that can enhance the understanding of how port conflicts affect a company's performance. Also, developing tools that measure the suitability of the mitigation initiatives during a PCSD that would support practitioners in their decisions making process as stressed by Stecke and Kumar (2009), thus preventing trade-offs.

Second, the manufacturers studied were handling the disruption on different levels. Some have reacted individually due to the availability of in-house potentials, while a few established joint efforts and outsourcing approaches due to limited resources. Similarly, the severity level of the PCSD was varying due to distinct scope of supply chains. So, it might be interesting to investigate the severity of a PCSD in relation to the characteristics mentioned above.

Finally, despite that qualitative research reveals detailed explanations of particular events that are currently happening or exist, through interviews and other qualitative approaches. However, normative research can reveal what manufacturers or individuals have to do (Tanner & Eppright, 1991). Our case analysis highlights the importance of future research in order to better understand the complexity of a PCSD before further advanced normative frameworks can be evolved. In other words, what is required is more empirical research based on grounded theories in linkage to PCSD.

7.4 Key message

Eventually, port conflicts generate widely varying impacts for supply chains that are potential to engender both short-terms and long-term effects. This paper introduced a framework that addresses the possible consequences and the severity degree to which different components of forestry manufacturing-oriented supply chains are affected. Thus, the paper provides insights to understand the effects of a PCSD.

The paper also introduced what is thought to be a convenient set of mitigation initiatives to date to handle a PCSD. Proactive initiatives were addressed that can help a manufacturer avoid the severe consequences. A formulation that fits in various supply chains was finally proposed that help determining appropriate initiatives.

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9 Appendix

Appendix 1: Aim and literature referrals of the interview guides

Question	Reference/Aim
1. What type of company are you? small, medium or large?	Enhance validity
2. Personal information <ul style="list-style-type: none"> ● How many years have you been working within supply chains? ● Would you like your identity to remain confidential? 	Enhance validity
3. Please provide a brief description of your international supply chain.	Identify scope of a supply chain
4. From a supply chain perspective, has Gothenburg APMT-labour conflict affected your company? If yes, how?	Overview of the consequences
5. On scale from one to five, how much do you assume the indicators below were affected after the port conflict occurred? 1= not affected, 2= slightly affected 3= no opinion 4= considerably affected 5= severely affected <ul style="list-style-type: none"> + Tangible consequences <ul style="list-style-type: none"> ● Financial performance i.e. increased costs ● Inventory level ● Distributions network i.e. delivery time ● Information sharing with customer/supplier + Intangible consequences <ul style="list-style-type: none"> ● Relationship with customer/supplier ● Customer loyalty 	Aim: explore the primary consequences of a PCSD References: <ul style="list-style-type: none"> ● Blackhurst et al. (2005) ● Wilson (2007) ● Simchi-Levi et al. (2008) ● Oke & Gopalakrishnan (2009) ● Porterfield et al. (2012) ● Lam & Su (2015) ● Loh & Thai (2015)
6. What actor within the supply chain handling the supply chain disruption in linkage to Gothenburg APMT-labour conflict?	To identify the nature of operations:in-house, joint, outsourcing
7. In a response to Gothenburg APMT-labour conflict, how do you tend to discover the conflict, recover and redesign your supply chain?	Overview of current mitigation initiatives in a response to the port conflict. The aim is to evaluate the performance of manufacturers in terms of preparedness

8. Do you think that the implemented solutions employed to mitigate the consequences resulted from Gothenburg APM terminals-labour conflict are effective, can be improved?	Improve the preparedness of manufacturers to handle a PCSD in the future
9. Will you return to Gothenburg APMT in case the conflict is resolved? If no, how that affect you in terms of cost and productivity on both long and short term?	Observe short-term and long-term consequences on manufacturers

Appendix 2: Interview guide for forestry manufacturers

Question
1. What type of company are you? small, medium or large?
2. Personal information <ul style="list-style-type: none"> • How many years have you been working within supply chains? • Would you like your identity to remain confidential?
3. Please provide a brief description of your international supply chain.
4. From a supply chain perspective, has Gothenburg APMT-labour conflict affected your company? If yes, how?
5. On scale from one to five, how much do you assume the indicators below were affected after the port conflict occurred? 1= not affected, 2= slightly affected 3= no opinion 4= considerably affected 5= severely affected <ul style="list-style-type: none"> + Tangible consequences <ul style="list-style-type: none"> • Financial performance i.e. increased costs • Inventory level • Distributions network i.e. delivery time • Information sharing with customer/supplier + Intangible consequences <ul style="list-style-type: none"> • Relationship with customer/supplier • Customer loyalty

6. What actor within the supply chain taking the responsibility of handling the supply chain disruption in linkage to Gothenburg APMT-labour strike?
7. In a response to Gothenburg APMT-labour conflict, how do you tend to discover the conflict, recover and redesign your supply chain?
8. Do you think that the implemented solutions employed to mitigate the consequences resulted from Gothenburg APMT-labour conflict are effective, can be improved?
9. Will you return to Gothenburg APMT in case the conflict is resolved? If no, how that affect you in terms of cost and productivity on both long and short term?

Appendix 3: Interview guide for logistics providers

Question
1. What type of company are you? small, medium or large?
2. Personal information <ul style="list-style-type: none"> • How many years have you been working within supply chains? • Would you like your identity to remain confidential?
3. Please provide a brief description of the international forestry manufacturing supply chain?
4. From a manufacturing supply chain perspective, has Gothenburg APMT-labour conflict affected your clients' forestry international supply chain? If yes, how?
5. On scale from one to five, how much do you assume the indicators below were affected within forestry manufacturers after the conflict has occurred? 1= not affected, 2= slightly affected 3= no opinion 4= considerably affected 5= severely affected <ul style="list-style-type: none"> + Tangible consequences <ul style="list-style-type: none"> • Financial performance i.e. increased costs • Inventory level • Distributions network i.e. delivery time • Information sharing with customer/supplier + Intangible consequences <ul style="list-style-type: none"> • Relationship with customer/supplier • Customer loyalty

6. Do you collaborate with the forestry manufacturers to resolve the disruption or is it the an owns responsibility?

- In more detail, how do you help the companies discover the disruption, as well as recover and redesign their supply chains?

7. Do you think that the implemented solutions by your clients to mitigate the consequences resulted from Gothenburg APMT-labour conflict are effective or can be improved?

9. Will you and your partners return to Gothenburg APM terminals in case the conflict is resolved? If no, how that affects you in terms of cost and productivity on both long and short term?

Appendix 4: Interview guide for forestry industrial organization

Question

1. Can you please provide brief information about your position?

2. Personal information

- How many years have you been working within the forestry industry?
- Would you like your identity to remain confidential?

4. From a supply chain perspective, how has Gothenburg APMT-labour conflict affected the forestry manufacturers?

5. On scale from one to five, how much do you assume the indicators below were affected within forestry manufacturers after the conflict has occurred?

1= not affected,

2= slightly affected

3= no opinion

4= considerably affected

5= severely affected

+ Tangible consequences

- Financial performance i.e. increased costs
- Inventory level
- Distributions network i.e. delivery time
- Information sharing with customer/supplier

+ Intangible consequences

- Relationship with customer/supplier
- Customer loyalty

6. Do you collaborate with the forestry manufacturers to resolve the supply chain disruption?

- In more depth, how do you help the companies to discover the disruption, as well as recover and redesign their supply chains?

7. What are the most durable and frequent mitigation strategies employed by manufacturers to mitigate the consequences of a disruption, as well as recover and redesign supply chains?

8. Do you think that the implemented solutions by the manufacturers to overcome the disruption resulted from Gothenburg APMT-labour conflict are effective or can be improved?

9. Do you think that the forestry manufacturers that have rerouted to other Swedish/European ports will return to the Gothenburg APMT in case the conflict is resolved? If no, how do you think that might affect the companies in terms of cost and productivity on both long and short term?