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Resilience of logistic service providers facing a port strike: a case study

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Resilience of logistic service providers facing a port strike: a case study

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Resumo

O objectivo desta dissertação é estudar o impacto de uma greve portuária em empresas prestadoras de serviços logísticos na cadeia de abastecimento. No âmbito desta dissertação, estas empresas são denominadas como 3PL (*third-party logistic providers*). Estas empresas são altamente dependentes dos portos marítimos para prosseguir a sua actividade, visto que efectuam serviços a nível internacional. Consequentemente uma perturbação no funcionamento dos portos pode prejudicar gravemente o negócio deste tipo de empresas. Entre as perturbações ao normal funcionamento dos Portos encontra-se a greve dos estivadores. Pretende-se analisar os efeitos negativos que provêm desta perturbação, e estratégias que os 3PLs poderão implementar de forma a tentar manter os seus níveis de performance nivelados e um rápido tempo de recuperação.

Com este objectivo, primeiramente é desenvolvido o estudo do estado da arte que abrange o sector marítimo-portuário e dos 3PLs no contexto de uma cadeia de abastecimento, aprofundando-se em seguida o conceito de uma cadeia de abastecimento resiliente, e por fim é desenvolvido um enquadramento teórico de forma a contextualizar o caso de estudo. Seguidamente, é elaborado um caso de estudo composto por três empresas da área de distribuição terrestre e marítima e operadoras portuárias com o objectivo de quantificar os impactos da greve portuária. A recolha de informação de fontes primárias é dividida em duas fases, sendo a primeira via e-mail e a segunda através de entrevista pessoal. Informação de fontes secundária é obtida através de notícias televisivas, internet e conferências – de forma a ser possível o cruzamento de informação. Por fim, através da análise da informação, são retiradas conclusões das medidas efectuadas por cada empresa de forma a minimizarem o impacto da greve, contribuindo assim para uma cadeia de abastecimento mais resiliente.

Deste estudo pode-se concluir que uma greve de estivadores cria na cadeia de abastecimento uma sucessão de efeitos negativos interligados, degradando todos os KPIs (*key performance indicators*) relevantes para a análise da performance dos 3PLs em estudo, sem que estejam disponíveis estratégias de mitigação e contingência verdadeiramente eficazes para reduzir os efeitos negativos da perturbação provocada por uma greve portuária.

Palavras-chave: cadeia de abastecimento, resiliência, operadores logísticos, greve portuária, performance

Abstract

The purpose of this thesis is to study the impact of a port strike on companies that perform as logistic service providers in a supply chain (SC), here denominated 3PL (*third-party logistic providers*). These companies are highly dependent on ports to perform their activity, since they provide international services. Consequently, a disruption in a port can seriously impair their business. A stevedores' strike is one of the possible disruptions that can affect ports. This study aims to analyze the negative effects caused by this disruption, and what strategies 3PLs may implement in order to keep their performance levels stable and have a quick recovery time.

Within this objective, the first step will be to establish a theoretical context about the maritime port's sector and 3PLs in a SC context, to then expand the concept of a resilient SC, and finally to develop a theoretical framework in order to better contextualize the case study. Subsequently, the impact of a port strike will be quantified by using a case study comprising three companies, covering the areas of land and sea distribution and port operations. Information from primary sources was assembled in two phases: first via e-mail and, in a second phase, through a personal interview. The information from secondary sources was obtained through television news, internet and conferences, enabling its cross-analysis. Finally, by analyzing the collected data, it will be possible to draw conclusions about the measures carried out by each company to minimize the negative effects of the strike, thus contributing to a more resilient SC.

As a conclusion, a stevedores' strike will create a snow-ball of negative effects in the SC, degrading all relevant KPIs (*key performance indicators*) of the 3PLs under study. No mitigation and contingency strategies available proved really effective to reduce the negative effects of a port strike disruption.

Keywords: SC, resilience, third-party logistics providers, port strike, performance

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List of Abbreviations

3PL - Third party logistics

KPI – Key performance indicator

SC – Supply chain

TEU - Twenty-foot equivalent unit

Chapter 1 - Introduction

1.1. Resilience in supply chains

Nowadays customers expect the highest quality in products/services they purchase, not only because of the worldwide economic crisis, but also due to the vast number of alternatives they are able to find in a global market. Companies are, therefore, facing a much more competitive business environment. This increase in customer exigency led companies to focus on their core competence, and outsource other activities that, though also needed to have a functional and successful business, can be considered as auxiliary. This practice contributed (and is still contributing) to the growth of third-party logistics (3PLs) all over the globe. With burgeoning global trade, fierce competition, higher customer expectations, and ever-expanding supply chains (SCs) around the world, 3PLs play an increasingly important role in the prevailing dynamic and volatile environment (Murphy & Daley, 2001). 3PLs supply a wide range of logistic services related to freight forwarding, shipping, handling, storage and packaging of goods in different logistics flows and SCs (Kilibarda, Zečević, & Vidović, 2012), but they may also manage and develop features such as information systems, inventory and also provide customer order fulfillment services (Boyson, Corsi, Dresner, & Rabinovich, 1999).

Companies can no longer depend only on themselves to ensure the quality of their products/services will, not merely satisfy but, in fact, exceed their customer's expectations. That is why companies' success is highly dependent on the success of the SC they are part of, and that is why Christopher (2000) sustains that individual businesses no longer compete as stand-alone entities but rather as SCs. A SC consists of all parties involved, directly or indirectly, in fulfilling a customer request. The SC not only includes the manufacturer and suppliers, but also transporters, retailers, and customers themselves (Chopra & Meindl, 2004). SCs must be properly capable of overpassing adverse situations, or in other words, must be resilient.

The resiliency of a SC is its capacity to deal with unforeseen events, to respond to the disruptions they might cause, and to recover while maintaining the chain performance at a desired level (Ponomarov & Holcomb, 2009). According to Sheffi & Rice (2005) resilience can be achieved by either creating redundancy or increasing flexibility. Most common forms of redundancy (safety stocks, the deliberate use of multiple suppliers even when the secondary suppliers have higher costs, and deliberate low capacity utilization rates) although always part of any SC with a resilient strategy, represent high costs, and have limited benefits, unless needed due to a disruption (Sheffi & Rice Jr, 2005). According to Jüttner & Maklan (2011), flexibility "ensures that changes caused by the disruption can be absorbed by the SC through effective responses", making it possible to create competitiveness advantage in daily operation. Flexibility uses concepts such as: adopting standardizing processes, plan to postpone, align procurement strategy with supplier relationships, continuous communication among informed employees, distribute power, cultivate passion for work, and implement recovery processes, among others, in order to better absorb a disruption. Flexibility is at the root of the concept of agility, that

enhances effectiveness and responsiveness in the SC, and it is a concept we will later analyze in more detail. Another measure to insure resilience in a SC is the employ of mitigation and contingency strategies. These strategies should be reinforced in the most vulnerable areas of the operation, to reduce the probability of occurrence of risks. Also important to provide a SC with resilience is the creation of partnerships and alliances between companies which by Lambert, Emmelhainz, & Gardner (1999), is "*a tailored business relationship based upon mutual trust, openness, shared risk, and shared reward that yield a competitive advantage, resulting in business performance greater than would be achieved by the companies individually*".

It is, therefore, plainly perceptible that SCs' resilience is a key factor in any business, requiring and involving a vast array of other concepts.

1.2. Theme justification

For a country such as Portugal, with a large maritime coast serving as a door to the Atlantic Ocean, sea economy is of great importance. DGPM (2012) and Fórum Empresarial da Economia do Mar (2013) provide us with valuable statistical information about Portugal's maritime economy:

i. In 2010 the total gross value added of uses and commercial activities of the maritime economy analyzed was $373x10^7$ euros, representing 2,5% of the Portuguese gross value added. In 2006 it represented 2,2%.

ii. The value of production of the uses and activities of the maritime economy in Portugal reached $8.174x10^6$ euros in 2010, corresponding to 2,4% of national production. In 2006 this corresponded to 2,2%.

iii. The total employment in uses and activities of the sea in Portugal's economy in 2010 came near to 109.000 employees in full time equivalent, which corresponded to 2,3% of national employment. In 2006 it corresponded to 2,1%.

iv. Portugal's maritime exclusive economic zone is about 1.730.000 km^2, equivalent to 20 times its land territory (which is around 91,470 km^2), and with enormous unexplored potential in areas such as transport and ports, recreational navigation, nautical tourism, fisheries, aquaculture and fish processing, materials, energy and biotechnology.

v. At the moment, the sea economy contributes to 2% to the national gross domestic product, with the potential to reach 6% of the gross domestic product, and it is believed that at 2025 the sea economy will represent 12% of Portugal's gross domestic product.

PwC (2013) conducted a study through a questionnaire grouping 40 people connected to the sea business, covering transversely all subsectors of the Portuguese maritime economy. When asked "In general, how do you see the scope for progress of technical and scientific knowledge in Portugal in

relation to the development of the economy of the sea?", the result was extremely positive, reaching: i) 72% for a high correlation; ii) 25% for medium correlation; and iii) 3% for low correlation. This result reinforces the importance of developing this area, with vast untapped potential. Moreover, around 37% of European transports are made by sea, and the objective is to increase this percentage, by implementing concepts such as sea motorways (Fórum Empresarial da Economia do Mar, 2013).Thereby Portugal, with its great geographic location and sea territory, should take advantage of these natural conditions. In order to do so, ports, which are a key-point in all of this, must be functional at all times and must be aligned to excellence, so that fails in their performance do not affect the companies and respective SC. But recent history tells us this is not what has been happening, with the occurrence of prolonged port strikes. It is therefore of great importance for companies that rely on ports to be resilient and to find measures to minimize the impact of those strikes.

1.3. Objective

The study is focused on a particular disruption: the stevedores' strike. The main objective of this study is to: i) evaluate the negative effects of a port strike in 3PL companies, ii) identify the impact of the negative effect in their performance levels, iii) find out what strategies the 3PL companies can implement so that the performance level does not decrease drastically and takes a minimum time to recover. The main contribution is to evaluate the role of 3PLs in the good functionality of a SC under a port disruption, so that their behavior will not compromise the performance of the entities downstream. Figure 1.1 provides an overview of the thesis work workflow.

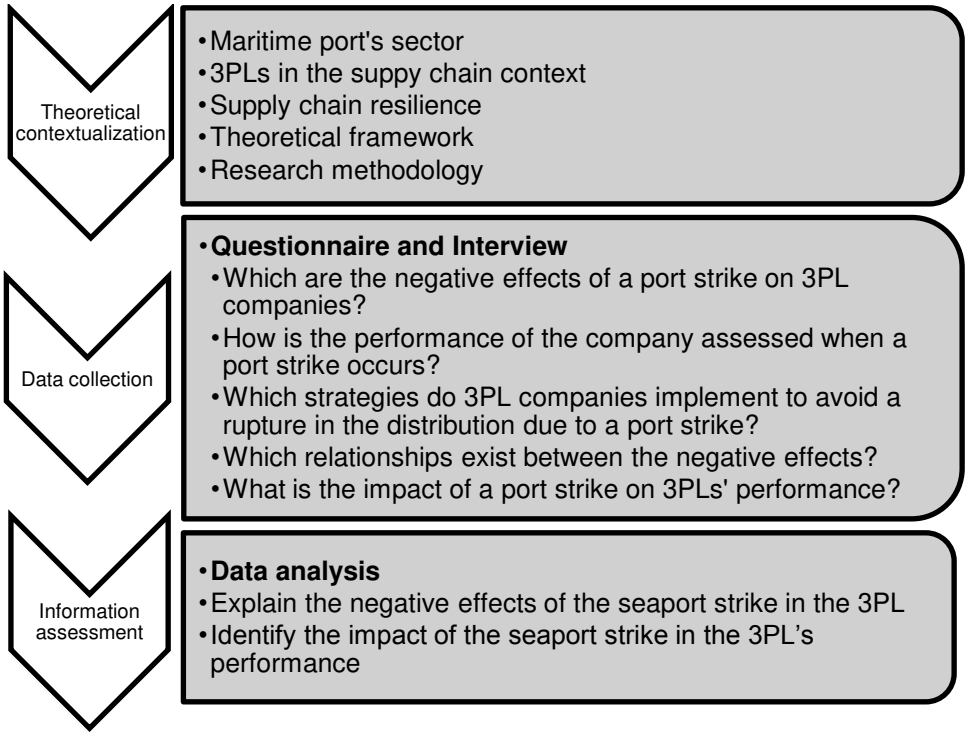

Figure 1.1 - Thesis workflow

The following research questions will serve as guidelines for this study:

- Which are the negative effects of a port strike on 3PL companies?
- How is the performance of the company assessed when a port strike occurs?
- Which strategies do 3PL companies implement to avoid a rupture in the distribution due to a port strike?
- Which relationships exist between the negative effects?
- What is the impact of a port strike on 3PLs' performance?

1.4. Methodology

This thesis follows a methodology of a case study, which we believe is the most adequate method when the objective is to understand, explore or describe events in a complex context in which several factors are simultaneously involved. As stated by Ponte (2006), a case study is an investigation that deliberately focuses on a specific situation that is supposed to be unique or special, at least in some aspects, seeking to discover in it the most essential and characteristic, and thereby contribute to the overall understanding of a certain phenomenon of interest.

The case study comprises three companies that perform services as logistics providers in the SC. One is an inland forwarder, another a shipping company and the third is a port operator. All of the three companies operate with containers in an international level, making them highly dependent of the good functionality of ports, a key point in their SC network. In this research, the investigation focuses on the impact of port strikes in 3PLs companies. The data consists in primary sources, involving questionnaires and interviews, and secondary sources like television news, websites and conferences. The primary data collection instrument is a questionnaire subdivided in two phases, a first phase answered via e-mail and a second phase consisting of a personal interview. The questions answered are based on the assumption of a long strike (more than 1 month) with medium-high adherence, similarly to the strikes in the Port of Lisbon that have been occurring since 2012.

1.5. The content

The structure of the thesis is divided in 7 chapters: Chapter I introduces the problem under study and the objective of this thesis. Chapter II presents an overall view of the worldwide port economy and its significance to Portugal. Chapter III introduces the concept of 3PL companies, their competences and importance. Chapter IV introduces the concept of SC resilience and associated aspects, such as: risk, disruptions, mitigation and contingency strategies and vulnerability. Chapter V provides a theoretical framework in order to better contextualize the case study. Chapter VI presents the methodology followed in this study, as well as the reasons behind it. Chapter VII introduces the companies within this study, along with results retrieved from the interviewees questionnaire answers. It also presents the importance of Lisbon's port, with an insight of the stevedores' strike in 2012 and 2013. Chapter VIII presents the conclusions of the case study, supported by data in chapter VII, as well as suggestions for future studies.

Chapter 2 - Maritime port's sector

2.1. The contemporary worldwide sea trading system

The book “how the shipping container made the world smaller and the world economy bigger” by (Levinson, 2008) provides a comprehensive history of containerization. The following text resumes some of the main facts retrieved from this book.

The idea of using containers as the main form of worldwide sea trading system was born in 1937, when Malcolm Mclean, a 24-years-old from New Jersey and founder of Sea-Land, had the idea of storing and shipping cotton in big metal boxes, that could be embarked in vessels. Over time, McLean improved his working methods as his company, Sea-Land (Maersk-Sealand later) expanded, making it one of the pioneers of the intermodal system, covering sea, river, rail, and port terminals.

The beginning of the container age was marked by the expedition of the ship IDEAL X on April 26, 1956, carrying 58 containers and 15.000 tons of oil. However it would take ten more years of hard work and planning before Sea-Land made an international containerization. On May 5, 1966, the adapted freighter "SS Fairland 'Sea Land, unloaded 50 units in Rotterdam, then the largest port in the world. As there was no proper equipment, the landing was done with the crane ship itself, another one of McLean’s creations. This was the maiden voyage of the Sea-Land to the European market and the first step towards internationalization. The speed and efficiency of the discharge of containerized goods led the shipping industry to quickly realize that this was the trading method of the future.

At that time, there were 9.000 stevedores working in the large Dutch Harbor, linking 25 service companies. Foreshadowing the revolution that would occur in shipping industry, the port director, Frans Posthuma, got the exclusivity of receiving containers destined for Europe, committing himself to prepare a terminal to land them. Soon after, in 1967, five stevedores companies operating in Rotterdam created the Europe Container Terminals, with only 208 employees to meet the growing movement of containers. The industry reacted to navigation unimaginable investments in ships, containers and terminals, evolving along with the demand, creating new agreements between competitors, shipping agencies and shipowners.

In order to fully grasp the subject of economy generated by the shipping activity, we must first introduce the term globalization, since it is the main driver of the augmentation of trade economy. Globalization is responsible for the increase of worldwide trade and exchanges, in a progressively more open, integrated, and borderless international economy. There has been a remarkable growth in such trade and exchanges, not only in traditional international trade in goods and services, but also in exchanges of currencies, in capital movements, in technology transfer, in people moving through international travel and migration, and in international flows of information and ideas (Intriligator, 2003).

With the increase of globalization, and the new economic geography it produced, many opposing barriers were overcome, allowing companies whose ambitions were purely domestic to become international companies exporting their products half way around the world almost as effortlessly as selling them nearby, and thus those who had no interest on going international, realized they had no other choice. One of the major changes that companies have to face, due to the globalization, is the challenge of transporting larger quantities for a smaller price (Buckley & Ghauri, 2004; Fawcett & Closs, 1993; Mussa, 2003).

With the increase of shipping demand and the evolution of technology, the costs associated with shipping decreased. Multinational manufacturers started to network their factories based on the cheapest location in which they could make a particular item, and to shift production from one place to another as costs or exchange rates might dictate (Levinson, 2008).

Due to the evolution of globalization, sea trade has changed considerably over the last years, and nowadays, in a global economy, ports are absolutely essential, as 90% of the European Union external merchandise trade and 40% EU internal merchandise trade is transported by ship (Buck Constultants, Catram Consultants, & ISL, 2009). Every year, over $35x10^8$ tons of cargo passes through European ports (Da Cruz, Ferreira, & Azevedo, 2013). The worldwide container shipping industry is arguably one of the most critical links in the expansion of trade and global SCs (Doherty, Philip, & Misrahi, 2012).

This worldwide growth of the shipping sector is clearly seen in Figures 2.1 and Table 2.1. Figure 2.1 shows the global merchant fleet according to type of vessel, and Table 2.1 displays the TEU (Twenty-foot equivalent units) ranking of the top 20 world container ports. The good position in this ranking of Asian ports, as well as their improvement, is rather noticeable. For example, the port of Ningbo ranked 50th in 2001, progressing to ranking number 6th in 2011.

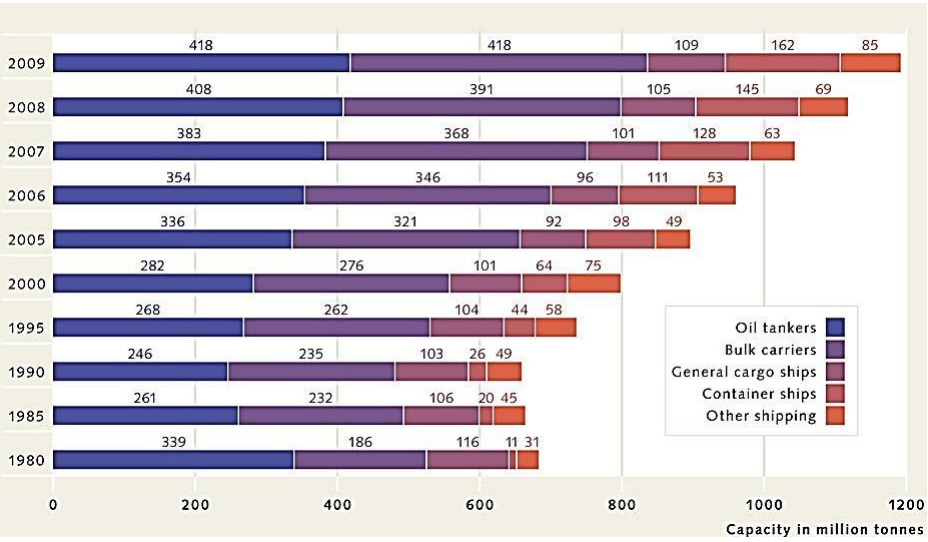

Figure 2.1 - Evolution of maritime commerce.

Source: World Ocean Review (2010)

Table 2.1 - TEU-ranking and growth% of the top 20 world container ports in 2011
Source: ISL (2012)

Ranking		Port (Country)	TEU% growth	
2011	2001		2010-2011	2001-2011
1	5	Shanghai (PR of China)	9,4	17,5
2	2	Singapore (Singapore)	15,1	6,8
3	1	Hong Kong (PR of China)	2,9	3,2
4	8	Shenzhen (PR of China)	1,0	16,1
5	3	Busan (Rep of Korea)	14,0	7,3
6	50	Ningbo (PR of China)	16,2	28,4
7	31	Guangzhou (Pr of China)	14,2	23,4
8	17	Qingdao (PR of China)	8,4	17,3
9	13	Dubai Ports (UAE)	9,0	13,7
10	6	Rotterdam (Netherlands)	6,6	6,9
11	26	Tianjin (PR of China)	15,0	19,1
12	4	Kaohsiung (Taiwan)	5,0	2,5
13	12	Port Kelang (Malaysia)	6,4	9,6
14	9	Hamburg (Germany)	14,2	6,8
15	11	Antwerp (Belgium)	2,3	7,5
16	7	Los Angeles (US)	1,4	3,5
14	47	Xiamen (PR of China)	24,1	17,4
18	49	Dalian (PR of China)	22,1	18,1
19	10	Long Beach (US)	-3,2	2,1
20	15	Bremen Ports (Germany)	21,0	7,1

2.2. Maritime cargo

Cargo transported by port vessels may be primarily differentiated according to the type of material being carried. Cargo can be classified in the following categories:

- **General Cargo**: Includes a large range of diverse goods, which can be subdivided in the following classes:

  - Pre-slung cargo: cargo remains trapped inside the slings that travel with the ships. This is a simple and inexpensive method, which can increase the productivity of stevedoring operations.
  - Pallet: cargo is transported and deposited on metal or wooden pallets of various dimensions, although there are trends to standardize them. They facilitate the load and discharge operation, with the use of specialized machinery.
  - Containerized Cargo: cargo is transported in closed containers, their dimensions being standardized by the International Standards Organization. Containers can be made with several materials, depending on the nature of the cargo they will be used for: steel, fiberglass

and other materials. They may also have special features to ensure that the cargo is properly cooled and ventilated.

- Roll-On/Roll-Off cargo: cargo is shipped in a horizontal movement by containers on chassis, for example. Vehicles like cars and trucks can also be included in this type of cargo.
- Cargo shipped in barges: the cargo is stored in barges that ensure its transport to the main vessel. Subsequently, they are hoisted directly from the barge to the respective ship.

- **Bulk cargo**: Covers all the products that are transported homogeneously and may be continuously manipulated. Bulk cargo can be classified in two major groups:

  - Solid Bulks: That can be further divided in:
    - Ordinary Bulks: covers minor density granular substances like cereal, fertilizer or salt.
    - Ore Bulks: include substances of greater density.
  - Liquid Bulk: That can be subdivided in:
    - Ordinary Bulk: Noncombustible and nontoxic liquid products, such as, water, wine, or olive oil, among others.
    - Petroleum products: including crude oil and its derivatives.
    - Liquefied Gases: includes natural gas, gases derived from oil distillation, like propane and butane, and chemicals such as methanol and various acids.

There are also two other different types of shipping between ports, according to the **distance of the transport**: i) deep sea shipping (ocean-crossing intercontinental shipping) and ii) short sea shipping, with no crossing of an ocean. The later can be further subdivided into:

- Feedering services (small and medium TEU capacity feeder ships that transport shipping containers to central container terminals, to be consolidated for long distance transport in larger vessels).
- Cabotage (shipping along coastal routes).
- Micro-cabotage.
- River-sea transport.

Short sea shipping also includes the concept of motorways of the sea: specific maritime routes with the objective of making distribution a greener solution by decreasing energy consumption, as well as, improve port communications. In the European Union the maritime routes strengthen the network of countries already in it and candidate countries. The European Union is focused in turning freight transport more sustainable, and has thus granted financial incentives through the Marco Polo program, which co-funds direct modal-shift or traffic avoidance projects (European Comission, 2013; Setra Mange, 2006).

At this moment in the European Union, routes have been defined as shown in Figure 2.2, but not all of them are yet operational. Leixões, Lisbon, Sines, Setúbal and Aveiro are the Portuguese ports with the capacity to operate in motorways of the sea services. However only Leixões, Lisbon and Sines ports are actually in the Trans-European Transport Network, a network which objective is to create a coherent European transportation system. It includes: i) feedering to combine deep sea transport with redistribution per secondary ports on smaller vessels, structuring the activity in a network of small ports around the main port; and ii) cabotage to transport passengers and goods between ports.

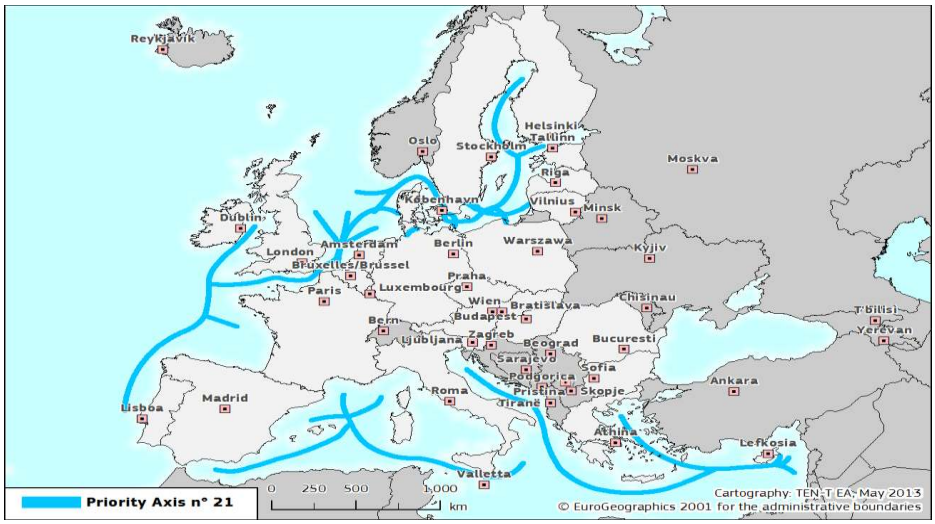

Figure 2.2 - Motorways of the sea
Source: TEN-T EA (2013)

2.3. Maritime ports

A port is an area sheltered from waves and currents, located on the edge of an ocean, sea, lake or river, for the mooring of boats and ships, with staff and services necessary to provide activity of loading and unloading cargo, and capable of temporarily stock cargo, as well as facilities with the capacity for the movement of people and cargo around the port sector (Brodie, 1997). According to Loh & Thai (2012), ports are companies where various individuals and interests coexist, and where internal and external groups collaborate to create and distribute value or wealth, while also pursuing their own interests and objectives. The port should be considered as a link between the maritime and land network and not just as an arrival or departure point (SaeR & ACL, 2009).

Different kind of port activity demands different kind of ships, carrying different kind of cargo, and consequently different kind of ports:

- Megahubs: ports with natural or built capacities to function as an operational platform able to operate in transshipment and that can handle operators with megaships with a high traffic rate.
- Hubs: ports with natural or built capacities to perform commercial and distribution functions. These ports can and should be in European networks of short sea shipping and motorways of

the sea, with the purpose of becoming a route's strategic point and creating partnerships with other European ports.

- Regional ports: ports with capabilities to perform commercial and distribution functions, within a regional scope.
- Local ports: ports with clearly local functions without proficiency to operate in international transport networks, and more oriented to fishing activities and recreational boating.
- Intermediate hub (or transshipment hub): is a port terminal used for ship-to-ship operations within a maritime transport system. These operations do not take place directly, which requires the temporary storage of containers in the port's yard (Rodrigue, Comtoisn, & Slack, 2006).

Ports have been natural sites for transshipment to transfer goods from one mode of transport to another, handling in the past two years, 90%of the volume of cargoes transported over the globe (UNCTAD, 2012). Every day at every major port, thousands of containers arrive and depart by truck and train, providing a link between maritime and inland transport and the interface between the sea and rivers and roads and railways. They establish the inter-modal interface between maritime, road and rail transport (Levinson, 2006; Radhika, 2012; Song & Parola, 2013).

Processes such as changes in containers and ship dimensions are forcing ports to improve their infrastructures in order to remain competitive, attract more shipping lines and consequently boost their performance (Da Cruz et al., 2013). In accordance to Islam & Olsen (2011), one of the most dynamic problems that maritime ports decision makers have, is the need to properly analyze where and how to upgrade the existing port capacity for rising port demands due to continuous growth in containerized trade and the tendency for bigger ships to harbor.

Itoh (2002), claims that for a port to be operationally efficient, it should take into consideration aspects such as the layout design, maintenance of berths, port strike ratio, gear of cargo handling, accessibility, warehouses, stacking areas, navigation assistance and other waterside and land-side facilities.

All these attributes and others such as geographic location, reliability, flexibility, capacity, traceability, but especially, proximity to other transportation methods (to allow intermodal transportation and the seamlessly transportation of cargo between ships, trains and trucks with minimum interruptions) will contribute to an increase in the demand of the port.

Table 2.2 shows the evolution of intermodal transportation in European countries between 2009 and 2011 in TEUs. The majority of the countries had a positive growth, contributing for a total average growth of 15,6%, including Portugal with an increase of 43,3%.

Table 2.2 - Domestic intermodal transportation by country: TEU and goods shipped 2009/2011
Source: International union of railways (2012)

Country	TEU		% change 2011/2009
	2009	2011	
Germany	2.554.000	3.268.000	28,0%
United Kingdom	1.340.850	1.530.000	14,1%
Italy	918.910	1.225.430	33,4%
Sweden	764.000	837.460	9,6%
Belgium	543.910	1.225.430	13,0%
France	591.730	606.670	2,5%
Spain	323.970	479.940	48,1%
Norway	515.360	386.000	-25,1%
Austria	468.210	376.930	-19,5%
Netherlands	335.000	339.300	1,3%
Switzerland	440.000	284.440	-35,4%
Romania	131.690	246.150	86,9%
Portugal	157.700	225.960	43,3%
Poland	70.790	166.490	135,2%
Czech Republic	98.370	155.170	57,7%
Slovenia	67.220	65.610	-2,4%
Finland	109.000	60.000	-45,0%
Ireland	6.000	25.000	316,7%
Slovakia	8.060	19.330	139,8%
Croatia	1.800	14.480	704,4%
Hungary	2.990	960	-67,9%
Bulgaria	2.310	270	-88,3%
Estonia	-	170	-
Total	9.451.870	10.928.140	15,6%

In order to keep demand growing, and to be able to gain customer loyalty while facing companies pressure to decrease their costs, particularly logistics costs, ports started to invest in information and communication systems, intermodal systems and added-value services. Investments in infrastructures and the outsourcing of logistics teams to operate on the products of the ports' clients are good examples of port's investments (Radhika, 2012; SaeR & ACL, 2009). This increase in integration between entities, and the increase in logistics complexity it implied, led to the necessity of having a better management system in the port environment. This way the port environment started to be taken as a crucial factor to be considered in SC management.

However, the integration of ports into SC management created a higher level of uncertainties for downstream planning, product movement and information exchange, due to the increase in the complexity range of processes and operations in ports. This increase was not followed by an intensification in coordination (SaeR & ACL, 2009), which is the natural procedure, when a SC is

divided among numerous service providers. Altogether, this resulted in a lack of standardization of load units, information systems, administrative regulations and procedures. According to (OECD, 2002):

“Although the standardization of load units which is essential to improve efficiency, mainly because of the intermodal transportation, it has proven to be difficult to achieve it due to factors such as infrastructure restrictions, preferences of road haulers and the increasing container sizes in maritime transport.”

The application of advanced information and communications technology, has allowed noteworthy improvements in the providing of continuous service through the use of electronic data interchange. However, the success of electronic data interchange depends not only on standardized data sets but also on compatible electronic data interchange systems between and among the intermodal entities and governments.

In maritime commerce there are numerous entities operating, and SCs can be extremely complex, with a lot of echelons and tiers. A simple disruption can widely propagate along the SC. In Figure 2.3 it is possible to see a port as an integrated logistics center with three main areas connecting the Landside link to the Seaside link. Within these three areas entities such as port authorities, customs, shipowners, freight forwarders, navigation agencies, port operators, stevedoring companies, among others, work together and are dependent on each other’s. Due to the high inter-dependence of these entities, if one of them stops all others may be affected - for example, if all stevedores’ strike, the intermodal terminal would not operate and could lead to a full stoppage of the port.

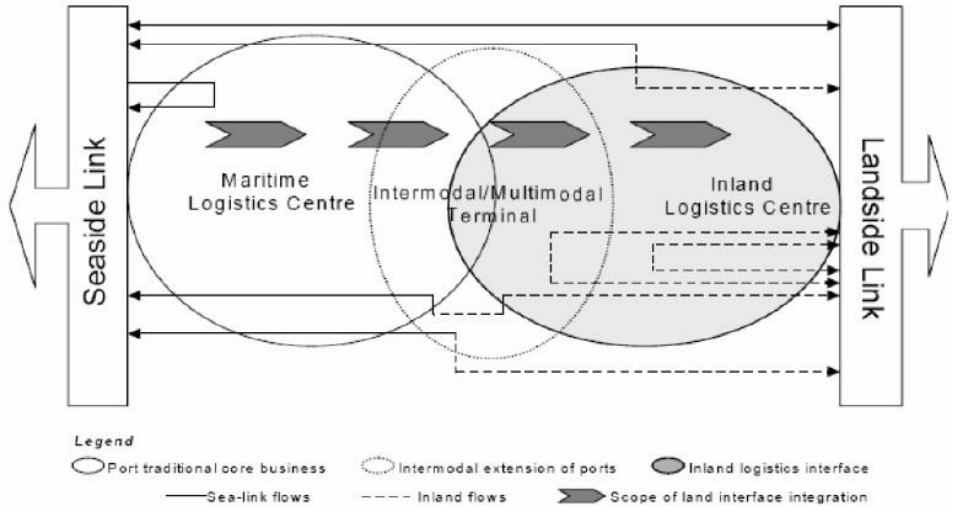

Figure 2.3 - A port as an integrated logistics center
Source: SaeR & ACL (2009)

This thesis focus on one specific disruption: the strike of stevedores. The activity of a stevedore can be described as:

The stevedores are the intermediaries between the shipping lines and the transport operators. As well as undertaking stevedoring activities (lifting cargo on and off vessels – the "ship side" activities), they also provide terminals for container transit and for the loading of containers on and off trucks and rail (the "landside" activities) (IPART, 2007).

2.4. Ports in Portugal

This section was written with data retrieved from the conference Fórum Empresarial da Economia do Mar (2013), a study made by the associations SaeR & ACL (2009), and using the IPTM (2012) statistics.

Portugal's geographical position and the Portuguese know-how about exploration and exploitation of the oceans, is a potential generator of business opportunities. The Portuguese ports management and regulations changed over the years due to economic and political issues and at the moment, they are structured as follows:

- Main ports: located in Leixões, Aveiro, Lisbon, Setúbal and Sines. They are managed by port authorities, which are companies with exclusively public capital operating under the auspices of two ministries: Ministério das Obras Públicas, Transportes e Comunicações (MOPTC – Ministry of Public Works, Transport and Communication) and Ministério Finanças e Administração Pública (MFAP – Ministry of Finance and Public Administration). These authorities have the form of limited companies with state capital and with full management autonomy, although superior overseen by the central administration.
- Secondary ports: located in Viana do Castelo, Figueira da Foz, Portimão, Faro and other ports situated in the Douro region. These ports are regulated by the Instituto Portuário e dos Transportes Marítimos regulations (IPTM – Institute of Ports and Maritime Transport).

Portugal's port system scheme is represented in Figure 2.4. Figure 2.4 shows the entities with public capital and the entities under state indirect management. The main entity, Ministério das Obras Públicas, Transportes e Comunicações (MOPTC) is responsible for the coordination and implementation of national policies in the areas of construction and public works in the areas of air, inland waterways, sea and land transport and communications. Instituto Portuário e dos Transportes Marítimos (IPTM) regulates, supervises and executes the planning and coordination of the maritime-port sector and supervises and regulates activities in this sector. Port authorities with exclusively public capital are: (i) Administração dos Portos do Douro e Leixões (APDL); (ii) Administração do Porto de Aveiro (APA); (iii) Administração do Porto de Lisboa (APL); (iv) Autoridade Portuária de Setúbal e Sesimbra (APSS); and (v) Administração do Porto de Sines (APS).

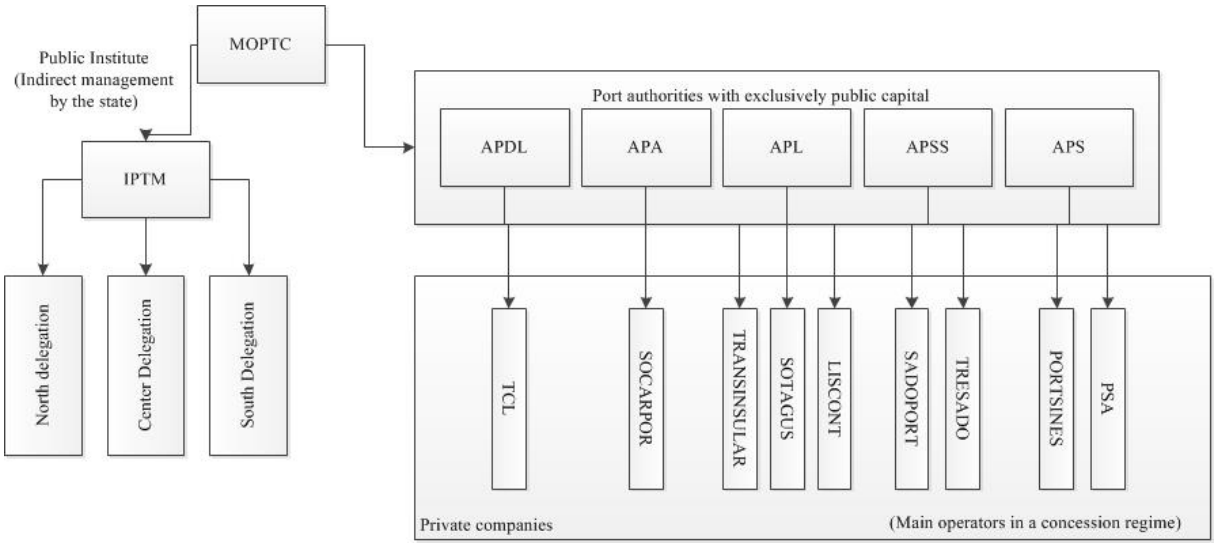

Figure 2.4 - Structural scheme of the port authorities, IPTM and main operators in a concession regime in Portugal
Adapted from: Brito (2013)

Leixões port is the major port infrastructure of the North Portugal handling around 16.000.000 tons (along with the Douro port). Half of the cargo handled is Liquid Bulk, although it has capacity to accommodate every type of cargo. The privileged geographic position also allows this port to be part of touristic cruise ships route.

With a capacity to accommodate containerized or Ro-Ro cargo, the port of Aveiro is classified as a main port. Currently it handles a little more than $3x10^6$ tons, divided between general fractional cargo and liquid bulk. The port has the capacity to enter into the Motorways of the Sea network.

The Port of Lisbon presents very good maritime conditions, in terms of accessibility and shelter, with a privileged location that grants strategic value. Despite being in the urban center of Lisbon, it has a high handling capacity of transoceanic containerized cargo and short sea shipping which represents 40% of the current 11.000.000 tons. It is also a privileged place for the reception of tourism cruises.

The port of Setubal, handles about 6.000.000 tons, and it ensures the highest portion of general cargo among the national ports and almost the all of the Ro-Ro cargo. His Multipurpose Terminal 2 is ready to handle moving containers, accommodate transoceanic vessels. In addition to general and Ro-Ro cargo, the port handles countless products which are associated to nearby industries.

The port of Sines is a deep-water port with the ability to perform operations of transshipment containers through Terminal XXI. It is the largest Portuguese port, handling 28.500.000 tons of traffic, 75% of the cargo being liquid bulk. In 2013 the growth rate of the container terminal reached 70% compared to 2012, the international average growth rate being around 6%. In the long-term the port can expand its capacity.

2.5. Conclusion

This chapter provides an overall perspective of the port's sector. It is possible to conclude that there has been a worldwide growth regarding sea commerce, and so, ports started to be essential keys in companies SCs to perform business. This continuous growth enforced ports to adapt and evolve to remain in business. One of the major changes in ports was the adaptation of logistic platforms towards intermodal transportation. All these changes and the fact that a port encompasses a lot of entities, lead to the increase of management efforts, in terms of information systems, administrative regulations, procedures and structures to reach bigger efficiency.

Chapter 3 - Third-party logistics providers in the supply chain context

3.1. Third-party logistics providers

The process of globalization and economic integration between countries has pushed companies to redesign themselves so they can survive. With flourishing global trade, fierce competition, higher customer expectations, and ever-expanding SCs around the world. 3PL play an increasingly important role in the prevailing dynamic and volatile environment (Murphy & Daley, 2001). In the last few years there has been considerable interest in the growth of 3PL all over the globe. Companies are rapidly focusing on one-stop global logistics services. 3PL's can improve logistics processes by allowing the companies to focus on their core competencies, ultimately reducing business costs and increasing client satisfaction (Sheikh & Rana, 2011). Table 3.1 lists the usual services performed by 3PL's.

Table 3.1 - Services provided by 3PL
Source: Regan & Song (2000)

Type of service	Examples
Transportation Distribution	General trucking/shipping service
	Intermodal transportation service (rail, road, ocean, air freight)
	Specialized services (bulk, tank, hazardous material, refrigerated…)
	Time-constrained services (just-in-time, overnight, same day…)
	Shipment tracking & tracing
Warehousing/Distribution	Public / Contract / Regional warehouse
	Operation technology (bar coding, radio frequency…)
	Value-added services (cross-docking, freight consolidation, pick & pack…)
	Order processing and fulfillment
Custom Services	Custom brokerage
	Duty drawback
Freight Finance Services	Freight audit
	Freight bill payment
IT Support	EDI capability
	Logistics information system & other software's
Product Support Services	Reverse logistics
	Value-added services (package, label, mark…)
Logistics Management/ Consulting	Fleet operation
	Distribution network design
	Carrier selection/ negotiation/ routing
	Facility location analysis / selection / design
	Inventory management

3PL companies provide a wide range of logistic services related to freight forwarding, shipping, handling, storage and packaging of goods in different logistics flows and SCs (Kilibarda et al., 2012). But they may also manage and develop features such as information systems and inventory, and also provide customer-order fulfillment services (Boyson et al., 1999). These interactions can turn into partnerships or alliances, which many authors consider as a crucial strategy to increase service value. According to Berglund, Laarhoven, Sharman, & Wandel (1999): 3PLs add value to users through improvement in operations and efficiency, getting results to their shareholders. Therefore, logistics outsourcing could bring a handsome payoff and become a part of corporate strategy (Sahay & Mohan, 2006).

So we can define a 3PL as an external provider who manages, controls, and delivers logistics activities of their clients. This relationship can be formal or informal, the intention is that this should be a mutually beneficial and continuous relationship. A strategic alliance between the 3PL provider and the client is often necessary to guarantee the quality of the performance (Hertz & Alfredsson, 2003).

Two major skills in a 3PL are: i) the ability to balance between adaptation and general ability of problem solving, and ii) the aptitude to balance between capability to highly adapt to individual costumers and organizing the systems and business in order to coordinate several costumers. Hertz & Alfredsson (2003), delineated four types of TPL providers based on 3PL providers' "ability of problem solving" and their "ability of customer adaptation". In Figure 3.1 it is possible to analyze the characteristics of third-party logistics with high ability of problem solving and high ability of costumer adaptation.

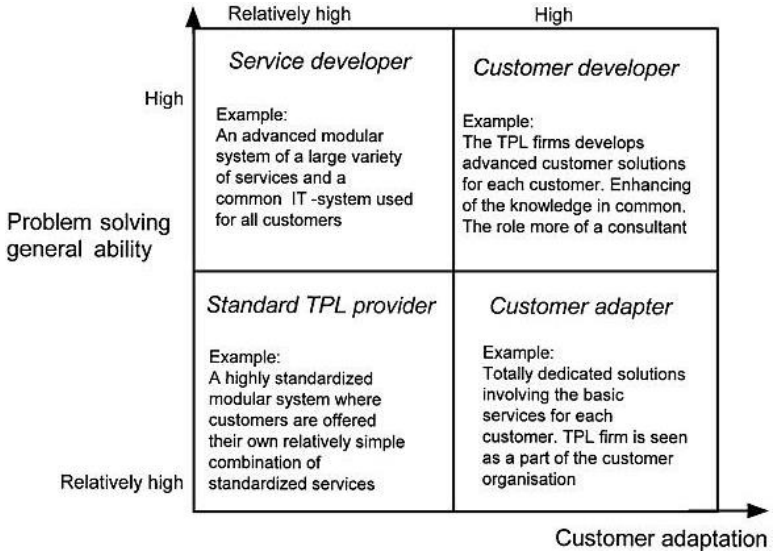

Figure 3.1 - 3PLs characteristics
Source: Hertz & Alfredsson (2003)

The highly classified 3PL providers can be characterized as: i) service developer, ii) customer developer, iii) standard TPL provider, and iv) customer adapter. A "standard 3PL" provider handles services such as warehousing, distribution and pick and pack. This type of providers, usually execute these services alongside their usual business. The "service developer" adds advanced value to

services. For example, this entity differentiates services according to customers, reduces stocking costs through cross-docking, offers personalized security systems and personalizes packages to different occasions.

An advanced service package often requires diverse sets of standardized activities that, when turned into models, can be connected according to each customer's characteristics. The "customer adapter" improves handling efficiency by taking over their activities and not necessarily developing services. This type of provider takes responsibility of all customers' warehouses and logistics activities, therefore, pledging to a short number of close clients. The most complex and advanced 3PL form is the "customer developer". This type of 3PL often takes over all of the customer's logistics operations, which involves a high integration with the client. In order to be efficient in this type of operation, 3PL must have a huge know-how and accurate methods. 3PL with costumer developer scope has fewer costumers than the others, due to the extensive and complex work they perform for each costumer.

3.2. The importance of partnerships

The establishment of strategic alliances has been used as a reaction to globalization and to the increase of uncertainty and complexity in business (Išoraitė, 2009). According to McKeon (1988), the traditional business-to-business relationship is transactional, while in a strategic alliance relationship it *extends over a long period of time, involves sharing of benefits and burdens, involves extensive planning and includes detailed operational information exchange*. This way both parties can profit from the collaboration, and a continuum relationship may lead to a higher dependency, cooperation and trust, if the parties involved are focusing on customer satisfaction. And when businesses do not go as planned, the risk can also be minimized.

A partnership is defined as ''*a tailored business relationship based upon mutual trust, openness, shared risk, and shared reward that yield a competitive advantage, resulting in business performance greater than would be achieved by the companies individually*'' (Lambert et al., 1999). In order to have a functional long-term alliance, the partnership should be able to provide flexibility (Lambert et al., 1999). A well-succeeded partnership will ensure advantages such as, decreased storage and labor costs, increased productivity, increased know-how, market expansion, and because of the dependency, the parties involved will reach out and help one another's. An example is the resilient practice of aiding the suppliers financially when they are in a bankruptcy or insolvency situation.

The case of port authorities and shipowners is an example where partnerships and cooperation are an important strategy, since both parties are co-dependent (Fórum Empresarial da Economia do Mar, 2013). In this type of partnerships the shipowners goal is to find a port that can provide a good service, and that is able to provide flexibility, capacity, good equipment, liability, with low probability of strikes, associated with low port taxes. But in order to get low port taxes, shipowners must guarantee large volumes of deliveries to increase profits for ports. Notteboom, Ducruet, & de Langen (2009); Pallis & Veggelas (2010), provide examples of partnerships among port authorities and among port operators.

Also Carbone & De Martino (2003); Heaver, Meersman, & Van de Voorde (2001), referred the case of port operators working within ports

There are several of other strategic alliances that may be made in the port environment. An example is CMA-CGM, a liner shipping company that has a concession on the port of Le Havre, which supplies value added logistics services to European retailers (e.g. Carrefour and Danone) through a strategic alliance with SDV international logistics (Brooks et al., 2013). Le Havre port also provides Renault with advantages in their productive process, through storage decentralization downstream in the SC with the vehicle preparation center in Le Havre, minimizing stock level and related costs for Renault. Renault also benefits in terms of transportation costs and capacity through the completely knock-down transportation method, performed by CMA-CGM (Carbone & De Martino, 2003). In this method the automobile parts are built in the factories/distribution centers and later on exported to be assembled in the destination point; in this case, the vehicle preparation center in Le Havre.

It is easily comprehensible why such partnerships are of great interest. For example, a shipowner will have interest in creating a partnership with a distributing company that operates in ports, because in situations such as a strike of truck drivers in the distribution sector, he will have a partner that is able to aid him, and he may even end up with a better outcome due to a higher performance comparatively to competitors. But, as studies demonstrate, 55% of 3PL relationships end after three to five years (Gulisano, 1997; Sahay & Mohan, 2006). Lambert et al. (1999), notes the main reasons for partnership failures: i) lack of shared/clear goals, ii) lack of communication, iii) lack of top management support, iv) lack of strategic direction, v) lack of mutual benefits, vi) uncertainty about provider's service levels, vii) unrealistic expectations, viii) uncertainty about provider's, ix) poor service levels, x) unrealistic expectations, among others.

3.3. Choosing a 3PL

When companies choose to outsource activities in their business, some critical factors need to be taken into account: reliability, responsiveness, assurance, empathy, tangibility, cost. The wrong decision when choosing an outsourcing company can jeopardize the business and image of a company, which in turn may lead to long-term negative impact.

Figure 3.2 illustrates the critical factors that shipowners should consider in the decision making process of finding and evaluating a 3PL. Within each of the critical factors in Figure 3.2 it is then necessary to evaluate certain features that may weight on the overall decision in choosing the 3PL. Table 3.2 lists the features ascribed to each factor, in order to facilitate decision making.

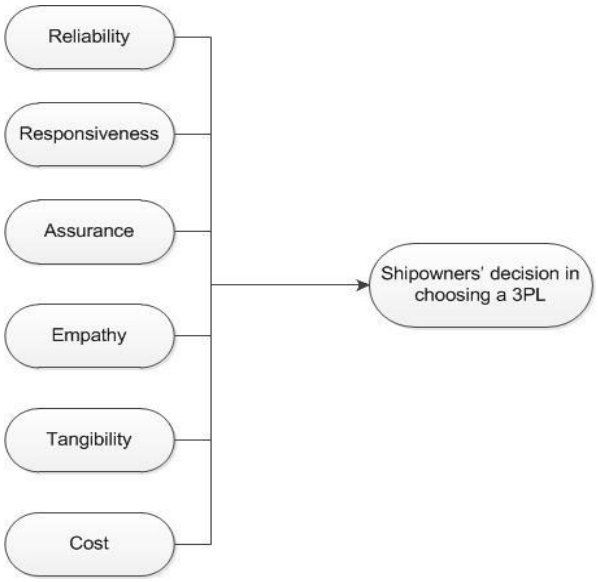

Figure 3.2 - Critical factors in choosing a 3PL
Source: Banomyong & Supatn (2011)

Table 3.2 - Relevant decision factors
Source: Banomyong & Supatn (2011)

Reliability	Responsiveness	Assurance	Empathy	Tangibility	Cost
Transit time Service consistency Document accuracy	Responsiveness Variety of services Express delivery Global coverage Updated rates Track and trace Containerization Consolidation	Reputation No goods damages	CRM Employee courtesy	Location Modern equipment Own CFS E-services Electronic data interchange	Price Discount Credit term
Legend: CRM: Customer relationship management; CFS: Container freight station; E-services: Use of information communication technologies					

A successful shipowner-3PL relationship, is characterized in the literature by the following features, as cited by Makukha & Gray (2004):

- Operational efficiency and effectiveness orientation.
- Cost reduction is a major driver.
- A 3PL is an associate but not an extension of a shipper, implementing one or more logistics functions.
- A 3PL meets the shipper's defined performance goals.

It is also imperative to emphasize the importance of a proper information system when using 3PLs: these alliances can only work properly if the information-flow between the parties involved is efficient and organized (Lai, Zhao, & Wang, 2006). Information technology in 3PL companies plays a vital role in synchronizing complex SC activities across logistics entities and their customers, working as a bridge, connecting customers in SC and logistics users (Lai et al., 2006).

Technology is critical since it increases SC visibility: for instance, the port community information system is an example of technology that has allowed the port to expand its own boundaries towards the hinterland. In this system, generally managed by the port authority, each network entity (shipping companies, terminal operating companies, port service providers, maritime agents, multimodal transport operators, freight forwarders, logistics operators, distributors, retailers and manufacturing companies) shares customized information on inbound and outbound flows, increasing the communication efficiency and effectiveness in the port (Brooks et al., 2013).

3.4. Measuring the performance of logistics providers

Key performance indicators (KPIs) gather a compilation of information that can be analyzed, with the objective of better understanding the company's overall performance (Torres et al., 2012). The KPIs help the company to recognize the problems in a certain activity. Moreover, they assist in the evaluation of the company's efficiency and effectiveness. They represent the basis for measuring business and project success. The purpose is to empower the measurement of performance within companies and the industry, allowing to companies to perform benchmarking (Konsta & Plomaritou, 2012).

Konsta & Plomaritou (2012) quotes Neely (1998), who states that in the management world there are seven reasons to use performance measurement's: the changing nature of work; increasing competition; specific improvement initiatives; national and international quality awards; changing organizational roles; changing external demands; and the power of information technology. Other reasons for using KPIs that aim to align business activities with the strategy of the organization performance against strategic goals are: increase focus on strategy and results, measure what matters and improve performance, align strategy with what human resource can do, improve communication, and put in priority projects (Konsta & Plomaritou, 2012). As affirmed by Maskel (1991), KPIs must:

- Be directly related to the manufacturing strategy.
- Primarily use non-financial measures.
- Change over time as needs change.
- Be simple and easy to use.
- Provide fast feedback to operators and managers.
- Be intended to foster improvement rather than just monitor performance.
- Be visible and shared with all employees.
- Be used to drive the continuous improvement process.

Physical distribution is an activity vulnerable to many external factors (such as fuel price volatility), whose disruptions may cause huge negative impacts in companies' performance, leading to a rising

uncertainty in the SC (Andreoli, Goodchild, & Vitasek, 2010). In the context of this thesis, the KPI's of physical distribution activities are of great importance, as it aims to study the negative impact of a disruption (port strike) on 3PL performance. Table 3.3 contains some of the most common KPIs and respective measure, relative to physical distribution.

Table 3.3 – KPIs used in the physical distribution context
Source: Freight Best Pratice (2005); Konsta & Plomaritou (2012); Varma (2008)

KPIs	Measures
Total order lead time	Average order to invoice time
On-schedule service	Percentage of on-schedule services
Cargo availability at destination point	Ratio between total available and total cargo
Transport lead time	Average time per order
Overall cargo damages/losses/thefts	Percentage of unavailable cargo
Delays	Delays percentage
Total greenhouse emissions	Average Diesel consumption
Transport cost	Average transportation cost
Cargo backlog	Percentage of backlogged cargo
Travel speed	Average speed per transport
Cargo re-routing	Percentage of diverted cargo
Injuries and fatalities	Percentage of Injuries and fatalities
Quantity per travel	Tones carried per travel
Documentation sent out within 48 hours of freight departure	Percentage of on-time documentation

Some of the most used KPIs in the port sector are identified in the following list, as provided by several works, e.g. Soberón (2012), Smith (2012), Olivier (2011), Marques & Carvalho (2007):

- Cargo handled per year.
- Containers effectively handled per month.
- Maximum handling capacity per month.
- Global operational area.
- Productivity.
- Average waiting time of full containers – to ship.
- Average waiting time of full containers – received.

3.5. Conclusion

In this chapter we introduced the concept of 3PL, the necessity to use them and the general services provided by them. Moreover, the 3PL are classified, according to the type of service provided, their problem solving capacity, and their costumer adaptation, as: a standard 3PL, a service developer, a customer developer or a customer adapter. We also discussed the importance of partnership between 3PLs and the critical factors on choosing a 3PL as a partner. Finally it is explained how KPIs can measure companies overall performance, evaluating their efficiency and effectiveness, and how they are extremely important as a management tool. In an overall perspective, it is possible to conclude that 3PL companies are extremely helpful, aiding SC companies to provide good service and overcome negative situations. The outsourcing of 3PLs grows along with globalization, due to the increase of complexity on logistic processes. In order to reach better results, 3PLs seek partnerships among themselves. In order to find the right partner, critical factors such as: reliability, responsiveness, assurance, empathy, tangibility and cost are cautiously weighted.

Chapter 4 - Supply chain resilience

4.1. The resilience paradigm

Nowadays factors such as global economic performance, market and competitors' expansion and high expectancies in quality services from costumers, lead to the necessity for SC to have a quick recovery in case of a disruption (Carvalho, 2012). Also, companies need to minimize the severity of the damaged caused by disruptions. They realize that disruptions, such as a loss of one critical supplier due to a fire in the factory or even because of a terrorist attack, cause high operational and financial undesirable impacts (Stecke & Kumar, 2009). Over the years, the trend focuses on SCs' search for procedures that can handle these types of situations. It is in this context that the resilience paradigm has a significant importance.

Resilience is described as an attribute that allows the SCs to be more competitive when disruptions occur (Christopher & Peck, 2004; Ponomarov & Holcomb, 2009; Sheffi, 2005b). The correct implementation of this paradigm allows companies and their SCs to handle the always inevitable disruptions, with more efficiency. Modern SCs are in fact dynamic networks connecting companies and industries. No organization is an island – even the processes which are carefully controlled, are only as good as the connections and knots that support them (Christopher & Peck, 2004). The problem is that many companies left risk management and the permanency of the business in hands of safety and insurance professionals. However, the construction of a resilient organization must be a strategic initiative that changes the operational way and increases competitiveness (Sheffi & Rice Jr, 2005).

Decreasing of vulnerability means not only the reduction of the probability of the occurrence of a disruption, but also more resilience – the capacity to recover from a disruption. Resilience can be achieved through creation of redundancy or at least flexibility (Sheffi & Rice Jr, 2005). To be able to reduce the risk (probability of occurring a disruption), SC strategies must be developed, allowing it to incorporate readiness, provide efficient and effective answer to the risk, and be able to recover to its original state, or even achieve a better one after a disruption (Ponomarov & Holcomb, 2009). But, as many authors like Greening & Rutherford (2011) state, the unpredictable nature of disruption makes it difficult to mitigate risk, and because of this, high-management should focus on the possible consequences that the disruption can cause, instead of what can originate them (Sheffi, Rice, Fleck, & Caniato, 2003).

Table 4.1 helps to clarify the definition of SC resilience by different authors.

Table 4.1 - Resilience definitions

Author	Resilience definition
Christopher & Peck (2004)	Resilience capability helps a SC to get back to original state followed by disruptions
Masten, Best & Garmezy (2008)	The process of, capacity for, or outcome of successful adaptation despite challenging or threatening circumstances
Gordon (2009)	In the world of science, the resilience concept can be initially traced back in engineering, representing the quality of a material of being able to store strain energy and then upon unloading to have this energy recovered, without breaking or being deformed
(Ponomarov & Holcomb, 2009).	The resiliency of a SC is its capacity to deal with unforeseen events, to respond to the disruptions they might cause, and to recover while maintaining the chain performance at a desired level
Hong, Paul & Hwang (2011)	SC resilience supports companies in proactively responding to changing market demand and disruption ahead of their competitors
Carvalho, Guilherme Tavares, & Cruz-Machado (2012)	SC resilience is concerned with the system ability to return to its original state or to a new one, more desirable, after experiencing a disruption, and avoiding the occurrence of failure modes. The goal of SC resilience analysis and management is to prevent the shifting to undesirable states, i.e., the ones where failure modes could occur

According to Sheffi & Rice (2005) resilience can be achieved by either creating redundancy or increasing flexibility. To Jüttner & Maklan (2011) redundancy is "related with the number of possible states a SC can take and number of changes it is able to cope with". As already stated above, common forms of redundancy in SC are constitution of safety stocks, the deliberate use of multiple suppliers (even when the secondary suppliers have higher costs), and deliberately low capacity utilization rates, and although redundancy is always present in SC with a resilient strategy, it represents high costs, and limited benefits, unless needed. As for flexibility, "it ensures that changes caused by the disruption can be absorbed by the SC through effective responses" (Jüttner & Maklan, 2011). According to Yossi Sheffi (2005), flexibility uses practices such as:

- Adopting standardizing processes to master the ability to move production among plants by using interchangeable and generic parts in many products.
- Planning to postpone, designing products and processes for maximum postponement of as many operations and decisions as possible in the SC, keeping products in semi-finished form affords flexibility to move products from surplus to deficit areas.
- Aligning procurement strategy with supplier relationships, since companies with strong relationships oriented to the same goal and sharing common objectives are less likely to be forewarned about supply problems.
- Implementing continuous communication among informed employees, to keep the personnel aware of the strategic goals, tactical factors, and day-by-day and even minute-by-minute pulse of the business.
- Implementing recovery processes and test them regularly, in order to be better prepared in case of real threat.

The deployment of such practices makes it possible to create a competitive advantage in daily operations, although, an accurate cost/benefit analysis must be done previously to reach an internal functional equilibrium, so that resilient practices do not consume all company's resources. According to Sodhi & Chopra (2004), "The big challenge for managers is how to mitigate risk intelligently positioning and sizing SC without decreasing profits. So while stockpiling inventory may shield a company against delivery delays by suppliers, building reserves in an undisciplined fashion also drives up costs and hurts the bottom line".

A resilient SC must be agile and the concept of SC agility appears associated to flexibility, as seen in the "House of Agility" illustrated in Figure 4.1. Although flexibility is a key component, it is not the only capability needed to achieve SC agility. Enhanced responsiveness and effectiveness are also major capabilities of an agile SC. The capacity of adaptation is also of major importance, because it is necessary to a SC to be prepared for the occurrence of unexpected events and to be able to quickly respond and recuperate from the negative effects, so it can return to the pre-disruption state, or adapt to a better one.

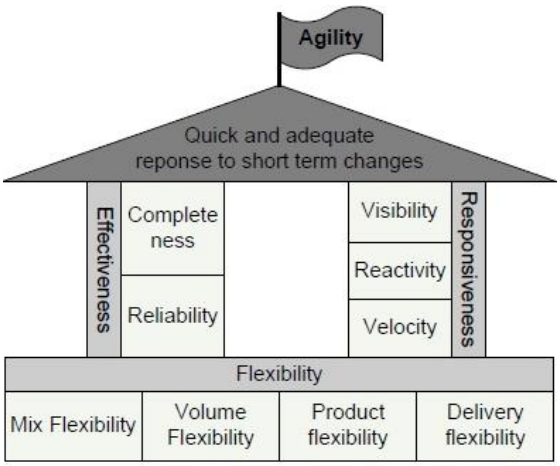

Figure 4.1 - House of agility
Source: Aurélie (2010)

Another common characteristic in the several definitions of resilience is "speed". A key concern of resilient SCs is to have a quick recovery to its normal behavior after the disruption. The variation of performance and speed recovery due to a disruption is related to the concept of "resilience triangle", that helps visualize the magnitude of the negative impact of the disruption (Figure 4.2).

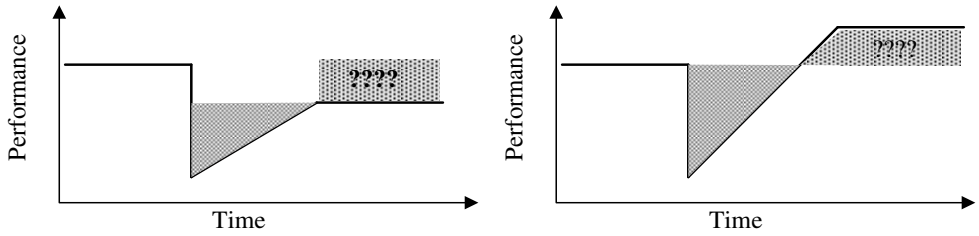

Figure 4.2 - The resilience triangle
Source: Carvalho (2012)

The "resilience triangle" has limitations such as the incapability to capture the disruption probability of occurrence, since it only models the systems behavior when subjected to a disruption. Additionally the “resilience triangle” does not consider the situations in which the performance is improved after the disruption, or where the performance does not recover back to its original state (Carvalho, 2012).

4.2. Supply chain risk, vulnerability and disruptions

The concept of risk is often confused with disruption. Many authors define, characterize and analyze the concept of risk inherent to a SC as being a kind of disruption or a source of disruption. So it is important to differentiate and define what is a risk and what is a disruption. Literature about risk is very rich and provides us with a lot of different, but yet similar definitions:

- Risk can be broadly defined as a chance of danger, damage, loss, injury or any other undesired consequences (Harland, Brenchley, & Walker, 2003).
- The probability that a particular adverse event occurs during a stated period of time, or results from a particular challenge (Royal Society, 1992).
- The probability of loss and the significance of that loss to the organization or individual (Mitchell, 1995).
- Risks in SCs are dynamic in nature; the frequency and severity of risk events keep changing. Some risks can be reduced or even eliminated, while new ones may appear anytime (Ravindran, Ufuk Bilsel, Wadhwa, & Yang, 2010).
- Risk in general can be defined as a collection of pairs of likelihood and outcomes (or impact) (McCormack et al., 2008).

One of many possible models for the connection and relation between possible risks and the SC is the one presented by Wagner & Bode (2006), which distinguishes four interrelated terms:

- Supply chain risk: is the deviancy between the expected value of a definite performance measure, which results in an undesirable consequence for the main organization. Therefore risk is equated to the loss due to the disruption of the SC. In this model the risk is taken as a purely negative event, not considering situations where it turns out to be a “pleasant adversity”, since it is not likely to turn out in real situations.
- Supply chain disruption: is an unintended, untoward situation, which leads to SC risk. For the affected companies, is a rare and anomalous situation in comparison to the daily-business. The nature of the risk can be vastly divergent, since SC disruptions can materialize from various areas internal and external to a SC.
- Supply chain risk source: is the cause that triggers the disruptions, these sources can be divided into three categories: demand-side, supply-side and catastrophic. Although these categories do not cover all risk events inherent in a SC, e.g. disruption due to internal operations or because of legislative changes. Though, these three risk sources belong unquestionably to the most significant problems in a SC risk management.

- Supply chain vulnerability: While a SC disruption is the condition that leads to the occurrence of risk, it is not the only basis of the final outcome. It is logical that vulnerable SC has a higher probability to suffer a disruption which consequently leads to a SC risk.

For a better comprehension of the SC environment and the definition of risk (McCormack et al., 2008) considers three perspectives: i) supplier facing, ii) internal facing and iii) customer facing, of the SC with the association of the respective risk. According to these authors: *"Supplier facing looks at the network of suppliers, their markets and their relationship with the "company". Customer facing looks at the network of customers and intermediaries, their markets and their relationships with the "company". Internal facing looks at the company, their network of assets, processes, products, systems and people as well as the company's markets"* (McCormack et al., 2008). Figure 4.3 shows how the aggregation of the three perspectives forms a global risk environment. It also shows risks associated to each environment.

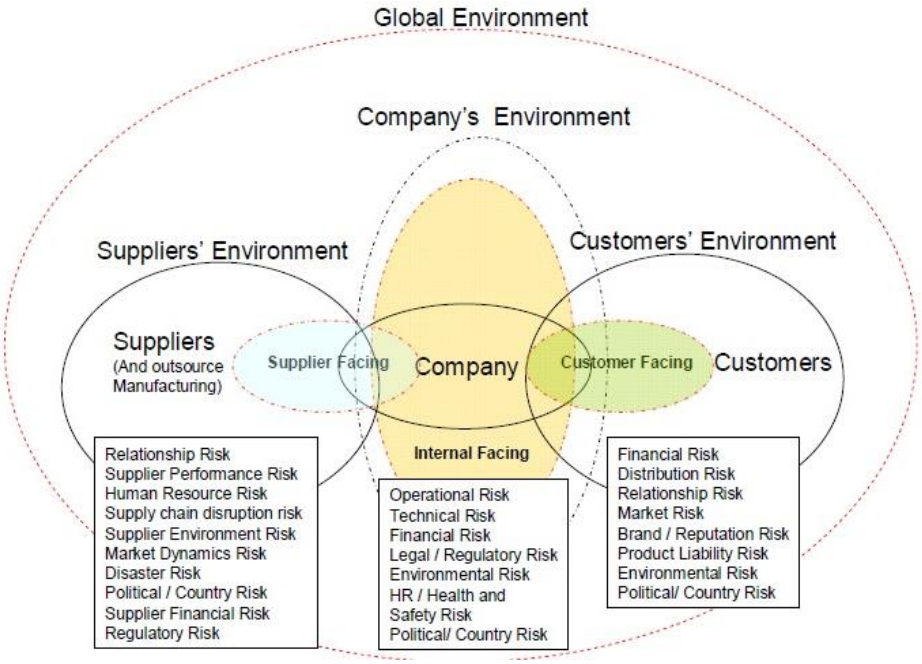

Figure 4.3 - Risk global environment
Source: McCormack et al. (2008)

Vulnerability is another concept that is embedded in the SC, since it is correlated with potential risks that may occur within it. As stated by Wagner & Neshat (2010), SC vulnerability is a function of certain SC characteristics in which the loss that the company incurs is a result of its SC vulnerability to a given SC disruption.

To manage SC vulnerabilities more actively it is necessary to have methods that can help managers measuring and tracking vulnerabilities in their SC. Companies need to know how much vulnerability exists in a SC and what drives that vulnerability, so that they can deliberately modify these factors to

achieve a level of SC vulnerability that matches the desired risk–reward trade-off (Wagner & Neshat, 2012).

Vulnerability is highest when both the likelihood and the impact of disruption are high. Rare, low-consequences represents the lowest levels of vulnerability and require little planning or action. Disruptions that combine high probability and low consequences are part of the scope of daily operations management in the normal flow of business. On the other hand, those characterized by low probability but high impact call for planning and a response that is outside the realm of daily activity (Sheffi & Rice Jr, 2005). Table 4.2 shows some quotations about the subject, to facilitate the comprehension of the concept. One practice to reduce vulnerability is to implement mitigation strategies. Mitigations strategies can increase visibility in the SC, thereby reducing its vulnerability to risk. Figure 4.4 shows an example of negative effects/disruptions in terms of their placement in the vulnerability map.

Table 4.2 – Supply chain vulnerability definitions

Author	Vulnerability definition
Christopher & Peck (2004)	An exposure to serious disruption, arising from risks within the supply chain as well as risks external to the supply chain
Asbjørnslett (2009)	Concept that may be used to characterize a supply chain system's lack of robustness or resilience with respect to various threats that originate both within and outside its system boundaries. The vulnerability of a supply chain system may be manifested both in its infrastructures – both nodal and modal, its processes, as well as the operation and management of the supply chain
Bakshi & Kleindorfer (2009)	Possibility of occurrence of a disruption. It is determined by a combination of the kind of infrastructure already in place for risk mitigation, as well as environmental factors such as political turmoil, proximity to a fault line/volcano, etc.'. . . 'Mathematically, we capture the concept of vulnerability through the supplier's marginal probability of disruption as a function of investment'.
Wagner & Bode (2009)	Susceptibility of the supply chain to the harm of [a supply chain disruption] is of significant relevance. This leads to the concept of supply chain vulnerability. The basic premise is that supply chain characteristics are antecedents of supply chain vulnerability and impact both the probability of occurrence as well as the severity of supply chain disruptions

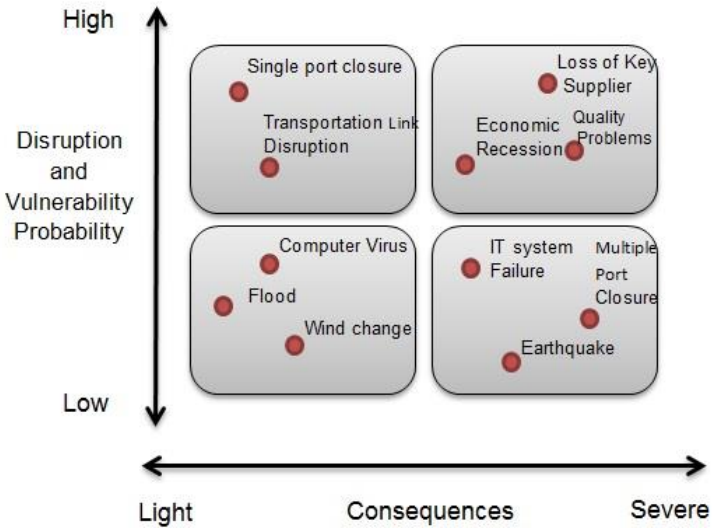

Figure 4.4 - Example of a vulnerability map for a single company
Source: Sheffi & Rice Jr (2005)

Disruptions increase vulnerability and can be defined between a specific range, covering deliberately targeted attacks, normal operating events and random disruption events. Sodhi & Chopra (2004), group diverse disruptions in risk/failure categories that may affect companies. This characterization is presented on Table 4.3.

Table 4.3 - Relationship between disruptions and risk categories
Source: Sodhi & Chopra (2004)

Disruption	Risk/Failure Category
Natural disaster Labor disputes Insolvency of the supplier War and terrorism Dependence on one supply source Loss of key staff Sabotage Industrial espionage	Rupture
Supplier with extreme high demand Low quality supplier Supplier disruption Constrains on border barriers Sudden change in transportation mode Loss and damage of goods in transit Lack of coordination Work Strikes	Delay
Supportive information Infra-structure malfunction Integration of an extended and complex network *E-commerce*.	Support systems
Imprecise forecast due to: long deadlines, seasonality, product variability Bullwhip effect due to: inaccurate data, lack of SC visibility Lack of information	Forecast
Vertical Integration on the SC Global outsourcing and market fluctuations	Intellectual property
Unstable exchange rate High demand of many parties of a single product of a single supplier Hiring regime (long term *vs.* short term)	Raw material/ Products acquisition
Number of clients Clients power purchase	Clients
Rate of obsolete products Ownership cost Product value Uncertainty on supply and demand	Inventory
Inherent capacity cost association Flexibility in the SC	Capacity

Svensson (2000), Hendricks & Singhal (2003), and Kleindorfer & Saad (2009) agree that a disruption is an non-planned and non-anticipated event that causes rupture in the normal flux of goods and materials inside the SC. These disruptions can occur in a specific location in the SC, hence the more complex the SC, the higher probability of these disruptions to appear (Sheffi & Rice Jr, 2005).

Different types of disruptions can also be categorized according to their impact, frequency and duration. Normally companies are more concerned about high impact disruptions that affect them with great severity, which usually happen with low frequency and cause long-term impacts. Also, companies worry about disruptions of low severity, but with high frequency that cause short-term

impact, which several times can produce a much higher impact in the SC. Relatively small, unintended disruptions in common markets (e.g. fuel price rise) can cause disruptions in SCs more severe than dramatic intentional acts such as 9/11 (Stecke & Kumar, 2009).

Disruptive events, if not handled with the appropriate measures can cause huge problems to companies, since one disruptive event can trigger another and so on, as illustrated in Figure 4.5. This way a snowball effect exponentially increases possible damages, and associated costs.

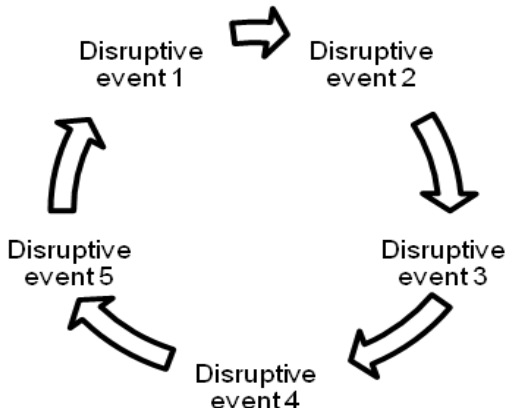

Figure 4.5 - Disruptive event: snowball effect

Japan's earthquake in March 2011 is an illustrative example of how an unexpected event can affect global SCs. We come across numerous media news describing this event's negative outcome in companies and respective SCs (Carvalho, Azevedo, & Cruz-Machado, 2012). Another example with a huge impact world-wide, once again due to natural causes, is the Eyjafjallajökull volcano, which produced an extensive ash cloud that led to the closure of most of Europe's airspace from 15 to 23 April 2010. In the weeks following this event, airspace was closed intermittently in different parts of Europe (Carvalho, Maleki, & Cruz-Machado, 2012).

When disruptions occur, depending on their nature, the impacts on the SC and its response diversify. Any significant disruption will have a typical profile in terms of its effect on company performance, whether that performance is measured by sales, production level, profits, customer service or another relevant KPI. Relevant disruptions display a distinctive profile according to their influence on the performance of the company, and those effects can be predicted, and plotted over time (Sheffi & Rice Jr, 2005). The nature of the disruption and the dynamics of the company's response can be characterized by eight phases shown in Figure 4.6, according to (Sheffi & Rice Jr, 2005).

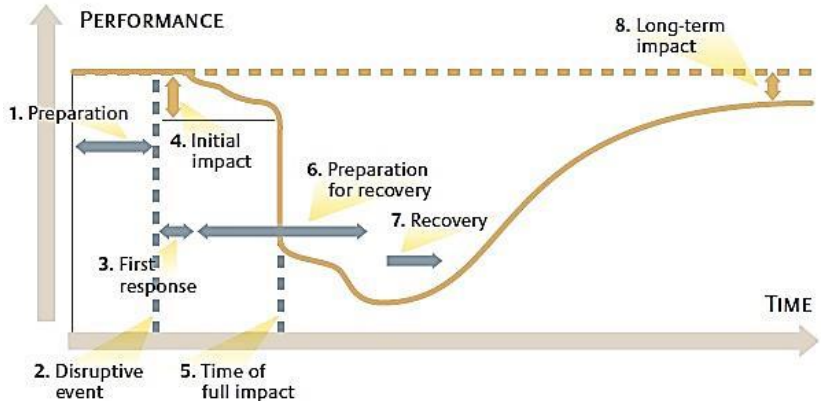

Figure 4.6 - Disruption profile
Source: Sheffi & Rice Jr (2005)

According to Figure 4.6 the following phases can be characterized in the following way:

1. **Preparation**: The negative impact of a disruption can be diminished when the company is able to anticipate and get ready for it. Storms, floods, strikes, or even the bankruptcy of a critical supplier, for example, may be preceded by warning signals, ranging from hours (storms) to even months (strikes and bankruptcies), giving the company some time to prepare. Others, by their own nature, will be impossible to predict: such is the case of a fire, or of a terrorist attack.
2. **The Disruption**: The disruption itself happens: the fire occurs, storm hits, supplier goes bankrupt, bomb explodes, or stevedores go on strike.
3. **First Response**: The first response purpose is to control the situation, saving or protecting lives and equipment, shutting down affected systems, and trying to keep damage from spreading.
4. **Initial Impact**: In some cases the disruption shows its full impact instantly – that is the case for a devastating storm, fire, or a bomb explosion. Other times, effects creep in more slowly, and flagging company performance will be felt more or less rapidly, depending on several factors such as the scale of the disruption, the endurance of the company, or of its chain of supply, and the preparations that may have been made.
5. **Full Impact**: When full impact occurs (immediate or within a delay), the most likely is that performance will dramatically decrease.
6. **Recovery Preparations**: Recovery preparations can start even before the disruption, if it was anticipated, or at the same time as first response: for instance, preparing alternative suppliers, or diverting production to other locations that won't be affected by a strike.
7. **Recovery**: Getting back to normal production levels may involve a period of working overtime.
8. **Long-term Impact**: It takes time to recover from serious disruptions, especially if it damages the company's reputation with its customers. Sometimes customers will look for alternative suppliers during a disruption, and will not return, even after it is over. The vulnerability of an organization to a disruption can be widely variable, depending on factors such as the type of

disruption, the company's structure (number of production sites or distribution centers, the levels of concentration of high value equipment...), or even of the brand's strength and the clients' perception of the very same resilience of the company.

Since the SC is a network of companies, it is essential that every company belonging to the network deploy the necessary practices to prevent the occurrence of failure; moreover, in case of failure, to minimize the negative effects and a quick recovery. Retrieved from Carvalho (2012), Figure 4.7 shows a chain reaction in a SC due to a failure mode in the supplier, which propagates along the SC provoking damages and reaching the customer.

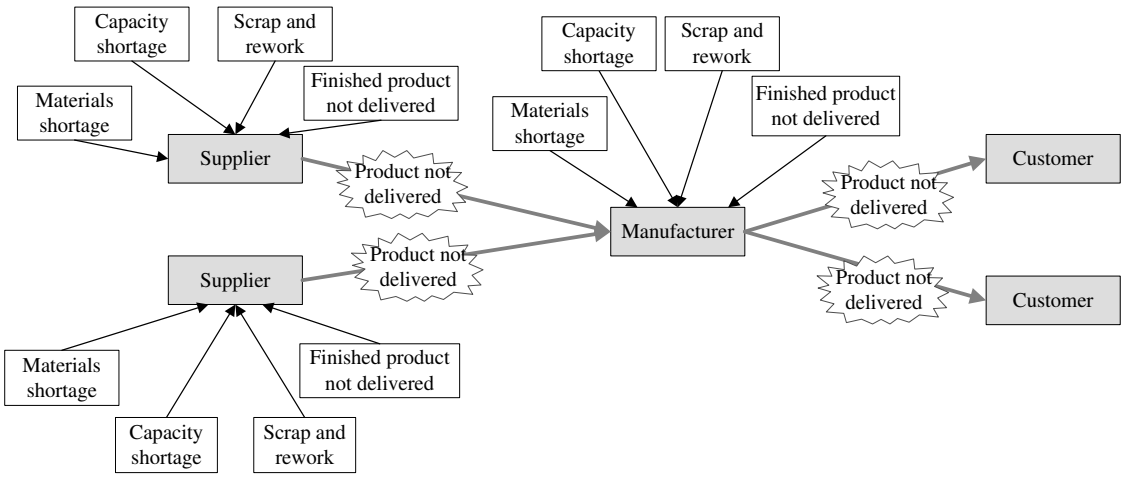

Figure 4.7 - Supply chain failure modes
Source: Carvalho (2012)

4.3. Mitigation and contingency strategies

When major disruptions occur, many SCs tend to break down and take a long time to recover. However, not only can some SCs continue to function smoothly, they also continue to satisfy their customers before and after a major disruption (Tang, 2006). The severity of the disruption on the SC performance is related to the existence of certain "characteristics" in SC that provide the ability to "absorb" the potential damages and to minimize the failure modes severity. These characteristics are related to the SC capabilities, and they are the reflection of SC mitigation and contingency strategies (Carvalho, 2012). First, these strategies should be able to help a company to reduce cost and/or improve customer satisfaction under normal circumstances. Second, the same strategies should enable a company to sustain its operations during and after a major disruption (Tang, 2006). Tomlin (2006) makes an important distinction between mitigation strategies and contingency strategies, stating that mitigation strategies actions are implemented before the occurrence of the disruption, while contingency strategies actions are implemented after the disruption strikes. Craighead, Blackhurst, Rungtusanatham, & Handfield (2007), state that contingency strategies are more reactive in nature, while mitigation strategies are more pro-active. In Table 4.4 it is possible to see some contingency and mitigation strategies.

Table 4.4 - Mitigation and contingency strategies
Source: Gurning, Cahoon, Dragovic, & Nguyen (2013)

Type of strategy	Example
Inventory and sourcing	Inventory polling at ports
	Utilizing agency service
	Apply other chain links
	Optimum ordering policy
	Postponement delays
	Supply flexibility
Contingency rerouting	Reserves routes
	Critical nodes mapping
	Applies other chain links
	Formal assessment
Business continuity planning	Changes to work practices
	Max. allowable interruption
	Develop warning systems
	Risk impact monitoring
Recovery planning	Apply discovery responses
	Apply recovery actions
	Network & procedures redesign

The overall objective of the mitigation and contingency strategies is to diminish the probability of unwanted scenarios, that is, situations where failure-modes occur. However, when unwanted scenarios happen, it is necessary to adopt new strategies in order to quickly recover to the initial state of performance of the company, avoiding a snowball effect of negative effects and preferentially without an exuberant increase in costs. Figure 4.8 illustrates the mitigation and contingency strategies objective.

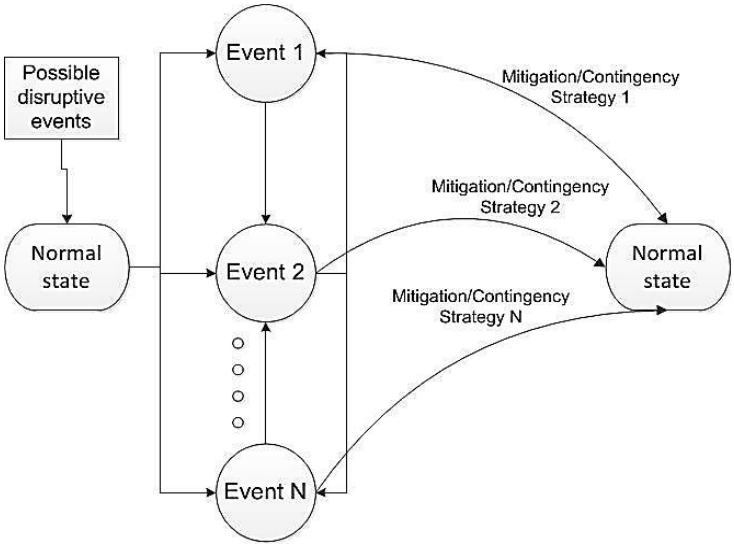

Figure 4.8 - From a disruptive event to the normal state through mitigation and contingency strategies

4.4. Conclusion

In this chapter we studied the concept of SC resilience. This concept involves a lot of other associated concepts such as: flexibility, redundancy, responsiveness and effectiveness. All these concepts are present in an agile SC, essential to any resilient SC, since an agile SC recovers faster from disruptions and, avoiding possible failures modes, has less vulnerabilities. Mitigation and contingency

strategies implemented are also key concepts to increase resilience in a SC, since these strategies can absorb potential damages and minimize failure modes severity. These are especially important concepts since our study focuses on the resilience of 3PLs towards a port strike.

Chapter 5 - Theoretical framework

5.1. Vulnerable areas for disruptions in a port environment

Due to globalization and continuous growth of international commerce, ports have become a major and complex infrastructure, comprising various and diverse entities working together. Ports are key-points for nowadays SCs and have been under great pressure from factors such as: increasing demand, ship sizes, environmental laws, economic factors, among others. Nowadays ports are considered integrated logistics centers, and thus ports malfunctions can have huge impacts on 3PLs, which in turn can spread negative effects all over the SC. Figure 5.1 illustrates the port integration in a SC.

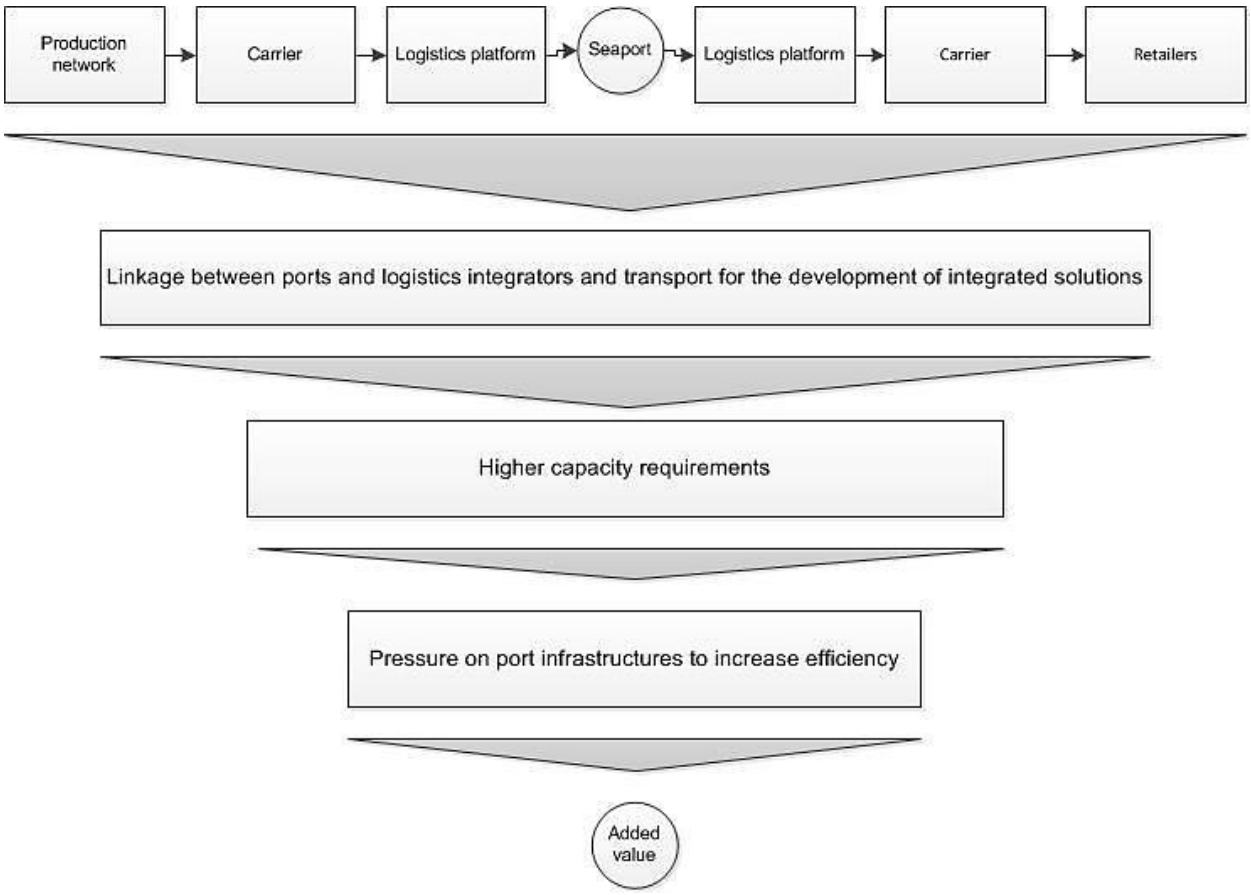

Figure 5.1 - Port integrated in a supply chain
Source: Palma (2012)

In a study executed by Colicchia, Dallari, & Melacini (2010) is possible to verify the impact and likelihood of occurrence of negative events for the main areas of vulnerability in an international transportation process. Table 5.1 displays the impact and likelihood of occurrence for main areas of vulnerability in an international transportation process.

Table 5.1 - Impact and likelihood of occurrence for the main areas of vulnerability
Source: Colicchia et al. (2010)

		Activity			
	Vulnerability Areas	customs and handling operations at loading port	Trans-shipment from feeder to mainline vessel	trans-shipments from mainline to feeder vessel	handling and custom clearances at port
Impact					
Ports related	Port cloggings	L/M	M	M	L/M
	Container loaded erroneously	H	H	H	
	Unavailability of equipment for transhipment	M	M	M	M
	Accidents during handling of stevedoring activities	M/H	M/H	M/H	M/H
	Lack of yard space	M	M/H	M/H	
	Strike of port workers	H	H	H	H
	Unavailability of space on the vessel	M		M	
Likelihood					
	Port cloggings	M/H	M/H	M/H	M/H
	Container loaded erroneously	L	L	L	M/H
	Unavailability of equipment for transhipment	L/M	L	L	M/H
	Accidents during handling of stevedoring activities	L/M	L/M		L/M
	Lack of yard space	M	L/M	L	
Legend: L denotes low; M medium; and H high					

Through Table 5.1 it is possible to verify that one the most vulnerable areas with more impact on ports is a strike of port workers, which highly impacts in four activities. This situation is likely to provoke a port clogging, since this vulnerable area deals with cargo handling operations, custom clearances and transshipments. So it is of major importance to find solutions to prevent such situations, in order to diminish the probability of affecting downstream SC entities.

The maritime transportation system is composed by several processes (Figure 5.2), encompassing open sea operations, such as vessel processes and land operations such as port infrastructures . When this system is subjected to a disruption these different processes can be affected, causing disruptive events/negative effects. These disruptive events can provoke a negative chain reaction, disturbing the downstream SC entities.

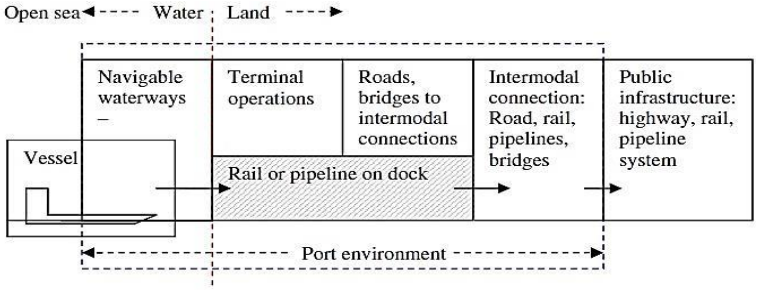

Figure 5.2 - Process of the maritime transportation system
Source: Øyvind, James, & Bjørn Egil (2011)

Øyvind et al. (2011), defines SC failure mode as *loss of the key functions and capabilities of the supply chain, loss of any such would reduce or remove the ability of the system to perform its mission*. It is possible to conclude that there are many possible disruptive events that can generate failure modes in a maritime transportation system, which is an extremely important knot in SCs. Thus it is of great importance to make it more resilient. Table 5.2 provides more information regarding failure modes in a maritime transportation system, and what may cause them to happen.

Table 5.2 - Failure modes in a maritime transportation system
Source: Øyvind et al. (2011)

Failure Modes	Examples
Internal operations interrupted	Power failure, machine breakdown, fire
Communications failure with vendors, customers or other sites	Systems fail, internet down
Loss of supply materials quality	Supplier fails or cannot deliver, bad product quality
Shipping unavailability	No transportation, ports closed, roads blocked
Work staff not available	Mass illness, work stoppage, strike
Financial cuts	Credit tightens, customer payments late
Low customer demand	New competitor, financial crash

5.2. Resilience strategies to maritime disruption

Figure 5.3 shows the framework for maritime disruption strategies in the three stages of disruption: pre-disruption, at-time disruption and post-disruption. Also it contains the action choices, such as changing variable values, copying strategies, or accepting or continuing the previous actions. This figure displays the strategies addressed by the literature (Table 4.4) time-framed in each state of disruption.

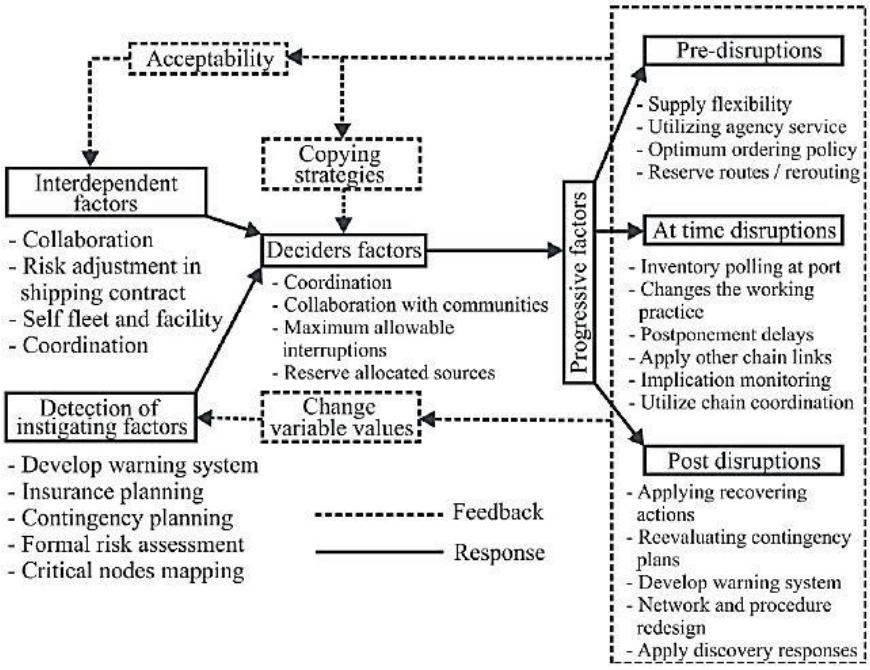

Figure 5.3 - A framework for maritime disruption strategies
Source: Gurning et al. (2013)

The literature contains few studies related to disruptions in ports operations. In a study made by Gurning, Cahoon, Dragovic, & Nguyen (2013), the authors conclude that most common strategies used to manage wheat SC during a disruptive event are: to adjust new routes on the maritime leg, utilize strategic stock (when there is no alternative source available), utilize back-up systems, and/or to implement business continuity actions. Options such as inventory pooling at ports, changes to working practices, applying other chain links, postponement delays, formal assessment of risk, determining the maximum allowable interruption, risk impact monitoring, and re-evaluating contingency plans are considered as strategies that are put into action in the post-disruption stage. Colicchia et al. (2010) also realized a case study in a home appliance retailer business, based in Northern Italy with suppliers positioned in Beijing (China). This study presents the effectiveness of certain mitigation and contingency strategies to enhance SC resilience, taken into consideration the supply lead time, through a simulation-based framework (Table 5.3).

Table 5.3 - Contingency plans and mitigation actions
Source: Colicchia et al. (2010)

Contingency	Mitigation
Use of multi-port calling, i.e. delivering the goods from port of origin to port of destination.	Pre-booking containers as soon as possible
Use of Hub & Spoke system in the initial phase, bypassing only the final feeder service from the second hub port. Once the mainline vessel has arrived at the second hub port in the Mediterranean Sea, containers are discharged from mainline vessel and, after customs inspections, road hauled to the final destination.	Bonded warehouse, shifting the customs inspections from the port of destination directly to the final destination, with the supervision of custom authorities.
Use of sea/air service. During the ocean shipping leg, the container can be unloaded at one of the scheduled ports of call in the Middle East (e.g. Dubai) where the goods are transferred onto an aircraft flying to the airport nearest to the final destination.	Service level agreements with shipping companies or freight forwarders on loading priorities at ports.
Use of airfreight, i.e. shipping non-containerized goods by means of a direct flight leaving from the airport nearest to the supplier's plant.	

The results of Colicchia et al. (2010) study show that contingency plans are of greater effectiveness, regarding supply lead time variability by 35,1%, compared to 16,0% achieved through mitigation actions and that the implementation of all the approaches (both mitigation actions and contingency plans) can lead to a reduction of 40,4% of supply lead time variability.

The purpose of this study is to understand the resilience of 3PLs companies when faced with a port strike. Gurning & Cahoon (2011) also follow a similar research design when studying possible multi-mitigation scenarios on maritime disruptions. In Figure 5.4 it is possible to overview the contextualization of the problem, from the likely stimulators of a strike, to the assessment of information.

The research will follow the theoretical framework in Figure 5.5. This framework is based on a disruption profile and the dynamics of the company's response proposed by Sheffi & Rice Jr (2005). It

focuses on the impact of port strikes in 3PLs, namely: i) the negative effects associated with the strike, ii) along with the consequences in terms of performance, iii) and the strategies adopted to avoid the negative effects, as identified in some studies about maritime and port disruptions, namely by Gurning & Cahoon (2011) and Øyvind et al. (2011).

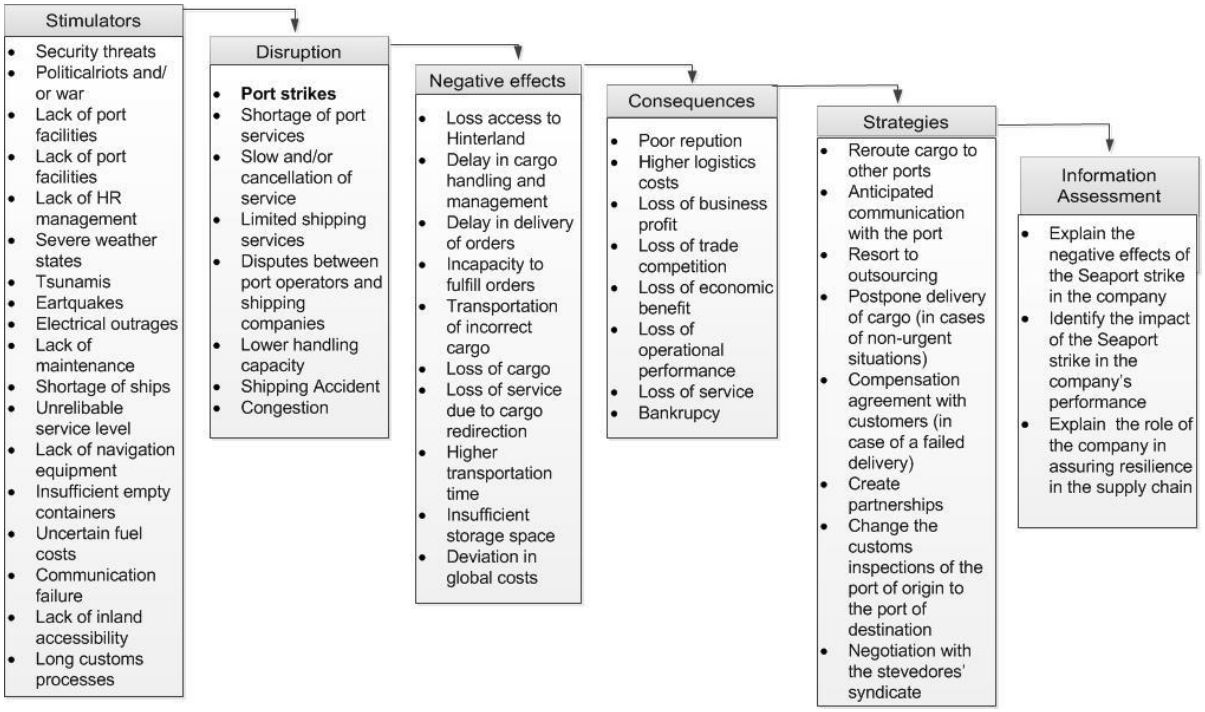

Figure 5.4 - Contextualizing of a case study related to a port strike
Source: Gurning & Cahoon (2011)

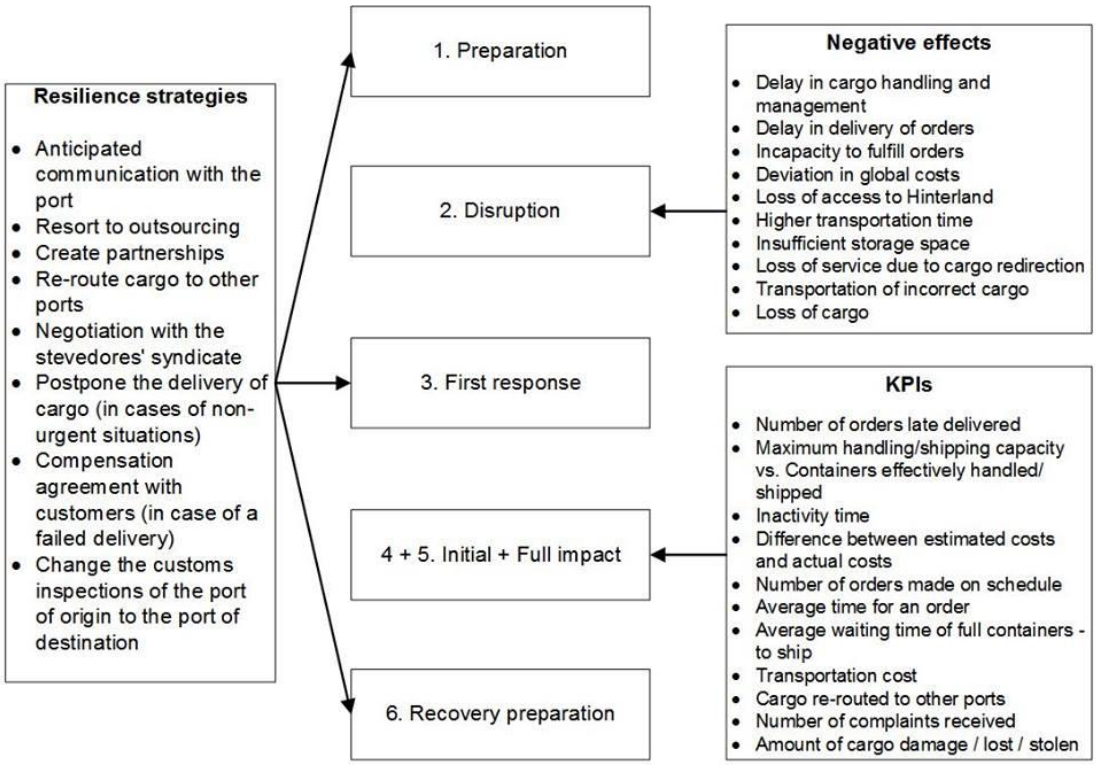

Figure 5.5 - Theoretical framework

5.3. Conclusion

This chapter develops the subject of ports environment in a SC context. Port environment has become a key knot in SCs, due to globalization, but as it comprises many different entities, its integration in SCs becomes difficult to manage, increasing the likelihood of 3PLs suffering huge impacts. The complex integration of a port environment in a SC, makes a port environment vulnerable to disruptions, that can provoke failure modes such as: internal operations interrupted, communications failure with customers or other sites, loss of supply materials quality, shipping unavailability, non-availability of work staff, financial cuts, or low customer demands, among others. A study made by Colicchia et al. (2010) (Table 5.1), shows that port clogging is one of the most vulnerable areas in an international transportation process, with medium-high likelihood to occur and medium-low impact in activities of customs and handling operations and trans-shipments. Strikes of port workers is also presented as a high impact situation that must be prevented. In order to do so, strategies must be deployed, before, during and/or after the disruption.

Chapter 6 - Research methodology

6.1. Selected research methodology

The preceding chapters described the state-of-art in order to better comprehend how 3PLs can be more resilient when facing a port strike. To continue research it is necessary to implement a research methodology. The research paradigm chosen is an important factor, if not even decisive, for any study, guiding researchers in their decision-options during their methodological work (Gomes, 2004). For this reason, investigators should know the different research paradigms/approaches so they can make future decisions (Patton, 1990). Spens & Kovács (2006) present us with two general approaches in the acquisition of new knowledge: the inductive and the deductive approach. Figure 6.1 illustrates the structure of both approaches used in the development of new theories.

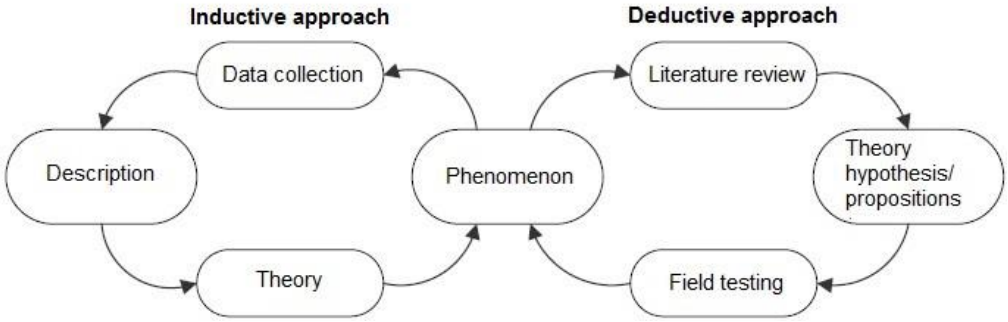

Figure 6.1 - Inductive and deductive research approaches
Source: Golicic, Davis, & McCarthy (2005)

Induction is typically defined as moving from the specific to the general, starting with data collection, analyzing the phenomenon and building, in the end, a substantive theory. While deduction, begins with the general, through pre-existing theories (literature review), in order to develop theories in forms of hypotheses or propositions that are then tested, corroborating or contradicting previous theories. Arguments based on laws, rules and accepted principles are usually used for deductive reasoning. Observations tend to be used for inductive arguments (Burney, 2008; Golicic et al., 2005). The development of this thesis relies on empirical observations and past occurrences data collection, this way following the inductive approach.

Eisenhardt & Graebner (2007) study describes and states that theories can be built through case studies, since a case study is an empirical inquiry that investigates a contemporary phenomenon, rich with empirical description, within its real-life context, particularly when limitations between phenomenon and context are not obvious (Yin, 2002). A case study research can be used to achieve different research objectives. Case study research has often been associated with description and theory development, used to provide evidence to create hypothesis and to explore areas where the existing knowledge is limited. As stated by Ponte (2006), a case study is an investigation that deliberately focuses on a specific situation that is supposed to be unique or special, at least in some aspects, seeking to discover in it the most essential and characteristic, thereby contributing to the

overall understanding of a certain phenomenon of interest. Eisenhardt (1989) defines eight steps to build theory from case study research, these steps go from the research questions definition, select the appropriate case, analyzing the data to shaping hypotheses and enfolding it within the existing literature. In this thesis it will only be followed until step 5, this is:

- Step 1 – Start the study: it includes the definition of the research questions and the identification of prior constructs. This way the study is focused and provides better support for construct measures, while retaining theoretical flexibility.
- Step 2 – Select the cases: choice should fall on theoretical useful cases that replicate extended theory by filling conceptual categories.
- Step 3 – Prepare instruments and protocols for data collection: this includes the development of protocols, combined quantitative with qualitative data sources to support the triangulation of data and synergies among sources of evidence.
- Step 4 – Entering the field: using multiple and flexible data collection methods to allow investigators to take advantage of emergent themes and unique case features.
- Step 5 – Analyzing data: within-case and cross-case analysis support theory generalization and search for common patterns.

Since this thesis focuses on more than one company, it is important to state that it does not follow a single-case design, but a multiple-case design, found more suitable as it allows an investigation of a particular phenomenon in diverse settings, through cross-case analysis and comparison. Multiple cases may also be selected to predict similar results (literal replication) or to produce contrasting results for predictable reasons (Yin, 2002).

6.2. Case selection

As described in section 2.4, the port's economic activity has been proved to highly contribute to the growth of national economy, in Portugal's case, mainly because of our country's privileged geographical location. Europe's objective of increasing this type of commerce is especially important to Portugal, which can benefit exponentially from this policy. But disruptions such as port strikes can severely damage these potential opportunities.

In the context of this thesis, and given the previous theoretical context, research is focused on the impact of port strikes in 3PLs and their resilience. Namely it is necessary: i) to identify: the negative effects associated with the strike, and respective consequences, ii) to identify the strategies adopted to avoid the negative effects and, iii) to assess the data and elaborate conclusions.

The case study is focused on strikes in the Port of Lisbon. The main reason for this choice is the events of the past two years: this port has been severely suffering from stevedores' long strikes that can be extremely harmful for the port performance, which means extremely harmful for many other entities connected in the same SC. The most recent severe strikes in the Port of Lisbon occurred in

the last trimester of 2012 and 2013. These strikes lasted a long period of time and had medium-high worker's adherence. In the scope of this thesis, data from both the strikes of 2013 and 2012 will be analyzed to better understand the phenomenon under study.

Since the objective is to study impact of port strikes in 3PL the case study comprises three 3PL companies operating in the Port of Lisbon. The companies were selected due to the type of activity each performs: one is an in-land freight forwarder company, another is a shipowner company and lastly a port operator company. All of them extensively cover various activities of 3PLs in a SC context. Also, all companies provide international services, being highly dependent on the well functionality of ports.

6.3. Research phase

Data was collected through primary sources (consisting in a questionnaire and an interview) and secondary sources (e.g. television news, websites and conferences). In figure 5.4 we present the framework that will guide the case study development.

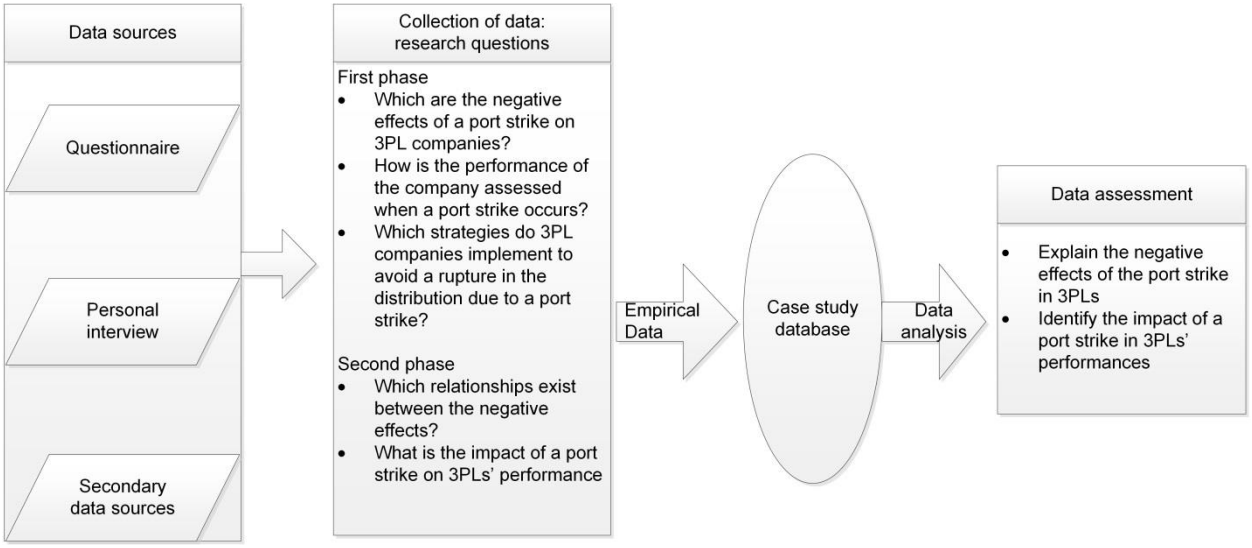

Figure 6.2 - Case study framework

6.3.1. Data collection

The objective of data gathering is to obtain a rich set of information that captures the research topic complexity (Carvalho, 2012). Qualitative data is a source of well-grounded, rich descriptions and explanations of processes occurring in local contexts. With qualitative data one can preserve the chronological flow, assess local causality, and derive successful explanations (Miles & Huberman, 1984). Cross-analyzing the information between the different sources will allow for better understanding of the phenomenon.

The collection instrument of primary data is a questionnaire subdivided in two phases: a first phase in which a questionnaire (Appendix A) is sent via e-mail and a second phase in which personal

interviews will be made using a structured interview protocol (Appendix B). With the information thus gathered it is possible to reach the case study objective and form our conclusions on:

1. The negative effects of a port strike in 3PLs.
2. The impact of a port strike in 3PLs' performance.

The questionnaires and interviews were made in Portuguese since both the interviewer and interviewees are Portuguese, eliminating the misinterpretation of data. The data was then translated to English. The interviewees held positions related to the daily operations of the companies and are highly aware of the phenomenon in study and with knowledge it. The interviewees were: director of operations, general manager and the president of the board of administration. Table 6.1 helps to summarize the first part of the research phase, showing the study purpose, the companies under study and the data sources description.

Table 6.1 - Data collection process

<table>
<tr><th>Study purpose</th><th>Companies under study</th><th colspan="2">Data sources description</th></tr>
<tr><td rowspan="2">First phase:

Which are the negative effects of a port strike on 3PL companies?
How is the performance of the company assessed when a port strike occurs?
Which strategies do 3PL companies implement to avoid a rupture in the distribution due to a port strike?
Second phase:

Which relationships exist between the negative effects?
What is the impact of a port strike on 3PLs' performance?</td><td rowspan="2">Company 1
Company 2
Company 3</td><td>E-mail questionnaire

Structured interview</td><td>Respondents:
Operations manager
General manager
President of the board of administration</td></tr>
<tr><td>Secondary data sources</td><td>Newspapers, Corporation and Companies websites</td></tr>
</table>

6.3.2. Data analysis

The objective of data analysis is to obtain reliable conclusions. To find reliable conclusions, according to Miles & Huberman (1984), data analysis should be structured with 4 components:

1. **Data collection**: as discussed in section 6.1.
2. **Data reduction**: the process of selecting, focusing, simplifying, abstracting, and transforming the "raw" data that appears in written-up field notes. Data reduction occurs continuously throughout the life of any qualitatively oriented project.
3. **Data Display**: The second major flow of analysis activity is data display. A "display" is a structured assembly of information that allows conclusion drawing and action taking. The most frequent form of display for qualitative data has been narrative text.
4. **Conclusion Drawing/Verification**: The third stream of analysis activity is conclusion drawing and verification. From the beginning of data collection, the analyst is beginning to decide what

things mean, is noting regularities, patterns, explanations, possible configurations, causal flows, and propositions. Final conclusions may not appear until data collection is over.

In Figure 6.3 it is shown an interactive model of data analysis.

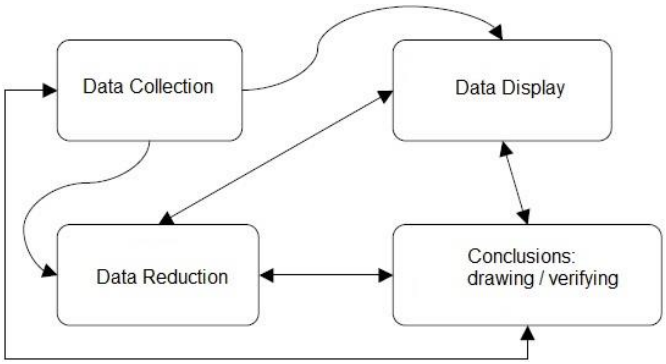

Figure 6.3 - Components of Data Analysis: Interactive Model
Source: Miles & Huberman (1984)

In this thesis, in order to acquire meaning from the data analysis and achieve trustworthy conclusions, data reduction and display methods are summarized in Table 6.2.

Table 6.2 - Research phase: Data reduction and display methods

Study purpose	Data reduction	Data display
Which are the negative effects of a port strike on 3PL companies?	Coding responses from the questionnaire Use a 5 points Likert scale to determine the occurrence level where 1 means “Never occurs” and 5 means “Always occurs”. Use a 5 points Likert scale to determine the the severity level where 1 means “Has no effect on operations” and 5 means “It affects operations in 100%”	Graph with the occurrence and severity of each negative effect
How is the performance of the company assessed when a port strike occurs?	Coding responses from the questionnaire Use 5 point Likert scale to determine the KPI relevance to the measure the company's performance during a strike where 1 means “Not relevant” and 5 means “Very relevant”	Table with the KPI relevance in a strike period
Which strategies do 3PL companies implement to avoid a rupture in the distribution due to a port strike?	Coding responses from the interview Use a 5 points Likert scale where 1 means “Strategy never implemented” and 5 means “ Strategy always implemented”	Table with the strategies' implementation frequency
Which relationships exist between the negative effects?	Coding responses from the questionnaire Use a negative sign, a positive sign or a zero to represent the influence of negative effects on the each other’s	Table with the relationships between negative effects
What is the impact of a port strike on 3PLs’ performance?	Coding responses from the interview Percentage variation that each KPI suffers when a strike occurs	Graphic with the average variation of KPIs during a strike period along

To validate the case study findings a tecnhical report (appendix C) was elaborate. Subsequently it was reviewed and discussed with key informants to assure that the data was correctly analysed and that all the relevant variables were included in the study.

6.4. Conclusion

This chapter provides information on the reasons behind the chosen methodology, as well as the theory of case studies and their practical implementation, namely the research phase, which includes data collection and data analysis. As stated, the methodology of this study follows a case study framework, with an inductive approach, starting with data collection, analyzing the phenomenon (port strike) and building, in the end, a substantive theory. The case study focuses on port strikes and its impacts on 3PLs in a SC, and measures to make it more resilient. This subject was chosen due to the contemporaneity and severity of the problem in Portugal. In order to better understand: the negative effects of a port strike in companies and their performances, and resilience of a 3PL when faced with a port strike, a research phase was conducted. The research phase consisted of key data collection from primary sources and secondary sources. The data collection from primary sources was conducted in two phases, a first phase via an e-mail questionnaire and a second phase by interview. The secondary sources were newspapers, corporation and companies websites to gather extra information.

Chapter 7 - Case study analysis

7.1. Port strike description

In order to better understand the impact of a port strike in 3PLs in a SC, and ways to make that SC more resilient, it is first necessary to understand the dimension of the impacts of a port strike. As this thesis studies the impacts of port strikes similar to past strikes in the Port of Lisbon, this section will initially: i) characterize the Port of Lisbon; ii) present the results of a small study regarding the impacts of re-routing cargo from Lisbon to Sines; and iii) exhibit statistical data from the Port of Lisbon strikes in 2012 and 2013.

This section contains information retrieved from the following secondary sources: IPTM (2014), Cargoedições (2014), Jornal Económico (2011), Expresso (2013), Diário Notícias (2012), Jornal de Negócios (2012), Público (2014a), Cargoedições (2011), RR (2012), Cargoedições (2013), Esquerda (2014), Público (2014b), SOL (2014), Portugaloffer (2014), and Eurogate (2014).

7.1.1. The Port of Lisbon's characteristics and importance

This subsection contains information collected by Mota (2013). The Port of Lisbon benefits from all the excellent conditions with which nature has endowed an enviable geographic and geo-economic location. Lisbon is approximately located at the intersection of the east-west sea route with the north-south route. The east-west route is the main hub of world trade, connecting East producers to the Northern European and United States' consumer markets. The north/south route serves commercial links between Europe, Africa and South America. The proximity to these transport routes allows the ships to scale in Port of Lisbon, and perform needed load transfers, without requiring significant deviations from their usual courses. Its geo-economic location is thus one of The Port of Lisbon's strengths. It is located in the most developed region of the country, ranked third in an Iberian context, among the most developed coastal regions. The Lisbon region concentrates 25,4% of the population and 37,1% of Portugal's gross domestic product. In the Greater Lisbon the population covered rises to 38% and the national gross domestic product reaches 48,3%.

To better illustrate the profoundly positive impact that the Port of Lisbon has on the local and national economy, Mota (2013) evaluate the additional cost and the increase in environmental impacts that would result from a utopian transfer of container handling in the Port of Lisbon to another port, in this case the Port of Sines. For the calculations the following assumptions, retrieved from Mota (2013) study, were established:

- Annual container handlings in the Port of Lisbon: 600.000 TEUs.
- Part of these containers that come from or go to north of the Tagus river: 90%.
- Average weight carried per TEU: 11 tones.
- Tare weight per TEU: 2 tones.

- Increase of transport distance from Sines from/to origins/destinations in the north of the river Tagus: 160 kms by road; 200 kms by rail.
- Increase of transport distance from Sines from/to origins/destinations in the south of the river Tagus: by road or rail: 0 kms.
- For the total of 540.000 TEUs to transport between Lisbon and Sines, 360.000 TEUs are transported by rail, and the remaining is transported by highway.
- Costs by mode of transport: see Table 7.1.
- Greenhouse gases (CO2) emissions into the atmosphere, by mode of transport: see Table 7.2.

Table 7.1 - Costs by mode of transport
Source: Mota (2013)

Mode of transport	Transportation costs € /tones x Km
Deep sea shipping (capacity between 8.000 and 10.000TEUs)	0,005
Short sea shipping (capacity between 800 and 1.000 TEUs)	0,015
Rail transportation(capacity between 40 and 50 TEUs)	0,027
Highway transportation	0,05

Table 7.2 - Emission of greenhouse gas (CO2) into the atmosphere
Source: CEFIC & ECTA (2011)

Mode of transport	g CO2 / tones x Km
Rail transportation	20
Highway transportation	70

Based on these assumptions Mota (2013) estimate the following additional costs for the transfer of containers from the port of Sines to Lisbon:

- Additional cost in land transportation: $44x10^6$ € / year.
- Emission of greenhouse gases: 45.000 tones / year of CO2.

These figures highlight the huge impact of this cargo transference on companies' economic and environmental performance -- even though during a period of strike, re-routing of cargo to other ports happens frequently, as we will later see.

7.1.2. The Port of Lisbon's strike of 2012

The Port of Lisbon's strike of 2012 started approximately in the last trimester and lasted for several months. It had repercussions throughout the year of 2013, leading to a new strike. The main cause, or its stimulator, was a new law regulating labor in ports, strongly opposed by the stevedores. In the Port of Lisbon this opposition was taken into extreme levels, leading to long strikes. A case similar to this

situation is the Port of Auckland, where a strike started in 2011 and remained unsettled, at least until 2012 (MUNZ & NZCTU, 2012).

At the beginning of the strike the Associação Comercial de Lisboa (Lisbon's Commercial Association) estimated high losses. Bruno Bobone, the president of the association stated Lisbon would have a decrease in exports of about 370 tons, and for imports something around 650.000 tons. In terms of value, that would mean about $425x10^6$ euros that would no longer be exported, the monthly value of exports through the Port of Lisbon. "We're talking about significant amounts that will put companies at loss". After the first month of strike, the true loss value was not even close to $425x10^6$ euros – in fact, it reached the staggering figure of 10^9 euros (RR, 2012).

Table 7.3 shows the progression of containers transport in each of the seven Portuguese major ports between 2011 and 2012, as well as, the percentage variation between the quantity of cargo handled in 2011 and 2010 and the variation between the quantity of cargo handled in 2012 and 2011. The negative performance of the ports of Lisbon and Setúbal in 2012, when compared to previous increase in 2011, is well patent, and due to the strikes in those ports (mainly the Port of Lisbon), others such as Leixões and Sines benefited due to cargo rerouted towards them. Comparing 2012 with 2011 annual handled TEUs Setúbal and Lisbon were the only ports displaying a negative variation in annual handled TEUs from 2011 to 2012. Although Setúbal had a decay of 36,0%, Lisbon's decay of 10,4% is the more significant, because that port handles a much larger volume of containers. On the contrary, all the other ports had a positive overall growth, particularly Sines and Leixões, that received most cargo rerouted from Lisbon: in the end of the last trimester alone, an estimated quantity of 30.000 containers were deviated from Lisbon to Leixões.

Table 7.3 - Total annual handled containers (TEU) in the main national ports until 2012
Source: IPTM (2012)

		2011		2012		Δ% 2011/ 2010	Δ% 2012/ 2011
		Quantity	%	Quantity	%		
Containers (TEU)	Viana do Castelo	632	0,0%	666	0,0%	3,8%	5,4%
	Leixões	514.087	32,2%	632.665	36,3%	6.3%	23,1%
	Aveiro	0	0,0%	0	0,0%	-	-
	Figueira da Foz	19.488	1,2%	19.826	1,1%	18,3%	1,7%
	Lisbon	541.907	33,9%	485.696	27,9%	5,7%	-10,4%
	Setúbal	77.127	4,8%	49.350	2,8%	51,7%	-36,0%
	Sines	445.185	27,9%	553.029	31,8%	18,4%	24,2%
	Total	1.598.426	100%	1.741.232	100%	11,0%	8,9%

It is important to understand the major impacts that a strike of this magnitude can lead to. Companies working inside the port (such as port operator companies) are completely dependent on the proper functionality of the port and their stevedores. In the year of 2012 port operators companies saw

approximately half of their work volume disappear, a loss with serious repercussions. These negative effects are spread along the SC. An example are the in-land freight forwarders, although they are not as dependent on the good functionality of the port as the port operators. These in-land freight forwarders have to deploy strategies in order to adapt in a strike period, such as: i) deviate cargo to other ports so their clients can still have their product on time; ii) adapt their partnership strategies in areas such as geographic positioning, possible alliances, level of integration in their clients' services, among others. The shipping companies are also some of the other SC entities affected by port strikes. As they have to operate with tight and complex schedules because of commitments in other distant ports; they need to rely on good timing and precise planning to perform their services with quality. A port strike disruption can heavily affect shipowners' logistic planning, and when a strike is long or recurrent, shipping companies tend to analyze other options, especially if they have other ports nearby that can "replace" the one in question. In this case, whenever possible, shipowners moved their business from the Port of Lisbon to the ports of Sines and Leixões. Tables 7.3 and 7.4 shows how the negative performance of the Port of Lisbon is accompanied by an increase of performance in Sines and Leixões ports.

The re-routing of cargo can reach high proportions, like it happened in the Port of Marseille, once one of the most important ports in Europe due to the rich Hinterland it covered, but that due to recurrent strikes lost several shipping companies to other ports. The case of Luanda port is another example of lack of port functionality: around 2007, shipping companies would sometimes remain weeks at sea until they could load or unload. The problem for shipowners was that there were no other nearby ports that could replace the Port of Luanda, making this port essential regardless of its lack of functionality.

7.1.3. 2013 The Port of Lisbon strike

The strike of 2013 is related to the strike in 2012. The stevedoring syndicate saw their interests as being threatened by the governmental labor law for ports, a new strike started around the last trimester of 2013, that lasted until a settlement was made between port operators and the stevedore's syndicate on the 14th of February of 2014. Table 7.4 illustrates the evolution and performance of 2013 regarding the handling containers at the seven main national ports. It is interesting to note the decrement of 1,1% of the handled containers in the Port of Leixões, and the increase in Lisboa and Sines, of 12,6% and 68,3% respectively.

Table 7.4 - Total annual handled containers (TEU) in the main national ports in 2013
Source: IPTM (2013)

		2013		Δ% 2012/ 2011	Δ% 2013/ 2012
		Quantity	%		
Containers (TEU)	Viana do Castelo	471	0.0%	5,4%	-29,3%
	Leixões	625.480	28,6%	23,1%	-1,1%
	Aveiro	0	0,0%	-	-
	Figueira da Foz	15.897	0,7%	1,7%	-19,8%
	Lisbon	547.047	25,0%	-10,4%	12,6%
	Setúbal	70.564	3,2%	-36,0%	43,0%
	Sines	931.036	42,5%	24.,2%	68,3%
	Total	2.190.495	100,0%	8,9%	25,8%

As shown in Table 7.4, notice how, notwithstanding the strikes in the last trimester of 2013, the Port of Lisbon displays substantial growth (12.6%), comparing to the previous year. This indicates that the strikes of 2013 were not as severe as the strikes in 2012. The volume decrease in Leixões was due to the fact that the cargo deviated from Lisbon it received in 2013 did not reach the high numbers of 2012, and not due to loss of its own usual customers. If the 30.000 containers deviated in 2012 were taken out of consideration, in order to calculate the normal growth of the Port of Leixões, its 2012/2013 variation rate would show an increment of 4%. Sines presents a huge growth of 68,3%. Some of this was growth gained by customers that abandoned services in the Port of Lisbon, but it was also due to new companies using Sines as a strategic point regularly, with special relevance for the double weekly stop of “Lion Service”, a service that links the Far East and Europe, done by MSC, Mediterranean Ship Company, coming from China, as well as the increased exports of fuels due to the new GALP refinery in Sines.

Table 7.5 presents data of containers handled in December 2013 comparing the percentage of the homologous month of the previous year and also the percentage of the average of the previous months of the same year. Although, the main concern in this thesis is the Port of Lisbon, it is important to explain the non-ordinary growth rate of Setúbal by 446,4% compared to December 2012. This extraordinary growth is mostly due to the fact that two new shipping lines have started to stop over at this port during this month. Focusing on the three largest ports, in the Port of Lisbon it is noticeable that even though the percentage variation of the average of December compared to the others months was -31,9%, the percentage variation of December 2013 compared to 2012 was 49,7%, proving once again that the strike impact of 2013 was not as severe as 2012, which is a very positive sign. The Port of Leixões had an increment of 9,8% in December, when compared to the average of the others months, although there was an decrement of 11,6% compared to the homologous month of 2012. This demonstrates that the cargo deviated from Lisbon to Leixões in 2012 was considerably higher than in 2013. As for the Port of Sines, it is possible to conclude that this port has been continuously growing over time.

Table 7.5 - Containers (TEU) handled per main ports in December 2013
Source: IPTM (2013)

		December 2013			
		Quantity	**%**	**Δ % for the 2012 homologous month**	**Δ % for the Jan-Dec average**
Containers (TEU)	Viana do Castelo	0	0,0%	-100,0%	-100,0%
	Leixões	57.232	31,2%	-11,6%	9,8%
	Aveiro	0	0,0%	-	-
	Figueira da Foz	960	0,5%	23,9%	-27,5%
	Lisbon	31.057	16,9%	49,7%	-31,9%
	Setúbal	11.054	6,0%	446,4%	88,0%
	Sines	83.315	45,4%	43,1%	7,4%
	Total	183.619	100,0%	24,9%	0,6%

7.2. Case study description

The case study involves three 3PL companies: ETE-Logística, Transinsular and Liscont. The information mentioned in this section was retrieved from the following secondary sources: Liscont (2014), Mota-Engil (2014), ETE-Logística (2014), Grupo-ETE (2014).

7.2.1. ETE-Logística

ETE-Logística belongs to the E.T.E. Group, which began in 1936 with its first company "Empresa de Tráfego e Estiva, S.A.", founded by Captain Luiz de Figueiredo, grandfather of the current shareholders, specializing as a port operator in the midstream loading and unloading of solid bulk cargos. At the time this was considered to be an innovative, efficient and revolutionary technique, reducing the permanent clogging of ships at Portuguese ports, and consequently port charges and waiting periods. Nowadays, the mission of ETE-Logística is to provide competitive solutions, such as door-to-door services. ETE Group main figures:

- Headquarters in Lisbon (Portugal), 12 offices in 6 countries, in 3 continents, 42 companies belonging to the Grupo ETE, with a total of 900 employees.
- Turnover of $147x10^6$ Euros
- Capital: 100% Portuguese
- 9 Port concessions – 5 km of berthing quays
- 20 ships - owned and chartered with regular shipping lines to over 60 ports. Over 2.000 vessel calls per year
- 2 shipyards, 23.000 m² of covered warehousing and 343.000 m² of storage over 9 locations

E.T.E. Group's main goal is to be recognized as an instrument in the increase of productivity of its clients' organizations Figure 7.1 displays the evolution of TEUs operated by ETE Group.

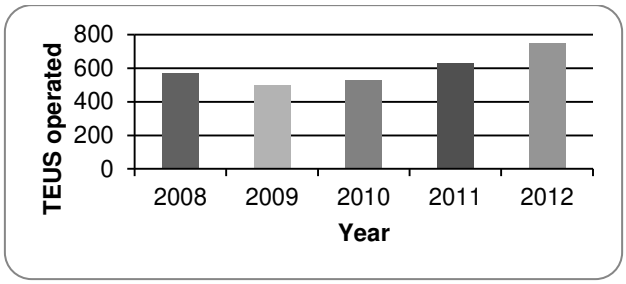

Figure 7.1 –TEUs operated by ETE Group
Source: Grupo-ETE (2014)

ETE-Logística offers a wide range of specific services, for companies and private customers. It coordinates and organizes transport operations, providing intermediate storage and distribution of goods ETE-Logística assures all transport services, by road, sea or air, always with the highest standards of quality, to and from any part of the world, with leadership position in the transport of goods to the Portuguese islands. ETE-Logística aims to establish everlasting partnerships and has a global network of national and international logistics agents. Currently ETE-Logística counts with Marfrete, Mardana, Manicargas, Navique and ETE-Logística Moçambique partnerships for the sector of logistic operators. As for the sector of road haulage ETE-Logística counts with Transportes Sousa Mendes that possesses a fleet of 50 semi-trailer trucks, in which 21 are owned by ETE-Logística. Anually the company use 20.000 own freights and subcontracts another 13.000, travelling an average of 1.000.000 kms. Table 7.6 illustrates ETE-Logística operations in more detail.

Table 7.6 - ETE-Logística operations
Source: ETE-Logística (2014)

Logistic operations	Details
Road haulage	Trucking services
Logistics arrangements for intermodal transportation	Maritime River and inland waterways Air Road Railroad
Warehouses	S.João da Talha, Lisboa Perafita, Leixões Caniçal, Madeira Ponta Delgada, Açores Maputo, Moçambique
Container stuffing and un-stuffing operations	Full container load (when one client reserves and fills the whole container) Less-than container load (when the container contains cargo from various clients)
Administrative operations	Custom procedures Insurance contracts

ETE-Group operates in all maritime sectors, such as port operations, logistics, naval construction and repair, as well as a shipping agent, not only in Portugal, but also in Cape Verde, Guinea-Bissau, Mozambique, Uruguay and Colombia. Regarding road haulage, ETE-Logística secures: i) a link connecting and integrating the full SC, ii) an own fleet of semi-trailers trucks and iii) ensures the

connection between port terminals, warehouses and clients facilities. ETE-Logística also counts with partnerships with other logistic operators for international coverage.

7.2.2. Transinsular

Transinsular was established by the initiative of the Portuguese Government in October 1984 following the termination of public enterprises Maritime Transport Company and National Navigation Company. In April 1999 ETE Group acquired the entire share capital of Transinsular-Island Maritime Transport, SA.. Transinsular is now the largest Portuguese owner of online services with a fleet of 8 ships and a turnover of 60.000.000 Euros. In terms of services, in addition to the regular shipping for the two Autonomous Regions and transport of cement, Transinsular inaugurated in 1988 two lines of regular transportation to West Africa, and in 1991, constituted the S&C - Gestão de Navios e Tripulações, Lda to execute the technical management of vessels and crews. In 1998, becomes a concessionaire of Santos terminal in Lisbon which later got transferred to Santa Apolónia Multipurpose Terminal, also in Lisbon.

Transinsular and Vieira & Silveira (which also belongs to ETE Group) share services and operations that are divided into two major areas: the services of regular shipping line and bulk cargoes. In the area of regular shipping, the companies operate in two segments: i) domestic lines, encompassing the Azores Line and Madeira Line, which offers a regular weekly service adequate to the needs of the Autonomous Regions and International Lines; ii) international lines service integrates the Africa Express Service serving the markets of the Canaries, Cape Verde and Guinea-Bissau. It also operates a unique service line that links directly Portugal to Boavista and Sal Island in Cape Verde, thus addressing the needs of domestic exporters. To cover these services Transinsular operates a containerizing fleet of about 7.200 units. Table 7.7 provides Transinsular services in more detail.

Table 7.7 - Transinsular services
Source: Transinsular (2014)

Transinsular services	Details
Azores Express	Routes between the Mainland and Azores Routes between Azores and Madeira Routes between Azores
Madeira Express	Routes between the Mainland and Madeira
Internacional Line	Routes between the Mainland, Cape Verde and Guinea-Bissau
Bulks	This service is responsible for all kinds of transport outside regular shipping services. The service is based either on the transport of long-term contracts or for sporadic transports of specific goods
Chartering	Contracts of chartering own vessels to third parties are also available (charter-out)

7.2.3. Liscont

Liscont belongs to Mota-Engil Group, which has been in business since 1946. Mota-Engil develops activities in construction and infrastructure management segmented by areas such as: Engineering and Construction, Environment and Services (waste, water, ports and logistics, energy and

maintenance), Transport Concessions (road, bridges and subways) and Mining. Mota–Engil today has a diversified, multinational profile, in its operations. Mota-Engil main figures:

- Headquarters: Oporto (Portugal), offices in 20 countries, in 3 continents, 200 companies belonging to the Mota-Engil group and with 19.404 employees.
- Rank 30 in the largest European construction groups with an approximately turnover of $2.314x10^6$ Euros
- EBTIDA, earnings before interest, taxes, depreciation and amortization: $362x10^6$ Euros with an approximately net profit of $5x10^7$ Euros in 2013.
- Portfolio of orders: $39x10^9$ Euros (81% in foreign markets).

Although Mota-Engil is a large group with different business areas, this study will only feature the logistics and port activity sector of Liscont. Liscont is a container port operator located at Alcântara-Sul pier, in a quay with 630 meters length and 13 meter deep. Liscont terminal has a deep-water navigation channel and is the only terminal in Portugal with the capacity to handle ultra-large container vessels on intercontinental routes. The terminal has 1.835 TEUs ground slots on a yard with a geometrical storage capacity of 8.592 TEUs, an operational capacity of 7.235 TEUs and with a total capacity of 340.000 TEUs/year in a 115.000 m² overall area. The terminal has no restriction for oversized containers with permission to load and unload dangerous cargo. Boasting an intermodal service, Liscont terminal connects to all main Iberian destinations, using block trains. With intermodal transport systems by road and rail, it is the access point to the Portuguese hinterland, a market of over 50.000.000 consumers. Figure 7.2 shows the Hinterland area accessed by Liscont.

Figure 7.2 - Liscont Hinterland
Liscont (2014)

7.2.4. Case study synthesis

The three companies in study provide transportation and distribution services (as can be seen in Table 3.1). ETE-Logística (in-land freight forwarder) also provides complementary services of warehousing and logistics management. Services such as: road haulage, cross-docking (cross docking is a distribution system in which merchandise received at a warehouse or distribution center is not stocked, but prepared for a loading delivery with finite storage time or, if possible null (Oliveira & Pizzolato, 2003)) and carrier selection/ negotiation/ routing, makes ETE-Logística a service adapter 3PL. Transinsular (shipowner) provides general shipping services but also provides specialized services such as bulk transportation. Transinsular can perform door-to-door shipping activities (a service undertaken for an “all-in freight charge” for delivery, acceptance or arrangement of delivery, and supplemental services for door-to-door transport from shipper to recipient (Yamato Transport Co. (2010)). The shipping, handling, import and customs duties activities are incorporated in an “all-in freight charge” service. Door-to-door activity is also a type of service provided by a service adapter 3PL. Lastly Liscont (port operator) provides intermodal transportation services, handling containers from land to shipowners and from shipowners to land, and is thus considered a standard 3PL provider. Table 7.8 summarizes the previous information

Table 7.8 - 3PLs under study

Company	SC role	Type of 3PL
ETE-Logística	In-land freight forwarder	Service adapter
Liscont	Port operator	Standard
Transinsular	Shipowner	Service adapter

7.3. Data analysis

7.3.1. Port strike negative effects

To provide data about the negative effects of a port strike, the interviewees were asked to fill in Table II of Appendix A taking into consideration the negative effects frequency and respective severity in their companies during a long port strike. The frequency of occurrence and severity of the negative effects were measured using a 5 point Likert scale, being: 1- "Never occurs/Has no effect in operations" and 5- "Always occurs/affects operations in 100%", respectively. For each negative effect an average level for the three companies under study was computed. To better comprehend which negative effects can most affect the SC the product between the occurrence average level and the severity average level was also calculated. Table 7.9 contains the negative effects frequency of occurrence and severity.

Table 7.9 - Port strike negative effects: frequency of occurrence and severity

Negative Effects	Occurrence 1- Never occurs 3- Usually occurs 5- Always occurs			Average level	Severity in operations 1- Has no effect in operations 3- Affects operations in 50% 5- Affects operations in 100%			Average level	Occurence X Severity
	ETE-Logística (In-land freight forwader)	**Transinsular** (Shipowner)	**Liscont** (Port operator)		**ETE-Logística** (In-land freight forwader)	**Transinsular** (Shipowner)	**Liscont** (Port operator)		
Delay in cargo handling and management	4	5	5	4,7	4	5	5	4,7	22,1
Delay in delivery of orders	3	5	5	4,3	4	5	5	4,7	20,2
Incapacity to fulfill orders	3	5	5	4,3	4	5	4	4,3	18,5
Deviation in global costs	4	5	4	4,3	4	5	3	4,0	17,2
Loss of access to Hinterland	3	3	2	2,7	5	5	5	5,0	13,5
Higher transportation time	4	4	1	3,0	5	5	1	3,7	11,1
Insufficient storage space	3	3	3	3,0	3	3	3	3,0	9,0
Loss of service due to cargo redirection	2	2	4	2,7	2	2	5	3,0	8,1
Transportation of incorrect cargo	1	1	1	1,0	1	1	1	1,0	1,0
Loss of cargo	1	1	1	1,0	1	1	1	1,0	1,0

In terms of adverse effects caused by a strike in the 3PLs under study, the majority of the negative effects provoked by port strikes present a value between 3 and 5 for the frequency of occurrence and severity. The lowest values belong to the negative effects “Transportation of incorrect cargo” and “Loss of cargo” with values of 1 both in terms of occurrence and severity. This can be explained because the interviewees considered that these negative effects are not enhanced by a port strike. It is important to note that the questionnaire was completed with the assumption of a prolonged strike (more than 1 month with medium to high-adherence), similar to the past strikes in the Port of Lisbon, and having it as example. The interviewees also explained that the severity of the impact of a port strike in their companies is less serious if other port alternatives exist nearby, due to the fact that shipowners may re-route their activities to those alternatives – though the consequences for the port on strike will be more grievous, since their business will be even more reduced as cargo is redirected to available alternatives.

The negative effect with the highest value of “occurrence x frequency” is “Delay in cargo handling and management”. From the in-land freight forwarder’s standpoint, it is important to state that this company does cargo handling and management in a cross docking warehouse. The company considered a level 4 in this negative effect occurrence, since a long port strike, which affects maritime services can lead to a non-capacity to containerize all cargo, slowing the activity of handling and

management of cargo. Severity level is 4 because an increase of cargo volume on the warehouse (due to the delays in maritime services) can lead to the stoppage of secondary operations or even the rejection of other new services, in order to fix the current situation. From the port operator's standpoint, this negative effect always occurs, since he is one of the SC middle-point entities, so any delay of other entities, including stevedores, will affect the port operator's services. Even if the cargo arrives on time, due to the strike adherence level, there is no hand labor to handle the load and this will provoke a delay. Therefore this 3PL attributed a level 5 both in occurrence and severity. From the shipowner's standpoint, although this activity is not a core competence, they are still affected by this negative effect, which originates either in the in-land freight forwarder or in the port operator. This negative effect is transferred and absorbed by the shipping companies, severely affecting their highly complex schedule planning, and is thus considered level 5, both in occurrence and severity.

The "Delay in cargo handling and management" is one of the biggest stimulator for the negative effect "Delay in delivery of orders" (the second most rated, with an occurrence level of 4,3 and a severity level of 4,7). From the standpoint of the in-land freight forwarder, the frequency of occurrence is 3, due to the fact that this negative effect also depends on the type of container being transported, a full container load or a less-than container load. In the case of less-than container loads the negative effect will be always more severe; because the negotiation with several clients usually consumes more time, and it is harder to come up with a viable solution to all of them, provoking a bigger delay. As for a full container load, negotiations are faster and may not provoke a delay. Viable solutions can either be to reroute cargo or stock it until shipping is possible, any of these solutions having an associated cost. Severity was considered level 4 for the same reasons as explained in the "Delay in cargo handling and management "negative effect. From the shipowner's standpoint this effect always occurs, and affects all the operations, since in a strike period the ship cannot load/unload their cargo, at least within the scheduled period, impairing pre-schedule services. From the port operator's standpoint, the act of delivery of orders consists in loading and unloading cargo. This negative effect is thus identical to the ""Delay in cargo handling and management", due to an high dependence between entities of the SC, and also because there are not many strategies a port operator can apply to overcome this effect.

The third most relevant negative effect, which is also highly co-related with the last two effects, is the "Incapacity to fulfill orders" with a level of 4,3 both in occurrence and severity. The explanation is similar to the one we presented for two previously described negative effects; yet with an aggravated effect, which is an high probability of having to refuse future services due to the great number of orders to fulfill, originating opportunity costs and bad company image.

The forth negative impact with higher significance is "Deviation in global costs" with an occurrence level of 4,3 and 4 in terms of severity. The standpoints of the in-land freight forwarder and of the shipowner are relatively equivalent. "Deviation in global costs" is due to the change in routes that leads to an increase of mileage covered and elapsed time, which subsequently provoke an upsurge in fuel and labor costs. This negative effect can aggravate the relationship between clients and these

3PLs, when discussions about who should cover the increment of costs occur. The in-land freight forwarder's attributed a level 4 in severity and occurrence to this negative impact, due to the fact that its effects will depend on the cargo handled being a full container load or a less-than container load. The number of customers involved may have an impact on the margin of cost, depending on how negotiations are settled with customers: usually the fewer customers involved, the better, since negotiations will be easier. It also depends on the type of contract: if the contract stipulates a door-to-door service, then these entities (in-land freight forwader and shipowner) must cover the extra costs involved, otherwise, it is not their responsibility. From the shipowner's standpoint this effect is considered level 5, both in severity and occurrence, once again due to the larger quantity of containers it carries per service. For the port operator this negative effect occurs almost every time, but the impact is not the same as suffered by the shipowner or the in-land freight forwarder: in the case of the port operator, the negative impact is due to the non-opportunity to use all the available resources, such as porticos and staff. The severity of the impact in operations is about 50% because it depends on the adhesion of the stevedores to the strike and its duration.

The fifth significant negative impact is "Loss of access to Hinterland". Despite being fifth in importance, as the frequency of its occurrence is not the highest, it can be the effect with the most negative long term impact in the SC. Losing temporary hinterland access due to punctual loss of transport connections or orders (that were re-routed to other areas) can result in a loss of potential service. But in the worst case scenario, where the hinterland access ends indefinitely, the scenario of loss of potential service changes to loss of clients and other future clients. As the scenario aggravates, the probability of an "abandoned port" becomes higher.

"Higher transportation time" ranked as the sixth most significant negative impact, as a consequence of cargo rerouting strategy. This negative effect does not apply to the port operator, since they do not transport cargo. However the shipowner and the in-land freight forwarder attributed level 4 for occurrence to this negative impact, due to the fact that this questionnaire was answered under the premise of a long strike with medium-high adherence, in which case the rerouting strategy is often used and leads to higher transport durations. As for severity, it affects 100% of the operations, because the ship(s)/truck(s) that will transport the cargo to the new different location will spend extra time in the transport, which will interfere with the schedule planning of future services.

"Insufficient storage space" is the seventh most noteworthy negative effect. All entities gave it a level 3, both in severity and occurrence. This impact is associated with the amount of workload and with the duration of the strike. So, in average, it is a negative effect that will always occur in a long crisis, and that has a considerable impact in operations, since it can lead to rejection of future services due to lack of physical space to store cargo. However these situations pass briefly, since the clients put all efforts in receiving their cargo as fast as possible, avoiding getting stalled along the SC.

The eighth negative impact is “Loss of service due to cargo redirection”. From the perspective of the in-land freight forwarder and of the shipowner it is considered both a level 2 in occurrence and severity, due to the fact that it is not common, or at least it hasn’t happened in previous strikes in the Port of Lisbon, to lose orders due to rerouting actions. But it also depends on where the cargo is deviated to and of the duration of the strike; plus, usually these entities are the ones providing the rerouting of cargo for their clients. In a worst case scenario, it is possible that these companies suffer from “Loss of service due to cargo redirection” because their customers may start changing services to other ports, which these companies do not operate: the customer may prefer to start dealing directly with a more distant port, instead of having to pay extra for constantly rerouting cargo from a nearby port frequently on strikes. The port operator’s viewpoint is completely different from the other 3PLs. This is the most severe negative effect, since the work volume decreases significantly when the cargo is rerouted to other ports, a port operator being a static entity, necessarily having to provide their services within their port of operation, there are no solutions available to overcome this negative effect. And as mentioned before, when this event happens recurrently, there is a high probability of clients “abandoning” the striking port. The port operator of this case study, used to perform 16.000 cargo movements per month before the strike, still reduced to approximately 4.000 cargo movements even two or three months after the strike ended.

The last two negative effects, “Transportation of incorrect cargo” and “Loss of cargo” had the lowest possible rate, as the entities did not considered these effects to be provoked by port strikes. Figure.7.3 helps to visualize the results of Table 7.9, positioning the negative effects in terms of occurrence and severity. The size of each bubble is determined by multiplying the values of occurrence and severity for each negative effect.

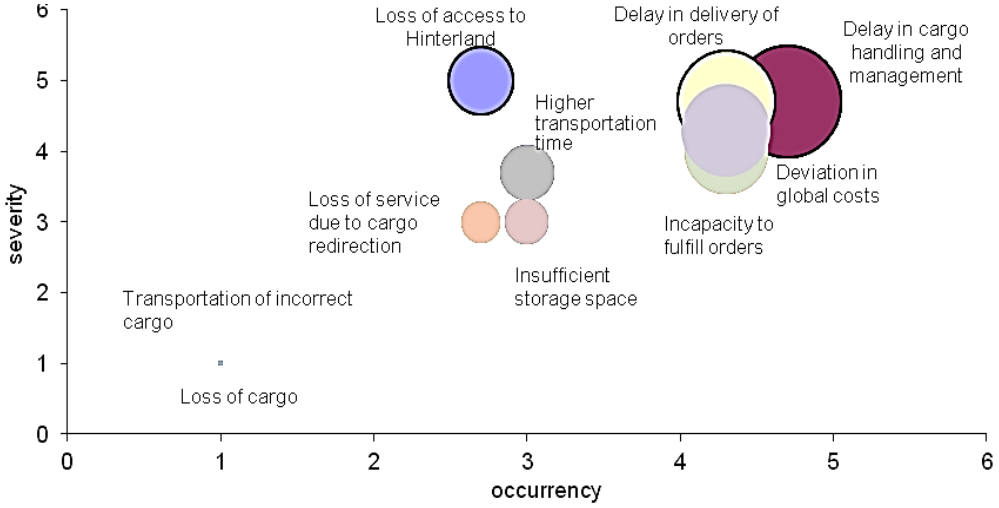

Figure 7.3 - Negative effects: severity x occurrence

It is possible to conclude that port strikes trigger several negative effects that reflect differently on different entities, causing a chain reaction that will eventually severely impair the whole SC. The most critical negative effect, in terms of severity, is the “Loss of access to Hinterland”, since it definitely leads to loss of service. It is important to notice that the negative effects with more probability of

occurrence also ranked top in severity. A study done by Colicchia et al. (2010), as shown in Table 5.1 shows that a strike will always have an high impact in port activities that will cause a port clogging when not performing properly.

Based on the results obtained, we can answer the research question 1 "Which are the negative effects of a port strike on 3PL companies?" as follows:

There are several negative effects derived from a port strike; according to the research results, the most significant ones, considering both severity and frequency of occurrence, are “Delay in cargo handling and management”, “Delay in deliver of orders”, “Incapacity to fulfill orders” and “Deviation in global costs”. Only two of the port strike negative effects do not affect operations, because all interviewees agreed that they are not provoked by a port strike. The remaining eight affect at least 50% of the operations, with a majority of negative effects affecting almost 100% of operations.

7.3.2. Key performance indicators

During the strike period, it is important for companies to track their performance, to compare the business level during a period of strike *vs.* a normal period. KPIs help this analysis of the impacts of the strike, aiding companies to overcome future disruptions.

To assess the most important KPIs used to measure the 3PLs performance during a long port strike, the interviewees were asked to fill in Table III of Appendix A. The KPIs relevance was measured using a 5 point likert scale, being: 1- “Not relevant” and 5- “Very relevant”. To better comprehend which KPIs are most relevant in a SC, the average relevancy level per KPI was also computed. Table 7.10 contains the KPIs and their respective relevance.

Table 7.10 - Key performance indicators relevance in a port strike period

Key performance indicators	**Relevance to the analysis of the company's performance during a strike** 1- Not relevant 3- Moderately relevant 5- Very relevant			**Average level**
	ETE-Logística (In-land freight forwader)	**Transinsular** (Shipowner)	**Liscont** (Port operator)	**-**
Number of orders late delivered	4	5	4	4,3
Maximum handling/shipping capacity *vs.* Containers effectively handled/shipped	4	4	5	4,3
Inactivity time	3	5	5	4,3
Difference between estimated costs and actual costs	4	5	3	4,0
Number of orders made on schedule	3	3	5	3,7
Average time for an order	3	4	4	3,7
Average waiting time of full containers – to ship	4	2	5	3,7
Transportation cost	4	5	1	3,3
Cargo re-routed to other ports	2	2	5	3,0
Number of complaints received	1	2	4	2,3
Amount of cargo damage / lost / stolen	1	1	1	1,0

One of the most important KPI is the “Number of orders late delivered”. A KPI that all three companies considered highly relevant, since the final objective of any of the 3PLs is to deliver the product on time to their clients, which in a strike period can be extremely hard. This indicator can be used as a tool for companies to study, for example, the necessity to upgrade their infrastructures to better endure a strike. Another KPI of great importance is “Maximum handling/shipping capacity *vs.* Containers effectively handled/shipped” because it allows the companies to compare and analyze the utilization rate and efficiency of their resources in a strike period *vs.* a normal period. The KPI “Inactivity time” also allows companies to ascertain their resources wastage, the decrease in work volume and the opportunity cost due to the strike. “Difference between estimated costs and actual costs” is very important from the perspective of the shipowner and the in-land freight forwarder. This KPI analyzes the increment of transportation costs, associated with the “Deviation in global costs” negative effect, and gives an indication on how much more profit or loss the company will obtain due to the strike – during a strike, in-land freight forwarders can sometimes profit, because a lot of customers will be searching to re-route cargo to other ports, giving in-land freight forwarders negotiation power. As for shipowners, it is rather difficult to profit in such situations due to the strict schedule of their services and the conditions they operate in. Clients do not ask shipowners to re-route their cargo because they know shipwoners will only re-route cargo, when there is no other possibility. For port operators this KPI will provide information on the diminution of utilization rate of fixed costs (for example, infrastructures such as porticos). Among all the interviewees, the shipowner was the one who considered this KPI more relevant, due its complex logistic planning, followed by the in-land freight forwarder, for similar reasons. The port operator did not find it as important as the other two companies, since for them a strike will not usually cause as many additional costs, more a lack of assets utilization and a drastic decrease of their business volume.

Similarly to the first KPI, the “Number of orders made on schedule” allows the company to quantity the number of orders performed on time, in a strike period. This KPI is more relevant to port operators, as in a period of strike, with the cargo already on their premises with no possibility to reroute it, it is only up to them not to get the cargo stalled in the port.

The KPI “Average time for an order” takes in consideration the order’s dimension dimensions and the number of clients relying on them. This is a very useful KPI to evaluate the impact of a strike on the average time to fulfill an order. For port operators, this KPI can be used to analyze the increment on time in function of the level of strike adherence.

The KPI “Average waiting time of full containers – to ship” is most relevant to the port operator, since the main function of this entity is to handle cargo in the port’s quay. The time consumed during this activity is crucial for the success of the company. This KPI is also taken into account by the in-land freight forwarder, as this entity performs a cross-docking service, having the responsibility for the loading and unloading of cargo, as well as its transport -- being so, the extent of the period during which the container is on hold to be transported is also important to this entity. The shipowner does

not consider this a very relevant KPI, since its activity consists only in the transportation of cargo; nevertheless it is affected by the delay of the other companies.

The KPI “Transportation cost” is irrelevant to the port operator since they do not perform transportation. It is, however, of great importance to the shipowner and to the in-land freight forwarder, because of the cost increase due to the upsurge of mileage and time when cargo is rerouted. In some cases, when this cost increase is covered by the client, these entities can actually augment their profit margin on transportation.

“Cargo re-routed to other ports” is a KPI relevant only to the port operator, because this KPI indicates the potential loss of service loss they have for operating in the striking port. For the in-land freight forwarder and for the shipowner this is not very relevant, as these are the entities that actually perform the rerouting of cargo, and not the ones not losing service.

The KPI “Number of complaints received” is not very relevant to the shipowner and to the in-land freight forwarder, because in a strike period the complaints will not be about their service, even though these entities can apply strategies, such as cargo rerouting to overcome a port strike and keep their clients. However for the port operator, it is of major importance to analyze complaints during a port strike period, since a port operator is a static company, responsible for the striking stevedores, with no considerable strategies to overcome the strike, risking the loss of clients (shipowners that may terminate service with the port). For this reason, this entity considers this KPI very relevant in a strike period, as it provides them with data pertaining to the decrease in the number of clients. These complaints can be transmitted to the port authorities that can help taking measures to safeguard the proper functioning of the port.

The KPI “Amount of cargo damage / lost / stolen” it is not considered relevant, since a port strike does not potentiate the variation of this KPI.

KPIs are very important, especially in a critic situation like a port strike, because they help to better understand its negative impacts and possible solutions. In this case, since a strike is such a severe disruption for the operations performed by these entities and causes so many negative impacts, almost every KPI plays an important role to assess the companies’ performance during the strike. The KPIs with higher relevance level are the ones that prove more vulnerable to change during a strike, and also because they are related to the service quality

Based on the results obtained, we can answer the research question 2 “How is the performance of the company assessed when a port strike occurs?” as follows:

The 3PL performance, when subjected to a disruption such as a port strike, can be assessed through KPIs. KPIs’ relevance in assessing the companies’ performances differ according to the type of

service that each company provides. From the research data, it is possible to estimate an average relevancy level per KPIs for the three companies. The results demonstrate that the most relevant KPIs are: “Number of orders late delivered”, “Maximum handling/shipping capacity *vs.* Containers effectively handled/shipped” and “Inactivity time”.

7.3.3. Resilience strategies

To analyze the strategies that the 3PLs used during a port strike, the interviewees were asked to fill in Table IV of Appendix A; taking into consideration the frequency of implementation of each strategy in their companies during a long port strike. The frequency of implementation was measured using a 5 point likert scale, being: 1- “Never utilized” and 5- “Always utilized”. To better comprehend which strategies are most utilized in a SC was also computed the average utilization level per strategy. Table 7.11 contains the strategies and their respective level of utilization.

Table 7.11 - Strategies implemented during a strike

Strategies	**Frequency of implementation (1-5)** 1- Never utilized 3 – Often utilized 5- Always utilized			**Average level**
	ETE-Logística (In-land freight forwader)	**Transinsular** (Shipowner)	**Liscont** (Port operator)	**-**
Anticipated communication with the port	4	5	5	4,7
Resort to outsourcing	4	3	3	3,3
Create partnerships	3	4	3	3,3
Re-route cargo to other ports	4	4	1	3,0
Negotiation with the stevedores’ syndicate	1	1	5	2,3
Postpone the delivery of cargo (in cases of non-urgent situations)	2	2	2	2,0
Compensation agreement with customers (in case of a failed delivery)	1	1	2	1,3
Change the customs inspections of the port of origin to the port of destination	1	1	1	1,0

The first mitigation strategy that all companies consider essential is "Anticipated communication with the port”. For the shipowner, timely communication is essential to find out about the possibility of a strike and its proportions, enabling him to mitigate risk by preparing in the best possible way for the situation. From the standpoint of the port operators, communication serves to alert the Port of possible strikes by its workers, so the information can reach other points of the SC. Despite strikes being always announced in advance by the stevedores syndicate, this communication between shipowners, in-land freight forwarders, port authorities and port operators promotes better visibility of the constraints the strike will provoke, and helps to find solutions that will suit all stakeholders.

The utilization of outsourcing solutions is a very common contingency strategy during a long period of strikes, due to the high possibility of the available resources being depleted. For example, in-land freight forwarders can contact other similar companies to use their transportation services. Shipowners can resort to chartering, and port operators can rent extra storage in a warehouse. This is a good strategy to overcome a negative effect such as the “Incapacity to fulfill orders”.

Another common mitigation strategy, which also depends on the level of strike recurrences, is the creation of partnerships to create win-win situations. Through the conciliation of services, companies have better chances to overcome negative effects, in this case, of a stevedore's port strike. All companies inquired in this case study belong to a group and, as such, partnerships already exist, so the necessity of making new ones is not as necessary. One good example of this strategy applied during the port strike in Lisbon is the creation of the company Porlis, a company that provides stevedoring activities. This company is majorly owned by Liscont, with 55% of total shares, 30% by Sotagus, 5% by multiterminal and the remaining 10% by a company outside the Mota Engil group, TMB, Terminal Multiusos do Beato.

The contingency strategy "Reroute cargo to other ports", although it may generate complications due to logistics re-planning, is almost always implemented during a prolonged strike, with strong adherence by in-land freight forwarders and shipowners. Also, the law allows shipowners to unload cargo in the port nearest to the port on strike, to avoid waiting off shore. As for port operators, as mentioned before, this is not a viable strategy, but a huge negative impact as they see their clients being diverted elsewhere. As also mentioned above, this strategy has an impact on costs that depends on what the contract these entities have with their clients states about who will cover the extra costs. This strategy may be profitable to in-land freight forwarders and shipowners, since with clients in urgent need to receive their cargo these entities possess a bigger negotiation power, allowing them to increase profit in transportation.

The mitigation strategy of "Negotiation with the stevedores' syndicate" is never implemented by the shipowner or by the in-land freight forwarder. However, is a strategy that port operators try to apply, although difficult to implement because it involves labor laws. Even though the shipowner does not negotiate directly with the stevedores syndicate, there are times that this entity is present at negotiations. For example, the interviewed company participated in the negotiations between the regional government, the stevedores syndicate and the port operators concerning the supply of the Azorean autonomous region. In this Portuguese region, located in the Atlantic Ocean, 90% of the cargo received is from the mainland, and therefore the region is extremely dependent on the well-functioning of the main continental ports. The goal of this negotiation was to ensure the least possible disruption in the transportation of priority cargo, such as cattle, food and medicine. The shipowner was present to determine if it was economically viable to make a trip to Azores carrying only cargo of this nature.

The contingency strategy of "Postpone the delivery of cargo (in cases of non-urgent situations)" is not taken into much account by any of the entities because the client, rarely agrees to it, even in a long strike and with storage-free type of deals, as mentioned in the "Client compensation agreements, in case orders are out of schedule" strategy.

The contingency strategy “Client compensation agreements, in case orders are out of schedule” depends on the type of contract and on the level of logistic integration that the company has with their clients. The companies in this case study do not use this strategy, due to the type of contract they establish with their clients. Port operators sometimes try to offer free storage until it is possible to ship the cargo, but customers are not interested in this type of deal, since they want their cargo to arrive as fast as possible.

Concerning the mitigation strategy “Change the customs inspections of the port of origin to the port of destination”, all three companies considered that they never implement this strategy. Firstly because international shipment does not allow it and secondly because the stevedoring strike does not affect customs inspections and customs boards do not affect the service level of this companies.

Under the event of a prolonged port strike, there are strategies that may be used by the entities on the SC to mitigate its effects, but due to the complexity of the problem and high inter-dependence of these entities, they are difficult to implement and they do not significantly solve the problem. In fact, of all these strategies, it is important to state that the only that can eliminate the strike threat is the “Negotiation with the stevedores’ syndicate” – with an average utilization level of 2,3 since of all the three companies, only the port operator can apply it; plus it is a strategy that involves a lot of time, implying morose negotiations regarding labor laws, rights and principles. All the other strategies cannot eliminate a strike, but only help the entities to better adapt and reduce its negative impacts.

Due to lack of data, it was not possible -- as made in the study by Colicchia et al. (2010) -- to analyze and quantify the effectiveness of each strategy. In this case study it was only possible to examine the strategy’s’ implementation by each entity. In an overall view, in terms of implementation of the eight strategies, Table 7.10 contains four mitigation strategies and four contingency strategies. The most used strategy is a mitigation one, “Anticipated communication with the port”, but it lacks effectiveness to solve the problem. Even so, the most effective one is also a mitigation strategy, but it is only used by one entity, the port operator. New and better mitigation strategies should be implemented to reduce the probability of a port strike probability, and to be able to keep up with the continuous growth of the containerization commerce. But effective measures such as hiring outside workers are restricted due to governmental laws:, for instance, the Port of Auckland was fined $40.000 by the Employment Relations Authority for illegal employment of strike breaking contractors in 2012 (Saveourport, 2012).

Based on the results obtained, we can answer the research question 4 “Which strategies do 3PL companies implement to avoid a rupture in the distribution due to a port strike?” as follows:

There are few available resilience strategies to avoid a rupture in the distribution due to a port strike. The strategy mostly used is “Anticipated communication with the port”. Strategies also often used are “Resort to outsourcing”, “Create partnerships” and “Re-route cargo to other ports”. But it is important to

state that the most effective one is “Negotiation with the stevedores’ syndicate” although it has a low level of implementation.

7.3.4. Relationships between negative effects

The stevedore strike provokes a set of negative effects that jeopardizes the 3PLS performance. Each negative effect can influence the occurrence and severity of others negatives effects in a behavior similar to a "snow ball effect". A negative effect can have a positive influence (when it reduces the severity of the other negative effect), a harmful influence (when it increases the severity of the other negative effect) or no influence at all, having, respectively, a positive influence, a negative influence, or no influence with other negative effects.

To evaluate the influences between negative effects, respondents were asked to fulfill Appendix B - Table I regarding the effect of a strike **negative effect *i*** towards a **negative effect *j***: the negative sign means it has a negative influence, the zero signal means it has no influence and the positive sign means that it has a positive influence.

Table 7.12, Table 7.13 and Table 7.14 display the most significant influences among the negative effects provoked by a stevedores’ strike. Every interviewee confirmed that all negative impacts lead to a progression of other negative effects, creating a negative snow ball effect.

Table 7.12 - Influences among the strike negative effects in ETE-Logística

Negative effect *j* / **Negative effect *i***	Loss of access to Hinterland	Delay in cargo handling and management	Delay in delivery of orders	Incapacity to fulfill orders	Loss of service due to cargo redirection	Higher transportation time	Deviation in global costs
Loss of access to Hinterland		**0**	**0**	**0**	**-**	**-**	**-**
Delay in cargo handling and management	**-**		**-**	**-**	**-**	**-**	**-**
Delay in delivery of orders	**-**	**-**		**-**	**-**	**-**	**-**
Incapacity to fulfill orders	**-**	**-**	**-**		**-**	**-**	**-**
Loss of service due to cargo redirection	**-**	**-**	**-**	**-**		**-**	**-**
Higher transportation time	**-**	**-**	**-**	**-**	**-**		**-**
Deviation in global costs	**-**	**-**	**-**	**-**	**-**	**-**	

Table 7.13 - Influences among the strike negative effects in Transinsular

Negative effect *j* / Negative effect *i*	Loss of access to Hinterland	Delay in cargo handling and management	Delay in delivery of orders	Incapacity to fulfill orders	Loss of service due to cargo redirection	Higher transportation time	Deviation in global costs
Loss of access to Hinterland		**0**	**0**	**0**	-	-	-
Delay in cargo handling and management	**0**		**0**	**0**	**0**	**0**	**0**
Delay in delivery of orders	-	-		-	-	-	-
Incapacity to fulfill orders	-	-	-		-	-	-
Loss of service due to cargo redirection	-	-	-	-		-	-
Higher transportation time	-	-	-	-	-		-
Deviation in global costs	-	-	-	-	-	-	

Table 7.14 - Influences among the strike negative effects in Liscont

Negative effect *j* / Negative effect *i*	Loss of access to Hinterland	Delay in cargo handling and management	Delay in delivery of orders	Incapacity to fulfill orders	Loss of service due to cargo redirection	Higher transportation time	Deviation in global costs
Loss of access to Hinterland		**0**	**0**	**0**	-	-	-
Delay in cargo handling and management	-		-	-	-	-	-
Delay in delivery of orders	-	-		-	-	-	-
Incapacity to fulfill orders	-	-	-		-	-	-
Loss of service due to cargo redirection	-	-	-	-		-	-
Higher transportation time	-	-	-	-	-		-
Deviation in global costs	**0**	**0**	**0**	**0**	**0**	**0**	

The three tables are relatively similar. All companies consider that the negative effect of “Loss of access to Hinterland” does not affect the following negative effects: “Delay in cargo handling and management” “Delay in delivery of orders” and ”Incapacity to fulfill orders”, since with no access to the Hinterland, no orders can arrive. The in-land freight forwarders’ and the shipowners’ tables present the most similarities, since both companies perform transportation activities. The in-land freight forwarder also performs cross-docking activity; that is why it considers “Delay in cargo handling and management” to negatively impact all the other negative effects. As for the shipowner, since it does not perform cargo handling and management, this negative effect is not taken into consideration, although this company will be affected if this activity is poorly performed by the other companies. As for the port operator, all negative effects influence negatively all the others, except for the “Higher transportation time”, since they do not perform transportation activities. “Deviation in global costs” too

does not affect other negative effects because it does not involve a quantitative economic impact, but only a waste of resources that it is not possible to use.

These negative effects all originate in the terminal operations as illustrated in Figure 5.2, consequence of failure mode “work staff not available due to a strike” (presented in Table 5.2). The negative effects potentiate each other’s, propagating along the port environment until they reach the final client. It is an alarming situation since, due to the high dependency between companies in the port environment, almost every negative impact has a severe impact in every company (as can be seen in Table 7.8), even when it is not their fault.

Figure 7.4 shows the influences between negative effects common to all three companies in the study.

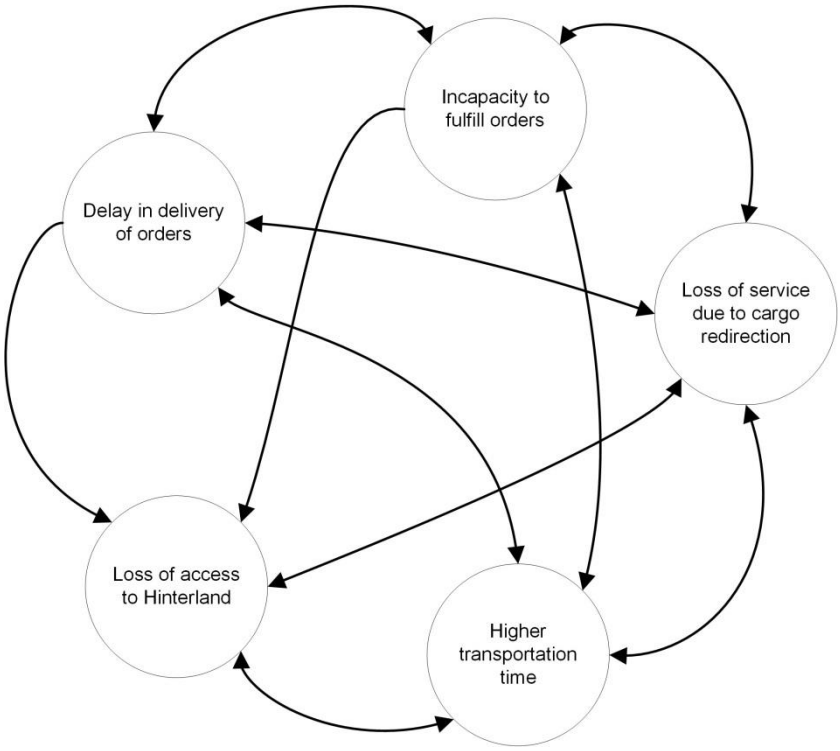

Figure 7.4 - Influences between negative effects common to all three companies in the study

Based on the results obtained, we can answer the research question 4 “Which relationships exist between the negative effects?” as follows:

In general, all negative effects potentiate other negative effects, except if the company does not provide a service that can be affected by that negative effect, or if there is no correlation between two or more negative effects. Of all the negative effects, only three do not potentiate the occurrence of failure modes, namely: “Loss of access to Hinterland” (partially) for all companies, “Cargo handling and management” for Transinsular and, “Deviation of global costs” for Liscont. “Delay in delivery of orders”, “Incapacity to fulfill orders”, “Loss of service due to cargo redirection” and “Higher transportation time” all provoke a cascade of system failures for all three companies simultaneously.

As already stated, “Loss of access to Hinterland” too affects other negative effects, but only partially as it will not affect “Delay in delivery of orders”, “Incapacity to fulfill orders” and “Loss of service due to cargo redirection”.

7.3.5. Strike impact on the key performance indicators

To evaluate the impact of the strike on KPIs, respondents were asked to fulfill Appendix B - Table II. Table II lists the aforementioned KPIs, and a scale, where the interviewees indicate the variation each KPI suffers due to a port strike. The percentages in Table 7.15 give us the full impact of the strike on the KPIs. To better comprehend the KPIs variation in the three companies under study, the average variation per KPI was also computed. The KPI relevance level when strike occurs was retrieved from Table 7.10 (Average level).

Table 7.15 – Key performance indicators variation during a port strike

Key performance indicators	Percentage variation on key performance indicators when a strike occurs				
	ETE-Logística (In-land freight forwader)	**Transinsular** (Shipowner)	**Liscont** (Port operator)	**Average variation**	**KPIs relevance**
Cargo re-routed to other ports	+60%	+90%	+90%	+80%	3,0
Inactivity time	+60%	+90%	+80%	+77%	4,3
Number of orders made on schedule	-40%	-80%	-90%	-70%	3,7
Average time for an order	+30%	+90%	+90%	+70%	3,7
Number of orders late delivered	+30%	+80%	+90%	+67%	4,3
Average waiting time of full containers – to ship	+40%	+40%	+90%	57%	3,7
Maximum handling/shipping capacity *vs.* Containers effectively handled/shipped	-30%	-30%	-90%	-50%	4,3
Number of complaints received	-	-	+90%	+30%	2,3
Transportation cost	+30%	+10%	-	+20%	3,3
Difference between estimated costs and actual costs	+30%	+10%	+40%	+27%	4,0
Amount of cargo damage / lost / stolen	-	-	-	-	1,0

Figure 7.5 also helps to visualize this large variation on KPIs, when compared with the average relevance level, a variation which is startlingly high on the most important KPIs. The x-axis represents the KPIs average variation and the y-axis represents the average relevance level per KPI. It is important to state, that in Figure 7.5 the KPI variation is in absolute value.

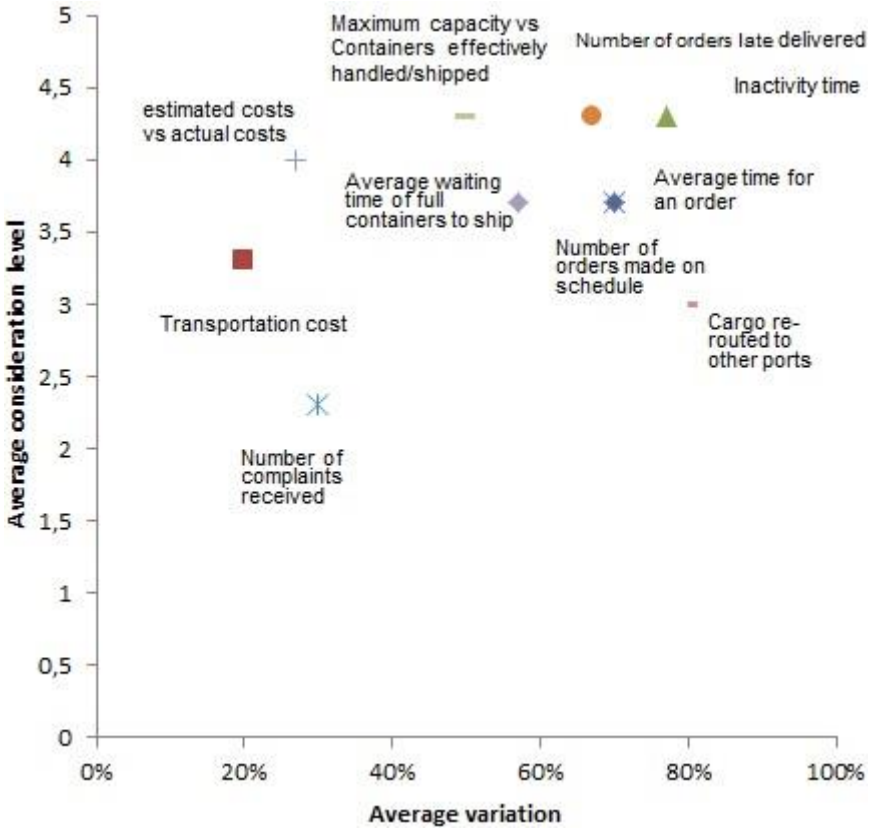

Figure 7.5 - Key performance indicators variation during a port strike *vs.* the KPI relevance

Evidence collected in the interview support that in general a strike generates a great variation on the KPIS of all companies. The port operator suffers the biggest variation, followed by the shipowner, and finally the in-land freight forwarder. It is also possible to conclude that during a period of strike, concerning the KPIs relevance level *vs.* KPIs average variation, the "cargo re-routed to other ports" is the KPI with the highest percentage of variation. This KPI increases significantly during a long strike, due to the high utilization of the strategy "re-route cargo to other ports". As it is possible to see in the study made by Mota (2013), the impacts, both economic and environmental, are extremely significant when the strategy "re-route cargo to other ports" is implemented in the long term. Thus this high variation during a strike period is extremely undesirable.

However, in terms of highest relevance levels, the KPIs "Inactivity time", "Number of orders late delivered" and "Maximum handling/shipping capacity *vs.* Containers effectively handled/shipped" stand out from the rest. The KPI "Inactivity time" also presents a high percentage of variation, placing in the farthest point of the graph's origin. The fact that the "Number of complaints" does not display a large variation is justified, as only one entity, the port operator, indicated this KPI as relevant to measure the strike impact. The other two entities are not held responsible for bad port service due to a strike, so complaints about this are not taken into account: there are a lot of complaints during a strike, but towards others entities, such as port authorities, port operators, stevedores and syndicates.

As for the KPI “Difference between estimated costs and actual costs”, it has a high relevance level to assess the companies’ performance during a strike period. However, the variation of this indicator is not very high since, in the port operator’s perspective, it only consists in a lower utilization of fixed costs. For the shipowner and in-land freight forwarder this KPI varies a little more, as it is linked to the increment of transportation costs. If there are nearby alternatives, these costs do not increase significantly during a strike, although they can escalate with the recurrence of the strike.

Based on the results obtained, we can answer the research question 5 “What is the impact of a port strike on 3PLs’ performance?” as follows:

The impact on KPIs differs from company to company, but from the research data it was possible to calculate an average variation. In absolute value, every KPI suffers a variation, at least of 20%. The KPIs that are more susceptible to variation are “Cargo re-routed to other ports”, with an average variation of 80%, and “Inactivity time”, with an average variation of 77%.

7.4. Discussion

The case study results could be compiled using the disruptive profile of the stevedores port strike in 3PLs companies can be described using the disruption profile proposed by Sheffi & Rice Jr (2005). Since the companies’ performance is affected after a disruption, the respective KPIs will be also affected. As mentioned in the theoretical foundations, a disruptive profile with 8 stages will develop. In this case, stage 4 (initial impact) and stage 5 (full impact) will be aggregated as one, initial impact and full impact, due to lack of data:

1. Preparation - Mitigation strategies:
    - anticipated communication with the port.
    - creation of partnerships.
    - negotiation with stevedores' syndicate.
    - change the customs inspections of the port of origin to the port of destination.
2. The disruption: Stevedores’ port strike that triggers significant negative effects, namely, “Delay in cargo handling and management”, “Delay in delivery of orders”, “Incapacity to fulfill orders” and “Deviation in global costs”. It is important to state that these negative effects, among others, have the capacity to negatively potentiate others, developing into a negative “snowball effect”.
3. First response:
    - Warn entities on the SC, giving priority to the client.
    - Re-organize logistics planning.
4. Initial impact + Full impact: Table 7.10 and 7.15. As stated before, in a strike of the same magnitude as the one under study, the most important KPIs are: “Number of orders late delivered”, with a direct impact on the companies’ reputation, “Maximum handling/shipping capacity *vs.* Containers effectively handled/shipped”, since it helps companies to evaluate the loss of capacity, and “Inactivity time”, useful to analyze the impact of the strike on the volume

of service level. The five most affected KPIs are: “Cargo re-routed to other ports”, “Inactivity time” and three other correlated KPIs: “Number of orders made on schedule”, “Average time for an order” and “Number of orders late delivered”.

5. Recovery preparations - Contingency strategies.
    - Resort to outsourcing.
    - Postpone delivery of cargo (in cases of non-urgent situations).
    - Reroute cargo to other ports.
6. Recovery: After a strike with the dimensions established before, the average recovering time is about five months, according to the interviewees. The recovery time depends on the scale of the strike, the damage done and the type of company.
7. Long-term impact: It is hard to quantify since it requires extensive historic data, which was not available. But the main long-term impact is the loss of client’s confidence in The Port of Lisbon, where all these three companies operate. The loss of confidence can lead the client to continue to work with the alternative port, instead of returning to The Port of Lisbon when the strike is over.

7.5. Conclusion

This chapter describes the case study. This case study consists of three companies: ETE-Logística, Transinsular and Liscont, operating in the Logistics, Shipping and Port sector, respectively. A port strike has multiple negative effects severely impacting on companies operating in these sectors, the most significant considering both severity and frequency of occurrence being “Delay in cargo handling and management”, “Delay in deliver of orders”, “Incapacity to fulfill orders” and “Deviation in global costs”. Performance of 3PLs during a port strike can be assessed by using several KPIs, the case study reveals that most important KPIs for this assessment are: “Number of orders late delivered”, “Maximum handling/shipping capacity *vs.* Containers effectively handled/shipped” and “Inactivity time” as the most important KPIs for this assessment. During a port strike, there are not many resilience strategies available to diminish its negative effects’ impacts. The case study provides evidences supporting the following strategies: “Anticipated communication with the port”, “Resort to outsourcing”, “Create partnerships” and “Re-route cargo to other ports”, as the most efficient strategy, “Negotiation with the stevedores’ syndicate” is rather difficult to implement. In general, all negative effects potentiate other negative effects, behaving as a snowball. A port strike impacts on all relevant KPIs. Though the case study support the identification of different impacts from company to company, the ones who proved more susceptible to variation were “Cargo re-routed to other ports”, with an average variation of 80%, and “Inactivity time”, with an average variation of 77%.

Chapter 8 - Conclusions and recommendations

8.1. Conclusions

The purpose of this study was to better understand how 3PLs can be more resilient when facing a port strike, using as example the recurrent strikes in the Port of Lisbon. In order to do so, a case study methodology based on an inductive approach was used. The primary data was gathered by means of questionnaire, in three Portuguese 3PLs companies, operating in three different positions in the SC.

The SC for cargo linking different continents usually consists of an in-land freight forwarder, linking the production plant to the port of shipment, where port operators handle the cargo to the shipowner that delivers it to the destination port, the same operations then following in the reverse order, finishing with the cargo in the premises of the end user. With the arising of the global economy and the consequent delocalization of production centers, logistic costs took an increasing share of the final cost of the product. Therefore, the objective is to reduce them to a minimum, with the support of 3PL companies.

Portugal's, and more specifically Lisbon's privileged location in the intersection of main commerce routes makes it a valuable logistic strategic point for the SC of worldwide companies. The Port of Lisbon is highly sought due to the good conditions it presents for load transfers, contributing greatly to the economic growth of the city and country. But the competition of other nearby ports with similar functions and capacities, such as the ports of Leixões and Sines, must not be disregarded, as these ports represent a potential threat to the Port of Lisbon due to its recurring and prolonged strikes. The cautionary tale of the Port of Marseille, that had the potential to be one of the top ports of Europe, having one of the richest hinterlands, but that due to recurrent strikes and nearby ports with similar capacity started to lose clients and is nowadays well below its potential, must not be forgotten. The Port of Lisbon is not in the same situation of lack of competition as the port of Luanda, which a few years ago had extremely bad service due to high port clogging's, but where the shipowners would wait offshore for weeks to be able to load and unload cargo, because it was the only viable economic option they had. Since the last trimester of 2012, the Port of Lisbon suffered two prolonged and severe strikes, which lasted until the first semester of 2014. Although there were two different strikes, the cause was the same.

In order to analyze the impacts of a stevedores' strike and the companies' behavior during that disruptive event, firstly it was necessary to: i) access which possible negative impacts derive from a strike, and weight them in terms of occurrence and severity of impact on operations; ii); evaluate KPIs in terms of relevancy to assess companies' performance during a strike iii) know what strategies 3PL companies implement to minimize the negative impacts; iv) comprehend the relationship between negative impacts; and finally; v) analyze the impact of the negative effects on KPIs. To accomplish this, it was first necessary to review extensive literature in order to collect a standard list of negative impacts, KPIs and mitigation and contingency strategies. Later on, with the data collected from

literature, a two phase questionnaire was elaborated and fulfilled by the interviewees, firstly via e-mail and secondly through personal interviews.

To analyze how 3PLs can be more resilient when facing a port strike, the interviewees were first asked to characterize a list of negative effects derived from a port strike, both in terms of occurrence and severity. From the list of ten negative effects, four stand out from the rest.

The first is “Delay in cargo handling and management” with a “severity x occurrence” level of 22,1 from a total of 25. This negative effect happens almost always, and affects approximately 100% of the operations: in a long strike the port’s workforce is reduced, and therefore the workflow will be slower than usual and delays will happen for sure. This effect propagates along the SC, generating failure modes like storage and transportation incapacity, and having severe consequences in operations, most times imposing a re-allocation of resources.

The second one, with a level of 20,2, is “Delay in delivery of orders”, an effect that is the consequence of the “Delay in cargo handling and management”, and that, as such, occurs almost always. As for severity, due to similar reasons, it also has an approximately 100% impact on operations. As delivering orders on time is what companies are committed to do for their customers, this negative effect can have very harmful repercussions, such as loss of service due to loss of customers.

The third one is “Incapacity to fulfill orders” with a level of 18,5. This negative effect is originated due to the previous two negative effects. Both occurrence and severity are for similar reasons, yet this negative effect highly increases the possibility to deny new service, due to the high number of orders waiting to be fulfilled, originating opportunity costs and bad company image.

The fourth one is “Deviation in global costs” with a level of 17,2. As with the previous ones, this negative effect is also very frequent, but with a different level of severity. The severity of its impact on operations for the port operator is not as critical as for the shipowner and the in-land freight forwarder, since for these two last companies, the deviation in global costs is related mainly to the increase of mileage on cargo transportation, which sometimes can even be profitable. As for the port operator, this deviation is only due to the lack of utilization of their resources.

The second step to be able to analyze how the resilience of 3PLs when facing a port strike was to understand which KPIs the 3PLs in the SC considered relevant to assess their performance during a strike period. From the list of twelve KPIs, two are clearly not relevant, namely “Amount of cargo damage / lost / stolen” and “Number of complaints received”. As for the remaining ten KPIs, they are in the range of moderately relevant to very relevant. The top three KPIs, with an implementation level of 4,3 are: “Number of orders late delivered”, “Maximum handling/shipping capacity *vs.* Containers effectively handled/shipped” and “Inactivity time”. It is of great importance for companies to keep track of "Number of orders late delivered” during a period of strike. This way, during a period of strike,

companies can calculate their levels of effectiveness and efficiency (especially the port operator, since their workers are the ones on strike). Through these indicators, companies can search for solutions to overcome this negative effect, like resorting to outsourcing. “Maximum handling/shipping capacity *vs.* Containers effectively handled/shipped” and “Inactivity time” are both correlated, since both this KPIs are used to analyze resources in terms of efficiency and utilization rate. These KPIs can help companies manage resources, for example, if re-allocation is required or if services of outsourcing are necessary.

The third step was to know and understand what strategies 3PL implemented to surpass the negative effects of the strike. The conclusion here is that there are not many strategies that 3PLs can apply, and the ones implemented are not really problem solvers, at least from the SCs’ point of view. 3PLs are, consequently not very effective in granting resilience and good functionality to a SC, when faced with a port strike. 3PLs try to find the best solutions to solve their own problems, though which is obviously an aid to the good functionality of a SC (as it helps the cargo reach its customer), somewhat also helping downstream entities. It is possible to understand this affirmation by the analyzing the variation of the volume of cargo received in periods of strikes, when compared to non-strike periods, as shown in the tables of the sub-chapter 7.1.2 and 7.1.3, and by analyzing the great KPIs variation during a strike in Table 7.15.

The strategies implemented are effective in diminishing some of the negative effects of the strike for the company that applies them, but is not so effective when it comes to obtaining a strong resilient SC as a whole. Of the eight strategies implemented, four do not reach the “usually implemented” level. Namely “Change the customs inspections of the port of origin to the port of destination” because it is not possible in international commerce; “Compensation agreement with customers (in case of a failed delivery)” because the 3PLs in study do not do this kind of contracts; “Postpone the delivery of cargo (in cases of non-urgent situations)” because clients want to receive their order as fast as possible; and finally “Negotiation with the stevedores’ syndicate” because only the port operator can apply it, and it is extremely hard to be implemented, due to number of entities involved and the complicated agreements they must reach, although when implemented it is the only strategy that solves the problem. As for the remaining four, the most used is “Anticipated communication with the port”, early communications being always indispensable so companies can better prepare for possible disturbances. Secondly comes “Resort to outsourcing”, which is effective for entities to overcome situations of over-capacity, and “Create partnerships”, which is also very useful, since the combinations of synergies can overcome negative situations. The creation of the company Porlis through the partnership between Mota-Engil and Terminal Multiusos do Beato is a very good example of this. Finally the strategy “Reroute cargo to other ports” is almost always used by the shipowner and the in-land freight forwarder, since it is a strategy that allows these companies to remain in business. As for the port operator it is not possible to implement it.

Lastly, it was necessary to understand the relationships between negative effects and their impact on KPIs. In general, every negative effect will potentiate other negative effects, except for the “Loss of access to Hinterland”, because with no access to the hinterland it is not possible to receive cargo. So “Delay in cargo handling and management”, “Delay in delivery of orders” and “Incapacity to fulfill orders” remains intact, although in a negative way.

As for the variation on the most important KPIs due to these negative effects, it is possible to conclude that every KPI suffers a variation. The minimum average variation is an increase of 20% on transportation cost, because the port operator does not weight in this average. The highest average variation is 80% for the cargo re-routed to other ports, which is normal during a prolonged strike when nearby ports with better service and capacity to absorb extra service are available -- although leading to negative impacts, as shown in the study done by Mota (2013). The second largest variation pertains to the KPI “Inactivity time” with an average increase of 77%, as when stevedores stop their activity, the dependent entities have to wait until they re-start, generating delays. The remaining three are KPIs which are similar and related: “Number of orders made on schedule” with an average decrease of 70%, “Average time for an order” with an average decrease of 80%, and finally “Number of orders late delivered” with an average increase of 67%. All these variations are due to the fact that the delays a strike provokes can also cause a state of over-capacity.

So in an overall view, a stevedores’ strike has a lot of negative effects that potentiate themselves and that have vast impacts on KPIs, since none of the strategies legally available to overcome the negative effects of a strike are very efficacious.

Stevedores’ strikes, with their potential to gradually reduce work volume, may lead to an abandoned port, crucially damaging SCs. Lisbon, having nearby ports that have better service and capacity to absorb service, risks following the path of Marseille port.

It is thus vital to the Port of Lisbon that their authorities and port operators can reach long-term agreements with their stevedores.

It would be very interesting if, in order to better understand the magnitude of this problem, future research about port strikes could present more quantitative data, instead of mainly qualitative, and if they would include steps 6, 7 and 8 as presented in the study by Eisenhardt (1989) to build theory from case study research:

- Step 6 – Shaping hypothesis or propositions: shaping constructs and emergent relationships among constructs, through searching evidences within cases and across cases.
- Step 7 – Enfolding literature: comparison with conflicting literature and with similar literature. It improves and sharpens construct definitions.
- Step 8 – Reaching closure: achieving theoretical saturation when possible.

A future study taking into account the final customer would also bring a new perspective to this issue, as it is his cargo going through the SC.

Finally, a future study analyzing the impact on KPIs of the mitigation and contingency strategies, so that the effectiveness of the strategies could be calculated, would certainly prove very useful.

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Appendix A

PROTOCOLO DE ENTREVISTA

O protocolo de entrevista específica o modo como as entrevistas serão conduzidas. A entrevista será elaborada de acordo com a seguinte ordem:

1. Apresentação do investigador e do entrevistado
2. Descrição do objectivo do estudo
3. Acordo de confidencialidade
4. Questionário

1. Investigador

O trabalho de investigação será conduzido pelo investigador Luís Brum, sobre a orientação da Professora Helena Carvalho, no âmbito da sua dissertação de mestrado do curso Engenharia e Gestão Industrial, da Faculdade de Ciências e Tecnologia da Universidade Nova de Lisboa.

2. Introdução e descrição do objectivo do estudo

Este estudo tem como objectivo, analisar o impacto das greves portuárias em empresas com funções de distribuição e se possível, encontrar soluções que consigam dar uma melhor resposta perante uma greve portuária, garantindo que o nível de performance da empresa não varie acentuadamente. Neste contexto é de elevada importância saber de que forma uma greve portuária influência a performance destas empresas, como estas empresas reagem, a severidade das repercussões da greve e que estratégias são implementadas de forma a minimizar os efeitos negativos dos distúrbios.

As entrevistas serão utilizadas na constituição de uma base de estudos de casos, que será utilizada na elaboração da dissertação.

3. Acordo de confidencialidade: procedimento para recolha e análise de dados

- A entidade dos entrevistados e organizações serão mantidas confidenciais. Não serão reveladas sem o prévio consentimento escrito dos interessados.
- Todos os dados resultantes da entrevista permanecerão na base de dados do investigador.
- Os dados associados ao estudo de caso poderão ser publicados em publicações (Teses, Comunicações e Artigos) desde que se mantenha a confidencialidade das fontes.
- Com a permissão dos entrevistados serão tomadas notas.
- Reserva-se o direito ao interlocutor de não responder a alguma questão que este considere não pertinente.
- As notas serão transcritas e sintetizadas pelo investigador. As sínteses serão posteriormente enviadas para o entrevistado para aprovação.

4. Entrevistas

O investigador não deve influenciar os seus interlocutores, abstendo-se nomeadamente de emitir opiniões ou orientar preconceituosamente as entrevistas e a selecção de documentos a analisar.

As questões a colocar dividem-se em duas fases, a primeira fase, que consiste no questionário 1, efectuar-se-á via correio electrónico, seguida de uma segunda fase que irá consistir numa entrevista pessoal.

1ª FASE: Questionário 1.

I. Informações gerais sobre o entrevistado e empresa

II. Quais os efeitos negativos provenientes de uma greve portuária
III. Como é avaliada a performance da empresa
IV. Quais as estratégias implementadas de forma a evitar uma ruptura na distribuição devido à greve portuária

2ª FASE: Entrevista pessoal.

I. Quais são as relações existentes entre os efeitos negativos
II. Qual o impacto no desempenho devido à greve nos indicadores de desempenho

QUESTIONÁRIO 1

Estratégias de gestão com o objectivo de reduzir os efeitos negativos de uma greve portuária nas cadeias de abastecimento

Este questionário tem por objectivo apoiar uma investigação que pretende identificar e caracterizar a capacidade de resposta das empresas de forma a evitar e/ou minimizar os efeitos negativos nas cadeias de abastecimento devido a uma greve portuária.

A sua contribuição é muito importante para o desenvolvimento deste estudo. Por favor aceite colaborar com esta investigação através da resposta às seguintes questões.

I. Informações gerais para identificação do entrevistado e da empresa.

Informações gerais sobre o entrevistado

- Nome: Função: Contacto telefónico: E-mail:

Informações gerais sobre a empresa

- Sector: Volume de negócios anual:
- Número de funcionários:

II. Quais os efeitos negativos de uma greve portuária.

Utilizando uma escala de 1 a 5, por favor assinale com uma cruz a sua percepção sobre a frequência de ocorrência e a severidade dos efeitos negativos abaixo referidos

Efeitos Negativos	**Ocorrência** 1- Nunca ocorre 3- Geralmente ocorre 5- Ocorre sempre					**Severidade nas operações** 1- Não tem efeito nas operações 3- Afecta em 50% as operações 5- Paragem total das operações				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
Perda de acesso ao Hinterland.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Atraso no tratamento e gestão de carga	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Atraso na entrega das encomendas	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Incapacidade para satisfazer encomendas	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Transporte de carga errada	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Perda de carga	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Perda de serviço devido a redireccionamento de carga	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Tempos de transporte mais elevados	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Espaço de armazenamento insuficiente	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Desvio nos custos globais de transporte	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Outros efeitos negativos? Por favor indique quais:	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

III. Como é avaliada a performance da empresa.

Utilizando uma escala de 1 a 5, por favor assinale com uma cruz a sua percepção sobre a relevância dos indicadores abaixo mencionados como ferramenta de análise da performance da empresa.

Indicadores de performance	**Relevância para a análise da performance da empresa durante a greve** 1- Não relevante, 3- Moderadamente relevante 5- Muito relevante				
	1	**2**	**3**	**4**	**5**
Número de encomendas efectuadas no horário previsto	☐	☐	☐	☐	☐
Carga desviada para outro porto	☐	☐	☐	☐	☐
Custo de transporte	☐	☐	☐	☐	☐
Quantidade de carga danificada/perdida/roubada	☐	☐	☐	☐	☐
Tempo em inactividade	☐	☐	☐	☐	☐
Tempo médio de realização de uma encomenda	☐	☐	☐	☐	☐
Número de reclamações recebidas	☐	☐	☐	☐	☐
Número de encomendas entregues tardiamente	☐	☐	☐	☐	☐
Diferença entre custos previstos e custos reais	☐	☐	☐	☐	☐
Capacidade máxima de movimentação/transporte de carga *vs.* Contentores efectivamente movimentados/ transportados	☐	☐	☐	☐	☐
Tempo em espera médio por contentores cheios para embarque (dias)	☐	☐	☐	☐	☐
Outros indicadores? Por favor indique quais:	☐	☐	☐	☐	☐
	☐	☐	☐	☐	☐
	☐	☐	☐	☐	☐
	☐	☐	☐	☐	☐

IV. Quais as estratégias implementadas de forma a evitar uma ruptura na distribuição devido à greve portuária.

Utilizando uma escala de 1 a 5, por favor assinale com uma cruz a sua percepção sobre a frequência com que as estratégias em baixo indicadas são implementadas na sua empresa.

Estratégias	**Frequência de implementação (1-5)** 1- Nunca utilizada 3 – Utilizada algumas vezes 5- Sempre utilizada				
	1	**2**	**3**	**4**	**5**
Redirecionamento de carga	☐	☐	☐	☐	☐
Comunicação antecipada com o porto	☐	☐	☐	☐	☐
Recorrer a soluções de terceirização	☐	☐	☐	☐	☐
Adiar entrega da carga (em casos de situações não-urgentes)	☐	☐	☐	☐	☐
Acordo de compensação com clientes (caso haja falha na entrega da encomenda)	☐	☐	☐	☐	☐
Recorrer a parcerias	☐	☐	☐	☐	☐
Mudar as inspecções alfandegárias do porto de origem para o porto de destino	☐	☐	☐	☐	☐
Negociação com sindicato dos estivadores	☐	☐	☐	☐	☐
Outras estratégias? Por favor indique quais:	☐	☐	☐	☐	☐
	☐	☐	☐	☐	☐
	☐	☐	☐	☐	☐
	☐	☐	☐	☐	☐

Appendix B

Entrevista Pessoal

Estratégias de gestão com o objectivo de reduzir os efeitos negativos de uma greve portuária nas cadeias de abastecimento

I. Quais são as relações existentes entre os efeitos negativos provocados pela greve portuária?

Utilizando os sinais de + ou -, por favor assinale nos espaços em branco abaixo, se o efeito negativo *i* influencia positivamente o efeito negativo *j*, no caso de diminuir a sua ocorrência, ou negativamente caso aumento a sua ocorrência. Se não tiver qualquer tipo de influência, coloque o número 0

Efeito negativo *j* / **Efeito negativo *i***	Perda de acesso ao hinterland	Atraso no tratamento e gestão de carga	Atraso na entrega das encomendas	Incapacidade para satisfazer encomendas	Perda de serviço devido a desvio de carga	Tempos de transporte mais elevados	Desvio nos custos globais
Perda de acesso ao hinterland							
Atraso no tratamento e gestão de carga							
Atraso na entrega das encomendas							
Incapacidade para satisfazer encomendas							
Perda de serviço devido a desvio de carga							
Tempos de transporte mais elevados							
Desvio nos custos globais							

II. Qual o impacto da greve portuária nos indicadores de performance da empresa?

Utilizando os sinais de + ou -, por favor assinale na escala em baixo apresentada, o decremento (-) ou o incremento (+) dos nos níveis nos indicadores de performance.

Indicadores de performance	**Variação no indicador desempenho**										
	0 %	10 %	20 %	30 %	40 %	50 %	60 %	70 %	80 %	90 %	100%
Número de encomendas efectuadas no horário previsto											
Carga desviada para outro porto											
Custo de transporte											
Quantidade de carga danificada/perdida/roubada											
Tempo em inactividade											
Tempo médio de realização de uma encomenda											
Número de reclamações recebidas											
Número de encomendas entregues tardiamente											
Capacidade máxima de movimentação/transporte de carga *vs.* Contentores efectivamente movimentados/ transportados											
Tempo em espera médio por contentores cheios para embarque (dias)											
Diferença entre custos previstos e custos reais											

Appendix C

Relatório técnico – folha de documentação	
Relatório No. 1	**Data** 24 Maio 2014
Titulo Resiliência em empresas prestadoras de serviços logísticos perante uma greve portuária	
Autores Luís do Canto Brum	
Professora Responsável Professora Doutora Helena Carvalho	
Projecto de investigação Dissertação para obtenção do Grau de Mestre em Engenharia e Gestão Industrial	
Tipo de relatório Relatório preliminar	
Notas suplementares	
Resumo Este relatório contém os resultados obtidos na primeira e segunda fase de estudo sobre resiliência em empresas prestadoras de serviços logísticos perante uma greve portuária. O estudo foi efectuado às seguintes empresas: ETE-Logística, Liscont, Transinsular.	
Palavras-chave Cadeia de abastecimento; Greve portuária; Efeitos negativos, Estratégias	
Restrições de acesso	**N.º de páginas** 8

Resiliência em empresas prestadoras de serviços logísticos perante uma greve portuária

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1. Introdução e descrição do objectivo do estudo

Este estudo tem como objectivo, analisar o impacto das greves portuárias em empresas com funções de distribuição e se possível, encontrar soluções que consigam dar uma melhor resposta perante uma greve portuária, garantindo que o nível de performance da empresa não varie acentuadamente. Neste contexto é de elevada importância saber de que forma uma greve portuária influência a performance destas empresas, como estas empresas reagem, a severidade das repercussões da greve e que estratégias são implementadas de forma a minimizar os efeitos negativos dos distúrbios. O questionário é constituído por duas fases.

Na primeira fase do questionário foi efectuado o levantamento de informação através de um questionário via e-mail com vista a analisar:

- Quais os efeitos negativos que provêm da greve portuária
- Como é avaliada a performance da empresa
- Quais as estratégias implementadas de forma a evitar uma ruptura na distribuição devido à greve portuária

Na segunda fase do questionário, foi efectuado o levantamento de informação através de uma entrevista pessoa com o objectivo de analisar:

- Quais as relações existentes entre os efeitos negativos
- Qual o impacto no desempenho devido a greve nos seguintes indicadores de desempenho?

O trabalho de investigação foi conduzido pelo aluno Luis do Canto Brum orientado pela Professora Doutora Helena Carvalho, no âmbito da sua dissertação para obtenção do grau de mestre em Engenharia e Gestão Industrial, da Faculdade de Ciências e Tecnologia da Universidade Nova de Lisboa.

2. Descrição dos resultados

2.1 Amostra

O estudo foi realizado em três empresas pertencentes a uma cadeia de abastecimento que passa pelo Porto de Lisboa.

Foi efectuado um questionário faseado, onde na primeira fase foi pedido aos entrevistados que respondessem ao documento demonstrado no Anexo A (Appendix A) e numa segunda fase, que respondessem ao documento demonstrado no Anexo B (Appendix B).

A Tabela 1 contém a caracterização da amostra estudada.

Tabela 1. Caracterização da amostra

	Tipo de serviço	*N.º funcionários*	*Entrevistado*
ETE-Logística	Transitário	100-150	Director of operations
Liscont	Operador Portuário	100-150	President of the board of administration
Transinsular	Armador	150-200	Director of the company

2.2 Quais os efeitos negativos que provêm da greve portuária?

Foram seleccionados os seguintes noves efeitos negativos provenientes de uma greve portuária:

- "Perda de acesso ao Hinterland".
- "Atraso no tratamento e gestão de carga".
- "Atraso na entrega das encomendas".
- "Incapacidade para satisfazer encomendas".
- "Transporte de carga errada".
- "Perda de carga".
- "Perda de serviço devido a desvio de carga".
- "Tempos de transporte mais elevados".
- "Espaço de armazenamento insuficiente".
- "Desvio nos custos globais".

A figura 1 ilustra os resultados da Tabela II do Anexo A. Esta figura posiciona os efeitos negativos consoante a sua ocorrência e severidade, onde o tamanho das bolas é dado pela multiplicação entre a ocorrência e a severidade

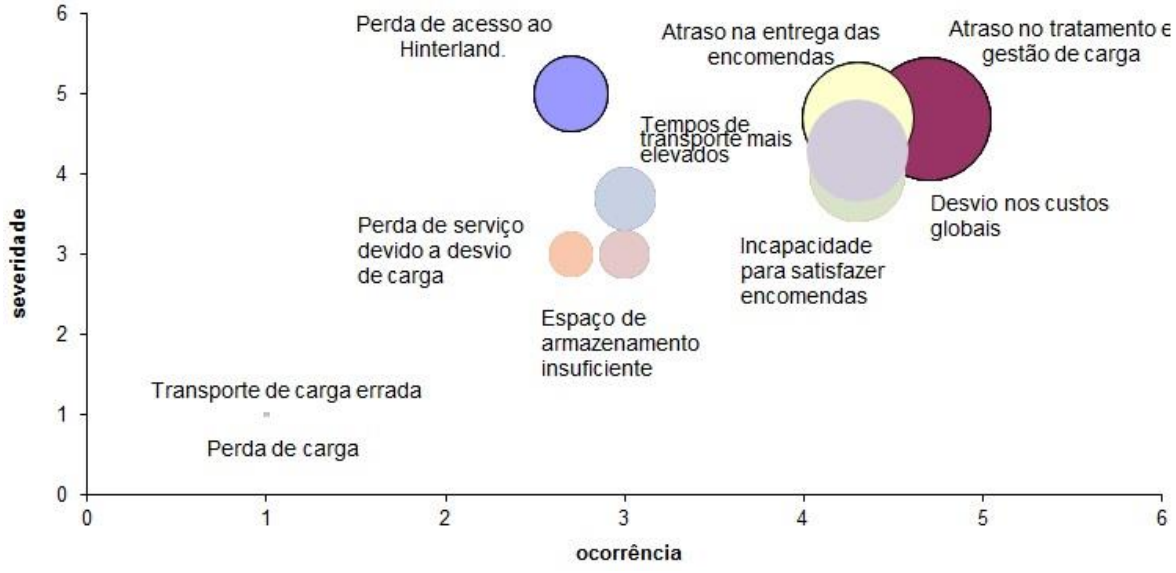

Figura 1 – Efeitos negativos: severidade x ocorrência

É possível concluir que quando ocorre uma greve portuária, provoca muitos efeitos negativos que afectam cada entidade de forma diferente. Em termos de cadeia de abastecimento, estes efeitos negativos nas várias entidades, amplificam-se devido à alta dependência entre as entidades. Apesar da maioria dos efeitos negativos se potenciarem uns aos outros, o efeito negativo mais crítico é a "Perda de acesso ao Hinterland" visto que leva a uma perda de serviço definitiva. É importante reparar que os efeitos negativos com mais probabilidade de ocorrência são também os efeitos com maior severidade.

2.3 Como é avaliada a performance da rede de distribuição?

Num período de greve, é importante para as empresas, acompanharam e controlarem a sua performance de forma a comparar os valores de negócio num período normal *vs.* num período de crise. Sendo assim, a utilização de indicadores de desempenho (KPIs) apropriados permite analisar os impactos que uma greve pode ter no seu negócio, ajudando assim as empresas a superar este distúrbio.

Neste cenário foram escolhidos os seguintes KPIs:

- Número de encomendas efectuadas no horário previsto.
- Custo de transporte.
- Quantidade de carga danificada/perdida/roubada.
- Tempo em inactividade.
- Tempo médio de realização de uma encomenda.
- Número de reclamações recebidas.
- Número de encomendas entregues tardiamente.
- Diferença entre custos previstos e custos reais.
- Carga desviada para outro porto.
- Capacidade máxima de movimentação/transporte de carga *vs.* Contentores efectivamente movimentados/ transportados.
- Tempo em espera médio por contentores cheios para embarque (dias).

Na Figura 2 estão representadas as respostas dadas pelos entrevistados à Tabela III do Anexo A.

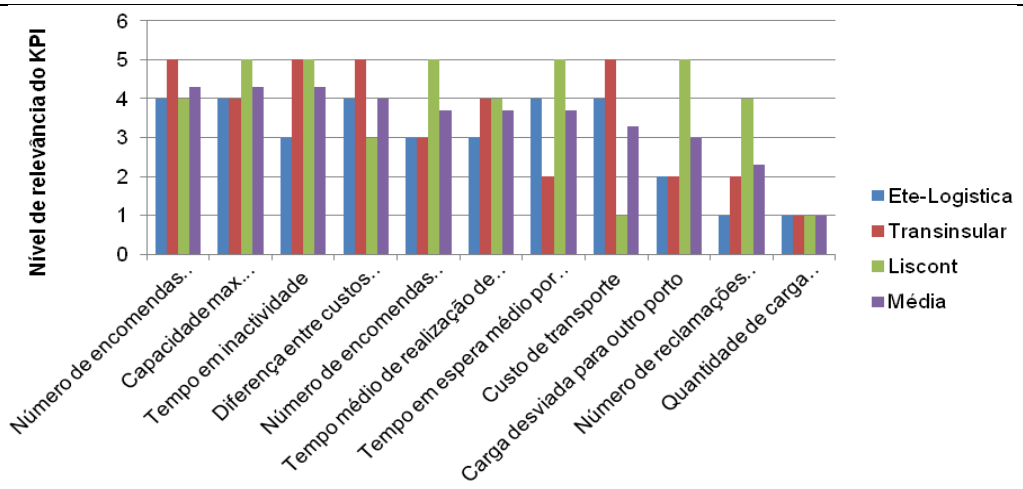

Figura 2 – Ponderação dos KPIs na avaliação da performance das empresas

Como referido anteriormente, os KPIs são muito importantes, especialmente numa situação crítica como uma greve portuária longa, visto que ajuda a entender melhor os impactos negativos e possíveis soluções. Neste caso, uma vez que uma greve é tão grave para todas as entidades e provoca tantos impactos negativos, quase todos os KPI desempenham um papel importante para avaliar o desempenho da empresa durante a greve. No entanto, em média, os KPIs mais relevantes são "Número de encomendas entregues tardiamente", "Capacidade máxima de movimentação/transporte de carga *vs.* Contentores efectivamente movimentados/ transportados" e "Tempo em inactividade", visto serem KPIs que variam bastante durante uma e que têm um impacto considerável em termos de qualidade no serviço. Já o KPI "Quantidade de carga danificada/perdida/roubada" foi desprezado dado que uma greve não influencia o seu valor em nada.

2.4 Que estratégias podem ser implementadas para evitar uma ruptura na distribuição devido há greve portuária?

A figura 3 contém as respostas obtidas relativamente à frequência de utilização das estratégias utilizadas para evitar e/ou minimizar os efeitos negativos de uma greve portuária dentro das seguintes hipóteses, apresentadas no Anexo A Tabela IV:

- Redireccionamento de carga para outro porto
- Comunicação antecipada com o porto
- Recorrer a soluções de terceirização
- Adiar entrega da carga (em casos de situações não-urgentes)
- Acordo de compensação com clientes (caso haja falha na entrega da encomenda)
- Recorrer a parcerias
- Mudar as inspecções alfandegárias do porto de origem para o porto de destino
- Negociação com sindicato dos estivadores

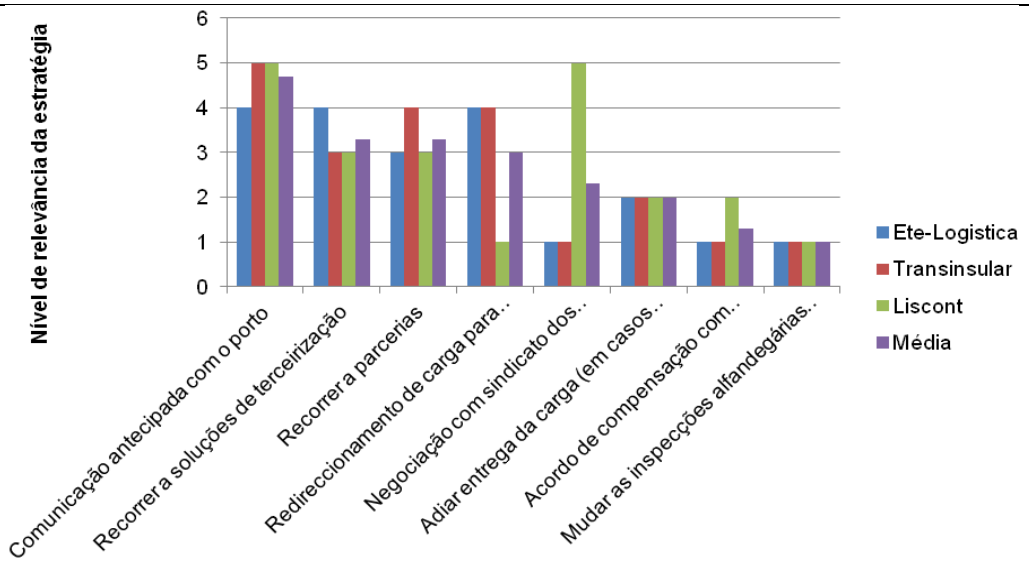

Figura 3 – Frequência de implementação das estratégias durante uma greve portuária

As estratégias mais implementadas em termos médios pelas empresas foram a " Comunicação antecipada com o porto", "Recorrer a soluções de terceirização", já a estratégia "Mudar as inspecções alfandegárias do porto de origem para o porto de destino" nunca é utilizada.

Em relação a todas estas estratégias, é importante referir que a única estratégia capaz de eliminar a ameaça de uma crise portuária é a "Negociação com o sindicato dos estivadores" que conta com um nível de consideração de 2.3, visto que das três entidades, apenas a entidade operadora portuária é capaz de fazer parte desta, porém é uma medida complexa e que requer muito tempo, visto que envolve negociações sobre leis e direitos laborais, assim como questões ideológicas.

2.5. Quais as relações existentes entre os efeitos negativos?

Foi pedido aos entrevistados que preenchessem a Tabela I do Anexo B, para melhor se perceber as relações entre efeitos negativos. Foi possível concluir que a maioria dos efeitos negativos se potenciam negativamente uns aos outros, propagando-se ao longo da cadeia de abastecimento até atingir o cliente final. É alarmante reparar que mesmo quando um efeito negativo não se inicia numa entidade específica da cadeia de abastecimento, esta é afectada na mesma por esse efeito negativo que é iniciado noutra entidade, devido à alta dependência existente entre entidades neste sector.

2.6. Qual o impacto no desempenho devido a greve nos seguintes indicadores de desempenho?

De forma a avaliar o impacto que uma greve portuária tem sobre os KPIs, foi pedido aos entrevistados que preenchessem a Tabela II do Anexo B.

A Figura 4 ajuda a visualizar os impactos nos KPIs conforme as respostas obtidas pelos entrevistados.

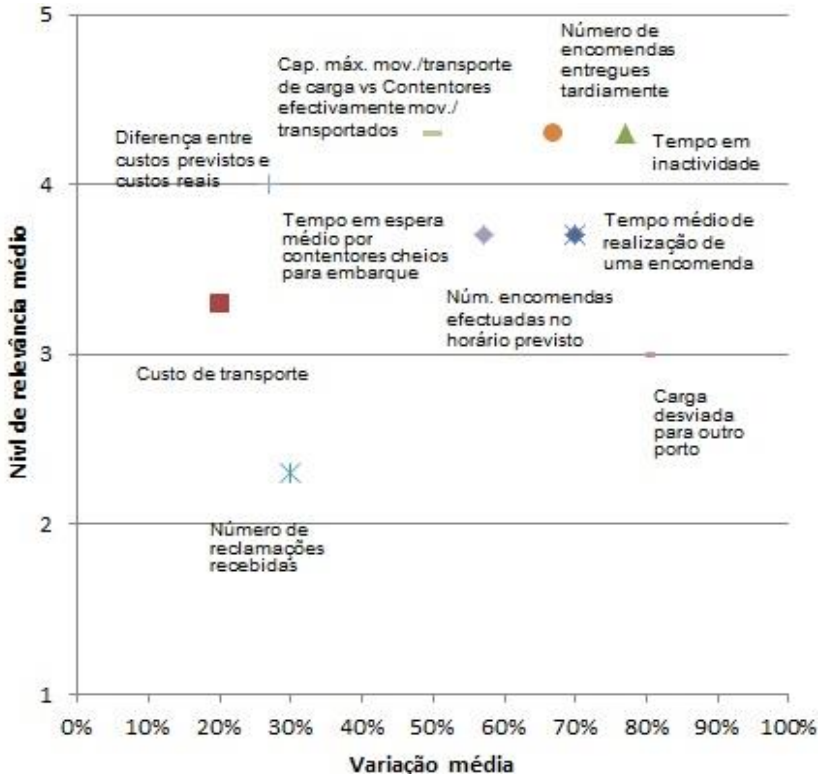

Figura 4 – Percentagem de variação dos KPIs versus nível de relevância médio

Pode-se concluir que numa época de crise, existe uma considerável variação média nos KPIs. Em relação à variação média, o KPI "carga desviada para outro porto" é o que mais varia em época de crise, visto que quando esta ocorre, este KPI aumenta significativamente, apesar do nível de consideração deste KPI não ser muito elevado, visto que duas das três entidades não sofrem grandes impactos, pelo menos no curto prazo, devido ao aumento deste KPI.

Em relação aos KPIs considerados de maior importância por parte das entidades como o "Tempo em inactividade", "Número de encomendas entregues tardiamente" e "Capacidade máxima de movimentação/transporte de carga *vs.* Contentores efectivamente movimentados/ transportados" apresentam também níveis consideráveis de variação. O KPI "Tempo em inactividade" também apresenta uma grande variação e por isso encontra-se no ponto mais longínquo da origem.

3. Conclusões

Com os dados acima apresentados, é possível concluir, que numa greve portuária, ocorrem diversos e severos efeitos negativos que se interrelacionam de uma forma negativa e que têm uma grande impacto sobre os KPIs. Para combater estes efeitos, as empresas recorrem a estratégias de mitigação e contingência, porém, estas não são muito eficazes em relação a minimizar significativamente os impactos negativos e futuras greves.