

IMPACT OF MAN-MADE DISASTERS ON COMMERCIAL LOGISTICS

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Abstract

Commercial logistics has become more unstable and volatile to man-made disasters due to the globalization of supply chains. Supply chains are becoming leaner and leaner every day to enjoy economics of scale and low cost. The leaner the supply chains are becoming the more exposed they are to the risks of man-made disasters. Just-in-Time (JIT) systems making supply chains even more exposed. Big companies are losing millions of dollars even some case billions due to issues occurred from man-made disasters. This paper is a qualitative review of impacts of man-made disasters on commercial logistics particularly focusing on supplier flow, warehousing, distribution and transportation. Illustrations from 9/11 terrorist attack, Ericsson supplier fire break, Toyota supplier fire break and many more are engrossed from the logistics and supply chain point of view.

Keywords: Man-made disaster, commercial logistics, supply chain risk, just-in-time, transportation, uncertainty, risk mitigation

INTRODUCTION

An event which leads to negative effects on life, property, livelihood or industry often causing permanent changes to human societies, ecosystems and environment is called “Disaster” (Patricelli, 2005). Disasters can be caused by naturally occurring events or it could be human-made. Earthquakes, hurricanes, flooding, or tornadoes are a few good examples of natural disaster. Anthropogenic or Human-made or Man-made disasters are disasters in which chief or direct cause of certain emergency is identifiable human action, which could be deliberate or otherwise. Compared to “technological” and “ecological” disasters, this largely involves situations in which civilian populations suffer with property losses, casualties, basic services and means of livelihood. The man-made events could be either unintentional (example: nuclear power plant event disruptions or an accidental toxic spill etc.), or deliberately caused (example: poisonings and various terrorist attacks etc.). Within logistics and supply chain management literature, a very good stream has dealt with impact of natural disasters as well as general issues like vulnerability and disruptions due to supply or demand volatility, on commercial logistics. However, literatures directly referring to issues related to impact of man-made disasters on commercial logistics are scarce. In this paper examples from 9/11 terrorist attack and Ericsson Fire Breakout will be highlighted though other issues will be discussed to demonstrate the sufferings from man-made disasters caused to commercial logistics.

METHODOLOGY AND APPROACH

This paper is basically a review of research related to human made disaster effect on commercial logistics. The paper is descriptive in nature and secondary data and information from several sources like journals, articles, reports etc. from newspapers, journals, magazines, company reports etc. are used. The paper discusses how prominent the effect of human made disaster could be on commercial logistics causing billions of dollars losses. Mitigation strategies are also discussed in the paper to avoid and cope up with hazardous situations and learnings form the past are tinted.

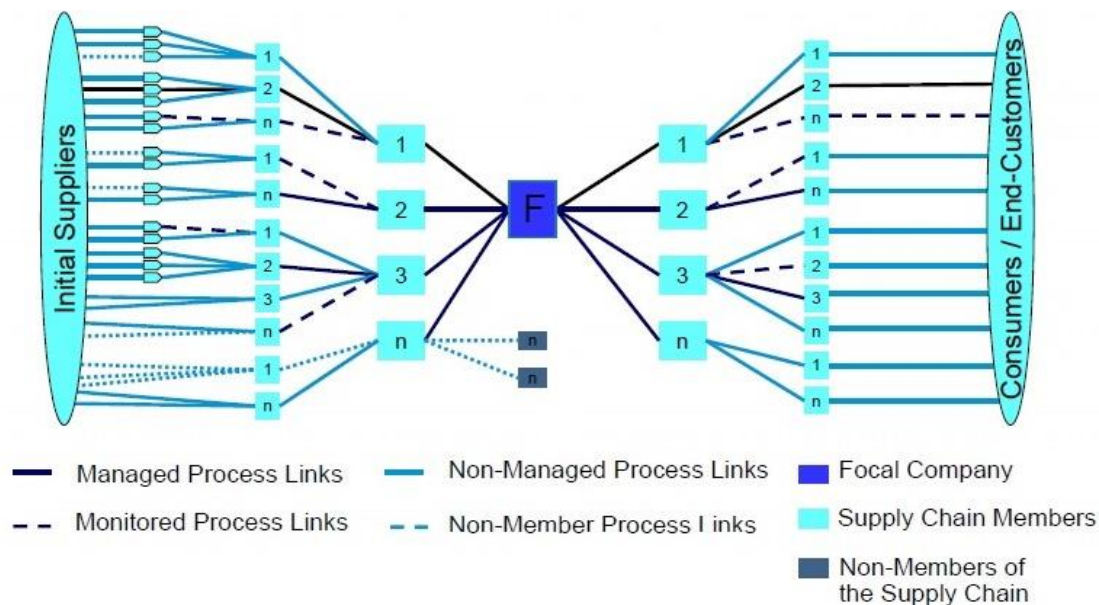
UNDERSTANDING COMMERCIAL LOGISTICS AND EFFECTS OF MAN-MADE DISASTERS

Commercial logistics has become more volatile to mad-made disasters mostly due to globalization of supply chains. Big companies are operating business over different continents and in many countries. Apart from that, due to cheap labor or cheap raw material costs, companies outsourcing their raw material or the whole production process over different continents which are far away from their business locations. Companies with JIT systems like

Toyota are saving money managing their inventory very efficiently, but on the other hand the risk of production failure due to effect of man-made disasters are quite high. Following a fire in February 1, 1997 at brake-fluid proportioning valve supplier named Aisin Seiki, Toyota was forced to shut down 20 of its 30 assembly lines on February 3 and also shutting down all of its plants and assembly line from February 4 to February 5 forcing a total shut down. This disruption lead Toyota to estimated sales loss of 70,000 vehicles which is approximately ¥160 billion in revenues and costs caused to Aisin was estimated to be ¥7.8 billion. Though Toyota recovered most of its losses but ¥20 billion to ¥30 billion loss was unavoidable, especially the setting up cost for the substitute p-valve plant (Nishiguchi & Beaudet, 1997).

In today's business world, to survive in the market, the competition is not only limited between individual companies but also between their supply chains (Li & Rao, 2005) (Trkman & Mc Cormack, 2009). Therefore, in order to understand the impacts on man-made disasters on commercial logistics it is important to understand the supply chain model first, here discussed the most accepted one by Lambert et. al (1998).

Figure 1 – The Model of (Lambert, Cooper, & Pagh, 1998)



In the figure above, it is visible that a focal company has suppliers (Tier 1) who supplies raw material to the company; but their supplier also has suppliers (Tier 2), who might also has suppliers (Tier 3). In this model, the author accentuated that the focal company should manage and monitor the most important suppliers in its supply chain, so that they can reduce the risk of disruptions which might be caused by man-made disasters. In most of the related literatures available, it is visible that the hazardous effect in commercial logistics for any focal company is

caused by the effect of man-made disasters on its suppliers business. “The leaner and more integrated supply chains get, the more likely uncertainties, dynamics and accidents on one link affect other links in the chain” (Norrman & Jansson, 2004). A typical example is, bankruptcy of Plas-tech, a Chrysler supplier driven by cash-flow and liquidity problems, led to temporary shutting down of four Chrysler plants in 2008 that resulted Chrysler losing millions of dollars (Trkman & Mc Cormack, 2009).

SOURCES OF UNCERTAINTY

Trkman & Mc Cormack (2009) separated two different sources of uncertainty to distinguish between different kinds of risk associated with disruptions.

Endogenous Uncertainty

According to the authors, the source of risk lies inside the supply chain and can lead to change in relations between suppliers and focal firm. The most remarkable ones are technology disorder.

Exogenous Uncertainty

The source of risk is considered outside of supply chains, which are categorized in two notable kinds. Discrete events like workers strike, terrorist attacks, contagious diseases etc. and continuous risks like inflation, price changes etc.

IMPACT ON DIFFERENT LOGISTICS FUNCTION

Man-made disasters include risks from both endogenous and exogenous uncertainty. The core functions which can be affected by man-made disasters are:

Supplier Flow (Material & Information)

This is the most affected part of logistics due to fire breakout and any other kinds of man-made disasters. Many of the big companies suffered millions of dollar due to the fact that their suppliers got fire in plant and could not supply raw materials for certain time. The most discussed and criticized event is the one of Ericsson’s sub-supplier fire breakout on March 18, 2000. Norrman & Jansson (2004) explained, the fire was actually in very small scale which lasted for only about 10 minutes at a sub-supplier’s plant in Albuquerque, New Mexico, USA. It was in a very small production cell not bigger than a conference room for 10 people. The fire was due power fluctuations caused due to the effect of lightning bolt hitting an electric line. The fire happened just because of the fact that when there was no electricity they did not had spare

diesel motor to run the fans. The whole accident was nothing while considering from a plant perspective but certainly it was in one of the plant's "clean rooms" which made it a big issue. The fire was so trifling that even the fire brigade was sent back when they came (Wall Street Journal, 2001). But when the annual report was announced from Ericsson in Spring 2001, they made major loss of \$400 million just because of the gaps of radio-frequency chips supply from that supplier which they used to produce in that clean room. For this supplier it took about 03 weeks to get in flow with production though the yield was only about 50 percent after 06 months and to get new equipment it would take a year at-least. This supplier was the only supplier of this chip for Ericsson and also for some lacking in information flow it took pretty long for the higher management of Ericsson to get aware of the situation. Ericsson had to give up its mobile phone business section as a consequence of this event. So, it is quite visible how terrible the impact of man-made disasters can be on any company regardless of its frequency and magnitude.

Warehousing

According to Center for Economic Business Research (2014), between the years 2009 to 2012, the annual average of fires in commercial warehouses was 588 annually causing the following impacts on business and the economy:

- A total of yearly £230.2 million direct financial loss to businesses
- An aggregated £62.8 million direct economic loss to GVA (Gross value added) and £127 million noteworthy loss due to lost indirect and induced multiplier impacts on economy

The table below demonstrates the direct financial and economic loss due to fire breakouts in 2012 (millions of pounds).

Table 1 – Direct Financial & Economics Loss Due to Fire Breakout

Loss Category	Financial Loss	Economic (GVA) Loss
Building*	81.3	-
Contents*	3.3	-
Machinery*	18.7	-
Stocks*	39.7	-
Business Interruption*	38.8	21.7
Loss of Rent	6.2	-
Other	7.1	
Business Failure*	23.8	23.8
Loss of Growth*	3.6	3.6
Local Business Interruption*	7.7	7.7
Total	230.2	56.8

Source: (Center for Economic Business Research, 2014)

The start (*) marked sectors from the above table are on focus for this study as they affect logistics process directly which in total makes loss of £216.9 million directly or indirectly to the commercial logistics sector. An example from fire breakout at one of Sony warehouse at Enfield, London on August 8, 2011 is discussed. Significant loss of structural integrity of the building which was 25 thousand square meters, as well as 3.2 million units of stock comprising more than 1.5 million CDS and other media was affected. The insurance was paid more than £80 million to cover the spoiled and burnt contents, where it was estimated £10 million loss for the warehouse building alone (Center for Economic Business Research, 2014). The loss from this fire was not only limited within Sony itself but a lot of other businesses as it caused severe direct disruptions to supply of stocks to more than 150 businesses and indirect loss from this event would be hard to measure.

The table below shows number of businesses severely affected by fire in different warehouses and their recovery time.

Table 2 – No. of Businesses Severely Affected by Fire in Warehouses & Their Recovery Time

Location	Company	Date	Warehouse Size	Type	Local businesses affected	Recovery time
Bicester	Polestar	Jun-13	Small	Magazine Depot	10	3 months
Coventry	Ney Ireland Ltd	Aug-12	Medium	Industrial	30	10 months
Dunhelm	Dunhelm Mill	Oct-11	Large	Retail	7	12 months
Enfield	Sony	Aug-11	Large	Retail	30	13 months
Loughborough	Jayplas	Apr-11	Medium	Recycling	3	
Heathrow	Servisair	Jul-10	Medium	Air Cargo	4	15 months
Leominster	Skymark Packaging	Jun-09	Medium	Packaging	60	Total Loss
Longbenton	Newcastle Productions	Jan-09	Large	Industrial	10	18 months
Atherstone	Undisclosed	Nov-07	Large	Food Packaging	25	Total Loss
Barking	Videotech Systems	Apr-07	Small	Retail	0	Total Loss
Cromwell	Momarts	May-04	Small	Art	31	Total Loss
Milton Keynes	Electrolux Dist. Cent.	Jun-99	Large	Distribution Centre	42	20 months

Source: (Center for Economic Business Research, 2014)

Distribution and Transportation

Likewise in supplier flow and warehousing, man-made disasters have enormous effects on distribution and transportation. Actually distribution is affected because transportation is affected and these issues may lead to serve financial loss to companies. The most issues on the topic

are related to the Terrorist Attack on 9/11 at United States of America (USA). During 9/11 and following days, manufacturers from USA were experiencing severe disruptions on supply of raw material due to transportation issues. Due to strict checking in borders, truck terminals and airports not only international supplies but also supplies from different parts of USA were also delayed. Due to delays in Mexican and Canadian borders, loaded trucks were delayed which resulted Ford to indolent several of its assembly lines (Sheffi Y. , 2001). Toyota has to suffer from the same event too. As air traffic was shut down, a supplier of Toyota was waiting to deliver steering sensors from Germany by Air; which caused Toyota to stop production for several hours at their Sequoia SUV plant in Indiana. Manufacturer like Toyota and Ford who operate in JIT inventory systems keeping inventory for only few days, maybe on some cases for only few hours had suffered a lot due to transportation disruption caused by 9/11 terrorist attack. Most of the loss in transportation did not happen due to the incident directly but indirectly. The government response to the incident led closing borders, cancelling flights, shutting down almost all kinds of operation, putting special security checks etc. and these issues caused loss to logistics operations. These issues also affected distribution of goods all over the country. Apart from terrorist attacks, sometimes traffic accidents of any kind can cause huge loss to the logistics process of any company. For example, accident of a truck carrying the most important and expensive material for a company can lead to loss of million dollars and as well as hampering production process. Such an accident can create huge congestion and traffic jam, which can cause delay to raw material supplies or distribution of goods of many companies causing millions of dollars loses.

MITIGATION STRATEGIES

During the past years, awareness of man-made disasters and their impacts on supply chains has grown significantly. More and more firms are starting initiatives concerning risk assessment. However, many of them do not take any action in risk management; they only assess their possible risk and then stop their activities. Tang (2006) explains several possible reasons. First, many companies underestimate the risk because of their inaccurate risk assessment. Second, a lot of them are not familiar with risk management and therefore simply do not know how to do it. Third, imprecise probabilities that a disruption occurs distort the results of risk assessment. All these factors make it difficult to set up a proper cost-benefit analysis and as a consequence, it is hard for person responsible to justify introducing contingency plans or mitigation strategies.

Many authors suggest different ways to prepare a commercial supply chain for possible disruptions. A basic way is to identify vulnerability points along the supply chain and to set up contingency plans to reduce the impacts (Oke & Gopalakrishnan, 2009).

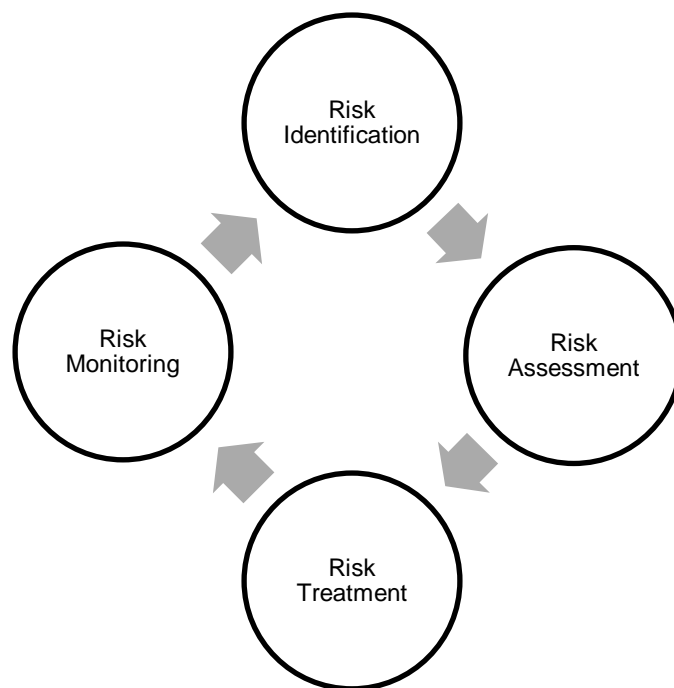
Sheffi et. al (2003) suggest to create a resilient supply chain. Based on case studies, they conclude that both an organization for resilience and a structured supply network design are needed to achieve such a supply chain. A resilient organization has to design contingency plans, which describe the procedures after a disruption in the supply chain and also define the roles and responsibilities of different persons explicitly. Moreover, it is important to perform trainings and education for company staffs. The contingency plans have to be tested through simulation so that all the staff is informed about what to do in case a man-made disaster occurs. The second part for creating a resilient supply chain is investing in supply network design. Companies can either focus on redundancy or on flexibility. Redundancy means that resources should be duplicated to reduce risk. This can be done by having more inventories, or by selecting multiple sources for a product, which leads to higher costs and inefficiencies within a company. When focusing on flexibility, companies should select suppliers that are able to modify their delivered quantities in a short period of time or the company itself should be able to up or downscale production. Of course these actions are also related with costs and investments. However, they create fewer costs than investing in redundancy and also have other advantages.

As mentioned before, a robust supply chain can help companies to reduce the impacts of man-made disasters. Tang (2006) states that the goal should be to manage supply chains more effectively and efficiently under normal circumstances and to improve reactions to supply chain disruptions to minimize the effects of these events. To achieve this goal, the author states various specific strategies. One way is to use postponement. By delaying the customization of a product, its supply chain is getting less vulnerable to disruptions. Another opportunity is to set up a so-called strategic stock. This means that some inventories should be kept at strategic locations and different partners within the supply chain should share the costs, if possible. Next, companies have the opportunity to arrange a flexible supply base, where one supplier is responsible for the material needed for regular production and another is responsible for additional or short-term demand. In this way, the risk of single sourcing is eliminated. Somewhat similar to that, the make-and-buy strategy suggests to, for example, produce expensive goods in house and to outsource production of basic parts. Furthermore, especially in areas where the number of suppliers is limited, companies can introduce economic supply incentives to help to attract additional suppliers. Investing in flexible transportation may as well lead to a more resilient supply chain. Using different transport modes, working together with transportation alliances or designing alternative routes reduce the impact of man-made disasters on commercial supply chains.

Although these strategies are needed to mitigate the impact of catastrophes, using them includes some challenges. Possibly, not all of the possibilities fit to a company's overall business strategy or there are formal regulations that impede realizing them. Overall, every firm has to analyze its own cost and benefits of each strategy and then has to decide if it is worth it to apply.

Coming back to the case study by Norman & Jansson (2004), an example of a supply chain risk management approach will be described now. After the incident, Ericsson introduced a companywide risk management approach. This approach can be divided into four phases, as shown in Figure 2.

Figure 2– Ericsson's risk management approach



Source: (Norrman & Jansson, 2004)

First, all the possible risks that might affect Ericsson's supply chain has to be identified. They do so by analyzing the supply chain upstream and all their suppliers and by classifying the risks. In the next step, an in-depth analysis is carried out using a special evaluation tool. All the risks are assessed based on their probabilities and impacts. Afterwards, during the risk treatment phase, mitigation strategies are developed and decided on. Moreover, response, recovery and restoration plans are established. Monitoring the different identified and assessed risks is the main task during the last phase (Norrman & Jansson, 2004).

CONCLUSION AND DISCUSSIONS

Man-made disasters can have severe impacts on commercial supply chains. As described in the sections above, disasters like the terrorist attack 9/11, as well as small-scale incidents may lead to heavy disruptions. More and more companies focus on JIT strategies, single sourcing and lean principles. It is proven that these operational strategies help to reduce cost and increase revenues, but most of the time it is only applicable under normal circumstances. Once an event happens that leads to supply chain disruption, the effects most probably are even more severe. Especially in the case of Ericsson, it can be shown what the impacts are, if a single supplier cannot deliver anymore. Not only procurement is affected but also transportation in general. As highlighted, shortly after 9/11 governments closed the borders and introduced heavy security checks. This made it almost impossible to operate for a lot of manufacturers.

After knowing how big the impacts of man-made disasters on commercial logistics can be, it should be of high priority to every company to invest in a risk management system. Not only identifying and assessing the risk, but also setting up contingency plans or investing in robust supply chains. By doing so, firms can improve their supply chain activities under normal circumstances and are prepared for any disruption caused by man-made disasters.

In future research, the topic can be extended to not only solutions but also to implementation models to the problems discussed in this paper. Simulation models can be built based on different industry and their characteristics as well as focusing on different logistics functions. Supplier and warehouse selection models for robust supply chains can be developed using dynamic linear programming; and for transportation and distribution issues, real time vehicle routing models could be developed to cope up with man-made disaster situations.

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