GLOBAL SUPPLY CHAIN DISRUPTIONS AND MITIGATION STRATEGIES

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Keywords


ABSTRACT

The purpose of this research paper is to examine the increasing reality of global supply chain disruptions experienced by industries worldwide and how these disruptions can be managed. Three recent disruptions that occurred in three different industries were explored and the findings show that supply chain disruption strategies were divided into proactive strategies, before a disruption has happened, and reactive strategies, after a disruption has occurred. These strategies were used, to varying degrees, in the selected cases.
Background

Introduction

The history of supply chains can be sketched back to 1984 and 1985 to the textile industry (Rhonda & Robert 1999). Different meanings for a supply chain have been defined. According to The Supply Chain Council (1997) definition, “the supply chain – a term increasingly used by logistics professionals – encompasses every effort involved in producing and delivering a final product, from the supplier's supplier to the customer's customer” (Rhonda & Robert 1999). All in all, a supply chain delivers a finished good or service from supplier to consumer. It includes a variety of stages: manufacturer, suppliers, transporters, warehouse, retailers, and final customers. A supply chain begins with the supplier of raw materials, extending through a manufacturing process to the distributor and retailer and finally to the consumer.

In the current economic environment, companies are making the strategic decision to expand their supply chain to include international / global resourcing. Global supply chains provide a source of competitive advantage as they provide access to cheaper labour and raw materials, better financing opportunities, larger product markets, arbitrage opportunities, and additional inducements offered by host governments to attract foreign capital (Manuj & Mentzer, 2008).

As supply chains continue to evolve and become more complex with international sourcing, the associated risk increases, as well as the probability for supply chain disruptions. With the recent increasing trend of industry responsiveness and agility and the decreasing level of on-hand inventory, a higher potential for disruption is occurring (Blackhurst et al., 2005).

Disruptions to global supply chains can result from unintentional and intentional events. Examples of unintentional disruptions include natural disasters, such as hurricanes and floods. These types of events could negatively affect transportation infrastructure, supply routes, and manufacturing facilities. Unintentional events can also be manmade; accidents could create transportation delays, production stoppages, or could affect production quality (Speier et al., 2011). Intentional disruptions, such as thefts and employee / union strikes, can create transportation and manufacturing delays.

The consequences of disruptions could have enormous economic effects; even small supply chain disruptions can have significant impacts and can be very costly in any part of the supply chain (Hendricks & Singhal, 2003, 2005b, 2005a). The remnants of supply chain disruptions could last for extended periods of time. In addition to economic impacts disruptions can also negatively affect consumer perception and loyalty, investor commitment, and partner relationships.

The following two examples demonstrate how disruptions can have negative financial impacts on a company: “In 1996, General Motors experienced an 18 day labour strike at a brake supplier factory that idled workers at 26 assembly plants with an estimated reduction in quarterly earnings of $900 million. In 1997, Boeing...
experienced supplier delivery failure of two critical parts with an estimated loss to the company of $2.6 billion.” (Blackhurst et al., 2005).

As supply chains continue to become more complex there is an increasing need to incorporate effective supply chain management and establish disruption mitigation strategies within a company. Identifying supply chain risks and predicting disruptions can help a company avoid disruptions within the supply chain. Unfortunately not all distributions are predictable. How a company handles the disruption during and after its occurrence can greatly influence the outcome of the disruption and its effects on the company and brand.

**Examples of Global Supply Chain Disruption**

No industry is immune to the threat of supply chain disruptions. As companies experience the pressure to remain competitive on both a global and regional scale, an increasing amount of companies are outsourcing product manufacturing, material procurement, etc. from global resources to decrease operating costs. To demonstrate that supply chain disruptions are not specific to certain industries, three recent disruptions are discussed below.

**Lululemon Athletica Inc.**

Lululemon Athletica Inc. is a Canadian company that specializes in manufacturing athletic apparel for men and women, particularly aimed at yoga and running activities. Lululemon was established in Vancouver, B.C. in 1988 and has since established an international presence with stores and showrooms located in the United States, United Kingdom, China, New Zealand, and Australia (Lululemon Athletica Inc., 2013). When Lululemon was created, the company took great pride in manufacturing their products in Canada. As demand increased Lululemon made the strategic decision to outsource manufacturing to partners in Asia.

On March 18, 2013 Lululemon issued a press release stating that “lululemon athletica inc. [NASDAQ: LULU; TSX: LLL] today notified guests that we expect a shortage in our supply of black Luon pants and crops. We have determined that certain shipments of product received from our factories and available in store from March 1, 2013 do not meet our technical specifications.” (Lululemon Athletica Inc., 2013)

When the Luon products were worn by the end user, the pants and crops had an unacceptably sheerness that did not meet Lululemon’s high standards. As a result of not meeting technical standards, Lululemon voluntarily removed all affected inventory from all their stores, showrooms, and e-commerce site. The affected products were manufactured using a material referred to as Luon. Luon is manufactured in Thailand and Vietnam and is made from a combination of nylon and Lycra spandex fibers (Lululemon Athletica Inc., 2013). The affected product represents approximately 17% of women’s bottoms in Lululemon stores (Strauss, 2013). As a result of this latest disruption to Lululemon’s supply chain, the company is struggling to meet demand. Lululemon
estimated that the disruption would cost them an estimated $12-$17 million in the first quarter of 2013 (Lululemon Athletica Inc., 2013).

**General Motors**

General Motors (GM) is one of the largest car manufacturers and was founded in 1908 by William C. Durant in the United State. In the 1920s, GM expanded and diversified the production lines into Europe with the philosophy and strategy of “a car for every purse and purpose”. Landmark innovations helped GM to define vehicles more than transportation and also GM started to open more plants outside the United States. In 1927 by designing the Cadillac LaSalle, GM brought a milestone to the automotive design. A revolution of new technologies like an air bag was introduced to the market between 1960s and 1970s. And finally years of 1980s and 1990s made GM to started operating as a single global company and expanded its production across the globe. Until 2009, GM was the world’s second largest car manufacturer in the world. But in the time of global financial crises, the company filed for bankruptcy and a new smaller GM has started to work since July 2009.

A tsunami on March 2011 in north of Tokyo, caused by an earthquake, forced part manufacturers and auto companies throughout Japan to shut down (an unintentional cause – natural disaster). As a result of the damage caused from the tsunami, suppliers of plastic, rubber, and electronic components could no longer produce these essential components required to assembly GM automobiles. As these components were specific to GM, an alternative supplier of these components was not readily available. The New York Time claims that “this event is the biggest catastrophe to hit the auto industry’s complex supply chain” (Bunkley, 2011). The manufacturing process of some of the automotive components is complex. If GM was able to overcome the issues of finding a supplier that could produce the same quality, quantity and price of the parts the lead time to produce these components with a new supplier would be approximately a year (Valdes-Dapena, 2011). As a result GM and other automotive companies are cutting down their vehicle outputs in the United States and Europe. One can see the supply chain disruption with an unintentional cause has decreased the number of production and made a challenge for GM to confront the demand.

From March to May 2011, the total value of Japan’s exports fell by 5% compared to 2010 and motor vehicle exports drop by 21%. GM increased the share of production in North America from 55% in January 2011 to 59% by June 2011. Other countries benefited from the disaster, including the United States, China, and South Korea who increased production by $10.8, $3.2, and $1.6 billion, respectively (MacKenzie et al., 2012).

**Canadian Pacific Railway Ltd.**

The Canadian Pacific Railway Ltd. (CP) network extends from the Port of Vancouver to The Port of Montreal, and to the United States industrial centers of Chicago, Newark, Philadelphia, Washington, New York City and Buffalo (Canadian Pacific). CP is the
method of transportation chosen by many producers, suppliers, and manufacturers within Canada. CP is known to transport coal, grain, fertilizer, imported consumer goods, and industrial products including automotive and forest, and accounts for about 40 per cent of Canada’s rail activity (Davison, 2012).

On May 23, 2012, workers initiated a strike by walking off of the job. The workers had been on strike for nine days when the Canadian government passed back-to-work legislation to end the strike. The Canadian government was placed under immense pressure by various industries across Canada to intervene in the CP strike due to the economic impact the strike was having on economies worldwide. The strike affected the transportation of exports and imports of finished goods and raw materials in and out of Canada (Davison, 2012).

Although it is not easy to calculate the total value of lost revenue to all industries, it was estimated that the strike would have cost $540 million per week in lost productivity and new expenses to mitigate the effects of the strike on the national economy (Jang, 2012).

Industries were forced to find alternative transportation methods for their products. Companies who solely rely on CP for transportation were forced to either stop production or stockpile, such as Teck Resources Ltd. who mines coal in British Columbia (Davison, 2012). Companies that were able to find alternative transportation were faced with higher shipping costs compared to using CP. Industries that were affected by transportation delays of final products or raw materials were able to use inventory if available however this is a short term solution as not many companies have large quantities of inventory as they rely on Just-In-Time deliveries (Davison, 2012).

**Literature Review**

With a rise in global sourcing, as demonstrated in the examples above, the issue of supply chain disruption is becoming a critical issue to various industries. This section reviews preventative supply chain disruption strategies, supply chain disruption management recovery tactics, and post disruption redesign approaches.

**Preventative Supply Chain Disruption Strategies**

The ability to prevent disruptions before they happen is an attractive capability to companies participating in today’s competitive market. Supply chain risk management plays a crucial role in preventing disruptions within global supply chain networks. Supply chain risk management is defined as “the identification and evaluation of risks and consequent losses in the global supply chain, and implementation of appropriate strategies through a coordinated approach among supply chain members” (Manuj & Mentzer, 2008). In order to select a suitable risk mitigation strategy the first step is to correctly identify the applicable supply chain risks. Team composition and supply chain complexity play an important role in risk identification and risk mitigation strategy selection (Manuj & Mentzer, 2008). As companies establish an international presence and / or outsource a portion of the
business, the level of complexity increases, which drives up the level of risks.

Visibility is another core element of supply chain mitigation (Blackhurst et al., 2005). The real time knowledge of current information at every node of a supply chain network can provide the necessary information required to maximize responsiveness and flexibility to be able to avoid and mitigate disruptions (Blackhurst et al., 2005). A lack of communication and the transmittal of incorrect information can lead to inefficient production planning and control. In terms of quality, “a high level of supply chain visibility between supply chain partners reduces product-and performance-related errors, thereby reduces number of defect, enhances the quality and responsiveness to upstream supply chain operations” (Tse et al., 2011).

The uses of intelligent systems can help companies identify potential risks at every node of the supply chain network. Some companies are implementing systems that effectively identify potential problems based on calculated predicted lead times for different global channels (Blackhurst et al., 2005). The chosen system to be used should incorporate multi-language functions and allow for human interaction once specified criteria have been detected by the system. Further testing and research is required in this field to create an intelligent system that considers past / historical events in addition to current situations to help predict supply chain disruptions.

Avoiding sole source suppliers and developing relationships with other companies is a potential mitigation option to avoid supplier disruptions. For example, one strategy is to obtain 70% of parts from a primary supplier and 30% from a secondary supplier in a different country. Should a disruption occur to one of the suppliers, the functioning supplier could ramp up production in the absence of the other.

Supply Chain Disruption Management

Once a disruption is discovered, the ability to manage the impact is highly desirable in today’s competitive market. Blackhurst et al. (2005) suggests that response time is one of the key factors dictating the impact of the disruption – the longer the response time, the higher the negative impact of the disruption. Resources must be immediately available for the reconfiguration of the supply chain to be effective and to reduce its impact. Example elements of supply chain mitigation are outlined below.

An example of supply chain mitigation is supply chain reconfiguration. Once a supply chain disruption is discovered, a company may attempt to restore the normal supply chain by managing available resources. Resource management can be conducted with real-time supply chain reconfiguration tools, such as a supply chain intelligent software agent. These programs have the capability to resolve conflicts quickly, make decisions based on a number of complex variables, and continually adapt to different situations. The software considers a series of preference thresholds to feed into a decision support system for managing disruptions (Blackhurst et al., 2005 and Adhitya et al., 2007). Managing resources can refer to human resources
required to carry out mitigation activities, or it could refer to managing inventories. When faced with a supply chain disruption, companies can explore the inventory options of stock piling, stock-outs, back-orders, safety stocks, and stopping production.

Blackhurst et al. (2005) and Adhitya et al. (2007) suggest a company may consider estimating the effects of a disruption once it has occurred (i.e. post risk assessment), including the extent of potential damage (e.g. cost, reputation, etc.) and implications it may have on the chain. Estimating the potential effects would be of considerable benefit to a business as it gives accurate insight and helps executives manage risk by determining the resources and steps necessary to mitigate its impact. Having a better understanding of the impact enables companies to develop a more structured approach to manage a supply chain disruption, thereby, in many cases, reducing the total time and effort required to mitigate a situation (Blackhurst et al., 2005). The effects can be estimated in a qualitative (e.g. jury of executive) or quantitative (e.g. prediction modelling) manner. Manuj & Mentzer (2008) suggests that additional research in the area of supply chain modelling is required.

**Post Disruption Redesign Approaches**

Once disruption occurs, there may be opportunities for a company to learn from the incident. Learning provides a platform for building dynamic capabilities. Should a company wish to make effective changes, the first step is to organize a meeting to capture feedback from various levels within the organization and between organizations (e.g. supply chain partners), soon after the incident. This valuable feedback can be used to generate a list of corrective actions and implement changes necessary to reduce the likelihood of having the disruption occur again (Manuj & Mentzer, 2008, Blackhurst et al., 2005).

If the distribution is severe enough to negatively affect consumer opinions, a company may want to initiate a public relations and / or marketing campaign to regain consumer trust, confidence and loyalty.

**Analysis and Findings**

**Analysis of Articles**

The implementation of risk management and risk mitigation strategies is not an easy task within global supply chain networks due to the level of complexity generally associated with international partners. Strategies that businesses implement before and after a supply chain disruption are important. The literature suggests that both situations need to be considered to attain the best performance in handling disruptions (Blackhurst et al., 2005, Adhitya et al., 2007, Manuj & Mentzer, 2008).

A common concept amongst all reviewed articles relating to preventative strategies for global supply chain disruptions was the importance of visibility within the supply chain network. Encouraging visibility amongst all levels of a supply chain structure will positively affect risk management practices, independent to the structural complexity of the supply chain.
network. The ability to obtain real time data at every node of a network allows for informed, quick decisions to be made, with the goal of avoiding disruptions.

Inter-organizational communications was also a common theme amongst the various papers reviewed. Sharing valuable information and historical events between different companies and industries provides valuable knowledge to help predict potential risks and possible supply chain disruptions. Correctly identifying applicable risks allows a company to select and implement the correct risk mitigation strategy. A list of risk mitigation strategies can be found in Appendix A. The selection of the correct risk management strategy has to consider the demand risk, supply risk, and cost to benefit ratio of implementing a risk management strategy. A highlight from the literature review states that “a supply chain that adopts and invests in strategies for managing the types of risks it faces should do better than supply chains that mismatch the type of risks faced and the risk management strategy selected.” (Manuj & Mentzer, 2008).

A review of the literature also demonstrates that many industries are turning to intelligent systems to help identify potential risks and manage them once they occur. This technology has predictive intelligence and allows real-time knowledge transfer, which promotes an environment where timely decisions can be made based on a number of complex variables. This technology is required to be dynamic and have the capability to continually adapt to changing situations, and feed into a decision support system to help determine the optimal mitigation strategy to be implemented. Further advancement in this area is required to incorporate historical knowledge in the technology to enable companies to make informed decisions.

Further, the literature review shows that many industries are looking into risk assessment, immediately after a disruption occurs, to better manage the situation in a more structured fashion. The benefit is reduced time and effort during the entire life cycle of a disruption. In addition, the literature suggests once a supply chain recovers from an event, companies in collaboration with supply chain partners, need to learn from the incident and design the company to be more resilient in the future.

**Applicability of Mitigation Strategies**

Lululemon was affected by an unintentional distribution that reduced the quality of their end product. Once the disruption was discovered they were quick to issue a press release informing consumers of the quality issue. They were also quick to assure consumers that full refunds would be issued and publically expressed concerns that the final product did not meet the company’s high standards. In taking this approach they were aiming to regain consumers trust and maintain cliental commitment to their brand. They also committed to investigating their quality assurance program to prevent disruptions like this from happening in the future.

GM was affected by an unintentional disruption as a result of a shortage of raw materials, forcing production to slow, and in some cases, halt production as a result of
part shortages from Japanese plants. Based on the findings from MacKenzie et al. (2012), GM reconfigured its supply chain to restore the flow of raw materials and production activities from Japan to the United States in a timely manner. GM demonstrated that their dynamic business model, with multiple suppliers and production facilities around the world, enabled the company to switch and ramp up domestic production quickly to restore their supply chain.

The disruption experienced by CP was an intentional disruption that affected many supply chains nationally and internationally. During the rail strike, many businesses reconfigured their supply chains to restore the flow by switching to other railway companies, such as Canadian National Railway, and the trucking industry at a higher cost (Davison, 2012). Davison (2012) indicates that companies like “Canadian Tire has measures in place to mitigate possible disruptions to its supply chain” by using additional trucks and other service providers to ship goods. Similarly automotive companies relying on CP for Just-in-Time deliveries were forced to switch to look at other ways to move auto parts and vehicles to restore their supply chain as quickly as possible. This situation demonstrates the resiliency of some organizations like Canadian Tire. Based on their proactive approach during the CP strike, one can infer their efforts in risk identification of potential events along the supply chain enabled them to accommodate the strike in a systematic approach, with minimal interference.

Conclusions

As more companies resort to global supply chains to remain competitive in today’s economic environment, more disruptions are occurring due to increased supply chain complexity. As supply chains continue to evolve the associated risks continue to increase. There is a need for companies to establish an effective supply change management system to identify, control and mitigate supply chain disruptions.

In this paper, various mitigation strategies to manage supply chain disruptions were presented. According to the articles, supply chain disruption strategies can be divided into proactive strategies, before a disruption has happened, and reactive strategies, after a disruption has occurred.

Identifying risks before they transformer into disruptions is crucial in preventing disruptions from occurring. Engaging in inter-organizational communication and taking advantage of knowledge transfer gives companies a leading advantage to predict disruptions from historical data / experiences. Incorporating visibility at every node of the supply chain structure, weather using verbal communication or technology, alerts companies of potential disruptions and provides companies the opportunity to avoid a disruption.

How a company manages identified disruptions can influence the outcome of the disruption. Quick response time can lessen the impact of a disruption. Typically the longer a disruption remains unnoticed, the greater the impact. As seen from the Lululemon discussion above, the company
companies was quick to acknowledge the disruption once the company was made aware of the quality issue.

Companies also have the option of reconfiguring once a disruption has been identified in an attempt to restore the normal supply chain by managing available resources. This mitigation method was demonstrated with both the GM and PC disruptions. The PC disruption highlighted the importance of having a mitigation strategy in place before a disruption occurs. In the case of Canadian Tire, the company had implemented a hedging mediation strategy (refer to Appendix A), as a result the company was not impacted as severally as other CP cliental.

After disruptions occur and have been managed, reactive strategies can be implemented. One reactive strategy includes taking the opportunity to learn from the disruption. A company could investigation the root cause of the disruption, analyze how the disruption was managed, and complete a lessons learnt exercise for the incident with the intention of preventing similar disruptions from happening in the future.

**Recommendations**

Of the three businesses reviewed, common attributes that companies should consider in managing supply chain disruptions include improved visibility at every node, supply diversification, and stronger QC/QC programs.

Companies should focus more on supply-visibility at every node of the network. By improving real-time visibility, which includes inventory tracking and tracing systems, physical audits and inspections, and forecasting expected demand, the quality of the data will improve, which means better company decisions will be made to anticipate and react to potential disruptions. For example, Lululemon could have minimized the damage, or even avoid the recall to consumers all together, if they had better visibility between the manufacturer/material supplier and the distributor. Unfortunately the defective material was not discovered until after it was available to consumers. A real-time tracking system would have caught the defect material immediately while the fabric was being assembled, and the public relations damage and inventory costs could have been minimized. The disadvantage is that tracking additional information can increase cost and adds additional complexity to business logistics.

Supply diversification, as demonstrated by GM and experience with CP, is important to consider in order to protect companies from disruptions. If one of the facilities is disrupted, then the other one can continue to operate. Geographical separation should also be considered for added protection. Diversification can also promote competition which can drive down costs. The disadvantage is that having additional facilities can increase cost and adds additional complexity to business logistics.

Developing stronger QA/QC programs would also help reduce supply chain risk. This can be accomplished by requiring supply chain partners to incorporate Total Quality Management (TQM) principles. For example, if the manufacturer/material
supplier had better TQM procedures in place, the defect could have been caught in the Thailand and Vietnam facilities, at the onset of manufacturing and the damage and inventory costs could have been avoided. The disadvantage is that an effective TQM program requires time and significant company resources in order to be effective. Another option is to shift the risk of quality to suppliers by making them partially or fully responsible for any quality issues that may arise from their products. The disadvantage is not all suppliers would be willing to share the risk.
References


### Appendix A – Supply Chain Risk Mitigation Strategies

(Manuj & Mentzer, 2008)

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<tr>
<th>Mitigation Strategy</th>
<th>Characteristics</th>
<th>Supply Risk / Demand Risk Classification</th>
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| **Postponement**    | • Delaying actual commitment of resources to maintain flexibility and delay incurring costs. | Suitable for supply chains facing:  
• Low supply and high demand  
• High supply and high demand |
| **Speculation**     | • A demand-side risk management strategy, opposite to Postponement.  
• Changes in from and the movement of goods to forward inventories should be made at the earliest possible time in the marketing flow in order to reduce the costs of the marketing system. | Suitable for supply chains facing:  
• Low supply and low demand  
• High supply and low demand |
| **Hedging**         | • Supply-side risk management strategy.  
• Having a globally dispersed portfolio of suppliers and facilities such that a single disruption will not affect all the entities at the same time and / or in the same magnitude. | Suitable for supply chains facing:  
• High Supply and low demand  
• High supply and high demand |
| **Control/Share/Transfer** | • Control / Share / Transfer of risk.  
• Takes a vertical integration approach. Increases the ability of a member of a supply chain to control processes, systems, methods, and decisions.  
• Vertical integration may take the form of forward or backward integration, and is therefore both a supply and demand risk management strategy. | Suitable for supply chains facing:  
• High Supply low demand are more likely to adopt backward integration  
• Low supply and high demand are more likely to adopt forward integration  
• High Supply and high demand are more likely to adopt both forward and backward integration. |
| **Security**        | • Encompasses information systems security, freight breaches, terrorism, vandalism, crime, and sabotage.  
• Security strategy is aimed at increasing a supply chain’s ability to sort out what is moving, and identify unusual or suspicious elements. | All types of supply chains will increase the use of security strategies |
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<th>Avoidance</th>
<th>Two types of Avoidance Strategy:</th>
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<td>Type 1: is used when the risks associated with operating in a given product or geographical market, or working with particular suppliers or customers, is considered unacceptable.</td>
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<td>Type 2: geared toward driving overall probabilities associated with risk events of a decision to zero by ensuring that the risk does not exist</td>
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<td></td>
<td>Type 1: Chosen when a supply chain has an option not to enter a high demand or supply risk environment.</td>
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<td>Type 2: is adopted when a supply chain has no option but to enter a high demand and/or supply risk environment.</td>
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