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IDENTIFYING, ACCESSING, AND MITIGATING RISK WITHIN THE SUPPLY CHAIN

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Abstract

Every supply chain has risks that threaten to disturb the flow of materials from one end to the other. These risks need to be identified, assessed for the purpose of determining a priority and then a mitigation plan needs to be developed. This process needs to be done without draining too many resources so that the company is no longer profitable. Each risk must be mitigated based on the risk and the resources available. Supply chain risk management (SCRM) is dependent on the relationships built in supply chain management (SCM). These relationships can be very helpful with data collection and facilitating communication throughout the supply chain.
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Introduction

Risk is something that can be greatly rewarding or detrimental to a company depending on the result. It is part of everyday life and part of doing business especially now that a lot of business is done at a faster pace on a global scale. A hurricane that makes land fall on the east coast of the United States may be a risk for a firm in Central Wisconsin and a customer in Central America. Where the same event would have little to no effect on a company that ships through the west coast. Learning to identify risks within a supply chain, analyzing the risks and mitigating those risks are all part of the future of Supply Chain Management (SCM), creating a need for Supply Chain Risk Management (SCRM), where supply chain management focuses on developing approaches for eliminating disruptions.

Supply chains are a system of companies that have a flow of product from the raw material to the customer or merely the flow of material within a signal company. Some are quite small and may be only made up of one or two companies. Others are large and span the globe with suppliers and customers in all parts of the world. The risks of a small company are not the same as the risks a large company may have and the way that they manage those risks is also dependent on the size and their available resources. Identifying those risks is the first step towards reducing the effect they have on the supply chain.

There are two base categories that risks fall into, disruptive and recurrent. “Disruptive risks tend to have a domino effect on the supply chain: An impact in an area – for example, a fire in a supply plant – ripples into other areas” (Chopra & Sodhi, 2014). On the other hand, recurrent risks are those that are common in the supply chain and are handled with good management practices. When determining the risks to a supply chain, mapping the nodes is helpful as it identifies the transition points in process and the supply chain. These areas are
where the greatest risks can happen. The threat of natural disasters, terrorism, piracy and labor disputes are not something that can be ignored, a disruption to the supply can have many ramifications. “It has the potential to cause physical damage, threaten production and distribution, damage sales, reduce company revenue, cut into market share, inflate costs, and cause budget overruns” (Revilla & Sanez, 2017). Once the risk is identified then it needs to be assessed for its effect on the system.

Analysis of supply chain risks whether they are a disruption, or a repetitive occurrence is the best way to develop the best mitigation strategy. There is a concept in change management that is applicable to this area of SCRM as well. That is creating enough support for the change so that the change takes hold. Using metrics and good management skills helps to determine which risks to focus the company’s resources on first. It may be impossible to predict that a natural disaster like a hurricane or tsunami will disrupt the supply chain, but it is not impossible to plan for that situation. Through analysis, a company can determine which risks would have the greatest effect and thus where to focus the company’s resources. As the company still needs to remain profitable and function efficiently, diverting resources to eliminate every risk may not be possible.

When the company comes to mitigating risks in their supply chain there are several strategies that can be put into place to address the risks that have been identified and analyzed. A company can make alternate suppliers available for raw materials and components necessary to their products. They can collaborate with suppliers to reduce the risk and share the benefits. Create a strategy of dual suppliers and secondary suppliers that allows for smaller disruptions. On the other hand, a risk may simply be accepted because there is only one supplier for the material, or it is deemed not cost effective for the mitigation strategy. Some companies may
increase inventories to avoid disruptions. Good management must be part of any mitigation strategy so that the best option is identified and implemented in a timely manner.

Risks to the supply chain will change as the supply chain grows and alterations occur. New markets, new technologies and process techniques, new suppliers, and many other changes will alter the supply chain and create new risks that need to be identified. Analysis of the risks to the supply chain allows the company to allocate the necessary resources and to determine if it is worthwhile to invest in mitigating the problem. Finally, a mitigation strategy needs to be developed and implemented to reduce or eliminate the risk. The interconnected nature of the supply chain creates an added difficulty to the process as the solution to one problem may create another risk. This is where proper management and constant monitoring is needed to continue identifying, assessing and mitigating risks to the supply chain.

**Literature Review**

It is recognized that every supply chain has risks and that managers need to reduce those risks that affect the function of the supply chain. However, managers and others in a position to make decisions need to identify all the risks in the supply chain and maintain a profitable company. Companies that don’t look at the potential risks don’t understand the effect that a risk would have to the bottom line. “Today’s managers know that they need to protect their supply chains from serious and costly disruptions, but most obvious solutions – increasing inventory, adding capacity at different locations and having multiple suppliers – undermine efforts to improve supply chain cost efficiency” (Chopra & Sodhi, 2014). According to Chopra and Sodhi managing supply chain efficiency and supply chain resilience are different and in that disruptive risk need to be addressed at a cost to efficiency and recurrent risks need to be addressed to improve both.
Recurrent risks are in the metrics of the company and there is ample data to analyze and good management practices will reduce the risk. “Disruptive risks tend to have a domino effect on the supply chain: An impact in one area – for example, a fire in a supply plant – ripples into other areas” (Chopra & Sodhi, 2014). Identifying risks is important to minimize disruptions and ignoring them can be very costly. The cost to managing disruptions may vary based on several factors but larger companies may be able to add peace of mind without major costs. By their large scale they can divide risks across a large network.

“In order to identify theses failure points within the network, supply chain systems need a holistic perspective to understand and capture the complex network of interconnected nodes” (Ghadge, Dani, Chester, & Kalawsky, 2013). Each time a product is converted from raw material, shipped, modified, or changes ownership there is a risk and the model of the network allows for easier identification of the risks and which risks are linked to others. It may also be necessary to develop a system of evaluating the mitigation strategy for further risks as Ghadge, Dani, Chester, and Kalawsky suggest the risk management process is cyclical in nature. Constant evaluation of the network is needed to identify risks that threaten the supply chain.

When each risk is identified, and assessment is taking place there are companies that will try to create a mitigation strategy that will work on all their risks and not create a strategy that is unique to each risk identified, there may be overlap but each mitigation should be developed for each risk. “Given that supply chain risk can be sparked by multiple different sources or contexts, the current research proposes that a firm’s supply chain risk mitigation strategies should be tailored to accommodate the particular characteristics of the risk contexts” (Chang, Ellinger, & Blackhurst, 2015). Accessing the supply chain so that disruptions can be
contained is recommended to limit the effect of the disruption based on the probability and the severity of the risk occurring.

During the identification process several risks will be identified and each has a different level of importance. During the assessment of these risks a priority needs to be identified so that the company’s resources are used most effectively. “This helps the top management to plan and utilize their important scarce resources effectively to mitigate the supply chain risk” (Punniyamoorthy, Tharmataiselvan, & Manikandan, 2013). Good management is going to improve the prioritization of the risks during the assessment and there are tools being developed to help. During the assessment of a heavy engineering supply chain Punniyamoorthy, Tharmataiselvan, and Manikandan found that the demand side of the supply chain ranked as the highest priority and this may be different for other industries. The tool does break the supply chain into smaller pieces allowing the different areas to be examined in detail and help to improve the results. Making it easier for companies to pick a direction to move forward and better utilize resources.

Other tools have been developed as well to aid in avoiding risk in future endeavors such as locating a plant in a foreign country. This uses a two-phase process to develop a list of desired locations and then a means of assigning risk values to the locations based on several factors. By creating this an overall score can be identified and used in the placement decision. Along with assessing the locations the risk for the location are identified for future mitigation strategies. “Companies all around the world have adopted expansion into the global markets as their most prominent corporate growth strategy” (Soni & Kodali, 2013). Having a tool that helps to assess the locations help to prevent problems while maintaining the supply chain and avoiding disruptions to the supply chain.
Once the risks have been identified and assessed for priority the mitigation comes down to the managers that need to weigh the risks and the cost to mitigate those risks. As managing disruptive risks is not a money saver in the short term however, those risks can be devastating in the long term. “Surveys have shown while managers appreciate the impact of supply chain disruptions, they have done little to prevent such incidents or mitigate their impacts” (Chopra & Sodhi, 2014). The goal has been to cut costs and create lean companies, which requires streamlining processes and reducing waste. However, mitigation strategies may require some waste to be added or left to protect against the unknown. Maintaining higher inventories or adding suppliers are just an example, but this adds cost that needs to be managed effectively to maintain financial performance of the company.

By mitigating risks, companies add resilience to the supply chain against disruptions. Often this is done through adding complexity to the system by adding inventory, capacity or developing secondary suppliers to guard against disruptions. However, companies that practice lean are doing what they can to reduce inventories and other things that are classified as waste. Along with removing waste they are also looking at the process to remove complexity. According to lean, waste is defects, overproduction, waiting, not utilizing talent, transportation, inventory, and motion. These items add complexity to the process and the supply chain, and by removing them the company is simplifying the supply chain. “Although the obvious benefit of employing redundant measures is protection against disruptions, the costs of excess resources can be significant” (Marley, Ward, & Hill, 2014). So, the goal in mitigation should be to simplify and add flexibility by removing complexity. Which will lower costs and free up resources like capacity that will help to improve the reaction to disruptions. The firm may still
SUPPLY CHAIN RISK MITIGATION

require increased inventory to manage some problem areas but not all. The goal through mitigation of risk, is to build resilience in the focal firm and the supply chain.

To benefit the supply chain, companies need to work with supply chain partners to develop a risk management plan that benefits all parties. Building relationships is a basic characteristic of successful supply chains and it is important to maintain those relationships. A risk to one firm is potentially a risk to others in the supply chain. Effective communication within the supply chain not only helps to identify new risks but also to ensure that mitigation strategies are successful and don’t create problems somewhere else in the supply chain. Developing effective communication within the supply chain and sharing information can also help to identify disruptions before they happen along with increasing knowledge of past successes and failures. In the research conducted by Revilla and Saenz in 2017, they found that firms that were working with their supply chain partners were less likely to have disruptions. Companies that were passive or only focused on their own problems had more supply chain disruptions. “Our research shows that firms can diminish the frequency of supply chain disruptions by actively cooperating with supply chain partners” (Revilla & Sanez, 2017). Risk management and supply chain management must become supply chain risk management using both to solve today's disruptive problems.

Advances in the area of information technology (IT) has helped to improve relationships within supply chains. “It is undeniable that information technology has helped in improving information sharing efficiently and effectively across supply chain partners, and by doing so, it has finally promoted transparency in building trust and commitment between the aforesaid partners” (Mandal, 2012). The use of IT is a means of developing a way of sharing data between supply chain partners by developing information systems that can provide real time tracking of
inventories in the firm and in the supply chain. Logistic companies have close to real time tracking but, on the flip side disruptions to the IT network can also be a risk. A loss of communication can be a disruption as it limits communication between partners and limits visibility to the supply chain. It should be managed like any other risk and highlights the need to identify risks in the entire supply chain.

A type of risk that may not be so easily identifiable is the supplier sustainability risk, this is a risk that a supplier is going to do something that negatively effects the firm to do business. How is the supplier perceived and how does that perception effect the business of others in the supply chain? If the supplier provides a component or raw material that cannot be sourced anywhere else does the firm just accept the risk? How supplier sustainability risk is mitigated is highly dependent on the focal firm. The firm can work with the supplier to improve their perception by providing feedback and creating an open dialog. The firm can give suppliers documentation as to how they expect them to conduct business and monitor the supplier’s actions. Firms can avoid suppliers or simply terminate suppliers that do not meet their requirements. Or accept it as the cost of doing business with that supplier. The type of relationship is influenced by the type of power structure in play between the supplier and the firm. If the supplier has a unique product then the relationship is going to be acceptance of the supplier because the firm has little to no power to effect change. A supplier and firm that are interdependent are going to have a long partnership that builds collaboration. Supplier sustainability is important in developing a socially responsible company and companies are judged on their supply chain partners as well.

Companies need to identify the risks that can cause disruptions like transportation, natural disasters, and political changes, but they need to be aware of the practices of their supply
chain partners. Companies need to find partners that share their goals and mission because being tied to companies that mistreat employees or pollute their environment are harmful to the company as well. All aspects of the supply chain need to be identified for risks assessed and mitigate as best as possible. Risks don’t go away just by avoiding them and poor planning for the future is a death sentence to a lot of companies.

**Discussion**

Risks fall into two basic categories repetitive risks and disruptive risks. Repetitive risks are those that are more internal to the firm and can be handled with good management. Metrics on delivery, cost, and quality are an indicator of risks companies need to identify and manage. Good management will identify these risks and developing relationships with supply chain partners can make it even easier. One of the fundamentals of supply chain management is to build relationships with supply chain partners for the purpose of improving the supply chain. This helps to facilitate improved communication and improving all the companies within the supply chain. This takes time and constant monitoring of metrics to avoid risks from developing. Though the end result is improved communication and improved metrics, this is the key to ending repetitive risks.

![Node approach to risk identification](image)
Whereas disruptive risks are harder to identify because of the fast-paced global market that most companies are in today. A disruptive risk is one that causes the firm to slow or stop output of products to their customers. Which can include the whole supply chain or just portions of it. The first step in removing or at a minimum reducing risks is to identify the risks in the supply chain. All the literature states that there needs to be a formal process to facilitate the identification process so that all risks are captured in the process. The process for this that can create the most complete list is a node approach shown in figure 1. A map of the supply chain that has each location and each interaction that the product must flow through. This map should include each time the product changes ownership, it crosses into a different region, crosses a different border, and all other points that can be identified and a risk associated with that node on the map. The complexity of the nodes will change with the size of the supply chain and the map is customized for every product or company, depending on how it is used. This tool can create a complete list of risks that have the chance to disrupt the flow of materials.

A third category that is of some interest is the social responsibility of the supply chain partners. There are lots of situations where others have suffered because a company was dumping waste illegally or the manufacturing conditions where not acceptable for worker safety. Companies are judged for not acting responsible and the legal problems can bankrupt companies, or the government can come in and shut them down until the problem is rectified. This can than become a disruptive risk and cause delays but, also can cause boycotting products and other problems for the focal firm in the supply chain. Identifying risks in the values of the company and their social and ecological impact is another area that should be addressed. Developing relationships and acquiring the most amount of data that is possible on the supply chain so the most informed decisions can be made, and all risks can be identified.
Again, another part of the identification process is building relationships with supply chain partners. All the tools will not help if there is not a constant accurate flow of information flowing both directions in a supply chain. Things like policy changes either with companies or governments, labor disputes, or even safety records have the chance to cause major problems. Countries change leadership and the politics can cause risks at border crossings, inspections, and changes to proper paperwork that can lead to disruptions in the flow of goods adversely, affecting the rest of the supply chain. Companies that have poor safety practices have the risk for a whole host of problems such as fires, injuries, and fatalities. Depending on the regulations this may cause a shutdown of the plant and again a disruption to the supply chain. When building relationships and sharing information, things like changes to shipping across borders can be communicated and risks identified while there is time to act. Also, during the information sharing information on company safety policies can be addressed. Probably needs to be part of the initial conversations as companies in the US and other countries know there are steep fines and other penalties that can be placed on companies that don’t comply. Effective communication as part of a supply chain relationship benefits identification of risk so much because identification is all about gathering information on the supply chain.

There are not a lot of tools associated with identifying risks other than gathering as much information as possible and then searching for the risks to the supply chain. This is where the node approach is helpful by showing points where risks can happen and then the information related to that point can be gathered and risks can be identified. By creating metrics to track supplier and company performance and building relationships with supply chain partners, there is a wealth of knowledge about the operation of the supply chain. Then through good management techniques the information can be examined, and a list of risks created. Though it
is so important for companies to identify risks, because disruptive risks can cause lost sales that ruin companies, there are still many companies that fail to do this and are blind-sided later when something does happen.

The next step is to assess the identified risks and determine a priority for mitigation. There are many factors that are at play at this stage, such as resources available, the likelihood of an event to happen, and the relationship between the firm and its supply chain partner. Companies may not be in a position to make a change because of their size or limited resources. Often creating a risk reduction doesn’t lower costs so it is important to focus what resources there are available at the highest risk. There are statistical tools that can break the risk down into different areas of the company and create a ranking for which may be the most likely to cause a problem. During this type of assessment, an area of focus is created, and the company can move on to mitigation. Other systems can break the risks down into categories that allow for multiple teams to focus on assessing more specific problems.

The statistical approach starts with the identified risks and a group of experts that may or may not be part of the company creates a complete list of the risks by adding additional items as they see fit to the list based on their knowledge of the industry and the supply chain. The risks are divided into six groups: supply, manufacturing, demand, logistics, information and environment. The risks are then scored, and the scores compared between the groups. This allows the company to prioritize risks of an area above those of other areas. This method still needs a group of experts to do the ranking and its possible that human error will miss something, but metric data can help to validate results as well. If the company finds that the supply side of the business is the biggest risk and the company examines the supply side metrics for delivery, quality, cost, and all the other metrics that are collected a plan can be put together to mitigate
risks. Other statistical tools are available for evaluating specific risks like plant placement in the world or in a specific region. The assessment process comes down to having the best people in a position to make the best-informed decision based on the system or tools that the company has to offer.

When a company gets the mitigation stage there are several factors that can affect the mitigation strategy. The relationships in a supply chain will be part of the mitigation process as well, because the type of relationship will determine what a company can change. Perhaps a company is dependent on a supply of a unique product and then it is going to be difficult for them to make a change in the supply chain. It would come down to the supplier to dictate what they are willing to change. Though, if a company and supplier are in a cooperative relationship then both parties can share resources to make the change necessary to protect the supply chain. Ideally there would be a cooperative decision and both parties would work together to reach a plan that benefits both companies. There can be relationships where the supplier is dependent on the company and in this relationship the company can dictate the change to the supplier. Lastly a company can determine that the risk is unimportant and avoid it completely and focus on the other risks.

“Supply chain risk management strategies can be classified into two basic categories based on how each of the alternative approaches reduces uncertainty: redundancy and flexibility” (Chang, Ellinger, & Blackhurst, 2015). Redundancy refers to maintaining safety stock, holding inventory, having multiple suppliers, and adding capacity. Whereas flexibility requires an increased level of supply chain relationships and being able to react to changes in the supply change. There is a need to have an increased amount of information sharing throughout the supply chain and greater level of responsiveness. The supply chain has a faster response time
and can share knowledge on potential risks within the rest of the supply chain. Figure 2 shows the need for flexibility and redundancy changes based on the severity and probability a risk will occur.

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The resources and size of a company will also affect the mitigation strategies of a company when using redundant methods. A company that is large will have some different strategies available such as creating multiple locations for manufacturing and distribution that utilize different regions creating some separation during a natural disaster or labor dispute. A small company may not have the resources to split the operations and would be better suited to have some excess capacity so that they are able to handle disruptions and can react quicker. Having extra inventory in either situation is not necessarily a good response to risk because it is adding risk to reduce another. “Although the obvious benefit of employing redundant measures is protection against disruptions, the costs of excess resources can be significant” (Marley, Ward, & Hill, 2014). Rather the use of lean manufacturing will remove the waste in the system and create a more efficient manufacturing process adding a greater level of redundancy to the company and keep costs lower. Creating secondary suppliers or splitting up incoming materials between multiple suppliers is also a technique for mitigating risks by dividing products up across multiple regions and creating different supply paths for products. Much like dividing parts of the
company it helps to reduce risk that one event would have a disruptive effect on the whole company. All of these techniques add redundancy to the supply chain making it more able to deal with disruptions.

Adding flexibility into the system there is a means to bend and flow past problems. This starts with building relationships in the supply chain so that efficient communication can be accomplished. With more knowledge of the current state of the supply chain companies have time to change and prepare for disruptive events lessening the effect or even eliminating it. The added collaboration among supply partners decreases the reaction time because the partners are working toward everyone’s best interest not just their own. A flexible strategy for mitigation is going to take time to build the necessary relationships needed in the supply chain and a system for information exchange but it is less resource dependent then redundant methods. By employing both flexible and redundant strategies the supply chain can handle disruptions of any kind and recover quickly from disruptions because the correct resources are going to be in place.

Any change carries risk and it should not be done without first looking at all the options available. “Today’s managers know that they need to protect their supply chains from serious and costly disruptions, but most obvious solutions – increasing inventory, adding capacity at different locations and having multiple suppliers – undermine efforts to improve supply chain cost efficiency” (Chopra & Sodhi, 2014). There is no set of steps to mitigate every risk in the supply chain, so each risk must be mitigated. There may be an instance where one strategy works to eliminate multiple risks, but it is not a certainty. Mitigating risks will take resources and is not a value-added process like manufacturing but companies that don’t eliminate risk leave themselves open to unseen disruptions.
Marley, Ward, and Hill evaluated 559 companies in 62 countries across 14 industries and found that only a small percentage of companies have not had a supply chain disruption in a 12-month period. Which shows a necessity for companies to identify, assess, and mitigate risks in their supply chains. There is no one perfect strategy for this but the risks can be disastrous. Though by creating redundancy and building a flexible supply chain many of the disruptions can be reduced or even eliminated.

**Conclusion**

Risk is present in every supply chain and the key is to develop a plan for identifying, assessing, and mitigating the risks. Risks can be recurrent but solvable by using good risk management methods and quantifiable metrics. A recurrent risk would be that a supplier is constantly having quality issues and there is a lot of scrap or rework. A company collecting data on incoming products can easily communicate this to a supplier and get the issue solved. Risks can be disruptive like a natural disaster that destroys a supplier’s manufacturing facility or stops shipments form leaving or entering a region. These types of risks require more assessment and mitigation to prevent. The last type of risk discussed is a social risk that creates problems with image or ability to do business with a supplier. Like a company that is dumping toxic waste which creates boycotting customers. This risk is prevented through building relationships and communicating the company’s requirements to the supplier.

There is no set way to do it but a structured method for identifying risks so that they are all captured. Using a node approach can do this by mapping the supply chain and providing information about the different transactions, border crossings, transportation methods, and so much more. Getting a complete list also requires collecting as much information as possible making supply chain management very important to this process, by building relationships with
supply chain partners more information is available. There is also a need to have good management in place not only to identify but also to assess the risks.

During the assessment process managers and possible industry experts can prioritize risk by using metric data and statistical analysis. Most strategies that break the supply chain up into pieces allow for the company to create an area of focus. This helps the process by focusing resources on the area that is the greatest risk to the company. It is highly reliant on the people doing the assessment and it is important to have the best people possible in a position to make these decisions so that mitigation can start.

Mitigation needs to be developed to address the risk, there is no magic bullet that works for all problems. Factors like size, available resources, and the particulars of the risk are going to affect the mitigation strategy. The probability of the risk and the severity of the risk should also go into determining the correct strategy. If the severity is high and the probability is low a redundant strategy is needed. Redundancy is achieved by using safety stock, excess inventory, backup suppliers, splitting suppliers, or some combination of these. Though the option of removing waste from the process will help to improve the efficiency of the process creating capacity and allowing for less inventory and supplier changes while still adding redundancy.

In contrast if the severity is low and the probability is high a flexible strategy should be used. This is dependent on creating strong relationships with supply chain partners and collaborating by sharing information. This allows the whole system to be seen and risks can be identified quicker and mitigated before there are disruptions to the supply chain.

Supply chain risk management relies heavily on companies using supply chain management to build relationships and creating supply chain partners. It is not widely used yet and the risks to companies are increasing because of the focus of global markets and the
increased speed at which business is conducted. There is a small amount of companies that can say they haven’t had a disruption to their supply chain, and no one can say it will never happen. The goal is to create a supply chain that can identify risks and act in a way that is not going to affect the profitability and efficiency of the company and supply chain. There is no one way to effectively eliminate risks but companies need to be actively looking for them and creating mitigation strategies.
References


