

MANAGING **RISK** IN THE GLOBAL SUPPLY CHAIN

A REPORT BY THE SUPPLY CHAIN MANAGEMENT FACULTY AT THE UNIVERSITY OF TENNESSEE

SUMMER 2014



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GLOBAL SUPPLY CHAIN INSTITUTE



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GAME-CHANGING TRENDS IN SUPPLY CHAIN

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Executive Overview



Over the last decade, many companies faced extreme supply chain challenges that stretched their capabilities to the breaking point. Both the preponderance of natural disasters and huge economic swings caused extreme challenges across the supply chain. These challenges have not diminished. Supply chains, which once functioned almost on autopilot, face many dangers today in both the global and the domestic market.

This paper covers a wide range of risks in the global supply chain and offers practical advice regarding risk mitigation strategies and tactics. This advice is grounded in research that examined how leading supply chain executives identify, prioritize, and mitigate risk in the supply chain.

The research team distributed a questionnaire across a wide range of companies, including retailers, manufacturers, and service providers. The researchers tabulated data from the responses of over 150 different supply chain executives. In addition, they completed in-depth, face-to-face interviews with senior executives from six prominent companies. Some findings were surprising. For example, despite recent unprecedented challenges, it appears that many supply chain executives have done very little to formally manage supply chain risk. In particular,

- ▲ None of those surveyed use outside expertise in assessing risk for their supply chains
- ▲ 90 percent of firms do not quantify risk when outsourcing production
- ▲ 66 percent had risk managers in their firms, either in legal or compliance, but virtually all of those internal functions ignored supply chain risk
- ▲ 100 percent of supply chain executives acknowledged insurance as a highly effective risk mitigation tool, but it was not on their radar screen nor in their purview.

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Given the magnitude of supply chain risk exposure, this last point is perplexing. Particularly, since insurance providers offer solutions to circumvent, protect against, or ultimately help companies financially recover from many of these risks. Insurance companies possess a preponderance of readily available data on supply chain risk. Such data can be invaluable in assessing and managing supply chain risk.

According to one interviewee, “Frankly, my boss isn’t asking me to look at it [risk]. It [risk management] is the right thing to do, but we aren’t rewarded for doing it.” Maybe that’s at the heart of the problem: few executives are compensated or incentivized in their day-to-day job to rigorously manage risks.

This paper examines these findings and more. But more importantly, it proposes a supply chain risk management process for companies of all sizes.



A SIMPLE THREE-STEP PROCESS
TO PROTECT YOUR BUSINESS
AGAINST SUPPLY CHAIN RISKS.



Risk is

a fact of life for any supply chain...there's always some element of risk.

Risk in the Global Supply Chain: Introduction

Due to its global nature and systemic impact on the firm's financial performance, the supply chain arguably faces more risk than other areas of the company. Risk is a fact of life for any supply chain, whether it's dealing with quality and safety challenges, supply shortages, legal issues, security problems, regulatory and environmental compliance, weather and natural disasters, or terrorism. There's always some element of risk.

Companies with global supply chains face additional risks, including, but not limited to, longer lead times, supply disruptions caused by global customs, foreign regulations and port congestion, political and/or economic instability in a source country, and changes in economics such as exchange rates.

The scope and reach of the supply chain cries out for a formal, documented process to manage risk. But without a crisis to motivate action, risk planning often falls to the bottom of the priority list. The low priority for managing risk in companies is puzzling. After all, supply chain risk management is a very popular topic at conferences and is written about extensively in books and articles. However, in spite of all of the discussion, we still see the vast majority of companies giving this topic much less attention than it deserves.

This risk apathy is driven by supply chain executives, who often find themselves at the center of the daily storm, striving to balance very demanding operational objectives while satisfying customers, cutting costs, and helping grow revenue. They must deliver results today while working on capabilities that will make their companies competitive in the future. They operate in the same maelstrom of competing priorities and limited time as their executive peers—but their scope of activities is broader, and they have less direct control over all the moving parts. In this environment, risk management receives a much lower priority than it should.

The repercussions of supply chain disruptions to the financial health of a company can be far-reaching and devastating. A study by Hendricks and Singhal emphasizes the negative consequences of supply chain disruptions (*Production and Operations Management*, Vol. 14, No. 1, Spring 2005). The

study analyzed over 800 supply chain disruptions that took place between 1989 and 2000. Firms that experienced major supply chain disruptions saw the following consequences:

- ▲ Sales were down 93 percent, and shareholder returns were 33-40 percent lower over a three-year period
- ▲ Share price volatility was 13.5 percent higher
- ▲ Operating income declined by 107 percent, and Return On Assets (ROA) declined by 114 percent.

But there is a silver lining. While risk cannot be eradicated, it can be identified, assessed, quantified, and mitigated. Once a risk management plan is developed, it can become a competitive advantage because so few firms have one.

This risk

apathy is driven by supply chain executives striving to balance very demanding operational objectives while satisfying customers, cutting costs, and helping grow revenue.





Risk: A Daily Fact of Life

Supply chain professionals from very large to very small companies face a wide range of risks that never make the headlines. Indeed, the Japanese tsunami and earthquake riveted the world a few years ago, but in the meantime, supply chain professionals have to deal with the unexpected day-to-day challenges that have just as much impact when taken as a whole on an organization.

Supply chain experts at UPS Capital, who specialize in risk mitigation, divide supply chain vulnerabilities into two categories of risk. There are day-to-day risks provoked by the normal challenges of doing business:

- ▲ Customer demand changes
- ▲ Unexpected transit delays
- ▲ Problems at suppliers, which delay critically needed components
- ▲ Theft, a much larger problem than most realize
- ▲ Production problems
- ▲ Warehouse shortages that cause serious delays in customer shipments.
- ▲ Cyber security

And there are the disruptions when “all hell breaks loose.” These usually cannot be predicted—epidemics, tsunamis, terrorism—but companies should be prepared with a *risk management process* to mitigate and minimize the impact of such events.

Although this paper more easily references the higher profile problems, the day-to-day problems cannot be ignored. Later in this paper we discuss methods to assess, quantify, and mitigate supply chain risks, whether large or small, routine or extraordinary, forecasted or unexpected.

Supply Chain

professionals have to deal with the unexpected day-to-day challenges.



Insurance

companies can be key partners in working with firms to minimize the financial effects of both daily supply chain risks and catastrophic disruptions.

Insurance: A Surprising Finding

Although we discuss risk mitigation strategies later in the paper, we thought it was important to highlight one of the most telling findings. We were surprised to learn that insurance is simply not on the radar screen of supply chain professionals as a risk mitigation approach. Yet when we discuss the usefulness of insurance with them in interviews, they quickly realize they have missed a highly effectively tool.

Insurance companies and brokers are willing and eager to share best practices and have a vested interest in avoiding losses. They can be key partners in working with firms to minimize the financial effects of both daily supply chain risks and catastrophic disruptions once the loss occurs. But more importantly, they can help companies find solutions to prevent the day-to-day problems that result in losses, thus avoiding the disruption and the subsequent claim settlement. No one wins in a loss. They regularly see the best and worst of supply chain practices and need to be on the winning side of mitigating risk for their clients—and their own bottom lines.

That's why specialized providers, including logistics companies, have entered the market with products specifically designed to mitigate supply chain risk. With volumes of logistics data, years of industry experience, and proprietary visibility tools, these companies offer new risk mitigation solutions that traditional business owners' policies do not provide.

For example, one recently introduced service was designed for the health-care industry. Proprietary technology proactively monitors expensive and highly sensitive shipments for time and temperature requirements. If the shipment is in jeopardy, proactive measures, such as re-icing or expediting to same day delivery, are taken. If the shipment is lost, damaged, or delayed beyond the point of recovery, the insurance company reimburses the customer for the full sales value rather than just the cost of the goods. Insurance can be about much more than receiving payments. The right insurance experts can help businesses avoid risk.

Specialized insurance services that come from diverse insurance industry providers can be an integral component of a company's risk mitigation approach. Before considering insurance or other risk mitigation solutions, most companies should consider and attempt to quantify the risks they face. Yet, as described later in this report, few companies formally undertake this critical first step.





The Alarming State of Supply Chain Risk Management

25%

Just 25 percent of a typical company's end-to-end supply chain is being assessed in any way for risk.

Despite the importance of identifying and mitigating risk as part of the supply chain strategy, the research rarely found robust risk practices among the firms that pursue a global outsourcing strategy. For example, when companies analyze highly risky global outsourcing decisions, they fall into three categories:

- ▲ Category one (36 percent): Consider unit cost plus transportation only
- ▲ Category two (54 percent): Also include inventory as part of the assessment
- ▲ Category three (10 percent): Add a risk quantification and assessment.

In other words, 90 percent of the firms *do not formally quantify* risk when sourcing production. As one SVP of supply chain told us in an interview, "On paper and without the risk thing, this global sourcing deal looks like a great return on investment. With risk, who knows?"

In a study done by *Risk and Insurance Magazine*¹, not one of 110 respondents rated their company as "highly effective" at supply chain risk management. Two-thirds described their effectiveness as low or "don't know." The typical supply chain manager estimates that just 25 percent of his company's end-to-end supply chain is being assessed in any way for risk.

Few supply chain professionals would dispute that the supply chain strategy in their firms should identify possible global supply chain risks, develop probability and impact assessments, and then create risk mitigation plans. Executing this process can help avoid much pain later. Practical examples to address these opportunities are included later in the white paper.

An Up-to-Date Twist on Risk: The Survey Says . . .

Given the popularity of supply chain risk at conferences and for articles, one could reasonably ask, “Is there anything new to say on the topic?” We definitely think so. The intelligence on this subject gets increasingly sophisticated, driven by the continuing complexities of the global environment. As a foundation for this white paper, we conducted a major survey of the state of supply chain risk management today. We obtained input from over 150 supply chain executives across multiple industries, and we conducted in-depth face-to-face meetings with six companies. The survey results provide the basis for this white paper and allow us to put an up-to-date “twist on risk.” Our intent is to provide practical guidelines that companies can use today to mitigate and manage supply chain risk.

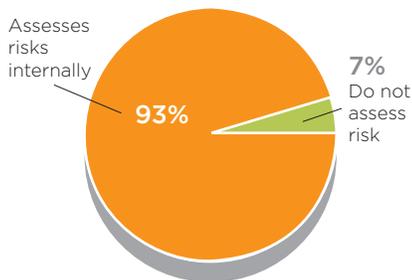
The survey data allow us to make up-to-date observations on the following five topics:

1. Documented Risk Management Processes
2. Facility Loss and Backup Plans
3. Supplier Loss and Backup Plans
4. Supply Chain Risks
5. Risk Mitigation Strategies

1.

Documented Risk Management Processes

How Risk Is Assessed



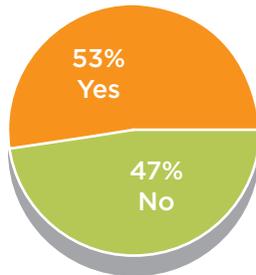
Not one of those surveyed uses outside expertise in assessing risk for their supply chain. Instead virtually all (93 percent) soldier on, doing the best they can within their own departments. (The rest admit they do not consider risk at all.)

The majority (66 percent) of companies have a risk manager somewhere in the firm, often in the legal or finance areas. But almost all of these internal company risk assessments ignore supply chain risk. Instead, they focus on product liability or overall financial issues that could impact shareholder value in a material and very public manner.

2.

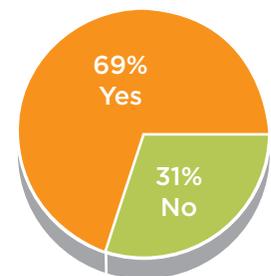
Facility Loss

Backup Plans for Factory or DC Shutdown



If a natural disaster or major equipment failure shuts down a company facility (a factory or a distribution center-DC), about half of the firms surveyed (53 percent) have a backup plan that can be implemented fairly quickly. The bad news is that the other half (47 percent) *do not* have a backup plan.

Documented Response Plan to Serve Customers

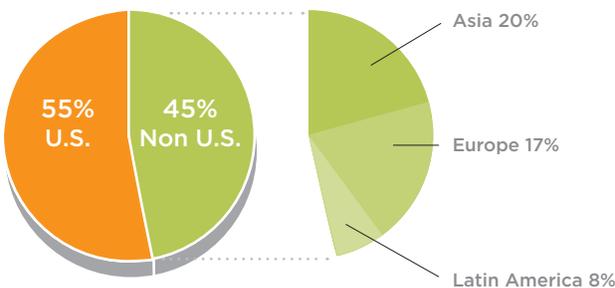


If disaster strikes, about seven in 10 companies (69 percent) have a documented response plan in place to salvage business with their customers either through product substitution, proactive communications, or inventory. This means that almost a third of companies do not have any disaster response plan in place for supply chain risk.

3.

Supplier Loss

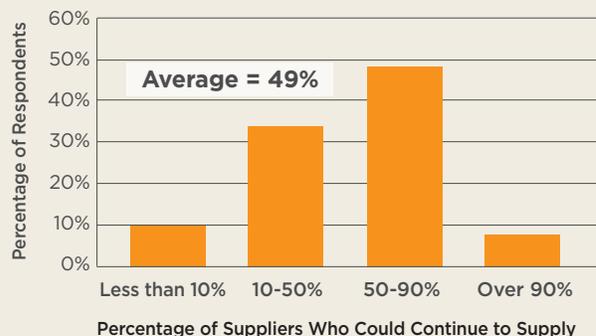
Global Spending by Region



The survey found that nearly half (45 percent) of supplier spending for U.S.-based companies is outside the United States, with 20 percent in Asia. Of course, longer supply lines increase supply chain risk.

On average, about 49 percent of the firms surveyed had suppliers who could continue to supply if they suffered a disaster in one location, meaning that over half (51 percent) *could not* continue supplying within a reasonable time frame.

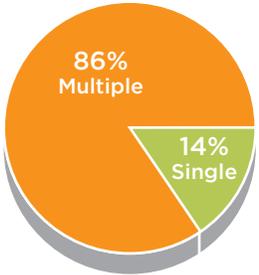
Supplier Continuity





Firms vary widely in terms of how many of their suppliers are sole sourced. In this survey, 38 percent of suppliers are sole sourced. But the spread is very broad. At just one standard deviation, the range for sole sourcing among the firms surveyed was 13 percent to 63 percent. It can safely be said that many firms take on the risk of sole sourcing with a relatively large number of their suppliers. Some do this for economic reasons, such as when one supplier has a significantly lower cost and/or higher quality, while others have practical reasons, such as when no other supplier can adequately satisfy the company's needs. Still others, unfortunately, may do this for relationship reasons, citing "we've always done business this way."

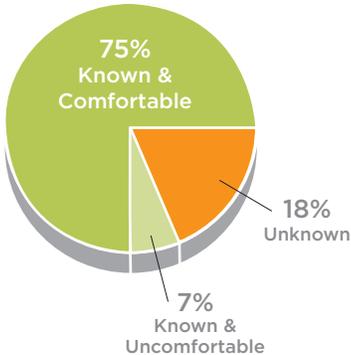
Transportation Carrier Sourcing



The vast majority (86 percent) of companies are multiple sourced with their domestic and global *transportation* carriers. Very few companies (14 percent) single source with transportation carriers, and less than a third of those have any concern about the sole sourcing arrangement.

Eighteen percent of those surveyed do not know the degree of concentration of their global shipments, and 7 percent say they know the degree of concentration and are uncomfortable with it. On the other hand, a large majority—75 percent of those surveyed—track this information in order to comfortably manage risk in global shipping.

Global Shipment Concentrations



4.

Supply Chain Risk Ratings

The **No. 1 risk** on the minds of those surveyed was potential quality problems. Long global supply lines make it very difficult to recover from quality issues. For example, Whirlpool decided years ago to outsource the production of dishwasher water seals to a Chinese supplier for a net savings of \$0.75 per unit. This totaled over \$2 million in annual savings. But soon after the arrangement was made, the Chinese supplier changed to a different rubber supplier. The seals made from this new rubber leaked in dry climates, causing a failure rate of nearly 10 percent.

By the time Whirlpool discovered the problem, over two million dishwashers had been produced with the defective seal, and two months worth of supply was in transit on the ocean. This cost the company millions of dollars and destroyed all savings from the project for over three years. Whirlpool could have avoided this problem by doing more planning and putting robust quality controls in place. Those controls now exist at Whirlpool and are excellent for the company as a whole, but it took a crisis to fully motivate action.ⁱⁱ

The **second-ranked risk** concerns the requirement for increased inventory due to a longer global supply chain. Caught up in the allure of low cost labor, 20 years ago companies rushed to Asia. This very long, extended supply chain requires companies to carry at least 60 to 75 days of supply in additional inventory. Most firms now understand the stress this additional inventory places on their company's working capital and cash flow. When contending with extremely long global supply lines, supply chain professionals find it extremely difficult to achieve the aggressive inventory turnover goals given to them by the CEO/CFO.

The No. 1

risk...of those surveyed was potential quality problems.





Both supply chain professionals and CFOs agree that burdening a company's working capital with the cost of added inventory requires a focused management effort to minimize the impact. Most supply chain professionals are not familiar with the available financial products that allow companies to maximize the amount of cash that can be borrowed against trading assets, such as inventory warehoused internationally and in transit inventory.

Financing products can be especially helpful to growing companies that need to maximize cash flow. A properly structured working capital loan or other financial bridge can help a company minimize financial strain and work its way through identified risks. For example, one company had a 270-day cycle time from its Chinese supplier, tying up cash in inventory for nearly nine months. By assessing the situation and quantifying the need for additional cash flow, the company used its in transit inventory as collateral for a loan, thus preserving cash flow.

Natural disasters stand as the **No. 3-ranked risk**, no doubt brought to top of mind with recent high profile natural disasters such as the Japanese tsunami and Thailand flooding.

Of least concern to supply chain professionals is terrorism and piracy, followed by customs delays. Firms have gotten much savvier about dealing with customs issues. They are taking full advantage of programs that speed customs processing, such as C-TPAT.



5.

Risk Mitigation Strategies

The No. 1 strategy used to mitigate supply chain risk is to choose financially strong, competent world-class suppliers. That is easier said than done. Firms tell us that it takes approximately two years to develop and fully certify a global supplier.

The second-ranked strategy used to mitigate supply chain risk focuses on compressing global shipping time and cycle time variation. Leading firms apply Lean principles and Six Sigma techniques to this effort. They map the value-stream of the end-to-end global shipping process and look for ways to reduce or eliminate waste and delays at every step.

The third-ranked strategy used to mitigate supply chain risk involves the use of visibility tools to closely track global shipments and take action when necessary. Leading firms use supply chain event management technology to send alerts to key personnel when action needs to be taken by someone, somewhere in the global supply chain to address potential delays.

Some other observations from the survey data:

- ▲ Predictive modeling, arguably the most sophisticated risk mitigation technique, seems to be as popular as the least sophisticated (merely reacting to a crisis with air freight or expedited shipping).
- ▲ Near shoring, at No. 8, is well down the list as a risk mitigation approach. Even though the trend to outsource globally is slowing, it does not mean there is a rush back to the United States.

A Great

method for [mitigating risk] is the failure mode and effect analysis approach.

Failure Mode and Effect Analysis

A company cannot devote enough resources to mitigate all risks. It must have an approach in place to identify the most important ones first. A great method for doing that is the failure mode and effect analysis (FMEA) approach. The military first used the FMEA approach as far back as the 1940s. It prioritizes risks based on three factors:

1. Seriousness of consequences
2. Likelihood of the problem ever occurring or frequency of occurrence
3. Likelihood of early detection of the problem.



Several firms have successfully applied this approach as a way of identifying high priority risks to the supply chain. This allows them to determine which risks require a mitigation plan and which are too low-impact or unlikely to warrant the effort. The real power of this approach lies in its use as a framework to discuss and debate risks with the supply chain strategy team. Given that risk analysis has a large subjective component, reaching consensus is critical. Two examples of this approach are described later in the white paper.

Using insurance as a risk mitigation tool is ranked last. We believe this is a lost opportunity for supply chain professionals, and we discuss it later in this paper.

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Best Practice Case Studies in Supply Chain Risk Management

While doing the research for this white paper, we encountered two companies that are leaders in supply chain risk management: IBM and Lockheed Martin. Although these are very large companies, we believe their stories hold valuable lessons for companies of any size. In addition, we found an outstanding supply chain risk management tool called SCRIS (Supply Chain Risk Identification Structure) and another called the Risk Exposure Index. Each of these best practices is described below.



IBM's chief risk management officer's assignment is to implement and sustain an enterprise risk management process. The goal is to ensure a world-class risk management process for each business unit. With IBM's huge global outsourcing budget totaling tens of billions of dollars, with over 20,000 suppliers, its supply chain is complex, especially since some suppliers by necessity are sole-source suppliers. Executing a global sourcing strategy where sourcing is conducted across developing countries (and with more than just first-tier suppliers) has a cumulative effect on the amount of risk introduced into the supply chain.

To manage risk, IBM's global sourcing process looks far beyond unit cost to the total cost picture. All of the dependencies are fully mapped, and whenever possible, backup sources are specified. The top risks are identified, along with their impact on the company's supply chain. IBM also develops contingency plans for events that will inevitably happen at some point in the future (e.g., a pandemic).

Several years ago, IBM developed and patented its Total Risk Analysis (TRA) tool. The need for this tool arose from the tremendous complexity of its supply chain, whose interactions went far beyond the ability of spreadsheets to comprehend. Initially IBM assumed a tool could be purchased, but the company quickly found that an acceptable option simply did not exist. The existing tools focused heavily on financial data modeling and fell far short of a comprehensive supply chain risk analysis.



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IBM's TRA tool collects a multitude of data on many dimensions from 53 countries. Countries are further divided into logical economic entities. The tool filters risks into a critical few, showing high-risk country-product-component combinations. Since it is important to avoid overwhelming the line organization, only the most important risks are surfaced for a required mitigation plan.

In March 2011, the Japanese tsunami and earthquake placed the TRA tool front and center, and it responded flawlessly. Within a few hours, IBM determined all of its potential supplier problems, immediately assembled details, and developed backup plans.

The IBM risk management system goes far beyond the TRA tool. It encompasses an entire management system with business process disciplines. TRA is at the core, but it's the management processes in place that effectively use the tool and react appropriately.

Mike Ray, IBM's VP of Business Integration and Transformation, spoke at the University of Tennessee's Supply Chain Forum in November 2013, where he told a story that demonstrates IBM's ability to react to a supply chain crisis. On July 25, 2008, just after an IBM executive embarked on a train in New York City, he received an instant message. The alarming message read, "There have been a series of bombings in Bangalore, India, earlier today!" The IBM sourcing center in Bangalore issues a huge volume of POs for thousands of suppliers around the world, and IBM, as well as those suppliers, absolutely depends on it. Its shutdown could mean a major disruption in IBM's supply chain.

As the train sped into the city, the executive messaged back that he hoped all the people in Bangalore were safe, and anyone not working should stay home. He then quickly determined that only 25 percent of the center's operations could be carried out. By 7 a.m. EST, while still on the train, he transitioned the remaining operations to a sourcing center in Budapest. By 7:30 a.m., arrangements had been made for the rest of the operations to be picked up by a center in Endicott, New York. In just one hour, IBM created duplicate support coverage, resulting in no disruptions anywhere in the world. When the IBM executive stepped off the train at 8 a.m., everything had been resolved.

As with IBM, Lockheed Martin's Aeronautics Company (LM Aeronautics) supply chain risk management tool instantly tells all of its supplier dependencies. If a disaster hits, the company immediately knows where to focus efforts to assess the impact. A company like Lockheed Martin has more to worry about than most because of its wide range of supply chain risks, especially its intellectual property risks.

The LM Aeronautics process focuses on risk mitigation with plans required for high priority risks. The company has developed a set of risk mitigation resources, which specify a list of questions to address common risk events. They also prescribe established lessons learned and best practices. The process also directs "boots on the ground" where appropriate. In addition, engineering design standards consider supply chain risk because simpler, less complex designs reduce supply chain risk.

As part of the disciplined risk management process, the company periodically conducts risk surveys at each major supplier site. Risks are identified, and when appropriate, detailed mitigation plans are developed. Finally, LM Aeronautics tracks and scorecards the completion of risk mitigation plans.

The risk management process also includes an analysis of suppliers' financial health, dashboards for suppliers, current and future demand on the suppliers, and capacity modeling, especially in light of the demands of other aerospace manufacturers (e.g., the demand for commercial aircraft can consume much of the capacity for certain commodities in the supply chain).

THE SUPPLY CHAIN RISK IDENTIFICATION STRUCTURE (SCRIS)

This tool was developed by the Council of Supply Chain Management Professionals (CSCMP) and Competitive Insights LLC to provide a reference model for identifying, mitigating, and measuring supply chain risk. SCRIS takes overall business continuity risk and breaks it down into multiple categories and multiple tiers. Thus it provides an excellent framework and checklist to manage overall supply chain risk. SCRIS can be used to develop supply chain risk management strategies. Just as important, it facilitates communications across the organization and motivates the appropriate level of focus on supply chain risk management.

RISK EXPOSURE INDEX

The Risk Exposure Index methodology was created by David Simchi-Levi at Massachusetts Institute of Technology (MIT). The index looks at a firm's entire supply chain, including first- and second-tier suppliers. It then estimates a "time to recovery," or TTR, to full functionality after a major disruption. Once the TTRs are known for each node in the network, it is possible to compute the financial impact on the firm and prioritize accordingly. This methodology invariably leads to actions to reduce the TTR for critical nodes in the network.



Recommendations to Manage Supply Chain Risk

To manage supply chain risk in your company, you will have to develop processes to Identify, prioritize, and mitigate risk.

▲ Risk identification

- What can go wrong?

▲ Risk assessment

- What is the likelihood it will go wrong?
- What is the magnitude of the consequences and overall impact on the firm?
- How quickly will the problem be discovered?

▲ Risk mitigation and management

- What options are available to mitigate the risks?
- What are the costs and benefits of each option?

Leading companies have a process that executes these steps continually over time. In the dynamic global environment, change is a constant. Risks identified and mitigated today become obsolete tomorrow. Risk management must be an ongoing process.

You should

be extremely sensitive to the manner in which your global suppliers do business.





Identify Risks

Your supply chain strategy team should set aside time to evaluate the risks facing your supply chain. As one supply chain professional told us after experiencing his share of costly risk situations, “Intuition and gut feel won’t cut it. You must have a disciplined risk management process.” Risks come into focus once you have determined your customers’ needs, completed an internal best practice evaluation, and assessed competition and technology. You should be in a good position to do that, assuming you have established a good foundation to place those risks in perspective.

You’ll have to gather data on your suppliers and on the countries in which you do business. And, you’ll have to create a way to organize the data, perhaps leveraging tools like those described above used by IBM or Lockheed Martin Aeronautics.

You’ll then have to schedule time for your team, perhaps assisted by outside experts, to brainstorm all the potential risks faced by your supply chain. This should be a free-flowing meeting, with plenty of time set aside. Members of the group should not let themselves feel intimidated or overwhelmed. The idea is to get everything on the table without any constraints or criticism. The team would ideally get together in a one-day off-site meeting to identify the risks facing the firm’s global supply chain. Listed below as thought starters are some risks your supply chain may face:

- ▲ Routine supply chain risks: These involve events like unexpected transit delays, changes in customers’ orders, problems with suppliers, theft, and warehouse or

production malfunctions, all of which can cause serious delays in customer shipments.

- ▲ Natural disasters: Although these are unpredictable, a few firms try to anticipate climatic disruptions and develop contingency plans. If a company has a facility in a hurricane-prone area, it can assume it’s only a matter of time before the odds catch up with the location.
- ▲ Quality problems: A long supply line often exacerbates quality issues. This risk often causes companies to carry more inventory. One firm, manufacturing consumer durable products, discovered a quality problem and was mortified to find that it had two months’ worth of supply in transit on the Pacific Ocean, all with the same defect.
- ▲ Forecast error: Long-range forecasts required by long global supply lines are notoriously inaccurate. Forecast error over long global lead times often results in major availability issues and excess inventory problems.
- ▲ Damage: Whether you’re importing or exporting, there is significantly more handling in the supply chain that exponentially increases the chance for damage.
- ▲ Political/civil unrest: While not a major concern, it should be on a company’s risk list and examined, depending on the countries of import and export.
- ▲ Culture clash: In April 2013, at least one employee at Foxconn jumped from the roof of the factory over fears of job cuts. (Foxconn is best known for making Apple products.)



Safety

There may be opportunities with product liability insurance to mitigate risks, from product design to manufacturing.

- ▲ **Strikes:** Strikes are a reality—for example, the 40-day Hong Kong port workers strike in April-May 2013. Strikes could also occur at production plants or facilities that supply critical parts.
- ▲ **Laws and regulations:** Unusual or unexpected application of regulations in a particular country must be considered, as must the Foreign Corrupt Practices Act in the United States.
- ▲ **Customs or port issues:** Customs regulations are always in flux. Failure by shippers to understand the rules and regulations can often cause excessive shipment delays and fines.
- ▲ **Terrorism:** Although quite rare, acts of terrorism often result in the addition of additional permanent costs to the supply chain far beyond the cost of the act itself.
- ▲ **Safety problems:** How many times are safety recalls issued on top-name brands? There may be opportunities with product liability insurance to mitigate risks, from product design to manufacturing.
- ▲ **Changes in economics:** For example, wages in China are escalating for a variety of reasons. Some point to the “one-baby” policy as a source of future increasing labor shortages, even though predictions call for that policy to relax. As reported by China’s National Bureau of Statistics, wages rose 14 percent for private-sector workers in 2012, compared with 12.3 percent in 2011. This contributed to nearly a 70 percent wage increase in the past five years.
- ▲ **Price or currency fluxions:** Extreme and unexpected changes in the price and availability of critical raw materials wreak havoc on a firm’s financial plans, as do swings in currency.
- ▲ **Intellectual property loss:** This is a major problem that should not be underestimated. Many firms, to their chagrin, have found they inadvertently created a new global competitor.
- ▲ **Siloed business processes:** For example, marketing can initiate a major promotion event that drives a spike in demand without allowing the global supply chain to plan ahead.
- ▲ **Technology:** Failed implementation of supply chain technology, such as Wal-Mart’s RFID saga, can have a huge negative impact on the supply chain. The six-year RFID drama may have moved the technology along a bit faster. But many believe it was extremely premature.
- ▲ **Pirate attacks:** Piracy on the world’s seas recently reached a five-year low, although it’s still a danger, with 297 ships attacked in 2012, compared with 439 in 2011.
- ▲ **Third-party risk:** The way your suppliers do business could unexpectedly impact your firm in a devastating way. This requires more in-depth discussion in the section below.

Third-Party Risk

You should be extremely sensitive to the manner in which your global suppliers do business. For example, on April 24, 2013, an eight-story garment factory in Bangladesh collapsed, killing over 1,000 workers. This building served several prominent retailers.

IDENTIFY



By July 2013 (three months later), 17 U.S. retailers announced plans to improve factory safety in developing countries. The bad publicity was exceeded only by the human toll in this tragedy, as a number of retailers faced intense and negative public scrutiny.

More firms realize that selection of third-party suppliers and the way those suppliers do business can have a huge impact on their business. Therefore, more companies plan to put in place processes to ensure their suppliers are:

- ▲ Doing business without any hint of corruption, including bribery
- ▲ Handling data in a secure manner
- ▲ Managing competently to maintain financial solvency
- ▲ Complying with the laws of the countries in which they operate, and

- ▲ Enjoying a good reputation where they operate by doing business legally and morally.

Supply chain professionals know that they have to be vigilant all over the world: China, India, Africa, Russia, South America, etc. Each of these countries has its own customs, laws, and practices—both visible and hidden.

Companies discover that supplier reputation trumps cost. This brings the vetting of global suppliers front and center. Leading companies rank their suppliers based on the potential risk they represent. Some use outside investigators. They develop checklists that the sourcing department must document and check off as they proceed through the procurement process. Due diligence is never done. Best practice companies do annual audits and/or make unannounced visits.

Most firms

realize that third-party suppliers can have a huge impact on their business.





Other Approaches to Identifying Supply Chain Risk

There are other activities that your team can use in a one-day off-site meeting to tease out potential risks. Often a valuable exercise is to engage in “war games” simulations. For example, what would happen if a major port were shut down for an extended period of time due to a catastrophic event like a dirty bomb explosion?

As part of a strategic planning process, your firm should invest time to consider disaster scenarios. Though you can't know when such events are going to occur, you can anticipate possible disruptions based on the location, geography, climate, and political environment of the places goods are sourced. Then, engage in mock exercises to prepare your company to better react to supply chain disasters. As an outcome of these exercises, your team should develop a risk management process that should be followed in the event of a crisis. An important part of this process includes a plan for communicating quickly to all stakeholders.

A few high profile examples may help your team in its disaster contingency planning. In August 2007, Mattel had to recall 18 million toys manufactured in China because of lead paint issues. Hasbro's stock surged and Mattel's fell, and the gap in shareholder value remained pronounced for over two years.

Other high profile examples include natural disasters like the 2010 Eyjafjallajökull volcano eruption in Iceland. Or the twin 2011 global disasters: the 8.9 earthquake and resulting tsunami in Japan and the massive floods in Thailand. These events were perhaps some-

what predictable in the sense that Japan is a volcanic region and Thailand is prone to flooding, but the scale of the 2011 events proved more extreme than even the most aggressive risk managers could have imagined.

The Honda factory in central Thailand was inundated by 15 feet of water at the high point of the flooding. This incident was minor compared to the earthquake, tsunami, and subsequent nuclear crisis that engulfed Japan. Toyota suspended production of the Prius in Japan after this event, losing 140,000 badly needed vehicles. Hundreds of other companies faced major disruptions to their supply chains from this disaster, some lasting through the end of the year. Boeing experienced major delays as a result of the tsunami because the impacted Japanese suppliers produce 35 percent of Boeing 787 components and 20 percent of Boeing 777 components. General Motors had to halt production in several plants because of shortages from Japanese suppliers. Honda faced severe problems because 113 of its suppliers were located in the affected region of Japan. These twin disasters in Asia in 2011 produced an estimated \$240 billion in losses.ⁱⁱⁱ

Disasters such as these only occur every 100 to 200 years. But because so many events can happen in a globally interconnected supply chain, the probability is high that something major will impact your supply chain. Over the 1980 to 2012 period, there were 71 mega natural disasters, causing \$766 billion in damage—of which only \$302 billion was insured—and the loss of over 115,000 lives.^{iv}

Sourcing offshore clearly carries a wide range of risks as evident in the examples above.

IDENTIFY



Long supply chains offer more opportunities for disruption by unforeseen events. Because of the impact on the corporation, global supply chain strategies must include a thorough risk analysis. But any impression that supply chain risk is an exclusively global phenomenon should be quickly dispelled. For example, in 2011 in the United States alone, there were 98 natural disasters (severe weather, floods, earthquakes, and fires). These events resulted in over \$26 billion in business losses, with over 65 people losing their lives.

A *Supply Chain Digest* article in 2006 detailed the “eleven greatest supply chain disasters of all time.” All of these events took place within the borders of the United States, and most had nothing to do with natural disasters.^v For example, Robert Smith, GM’s CEO in the 1980s, invested billions in robot technology during his tenure. The company deployed

14,000 sophisticated robots, yet GM plants continued to have more employees per plant than the competition (1,500 more than a Mazda plant producing the same volume). Toyota employed the Lean philosophy, and the rest is history. The cost of the GM robot investment exceeded the market capitalization of Toyota and Nissan at the time. In 1996, Adidas tried to implement one warehouse management system in a U.S. warehouse, which failed, followed by another failed attempt. The new technology was too complex and untested and resulted in the company’s filling only 20 percent of its orders for one 30-day period.

Countless other examples exist of local supply chain disasters and their devastating impact on the firm’s performance, ranging from natural disasters to software failures. Whether local or global, supply chain risk must be identified, prioritized, and mitigated.



Prioritize Risks

Once you and your team identify the risks facing your supply chain, you next face a daunting task. Now you must prioritize the risks. Line organizations have the capacity to deal seriously with only a few high priority supply chain risks, making prioritization crucial in the risk management process. A couple of examples showing how this has been done in other companies may be helpful. The examples rely on a version of a process engineered long ago to identify and prioritize risks as well as the FMEA approach mentioned earlier in the paper.

EXAMPLE ONE: Addressing Supply Chain Risk at a Food Manufacturer Using FMEA

As part of its supply chain strategy, a food products manufacturer was considering outsourcing warehouse operations to a third

party. To assess the risks associated with this move, the manufacturer used a table much like the one below to guide the risk discussion. The supply chain group identified 13 risks and, using the approach outlined, prioritized these risks. Eventually, the group decided to launch mitigation projects for the top five prioritized risks. The table below illustrates using just two of the risks identified.

After using the FMEA process to prioritize the various risks, the company established a risk mitigation plan, called “recommended action” in Table One. Once the supply chain group completed and gained approval for the supply chain strategy, it assigned responsibility for each of the five high priority risk management projects and made those projects a standard part of the weekly strategy implementation meeting.

Table One: Food Manufacturer Risk Analysis		
	Risk 1: Safety of Food Product	Risk 2: Freshness of Product
Severity* (1-10)	9	6
Probability of Occurrence* (1-10) High probability = 10 Low probability = 1	2	4
Probability of Early Detection* (1-10) High probability = 1 Low probability = 10	6	2
Probability Index (Multiply Three Items Above)	9 x 2 x 6 = 108	6 x 4 x 2 = 48
Recommended Action	Purchase insurance	Audit inventory and ensure stock rotation
Responsibility	Safety engineering	Third party with company oversight

*Scores determined by group consensus

PRIORITIZE



EXAMPLE TWO: Addressing Supply Chain Risk at a Durable Goods Manufacturer

In another example, a durable goods manufacturing company felt that its supply chain strategy should include some important outsourcing decisions. It decided to test that assumption by evaluating the risk associated with outsourcing a key manufacturing component to a Vietnamese manufacturer. The manufacturer used a modified version of the previous approach, but this firm focused on two factors. First, the group estimated, through consensus, the *probability* of occurrence for each risk and then multiplied that by the *estimated cost* of the occurrence. Although the data are heavily disguised, the analysis, done in a group setting, looked very much like that shown in Table Two.

The firm used this analysis in two ways:

1. The supply chain team made sure the ROI on the outsourcing project included the “cost of risk,” which in this case was \$22.12 per unit. The outsourcing savings without risk stood at a net \$55 per unit, which safely exceeded

the risk estimate. The group fully recognized the subjective nature of this analysis. Yet, the act of discussing the potential sources of disruption and estimating their costs gave the supply chain group some assurance that the project would still be viable even if it encountered one or more of the potential risks.

2. Once the supply chain team completed the supply chain strategy, it launched several projects designed to reduce the probability that any of these risks would occur. These mitigation actions decreased the estimated risk cost from \$22.12 to \$12.74, which included the cost of the mitigation activity, giving the team further assurance of the project’s feasibility.

Your strategy team should use a process like those previously described to prioritize supply chain risks. This will provide a framework to engage in a group discussion to reach consensus on the subjective issues associated with risk evaluation. After this step, your team will be in a good position to brainstorm ways to mitigate the highest priority risks facing your supply chain.

Table Two: Outsourcing Risk Analysis

Risk	Estimated Potential Loss, Stated as Cost in \$ Per Unit	Subjective Probability of Occurrence	Net Loss Per Unit (Multiply the Prior Two Columns Together)
Quality Failure	25.00	0.10	\$2.50
Safety Failure	100.00	0.01	\$1.00
Unexpected Demand Spike	30.00	0.25	\$7.50
Currency Change	20.00	0.25	\$5.00
Intellectual Property Problem	10.00	0.25	\$2.50
Source Disruption Force Majeure	30.00	0.10	\$3.00
Port Problem	25.00	0.025	\$0.62
Total			\$22.12



Mitigate Risks

At this point in your risk management process, you have prioritized the risks faced by your supply chain. In the next step, you need to develop mitigation plans for the top risks. The line organization needs to be deeply involved and own this part of the process. Clearly, it has time to deal with only the top three to five highest priority risks.

What goes into a risk mitigation plan? Certainly such plans involve some art and some science. The plan should focus on significantly reducing either the probability of occurrence and/or the degree of impact. It could also involve installing an early warning system. Like a serious disease, risk events that are caught early can often be managed successfully. Some elements that companies routinely use in their risk mitigation plans include

- ▲ **Insurance:** Firms need to work with insurance providers and create a plan to use insurance to mitigate risk where appropriate, based on an objective cost-benefit analysis (described in more detail later).
- ▲ **Best practices approaches:** Companies would be well served to employ one of the best practice models previously described.
- ▲ **Inventory:** Some call this “the no-brainer” approach to mitigating risk. It is certainly the most often used, either by design or accident. How much additional inventory results if a source is moved globally without making systemic improvements in the supply chain process? Many of those we talk to say 60 to 75 or more days of supply! Incidentally, some companies try to offset this severe working capital impact by extending payment terms, using higher payables to offset higher inventories. Of course, this does nothing to address the

problem of slow response to customer demand.

- ▲ **Expedited shipping:** Some firms accurately realize that “stuff happens” and that they may need to expedite shipments globally in spite of the best-laid plans. Therefore, they prepare thoroughly for that day. In fact, some assume a percentage of the shipments will be expedited or airfreighted when they initially plan for a global source. Knowing this, the proactive supply chain manager may consider investigating different types of insurance coverage. Some policies cover the costs of expedited shipments, depending on circumstances.
- ▲ **Import excellence:** Leading companies realize that the better they become at global shipping, the less risk they incur. They strive to achieve import excellence, get the highest C-TPAT certification, and optimize incoterms (international commerce terms, which specify liability and responsibility throughout the global supply chain).
- ▲ **Competent partners:** Although it is potentially costly, some companies develop a second domestic source that can be quickly ramped up. They insist on dealing with strong, competent world-class suppliers, ideally with a “first world” parent. Those who have done this effectively contend that it can take at least two years to develop and certify an excellent source.
- ▲ **Financially strong partners:** One major buyer defaulting on a payment could spell disaster for a small to medium-size enterprise. Trade credit insurance, used for many years throughout Europe, is now becoming increasingly popular in the United States. It can help protect domestic and

Proactive

supply chain managers may consider different types of insurance coverage.



international accounts receivables against unexpected bad debt loss due to insolvency or protracted (slow pay) customers. Companies today are using trade credit insurance as a means to safely and more confidently expand into new markets.

- ▲ **Design for globalization:** The simpler the product design and the fewer parts and SKUs involved, the less risk there is in a global supply chain. Leading firms design for globalization. They minimize component parts and SKUs and have rigorous beginning of life tollgates and end of life processes for their products.
- ▲ **Supply chain event management:** An early warning system is crucial if risks are to be identified quickly enough to do something about them. Supply chain event management (SCEM) systems put in place criteria that trigger alerts. For example, if a container of critical parts faces a delay at a port, the SCEM system should send an alert to allow the problem to be addressed quickly.
- ▲ **Lean/Six Sigma:** When firms apply the principles of Lean and Six Sigma to their global supply chain, along with value-stream mapping, they find a multitude of ways to reduce cycle time and variation by eliminating wasteful activities in the process. Risk diminishes as cycle time and variation decline.
- ▲ **Internal functional silo management:** When supply aligns with demand, supply chain risks diminish. Leading companies include supply chain risk management as part of their S&OP (sales and operations planning process) or their IBP (integrated business planning process).
- ▲ **Contracting:** Supply shortages invariably happen. Some firms anticipate the inevitable and work with suppliers to make sure their firms get more than their fair share during serious shortages.
- ▲ **Disaster preparation:** The idea is to know whom to call if a natural disaster strikes, such as the American Red Cross, the state office of emergency management, FEMA, etc. In other words, buy the umbrella before it rains.
- ▲ **Contingency planning:** Leading companies have documented contingency plans for risks that would have a devastating impact. This would include detailing what would happen if the company lost a major supplier, one of its factories, or one of its DCs.
- ▲ **Forward buying or hedging:** Hedging is a way for a company to minimize or eliminate foreign exchange risk, as well as the risk of commodity price increase, at a cost.
- ▲ **Supplier segmentation:** The idea is to segment suppliers by total financial impact on the firm. This does not necessarily mean total supplier spend. It is clearly possible for a very inexpensive component to shut down a major assembly line. Risk mitigation plans should be developed for the most critical suppliers.



Using Insurance to Mitigate Risk

The least used strategy in our survey for supply chain risk mitigation involves the use of insurance. Unfortunately, as discussed in the introductory section, insurance does not fall in the comfort zone for supply chain professionals. However, an inexpensive insurance solution can mitigate a wide range of problems, from a port strike to lost cargo. Supply chain professionals we talk to assume that insurance is the purview of other specialists in the corporation. By doing so, they miss a great opportunity to selectively use insurance to mitigate key risks. Insurance provides the financial backstop when a loss occurs, but a company can also leverage the broker's and insurance company's expertise and experience in preventing losses before they occur, especially the day-to-day challenges previously mentioned. As stated earlier, not one of those surveyed uses outside expertise in assessing risk for their supply chain.

One simple approach supply chain professionals could employ is calculating an "expected loss" for each major supply chain risk as follows:

Expected loss = (cost of loss) x (subjective probability of loss)

Once calculated, expected losses can be compared with the cost of insurance to cover that loss. The expected loss includes the product value, the customer and lost sales impacts, and the expediting costs to recover.

Supply Chain Professionals May Not Understand Insurance Products

Most supply chain professionals have very little expertise on insurance products that

can help mitigate supply chain risk. Many we talk to mention that they use carrier liability programs, thinking this is insurance, but it is not. Carrier liability programs rarely cover the full value of lost or damaged items. In addition, positive claims settlement outcomes from the carriers can be difficult as the carrier programs typically provide only the bare minimums as required by law.

According to a January 2013 article that appeared in *Inbound Logistics*, "What you don't know about transportation liability can cost you big time . . . plaintiff attorneys are increasingly moving up the supply chain—from carrier to broker, and possibly even shipper—for compensation." This finger-pointing is primarily due to the lack of clarity regarding liability because risk ownership can change throughout the supply chain. It's important to understand who owns what risk, when is it owned, and how can it be mitigated.

Fortunately, insurance programs are available both for parcels and freight/cargo, regardless of the transportation mode or carrier used. These programs go well beyond standard carrier liability limits. They can actually cover high-value, time-sensitive, and temperature-sensitive perishable goods and other hard-to-value items in the event of loss, damage, or delay. Other programs offer consequential loss coverage, provided the shipper can quantify damages.



Conclusion

Due to its global nature and systemic impact on the firm's financial performance, the supply chain arguably faces more risk than other areas of the company. Risk is a fact of life for any supply chain. In spite of that, the vast majority of companies give this topic much less attention than it deserves.

Supply chain risk cries out for a process to manage it. **We recommend that you implement the three-step risk management process described in the white paper:**

- ▲ **Step One-Identify:** Your supply chain strategy team should set aside time to identify the risks facing your supply chain. This should be a free-flowing exchange, with plenty of time set aside. The group should not let themselves feel intimidated or overwhelmed. There are no bad ideas or suggestions. Get everything on the table without any constraints or criticism. A key to the success of this exercise is to identify the right stakeholders. The team should ideally get together in an off-site meeting to recognize the risks facing the firm's global supply chain. In addition, this should be done regularly. Risk changes constantly. Once you've solved one risk, another surfaces. Depending upon your business, it may be time to advocate for a permanent risk manager who focuses solely on preemptive supply chain risk management and solutions.
- ▲ **Step Two-Prioritize:** Once you and your team identify the risks facing your supply chain, you should prioritize them to avoid overwhelming the organization. Do not try to solve all the risks facing your supply chain at once. Regardless of a company's size and geographical scope, several methodologies exist to prioritize risks. This study mentions several tools that companies can use, including the Failure Mode and Effect Analysis (FMEA) and others.
- ▲ **Step Three-Mitigate:** In the final step of a risk management process, mitigation plans need to be developed for the highest priority risks. The line organization should be deeply involved in, and own this part of the process, as should the other stakeholders.

What goes into a risk mitigation plan? Clearly such plans involve some art and some science. The plan should focus on significantly lowering the probability of occurrence and/or the degree of impact, and could include any of the mitigation ideas discussed in the white paper. This includes relying on experts. One of the most surprising findings of this paper was that none of those surveyed used outside expertise in assessing risk. Solutions can come from many different areas, including academia, logistics providers, vendors, insurance companies and others.

In summary, it should be clear: supply chain professionals cannot afford to delay fortifying their supply chains against disaster; they must install a risk management process now to ensure continuity and resilience for the long-term.



About the University of Tennessee

The highly ranked supply chain management program at the University of Tennessee is housed in the college of business administration. It provides undergraduate, MBA, and doctoral student education, with 30 faculty members. The supply chain management faculty at the University of Tennessee is ranked No. 1 for academic supply chain research productivity.

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ⁱ Marsh, Inc., and Risk and Insurance Magazine, "Supply Chain Survey Report," April 15, 2008.

ⁱⁱ Slone, Dittmann, Mentzer, *The New Supply Chain Agenda*, Harvard Business Publishing, 2010.

ⁱⁱⁱ Powell, B. (2011, December 12). The global supply chain: so very fragile. *CNN Money*. Retrieved January 23, 2011, from <http://tech.fortune.cnn.com/2011/12/12/supply-chain-distasters-disruptions/>.

^{iv} Data assembled from information by Munich Re.

^v Gilmore D. (2006, January 26). Worst Supply Chain Disasters. *Supply Chain Digest*. Retrieved January 23, 2011, from <http://www.scdigest.com/assets/FirstThoughts/06-01-26.cfm>.

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A FINAL NOTE

We hope you have found the material in this white paper helpful and useful. We at the University of Tennessee are committed to translating our No.1 position in academic research into information useful for practitioners. We believe the real world of industry is our laboratory. It's why we have the largest Supply Chain Forum in the academic world, with over 50 sponsoring companies. We are always looking for industry partners to assist us in this journey. Let us know if you are interested in being one of our valued partners.

FEEDBACK

We'd like to hear your opinion of the research presented in this report. Also, we would like to learn more about the strategies that your firm uses to successfully manage risk in your supply chain. Go to the Global Supply Chain Institute LinkedIn or Facebook pages and tell us what you think.

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