

Identifying the Factors for Successfully Managing Supply Chain Risks

by

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TABLE OF CONTENTS

INTRODUCTION	P. 3
RESPONDENT PROFILE	P. 4
HOW RESPONDENTS MANAGE SUPPLY CHAIN RISK	P. 5
<u>FACTOR 1. CORPORATE STRATEGY</u>	P. 6
○ DATA AND OBSERVATIONS	P. 6
○ CONCLUSIONS AND RECOMMENDATIONS	P. 6
<u>FACTOR 2. SUPPLY CHAIN ORGANIZATION</u>	P. 8
○ DATA AND OBSERVATIONS	P. 8
○ CONCLUSIONS AND RECOMMENDATIONS	P. 12
<u>FACTOR 3. PROCESS MANAGEMENT</u>	P. 12
○ DATA AND OBSERVATIONS	P. 12
○ CONCLUSIONS AND RECOMMENDATIONS	P. 13
<u>FACTOR 4. PERFORMANCE METRICS</u>	P. 15
○ DATA AND OBSERVATIONS	P. 15
○ CONCLUSIONS AND RECOMMENDATIONS	P. 16
<u>FACTOR 5. INFORMATION & TECHNOLOGY</u>	P. 16
○ DATA AND OBSERVATIONS	P. 16
○ CONCLUSIONS AND RECOMMENDATIONS	P. 18
CONCLUDING COMMENTS	P. 19
APPENDIX (RESEARCH QUESTIONNAIRE RESULTS)	P. 21

INTRODUCTION

On behalf of Western Michigan University (WMU) and the Center for Integrated Supply Management, our group conducted a research project about the potential for managing risks in Supply Chain Management (SCM). Managing supply chain risks is emerging as a viable, proactive, and strategic SCM application. This project's focus is on the structure, implementation, and maintenance of a formal system for managing risks in the supply chain. A common theme is that the decision to manage supply chain risks constitutes a major undertaking for most firms. Such an undertaking, it is argued, does not take place in a vacuum. Rather, it is a response to a number of factors or influences. However, no research to date has empirically identified these factors and explained how they can be leveraged into a competitive advantage. In this study, we use data from 37 firms and SCM managers to identify which factors affect the decision to develop a system for managing supply chain risks and we also explain how these factors can influence the level of success.

Certain factors were identified as having a critical impact on predisposition and progress toward managing risks in SCM. These factors included: Corporate Strategy, Supply Chain Organization, Process Management, Performance Metrics, and Information & Technology. These factors describe a situation where the respondents saw managing risks as an extension of their SCM movement. There seems to be recognition that succeeding requires more than simply creating a new program or department. It is argued that these various factors act to pre-condition the firm and its systems to the introduction, acceptance, and progress on managing SCM risks. The report begins with a profile of the respondents and how they manage supply chain risks. The report then concludes with an evaluation of the factors underlying the decision to develop a system for managing supply chain risks and how these factors can be leveraged into a competitive advantage.

How Respondents Manage Supply Chain Risk

Q1. Usage of supply chain risk evaluation tools, techniques, and methodologies:

Plan to implement an application within 1-2 years: 8% *Currently using an application: 24%

Plan to evaluate an application within 1-2 years: 8% No plans to use anything: 8%

* All firms agreed there is no obvious single application for managing supply chain risks on the market today.
These 52% are actually only using existing SCM applications for managing risk.

Q2. Spending plans next year for managing risks in the supply chain (e.g., IT, support services, process changes, etc.):

Less than \$500,000: 46% \$500,000-\$1,000,000: 14% \$1,000,000 - \$5,000,000: 8%
Unanswered: 32%

Q3. Budget for managing supply chain risks increase, decrease, or stay the same next year:

Increase: 41% No change: 54% Unanswered: 5%

Q4. Area within company that usually takes ownership of investments for managing supply chain risks:

Risk Management: 10% Supply Chain/Purchasing: 44% Legal: 3% Logistics: 15%
Accounting/Finance: 3% Manufacturing/Operations: 11% IT: 8% Quality: 5%
Other (Engineering and Maintenance): 2%

Q5. Funding for managing supply chain risks comes from:

General operations budget: 32% Specific departmental budget: 38% General finance budget: 8%
General IT budget: 8% Specific budget to address supply chain issues: 14%

Q6. Techniques used to identify and analyze risk in supply chain:

Sample of responses: Risk management organization, manual capacity studies and SAP, on-site supplier visit and audit, Quality Department approving/analyzing all raw material before use, D&B reviews, review wealth of suppliers by looking at supplier's S&P index, usage data and centralized safety stock, Monte Carlo simulations and Game Theory, utilize MRP to meet production plan, market reports, buyer feedback and global news monitoring and communication, vendor credentialing devices that include extensive analysis of finance, automated product recall notification that include FDA and non-FDA alert notifications, constant review of product usage, contract review and updates, single vs dual sourced analysis, constant surveillance, detailed supplier supply chain touch point location info, DNBi risk management group, supplier interviews, peer networking, supplier surveys, approved under list supplier rating system and sourcing councils, supplier competency reviews, supplier scorecard, visiting supplier, non-conformance and networking, & inventory optimization planning in setting up safety stock.

FACTOR 1. CORPORATE STRATEGY

Data and Observations:

Firms overwhelmingly agreed there is no obvious single application for managing supply chain risks on the market. Most firms (52%) are only using existing SCM applications for managing risk (see Q1). In the absence of risk management applications, these firms are building risk considerations into traditional SCM applications (e.g., spend, contract, & inventory management, demand planning, benchmarking, building long-term partnerships, etc). An additional 8% said they would like to implement a SCM risk application in 1-2 years, and another 8% said they are considering it. This indicates that while specific supply chain risk applications do not exist, interest levels are very high (80%). The 80/20 rule resurfaces as 80% of the firms have placed a priority on managing supply chain risks. The following questions were also asked on 1 to 7 scale (strongly disagree to strongly agree): 1) Managing supply chain risk is an increasingly important initiative for our operations; and 2) Without a systematic analysis technique to assess risk, much can go wrong in a supply chain. The means for both questions were well above 5.00 and had very small amounts of variance. Again, interest and need levels for supply chain risk applications remains high.

8% of the firms said they will spend between \$1M-\$5M in services, technology, and personnel to support managing supply chain risks, while 14% actually plan on spending \$500,000-\$1M. Another 46% said they plan on spending more modest amounts of less than \$500,000. 32% would not answer the question because of its proprietary nature, but indicated a moderately large amount of spend was planned. Not surprisingly, larger companies will invest more than smaller ones. The manufacturing firms look very similar in their higher spending efforts with a focus on supplier failure, whereas the non-manufacturing firms indicate lower spending levels with a focus on logistics failures.

These questions were also asked on 1 to 7 scale (strongly disagree to strongly agree): 1) Our spending intentions for managing supply chain risks are very high (mean=3.75, var.=2.36); and 2) We do plan on investing nontrivial amounts in managing supply chain risks (mean=4.00, var.=3.49). In this study, there was dedicated funding for managing supply chain risks and 95% indicated that such budgets will increase or stay the same (see Q4). However, only 38% will come from specific SCM departmental budgets and 44% indicated that SCM takes ownership of such investments (see Q5 and Q6). While spending intentions for managing supply chain risks are moderate, funding is poorly targeted and ownership is not centered within the SCM discipline. Managing risks is just now reaching the core of traditional and mature SCM applications.

Conclusions and Recommendations:

A common theme identified from the cases was that while there were few examples of best practice, there were valuable lessons to be learned from the way individual companies managed risks. It was agreed that the management of risk should be a core issue in the planning of any organization. Firms have increased their exposure to risk through their SCM initiatives which focus on cost reduction. Few firms in this study made a formal assessment of supply chain risks or had a strategy in place. These findings indicate the importance of dedicated resources and aligning risk management with corporate strategy.

Formulating an appropriately aligned organizational strategy can to a certain extent mitigate risks in the supply chain. While the actions of competitors, customers, and suppliers external to the company cannot be strictly controlled, formulation of an appropriate strategy can help a company prepare for many events. The companies in this study have a strategy committed to investing heavily in the development of their supply chains to increase cost efficiency in alignment with corporate strategy. However, they also need to limit their exposure to risk by investing in the implementation of systems to increase monitoring and control of their suppliers, while also aligning their strategies with corporate risk management groups. With significant opportunities for improvement, there was no indication that such systems and alignment were in place.

Most professional bodies which deal with risk take the view that risk management should be a continuous process which runs throughout the organization's strategy. It should address methodically all risks surrounding the organization's activities past, present, and in particular, future. It must be integrated into the culture of the organization with an effective policy and process led by senior management. It must also translate the strategy into tactical and operational objectives, assigning ownership throughout the organization with each manager and employee responsible for the management of risk as part of their job description. It must support accountability, performance metrics and rewards, thus promoting operational efficiency at all levels, including SCM.

Most of the risk management strategies in this study appear to be fragmented – one group buys insurance, another administers claims, another handles everything related to safety or security, etc. The perspective of a holistic and enterprise wide approach is a new approach concerned with managing risks to provide reasonable assurance to all stakeholders (including SCM) regarding the achievement of company objectives. In reality, SCM covers the supply chain from suppliers to your company and not from your company to customers. Only the corporate risk management group can address risks for the entire supply chain and life cycle of a program. An effective strategy for managing risks in the supply chain requires a closely aligned strategy and relationship between risk managers and others in the organization. Risk management can provide its traditional expertise and information. Other functions such as purchasing, sales, marketing, finance, operations, and logistics can bring additional expertise. As a cross-functional collaborative team, these holistic and enterprise wide functions can create and implement a supply chain risk strategy that is strategically aligned with corporate objectives. This will require obtaining senior management understanding and approval, and setting up organizational responsibilities.

Gaining management support is often the most challenging part of implementing a proactive system for managing risks in the supply chain. It is necessary to emphasize the importance of supply chain risk management to senior management in order to get the properly targeted resources necessary to implement such a system (rather than the poorly targeted budgets seen in this study). Depending on the management culture, this should be the first step but could be the last. The firms in this study strongly disagreed supply chain risk initiatives are driven from the bottom up. This indicates the strong potential for a proactive approach since supply chain risk initiatives appear to be driven from the top down.

This study recommends having an organizational strategy fully committed to undertaking risk assessments in the supply chain and at the very least the need for business continuity planning when the

company is exposed to the supply chain. As a part of organizational strategy, it would behoove these firms to build a valued and respected risk management function. Progressive organizations will implement a risk management strategy to enable them to react to potential issues in a streamlined fashion. By having a plan, organizations are able to minimize a large ripple effect in other operations within their organization and across their supply chain.

FACTOR 2. SUPPLY CHAIN ORGANIZATION

Data and Observations:

Risk management in this study was mostly handled by a corporate function, usually dealing with insurance companies and some security issues. However, risk management in the supply chain has emerged rather recently and it appears many managers and functional areas are not involved. The following questions were asked on 1 to 7 scale (strongly disagree to strongly agree): 1) My workplace uses supply chain risk managers who work closely with corporate risk management (mean=3.53, var.=3.28); and 2) I fully understand the activities being performed by our risk management group (mean=4.06, var.=3.48). On a higher level, the corporate function is involved with risk management and has contact with insurance companies, but does not necessarily coordinate risk management activities in the whole group, not does it appear to develop directives.

Most of the firms in this study have outsourced one or more of its non-core business functions. For financial reasons, resource constraints, and/or the need to tap into expertise they do not have, outsourcing has become a key aspect of many strategic initiatives. The following question was asked on 1 to 7 scale (strongly disagree to strongly agree): 1) We are planning to outsource all or some of our risk management functions. The mean was only 2.66 with little variance. The organizations in this study have no intentions to outsource risk management and are strongly inclined to develop these skills internally by purchasing a risk management application for internal use, and specifically in the SCM area. However, the following questions were asked on 1 to 7 scale (strongly disagree to strongly agree): 1) There is no single set of tools or technologies on the market for managing supply chain risks; and 2) Managing supply chain risk is an increasingly important initiative for our operations. The means were well above 5.00 and had small amounts of variance. Again, interest and need levels for supply chain risk applications remains high.

Respondents in our study see a broad set of risk factors that pose a disruption to their supply chains. These risks did not vary much by industry, and most were shared (see Table 1.1). Natural disasters or accidents was the top risk factor and common across all respondents. Supplier failure/reliability, bankruptcies of suppliers, logistics failure, port cargo security, customer-related, strikes/labor disputes and diminishing capacity were distant seconds. The non-manufacturing respondents were more inclined to place a higher priority on logistics failure which is not surprising since they were mostly made up of a distributor, transportation management companies and a clinical testing.

Respondents were asked to rank order five of the following risks which would have the greatest severity or impact on the supply chain if it occurred (e.g., 1=most severe, 2=second most severe, etc.). The numbers below indicate the frequency of responses.

Natural disasters or accidents (tsunamis, hurricanes, fires, etc.)		26
Supplier failure/reliability		16
Bankruptcy, ruin, or default of suppliers, shippers, etc.		12
Logistics failure		11
Port/cargo security (information, freight, vandalism, sabotage, etc.)		10
Customer-related (demand change, system failure, payment delay)		9
Strikes – labor, buyers and suppliers		8
Diminishing capacities (financial, production, structural, etc.)		8
Energy/raw material shortages and power outages		8
Geopolitical event (terrorism, war, etc.)		7
Government regulations (SOX, SEC, Clean Air Act, OSHA, EU)		7
Contamination exposures – food, germs, infections		6
Information delays, scarcity, sharing, & infrastructure breakdown		5
Attracting and retaining skilled labor		5
Commodity cost volatility		5
Legal liabilities and litigation		4
Currency exchange, interest, and/or inflation rate fluctuations		4
Intellectual property infringement		3
Customs Acts/Trade restrictions and protectionism		3
Degree of control over operations		3
Contract Failure		2
Return policy and product recall requirements		2
Weaknesses in the local infrastructures		1
Obtaining proper bonds & licenses		1
Lack of trust with partners		1
Measuring tools – metrics translate differently		1
Fraud or scandal		1
Tax issues (VAT, transfer pricing, excise, etc.)		1

Table 1.1

While the majority of the manufacturing respondents identified natural disasters or accidents as their top risk factor, they also attributed the majority of their downtime in operations to supplier failure. In general, these firms have reacted to manage this risk factor, along with others such as bankruptcy, ruin, or default of suppliers, shipper's logistics failure, etc., by building risk considerations into current SCM applications. Customer-related was also a growing concern, but with limited amounts of systems to manage its risk. For example, the majority of the firms strongly disagreed that they were using hedging strategies (to protect against commodity price swings) and speculation (forward placement of inventory, forward buying of raw material, etc.) for managing supply chain risks (and yet it was identified as one the top risk factors). Not surprisingly, firms were very disappointed with their supply chain's performance on lower commodity prices and reduced material price volatility. Only one firm in the entire sample had a system in place to proactively manage commodity prices. This firm had a dedicated staff that used a price sliding system on key commodities which were tied to market indices (e.g., plastics, metals, rubbers, etc.).

Notice that some of the top risk factors are to a large extent beyond the control of buying organizations (e.g., natural disasters, default or ruin of supplier, geopolitical events, or perhaps even supplier failure). Managers insisted that while preventing these will not be possible, reacting to them quickly is an option through contingency planning. The firms in this study are recognized as leaders in SCM and several have received formal recognition by industry associations for their ability to use SCM applications in a customer-driven manner. For example, these firms were very satisfied with their supply chain group's performance on the following issues: after sales service performance, supplier reliability, inventory management, delivery reliability, order completeness, damage free delivery, and meeting customer service levels. However, they did not show a proactive commitment to risk management. However, these questions were asked on 1 to 7 scale (strongly disagree to strongly agree): 1) We are prepared to minimize the effects of disruptions (terrorism, weather, theft, etc.); 2) Proactive risk mitigation efforts applied to the supply chain is common practice for us; and 3) We can actually exploit risk to an advantage by taking calculated risks in the supply chain. The means were very low and had small amounts of variance.

Most of the firms strongly agreed that managing supply chain risks is driven by reactions to failures rather than being proactively driven. Most managers agreed that they have had supply disruptions that have caused financial hardships in the past 24 months. There was no indication that managing risk was being driven by anything other than failure and remediation. However, the largest gaps in performance for reducing disruptions were in tighter financing conditions, exchange rate fluctuations, and commodity cost volatility (see Table 1.2). While supplier failure is a high risk factor for all the firms and will increase in risk for several of the firms, 13 firms did say that they expect supplier failure to be less of a risk in the future. A close assessment of these 13 firms reveals that they have done the most to build risk considerations into as many SCM applications as possible.

The respondents were asked if each supply chain risks would increase, stay the same, or decrease in the next 1-2 years?

Risk will decrease in the next 1-2 years	Risk will not change in the next 1-2 years	Risk will increase in the next 1-2 years
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Increase, Decrease, or No Change in Supply Chain Risk in the next 1-2 years

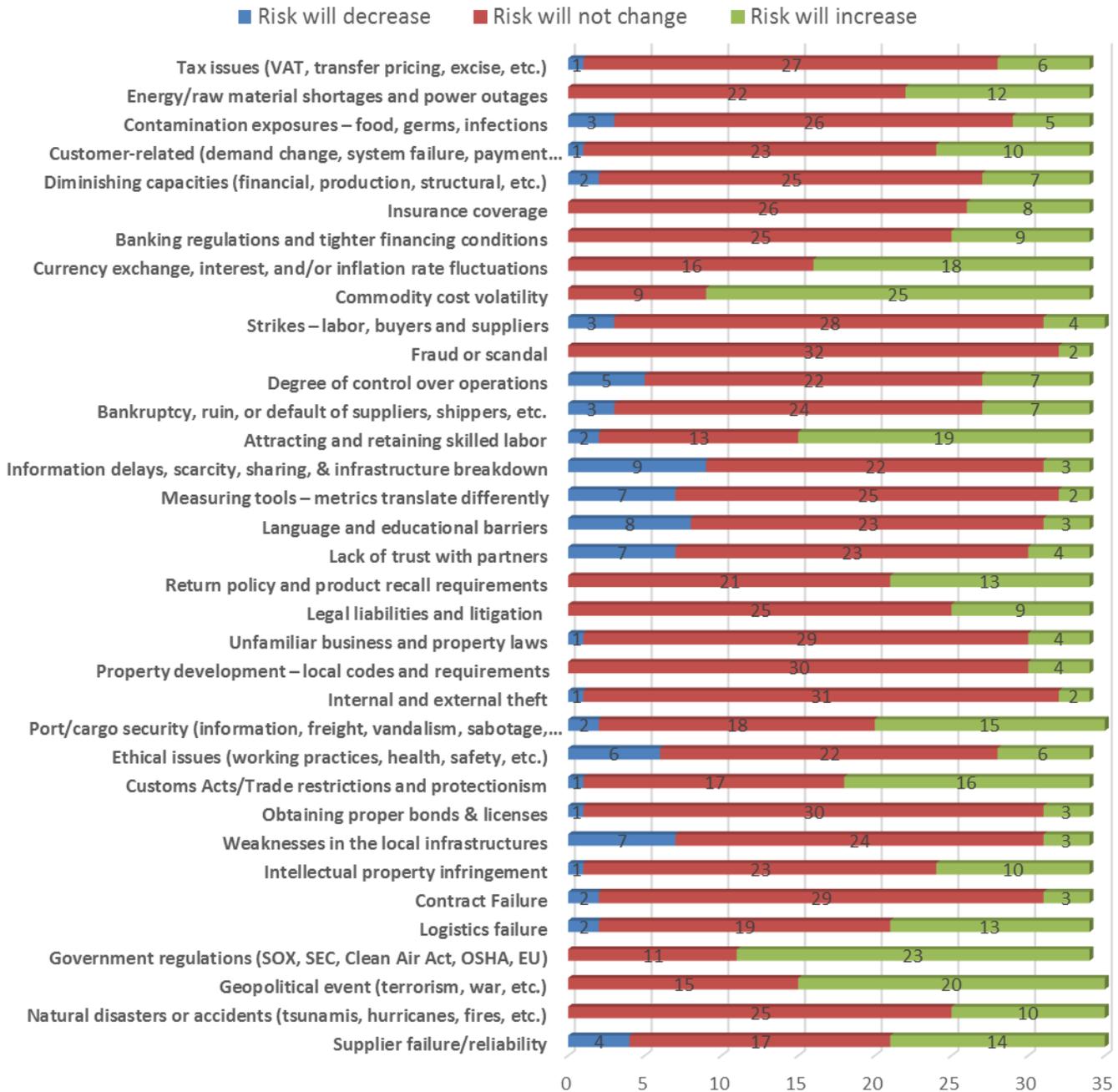


Table 1.2

Conclusions and Recommendations:

There was no indication that risk management has become a main part of the firms' SCM activities or that it even helped SCM meet the organization's objectives. It is recommended that corporate risk management groups focus on positioning the entire organization to try to avoid supply chain disruptions, and to develop strategies to manage the impact of them should avoidance not be possible. More tools are needed to assist in risk management at the supply chain level and not just at the level of the individual firm. This study concluded that the use of managing risks in the supply chain was complacent. It appears that in developing supply chain strategies which focus on cost reduction, these firms have played down the risks from supply chain disruptions. Risk considerations are still reactive in nature but have the potential of adding value in a proactive, strategic, and long-term manner.

The recommendations of this study describes ideal conditions as being where there is a supply chain risk manager who is responsible for development and implementation of managing risks in the supply chain. This supply chain risk manager should also work closely together with corporate risk management, as well as with the supply chain managers. In this study, a gap was suggested as firms failed to use supply chain managers who work closely with corporate risk management and managers did not fully understand the activities being performed by their risk management groups.

Supply chain managers should also use the tools and processes developed by supply chain risk managers to analyze, assess, and manage risk in their supply chains. In the absence of risk management applications, the supply chain managers in this study are building risk considerations into existing traditional SCM applications (e.g., spend, contract, & inventory management, demand planning, benchmarking, etc). This study shows that mostly supply chain managers run and coordinate the work to maintain an optimal balance between risk exposures and costs for damages versus protection activities. Supply chain managers are the interface to other functional areas and they are also responsible for risk management in the supply chain. Core production should of course support SCM with risk management issues. This means that many different players could be involved in sharing responsibility for implementing and maintaining a system for risk management. This could make roles unclear, so responsibilities need to be defined. However, the key responsibility lies with supply chain managers that should run risk management work in their respective parts of the supply chain.

FACTOR 3. PROCESS MANAGEMENT

Data and Observations:

This study showed that documenting the likelihood & impact of risks was not a key part of SCM and that supply chain risk information was not readily available to key-decision makers. Furthermore, very few of the firms are actually able to exploit risk to an advantage by taking calculated risks in the supply chain and even fewer were prepared to minimize the effects of disruptions. These questions were asked on 1 to 7 scale (strongly disagree to strongly agree): 1) A key part of our supply chain management is documenting the likelihood & impact of risks (mean=3.89, var.=2.82); and 2) Supply chain risk information is accurate and

readily available to key-decision makers (mean=4.20, var.=2.80). There was some debate as to the validity and usefulness of tools to operationalize the process. The managers did tend to prefer approaches which combine subjective and objective measures because this allows them some freedom rather than being pushed into taking decisions solely on complicated numerical analysis. Failure Mode Effects and Analysis (FMEA) is a mainstream tool used to collect information related to risk management decisions for most companies in an engineering capacity, but not in a supply chain capacity. There were several documented procedures to complete an FMEA across industries in this study, especially in automotive. Most managers supported a modified version of the tool that could be used to help evaluate the risk of SCM decisions.

Several of the firms used financial reports and questionnaires during supplier approval to compare supply candidates to the business requirements of the buyers or project teams. When justified by a perceived level of risk, a few of the firms went one step further and had candidate comparison matrices (e.g., supplier profiling form and supply Chain PFMEA). Additionally, most had formal processes for supplier visits (e.g., Rapid Plant assessment, site verification of the supplier questionnaire, etc.). Some firms actually used life cycle management with supplier report cards and their buyers would conduct periodic supply chain reviews. In one firm, sourcing was assigned risk ownership and they used FMEA principles to evaluate risk impact. For each risk, they would assess what the financial impact would be in the event of a disruption. They then assigned a probability to each risk area and then they prioritized by multiplying the financial impact by the risk probability. Again, most firms are only using existing SCM applications for managing risk with no formal risk management system in place. In the absence of risk management applications, these firms are building risk considerations into traditional SCM applications.

Conclusions and Recommendations:

Managing supply chain risks should occur at all levels of the supply chain, and the process should support integration with supplier and customer risk management activities. The process should be active in all stages of the acquisition life cycle, starting with technology development and continuing through acquisition, production, maintenance, repair, and disposal. The scope of the process should include all types of risks appropriate for the supply chain. In addition to the common causes of disruption, risk identification should consider economic, political, environmental, regulatory, manufacturing readiness, and technological obsolescence issues. All levels of management should be actively engaged in risk management, including strategic, business, program, technical, and tactical levels. The process should both leverage common tools for assessing risk, but also develop specific SCM mitigation tools and solutions.

A method for analyzing supply chain risk must be a cross-functional process that involves senior management as well as key stakeholders from finance, operations, internal audit, and risk management. However, the companies in this study have not adopted this boundary spanning process. Instead, they have managed risks within functional areas. However, it was acknowledged that the most effective forms of risk management demands involvement across multiple areas of the organization.

The process begins with an assessment of the supply chain. This can usually be done with internal resources but might require the assistance of outside consultants. In either case, it was agreed that this

assessment would take the most effort. While generally lacking among firms, this study indicates the importance of having a process that will allow an organization to analyze, prioritize, and measure the economic impact of risks in the supply chain. Such a process should provide decision makers with financially justified value propositions for initiatives that are aligned with the company's strategic goals. Though a number of different risk management processes have been put forward, most tend to follow the generic process offered in this study with the following key elements.

- **SCM Risk Planning**: develops an overall plan for assessing, handling, and communicating supply chain risks. It identifies how risk priorities are established, how risks are communicated, the training resources required, and the stakeholders responsible for each of the risk management activities.
- **SCM Risk Identification**: uses tools that enable a thorough investigation of all possible sources of risks within a supply chain. To be effective, this part of the process must be conducted throughout the supply chain and life cycle of the program.
- **SCM Risk Analysis**: assess each risk in terms of its likelihood of occurrence, and the estimated impact should the risk occur. This study recommends a modified version of the FMEA tool that could be used to help evaluate the risk of SCM decisions.
- **SCM Risk Handling**: stakeholders rank order the risks and determine what options exist to mitigate the most likely and/or serious risks. Mitigation strategies can either lower the likelihood that the risk will occur or reduce or eliminate the impact should it occur. These plans must be assessed both in terms of their cost as well as their impact on the likelihood and severity of the risk. Based on this analysis, mitigation strategies are selected that provide the greatest return to the company. Our study shows that many risks are actually common across a large number of suppliers and industries. What is implied is that the same mitigation strategy may be successful in addressing a broad range of supply chain risks.
- **SCM Risk Monitoring**: systematically track the risks and the risk handling plans against cost, schedule, and performance metrics, to ensure that risks are being managed as planned. In other words, measure and monitor performance to maintain a balanced risk profile.

Understanding the risks within a supply chain requires an in-depth knowledge of business operations. To develop this understanding, the company must begin with interviews and workshops typically involving a cross-functional team of subject matter experts representing sourcing, manufacturing, and logistics. The company must collect its financial and risk performance data (e.g., average lead times, safety stock levels, other inventory levels, etc.) and benchmark it against industry and functional comparisons. This process enables the organization to develop a detailed picture of its supply chain, which in turn helps it identify potential risks more

easily. A few managers took the view that effective supply chain risk management does not need to be a highly formalized and structured process. However, this study favors a more formal, structured process for managing risk.

FACTOR 4. PERFORMANCE METRICS

Data and Observations:

All of the firms in this study have developed and monitor a set of performance metrics to maintain a risk profile for their supply chains. They do so by using an assortment of tools and techniques such as: initial supplier evaluations, QS audits, industry benchmarking, supplier questionnaires, report cards, capacity planning, lead-time analysis, financial risk assessment, business continuity plans, risk analysis based on accounts payable performance, historical data, technical capability assessment, on-site capability reviews, forecasting techniques and analysis, data tracking with customers to identify demand trends, supplier performance measurement, etc. The majority of the firms also used supplier risk rankings, similar to credit scores used in the financial industry, to measure suppliers on stability, contingency planning, and on-target delivery performance. These tools allow the firms to ask some basic questions such as: Do suppliers maintain consistent quality and delivery performance and is lead-time volatility increasing? While most of the firms track this type of performance through supplier scorecards to monitor leading indicators that impact risk, none had an ongoing risk-review process to ensure that they keep their risk profile within an optimal range of economic impact.

This study also demonstrates that the measurement of risk factors does not necessarily require a new or unique set of performance measures. For example, one firm used average on-time delivery as a measure of supplier performance and chose to look more closely at the peaks and valleys of this indicator to determine the supplier's risk impact on its own delivery performance. In another example, key metrics were established to measure the risk associated with key suppliers and their performance against service level agreements. Supplier agreements were then aligned with the established levels negotiated with the company's key customer agreements.

In general, the development of proactive risk management performance metrics in the supply chain was lacking in this study. The supplier scorecards were not balanced, optimal, and supported reactive decision making. The firms in this study do equip themselves with management scorecards that can identify some trends in advance. They often referred to them as dashboards, reviews, audits, etc., and they allowed managers to view the progress of their supply chains according to a collection of performance indicators. In this manner, they do get some early warning signs if suppliers or carriers are underperforming. However, they fall short on having systems with event-based alerts that let them know when their supply chains are at risk. Until that happens, managers will not take appropriate and well managed risks (e.g., they will outsource to low cost regions to meet their cost savings goals and not stay within an optimal range on the risk management side).

In general, no one was compensated or incented in their day to day job to look at and evaluate the risks within an optimal range of economic impact. For example, a typical off-shore target for several supply chain managers was to achieve x million dollars of component off-shore in y years. Such situations forced managers to inevitably compromise on risk issues as they focused on achieving cost efficiency. None of the firms have developed some sort of on-demand platform that helps them predict supplier failures before they occur. Managers were mostly concerned with risks on the supply and demand sides of the supply chain. It is not that they ignore operations risk, but typically operations risk management resides in other departments such as corporate risk or finance, and is covered by buying insurance or hedging foreign exchange exposure.

Conclusions and Recommendations:

A key component of the supply chain risk management framework is to develop and monitor a set of performance metrics to maintain an optimal risk profile of an organization's supply chain. In response to this, it is recommended that a risk-adjusted view of current and traditional SCM performance metrics be used. In addition, key risk measures may be added to monitor potential upstream and downstream disruptions in the supply chain. New measures might also be added to monitor supplier contingency planning processes and procedures that already exist as traditional SCM applications. Establishing a set of supply chain risk measures across an organization's supply chain can culturally institutionalize the importance of managing risks in the supply chain. As decisions are weighed in terms of both the financial benefits and the impact to supply chain risks, the results should lead to a more proactive approach with long-term benefits to the entire supply chain.

This study suggests that performance metrics are an important determinant of the temporal perspective of supply chain managers. If the reward system only rewards those who achieve their objectives irrespective of due attention to risks, then managers will strive to achieve objectives at the cost of disproportionate risks. In most of the firms in this study, the major objectives were to reduce inventory, improve in-stock availability, and cut costs. Most of these firms had specific targets for off-shore sourcing that that forced managers to inevitably compromise on risk issues. Managing risks in the supply chain was perceived as something that contradicts the process of achieving these company objectives.

The most appropriate strategy might not be adopted because of factors such as performance metrics. Developing metrics that accurately and fully tap the impact of effectively managing risks in supply chains will drive managers to take appropriate and well managed risks. Although the development of specific performance metrics is beyond the scope of this study, it is certainly an area ripe for future research.

FACTOR 5. INFORMATION & TECHNOLOGY

Data and Observations:

In this study, firms had information of what goes on in other parts of the supply chain. Furthermore, the questions were also asked on 1 to 7 scale (not used to extensively used), To what extent are the following used in managing your supply chain and risks within it: 1) Information gathering; and 2) Establishing good communications with suppliers. The means for both questions were very high (well above 5.00) and had small

amounts of variance. In this study also, information delays, scarcity, sharing, & infrastructure breakdown was seen overwhelmingly as one of the lowest rated risk factors both currently and for the future.

These findings are not surprising given that firms in this study showed that a wide variety of information-based technology and applications are being spent for their SCM efforts (e.g., ERP configuration systems, electronics reverse auctioning, radio frequency identification, Collaborative Planning Forecasting and Replenishment – CPFR, etc.), but very few firms showed that their technologies are being used to support risk considerations. Respondents agreed that the key to improved supply chain visibility was sharing information among supply chain members. However, there was only one company that demonstrated an increased focus on inventory optimization to deal with the risk of out-of-stocks or to buffer against the increased risk of supply disruptions. The role of supply network design and optimizations tools is still evolving on the SCM side. Some of the firms in this study do indeed make use of network design tools for infrequent, long-range decision making, such as manufacturing location or distribution capacity given long-term demand expectations. However, there was no indication that there are new cases of usage, such as helping companies understand, model, and cope with increasing levels of uncertainty in the supply chain or network.

Few of the firms used technology applications to do the following (with the exception of the 3 electronics and 1 food manufacturer): joint technology development initiatives, data warehousing, network design analysis programs, demand signal repositories, inventory optimization tools, and forecasting techniques (e.g., to pre-build & carry additional inventory of critical items). These techniques would be useful in managing risk and continuity with regard to new product launches as might be more required for electronics manufacturers than say automotive. These firms were more inclined to embrace techniques such as scenario planning and capacity modeling. The electronics industry is known for risk stemming from short product lifecycles and high demand uncertainty. The food manufacturer made use of exploring a range of alternative supply sources and transportation routes between its distribution centers and customers. This was the only indication of a firm turning network analysis into a continuous process of refinement that allows them to reduce risk while identifying opportunities.

The firms in this study did not use their technology to evaluate their supply chain networks and lacked disciplined network-analysis programs. The more advanced firms in this study did leverage their technology to periodically assess strategic decisions about where to locate distribution centers and manufacturing capacity. They did look at what network design would allow them to service customer demand at the lowest cost and risk. None of them however were using network-design tools in innovative ways such as modeling the networks of their key competitors to test various scenarios and to perform frequent what-if analysis. None were also employing network-design tools to assess risks in the design of the network or even using simulation techniques to test network-configuration options.

Most of the technology supported the following SCM applications for the purposes of managing risk: information gathering, partnership formation and long-term agreements, supplier development initiatives, supplier performance measurement systems, consistent monitoring and auditing of a supplier's processes, using an approved list of suppliers, visiting supplier operations, establishing good communications with suppliers, inventory management (buffers, safety stock levels, optimal order & production qty.), spend

management and analysis, credit and financial data analysis, business process management, contract management (e.g., leverage tools to monitor performance against commitments), and contingency planning (jointly with suppliers).

Inventory management in particular was a critical SCM application used to buffer risk and serve as a de-coupler between echelons of the supply chain. Some companies have adopted software tools to address multi-echelon inventory optimization. Firms are using these tools to apply probabilistic forecasting techniques to make inventory policy and configuration decisions and to evaluate different inventory strategies, though none of them used it to evaluate postponement strategies. Used effectively, they can help companies improve customer-service levels and fill rates, dampen the impact of supply disruptions, reduce risk, and yield better trade-off decisions between customer-service levels and required inventory investment.

Overall, the firms in this study did not engage in proactive modeling exercises as part of a concerted sales and operations planning process. As an example, they lacked a strong what-if capability and could not do cost versus delivery trade-offs. It was agreed though that internet-based systems will become the common platform for supply chain integration and that the use of supply chain planning software will increase dramatically.

Conclusions and Recommendations:

Technology has emerged as a key enabler to realize data and information integration in the supply chain. Making use of technology in general, results in reducing disruption risks in the supply chain. Current information technologies allow for improved integration of information flows and supply chain visibility among all participants. Shared information reduces uncertainty and reduces the need for non-value added cost drivers such as safety stocks. As a result, the system becomes more responsive and eventually could become demand driven rather than forecast driven. A few select samples from this study demonstrates that information driven supply chains hold the potential to perform significantly better than those that do not have access to information beyond their corporate boundaries.

Confidence in a supply chain is weakened when the length of time it takes to complete all the needed steps in the end-to-end pipeline process is longer and inconsistent. Associated with this length and inconsistency is the lack of visible, accurate, and real-time data. A key element in dealing with supply chain risk goes beyond documenting the likelihood and impact of risks, but also getting visibility to risks when they occur and translating that risk information to key decision makers so that they can evaluate and act on information. Throughout the supply chain, key operational data and information such as inventory, demand, forecasts, production and shipment plans, work in progress, yields, capacities and backlogs should be accessible easily by key members of the supply chains. Such information should be accurate and timely, rendering it useful for all parties for planning and re-planning purposes. Thus, it is important that data and information are tightly managed and that any updates are made as timely as possible. The accuracy of the data should be a source of confidence to the parties using the data.

CONCLUDING COMMENTS

Managers agreed that without a systematic analysis technique to assess risk, much can go wrong in a supply chain (i.e., unexpected cost, extended lead times, poor quality, or numerous other negative performance variables). Analyzing the risk associated with SCM is a relatively new subject, and little has been done to assist managers with this process. But one thing is certain, documenting and analyzing risk must be an essential part of continuous improvement. It becomes critical to have an easily understood method to identify and manage risk.

While many factors have been cited as influencing the predisposition towards having a system for managing risks in the supply chain, certain factors were identified as having a critical impact on predisposition and progress towards this. These factors included: Corporate Strategy, Supply Chain Organization, Process Management, Performance Metrics, and Information & Technology. These factors describe a situation where the respondents saw managing supply chain risks as an extension of SCM. They also describe a situation in which respondents recognized that success with managing risks requires cross-functional teams and cooperation. There seems to be recognition that succeeding requires more than simply introducing a new program or department. Rather, it is an undertaking that requires the participation of multiple parties working together. It is argued that these various factors act to pre-condition the firm and its systems to the introduction, acceptance, and progress on managing risks in the supply chain.

Appendix
Research Questionnaire Results

Final Results

General Information (Optional)

	Job Title:	Duties:
Firm1:	Sr. Manager	Logistics, Systems Support, Reporting, Cost Management
Firm2:	N/A	N/A
Firm3:	N/A	N/A
Firm4:	N/A	N/A
Firm5:	Director, Global Materials, Logistics, & Freight Management	Leadership & strategic director responsibilities
Firm6:	VP Customer Supply Chain	Transport, Order to cash
Firm7:	Centralized Inventory Assoc. Manager	Manage team of 6 individuals along with inventory mix & placement project management work
Firm8:	N/A	N/A
Firm9:	Supply Chain Manager	Develop supply chain for \$160M in spending for Global Business Units
Firm10:	N/A	
Firm11:	Head of Supply	Strategic sourcing manager outside machinery
Firm12:	N/A	N/A
Firm13:	N/A	N/A
Firm14:	Director, Head of Purchasing & Supply Chain	
Firm15:	Operations Manager	Responsible for cross dock operation
Firm16:	Sourcing Specialist	Sourcing, negotiation, commodity management
Firm17:	Director, Supply Chain	Demand forecasting, sales & operations, material management, warehouse & logistics
Firm18:	N/A	N/A
Firm19:	Category Manager	
Firm20:	N/A	N/A
Firm21:	Sr. Project Manager	Corporate Supply Chain duties includes Network Design/ Warehousing
Firm22:	N/A	N/A
Firm23:	Logistics Supervisor	Supervise team of forecasting & replenishment buyers in the food service industry
Firm24:	Global Implementation Manager	Powertrain processes & Pre-PS
Firm25:	N/A	N/A
Firm26:	SCI Team Lead	SCI Process, Corporate Initiatives, Supervise Factory buyers
Firm27:	Supply Chain Network Analyst	Network analysis
Firm28:	Head of Logistics	Inbound, Outbound, International Transportation Management
Firm29:	N/A	N/A
Firm30:	N/A	N/A
Firm31:	Quality Processes & Tools Manager	Manage project managers that coordinate system analysis & Implementation across the enterprise
Firm32:	Master Scheduler	
Firm33:	Supply Chain Analyst	
Firm34:	N/A	N/A
Firm 35:	Vice President	Supply Chain & Security
Firm36:	Manager	Production Parts Purchasing
Firm37:	N/A	N/A

Table 1.1

COMPANY BACKGROUND INFORMATION

The questions in this part should be answered at the level of your entire organization.

Which of the following best describes the MAIN ACTIVITY of your company?

- | | | | |
|---------------------------|--------------------------|---------------------------------|--------------------------|
| Aerospace/Defence | <input type="checkbox"/> | Health Care | <input type="checkbox"/> |
| Agriculture | <input type="checkbox"/> | House building and Construction | <input type="checkbox"/> |
| Automotive | <input type="checkbox"/> | Leisure Industries | <input type="checkbox"/> |
| Banks/Financial Services | <input type="checkbox"/> | Manufacturing | <input type="checkbox"/> |
| Chemicals | <input type="checkbox"/> | Office Equipment | <input type="checkbox"/> |
| Computer Hardware | <input type="checkbox"/> | Public Sector | <input type="checkbox"/> |
| Computer Software | <input type="checkbox"/> | Publishing / Broadcasting | <input type="checkbox"/> |
| Consumer Products | <input type="checkbox"/> | Telecommunications | <input type="checkbox"/> |
| Electronics | <input type="checkbox"/> | Transportation | <input type="checkbox"/> |
| Food | <input type="checkbox"/> | Other | <input type="checkbox"/> |
| Fuel, Utilities and Power | <input type="checkbox"/> | Please specify: _____ | |

Manufacturing (32/37):

- 7 automotive first tier suppliers, and 25 other (e.g., agriculture, aerospace and defense, medical equipment, consumer products, fuel, utilities and power, home building material)

*29/37 can be classified as capital intensive high volume producers use assembly lines in operations

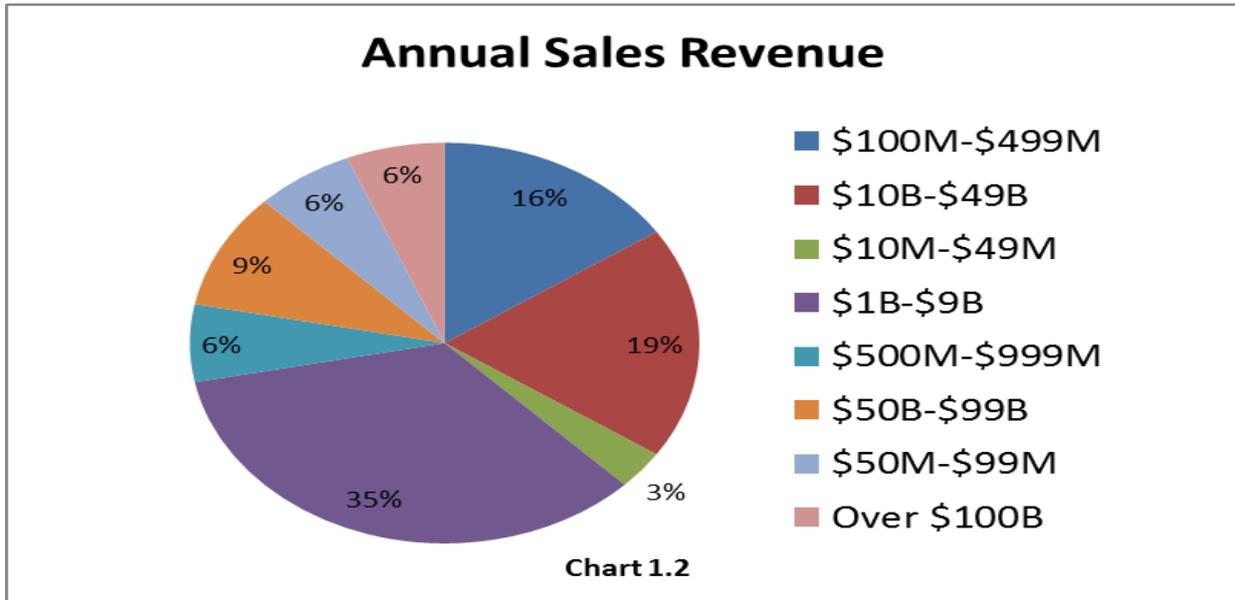
*8/37 can be classified as low volume producers of highly customized and engineered products

Non-manufacturing (5/37):

- 1 distributors, 3 transportation management, and 1 clinical testing
-

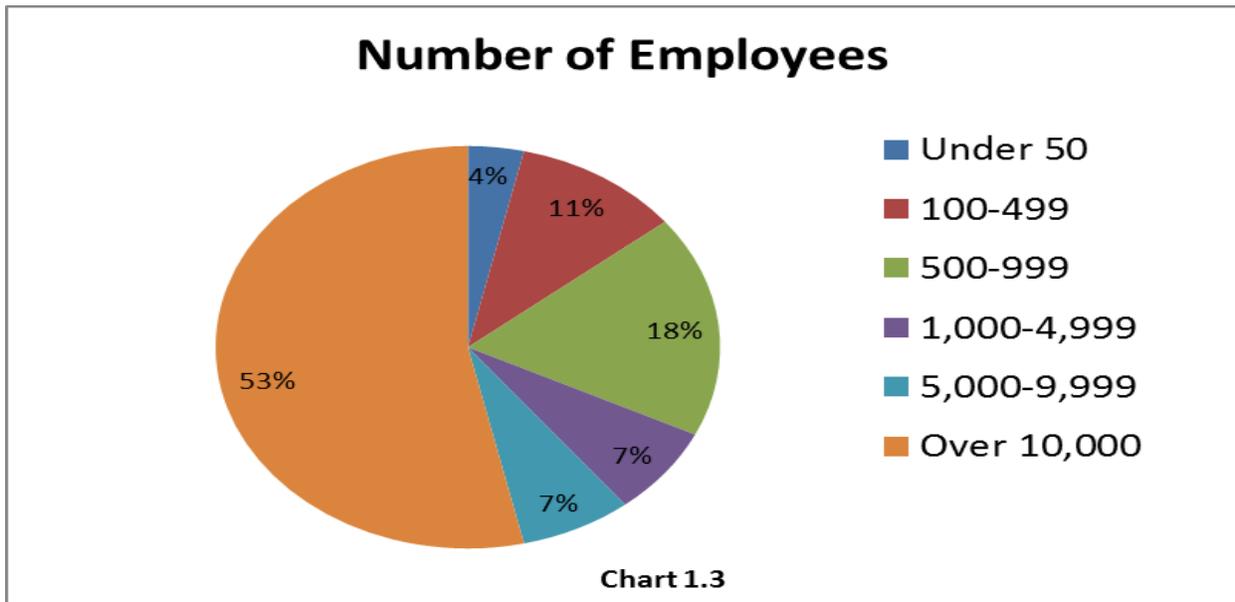
What is the annual sales revenue of your company?

- | | | | |
|---------------|--------------------------|-------------|--------------------------|
| Under \$10M | <input type="checkbox"/> | \$1B-\$9B | <input type="checkbox"/> |
| \$10M-\$49M | <input type="checkbox"/> | \$10B-\$49B | <input type="checkbox"/> |
| \$50M-\$99M | <input type="checkbox"/> | \$50B-\$99B | <input type="checkbox"/> |
| \$100M-\$499M | <input type="checkbox"/> | Over \$100B | <input type="checkbox"/> |
| \$500M-\$999M | <input type="checkbox"/> | | |



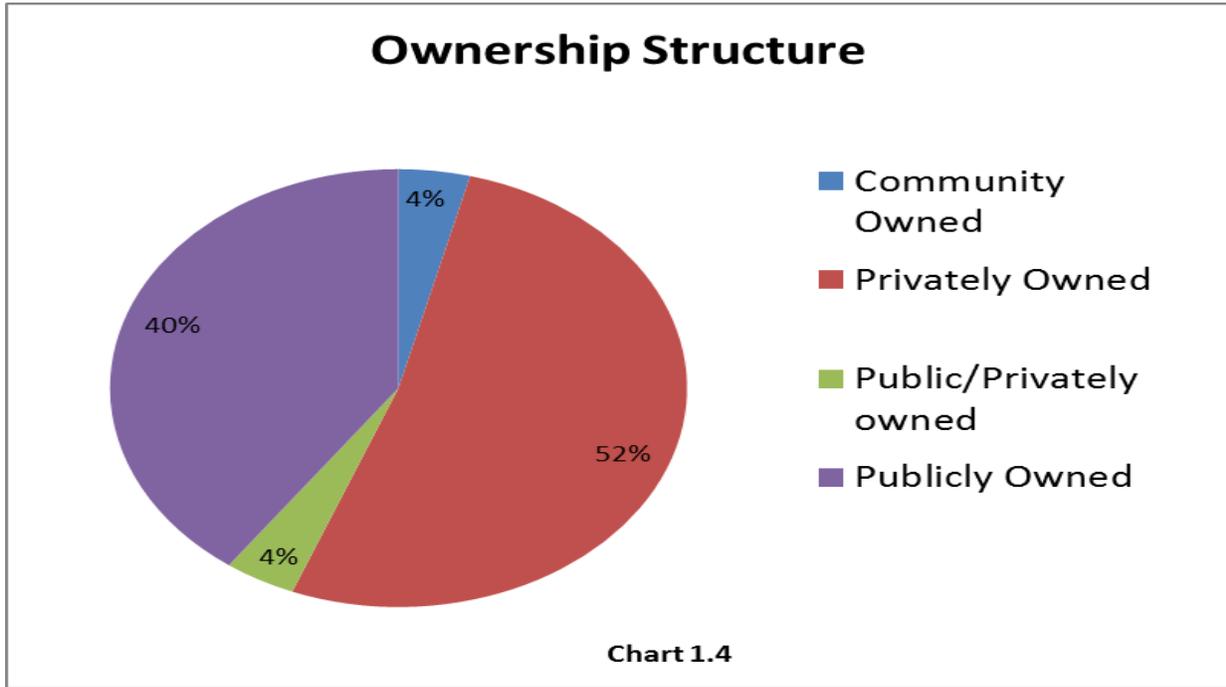
What is the NUMBER OF EMPLOYEES in your company?

- | | | | |
|----------|--------------------------|-------------|--------------------------|
| Under 50 | <input type="checkbox"/> | 1,000-4,999 | <input type="checkbox"/> |
| 50-99 | <input type="checkbox"/> | 5,000-9,999 | <input type="checkbox"/> |
| 100-499 | <input type="checkbox"/> | Over 10,000 | <input type="checkbox"/> |
| 500-999 | <input type="checkbox"/> | | |



What is the OWNERSHIP STRUCTURE of your company?

Privately Owned Publicly Owned Public/Private Owned



Which GEOGRAPHICAL REGIONS account for your sales revenue? (check all that apply)

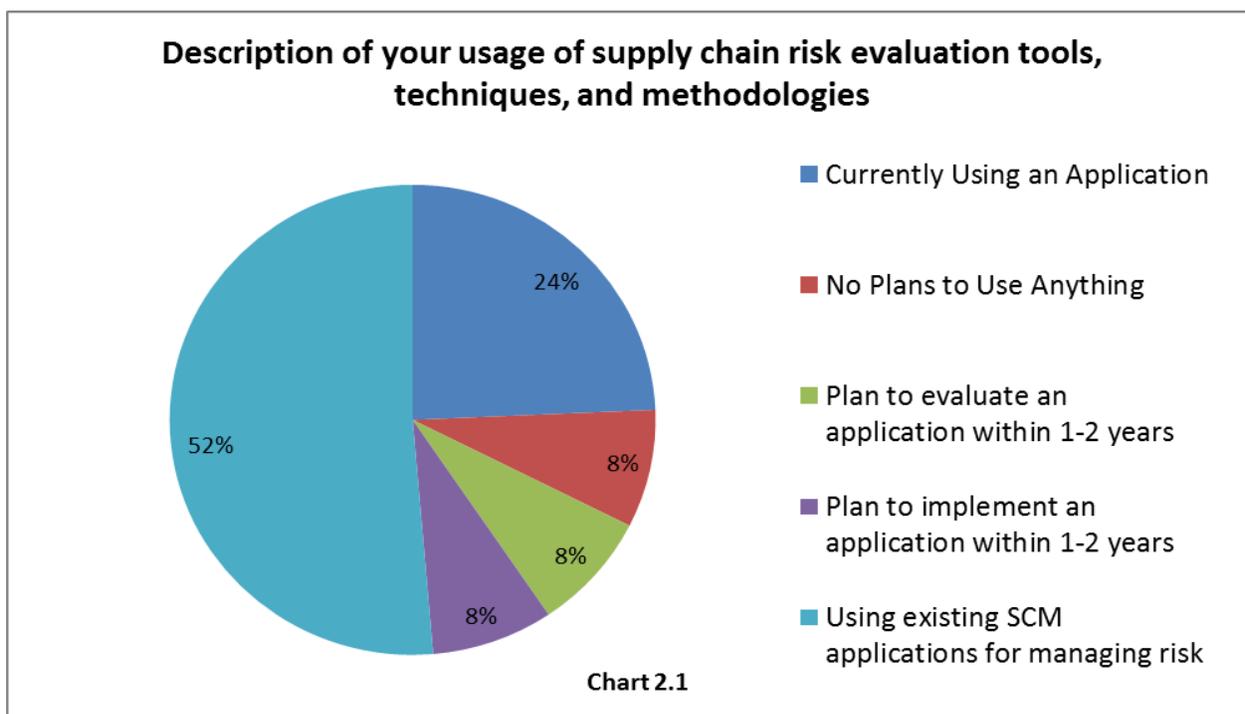
Africa (13/37 firms) Europe (25/37 firms)
North America (36/37 firms) South America (21/37 firms)
Asia (24/37 firms)

Managing Supply Chain Risk

Managing supply chain risk applies the techniques of risk management to the supply chain. It develops an enterprise view into the risks deep within a supply chain, and gives companies a tool that they can use to identify and manage risks to reduce their potential impact. Effective risk management includes a process that systematically identifies potential failures in the supply chain.

Which best describes your usage of supply chain risk evaluation tools, techniques, and methodologies?

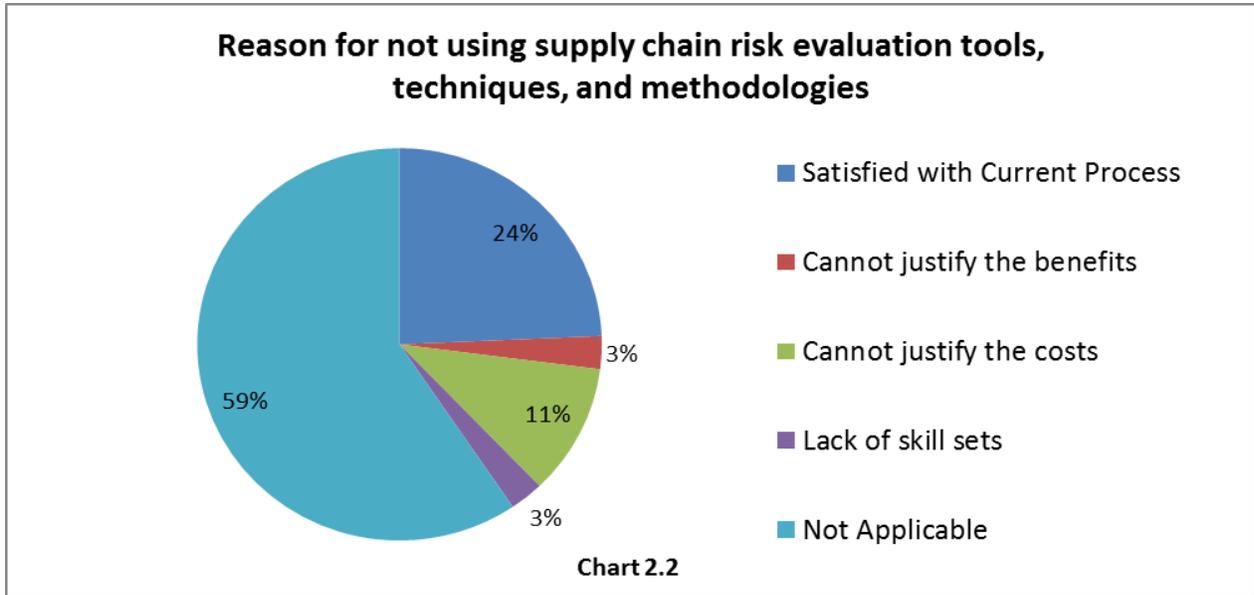
- Plan to implement an application within 1-2 years *Currently using an application
Plan to evaluate an application within 1-2 years No plans to use anything



* All firms agreed there is no obvious and specific single application for managing supply chain risks on the market today. The 52% are actually using existing SCM applications for managing risk. In the absence of risk management applications, these firms (52%) are building risk considerations into existing traditional SCM applications (e.g., spend, contract, & inventory management, demand planning, benchmarking, etc). An additional 8% said they would like to implement a SCM risk application in 1-2 years, and another 8% said they are considering it. This indicates that while actual specific supply chain risk applications are non-existent, interest levels are very high (80%). The 80/20 rule resurfaces. 80% of the firms have placed a high priority on managing supply chain risks and 20% do not.

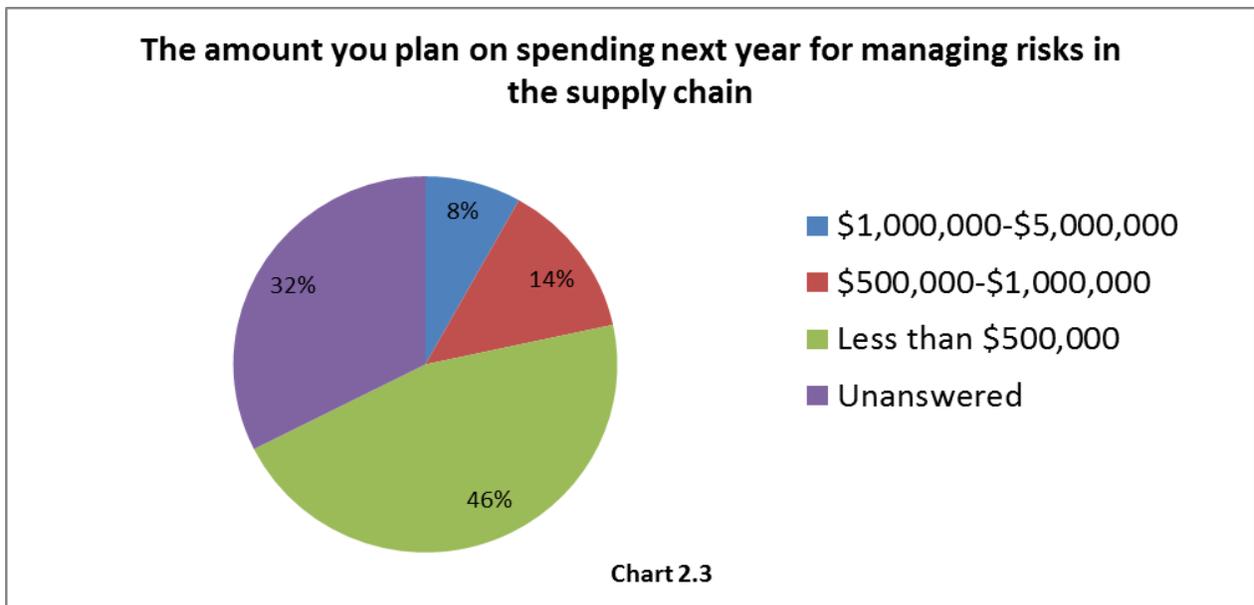
If you are not using any tools, techniques, or methodologies for managing supply chain risks, then what is the major reason?

- Satisfied with current process Cannot justify the benefits
 Cannot justify the costs Lack of skill sets



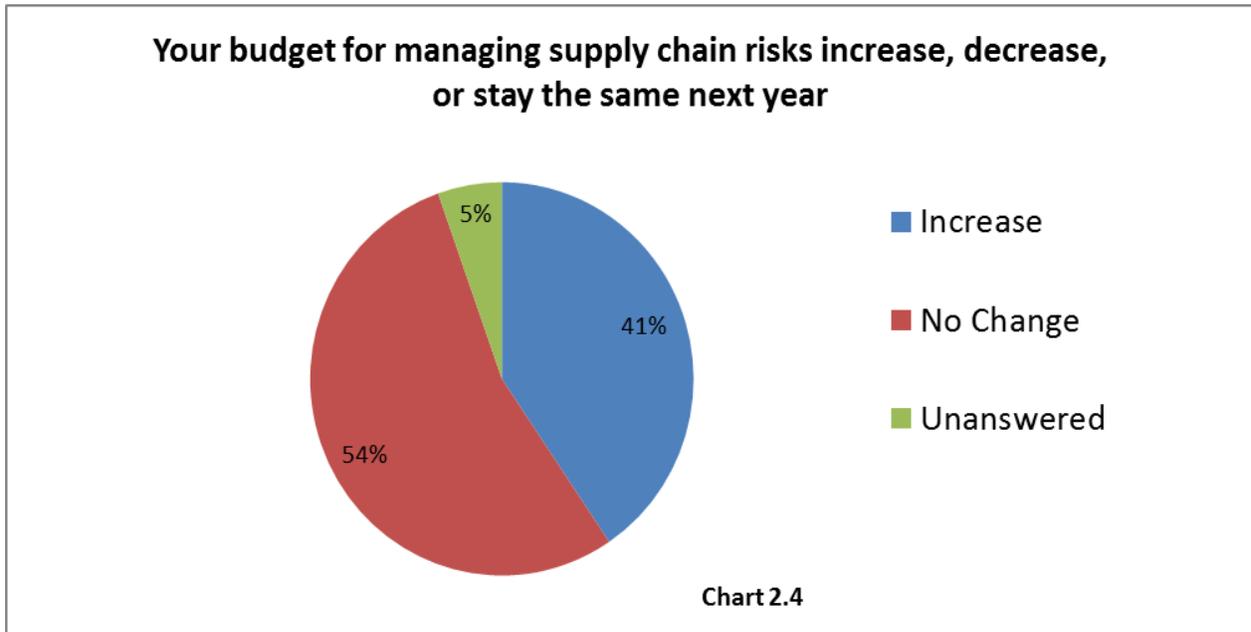
Approximately how much do you plan on spending next year for managing risks in the supply chain (e.g., IT, support services, process changes, etc.)? Feel free to skip this question if you are uncomfortable with the dollar signs associated with it.

- Less than \$500,000 \$500,000-\$1,000,000
 \$1,000,000 - \$5,000,000 More than \$5,000,000



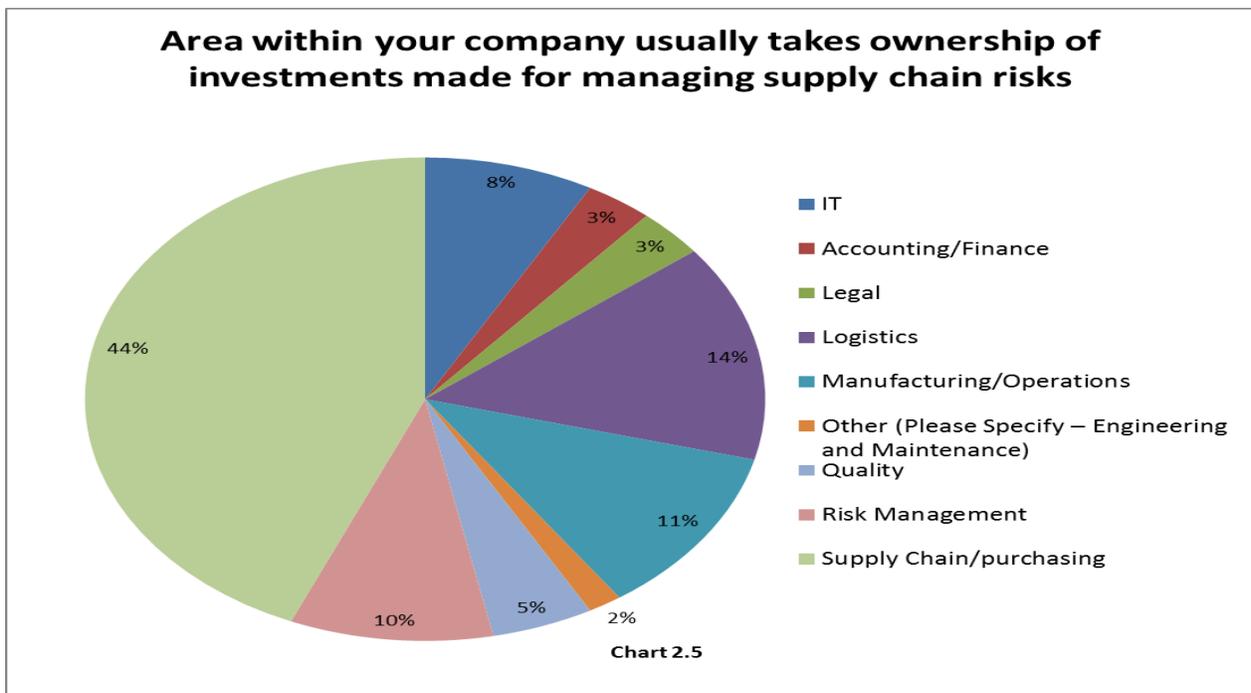
Will your budget for managing supply chain risks increase, decrease, or stay the same next year?

Increase Decrease No change



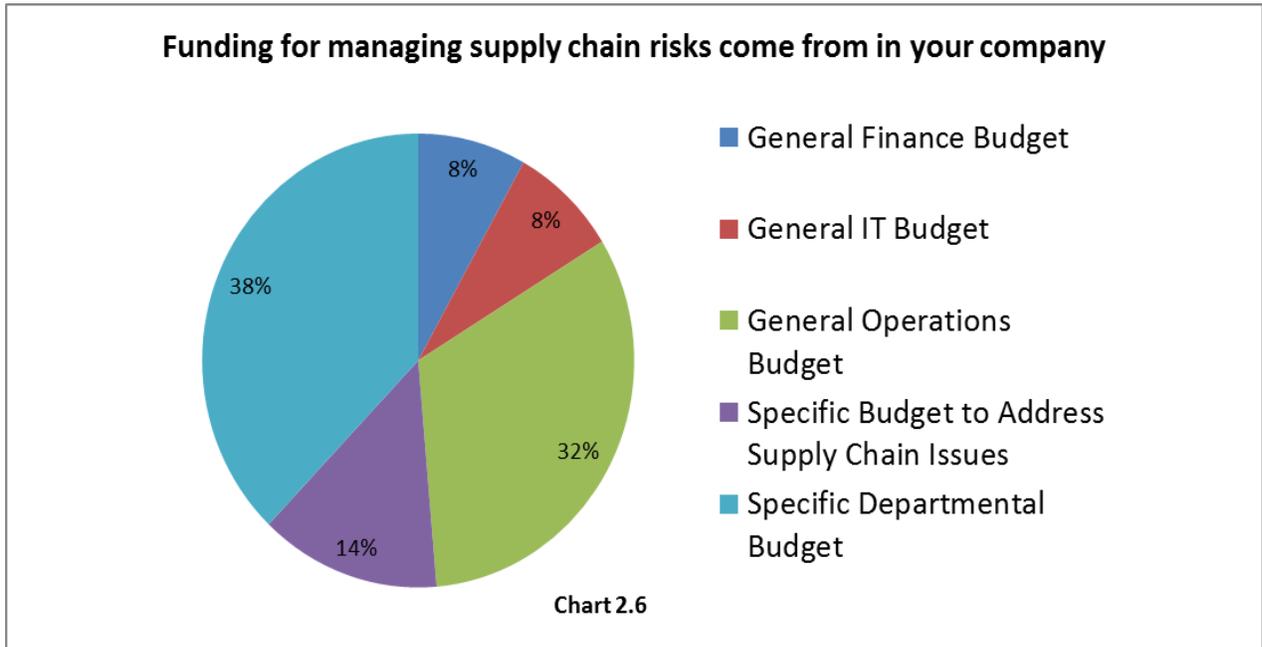
Which area within your company usually takes ownership of investments made for managing supply chain risks?

Risk Management Supply Chain/Purchasing Legal Logistics
 Accounting/Finance Manufacturing/Operations IT Quality
 Other (Please Specify)



Where does the funding for managing supply chain risks come from in your company?

General operations budget Specific departmental budget General finance budget
General IT budget Specific budget to address supply chain issues



With a 1 to 7 scale and a sample size of 46 firms, the Variance (Var.) for each question can generally be interpreted as follows. A Var. of > 2.00 implies there was a sizeable amount of variation in the responses and <2.00 implies less variation. You will notice that in general, the questions with a high mean (>5.00) had low variances (<2.00). The majority of the companies answered towards the high end (Mean >5.00) with less variation. However, there was a larger amount of variation for questions with a mean of <4.00. The minimum and maximum responses for each question are highlighted in yellow.

Please circle a number using the 7-point scales with:

1= Not used to **7= Extensively used**

To what extent are the following used in managing your supply chain and risks within it?

Information gathering	1	2	3	4	5	6	7
Mean = 5.84, SD= 1.31, Var.= 1.75(low), Kurt= -0.59, Skew= -1.05							
Training programs	1	2	3	4	5	6	7
Mean = 3.61, SD= 1.71, Var.= 2.93(high), Kurt= -0.88, Skew= 0.43							
Joint technology development initiatives	1	2	3	4	5	6	7
Mean = 3.73, SD= 1.57, Var.= 2.48(high), Kurt= -0.00, Skew= 0.38							
Partnership formation and long-term agreement	1	2	3	4	5	6	7
Mean = 5.16, SD= 1.34, Var.= 1.81(low), Kurt= -0.53, Skew= -0.24							
Supplier development initiatives	1	2	3	4	5	6	7
Mean = 4.84, SD= 1.48, Var.= 2.20(high), Kurt= 1.00, Skew= -0.90							
Supplier performance measurement system	1	2	3	4	5	6	7
Mean = 5.27, SD= 1.37, Var.= 1.87(low), Kurt= 1.84, Skew= -1.14							
Consistent monitoring and auditing of a supplier's processes	1	2	3	4	5	6	7
Mean = 4.73, SD= 1.57, Var.= 2.48(high), Kurt= -0.46, Skew= -0.29							
Using an approved list of suppliers	1	2	3	4	5	6	7
Mean = 6.33, SD= 1.04, Var.= 1.09(low), Kurt= 8.02, Skew= -2.05							
Multiple sourcing (rather than sole sourcing)	1	2	3	4	5	6	7
Mean = 4.27, SD= 1.48, Var.= 2.20(high), Kurt= -0.19, Skew= -0.60							
Visiting supplier operations	1	2	3	4	5	6	7
Mean = 5.00, SD= 1.53, Var.= 2.33(high), Kurt= -0.37, Skew= -0.25							
Establishing good communications with supplier	1	2	3	4	5	6	7
Mean = 5.92, SD= 1.01, Var.= 1.02(low), Kurt= -0.19, Skew= -0.86							
Increasing product differentiation	1	2	3	4	5	6	7
Mean = 4.27, SD= 1.71, Var.= 2.92(high), Kurt= -0.33, Skew= -0.31							
Speculation (forward placement of inventory, forward buying of raw material, etc.)	1	2	3	4	5	6	7
Mean = 4.41, SD= 1.50, Var.= 2.25(high), Kurt= -0.49, Skew= -0.33							
Inventory management (buffers, safety stock levels, optimal order & production qty.)	1	2	3	4	5	6	7
Mean = 5.97, SD= 1.26, Var.= 1.58(low), Kurt= 1.29, Skew= -1.27							
Data warehousing	1	2	3	4	5	6	7
Mean = 4.78, SD= 1.84, Var.= 3.40(very high), Kurt= -0.75, Skew= -0.51							
Spend management and analysis	1	2	3	4	5	6	7
Mean = 5.39, SD= 1.29, Var.= 1.67(low), Kurt= -0.99, Skew= -0.20							
Inventory optimization tools	1	2	3	4	5	6	7
Mean = 5.16, SD= 1.59, Var.= 2.53(high), Kurt= -0.77, Skew= -0.41							
Credit and financial data analysis	1	2	3	4	5	6	7
Mean = 5.22, SD= 1.46, Var.= 2.12(high), Kurt= -0.75, Skew= -0.59							
Business process management	1	2	3	4	5	6	7
Mean = 4.92, SD= 1.44, Var.= 2.08(high), Kurt= -0.47, Skew= -0.39							
Hedging strategies (to protect against commodity price swings)	1	2	3	4	5	6	7
Mean = 3.92, SD= 1.76, Var.= 3.11(very high), Kurt= -0.84, Skew= -0.20							

Contract mgmt (e.g., leverage tools to monitor performance against commitments)	1	2	3	4	5	6	7
Mean = 4.72, SD= 1.52, Var.= 2.32(high), Kurt= -1.05, Skew= -0.22							
Benchmarking (internal, external, industry-wide, etc.)	1	2	3	4	5	6	7
Mean = 4.95, SD= 1.63, Var.= 2.66(high), Kurt= -0.01, Skew= -0.48							
Forecasting techniques(e.g., to pre-build & carry additional inventory of critical items)	1	2	3	4	5	6	7
Mean = 5.30, SD= 1.54, Var.= 2.38(high), Kurt= 0.77, Skew= -1.01							
Contingency Planning (jointly with suppliers)	1	2	3	4	5	6	7
Mean = 4.35, SD= 1.77, Var.= 3.12(very high), Kurt= -1.25, Skew= -0.28							

Please circle a number using the 7-point scales with:

1= Strongly disagree to **7= Strongly agree**

Managing supply chain risk is an increasingly important initiative for our operations.	1	2	3	4	5	6	7
Mean = 5.89, SD= 1.13, Var.= 1.27(low), Kurt= 0.42, Skew= -0.89							
My workplace plans on evaluating or implementing supply chain risk tools and technologies.	1	2	3	4	5	6	7
Mean = 4.41, SD= 1.67, Var.= 2.80(high), Kurt= -0.65, Skew= -0.13							
Supplier reliability and continuous supply is the top risk factor for our supply chain.	1	2	3	4	5	6	7
Mean = 5.73, SD= 0.93, Var.= 0.87(low), Kurt= 0.84, Skew= -0.72							
We have a dedicated budget for activities associated with managing supply chain risks.	1	2	3	4	5	6	7
Mean = 3.75, SD= 2.08, Var.= 4.31(very high), Kurt= -1.30, Skew= 0.05							
We apply high levels of analytical rigor to assess our supply chain practices.	1	2	3	4	5	6	7
Mean = 4.76, SD= 1.75, Var.= 3.08(very high), Kurt= -0.61, Skew= -0.49							
Supply chain risk initiatives are driven from the bottom up rather than top down.	1	2	3	4	5	6	7
Mean = 4.41, SD= 1.79, Var.= 3.19(very high), Kurt= -0.74, Skew= -0.41							
We are currently using some form of supply chain risk management tools and services.	1	2	3	4	5	6	7
Mean = 4.89, SD= 1.73, Var.= 2.99(high), Kurt= -0.19, Skew= -0.71							
Managing supply chain risks is driven by reactions to failures rather being proactively driven.	1	2	3	4	5	6	7
Mean = 3.95, SD= 1.75, Var.= 3.05(very high), Kurt= -1.43, Skew= -0.14							
We have placed an increased focus on inventory management to deal with supply risks.	1	2	3	4	5	6	7
Mean = 5.38, SD= 1.30, Var.= 1.69(low), Kurt= -0.08, Skew= -0.52							
We use network design and optimization tools to cope with uncertainty in the supply chain.	1	2	3	4	5	6	7
Mean = 4.47, SD= 1.65, Var.= 2.71(high), Kurt= -0.86, Skew= -0.21							
Taxes such as excise and VAT impact our supply chain decisions.	1	2	3	4	5	6	7
Mean = 3.78, SD= 2.11, Var.= 4.46(very high), Kurt= -1.33, Skew= 0.14							
A key part of our supply chain management is documenting the likelihood & impact of risks.	1	2	3	4	5	6	7
Mean = 3.89, SD= 1.68, Var.= 2.82(high), Kurt= -1.27, Skew= -0.08							
Supply chain risk information is accurate and readily available to key-decision makers.	1	2	3	4	5	6	7
Mean = 4.24, SD= 1.67, Var.= 2.80(high), Kurt= -0.81, Skew= -0.26							
Our spending intentions for managing supply chain risks are very high.	1	2	3	4	5	6	7
Mean = 3.75, SD= 1.54, Var.= 2.36(high), Kurt= -0.40, Skew= -0.20							
Funding for managing supply chain risks will come from a general operations budget.	1	2	3	4	5	6	7
Mean = 3.75, SD= 2.06, Var.= 4.25(very high), Kurt= -1.34, Skew= 0.05							
We do plan on investing nontrivial amounts in managing supply chain risks.	1	2	3	4	5	6	7
Mean = 4.00, SD= 1.87, Var.= 3.49(very high), Kurt= -1.09, Skew= -0.03							
We can actually exploit risk to an advantage by taking calculated risks in the supply chain.	1	2	3	4	5	6	7
Mean = 4.23, SD= 1.80, Var.= 3.24(very high), Kurt= -0.86, Skew= -0.20							
I fully understand the activities being performed by our risk management group.	1	2	3	4	5	6	7
Mean = 4.06, SD= 1.87, Var.= 3.48(very high), Kurt= -0.89, Skew= 0.19							

We are planning to outsource all or some of our risk management functions. Mean = 2.47, SD= 1.63, Var.= 2.66(high), Kurt= 0.24, Skew= 0.93	1	2	3	4	5	6	7
Risks associated with transit delays or import operations are proactively managed. Mean = 5.19, SD= 1.52, Var.= 2.32(high), Kurt= 0.72, Skew= -0.93	1	2	3	4	5	6	7
Risks associated with efforts toward shorter production times are proactively managed. Mean = 4.68 SD= 1.53, Var.= 2.34(high), Kurt= -0.32, Skew= -0.30	1	2	3	4	5	6	7
My workplace uses supply chain risk managers who work closely with corporate risk mgmt. Mean = 3.53, SD= 1.81, Var.= 3.28(very high), Kurt= -0.15, Skew= 0.52	1	2	3	4	5	6	7
Supply chain employees understand government legislation & geopolitical issues. Mean = 3.78, SD= 1.57, Var.= 2.45(high), Kurt= -0.51 Skew= 0.29	1	2	3	4	5	6	7
We are prepared to minimize the effects of disruptions (terrorism, weather, theft, etc.) Mean = 4.54, SD= 1.61, Var.= 2.59(high), Kurt= -0.56, Skew= -0.25	1	2	3	4	5	6	7
There is no single set of tools or technologies on the market for managing supply chain risks. Mean = 5.31, SD= 1.83, Var.= 3.36(very high), Kurt= 0.21, Skew= -1.07	1	2	3	4	5	6	7
Without a systematic analysis technique to assess risk, much can go wrong in a supply chain. Mean = 5.89, SD= 1.02, Var.= 1.04(low), Kurt= 0.05, Skew= -0.60	1	2	3	4	5	6	7
We have placed an emphasis on incident reporting to decrease the effects of disruptions. Mean = 5.00, SD= 1.62, Var.= 2.61(high), Kurt= -1.08, Skew= -0.50	1	2	3	4	5	6	7

Please circle a number using the 7-point scales with:

1= Strongly disagree to **7= Strongly agree**

Our suppliers are required to have secure sourcing, business continuity, & contingency plans. Mean = 4.78, SD= 1.49, Var.= 2.23(high), Kurt= -0.61, Skew= -0.25	1	2	3	4	5	6	7
It is critical for us to have an easily understood method to identify & manage supply chain risk. Mean = 5.43, SD= 1.01, Var.= 1.03(low), Kurt= -1.05, Skew= 0.03	1	2	3	4	5	6	7
Proactive risk mitigation efforts applied to the supply chain is common practice for us. Mean = 4.68, SD= 1.55, Var.= 2.39(high), Kurt= -0.95, Skew= 0.20	1	2	3	4	5	6	7
We are hedging our raw materials exposure to reduce input cost volatility. Mean = 3.97, SD= 1.81, Var.= 3.26(high), Kurt= -0.90, Skew= 0.01	1	2	3	4	5	6	7
Key metrics are in place to measure the risk associated with key suppliers. Mean = 4.69, SD= 1.62, Var.= 2.62(high), Kurt= -0.49, Skew= -0.33	1	2	3	4	5	6	7
Our company uses real-time inventory information and analytics in managing the supply chain. Mean = 5.76, SD= 1.59, Var.= 2.52(high), Kurt= 1.39, Skew= -1.42	1	2	3	4	5	6	7
Risks of moving manufacturing facilities overseas are carefully evaluated. Mean = 5.09, SD= 2.06, Var.= 4.26(very high), Kurt= -0.18, Skew= -0.97	1	2	3	4	5	6	7
Risks of not being able to fulfill a spike in consumer demand are carefully evaluated. Mean = 5.22, SD= 1.51, Var.= 2.29(high), Kurt= -1.49, Skew= -0.14	1	2	3	4	5	6	7
We actively benchmark our supply chain risk processes against competitors. Mean = 3.61, SD= 1.69, Var.= 2.87(high), Kurt= -0.59, Skew= 0.39	1	2	3	4	5	6	7
We have had supply disruptions that have caused financial hardships in the past 24 months. Mean = 4.36, SD= 2.28, Var.= 5.21(very high), Kurt= -1.42, Skew= -0.26	1	2	3	4	5	6	7
We are very concerned about our supply chain resiliency, and the failure implications. Mean = 4.89, SD= 1.65, Var.= 2.73(high), Kurt= -0.41, Skew= -0.54	1	2	3	4	5	6	7

Please rank order five of the following risks which would have the greatest severity or impact on your supply chain if it occurred (e.g., 1=most severe, 2=second most severe, etc.). The impact might be in terms of financial losses, delivery delays, quality to the customer, loss of reputation, property damage, etc.

- Supplier failure/reliability
- Natural disasters or accidents (tsunamis, hurricanes, fires, etc.)
- Geopolitical event (terrorism, war, etc.)
- Government regulations (SOX, SEC, Clean Air Act, OSHA, EU)
- Logistics failure
- Contract Failure
- Intellectual property infringement
- Weaknesses in the local infrastructures
- Obtaining proper bonds & licenses
- Customs Acts/Trade restrictions and protectionism
- Ethical issues (working practices, health, safety, etc.)
- Port/cargo security (information, freight, vandalism, sabotage, etc.)
- Internal and external theft
- Property development – local codes and requirements
- Unfamiliar business and property laws
- Legal liabilities and litigation
- Return policy and product recall requirements
- Lack of trust with partners
- Language and educational barriers
- Measuring tools – metrics translate differently
- Information delays, scarcity, sharing, & infrastructure breakdown
- Attracting and retaining skilled labor
- Bankruptcy, ruin, or default of suppliers, shippers, etc.
- Degree of control over operations
- Fraud or scandal
- Strikes – labor, buyers and suppliers
- Commodity cost volatility
- Currency exchange, interest, and/or inflation rate fluctuations
- Banking regulations and tighter financing conditions
- Insurance coverage
- Diminishing capacities (financial, production, structural, etc.)
- Customer-related (demand change, system failure, payment delay)
- Contamination exposures – food, germs, infections
- Energy/raw material shortages and power outages
- Tax issues (VAT, transfer pricing, excise, etc.)

Please list any other risks not listed above that impact your supply chain:

Natural disasters or accidents (tsunamis, hurricanes, fires, etc.)	↑	26
Supplier failure/reliability	→	16
Bankruptcy, ruin, or default of suppliers, shippers, etc.	→	12
Logistics failure	→	11
Port/cargo security (information, freight, vandalism, sabotage, etc.)	→	10
Customer-related (demand change, system failure, payment delay)	→	9
Strikes – labor, buyers and suppliers	↓	8
Diminishing capacities (financial, production, structural, etc.)	↓	8
Energy/raw material shortages and power outages	↓	8
Geopolitical event (terrorism, war, etc.)	↓	7
Government regulations (SOX, SEC, Clean Air Act, OSHA, EU)	↓	7
Contamination exposures – food, germs, infections	↓	6
Information delays, scarcity, sharing, & infrastructure breakdown	↓	5
Attracting and retaining skilled labor	↓	5
Commodity cost volatility	↓	5
Legal liabilities and litigation	↓	4
Currency exchange, interest, and/or inflation rate fluctuations	↓	4
Intellectual property infringement	↓	3
Customs Acts/Trade restrictions and protectionism	↓	3
Degree of control over operations	↓	3
Contract Failure	↓	2
Return policy and product recall requirements	↓	2
Weaknesses in the local infrastructures	↓	1
Obtaining proper bonds & licenses	↓	1
Lack of trust with partners	↓	1
Measuring tools – metrics translate differently	↓	1
Fraud or scandal	↓	1
Tax issues (VAT, transfer pricing, excise, etc.)	↓	1

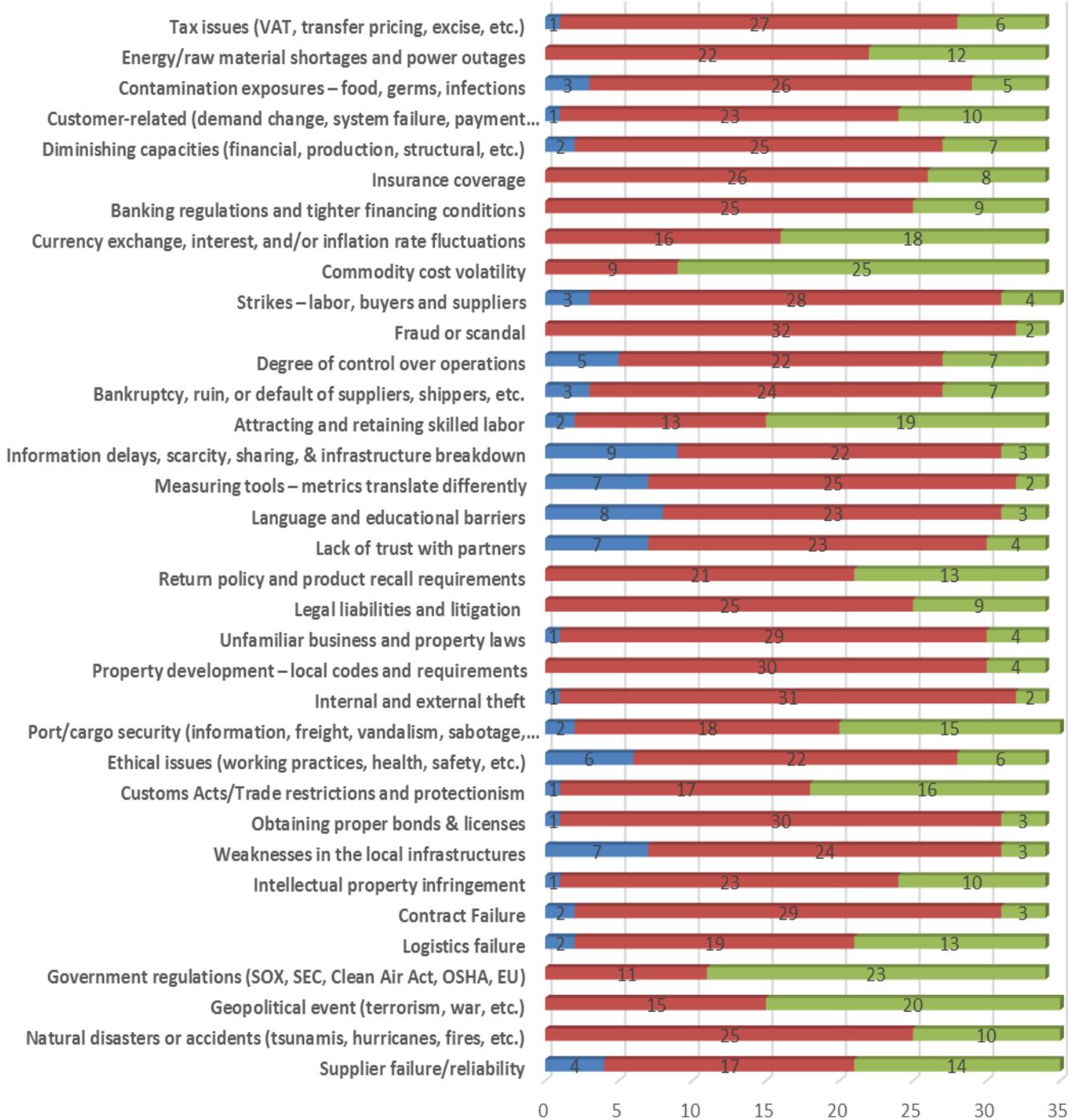
Table 4.1

The numbers above indicate the frequency of the responses.

<p>Do you believe the supply chain risk will increase, stay the same, or decrease in the next 1-2 years? Please check a box.</p>	<p>Risk will <u>decrease</u> in the next 1-2 years</p>	<p>Risk will not change in the next 1-2 years</p>	<p>Risk will <u>increase</u> in the next 1-2 years</p>
Supplier failure/reliability	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Natural disasters or accidents (tsunamis, hurricanes, fires, etc.)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Geopolitical event (terrorism, war, etc.)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Government regulations (SOX, SEC, Clean Air Act, OSHA, EU)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Logistics failure	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Contract Failure	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Intellectual property infringement	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Weaknesses in the local infrastructures	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Obtaining proper bonds & licenses	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Customs Acts/Trade restrictions and protectionism	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ethical issues (working practices, health, safety, etc.)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Port/cargo security (information, freight, vandalism, sabotage, etc.)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Internal and external theft	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Property development – local codes and requirements	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Unfamiliar business and property laws	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Legal liabilities and issues	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Return policy and product recall requirements	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Lack of trust with partners	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Language and educational barriers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Measuring tools – metrics translate differently	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Information delays, scarcity, sharing, & infrastructure breakdown	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Attracting and retaining skilled labor	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Bankruptcy, ruin, or default of suppliers, shippers, etc.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Degree of control over operations	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Fraud or scandal	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Strikes – labor, buyers and suppliers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Commodity cost volatility	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Currency exchange, interest, and/or inflation rate fluctuations	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Banking regulations and tighter financing conditions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Insurance coverage	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Diminishing capacities (financial, production, structural, etc.)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Customer-related (demand change, system failure, payment delay)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Contamination exposures – food, germs, infections	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Energy/raw material shortages and power outages	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Tax issues (VAT, transfer pricing, excise, etc.)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Increase, Decrease, or No Change in Supply Chain Risk in the next 1-2 years

■ Risk will decrease ■ Risk will not change ■ Risk will increase



Graph 5.1

What processes and techniques does your company use to identify and analyze risk in its supply chain?

- Firm1** Risk management organization
- Firm2** Manual capacity studies and SAP
- Firm3** Potential supplier self-surveys, onsite supplier visit and audit; which can include a longer supplier development plan should there be a need, requirement of suppliers to maintain ISO certification, require use of AIAG (Truck & Bus) protocol for PPAP submissions, monthly supplier performance scoring and review, Value Stream Mapping (using the SCOR model) with suppliers to better understand their supply/value chain (new method). Use of a FMEA to evaluate sourcing decisions to identify potential risks (new method). Semi-annual business reviews with suppliers (including financial review). Commodity Strategies to address: Spend analysis, Potential alternate suppliers, Ease of component qualification. Contract Development/Management: Confidentiality clauses, Intellectual Property clauses, Tooling bailment clauses; 1) Cost management clauses and 2) Supplier performance requirements clauses
- Firm4** Quality Dept. approving/analyzing all raw material before use; requiring all necessary documentation before approving a supplier and raw material, our CRM/ERP system will not allow non-compliant materials to be shipped
- Firm5** D&B Reviews, supplier audits, supplier development, long term contracts
- Firm6**
- Firm7** We have very minimal techniques that are used. Primarily we react to incidents as they occur.
- Firm8**
- Firm9** TE uses market data by region from Public domain resources. We also will contract with outside consultants for specific products.
- Firm10** Look to see how much of a business Stryker is compared to total volume, review blanket POs to see how much we are in term of a completion, look at supplier's S&P index - review wealth of suppliers, audit suppliers
- Firm11** Usage data, centralized safety stock, forecasting
- Firm12** Unfortunately we do very little in being proactive in risk management. We currently are trying to get to a semi-live inventory system. We control inventory in 2 primary ways. 1st is what we call planners, we have to manual count the items and upload them into our ERP system, then we can look at usage and requirements. Other way is use of Kanban / Visual control systems. These systems are really effective and low cost to manage. However they still have their limitations on when demand spikes above what was planned for.
- Firm13**
- Firm14** When first introduced, we do quality audit for every supplier we use. In addition, we use a financial evaluation if the company is publicly traded or request financial records.
- Firm15** Key metrics performance measure which allows us to measure failures and growth potential.
- Firm16** Buyer Feedback, global news monitoring and communication (i.e. port strikes, natural disasters, etc), supplier maps, supplier risk score (not updated regularly), supplier financial/credit risk, approved supplier list, sourcing network, word of mouth.
- Firm17** Monte Carlo simulations & game theory
- Firm18** We utilize our enterprise system-SAP, we utilize MRP to meet production plan, we have a bolt that is used to forecast our production plan, we have a separate system to manage and coordinate freight hauls of materials coming in as well as inner company transfers and finished goods shipping down-streams to customers.
- Firm19** We have several different processes and techniques depending on the situation and type of risk. For health, safety, security, and environmental, we utilize 3rd parties to evaluate and monitor vendor performance. Regarding supplier quality, we perform site audits on vendor's shops, maintain an approved manufacturers lists, and monitor performance through supplier performance management. We also have a business intelligence group that keeps abreast on what's going on in the industry and any issues with our key suppliers/customers. We also perform surveillance on our bigger, long lead items like fabricated equipment.
- Firm20** Approved under list, supplier rating system, sourcing councils
- Firm21**
- Firm22** Spreadsheets, market reports, visiting suppliers, non-conformance & networking
- Firm23** We have a reporting infrastructure that pushes reporting to identify projected product loss in terms of cases & dollars. We then have a process in place to work through those issues & track results, causes, etc, use ERP system, track vendor's performance
- Firm24** We actively monitor global news sources, intelligence from industry employees and forecasters, and we monitor the financial health of suppliers throughout the manufacturing industry.
- Firm25**
- Firm26** We use supplier driven data that describes the supplier risk due to multiple factors. Financial status, product quality, and delivery all play a role. We have a specific team at the Enterprise level that monitors suppliers and reports out to manager's as potential concerns arise.
- Firm27** We are a distribution company so our customer demand is wildly inconsistent. We mainly build risk factors into
-

our calculations for forecasting, safety stock, and general stocking level calculations. We are also building new forecasting tool to include more robust factors for assessing risks. When possible, we also attempt to diversify our customer base for specific materials.

Firm28 We have a risk management organization and reporting information operations and procurement jointly analyze

Firm29 Vendor credentialing devices that include extensive analysis of finances, automated product recall notification that include FDA and non-FDA alert notifications.

Firm30 Our supply chain teams always reports any risks that are apparent to top management and processes are put into place to improve/reduce risks, constant review of product usage, daily review of cases to notify if there will/is an influx of patients needing more supplies, contract review and updates

Firm31

Firm32 Supplier scorecard/ on-time delivery metrics, Single vs Dual Sourced Analysis, Non-Conformance/ Quality reports, Geographic location, Proximity to our facilities, DNBI Risk Management report

Firm33 Supplier surveys, Mapping risks in tools such as Google Earth, Constant Surveillance, Detailed supplier supply chain touch point location information,

Firm34 Vendor credentialing devices that include extensive analysis of finances, etc

Firm35 Supplier interviews, peer networking, financial review of suppliers- both 1st and 2nd tier, overall industry intelligence gathering (for example; speaking with supplier's supply chain staff at SC conferences), use a third party vendor credentialing service that provide some level of supplier intelligence, background checks, including D&B and Credit Ratings on vendor prior to their first purchase.

Firm36 We don't have any software or packages to manage the supplier risk. Our methods regarding risk are far more manual. We don't contract any supplier like BBK to manage our supplier risk, so we send in our teams. E.g. include: *sending our suppliers survey (related to disaster, political issues, strikes, chemical used and so on *monthly supplier scorecard * monthly financial risk evaluation *Annual order policy evaluation (using approved, recommended suppliers) *Material or exchange rate adjustments (contracts) *Our manpower is current 1 Engineering Section Leader w/ support of Corporate or NA Purchasing team (if crisis, cross functional team formed) *Critical parts are dual sourced usually in separate geographical areas

Firm37

What do you see as the major failure modes in the supply chain today?

Firm1 Rail/Ocean

Firm2 Increased volume vs diminished capacity, Failure / Quality issues of Chinese suppliers, Over capacity suppliers missing sea freights, causing air freights.

Firm3 "Mercury Procurement has identified 14 areas that will be addressed when considering the major failure modes in the supply base (in descending order of importance). • Financial Risk • Quality Risk • Delivery Risk • Security Risk • Design Risk • Contract Risk • Reputation Risk • Innovation Risk • Fraud Risk • Customer Concentration Risk • Criminal Risk •Geographic Risk • Intellectual Property Ownership/Infringement Risk • Political Risk"

Firm4 Being too dependent on current suppliers of compounded flavors. We are focusing heavily on resolving this issue

Firm5 Natural disasters, Supplier financial risks, supplier compliance with LTAs,

Firm6

Firm7 Recalls, government regulations / requirements, and supplier reliability are the biggest areas of possible failure.

Firm8

Firm9 Globalization and the lack of infrastructure to support it. As an example, India, good education system with a poor logistics capability. Brazil has the technical ability however the Brazil tax structure inhibits global growth.

Firm10 International shipping concerns, changing/moving from one supplier to another,

Firm11 Quality decrease within organization-start working back on quality, site visits by ISO categories

Firm12 There are too many to list. If one vendor that isn't dual sourced goes down we will have to shut lines down. Big issue we face with dual sourcing is the cost of tooling. We purchase a lot of components overseas and the cost to duplicate the tooling state side will be in the realm of \$250K+. We are discussing options but this is a major hurdle in a private equity world. Typically we have to have a fast pay back on the tooling, so trying to spend that much money to keep a potential problem from happening is not an easy sell.

Firm13 Rail and Road Transportation: Congestion, Lack of Space, Lack of Qualified Drivers and Lack of Equipment

Firm14 Our biggest failure with our supply chain are 1)late deliveries/ lack communication due to late deliveries, 2)quality hiccups (especially on new products)

Firm15 Not being able to react to failures.

Firm16 Single sourcing, informal/infrequent global disaster monitoring and communications, Infrequent/informal supplier visit and audit schedule, no supply chain risk summary, no risk mitigation budget

Firm17 Short term demand forecast accuracy, transportation capacity, timed deliveries

Firm18 Rail is always unreliable mode, for truck companies managing it will need to continue to invest in capital and

	have adequate skilled drivers available to meet the demand to move raw materials when and where needed.
Firm19	Quality – quality is always a top concern for us given the nature of what we do. Being a leader in the industry from a safety and environmental perspective we often go above and beyond what’s required by the EPA, OSHA, etc., Infrastructure breakdown – we have outdated infrastructure and keep putting more through it (roads, rails, etc.). We’re heavily reliant on pipelines, rails, roads, and the ports, and natural disasters.
Firm20	Communication - lack of info from customer
Firm21	
Firm22	Inventory accuracy, quality issues, lead times, custom delays, ERP
Firm23	The growing strain on the freight market, especially with DOT requiring Driver’s hours to be logged electronically this year, there is more concern about added trucks being required to maintain current business with the outside carriers we utilize & a lack of capacity, equipment, & human resources to manage it effectively. The Education segment is also become increasing a larger challenge with Nutritional Guidelines being increased with a larger Whole Grain requirement each year, among other areas. Suppliers have had to scramble to re-formulate products, come up with new products, and there is a very large uncertainty in demand as Schools are feeling the way through what products are being consumed & work well in their School Lunch programs. This makes forecasting, replenishment, & the trickle down to the supplier base very difficult to react to with little market intelligence to plan off of.
Firm24	Labor unrest, political instability, and economic challenges in emerging, as well as, established markets/countries
Firm25	
Firm26	We often struggle with communication, and understanding the risk of what obstacles are in the way for our suppliers. We often startup new programs with newly designed and sourced parts. We do evaluate our suppliers with basic audits, but depending on the skills of the audit team, sometimes small concerns and weaknesses are missed.
Firm27	One of the biggest failure modes in general is over-seas vendors. The sheer geographical distance is a barrier when vendor issues arise, but also the lead time of the product from order to delivery is a huge risk. Especially in distribution this can be detrimental. We order material 3-6 months ahead of delivery and by the time the material has arrived it is possible that the entire customer landscape has shifted and demand is now different. The lead time causes a huge risk in our supply chain. Domestically, logistics is one of our biggest failure modes. Relying on LTL carriers as the final touch point of the material to our customer is a high risk. We are relying on them for on time delivery, capacity, and quality. Carrier capacity and cost fluctuation are hard for us to calculate when assessing risk and prove to be a monumental challenge. When we utilize our own private fleet, these risks are more under control but as of today our private fleet capacity is somewhat limited. As a distributor, we are constantly held in the middle of all the risks our vendors and customers face and these can snow ball.
Firm28	Ocean/Rail
Firm29	Increasingly tighter margins challenge manufacturer's distribution to be able to provide consistent supply support.
Firm30	Lead times, Recalls, Backorders/Stock-outs, Data transparency, Customer support/service
Firm31	
Firm32	Disruption in supply, Disruption in transportation
Firm33	Natural disaster such as the earthquake in Japan pose a huge impact in supply chain, however, Gentex has been successful in mitigating impacts caused by such factors. They have been successful by utilizing their tools and networks to still get parts delivered where they were most needed for production during these disasters.
Firm34	Increasingly tighter margins challenge manufacturer's distribution to be able to provide consistent supply support.
Firm35	Infrastructure/Logistics, Failure to provide transparency of demand, thus continued bull whip issues
Firm36	We are struggling most in capacity management. This is from both an in-house and supplier capability point of view. As automotive volumes keep coming back the suppliers are still somewhat lean and sometimes unable to invest. The supplier who do invest are now requiring plant expansions to hold additional equipment and this takes much higher level of approval. Suppliers are always having hard time with turnover and finding qualified labor. Managing capacity is getting more complex as the numbers of global common platforms continue to grow. This results in more and more surprise or unplanned volumes. We need a more automated way to manage machine and tool capacity of our suppliers.
Firm37	

What do you see as the major failure modes in the supply chain in the future?

Firm1	Truck / Ocean
Firm2	I see a push to localize. I see company failing to localize supply struggling with logistical issues and customer

	service, quality.
Firm3	Many of the same failure modes listed above; however, in a different order of importance. In a global market, the security of both information and products will continue to be an issue to be addressed. The security of information is critical as it relates to Innovation Risk as suppliers continue to be active partners in new product development. I believe there will be an increase in Governmental/Regulatory Risk as industries are faced with additional requirements either on the business itself or on the products/services being provided
Firm4	As we get buyer we need to buy in larger increments, this will bring along the need for contracts/partnership and new materials and vendors to be approved to purchase from. This puts a strain on our Quality Dept., scaling up our product to handle more batches, more complex batches and more time consuming batches.
Firm5	Raw material availability in certain regions, inflation in emerging markets i.e. China and Brazil, natural disasters
Firm6	
Firm7	We will continue to have many of the same failure modes for the next 3-5 years based on upcoming government regulations.
Firm8	
Firm9	The lack of uniform Law that protect Human rights, environment and counterfeit products.
Firm10	Skilled labor - lack of machinist, move away from off-shoring.
Firm11	Low Cost Source-resourcing off, Mexico great offshore because of automation, resourcing supplier development group
Firm12	For us I think the above will be true in the future as well.
Firm13	Rail and Road Transportation: Congestion, Lack of Space, Lack of Qualified Drivers and Lack of Equipment
Firm14	Biggest risk will continue to be occasional part shortages to the line and inadequate resources on both sides (buyer and vendor) to communicate late deliveries.
Firm15	Natural disasters or accidents.
Firm16	Similar/Same as processes as currently with increasingly complex supply chain. Retirement of senior professionals with "tribal" knowledge of risk identification and mitigation techniques
Firm17	Demand volatility coupled with compressing lead times.
Firm18	Ocean transport is a changing market that will probably get more demanding and difficult.
Firm19	Quality – quality is always a top concern for us given the nature of what we do. Being a leader in the industry from a safety and environmental perspective we often go above and beyond what's required by the EPA, OSHA, etc. Infrastructure breakdown – we have outdated infrastructure and keep putting more through it (roads, rails, etc.). We're heavily reliant on pipelines, rails, roads, and the ports. Natural Disasters – hurricanes, earthquakes, severe weather all have a huge effect on the oil and gas industry.
Firm20	Communication, Willingness to supply info to grow globally
Firm21	
Firm22	Geopolitical, Market Volatility, Regulation, Natural Disasters/Weather, Food sustainability
Firm23	Customer expectations are increasing at a rapid rate. Companies like Amazon.com are setting the bar with nearly instantaneous deliverables. While my company fully recognizes that & is on the forefront of our industry in investing our own e-business applications & resources to be a pioneer in this space within our industry, will our Supplier base be able to keep up & respond?
Firm24	Labor unrest, strikes, and other socio-economic events are the primary failure mode that I see in the future.
Firm25	
Firm26	We will continue to push for a leaner and stronger supply base. I see our major concerns being in our ability to not push them too far. I could see us struggling once we burden our suppliers with too much too fast. We will work with the Enterprise team to support their goals, but will remain cautious to not turn good suppliers into bad suppliers.
Firm27	I believe over-seas supply/demand will continue to be a humongous risk and possibly even more so. The political tensions can change at any moment and have an impact on our supply and it is very hard to predict. Also, domestic and global natural disasters do not seem to be decreasing and are having impacts at unprecedented levels which I believe will continue.
Firm28	Truck drivers/capacity constraints
Firm29	Increasingly tighter margins challenge manufacturer's distribution to be able to provide consistent supply support.
Firm30	Customer support/service, Reliance on technology - delays, breakdowns, etc, Shortened product life cycles, Regulations
Firm31	
Firm32	Disruption in supply, Disruption in transportation, Disruption in demand (possibly)
Firm33	ILWU labor strikes pose a future risk for Gentex because it could cause issues shipping by sea freight. Gentex has currently verified and deployed contingency plans and risk mitigation strategies for this risk, along with verifying strategies of suppliers who utilize west coast port.
Firm34	Increasingly tighter margins challenge manufacturer's distribution to be able to provide consistent supply

support.

Firm35 Infrastructure/Logistics, Failure to provide transparency of demand, thus continued bull whip issues.

Firm36 From raw material point of view, we use tons of aluminium. However in this market, DENSO is actually a small fish to these suppliers. There are other industries and OEM's buying far more aluminium than DENSO so they get priority on capacity & pricing. For e.g. in the future Ford will develop an all aluminium body which will take over a larger share in the aluminium industry. I don't call this a 'failure mode' however we do need to take special activities to make sure our relationships with these companies remain strong.

Firm37

Discuss the three most significant challenges, barriers or limiting factors that are having the most negative impact on supply risk management.

Firm1 Supplier performance, Willingness to invest, Capacity constraint

Firm2 Long lead logistics, Increased volumes vs over-capacity suppliers, Poor supplier quality

Firm3 Lack of Technology: there is no single solution by which all aspects of Supply Chain Risk Management can be assessed, analyzed and reported, Supplier participation/compliance in assessment activities, Lack of 3rd party assessment/certification/reporting to aggregate a supplier's response for use by their customers.

Firm4 Purchasing in small amounts, Lack of human capital to get the daily tasks done, Lack of physical space to produce, store

Firm5 Government regulations and protectionism regulations – Russia / Argentina, Natural disasters that affect a supplier site that has sole sourced items. Weather related issues (Hurricanes / floods / winter storms) that impact ports and road ways, Supplier financial issues that lead to inconsistent supply on short notice.

Firm6

Firm7 Supplier diversity, Supplier location (International vs Domestic), Supplier quality (suppliers do not perform to our standards without significant monitoring and pushing)

Firm8

Firm9 Capital investment - Lack of confidence in the global economy, Low Cost Countries – Understanding the risk of sourcing to these suppliers, Time to market – Customers' expectations of lead time.

Firm10 Accurate forecasting, Compliance/Customs

Firm11

Firm12 Lead time / quality for components purchased overseas, Rapid growth / increase demand due to increase in sales, The fact we are years behind on technology and do not have visibility into our inventory levels.

Firm13

Firm14 Lack of resources(both costs and people) to perform due diligence on supplier risk, Lack of time for onboarding of supplier / new parts before it's too late to evaluate risk

Firm15 Acts of nature – weather, Government regulations, Transportation failures

Firm16 No formal process to identify, prioritize, monitor, and mitigate risks, Retirement of experienced individuals with high level of risk mitigation knowledge, Drive to decrease inventory buffer, less inventory in supply chain = reduced risk buffer

Firm17 New carrier regulations, Financial credit to fund working capital, Capital investment

Firm18 Role changes when people move up or change company, so there is learning curve which leads to inefficiency and potential risk, Communication- continued improvement on processes and skills to communicate, Delivery specifically trucking - qualified people to drive trucks.

Firm19 Management doesn't always understand the implications and therefore isn't giving the attention needed (or resources), Increased competition in the marketplace – we find ourselves competing for shop space with all the other majors. We have internal stakeholders pushing to explore new shops with shorter lead times which sounds good from a commercial standpoint but adds risk from a quality standpoint. We need to ensure they're properly vetted and we put appropriate surveillance on the work, Shorter project timelines – our industry is booming right now with project activity and often times the economics are based on those earliest to the game. With this being said, it creates tightened timelines for project activities which increases supply chain risk.

Firm20 Lack of info, Openness of supplier, Time to dedicate to SRM - Not enough

Firm21

Firm22 Cash availability for inventory, ERP, supply chain function

Firm23 In the food industry... Customers need to have a revolving menu, so transitioning products at a high frequency, bringing in new, unique products very quickly, and forecasting to that, & our suppliers performing, The holidays & winter weather are very grueling in our industry, much of the supplier base close for the holidays so additional load building & inventory is required to cover through these periods where sales are in flux & weather conditions cause delays in so many areas, uncertainty is at a high, The tightening freight market

Firm24 Changing the perception that SRM is an "Insurance Policy" and/or only Reactive, Allocating sufficient resources

to implement and maintain a successful strategy, Value Chain Transparency to enable pro-active SRM analysis throughout the value chain.

Firm25

Firm26 Communication, understanding orders, delivering on quality. We can't communicate enough. Even domestic suppliers need attention, it is not just an overseas issue. We must focus on regular, yet productive meetings to share information. We have a peak season, and suppliers must understand and be able to build to that order cycle, and not flat load their production planning. We must have suppliers that can deliver quality parts. We must be diligent with our DPAR and PPAP processes. We must perform special process audits as needed. We must make sure the suppliers know their contribution to the development/production of these parts.

Firm27 The unpredictability of natural disasters is probably at the top of the list. It is impossible to calculate the magnitude of risk involved. There are some ways to account for this based on geography (e.g. Japan is at higher risk than China), but it is still relatively hard to account for. Logistics companies. As a distributor we work with countless logistics companies and transportation management companies and the health of our business relies on them. We had a negative experience handing over the reins of our logistics to a TMS company, and it blew up (blame is on both sides). As a distributor we have to absorb our own internal risk as well as the risk of our vendors and customers. It is challenging enough managing internal risk, but the complications are severe with countless companies are involved. I'm guessing this is nearly as big of a problem with manufacturing companies.

Firm28 Capacity of suppliers (carriers), Lack of investment, Lack of practice measures to mitigate risks

Firm29 Limited supplies, low inventory, limited visibility into utilization

Firm30 Growth, vendor proliferation, decreasing reimbursement impacting financials

Firm31

Firm32 Lack of visibility and awareness of the need, Lack of manpower to drive risk management, Lack of financial support to implement

Firm33

Firm34 Limited supplies, low inventory, limited visibility into utilization

Firm35 Internal appreciation of the need to perform this task, and the resources to do it correctly, Funding/Budgets, Staff skill sets

Firm36

Firm37

What specific measures do you use to determine that the appropriate supply risk management strategy was selected and that it was successful?

Firm1

Firm2 Meeting customer requirements, quality metrics & on-time delivery

Firm3 Suppliers are measured on Cost Management (variance to standard, continuous improvement opportunities, etc), Delivery (on-time to a given delivery window) and Quality (ppm) performance. Monthly scorecards are sent to both the supplier and to the Category Manager for review. Also, warranty rates are monitored relative to product quality going to our customers, both in the near term and throughout the warranty period. First pass approval rates for PPAP submissions are tracked. Audit forms have a scoring system with minimum scoring requirements to pass.

Firm4 Nothing too extreme, we did have extra products, expired products and returned products.

Firm5 D&B measurement of risk vs actual supplier issues, Material availability vs planned safety stock / time coverage, Supplier performance vs Supplier development investment.

Firm6

Firm7 Number of failures

Firm8

Firm9 We build risk clauses into our global agreements

Firm10 Continuous improvement, pre-post audit reviews

Firm11 Time sense, can do new tooling and upgrades

Firm12 We try to keep a couple weeks of extra inventory to absorb increase in demand, but that is about it.

Firm13

Firm14 When we bring on new supplier, we perform quality audits 100% of the time. Occasionally do financial audits. Perform technical audits on the quoted products with the supplier and the reviews of suppliers business (products/customers) before we select the customer for sourcing.

Firm15 Metrics

Firm16 Profitability, premium freight costs, on time delivery to customer, supplier delivery, quality (RPPM).

Firm17 Raw Materials Stock-out

Firm18	I have good open lines of communication with my suppliers to address their business and hurdles. I also perform financial analysis to ensure that they are a good source to enter into relationship with and we can rely on them to supply for us.
Firm19	Not enough...unfortunately. We typically don't do "wrap-ups" unless it's a large scale project or something goes wrong. When we do perform these types of activities, we look at things such as delivery, quality, overall project execution, etc.
Firm20	Ensuring supplier is supplying good quality products when Mann Hummel asks for it.
Firm21	
Firm22	We don't have this
Firm23	Service Level performance (in stock %), as well as Product Loss, Weeks on Hand evaluations, etc. We also do Lessons Learned sessions cross-functionally through busy seasons to work through what worked well, where our greatest issues lied, etc.
Firm24	No standard measurements are in place today. The primary indicator of success is no interruption of vehicle/engine/transmission production.
Firm25	
Firm26	We focus on quality and delivery metrics first. Then there are others related to capacity and finances. We have Enterprise support tracking all of these items, and sharing data with the extended teams. It seems to work well, but is dependent on issues and feedback going back to that team as well.
Firm27	Unfortunately for the most part we manage failures. When something goes wrong we evaluate why it was missed and what risk factors need to be in place now to prevent future occurrence. However, inventory risk we constantly manage with hundreds of daily metrics. Basically, we are trying to determine: Did we have the right quantity of material at the right time in the right place?
Firm28	Financial implications mitigated
Firm29	We manage this by a comprehensive review at each incident and/or near miss.
Firm30	
Firm31	
Firm32	We don't measure it well. Basically success if achieve if we avoid running out of products to support customer needs.
Firm33	
Firm34	We manage this by a comprehensive review at each incident and/or near miss.
Firm35	The selected strategy is essentially the path of least resistance as it uses pre-existing resources. Efficacy or level of success is not measured.
Firm36	
Firm37	

How does top management recognize the important of supply risk management (e.g., is supply risk management linked with corporate risk management?)

Firm1	Yes
Firm2	It managed within customer teams. It is mainly a Purchasing function to mitigate supply risk.
Firm3	Yes, Mercury is working closely with Brunswick's corporate Risk Management team on supply risk management strategy/planning.
Firm4	They are very aware and in tune with the risk of our supply chain mostly recognized by past issues
Firm5	Internal audit activities, D&B reporting support, Increased headcount for SQE and development
Firm6	
Firm7	Not that I can tell
Firm8	
Firm9	We are not able to discuss this
Firm10	Working with consulting firm - IBP - process improvements
Firm11	Corporate Reports to CEO, supply chain is very important
Firm12	They do not want to run out of inventory, but are unwilling to allocated resources / funds to mitigate risk.
Firm13	It should be more recognized in a global level
Firm14	Top management fully supports purchasing and supply chain initiatives. We don't have resources to buy an elaborate software system to evaluate supplier risk, but our company and our supply base barely have the resources to maintain the basics of our current business (buying product, making product, quoting product, delivering product).
Firm15	
Firm16	Improved corporate risk management tools (online portal) feeds from divisions to corporate office, Corporate contract documents and manuals available, use of approved supplier list for all suppliers

Firm17	Risk Management quarterly strategy review sessions
Firm18	Supply chain is an integral part of our business and top management are fully aware of it as a breakdown and impact product and delivery. They provide support to make needed improvements to the systems and processes.
Firm19	Not on their radar like corporate risk management.
Firm20	Review before parts are sourced to a supplier
Firm21	
Firm22	We are getting better but not totally convinced
Firm23	Not sure I have the insight into their discussions in this area.
Firm24	Supply Risk Management has been incorporated into the corporate "Creating Value Roadmap". It is reviewed on an annual basis by the Board of Directors Audit Committee
Firm25	
Firm26	I believe so, but is a much larger team at that point. I am not directly connected to know, but it should be a portion of the upper management regular risk discussion.
Firm27	Yes, but the link is not sound. This company is a new company (3 years) and is owned by a private equity firm. That being said, the entire venture is a huge risk and can change at any moment. Top management is constantly taking risks and allowing the lower parts of the organization to manage the day to day risk. Top management IS evaluating risk in detail when setting direction of the company. For instance, a new focus has been on acquisitions to hedge risk and take more control.
Firm28	Yes
Firm29	Yes
Firm30	
Firm31	
Firm32	It's recognized among all levels of management but has only started to gain any priority-focus. Thailand tsunami opened the eye of management.
Firm33	
Firm34	Yes
Firm35	It is not recognized as important outside of supply chain - until a problem occurs. That it is why didn't we see this coming?
Firm36	
Firm37	

What resources and support does top management allocate to supply risk management, are such allocations sufficient – if not, what is most lacking?

Firm1	Focus & clear plan
Firm2	Standard purchasing personnel and budget.
Firm3	Brunswick's Risk Management team has been working with Mercury on supply risk management strategies; however, due to limitations found regarding technology solutions to address assessment, analysis and reporting, monetary resources have not yet been allocated.
Firm4	We have an on-staff software developer so that we can code to avoid supply chain issues i.e. not allowing product to ship without meeting all necessary parameters
Firm5	Budgetary support, We could always use more headcount, yet overtime the headcount has increased, Investment in new IT tools to manage an increased level of transparency i.e. TMS, B2B PO exchange, supplier capacity management.
Firm6	
Firm7	Resources are very limited. The biggest thing we need is someone with enough understanding of this highly regulated environment who can help drive supplier diversity, and supply chain diversity.
Firm8	
Firm9	We are not able to discuss this.
Firm10	There are regular reviews that examine supplier's performance
Firm11	Corporate Supply Chain group sentorcercs
Firm12	Currently none
Firm13	Risk should start from the bottom and top so we can meet in the middle.
Firm14	We are a \$360M company and every head or budget allocation must be justified to create value. A position or significant allocation of money allocated to manage supply risk would be questioned.
Firm15	Pulling subject matter experts from various departments within the organization to address logistics failures or risk management failures.
Firm16	Increased corporate support for supply chain (training and heads), Corporate contract documents and manuals

	available, use of approved supplier list, independent sourcing units for low cost country suppliers.
Firm17	Corporate sourcing and financial resources
Firm18	Funds are budgeted and sufficient.
Firm19	Not much...usually these SRM items are brought up by the procurement rep assigned to the project; however, not always supported to the level needed (in my mind).
Firm20	Time spent and allocated to funds
Firm21	
Firm22	Good financial support-when important and are measureable i.e. sales
Firm23	Supplier performance & partnership to track & improve key metrics, such as fill rate, on time %, etc. There's emphasis on it, but mainly on the very-top level supplier base & the tools aren't quite there yet to readily provide & review this with the entire supply base, at least not as readily as we'd like
Firm24	Current resources are insufficient to take the SRM strategy to industry leading levels. Developing the business case for allocating resources is a known industry challenge.
Firm25	
Firm26	From my perspective (middle manager), the risk is managed by Supply Councils and their Supply Base Managers regularly, as they directly own the supplier relationships at the Enterprise level. They will use others to support their needs. I do not know specifics, but I assume there are people or groups helping them gather data to dive into their areas of concern.
Firm27	I am not exactly sure on the amount of resources being poured in to risk management. From my exposure, I would say that they are not sufficient. The thing that would be lacking the most is investment in our own plants/warehouses with the latest equipment to avoid equipment/facility failure and to keep up with the necessary productivity. However, as a distribution company we have many locations so it is easy to be reactionary when something fails and continue business.
Firm28	No-not enough strategic focus on how to mitigate or avoid risks
Firm29	Limited
Firm30	Through a comprehensive supply chain team e.g. Purchasing, Contracting, Materials Management
Firm31	
Firm32	Resources are scarce to support in depth supply risk analysis. KPI's don't target supply interruptions effects on financial goals.
Firm33	
Firm34	Limited
Firm35	Risk management is assumed to be part of SC's job, with no additional resources allocated to this function. It is integrated into SC processes.
Firm36	
Firm37	

If top management does not recognize the importance and/or does not allocate sufficient resources, what does or should supply managers do to change the situation?

Firm1	Use 3 rd party
Firm2	Make a case for risk budget, however our travel budget is hefty and normally we can get further budget from our customers with solid risk outlines.
Firm3	Supply managers need to educate themselves to better understand the topic of Supply Chain Risk Management and its multiple facets. In doing so, they would be equipped to paint the picture of what life would be like should any of the tragic events come to pass. Helping top management understand how an event would affect the business and them personally is crucial for top management to gain an appreciation and an understanding of the importance of Supply Chain Risk Management. But, once sufficient resources are available, a manager better know where to deploy the resources best to ensure that a return on the investment is being realized.
Firm4	
Firm5	Continue to highlight risks, Find alternate sources of supply, Develop cross functional tools to mitigate the risks, Continued supplier development
Firm6	
Firm7	We work with the suppliers very closely to prevent as many issues / errors as possible. We also work with them to ensure they are able to pass appropriate inspections from different entities.
Firm8	
Firm9	
Firm10	Bring the situation to their attention - allocate dollars to reviewing security in supply chain
Firm11	
Firm12	Present data showing the cost impact of shutting down facilities vs increase cost of risk management. Still

struggle on % chance on having issues. Historically we only had a few issues that caused significant impact to the bottom line.

Firm13 They recognized but how to change the situation is the question.

Firm14 We don't see the need to change the situation. If we begin to see supplier failure in the market, we might be more willing to allocate resources. At this point, we have not seen how an investment in risk management would have justified itself.

Firm15 Display their collection of data to overturn their decision.

Firm16

Firm17

Firm18 It's about doing the analysis and conveying it to top management. At some point return on investment and correct decision need to be made for the continuity of the organization. For instance, many companies in the gulf treated risk differently before Hurricane Katrina than they did afterwards. Afterwards, they had contingency plan which took resources and cost into consideration but the additional costs were deemed to be the best interest for long term company success.

Firm19 Educate our stakeholders. Demonstrate the value add and potential risk that can be mitigated.

Firm20 Present to leadership on importance of SRM

Firm21

Firm22 Find ways to measure it

Firm23 Drive the emphasis & calculate the \$ impact that it can have in resource hours, product loss, lost sales prevented (which = \$). Ultimately a \$ projection in a simple format is ideal for an executive audience.

Firm24 Training and education on how Supply Risk Management is an enabler for reducing costs in the value chain, as well as, enhancing sourcing decisions is a mindset change necessary to change the situation.

Firm25

Firm26 In that case, we must all share more information to the upper levels. We do work well amongst our teams, but we need to feel prepared to speak up and give information to other upper levels to make informed decisions.

Firm27 Use industry data on risk management and its value. Use internal data from past failures to prove the cost benefit of investing in risk management.

Firm28 Utilize partners other resources

Firm29 Self-manage

Firm30 Top management recognizes the importance

Firm31

Firm32 My feelings are that education needs to occur at all levels of the organization so that managers are made aware of the implications of supply interruptions. What I have seen is that until a crisis happens people (management) does not want to deal with it.

Firm33

Firm34 Self-manage

Firm35 Educate peers

Firm36

Firm37

How are individuals who are responsible for supply risk management assessed and compensated for their risk management efforts?

Firm1

Firm2 As purchasing agents

Firm3 At this time, those people who are working on risk management activities are doing so as a part of their normal job requirements, so their annual goals reflect the level of performance that is expected. As to compensation, each person is compensated based on their individual performance to their goals.

Firm4 The individuals that are set in place to avoid risk in the supply chain are guided by success and failures. Compensated in standard salary and expected to do a great job @ to avoid risk

Firm5 Relatively subjective assessment when it comes to how affective we are at proactive risk mitigation, Measure the level of product stock outs on a daily / weekly / monthly / quarterly / annual basis over time. Details are reviewed at the site, region, and global level from a 'paretoized' perspective. We look for trends in the data.

Firm6

Firm7 We do it because if we don't it makes other aspects of our positions more difficult. There is no specific compensation currently provided.

Firm8

Firm9 We have a process that define role and responsibilities that are imbedded into TE's HR policy. This relates to each employees yearly assessment that is defined as SET- Strategy, Execution and Talent. Strategy: Develops

a plan for the future and plans accordingly. Execution: Achieve plan and focus on what's important. Talent: Emphasizes talent development – our people are our only sustainable advantage.

Firm10 OID/PPV/DPM measurements

Firm11 Salary, bonus ties to site / corporate goals based on seniority.

Firm12 We do not have any

Firm13 Not aware

Firm14 Not applicable. As said in the sourcing process we audit quality, technical ability of supplier and financial situation occasionally. We don't allocate a permanent resources or budget for this activity as it is integral to the sourcing process.

Firm15 It's part of their roles and responsibilities for their specified job performance.

Firm16 Not sure

Firm17

Firm18 Employees at our company work with their managers to set business and personal development each year. We have performance reviews and incentive program that is on top of base salary.

Firm19 Individuals are compensated based on a variety of competencies and goals. SRM is typically not something that falls into this process but is a component in bigger efforts that would (i.e. sourcing strategies and results/savings for a particular project).

Firm20 Part of everyone's job compensation is by meeting corporate targets of EBFT & ROCE with good suppliers which compensates by our bonus.

Firm21

Firm22 As part of an employee's annual performance review and annual goal setting discussions, as well as evaluation during the year. May be part of job description or may be specific objectives.

Firm23 We do have a Risk Management team, but I am not sure how their performance is reviewed or compensated, We do have a Systems Team within our Supply Chain Department that are measured on project performance, training execution, and several other goals where performance is almost entirely gauged by project completion dates, Their bonus is structured with a timeline for each goal so if they did not complete it in time to earn 100% of the points for Project A, they may receive 80% of the points if they completed it weeks after.

Firm24 Supply Risk individuals are compensated equal to other Purchasing employees at the same Leadership Level

Firm25

Firm26 We do not typically incentivize our work. I would only speculate that in the right portion of some manager's goals that there are specific line items to address this topic. If those line items are not met, they affect their achievement of goals and their evaluation for the year. If there are positions that are more directly tied to risk, I am assuming their goals are much more specific.

Firm27 For the most part there is no correlation for major risk other than standard goal setting and performance review. There is measurement of risk management from the daily inventory standpoint. As a department that is responsible for all the inventory metrics, we are assessed based on hitting inventory goals and how often we failed a customer wanting a material. Bonus values are somewhat determined by goals being met. Extraordinary effort and results are compensated through the annual review process.

Firm28 Not sure

Firm29

Firm30 Comprehensive performance management structure e.g. goal setting, goal monitoring, goal reviewing, performance-based compensation

Firm31

Firm32 No financial incentives are tied to risk management. Bonus plan based on net operating income (1x a year) which is (indirectly) effected by how well management is able to mitigate supply interruptions.

Firm33

Firm34

Firm35 They are not. Compensation is driven by expense reductions/controls.

Firm36

Firm37

Failure Mode & Effects Analysis (FMEA) is a tool for identifying, analyzing, and prioritizing potential failures. FMEA is a well documented and proven technique commonly used to evaluate the risk for failures in product and process designs. Every potential failure identified is evaluated based on likelihood and severity.

FYI: Results from first survey, these questions were not built into the above survey (the firm numbers are not a match to the new survey – meaning Firm 1 of new survey is not the same as Firm 1 old survey below)

IF YOUR COMPANY IS NOT CURRENTLY USING THE FMEA MODEL, IT IS BECAUSE...

THE MAJORITY OF THE COMPANIES DO NOT USE FMEA (27/46 WERE NOT USERS)

Please circle a number using the 7-point scales with:

1= Strongly disagree to **7= Strongly agree**

There is no noticeable "explicit" value yet.	1	2	3	4	5	6	7
Mean = 4.43, SD= 1.79, Var.= 3.22(very high), Kurt= -0.95, Skew= -0.36							
There is not enough knowledge of the FMEA procedure.	1	2	3	4	5	6	7
Mean = 5.27, SD= 1.48, Var.= 2.20(high), Kurt= 0.84, Skew= -0.97							
FMEA is too time-consuming.	1	2	3	4	5	6	7
Mean = 4.10, SD= 1.52, Var.= 2.31(high), Kurt= -0.24, Skew= -0.38							
It is too confusing or complicated.	1	2	3	4	5	6	7
Mean = 3.50, SD= 1.48, Var.= 2.19(high), Kurt= -1.02, Skew= 0.14							
It would not be compatible with our software or processes.	1	2	3	4	5	6	7
Mean = 3.57, SD= 1.81, Var.= 3.29(very high), Kurt= -1.27, Skew= 0.02							
It is not recognized or required by our industry.	1	2	3	4	5	6	7
Mean = 4.21, SD= 1.64, Var.= 2.69(high), Kurt= -0.70, Skew= -0.42							
It is difficult for us to estimate failure modes using tools such as the FMEA model.	1	2	3	4	5	6	7
Mean = 3.96, SD= 1.32, Var.= 1.74(low), Kurt= -0.49, Skew= -0.35							
Not enough failures are experienced to justify using it.	1	2	3	4	5	6	7
Mean = 3.62, SD= 1.82, Var.= 3.32(very high), Kurt= -1.19, Skew= 0.12							
Never heard of FMEA.	1	2	3	4	5	6	7
Mean = 2.69, SD= 2.38, Var.= 5.65(very high), Kurt= -0.74, Skew= 1							
My organization is only considering future FMEA usage.	1	2	3	4	5	6	7
Mean = 3.19, SD= 1.47, Var.= 2.16(high), Kurt= -0.56, Skew= 0.05							

IF YOUR COMPANY CURRENTLY USES THE FMEA MODEL, THEN PLEASE ANSWER THE REST OF THE SURVEY

ONLY 19/46 FIRMS SURVEYED WERE FORMAL USERS OF THE FMEA MODEL

1. *Are functional teams established to implement your FMEA procedure (Yes or No)?*

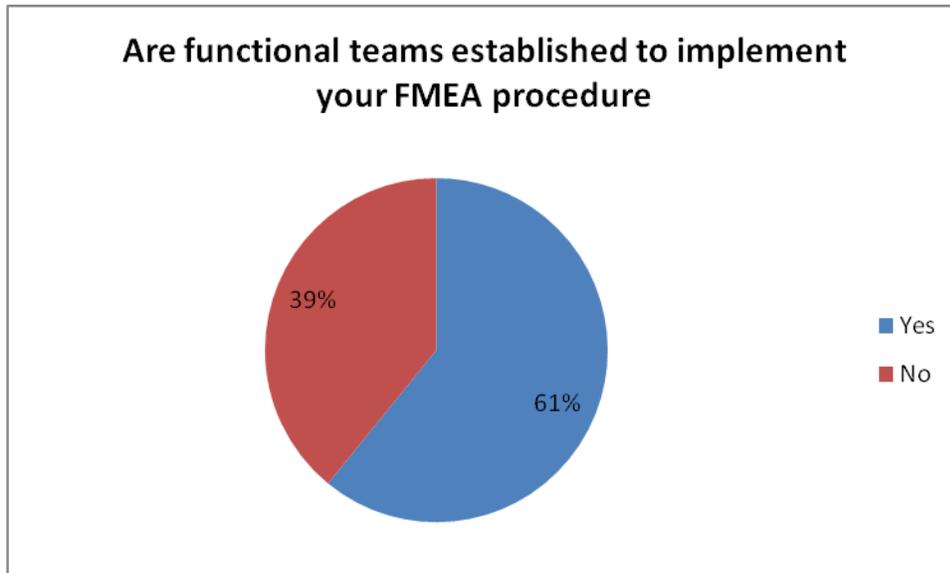


Chart 6.1

2. *Are the FMEA procedures & goals clearly communicated to all employees (Yes or No)?*

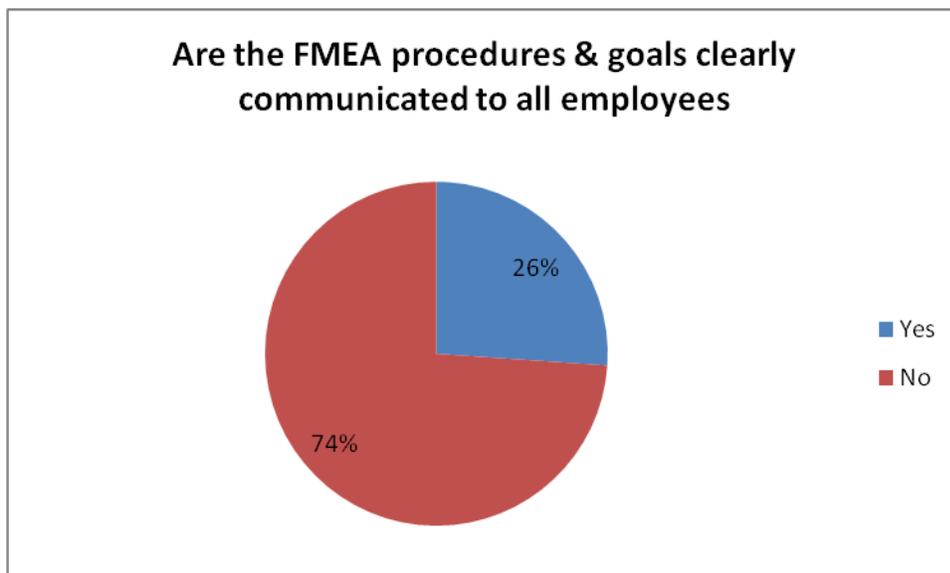


Chart 6.2

3. Are the FMEA procedures & goals clearly communicated to supply chain employees (Yes or No)?

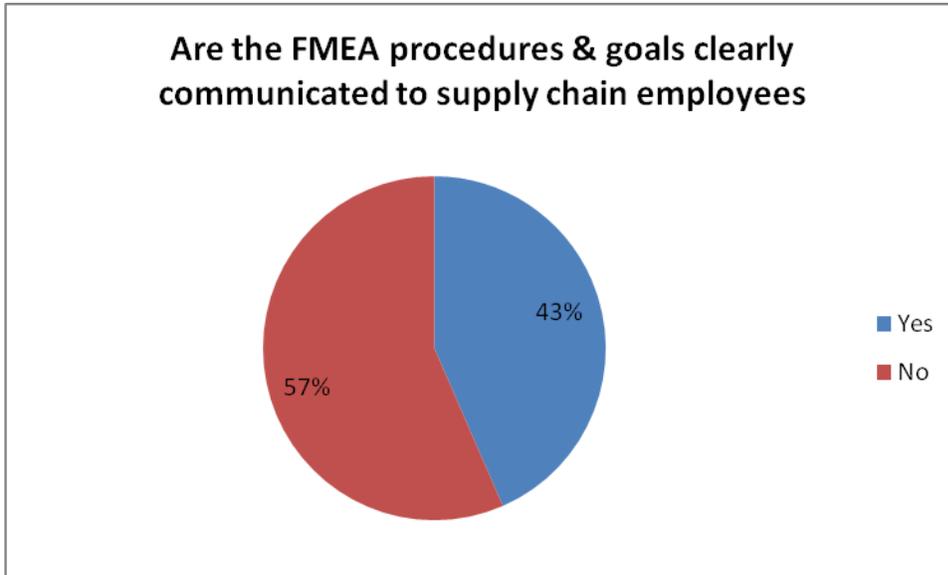


Chart 6.3

Please circle a number using the 7-point scales with:

1= Not an important reason

to

7= Very important reason

What is the reason for using FMEA?

Needed for quality system

1 2 3 4 5 6 7

Mean = 5.62, SD= 1.91, Var.= 3.65(very high), Kurt= 1.57, Skew= -1.53

To improve process performance

1 2 3 4 5 6 7

Mean = 6.19, SD= 1.12, Var.= 1.26(low), Kurt= 2.23, Skew= - 1.58

To reduce total costs

1 2 3 4 5 6 7

Mean = 5.00, SD= 1.55, Var.= 2.40(high), Kurt= 1.13, Skew= - 1.16

Reduce total failures whether big or small

1 2 3 4 5 6 7

Mean = 6.33, SD= 0.97, Var.= 0.93(very low), Kurt= 1.52, Skew= - 1.50

Contractor/customer requirements

1 2 3 4 5 6 7

Mean = 4.86, SD= 1.85, Var.= 3.43(very high), Kurt= 0.03, Skew= - 0.87

Required by upper management

1 2 3 4 5 6 7

Mean = 4.69, SD= 1.78, Var.= 3.16(very high), Kurt= -0.03, Skew= -0.90

Improve image of the company

1 2 3 4 5 6 7

Mean = 4.14, SD= 2.03, Var.= 4.13(very high), Kurt= -1.31, Skew= -0.29

Please circle a number using the 7-point scales with:

1= Strongly disagree to 7= Strongly agree

Customer requirements were used when developing FMEA. Mean = 5.05, SD= 1.80, Var.= 3.25(very high), Kurt= 0.58, Skew= -1.10	1	2	3	4	5	6	7
Mgmt has provided the resources and provisions for enabling employees to use FMEA. Mean = 4.75, SD= 1.48, Var.= 2.20(high), Kurt= 0.50, Skew= -0.81	1	2	3	4	5	6	7
The use of FMEA has led to: Higher product reliability. Mean = 2.69, SD= 1.64, Var.= 2.68(high), Kurt= 2.68, Skew= - 1.80	1	2	3	4	5	6	7
The use of FMEA has led to: Higher product quality. Mean = 5.80, SD= 1.24, Var.= 1.54(low), Kurt= 3.81, Skew= -1.79	1	2	3	4	5	6	7
The use of FMEA has led to: Better quality planning. Mean = 5.45, SD= 1.57, Var.= 2.47(high), Kurt= -0.69, Skew= -0.67	1	2	3	4	5	6	7
The use of FMEA has led to: Continuous improvement in product and process design. Mean = 5.45, SD= 1.36, Var.= 1.84(low), Kurt= 1.42, Skew= -1.36	1	2	3	4	5	6	7
The use of FMEA has led to: Lower manufacturing costs. Mean = 4.75, SD= 1.74, Var.= 3.04(very high), Kurt= -0.55, Skew= -0.57	1	2	3	4	5	6	7
The FMEA process covers the entire global supply chain. Mean = 4.21, SD= 1.87, Var.= 3.51(very high), Kurt= -1.18, Skew= 0.17	1	2	3	4	5	6	7
Global suppliers of your organization are encouraged to implement FMEA. Mean = 4.74, SD= 1.73, Var.= 2.98(high), Kurt=-0.05, Skew= - 0.70	1	2	3	4	5	6	7
FMEA is often too vague and causes confusion for those in the supply chain. Mean = 4.11, SD= 0.88, Var.= 0.77(very low), Kurt= 0.21, Skew= -0.78	1	2	3	4	5	6	7
The format of FMEA software and documentation is consistent within all participants. Mean = 3.32, SD= 1.42, Var.= 2.01(high), Kurt=-0.74, Skew= 0.03	1	2	3	4	5	6	7
Design requirements are defined in quantifiable terms to all parts of the supply chain. Mean = 3.58, SD= 1.26, Var.= 1.59(low), Kurt=-0.81, Skew= -0.57	1	2	3	4	5	6	7
The process ensures the inclusion of input from both suppliers and customers in SCM. Mean = 3.95, SD= 1.39, Var.= 1.94(low), Kurt=-0.48, Skew= -0.45	1	2	3	4	5	6	7
FMEA is a group oriented assignment. Mean = 4.74, SD= 1.48, Var.= 2.20(high), Kurt=-0.84, Skew= 0.05	1	2	3	4	5	6	7
The current FMEA could be improved in terms of organization and efficiency. Mean = 5.16, SD= 1.21, Var.= 1.47(low), Kurt=-0.52, Skew= -0.13	1	2	3	4	5	6	7
I would be more likely to use FMEA if our IT/ERP system included it. Mean = 4.25, SD= 1.65, Var.= 2.72(high), Kurt=-0.49, Skew= - 0.05	1	2	3	4	5	6	7
FMEA is applied in all functional areas of the company, including supply chain mgmt. Mean = 4.15, SD= 1.60, Var.= 2.56(high), Kurt=-1.01, Skew= -0.44	1	2	3	4	5	6	7
The FMEA process is the job of a few personnel and implementation is not widespread. Mean = 4.37, SD= 1.50, Var.= 2.25(high), Kurt=-0.68, Skew= 0.17	1	2	3	4	5	6	7

Please circle a number using the 7-point scales with:

1= Not an issue to 7= Major issue

Since using FMEA, how much of an issue and source of difficulty have the following factors been?

Obtaining accurate quality information.	1	2	3	4	5	6	7
Mean = 4.05, SD= 1.23, Var.= 1.52(low), Kurt= 0.84, Skew= -0.66							
Finding reliable data.	1	2	3	4	5	6	7
Mean = 4.10, SD= 1.25, Var.= 1.57(low), Kurt= 0.75 Skew= -0.74							
The ability to explain a defect clearly and understandably.	1	2	3	4	5	6	7
Mean = 3.95, SD= 1.35, Var.= 1.83(low), Kurt=-0.14, Skew= 0.50							
Identifying preventative actions for each failure.	1	2	3	4	5	6	7
Mean = 3.84, SD= 1.38, Var.= 1.92(low), Kurt= -0.55, Skew= -0.25							
Team commitment, members know and understand the importance.	1	2	3	4	5	6	7
Mean = 4.37, SD= 1.42, Var.= 2.02(high), Kurt= -0.54, Skew= 0.43							
Lack of time, inability to work around members' schedules to set up time.	1	2	3	4	5	6	7
Mean = 4.68, SD= 1.42, Var.= 2.01(high), Kurt= -0.74, Skew= -0.03							
Determining how much detail is necessary to complete the analysis.	1	2	3	4	5	6	7
Mean = 4.53, SD= 1.35, Var.= 1.82(low), Kurt= 1.54, Skew= -0.67							
Lack of creativity.	1	2	3	4	5	6	7
Mean = 3.37, SD= 1.30, Var.= 1.69(low), Kurt= -0.78, Skew= -0.44							
The team's ability to agree on potential failures and why they occur.	1	2	3	4	5	6	7
Mean = 3.68, SD= 1.11, Var.= 1.23(low), Kurt= -0.56, Skew= 0.44							
Getting the team involved, motivated, trained, and focused.	1	2	3	4	5	6	7
Mean = 4.32, SD= 1.38, Var.= 1.89(low), Kurt= -0.80, Skew= 0.36							
Finding Risk Priority Numbers (RPN).	1	2	3	4	5	6	7
Mean = 3.58, SD= 1.07, Var.= 1.15(low), Kurt= 0.54, Skew= -0.84							
Difficulty in identifying and ranking severity of the failures.	1	2	3	4	5	6	7
Mean = 3.74, SD= 1.41, Var.= 1.98(low), Kurt= -0.67, Skew= -0.14							
Documenting all the data and requirements needed to complete the FMEA.	1	2	3	4	5	6	7
Mean = 4.00, SD= 1.56, Var.= 2.44(high), Kurt= -0.35, Skew= 0.10							
Consistency in the assessment of each failure.	1	2	3	4	5	6	7
Mean = 4.21, SD= 1.47, Var.= 2.18(high), Kurt= -0.27, Skew= -0.64							
Lack of management support.	1	2	3	4	5	6	7
Mean = 3.32, SD= 1.60, Var.= 2.56(high), Kurt= -0.92, Skew= 0.15							
Confusion in FMEA terminology.	1	2	3	4	5	6	7
Mean = 3.68, SD= 1.57, Var.= 2.45(high), Kurt= -0.97, Skew= -0.29							
The ability to overlook sets of data that are needed to assess the severity of a failure.	1	2	3	4	5	6	7
Mean = 3.79, SD= 1.47, Var.= 2.18(high), Kurt= -0.31, Skew= -0.52							
Most personnel from various functions do not have adequate knowledge on failures.	1	2	3	4	5	6	7
Mean = 4.74, SD= 1.63, Var.= 2.65(high), Kurt= -0.26, Skew= -0.56							

What impact do you feel FMEA currently has in your business environment?

Firm1	Lower cost of quality
Firm2	It has helped our product entry into various markets
Firm3	Let me first be clear that I am answering from the sourcing perspective. Our quality department uses FMEA extensively. In sourcing we have an FMEA form, but we only use it in the very highest risk situations
Firm4	I think it's had a great impact; we've definitely made large strides and improvements. However we still have a long way to go
Firm5	
Firm6	Major
Firm7	
Firm8	
Firm9	
Firm10	It helps where used, but only used in engineering
Firm11	Minimal
Firm12	I believe the FMEA tool has an impact when it is properly utilized
Firm13	
Firm14	It is an important part of our quality system. DFMEA + PFMEA are routinely used for product and process design. Improvements in both products and processes have been obtained
Firm15	Has helped create more consistent support for investment in process reliability on the shop floor
Firm16	
Firm17	
Firm18	
Firm19	
Firm20	
Firm21	
Firm22	FMEA has made a positive impact to our company. We are starting to identify and prevent problems from occurring
Firm23	
Firm24	
Firm25	It is a tool to assist in improving out processes and get better at making the products we sell
Firm26	Used for product development and six sigma projects
Firm27	
Firm28	
Firm29	
Firm30	Engineering process used to determine RLA
Firm31	Mandatory to achieve quality parts /auditing
Firm32	Currently, it has a major impact on engineering and quality, as those two functions are entrenched in reviewing and in some cases re-creating all DFMEAs related to the products we produce. We have had 3 recent recalls due to product failures, which has forced us to re-look at things
Firm33	Positive, if treated as the living document it is and if it is used properly and consistently. Excellent tool for conveying lessons learned to current and new processes
Firm34	
Firm35	
Firm36	
Firm37	It is an engineering tool for design and improvements
Firm38	
Firm39	
Firm40	
Firm41	
Firm42	
Firm43	Drives continuous improvement throughout our functional areas. The more the effectiveness of FMEAs is demonstrated, the more the workforce embraces the importance of FMEAs and data-driven decision-making.
Firm44	
Firm45	
Firm46	

Table 7.1

How could FMEA be more effectively used to help reach the organizational goals of your company?

Firm1	It's the tools that lead up to it are the issue
Firm2	FMEA is being used today and is part of our quality culture
Firm3	I believe it would help improve process planning
Firm4	A more widespread rollout among different functions
Firm5	
Firm6	User friendly on all working operating systems
Firm7	
Firm8	
Firm9	
Firm10	
Firm11	Currently used to identify new product development issues. Should include total supply chain
Firm12	It is a tool that is utilized during green belt certification; however it appears for the most part it is put back in the "tool box" to collect dust once individuals are certified
Firm13	
Firm14	The principles could be used as part of the supply chain risk processes
Firm15	More overall organizational awareness and understanding
Firm16	
Firm17	
Firm18	
Firm19	
Firm20	
Firm21	
Firm22	We need more training and practice in completing a FMEA. Once we are fully trained, this will be a very powerful tool
Firm23	
Firm24	
Firm25	Have training courses down to the shop floor level for a general understanding
Firm26	Adopt six sigma methodology and project management sourcing
Firm27	
Firm28	
Firm29	
Firm30	Implemented in the supplier selection process
Firm31	More organized
Firm32	Training and time. We need to train everyone on how to do then the SAME way, as consistency is necessary, and we need to time and resources available to dedicate to this cause, as everyone recognizes the importance. Need to prioritize these efforts in our daily workload
Firm33	Previous program FMEAs should be heavily consulted and reviewed when creating a new one. If also kept-up-to-date, quality issues will decrease
Firm34	
Firm35	
Firm36	
Firm37	
Firm38	
Firm39	
Firm40	
Firm41	
Firm42	
Firm43	Utilize at upper management level for business processes and objectives
Firm44	
Firm45	
Firm46	

Table 7.2

What industry trends do you see for FMEA in the next several years?

Firm1	Only best in class will use it
Firm2	More use
Firm3	I believe the process will become more acceptable since we are seeing an influx of people with engineering and quality backgrounds in our sourcing organization
Firm4	I think it's going to identify the companies that are doing well and it's going to weed out the ones that aren't using it
Firm5	
Firm6	
Firm7	
Firm8	
Firm9	
Firm10	
Firm11	With greater supply chain awareness, our company will includes more cross functional participation
Firm12	A better understanding of the risks involved with globalization would be of great benefit (1. Currency exchange, intellectual property infringement, increasing wage rates, 2. Correlation between logistics costs and raw material/energy costs, as well as overall impact of increase in volume/demand requirements as more companies source internationally
Firm13	
Firm14	Unknown
Firm15	Increased use
Firm16	
Firm17	
Firm18	
Firm19	
Firm20	
Firm21	
Firm22	I personally feel that most companies will not incorporate FMEA to all functional areas of the company. Unfortunately, it is and will continue to be considered a tool for engineering and quality until it is taught and pushed through the supply chain issues
Firm23	
Firm24	
Firm25	I see FMEA being more and more important, especially in today's environment
Firm26	As six sigma methodology usage increases it is likely that OEMs and suppliers would increase
Firm27	
Firm28	
Firm29	
Firm30	FMEA worksheets applied to supply base
Firm31	Growing down the supply chain
Firm32	With the new edition of the FMEA manual that AIAG just put out, it is clear that the manufacturing and auto industries feel it is an important part of everyday life
Firm33	New AIAG FMEA 4 th edition just released. Expected that the industry will take time to implement the changes and ideas in the manual. Once done, they will proceed based on how successful it was
Firm34	
Firm35	
Firm36	
Firm37	At our company- improved products and reduced risk
Firm38	
Firm39	
Firm40	
Firm41	
Firm42	
Firm43	More use as a business management tool instead of just a product and operations process improvement tool
Firm44	
Firm45	
Firm46	

Table 7.3

What type of advantage has your company gained over those who do not participate in FMEA?

Firm1	When disruptions occur they are minimal in the time it takes to solve the issue
Firm2	Ease of doing business with key customers
Firm3	But we did avoid a supply situation that would have been disastrous a few years back. The FMEA process gave us a structured method to identify and prioritize the risks for presentation to the project team
Firm4	Not sure
Firm5	
Firm6	Visibility
Firm7	
Firm8	
Firm9	
Firm10	
Firm11	Unknown
Firm12	Individuals in the company are able to gain a better understanding of all process steps involved in a process for which they may only be involved in a small segment thereof. In addition, the ability to prioritize and address risks has mitigated some unnecessary costs which would have impacted the business
Firm13	
Firm14	Improved product quality and reliability
Firm15	Better process and product reliability
Firm16	
Firm17	
Firm18	
Firm19	
Firm20	
Firm21	
Firm22	I already identified several major risks that need to be resolved by using FMEA in my role as supply chain manager. The main advantage is customer satisfaction due to having quality products available to manufacture our double-action doors
Firm23	
Firm24	
Firm25	Our products are more reliable. It shows a "story" and helps in the process of improvement
Firm26	Quality improvement
Firm27	
Firm28	
Firm29	
Firm30	None
Firm31	Customers and validation
Firm32	We are getting better, but I don not believe we have an advantage as of yet
Firm33	Difficult to say. We require FMEA of all our suppliers. Thus, I am not familiar with any companies that do not use it at all
Firm34	
Firm35	
Firm36	
Firm37	
Firm38	
Firm39	
Firm40	
Firm41	
Firm42	
Firm43	More efficient and effective use of our limited resources. Increased customer satisfaction.
Firm44	
Firm45	
Firm46	

Table 7.4

To what extent could a modified version of FMEA be used to manage risks in your supply chain?

Firm1	More wildly adopted
Firm2	
Firm3	Disguise it as a survey or questionnaire
Firm4	Currently I think it use it more in our logistic side versus procurement. And I think with all the increase in raw materials and commodities, it would definitely be a great impact for them to use
Firm5	
Firm6	Tool to identify risk easily
Firm7	
Firm8	
Firm9	
Firm10	
Firm11	Definite opportunity
Firm12	I could see it as a great benefit in identifying potential problems which may occur in order to proactively manage the issue, as opposed to waiting until something goes wrong to put a risk mitigation plan in place
Firm13	
Firm14	Severity, occurrence, detection, incorporated into supply chain risk management practices
Firm15	We already have used a modified version for both supply chain management and new business opportunity evaluation
Firm16	
Firm17	
Firm18	
Firm19	
Firm20	
Firm21	
Firm22	FMEA is more than just a software or spreadsheet. It is a thought process. In saying that, the FMEA can be modified any way necessary to be able to achieve the mind frame of what can go wrong and what will we do to prevent that failure from occurring or reduce that chances of it occurring
Firm23	
Firm24	
Firm25	FMEA data that is electronic and integrated
Firm26	Over 50%
Firm27	
Firm28	
Firm29	
Firm30	Make the input format more "user friendly's
Firm31	More widely across supply chain and visibility
Firm32	Using FMEA in the supply chain group here is a long way off. We do not have the resources to get this completed right now. Too many operational issues, and commercial issues related to commodity inflation and currency changes
Firm33	Already being done with full FMEA, not modified
Firm34	
Firm35	
Firm36	
Firm37	I would like to see this
Firm38	
Firm39	
Firm40	
Firm41	
Firm42	
Firm43	There is a great opportunity for this to drive internal and external improvements in supply chain performance
Firm44	
Firm45	
Firm46	

Table 7.5