



RESEARCH REPORT JULY 2014

INNOVATIVE APPROACHES TO SUPPLY CHAIN RISK

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CONTENTS

EXECUTIVE SUMMARY	4
INTRODUCTION	5
HOW SMALL RIPPLES CAN CAUSE MAJOR WAVES.....	7
IDENTIFYING AND ASSESSING RISK	9
QUANTIFYING AND PRIORITISING RISK	14
MITIGATING RISK AND SPEEDING RECOVERY	17
CONCLUSIONS & RECOMMENDATIONS	19
REFERENCES	21

EXECUTIVE SUMMARY

Major events such as the global financial crisis, the 2011 natural disasters in Japan and Thailand and the European horsemeat scandal last year have exposed the extent to which modern supply chains are complex, interdependent ecosystems. What starts as a small ripple – a factory fire, a strike, a material shortage – can quickly be magnified across the network, causing significant disruption for customers further downstream.

Managing supply chain risk has always been a challenging prospect, not least because of the many sources of potential risk, both physical and reputational. On the supply side, the need to focus not only on direct/tier-1 suppliers but also on their suppliers at tiers 2, 3 and beyond – ignorance of which has hit some companies hard in recent years – raises the bar still further.

The majority of companies currently have relatively immature supply chain risk management capabilities, but most are now investing to upgrade their practices. Developing a more systematic, focused and proactive approach requires action in four areas: identification and assessment, quantification and prioritisation, mitigation and recovery.

- **Identifying and assessing risk.** Without visibility of risks across the supply chain, and a good understanding of the companies involved, it's impossible to fully assess the likely consequences of disruptions or target mitigation efforts. Supply chain risk leaders like Cisco Systems and IBM not only engage in a dialogue with suppliers and customers, they also use visual risk mapping and scenario planning techniques, monitor real-time data and social media and use predictive analytics to forecast future outcomes.

- **Quantifying and prioritising risk.** Limited resources mean it's essential to focus risk management efforts where they are most needed and will deliver the biggest benefits. Standard models that are used to plot likelihood of occurrence against business impact can work well for recurring operational risks like supplier performance or demand forecast issues, but are less effective for hard-to-predict incidents like natural disasters. An alternative methodology developed by MIT professor David Simchi-Levi requires supply chain managers to assign financial impact and time to recovery (TTR) figures at a site and component level in order to quantify potential losses and focus mitigation strategies, including for critical but low-spend suppliers that may otherwise be overlooked.
- **Mitigating risk.** New SCM World research data shows that active inventory tracking and dual sourcing are considered to be the most effective risk mitigation strategies. Supply chain risk leaders are actively working to reduce their reliance on sole- and single-sourced parts and identify where qualifying additional suppliers that are genuinely independent alternatives (ie, they don't rely on the same network of sub-tier suppliers) makes the most sense. They are also increasing their use of standard component designs, segmented and regionalised supply chain strategies, and actionable business continuity plans (BCPs).
- **Speeding recovery.** BCPs that have been developed and tested with suppliers are a key factor in being able to respond quickly when a disruption occurs. Companies like Nissan invest time and money to ensure they are fit for purpose. They also have centralised incident management teams that can swing into action to collect data, communicate the latest developments, co-ordinate planning and make decisions about where to spend money to speed the return to normal operations – for example, by buying up alternative materials or capacity.

INTRODUCTION

The earthquake and tsunami that devastated northern Japan in March 2011 had a massive effect on the country's automotive industry. Around 80% of plants were forced to suspend production in the weeks following the disaster, output fell by 60% compared to March and April the previous year and it took six months to recover to pre-disaster levels. As Japan's biggest automaker, and one reliant on many domestic, single-sourced parts suppliers, Toyota was particularly badly hit. Supply shortages prompted billions of dollars in lost sales and additional costs, causing its half-year profits to plunge by over 70%.

Speaking to journalists a year later, Shinichi Sasaki, Toyota's Executive Vice President responsible for purchasing, admitted: "Our assumption that we had a total grip on our supply chain proved to be an illusion." For a company renowned for its tightly integrated network of Japanese suppliers and strong relationships, it was a remarkable statement. Toyota simply did not know who was producing all of its components or where their manufacturing sites were located, let alone what contingency plans they had in place to cope with a major disruption.

To be fair to Toyota, this description applies to the majority of companies. Events such as those in Japan and the floods in Thailand later the same year have certainly acted as a wake-up call across many industry sectors and spurred new attention and investment on supply chain risk. But relatively few companies have yet developed the sort of proactive, forward-looking, data-rich approach that is required to mitigate risk effectively across the complex, interdependent supply chains we rely on today.

THE CHALLENGES OF SUPPLY CHAIN RISK

The first challenge for any company seeking to improve its supply chain risk management capabilities is the sheer variety of both physical and non-physical (ie, brand and reputation-related) risks that need to be considered. These include not only geographic factors such as natural disasters and political unrest, but also supplier quality and labour issues, volatility in raw material prices and customer demand, shipping disruptions, IT security breaches and regulatory

changes. Figure 1 (see next page) shows the risks that respondents to SCM World's latest Chief Supply Chain Officer Survey are most concerned about in 2014-15.

Second, there's the need to understand not only potential risks among your direct suppliers, but also their suppliers – those in sub-tiers 2, 3 and even further upstream, as Toyota discovered to its cost. This multiplies the size of what was already a considerable and daunting task.

A third challenge is the huge increase in the type and volume of data available, whether numeric and residing in internal databases (so-called "structured" data) or proliferating across the internet, much of it in a narrative or "unstructured" format. Such information is growing by an estimated 50% a year. How on earth do you cut through all the noise and find data that is reliable and relevant to your supply chain risk strategy?

Fourth, and perhaps most challenging of all, is the in-built tension between risk mitigation on the one hand and supply chain efficiency on the other. Companies have spent years reducing costs in everything from sourcing to logistics through greater consolidation, offshoring, lean and just-in-time programmes. And yet increasing the resilience of supply chains to major disruptions in some cases requires the reverse, whether through qualifying additional suppliers, spreading volumes or increasing inventory buffers. Making the case for such investment to executives who may not see a problem and who are rewarded for further efficiencies isn't easy.

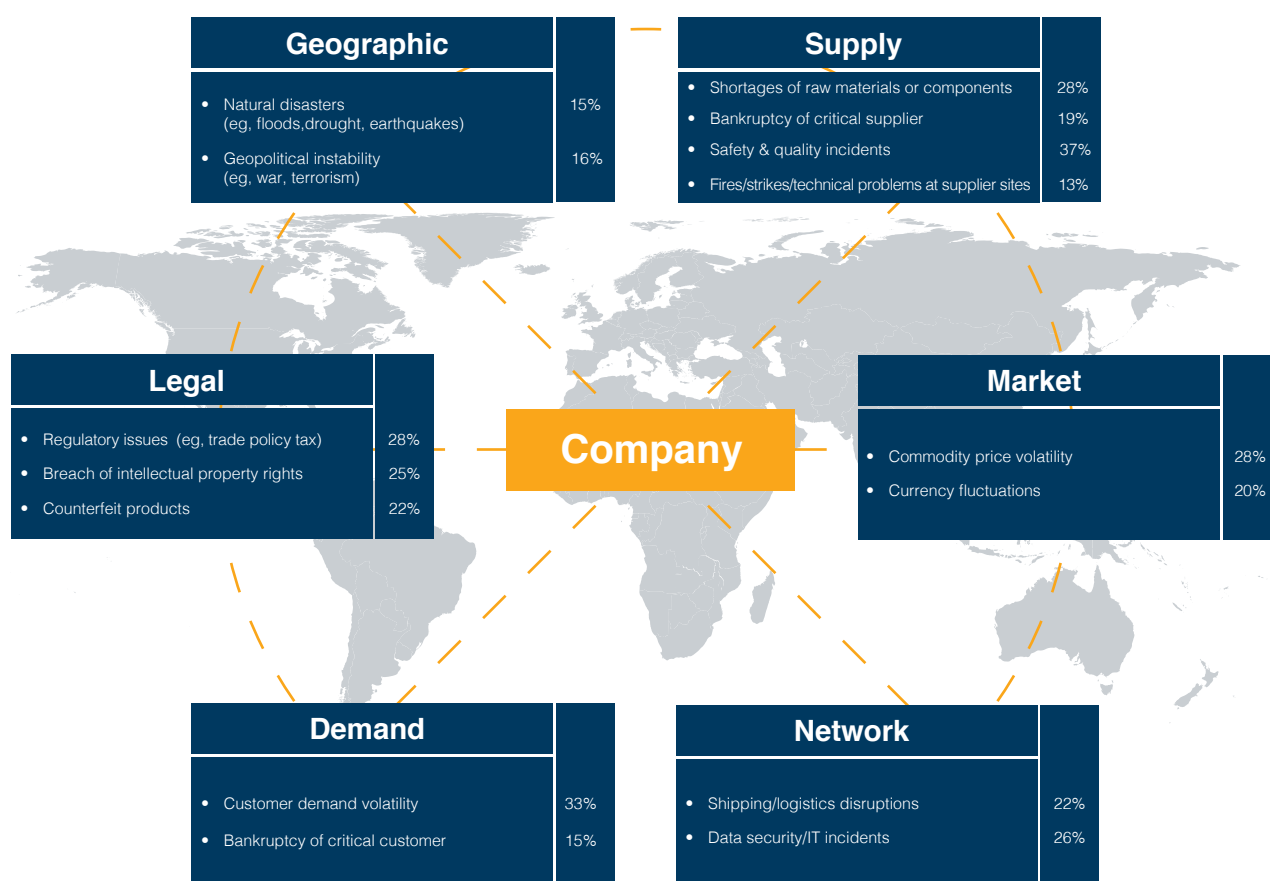
Despite these and other challenges, three-quarters of firms now see supply chain risk management as an important priority and more than half are investing in their supply chain function's capabilities to tackle it, according to a recent study by Accenture.¹ Almost all reported a positive return on investment from their risk management efforts, although just 7% said they were achieving in excess of 100% ROI.

These leading companies view supply chain risk not only as a threat that needs to be countered, but also as an opportunity to steal a competitive advantage over their rivals. They are investing in innovative tools

and techniques, from data analytics and geospatial mapping to social media monitoring, to better understand their supply chains, design more resilient strategies and develop plans that significantly reduce the financial impact of disruptions. In other words, they are building supply chain risk mitigation into their day-to-day operations.

The aim of this report is to highlight some of the latest thinking and practices around supply chain risk management, and in doing so provide guidance to companies that are seeking to improve their capabilities in this vital discipline.

Figure 1 Types of supply chain risk



Source: SCM World CSCO Survey 2014 (provisional data)

% of respondents 'very concerned' about each risk type in 2014-15
n=962

HOW SMALL RIPPLES CAN CAUSE MAJOR WAVES

Major disruptions during the past few years have exposed the extent to which modern supply chains are characterised by complex and interdependent ecosystems. In the global financial crisis from 2008, companies found out just how little they really knew about the stability and viability of some of their key suppliers. The financial data they had access to was often woefully out of date, and when suppliers started to experience difficulties in delivering materials and components – or in some cases failed completely – many buyers were caught flat footed.

The natural disasters in Japan and Thailand in 2011 exposed companies' ignorance about the networks of sub-tier suppliers and their ability to bring entire supply chains to a grinding halt. Even those that thought they had mitigated potential risks by having alternative tier-1 suppliers in place discovered that these firms actually relied on the same pool of tier-2 or tier-3 suppliers. Meanwhile, the horsemeat scandal in Europe in 2013 shone a very public light on the dizzying array of interrelationships between beef product distributors, manufacturers, processors, abattoirs and farmers – in some cases as far back up the chain as levels 4, 5 and even 6 – and sparked a public relations nightmare for brand owners and retailers alike.

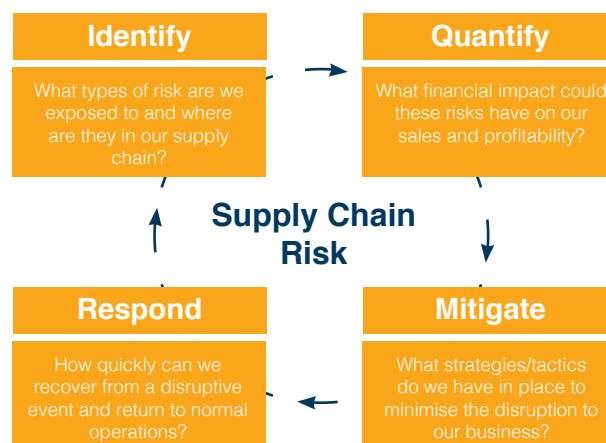
What all of these events have demonstrated is that what starts as a small ripple somewhere in the system – a climatic event, a factory fire, a strike, a material shortage – can reverberate out and become a major wave (literally in the case of the Japanese tsunami), causing significant disruptions for suppliers and customers further downstream. “A collapse in one part of the network can have a magnifying effect on every part of the network,” says David Simchi-Levi, a professor of civil engineering at the Massachusetts Institute of Technology (MIT) and leading expert on supply chain risk. “These interrelationships are either not well understood or are ignored by most companies.”

FOUR STAGES OF SYSTEMATIC RISK MANAGEMENT

Getting better visibility of your supply base and understanding the relationships and dependencies

between different firms is the first stage of a more systematic approach to managing supply chain risk. Subsequent stages focus on quantifying the potential impact, designing appropriate risk mitigation plans and strategies, and then putting those into action if and when a disruptive event occurs (Figure 2).

Figure 2 A systematic approach to supply chain risk



- 1. Risk identification and assessment.** At a fundamental level, the questions here include: what risks are we exposed to within our supply chains? Who are our direct suppliers and where are their production and distribution sites located? Digging a little deeper, who are our suppliers' suppliers and what do their footprints look like?
- 2. Risk quantification.** Limited resources dictate that we focus our risk management efforts on where they are most needed and beneficial. The key question here is: where would disruptions have the biggest negative impact on our sales revenue and profitability? Putting some hard dollar figures on this is vital not only for targeting resources, but also for securing executive support and investment.
- 3. Risk mitigation.** Given what we know about the composition of our supply networks and our most critical risks, what tactics and strategies should we put in place to minimise and mitigate the threat of potential disruptions? How do we build greater resilience into our supply chains and the way we do business across the globe?

4. **Event response and recovery.** When disaster strikes (as it inevitably will somewhere and in some form), how quickly can we and our suppliers implement those mitigation plans and ensure the resumption of normal daily operations? How successfully can we limit the impact on our customers and the damage to our top and bottom lines?

Effective supply chain risk management is not a static exercise or a linear process. It requires constant monitoring, ongoing assessment and the periodic re-evaluation of contingency plans, whether or not they have actually been implemented. In the remainder of this report, we'll look at the approaches and practices of leading companies at each of these stages as they seek to develop and refine their supply chain risk capabilities.

THE ENTERPRISE DIMENSION

Supply chain risk management cannot take place effectively in a vacuum; it needs to be integrated into a broader enterprise-wide approach to risk identification, assessment and mitigation. Leading companies and supply chain functions operate in an environment that has four defining characteristics:

1. **Organisation.** Risk strategy and activities are co-ordinated centrally under the leadership of a senior executive. Responsibility for regional and business unit specific risks are delegated within this structure, as appropriate, while firms like Starbucks use centres of excellence to support local operations in areas such as commodity intelligence and data analytics, as well as incident management. Around a fifth of companies have a specific supply chain risk team within the global supply chain organisation, according to research by Accenture.
2. **Appetite.** Companies need to decide how much risk they are willing to bear and what their tolerance levels are. At Olam International, a \$20 billion Singapore-based agribusiness supplier of commodities such as nuts, coffee, cocoa, rice and cotton, this is expressed as a percentage of equity capital for a given financial year. Risk exposures and returns, including across supply chain, are budgeted and monitored against this limit, explains Jagdish

Parihar, Managing Director and Global Head of Risk. If you don't size risk and set boundaries around it, he says, "it's like driving a car without a speedometer".

3. **Culture.** A strong risk culture led from the top is also essential, Parihar adds. This needs to be proactive, data driven and emphasise cross-functional communication and collaboration, rather than silo behaviour. Risk mitigation efforts also need to be prized and rewarded by senior management. "This is extra work we weren't doing before," says Lou Ferretti, who heads up supply chain risk for IBM, "so it has to deliver value. I used to have to drag people into this. Today I don't."
4. **Process.** Robust governance, controls and reporting mechanisms are required to evaluate and manage risk across business functions, divisions and regions. Regular updates against key risk metrics, using dashboards and scorecards, provides visibility and drives periodic reassessment of mitigation priorities and strategies. At IBM, online communities are used to share risk data across the supply chain and procurement organisation and there is a standard method for reporting the impact of supply chain disruptions and recovery actions to the company's sales teams and customers when necessary.

IDENTIFYING AND ASSESSING RISK

Building up a picture of the numerous players and potential sources of risk across the value chain, whether on the supply or demand sides, is essential. Without good visibility, it's impossible to adequately assess the likely consequences of disruptions or target mitigation efforts to where they are needed most. Not surprisingly, the visibility that most companies have is akin to that of a short-sighted person: while they have a reasonably clear picture of what's going on in close proximity, the further away they look, the more blurry things become.

Data from our 2014 CSCO survey illustrates this perfectly. Asked where they currently have good or very good risk visibility, 9 out of 10 respondents pick internal plants and operations. And three-quarters believe the same is true of direct (tier-1) suppliers and customers. But in the case of indirect relationships, visibility levels drop by more than half. On the supply side, only 35% are confident about their insights into tier-2 suppliers and just 17% feel the same about suppliers at tier-3 or beyond (Figure 3).

GETTING VISIBILITY IN THE SUB-TIERS

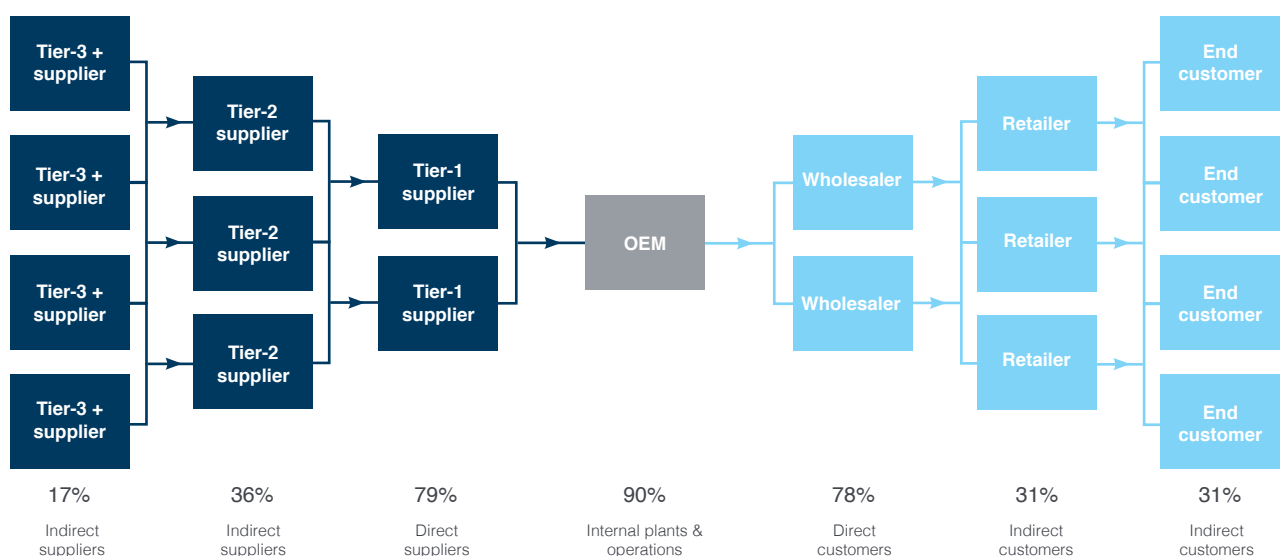
Getting a clearer picture of who sub-tier suppliers are in a bid to avoid nasty shocks and surprises is by no means a simple task. Previous research by SCM World found that by far the most popular method is simply to ask tier-1 suppliers to provide information about their own suppliers, whether during an RFP-based sourcing

exercise or in the form of a mid-contract request. Almost two-thirds of companies say they do this, compared with half who rely on internal or third-party intelligence.

The problem with this approach is that tier-1 suppliers are often reluctant or unwilling to disclose full details about their suppliers and sites. When Toyota began mapping its supply chain in Japan in the aftermath of the 2011 disaster, it found that about half of its 500-plus direct suppliers refused to comply. Many cited competitive advantage as the reason. Other companies that have sought to map their sub-tiers have encountered the same issue. Boeing, for example, which has a complex network of 10,000 tier-1 suppliers in more than 50 countries and with multiple connections between the various tiers, discovered during a pilot project in 2012 that even those that were willing to provide names and addresses of their own suppliers wouldn't disclose information such as the dollar value or percentage of their business with them or with Boeing's competitors.

This caused the aerospace & defence giant to think carefully about the data it really wanted from suppliers, and demonstrated the need to explain clearly to them the reasons for collecting it. "Companies have to trust that Boeing is going to use this information to manage risk, not to disintermediate suppliers out of their own supply chains," says Dana Hullinger, Boeing's Director of Supply Chain Strategy & Architecture Supplier Management.²

Figure 3 Risk visibility across the value chain



Source: SCM World CSCO Survey 2014 (provisional data)

% of respondents saying they have 'good' or 'very good' risk visibility
n=942

THE POWER OF PREDICTIVE ANALYTICS

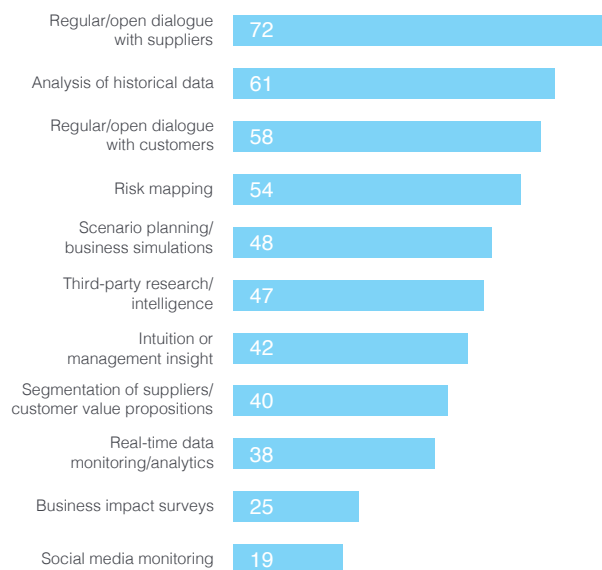
Communication with suppliers is also the primary method companies use to identify their potential exposure to supply chain risks in general, according to our CSCO study. Seven out of 10 respondents say they do this, while 60% analyse historical data on issues such as the performance and financial stability of their suppliers (Figure 4). Around half use risk mapping or scenario planning, while a minority are taking advantage of the latest techniques like real-time data analytics (38%) or social media monitoring (20%).

Using data analytics to uncover vital insights with which to make better decisions is certainly hot on the demand side of business. Supermarkets like Tesco, for example, use it to trawl hundreds of millions of purchases made by customers over a period of several years to make detailed forecasts about what they are likely to buy next, depending on the season, weather conditions and the area in which they live. Sudden rises in temperature during the summer months, for instance, will prompt customers to spend more on items like cold beer, ice cream, soft fruits, prepared salads and barbecue meats. To avoid empty shelves, supermarkets need to get ahead of these spending habits and make accurate predictions about what to order more (or less) of on a store-by-store basis.

“Predictive analytics” on the supply side is less established, but leading companies are already applying these techniques to identify potential risks in their supply chains before they cause disruptions. Like many automotive firms, powertrain specialist BorgWarner found that in a volatile economic environment, traditional methods of assessing supplier risk failed to anticipate emerging problems quickly enough. To tackle this, its supply chain organisation designed an early warning tool that analyses supplier performance data from its SAP system using a mathematical model known as “Hidden Markov”. This evaluates patterns in the data, such as planned versus actual deliveries, to predict the likelihood of sub-par performance in the coming weeks.

This analysis is combined with supplier financial data to create a grading system that helps the company’s managers keep a close eye on higher-risk suppliers and take appropriate mitigating actions.³

Figure 4 Methods used to identify risk exposure



Source: SCM World CSCO Survey 2014 (provisional data)

% of respondents
n=944

VISUAL MAPPING AND SOCIAL MEDIA

Another technology adopted by leading companies is geographic or geospatial analytics. This takes data about internal and supplier facilities, manufacturing plants and distribution centres and plots it visually on a map to give a picture of a company’s global supply chain. HP used this to help streamline and optimise its network as part of a major transformation initiative, but has also applied it to supply chain risk management as part of a comprehensive programme that has been running since 2001.

Cisco and IBM are two other hi-tech firms that use visualisation techniques to assess risk within their supply chains. During the Japanese earthquake and tsunami, for example, Cisco used a “heat map” showing the impact of the disaster on specific supplier locations to inform executives and guide the work of its supply chain incident management team (see Figure 5). IBM uses a geospatial map to track events such as the recent flare-up of hostilities in Israel, as well as a global flood modelling tool that assesses likely developments in Thailand and other high-risk regions. “If November 2011 happened again, we would be able to take pre-emptive actions that we weren’t able to do before,” says Lou Ferretti, who leads risk management for IBM’s Integrated Supply Chain organisation.

The company also has an active social media monitoring programme that analyses sentiment based on certain keywords, such as “Ukraine” and “conflict minerals”, and is currently trialling a mobile app that delivers information to managers on the ground and allows them to contribute local intelligence that complements the data analysis generated by software tools and statistical algorithms. While only a fifth of supply chain practitioners say they are using social media to provide an early warning of potential disruptions today, our CSCO survey data indicates that twice that number expect to do so in the future.

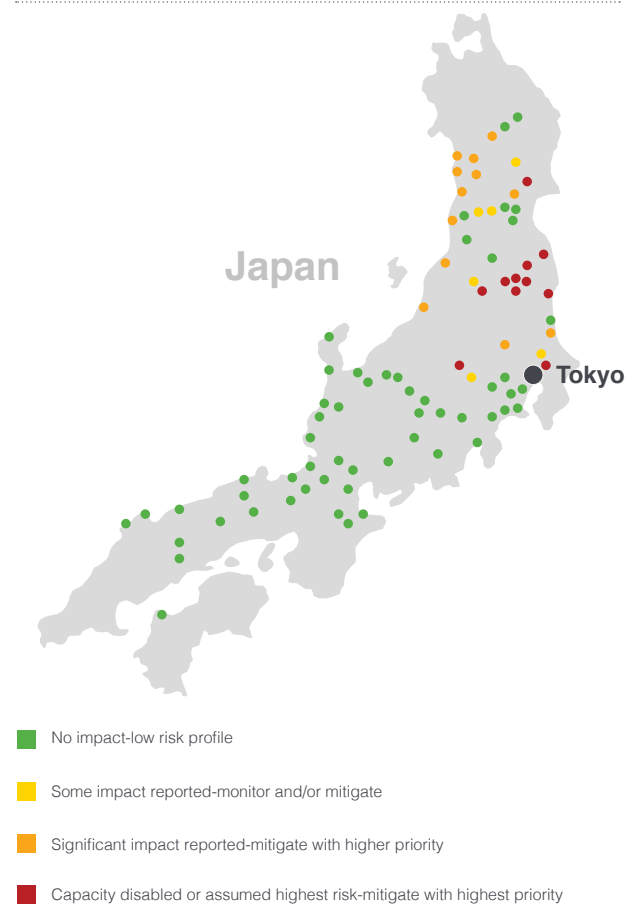
German carmaker BMW is one of the early movers. As the company has expanded its global footprint in recent years it has become exposed to a broader range of both suppliers and potential risks. To address this, it worked with academics at Manchester Business School in the UK to design a system called Enterprise 2.0. This takes unstructured data from social media sites, blogs, wikis, chatrooms and other sources, both internal and external – an estimated 80% of all data in existence today – and analyses it using a two-stage cognitive process based on the work of Nobel Prize-winning psychologist Daniel Kahneman. The system has two main components:

- **E-listening** – keyword searches and a self-learning algorithm process are applied to select the right information and compress it into interesting and useful data. This is then added to an iPad app or to Google Maps to give supply chain managers strategic intelligence and to help inform decision making.
- **Geo-tagging** – supplier plants and locations are tagged and matched to geographical and surveillance data to build up a picture of potential threats. This is monitored at a central location to facilitate real-time risk assessment and keep BMW abreast of natural disasters and when they are likely to affect suppliers' production.

As well as allowing BMW's purchasing function to be more proactive around developments such as supplier consolidation, the system is also providing greater visibility of suppliers at tiers 2, 3 and 4, both in terms of who they are and where their production plants are located. The aim is not only to manage risk better, but also to share information and collaborate across the extended network – for example, in scouting for new

innovations. Indeed, BMW has already used the system to identify a new materials supplier for its i series electric cars that was previously unknown.⁴

Figure 5 How Cisco mapped the 2011 disaster in Japan



Source: Cisco Systems

Another company that actively uses e-listening techniques is The Coca-Cola Company. It has established a network of Consumer Response Centres, or CRCs, in many of the 207 countries in which it operates to monitor local comments and opinions about its products. While the primary purpose of this is to “be part of the conversation” with consumers and government officials on issues, explains Carletta Ooton, Coca-Cola's Vice President, Global Technical Operations and Capability Development, the CRCs also serve as a useful source of risk information in areas such as the environment (water usage, waste treatment, packaging), fleet safety and product quality. If someone posts a photo of a foreign object in one of the company's beverages on a social media site, for example, Coca-Cola can quickly investigate whether it's a fraudulent act or a genuine problem that needs to be fixed.

This data, plus other social listening and engagement across the Coca-Cola system is also connected in through a new network called The Hub. This idea was inspired by data analytics techniques used during Barack Obama's successful 2012 presidential re-election campaign. The company is also in the process of designing what it calls a "Technical Smart City" – a virtual and visual collection of interconnected "data neighbourhoods" to improve overall visibility and accuracy of information.

DATA-DRIVEN CULTURE

Building visual supply chain maps, analysing historical trends to predict future events, monitoring social media posts, using real-time data to create leading rather than lagging indicators... it's a stark contrast to the ad-hoc and intuition-based approach to risk management that many firms still rely on today.

Innovators in supply chain risk use these tools and techniques within an enterprise-wide "culture of data-driven decision making" that informs and shapes their risk mitigation strategies, says MIT's David Simchi-Levi. "When you are dealing with complex networks that have evolved over time, intuition can be misleading and take you in completely the wrong direction."

TOOLS FOR MANAGING SUPPLY CHAIN RISK

Like supply chain risk management itself, the market for software tools and services in this domain is very much in the evolving phase. At present, there are no comprehensive, all-in-one solutions for supply chain risk management available to buy off the shelf. This has prompted leading companies to develop their own internal systems for mapping, assessing and quantifying risks across their supply chains.

In a useful overview published last year by ChainLink Research,⁵ co-founder Bill McBeath divides the supply chain risk solutions market into three categories:

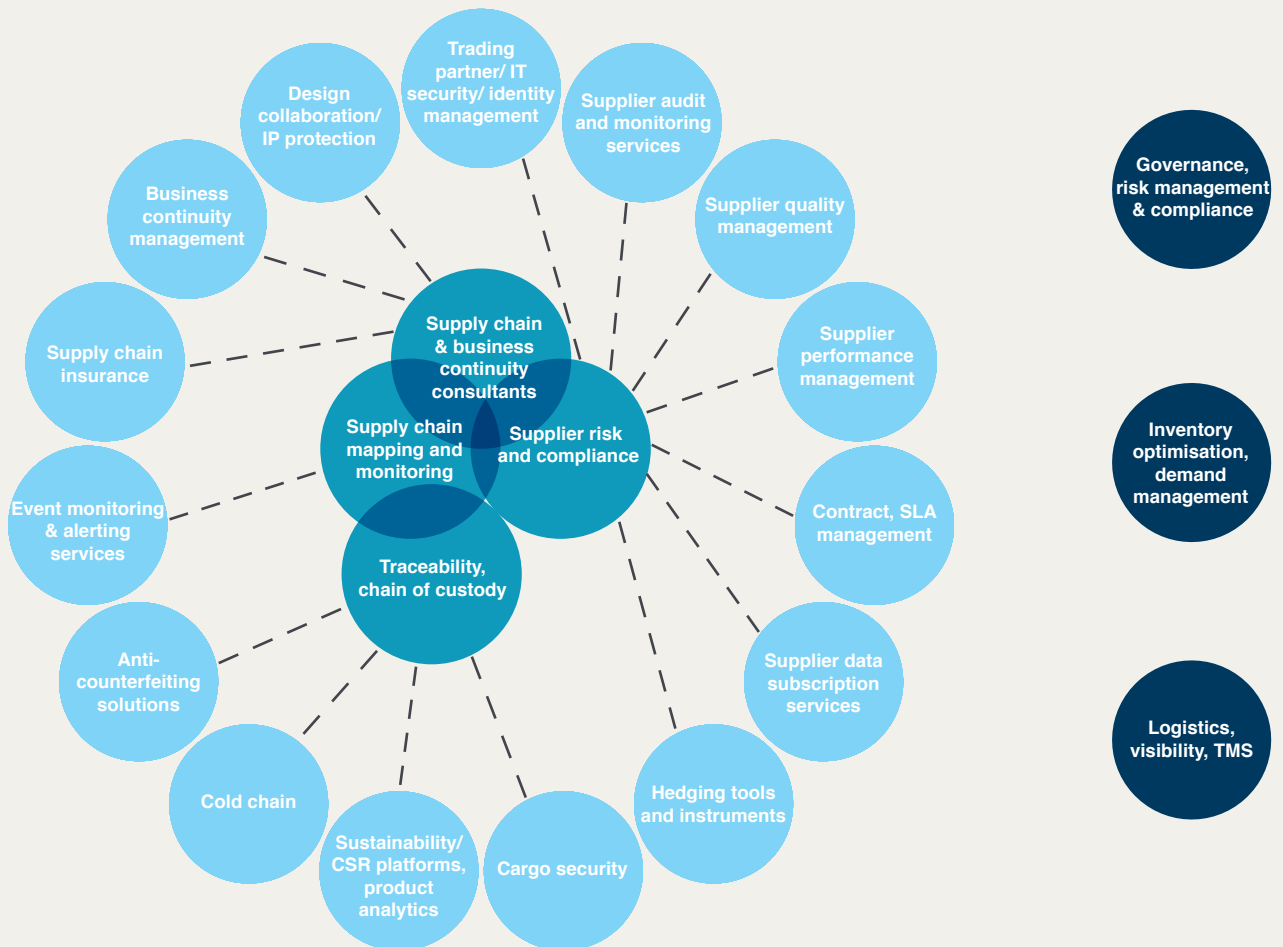
Core – software designed to map and monitor supply chain risk, supplier compliance and upstream traceability, plus services provided by specialist risk and business continuity consultants. Companies offering solutions here include Resilinc and Achilles in sub-tier

mapping and monitoring, Aravo and Hiperos in supplier risk/compliance, SAP and Apriso/Dassault Systèmes in traceability and Deloitte in risk consulting.

Supporting – applications focused on 15 different areas of supply chain risk, including anti-counterfeiting, cargo security and IP protection, as well as data providers like Dun & Bradstreet and Equifax, insurers like Zurich and Marsh, and auditors like SGS.

Ancillary – enterprise solutions used primarily for other purposes but which can help to manage risk. Examples here include Kinaxis, Terra Technology, JDA and E2open in demand management and inventory optimisation, Epicor and MetricStream in risk governance and compliance, and Amber Road, Manhattan Associates and GT Nexus in transportation, product flow and trade management.

Figure 6 Supply chain risk solutions and services



Source: ChainLink Research

Core Supporting Ancillary

QUANTIFYING AND PRIORITISING RISK

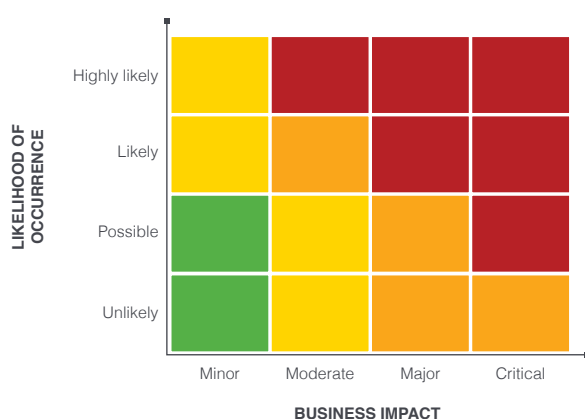
As with other supply chain initiatives like supplier collaboration, limited resources mean that it's essential to focus your risk management efforts on where they are most needed and will have the biggest benefits. The standard way of doing this is to plot different types of risk on a matrix that has likelihood of occurrence on one axis and business impact on the other, as illustrated in Figure 7. Using this approach concentrates attention on higher-probability, higher-impact risks: those colour-coded red.

This may work reasonably well in the case of recurring operational risks where historical data is available: supplier performance, demand forecast accuracy, port delays, and so on – what Simchi-Levi describes as “controllable” or “known-unknown” risks. But for less frequent disruptions such as natural disasters, epidemics and terrorist attacks, it's extremely difficult, if not impossible, to:

- a) assign a probability to these events occurring
- b) predict their likely impact across a supply network

And yet as recent experience of such “unknown-unknown” events has shown, the financial impact on companies whose operations and suppliers are located in affected areas can be devastating. Ignoring such risks and hoping that they either don't happen or that reactive crisis management will be enough to get you through if disaster strikes may not be the best strategy (even though it is still a common one), and could even be career-limiting.

Figure 7 A typical risk evaluation matrix



AN ALTERNATIVE MODEL

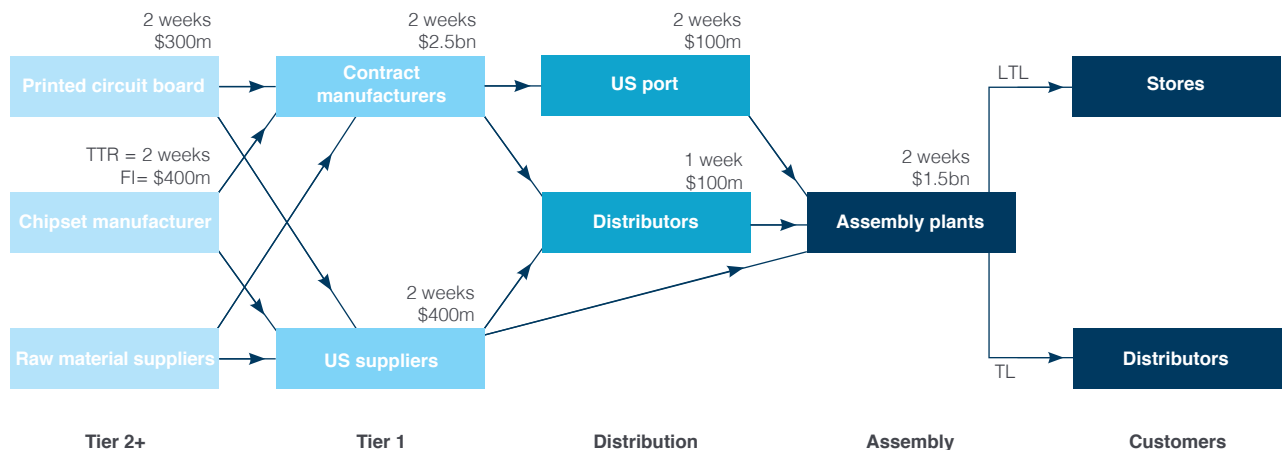
To work around these issues, Simchi-Levi has devised an alternative approach that he calls the Risk Exposure Index (REI). Just as Value at Risk (VaR) methodology allows investment banks to gauge the risk exposure they have in their portfolios and take steps to limit it, so the REI allows companies to understand the dependencies within their supply chains, estimate hard-dollar impacts and prioritise their risk mitigation efforts, he argues.

Rather than attempting to calculate the likelihood of a disruption occurring, risk managers instead concentrate on the financial impact that each supplier site along the supply chain would have if it were taken out of action temporarily. This is calculated by estimating the hit to the company's sales revenue during the time it would take a supplier to return to normal operations, whether two, four, eight weeks or longer – in other words, the time to recovery (TTR), a key metric in supply chain risk management. Figure 8 (see next page) shows an example of this approach applied to a hi-tech manufacturer.

Such a mapping exercise flags up which nodes in the supply chain would have the biggest financial impact if a disruptive event (regardless of type) happened. In the case of this hi-tech manufacturer, a two-week shutdown at one of its contract manufacturers is estimated to carry a price tag of \$2.5 billion – a far higher figure than for printed circuit board or chipset suppliers, or its own assembly plants. This signals that risk mitigation efforts ought to be directed more heavily at contract manufacturers.

While gathering such data may not be easy, Simchi-Levi insists that it is possible to arrive at an estimate of financial impact that is “good enough”. Dozens of companies in the aerospace & defence, industrial, pharmaceutical, hi-tech, service and automotive industries are now using the REI methodology to quantify their risk exposures and prioritise their mitigation strategies, he says.

Figure 8 Quantifying risk exposure: a hi-tech example



- Time-to-recovery (TTR) is the time it takes to recover to full functionality after a disruption
- Financial impact (FI) is lost sales during TTR
- The Risk Exposure Index (REI) is the maximum FI over all nodes in the supply chain

Source: Professor David Simchi-Levi, MIT

SHINING A LIGHT ON HIDDEN RISKS

Mapping the financial impact of supplier production sites has the added benefit of shining a light on previously “hidden risks”, adds Simchi-Levi. Procurement professionals naturally focus their attention on suppliers with whom they spend the most money each year. The problem with this is that lower-spend suppliers can have a disproportionately big financial impact if their parts are not delivered on time or in sufficient quantities. In 2007, for example, Boeing suffered major delays to production of its 787 Dreamliner because of a shortage of aluminium and titanium fasteners – small but critical components used to bolt sections of the airplane together.

When Ford Motor Company mapped its North American supply chain, consisting of around 4,000 tier-1 suppliers and 55,000 parts, it discovered that just 2% of supplier sites would have a significant impact on the company’s profits during either a two- or eight-week shutdown. Most accounted for relatively small annual purchases.⁶

The dangers of relying on annual spend to direct risk efforts is underlined by Nick Wildgoose, a former procurement director who now leads Zurich’s supply chain risk insurance business. Unlike, say, cover for commercial property fire and theft, the company has no actuarial tables with which to price risk for named suppliers and materials, so it has to conduct a detailed assessment of a potential customer’s supply chain in order to create a suitable policy.

As part of this exercise, it looks specifically at the likely revenue and profit impact of disruptions not only at the tier-1 level, but also at sub-tier suppliers too. “Research shows that over 40% of supply chain disruptions are caused by events at tiers 2, 3 and lower,” says Wildgoose, who also chairs the Supply Chain Risk Leadership Council, an industry body run by firms including Cisco, Procter & Gamble and John Deere.⁷

CASE STUDY: CISCO SYSTEMS



From reactive to innovative supply chain risk management

Since 2004, Cisco has steadily developed its supply chain risk management capabilities away from a reactive, crisis-orientated approach to one that is both proactive and innovative in the way it addresses a highly outsourced and configure-to-order based supply chain. The company now has a 13-strong supply chain risk management (SCRM) team within its supply chain operations organisation focused around four key processes:

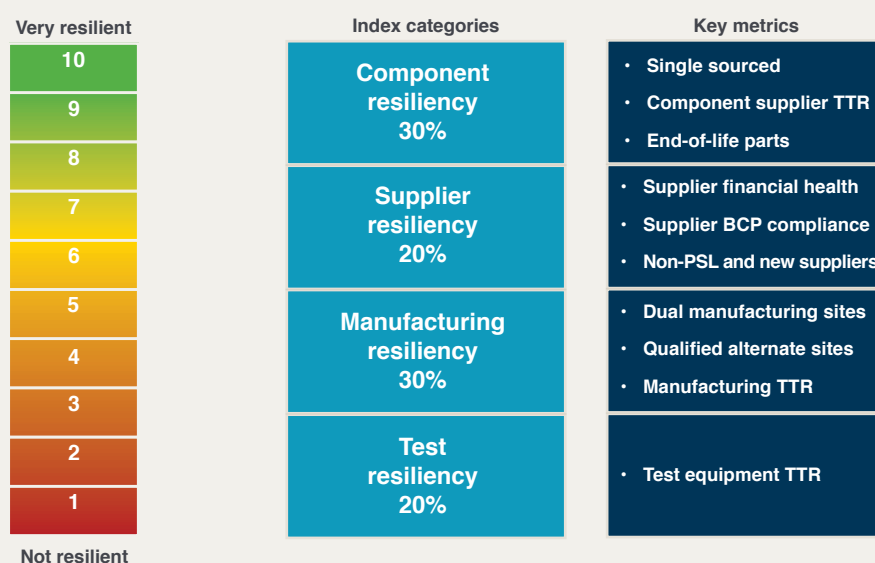
1. **Product resiliency** – identifying components where recovery times are outside of the 8-12 week period that Cisco considers acceptable, and working with global supply managers to qualify second sources, line up alternative production sites, create inventory buffers, and so on.
2. **Supply chain resiliency** – focused on the company's top 500 products by revenue, this aims to strengthen resiliency across its manufacturing, logistics and transportation partners and improve time to recovery if a disruption occurs in the network.
3. **Incident management** – 24/7 monitoring of supply chain incidents that are disruptive, or have the potential to be disruptive, to the company's

operations. Dashboards and playbooks are among the capabilities used to alert senior management, organise a cross-functional response and qualify the likely impact at a supplier level and site level within a few hours.

4. **Business continuity planning** – a half-yearly process used to assess the ability of key suppliers to mitigate the effects of a disruption and recover as quickly as possible. A web-based tool is used to collect more than three dozen data points, while audits and drills are used to test business continuity planning (BCP) readiness and drive improvement activities.

During the past couple of years, Cisco's SCRM team has focused on extending its knowledge of sub-tier suppliers (by capturing city, state and country location data as a minimum), increasing resiliency through a reduction in the number of single-sourced components, and making internal risk data more actionable for its 16 business units. The latter has been done, explains Nghi Luu, who manages the SCRM team, by breaking down its pioneering Resiliency Index – a weighted, aggregated 1–10 score derived from 17 key metrics (Figure 9) – into a more granular format that highlights each division's most at-risk suppliers and sites.

Figure 9 SCRM Resiliency Index



Source: Cisco Systems

MITIGATING RISK AND SPEEDING RECOVERY

Conducting this type of analysis can help to determine the most appropriate mitigation strategies for each supply segment (Figure 10). In Ford's case, one of the outcomes was to track daily inventory levels for components supplied by lower-spend but critical suppliers. Our CSCO survey data shows that active inventory tracking is tied with dual sourcing as the most popular risk mitigation tactic among supply chain practitioners, with 45% rating it as "very effective".

BorgWarner has used the output from its supplier performance monitor system not only to keep a close watch on inventory from higher-risk suppliers, but also to give its supply chain managers the confidence to reduce safety stocks of components from more robust suppliers, with obvious cost benefits for the company.

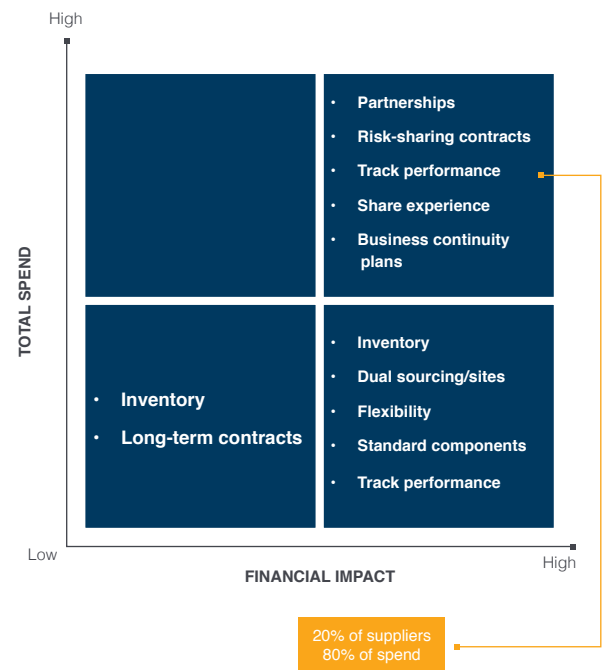
Supplier mapping and segmentation can also expose the fact that dual sourcing may not be a silver bullet if it turns out that alternative tier-1 suppliers are dependent on the same pool of sub-tier suppliers – as automotive and hi-tech OEMs discovered too late during the Japanese and Thai disruptions in 2011. Indeed, notes David Simchi-Levi, in some circumstances it may actually be prudent to consolidate volumes with fewer suppliers in order to persuade them to build additional production sites.

IN PURSUIT OF QUALIFIED SUPPLIERS

Nevertheless, having alternative qualified suppliers ready in waiting, if not actually in production, remains a key objective for supply risk management leaders. The challenge is deciding where it is both feasible and makes business sense from a cost-risk balancing perspective. In the automotive industry, many parts are so investment heavy, in terms of tooling costs, that having a second source solely for risk mitigation rather than capacity reasons can be tremendously expensive, explains Peter Carlsson, Vice President, Supply Chain at Tesla Motors. To second source an entire vehicle would cost the company hundreds of millions of dollars, he says.

In hi-tech, Apple, under the leadership of former supply chain chief Tim Cook, has gradually shifted some iPhone and iPad production away from its

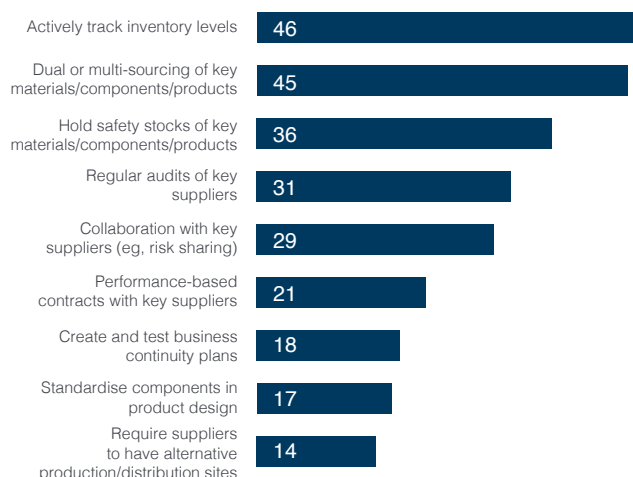
Figure 10 Using supplier segmentation to drive mitigation actions



Source: Professor David Simchi-Levi, MIT

primary contract manufacturer Foxconn to other Taiwanese firms such as Pegatron and Wistron, partly to ensure it is better able to fulfil demand for newly launched products but also for risk diversification reasons. And at Cisco Systems, an initiative known as Global Component Risk Mitigation is using a central database of single-sourced items as a way to raise visibility of the issue company-wide and drive cross-functional discussions about where second qualified suppliers are most urgently needed.

Standardising the design of components – particularly those not visible to customers – so that they can be used across product lines and be manufactured by several suppliers is an evolving strategy being pursued for both risk and cost reduction reasons. But it remains a minority one for now: just 17% of supply chain practitioners currently rate this as a "very effective" method of risk mitigation, with another 39% seeing it as "moderately effective" (Figure 11). Speaking in 2012, Toyota EVP Shinichi Sasaki said the company would aim to have common designs for half of its 4,000-plus components within four years, along with more dual sourcing and extra inventory buffers.

Figure 11 Supply-side risk mitigation tactics

Source: SCM World CSCO Survey
2014 (provisional data)

% of respondents saying
'used and very effective'
n=938

Segmenting product lines and organising production, distribution and inventory practices around each is another option for diversifying risk. Premium drinks maker Diageo, for example, has divided its Asian supply chain into three categories – efficient, responsive and agile – according to the complexity of its products and the level of demand predictability. It uses a network of 13 local manufacturing plants in the region to serve customers in a timely way and at the same time minimise the impact of supply disruptions across its network. Two-thirds of our CSCO survey respondents see postponement or late-stage configuration as an effective risk mitigation strategy, while the same proportion are moving some manufacturing capacity onshore or near-shore to diversify their production footprints.

CONTINUITY PLANNING PAYS DIVIDENDS

Of course, even proactive and forward-thinking companies will suffer from disruptions of one kind or another in any given year, notes Rob Handfield, Bank of America Professor of Supply Chain Management at North Carolina State University. Being able to respond and recover quickly is therefore a key risk management capability in its own right. Companies like industrial equipment maker Caterpillar that have dedicated supply chain risk managers and a central function that takes charge of data gathering, communications and co-ordination can steal a march on competitors in the event of a crisis, he argues.

Nissan used this approach to great effect in the aftermath of the Japanese earthquake and tsunami in 2011. A Global Disaster Control Headquarters led by the company's Chief Operating Officer, Toshiyuki Shiga, and recovery committee chaired by a chief recovery officer swung into action to implement contingency plans created during extensive disaster simulation training. Whereas production in the country's auto industry ended the year down almost 25%, Nissan – which had a more regional and decentralised supply chain than Toyota – decreased by just 3.8%. "This experience has instructed us in the necessity of an actionable BCP (business continuity plan) that encompasses all our suppliers, including those in the second and third tiers," said Shiga.⁸

Like Nissan, Cisco has invested to get better visibility beyond its direct suppliers and extend its highly structured BCP approach into the sub-tiers of its supply base during the past 18 months, explains Nghi Luu, Senior Manager, Supply Chain Risk Management. The networking leader uses a twice-yearly BCP process based around five steps:

1. Identifying key nodes and high-impact potential
2. Evaluating preparedness using an objective format
3. Mapping critical components to supplier sites
4. Identifying time to recovery (TTR) at the supplier site and component level
5. Validating BCPs through audits and drills

This, combined with a "war room" incident management team, helped the firm mitigate more than \$100 million in potential revenue losses and avoid over \$20 million in additional component costs during the Japanese crisis.

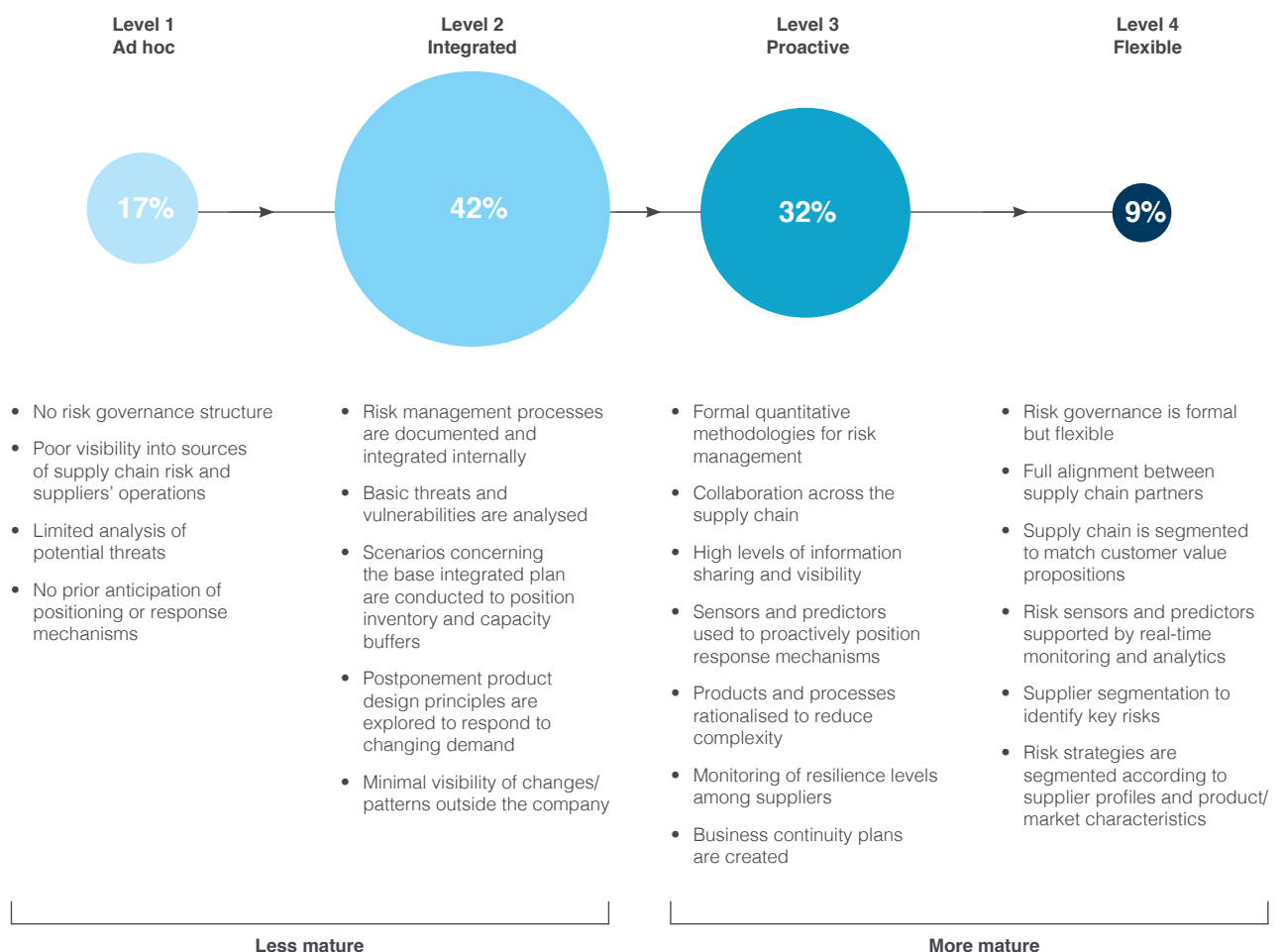
Although only 15% of supply chain organisations say they don't use BCPs at all, according to our research, another 30% rate them as either ineffective or only marginally effective in managing risk. This indicates that further work is required at many companies to translate strategic risk mitigation intent into practical recovery action, including through closer collaboration with key suppliers.

CONCLUSIONS & RECOMMENDATIONS

Supply chain risk management has always been a challenging proposition, given the many sources of potential risk and the fact that some of the most obvious “solutions” run counter to our continuing pursuit of cost efficiencies. The need to go beyond tier-1 suppliers, as demonstrated by a series of economic, climatic and other events during the past few years, has only made the task harder. Today, companies need to know far more about the sub-tiers of their supply bases – who those firms are, where their production plants and other facilities are located, what policies and procedures they have in place and the degree to which they are dependent on other nodes in the supply chain.

The good news is that most companies are now taking supply chain risk seriously and investing in internal capabilities to manage it. Many are also seeing returns on that investment in the form of financial payback. But supply chain risk management remains a nascent discipline and the majority of companies are at an earlier stage of maturity. Analysis by PricewaterhouseCoopers and MIT last year found that while a third of firms could be classified as “proactive”, just 9% display fully mature characteristics such as risk strategies segmented at the supplier, supply chain and product segment level (Figure 12).⁹

Figure 12 Supply chain risk management maturity



Source: PwC/MIT Forum for Supply Chain Innovation

% indicates proportion of companies classified at each level
n=209

Understanding your existing capabilities is a good starting point for development efforts. The Supply Chain Risk Leadership Council has created a useful self-assessment maturity model that covers five dimensions: leadership, planning, implementation, evaluation and improvement.

The Excel-based tool asks managers to rate their organisation in 23 areas using a 15 scale from “reactive” to “resilient”, guided by competency definitions. The tool, which is available free from the SCRLC’s website, displays the results automatically on bar and spider charts to highlight capability gaps that may need to be addressed.¹⁰

When it comes to strategies and solutions, supply chain risk expert Rob Handfield at North Carolina State University notes that “everyone is trying different things at the moment”. For leaders in the field, as this report has illustrated, these things include:

- risk mapping of supply networks at a site and component level;
- estimating the financial impact of disruptions and time to recovery (TTR);

- collection and analysis of both real-time and historical data;
- mathematical models and algorithms that predict future events;
- monitoring of social media as part of local intelligence gathering;
- visualisation and other tools to focus attention on areas of high (and low) risk;
- creating actionable continuity plans in partnership with suppliers.

A situation where supply chain executives have full visibility of their entire supply chains – and real-time information available at the press of a button or swipe of the hand – may lie in the distance. But for now, the ability to get alerts quicker and take mitigating actions faster than other customers in the market when a disruption occurs is an edge worth having. As IBM’s Lou Ferretti puts it: “Time gives you options.”

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