PROTECT YOUR SUPPLY CHAIN

RISK AND RESILIENCE IN THE ENGINEERING & MANUFACTURING SUPPLY CHAIN

WHITE PAPER
IS YOUR ORGANIZATION EQUIPPED TO THRIVE IN TODAY’S VOLATILE RISK LANDSCAPE?

This whitepaper will detail innovative solutions being deployed by engineering and manufacturing companies to manage the unique threats to their supply chains.
EXECUTIVE SUMMARY

The fourth industrial revolution is creating highly complex and interdependent supply chains in engineering and manufacturing. To remain secure, efficient and competitive, companies need new, proactive approaches to supply chain resiliency and risk management. To succeed in ever-changing global markets, companies should adopt new digital technologies capable of supporting this transformation process.

Since the first industrial revolution, the engineering and manufacturing (E&M) industry has played a huge role in driving innovation, economic growth, and prosperity around the globe. As technology becomes embedded within societies – the so-called fourth industrial revolution – E&M remains as important as ever, accounting for approximately 17% of global GDP and around 15% of employment.

Manufacturing companies export more than $11 trillion of goods every year which represents more than 70% of all global trade. E&M companies are particularly focused on productivity, as this is a key element of profitability. The per-hour economic output of a manufacturer, for example, is about twice the output of a typical retail or food service organization, and four times the output of agriculture.

The E&M industry has also demonstrated significant productivity improvement over time, successfully developing and adopting new technologies, new lean working methods, and new business models. It is no surprise that governments around the world are eager to promote and develop domestic E&M activity.
CHAPTER 1: THE ESSENTIAL SUPPLY CHAIN

A complex supply chain is both an enabler and the consequence of E&M success. Many of the key innovations in recent decades have had significant implications for corporate structure and for managing flows of materials, components and finished goods.

Disaggregation came first. The vast and vertically integrated manufacturing operations of the 19th and early 20th centuries were replaced by networks of specialized suppliers. Concentrating investment, capacity, and knowledge in a few core areas allowed E&M companies to excel.

But greater specialization created the need for efficient transportation of parts and sub-assemblies between multiple stakeholders.

Then there was lean manufacturing. Pioneered in the automotive industry, the principles of never-ending adaptation, continuous improvement, and relentless elimination of waste generated some of the greatest gains in manufacturing quality and efficiency. At the same time, this put additional demands on supply chain performance as lean manufacturing requires streamlined product flows, minimal inventories, and just-in-time delivery.

Next came globalization. The rapid industrialization of emerging economies – especially China – created important new markets and added significant new sources of supply.

To capitalize on these opportunities, E&M companies reconfigured their manufacturing and supply networks and, inevitably, this stretched the supply chain further still.

Most recently, we have seen a transformation in the manufacturer-customer relationship because of the growing trend of servitization. Manufacturers no longer simply produce and sell products; more and more companies are also monitoring, servicing, supporting, upgrading and even operating products on behalf of their customers. Rather than merely buying a product outright, customers are increasingly willing to pay for usage and for additional services after purchase. This impacts the supply chain, increasing the value of aftermarket activities such as the spare parts provision and end-of-life equipment recovery.

Together, these industry-wide developments and innovations are impacting the essential E&M supply chain.
Multiple economic, environmental, political, social, and technological forces are reshaping the E&M industry today. In the coming years, we anticipate six major areas of change:

**Digitalization**: Technological innovations will provide opportunities for more sophisticated products and services, with disruptive new players entering traditional markets.

**Compliance and sustainability requirements**: Driven by demanding stakeholder expectations, companies will need to address the environmental and social impacts of their activities.

**Shifting markets**: Continued rapid growth will shift the economic center of gravity to emerging markets. That will encourage the creation of local and regional manufacturing networks, with new investments in the fastest growing regions, along with near-shoring and re-shoring of some activities.

**Volatility and exogenous threats**: Commodity price volatility, greater political instability, and increased ecological risk will lead to more uncertainty in planning, decision making and sources of revenue.

**Customization and convergence of B2B and B2C**: Changing customer needs will drive customer-centricity and complexity through customized products, solutions, and processes inspired by B2C markets.

**Labor shortages**: Greater competition for highly skilled workers will impact business productivity and some companies will find it difficult to implement new technologies and business models.

Already many E&M companies are reacting to these trends and proactively reshaping the industry, evidenced by significant changes in planning, manufacturing, and distribution. Other forces at work include ever-changing customer demand, technological development, and growing competition, leading companies to develop new and often disruptive business models, particularly with advanced services playing an increasingly important role.

The above trends and changes have significant implications for the supply chain. To ensure setup and management of today’s E&M supply chain supports future requirements, companies are likely to focus on more regional design (still within the context of the global network) and greater sustainability, connectivity, integration, and agility in the supply chain.
CHAPTER 3: SUPPLY CHAIN RISK

In aggregate, these recent, current and emerging trends increase the complexity and criticality of the E&M supply chain. This makes companies more vulnerable should things go wrong. A delay of even a few hours in the delivery of critical components can disrupt carefully planned production schedules or leave customers with expensive assets sitting idle. More significant supply problems can cause lasting damage to a company’s reputation, market value and profits. 2013 research by the World Economic Forum found that, on average, a major supply chain disruption will reduce a company’s share price by 7%.

A key challenge for E&M companies and their supply chain management teams is the sheer diversity of events with the potential to affect product and component delivery. Let’s look at a few examples.

INDUSTRIAL ACCIDENTS

In August 2015, two explosions at a chemical warehouse in the Chinese port of Tianjin caused 159 fatalities and injured more than 800 people. The blasts left a crater at the warehouse site and damaged buildings up to two kilometers away. Tianjin is Northern China’s largest port and one of the world’s busiest. Roughly 8,000 new cars stored at the port were destroyed, and manufacturers including Airbus, John Deere, and Toyota were forced to suspend operations at nearby facilities. Companies across China faced delays and disruption to raw material supplies, from oil to iron ore, and had to look for different export routes to get products to customers overseas.

In 2016, production schedules at aircraft makers Airbus and Boeing were disrupted by the late delivery of seats and other interior components produced by supplier Zodiac Aerospace. The delivery problems were blamed on a number of factors, not least of which was an explosion in a resin-drying oven at the company’s plant in Newport, Washington, USA. A report into the accident by safety regulators noted that the incident was “highly predictable given the operating conditions” and the company was fined $1.3 million for safety violations.

EXTREME WEATHER

Strong winds and heavy precipitation can disrupt transportation and damage supplier facilities. The resulting delays may only last for hours, but in the worst cases, as when critical inventory or production machinery is destroyed, their impact can last for months. In 2017, for example, Hurricane Harvey swept across large parts of Texas. Among the worst-affected regions was the Houston area, a hub for the oil & gas and petrochemical industry. Hundreds of factories, warehouses and distribution centers were hit by the storm, disrupting 18% of all US oil and gas production and one-third of US chemical production. As the resulting shortages of critical industrial building blocks rippled across the supply chain, it took several months for some players to return to full production. With the market already constrained by high demand, this resulted in shortages and price increases for a wide range of manufacturing inputs, including paints, resins and specialty chemicals.
CYBER RISKS

Manufacturing supply chains depend as much on the flow of information as on physical goods. Especially in fast-moving just-in-time environments, manufacturers may require their suppliers make and dispatch products within days or even hours. To do so, companies rely on sophisticated digital communication, planning, and operations management tools – systems that are vulnerable to cyber-attack.

For example, in 2017, the “NotPetya” computer virus infected hundreds of companies around the world, locking staff out of their machines and irreversibly encrypting vital data. The outbreak, believed to have been intended to disrupt economic activity in the Ukraine, caused widespread global disruption. Affected companies included Maersk, the world’s largest container shipping line, and glassmaker Saint Gobain.

FINANCIAL RISK

Suppliers can run into financial problems too. Businesses facing difficulty may attempt to conceal the extent of their problems from customers, for fear of losing sales. The result can be a sudden loss of supply if beleaguered companies are forced to cease operations. The impact of such losses compounds if the affected company is a sole supplier of critical parts, or if it holds customer property, such as specialized tooling. In 2016, automaker General Motors was forced to take court proceedings to ensure a key supplier of interior components kept its production lines running until replacements could be sourced. In the same year, the bankruptcy of Hanjin Shipping, a major South Korean container shipping line, meant vessels were impounded by authorities or refused entry to major ports to offload their cargoes.
CHAPTER 3: SUPPLY CHAIN RISK

COMPLIANCE AND SUSTAINABILITY

The environmental and social impact of industrial activities receives ever-increasing scrutiny by governments, NGOs, and other stakeholder groups. Companies must ensure that their own operations – as well as their suppliers - comply with all relevant standards and regulations. Failure can lead to fines and reputational damage. Compliance issues can disrupt supply chains too. Regulators are increasingly willing to shut down operations where problems are found. In China, for example, factories have been required to cease operations in the run-up to high-profile events, such as the country’s annual parliamentary sessions, in order to improve the air quality around Beijing.

STRIKES AND LABOR ISSUES

Industrial action at supplier facilities or transportation logistics bottlenecks like seaports and airports can have a rapid and significant impact on manufacturing supply chains. In the US, import and export flows have been impacted several times in recent years by labor disputes affecting operations at ports along the west coast. Companies reliant on these ports may be forced to re-route shipments, which extends transit times, or switch critical shipments to more expensive air freight. A US trade body, the National Association of Manufacturers, estimated that a five-day west coast port shutdown would cost the US economy $1.9 billion per day, with the manufacturing and retail sectors among the most severely affected. Previously after disputes, some supply chains have taken months to fully recover.

The list above is not exhaustive. Countless factors can potentially impact manufacturing supply chains, ranging from natural and man-made disasters to minor local incidents. For just-in-time supply chains or the delivery of critical spare parts to a customer site, even road congestion or the breakdown of a single vehicle can result in extended downtime and costly loss of production.
E&M companies increasingly recognize that risk is an inevitable consequence of the current and future business environment. They also understand that a proactive approach is the most effective way to manage these risks. With appropriate contingency planning, full visibility and fast, flexible operations, an organization can greatly improve its ability to avoid the delays and losses associated with supply chain incidents.

At every stage of the product lifecycle, leading organizations now consider the risk implications of the decisions they make – decisions such as the selection of suppliers and manufacturing locations and the way supply chains are configured and operated. This may necessitate trade-offs. For example, if a company sources critical components from more than one supplier, this may negatively impact economies of scale and add management complexity but it may also positively impact security of supply. Similar compromises may be needed for decisions affecting inventory size, composition, and buffer stocks. Choosing suppliers and locating manufacturing sites closer to the end customer can reduce logistics risks and increase responsiveness. Risk may be lowered by operating in countries with political and social stability and robust infrastructure rather than in places with lower labor costs.

Once supply networks are running, companies must be able to predict, detect and respond to supply chain issues as quickly as possible. The best way to manage supply disruption is to avoid it by re-routing shipments or adapting production plans before end customers are affected. To do that, companies need a clear picture of the location and status of parts, products and materials in transit, as well as the status of transportation assets. They also need a wider perspective, with early, accurate warning of incidents and events with the potential to disrupt supply chain operations. Increasingly, companies are turning to new digital tools to gain the visibility they need.

“You can only manage supply chain risks if you have the right information,” says Wolfgang Lehmacher, Head of Supply Chain and Transport Industry at the World Economic Forum.

Good data management is a key enabler in supply chain risk management. The advent of the Industrial Internet of Things (IIoT) is transforming companies’ ability to monitor and control their supply chains. They can now achieve real-time visibility on the location of assets, like ships, trucks and aircraft, and they are beginning to make greater use of big data analytics and artificial intelligence tools to predict problems earlier and respond more effectively.”

Wolfgang Lehmacher – Head of Supply Chain and Transport Industry at the World Economic Forum
The challenge for companies has always been to balance the complex trade-offs between the many sources of risk and other considerations, such as transport cost, flexibility, and lead time. Now, companies can use advanced digital tools that aggregate data on multiple sources of supply chain risk, from historical incidents of natural disasters to the threat of political instability, terrorism, labor disputes, and transportation delays. These systems can even geo-code that data to street address level, allowing companies to assess overall risk at every point in their networks and drill down to understand the specific nature of those risks.

Using such tools, it becomes possible to generate detailed risk heat maps for different regions or transportation lanes, supplementing companies’ existing transportation risk analysis processes, and allowing them to focus more attention on the route segments that present the greatest risks. That saves time, reduces costs, and improves the effectiveness of transportation planning.
LOGISTICS CONTROL TOWERS

Driven by the need to keep complex, just-in-time supply chains operating effectively, manufacturers have been early adopters of logistics control towers to oversee their logistics operations and monitor disruptions. A control tower is a centralized command hub in which diverse information sources on logistics flows and network status are consolidated with early warning of potentially disruptive events in order to manage threats to day-to-day operations.

Shipment visibility is the fundamental basis for every logistics center of excellence. Best-in-class supply chain risk management systems incorporate advanced network analysis tools. These allow companies to map and visualize their entire supply network, including production, distribution, customer sites, transportation routes and critical supply chain nodes such as ports, airports and rail terminals. The network model is linked to shipment status information, the company’s internal transport management system and those of its external logistics partners, providing total transparency on the status of the network and material moving through it.

Where supply chains rely on containerized sea freight, vessel tracking systems now allow the position and progress of cargo ships to be monitored using the vessel’s native GPS. These systems can also show potential weather threats along the route of each vessel as well as calculating the estimated time of arrival (ETA) for each vessel based on its current distance from destination port. Automatically benchmarking this estimate against the scheduled arrival time allows the system to highlight deviations from the plan and provide the earliest possible warning of potential delays.

The most advanced logistics control towers strive to avoid supply chain incidents, not merely respond to them. Advanced incident monitoring systems can now supply near real-time information on events with the potential to disrupt supply chains. Combining inputs from multiple sources, including traditional and social media and proprietary intelligence sources, incident reports are linked to companies’ supply chain network models, ensuring rapid receipt of relevant information about the nature of the disruption and even the specific shipments that are affected. After the 2012 Tianjin explosion, for example, companies using these systems received notification of the incident more than two hours before information about the disaster reached conventional media channels.
Companies across the world rely on technologies from Schneider Electric to manage energy and run processes in ways that are safe, efficient, reliable and sustainable. To keep its complex supply chains running smoothly, the multinational manufacturer operates a network of seven regional supply chain control towers. “Our decision to in-source the management of our supply chain control towers was driven by a desire to improve the predictability and reliability of shipments, both to our end customers and to internal factories and distribution centers,” says Clara Beuttenmuller, Global Director, Transport Transformation.

On any given day, there will be around 8,000 shipments of parts or products moving between internal Schneider sites, with thousands more destined for end customers. The control towers have two primary roles, says Beuttenmuller, “The proactive management of exceptions, and the support our overall risk management, business continuity and contingency planning activities.”

Each control tower is powered by DHL Resilience360, a cloud-based digital supply chain risk management platform that provides end-to-end network visibility and near-real-time monitoring of global events. Schneider utilizes this innovative tool to track shipments across a network of 200 factories, 98 distribution centers, dozens of supplier sites, and key ports and airports. “The control tower staff uses the platform and other data sources to identify anything in the network that is at risk of being late,” says Beuttenmuller. “When that happens, we work with our logistics partners and activate the necessary contingency plans to prevent or minimize delays.”

In most cases, she says, the system allows Schneider to identify problems and take mitigating action within 24 hours of a potentially disruptive event. “At 4.00pm one day in January, for example, we received notification from Resilience360 about port congestion in Vietnam. We were immediately able to contact our five logistics providers, assess the situation and re-route a number of containers.

“By acting so quickly, we avoided having to use air freight, prevented a potential production shut down and ensured there was no end-customer impact.”
Logistics risks and challenges don’t end once an engineering or manufacturing company has delivered its product to the customer. Many of those products play business-critical roles and may remain operational for decades. For these expensive assets, customers require support throughout the entire lifecycle, often provided by the OEM. As manufacturers extend their service offerings, they increasingly assume more responsibility for monitoring, maintaining and even operating assets in the field.

The aftermarket presents complex logistical challenges. Demand for service parts or replacement components can be unpredictable and customers may be dispersed all over the world, often in remote, inaccessible locations. The high cost of downtime – keeping a commercial airliner on the ground waiting for spare parts can cost up $150,000 per hour – makes it critical to ensure short lead times and fast response times.

To deliver the required high service levels while keeping costs under control, E&M companies are now also applying advanced risk management tools and approaches to their aftermarket operations. These include risk assessment at the network planning stage to help decide how spare parts inventories should be distributed, real-time incident monitoring to predict both transportation issues and potential demand spikes, and centralized control towers to track the movement of shipments to customers, distribution centers and service facilities.
In some engineering sub-sectors, the transportation of oversized loads is a key logistics challenge.

Moving large objects on public roads is a costly, difficult and highly regulated task, calling for meticulous planning and execution. In the past, lane risk assessments focused solely on road grading and overhead obstructions like bridges, traffic signs and utility lines. But plenty of other external risks can impact these costly, critical deliveries and even bring them to a standstill.

Advanced digital lane risk assessment tools allow companies to identify optimal transport routes for oversized cargo by providing detailed data not just on physical limitations but also on factors such as typical traffic and conditions, infrastructure problems and regulatory restrictions. The consolidation of multiple data sources also informs logistics planners of future events – protests, construction projects and public holidays, for instance – that can cause unanticipated delays along routes. Thiago Aracema, Vice President of North America Oil and Energy for DHL Industrial Projects, adds that “other benefits of the technology include monitoring ports through which international deliveries are being shipped for weather forecasts, port congestion or customs strikes.”

All in all, by gaining end-to-end supply chain visibility, companies can more precisely select transportation routes that ensure, to the best possible extent, their valuable cargo will travel unobstructed and arrive on time.
CHAPTER 6: PROCUREMENT AND SUPPLIER MANAGEMENT

Similar technologies can also be used to generate a detailed picture of risk exposure at the production facilities of existing and potential suppliers. This enables E&M companies to incorporate supply chain risk assessment more effectively into their sourcing and network planning decisions.

SUPPLIER QUALIFICATION

For some time now, companies in the automotive sector have considered the so-called “C-price” when sourcing components and now an increasing number of E&M companies are doing the same. The A-price represents the cost of the component, the B-price is the logistics cost for bringing the component to the factory, and the “C-price” represents the probable cost of failure or disruption due to production outage, premium logistics costs, charters, abnormally high buffer stock, higher monitoring and management costs and, in the worst case, reputational loss. Companies can look at historical data to establish a likely minimum-to-maximum range of C-price costs across the supply base.

Digital solutions help to automatically gauge risk exposure for individual supplier locations. Information on natural disasters, socio-political risks, logistics accessibility, sustainability risks, and personal security can be included in the decision-making process and also reflected in a supplier qualification portal to provide all information at a glance. When this type of information on the true total cost of ownership is readily available, the C-price can be used as a tie-breaker when A- and B-prices are similar.

SUPPLIER THREAT MONITORING

In fast-changing, complex global supply chains, it is increasingly difficult to understand and monitor suppliers. While fire is the biggest cause of business interruption, natural disasters and supplier failure (insolvency) are also important risks, followed closely by cyber risk. After the 2007-08 financial crisis, procurement organizations started to closely monitor their suppliers’
financial situations and develop processes and technologies to do so efficiently. New solutions to holistically monitor all key risk factors specific to the supply chain in near-real-time have given greater visibility to procurement departments. Complementing existing processes with enriched data significantly cuts implementation time and allows procurement and category manager resources to focus on threat resolution rather than identification. Narrowing the time window between an initial threat and the mitigation response minimizes the likelihood of business interruption.

COMPLIANCE AND SUB-TIER IDENTIFICATION

An E&M company’s direct suppliers are only the tip of the risk iceberg. Behind them may be many tiers of sub-suppliers, some of which could be the only source of critical components or technologies.

Increasingly, companies are recognizing the importance of full transparency on risks and supplier compliance through every supply chain tier. Some are using digital tools to achieve this transparency. Automated survey portals are a fast, efficient way for companies to collect critical data on supplier facilities, processes and compliance procedures. These platforms can be used to address a wide range of information-gathering requirements, for example on business continuity management or conflict minerals. The most advanced of these systems automatically manages the iterative collection of data through multiple supply chain tiers, generates summary reports, and allows companies to drill down into the data to identify risk hot spots.

SUPPLIER BANKRUPTCY AND CORPORATE SOCIAL RESPONSIBILITY MONITORING

Financial problems typically reveal themselves very late in a long chain of events: changes in management or the loss of big contracts can be early indicators that a supplier is struggling financially. Moreover, suppliers facing allegations of corruption, environmental pollution, or child labor can have a damaging effect on the supply chain.

New tools use sophisticated artificial intelligence technology to automate and accelerate the task of identifying and interpreting the early indicators of supplier internal distress. Such systems apply advanced machine learning (ML) and natural language processing (NLP) technologies to analyze diverse data sources for tell-tale indicators of potential supplier financial problems or corporate social responsibility (CSR) issues.

Companies can get a head start on the competition with better awareness of supplier financial issues and ensure a smooth transition to an alternative supplier if necessary. Advanced knowledge also creates more options. For example, sufficient lead time before supplier failure could allow a company to provide financial assistance to avoid business interruption. Similarly, any CSR issues can be communicated proactively and non-compliant suppliers may be excluded to avoid reputational damage.
CASE EXAMPLE:

**Procurement and supplier risk management at KONE**

At elevator and escalator manufacturer KONE, the long-term quality and stability of the supply base is critical to business. The company’s products are usually installed as part of large-scale construction or renovation projects, so precise timing of delivery and commissioning operations is vital. Additionally, their products must be supported and maintained to ensure safe reliable operation, often for decades. Sourcing Risk Manager Aki Latvanne explains that the company’s standard supplier evaluation process now includes a comprehensive risk assessment, performed during the R&D phase of every new product development project.

KONE’s relationships with suppliers are typically long term, and active supplier risk management is a continual process. “We run regular risk engineering audits with our suppliers,” says Latvanne. “And as part of our internal business continuity planning processes, we evaluate supplier-related risks and work with suppliers to manage those risks, with plans updated every six months.” The company also has processes in place to monitor the financial stability and other external threats to its suppliers. “Many of our suppliers are privately owned, so they don’t always publish detailed financial results,” he adds. “It is important to us to have multiple sources of information to validate supplier financial health.”

“Our Supplier Quality Management function ensures every new supplier passes key milestones related to capacities, risks and financial stability.”

Aki Latvanne – Sourcing Risk Manager, Kone
The E&M industry is built on innovation and technological progress. Its ability to continually evolve has helped to deliver significant economic and social benefits across the world. However, with progress comes greater complexity.

It is not just E&M products that are more complex but also the manufacturing and supply networks needed to make and support these products. Leading companies are already deploying innovative digital tools and management approaches to deal with this complexity and associated risks through more proactive and efficient supply chain management.

Companies that succeed in exploiting these rapidly evolving capabilities will gain a distinct competitive advantage as supply chains become increasingly globalized and interdependent.
At DHL, we define the engineering and manufacturing sector to include companies that manufacture and service in the following market segments: aviation and aerospace, power generation and distribution, production lines and components, construction, transportation, tunneling, mining and extraction, agriculture, defense, and healthcare equipment.


Source: WTO. [https://www.wto.org/english/res_e/statis_e/wts2017_e/WTO_Chapter_04_e.pdf](https://www.wto.org/english/res_e/statis_e/wts2017_e/WTO_Chapter_04_e.pdf)


http://www.runwaygirlnetwork.com/2016/01/13/zodiac-dropped-from-a330neo-fined-by-us-regulators/


http://www.scbriefing.com/gm-avoids-catastrophic-disruption-as-key-supplier-files-for-bankruptcy/


https://www.airspacetechnologies.com/blog/an-aog-can-cost-up-to-150k-hr-how-to-combat-this-cost-2018
