



RISK AND RESILIENCE IN THE CHEMICALS SUPPLY CHAIN

DHL Customer Solutions & Innovation – Resilience360

RISK AND RESILIENCE IN THE CHEMICALS SUPPLY CHAIN



Source: DHL Corporate Net

Globalization, rising customer demands and an increasingly stringent regulatory environment are driving complexity – and risk – in the chemicals sector

From corn to computer chips, chemicals are essential to the production of almost everything people make, buy and consume. While it is largely invisible to the end user, the industry that supplies those materials is a true giant. In 2015 alone, the global chemicals sector was worth €3.5 trillion (\$3.7 trillion)¹.



Source: DHL Corporate Net

It is also an extraordinarily dynamic business and has more than doubled in size in the decade between 2005 and 2015. During the process of that growth, the sector broke free of its traditionally regional roots to become a truly global business. China, now the world's number one chemicals producer, more chemical products than the two next largest regions – Europe and North America – combined. The development of new manufacturing capabilities (especially in China, where the chemicals industry grew 25 percent a year between 2003 and 2013²) and access to new feedstock, such as US-produced shale gas, has seen centres of production shift rapidly around the globe.

¹ <http://www.cefic.org/Facts-and-Figures/Chemicals-Industry-Profile/>

² <http://www.consultancy.uk/news/2745/global-chemicals-market-to-grow-to-51-trillion-by-2020>

COMPLEXITY

The supply chains required to support the chemicals industry are hugely complex. The sector ships around 700 million tonnes of freight every year¹, 70 percent of which is intermediate product destined for further processing within the industry. The networks that carry that intermediate freight must continually adapt in response to evolving demand and changes in the cost and availability of inputs.



Downstream supply chains are increasingly complex. “The industry is entering the ‘age of application’,” says Michael O’Hara, Global Sector Head, Chemicals, at DHL Global Forwarding.

“Increasingly, companies are manufacturing specific products designed for a specific purpose and a specific end-customer.”

Those customers want to keep costs down and inventories low, driving the industry toward more frequent shipments of smaller volumes of end-product, delivered just-in-time to customer sites. The need for faster delivery is making air freight an increasingly important mode for chemical logistics. Chemicals and related products account for 18 percent of the air freight carried from North America to Europe, for example, and 13 percent of the freight moving in the opposite direction.²

1 http://www.dhl.com/content/dam/downloads/g0/logistics/white_papers/dhl_chemical_whitepaper_5_levers_2015.pdf

2 Boeing World Air Cargo Forecast 2016-2017, page 28 <http://www.boeing.com/resources/boeingdotcom/commercial/about-our-market/cargo-market-detail-wacfc/download-report/assets/pdfs/wacfc.pdf> Page 28

RISK

Rising complexity leads to greater supply chain risk. Production facilities distributed around the world can be affected by severe weather events, or technical breakdowns. Globalization has led to consolidation in the production of some materials, driving an increase in single-sourcing, which can exacerbate the impact of supply disruptions. Long, multi-stage transportation routes are more exposed to problems caused by vehicle breakdowns, congestion or labor disputes. Even short delays can create big issues if disruption stops a customer’s production lines, and suppliers can face large fines if they can’t meet agreed delivery levels. Some products need to be shipped in a temperature-controlled environment; waiting too long on a hot road side or in frozen railway marshalling yard could destroy a valuable load.

Moreover, the toxic, flammable or explosive nature of many chemical products creates significant additional challenges in the supply chain. The assets and processes used in transportation and storage must be carefully managed and controlled to reduce risks and ensure they comply with national and international regulations.

In recent years, the importance of safety has risen up the global agenda. In 2015, a series of explosions at a chemicals warehouse in the Chinese port of Tianjin killed 173 people and injured hundreds more. The tragedy revealed shortcomings in planning and enforcement – the facility was located within a few hundred meters of a residential area, for example, in contravention of national regulations. As a direct result of the incident, plans were drawn up to close or move 85 chemical companies from heavily populated areas in and around Tianjin. The relocation of two large chemical plants from the city is expected to cost around \$4.4 billion.³ The government report into the incident also found lax implementation of safety regulations and inadequate safety management. That prompted a nationwide inspection of business engaged in dangerous materials and explosives.⁴

3 http://www.joc.com/port-news/asian-ports/tianjin-spend-billions-relocating-chemicals-factories_20160126.html

4 <http://thediplomat.com/2015/08/after-tianjin-blast-china-takes-a-close-look-at-safety-regulations/>

High profile accidents in the chemicals supply chain are not just a developing world problem. In 2013, an explosion at a fertilizer storage and distribution facility in Texas killed 15 people, twelve of them volunteer fire fighters, and extensively damaged more than 150 buildings, including nearby homes and schools.⁵ The European Major Accident Reporting System (eMARS) recorded more than 100 major incidents in chemicals manufacturing or distribution in the ten years between 2007 and 2016.⁶

Then there are external risks. The high value, and dangerous nature, of some chemical products makes them a potential target for theft or acts of terrorism. In the ten years following the 9/11 attacks in the US, the American Chemistry Council estimates that its members spent an additional \$10 billion upgrading the security at manufacturing plants and storage facilities.⁷

REGULATION AND COMPLIANCE

As they design and operate their supply chains, chemicals companies must navigate a complex web of national and international regulations. While the labelling of hazardous materials is broadly standardized, with most regions adopting the UN Recommendations on the Transport of Dangerous Goods, standards for packaging, operating procedures and documentation vary considerably by transport mode and by region. Sea and air transport are governed by the international Maritime Dangerous Goods Code and the ICAO Technical Instructions for the Safe Transport of Dangerous Goods by Air, respectively. Other transport modes are subject to specific national or regional regulations. In Europe, for example, the transport of dangerous goods by road is covered by the ADR agreement while separate regulations exist to cover the use of inland waterways (AND) and rail networks (RID).⁸ Title 49 of the US Code of Federal Regulations governs the transport of hazardous material over land. In 2014, the US government also adapted and renewed its Chemical Facility Anti-Terrorism Standards (CFATS) program for a further four years. Those rules require chemical facilities to assess their vulnerability to terrorist attack, what the potential consequences of an attack might be and to show that they have a suitable risk mitigation strategy in place.

5 http://www.csb.gov/assets/1/19/West_Fertilizer_FINAL_Report_for_website_0223161.pdf

6 <https://emars.jrc.ec.europa.eu/?id=1>

7 <http://www.wvgazette.com/News/201109110210>

8 <https://www.unece.org/transport/areas-of-work/dangerous-goods/legal-instruments-and-recommendations/ghs/transdangerpublichsimplementation-e/legal-inst-list.html>

DIGITALIZATION OF RISK MANAGEMENT IN THE CHEMICALS SECTOR

To address the challenges posed by complexity, supply chain vulnerability and regulation, chemicals companies must continually strengthen their risk management processes and capabilities. “The days of being responsive are over,” says Darrell Zavitz, Advisory Board Member at the Center for Resilience, Ohio State University, and former senior supply chain executive at Dow Chemical Company.

“You need to be preemptive: control what you can, standardize what you can, and develop reliable, repeatable processes.”

Lane risk assessments for dangerous goods

Modern risk tools help aggregate data on multiple sources of supply chain risk, from historical incidents of natural disasters to the threat of political instability, terrorism, labour disputes or transportation delays. Risk data is geo-coded to the street address level, allowing companies to assess the overall level of risk at every point in their networks and be able to understand the specific nature of those risks at a very granular level.

Evonik Industries AG is one of the world’s leading specialty chemicals companies. In a sector where health, security, safety and environmental protection heavily influence a company’s reputation and profits, risks must be carefully controlled. That makes risk management a key concern for the company’s services unit, Evonik Technology & Infrastructure GmbH, which is responsible for managing site operations, utilities and waste, technical services and logistics.

For more than five years the company has been running its own transport risk analysis with its proprietary methodology based on business continuity management assessment best practices to identify, evaluate and improve risks of all routes, regardless of the mode of transportation. In light of the Responsible Care initiative for the global chemistry industry and to aid its continuing efforts to improve transparency and responsiveness in its logistics processes, Evonik has adopted DHL Resilience360, a cloud-based supply chain risk management platform.

Evonik was able to integrate all its relevant supply chain data into the DHL Resilience360 platform. Using aggregated data from an extensive database of historical incidents, DHL Resilience360 generated Heat Maps, visualizing the incident density and severity to highlight risk hotspots. Incident Monitoring also gives real-time notifications when accidents, delays, strikes or other disturbances arise. In combination, the risk Heat Maps and incident reports help the company to prioritize its overall risk reduction efforts, identifying the most vulnerable parts of its dangerous goods deliveries and enabling a more directed approach for audits and interventions where necessary.

These system can be used to generate detailed Risk Heat Maps for different regions or transportation lanes, supplementing chemicals 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.

Network, supplier and production footprint planning

Following the lead of the automotive sector, some companies are considering the so called "C-price" when sourcing components from a supplier. The "A-price" represents the cost of the component, the "B-price" is the logistics cost for bringing the component to the factory. The "C-price" represents the probable cost of failure or disruption. This failure or disruption is associated with costs such as production outage, premium logistics cost, charters, abnormally high buffer stock, higher monitoring and management costs or, in the worst case, reputational loss. Companies can establish a range of the likely minimum to maximum of these C-price costs across the supply base by looking at historical data. The Resilience360 Risk Exposure Index can help these businesses in dimensioning the C-price for individual suppliers and act as a "tie-breaker" when the A and B prices are similar.

Assessment tools are used by many companies today in their network planning activities. This allows chemicals companies to incorporate supply chain risk assessment more effectively into their sourcing and networking planning decisions by providing a detailed picture of the risk exposure at the production facilities of potential suppliers or sites identified for capital investments.

Supplier management

Many of the most significant vulnerabilities in chemicals companies' supply chains lie outside their direct control. They rely on hundreds of suppliers, carriers and other intermediaries, each with a vital role to play in the safe, efficient execution of manufacturing and transportation activities.

In fast changing, global supply chains, understanding and monitoring diverse, widespread and massive amounts of supplies is a growing burden. Secure, configurable mechanism that enables companies to collect critical data on supplier facilities, processes and compliance procedures are needed. These fully customizable platforms provide pre-defined survey templates to suit a wide range of information requirements (for example on business continuity management or certifications, such as Customs Trade Partnership Against Terrorism (C-TPAT) licenses. They automatically manages the iterative collection of data through multiple supply chain tiers, generates summary reports and allows companies to drill down into their data to identify risk hot spots.

Internal supplier struggles – such as financial problems, changes in management or the loss of big projects – can also have damaging effects on the supply chain. Innovative technologies utilize sophisticated artificial intelligence technology to automate and accelerate the task of identifying and interpreting the early indicators of supplier internal distress. The spate of large mergers and acquisitions in the chemicals industry– such as DOW and DuPont, Bayer and Monsanto or ChemChina and Syngenta, is likely to drive a secondary wave of supplier-base rationalization.



That will then create an increased risk of supplier insolvencies.⁹ Resilience360 supply watch uses advanced Machine Learning (ML) and Natural Language Processing (NLP) technologies to analyze diverse data sources for tell-tale indicators of potential supplier problems. This helps business detect problems upstream and mitigate the issues before they happen.

Logistics Centers of Excellence

Driven by the demand for safety in the transport of hazardous good, the chemicals industry was an early adopter of logistics centers of excellence to oversee their logistics operations and monitor disruptions. A comprehensive risk platform should also provide such centers with a suite of tools to increase supply chain transparency and provide earlier warnings of potentially disruptive events:

Shipment visibility is the fundamental basis for every logistics centre of excellence. Advanced network analysis tools allow companies to map and visualize their entire supply network, including production, distribution and customer sites, transportation routes and critical supply chain nodes such as ports, airports or rail terminals. The network model can be linked to shipment status information from any transport management system, be it customers' own internal systems, DHL's internal systems or those of other external logistics partners, providing total transparency on the status of the network and material moving through it.



Source: DHL Corporate Net

Risk monitoring solutions supply near real-time information on events with the potential to disrupt supply chains as well as potentially affected shipments. Combining inputs from multiple sources, including traditional and social media, and DHL's own tracking and monitoring activities, incident reports are linked to customers' supply chain network models, ensuring they receive rapid, relevant information about the nature on the disruption and even the specific shipments affected. After the 2012 Tianjin explosion, for example, Resilience360 was able to notify customers of potential disruption more than two hours before information about the disaster reached conventional media channels.



Sea freight remains the major international transport mode for the chemicals sector. At the start of 2016 Chemicals companies faced major disruptions in their supply chain. Due to the low oil price cargo ships avoided the Suez Channel and took a 12 day detour around Africa¹⁰. This surprise change in schedule stopped production at some chemicals companies for several weeks¹¹. With vessel tracking technology embedded in risk visibility platforms, cargo ships can be monitored using the vessel's native GPS. and the system also shows the potential weather threats along the route of each vessel. Vessel Tracking also calculates the estimated time of arrival (ETA) for each vessel based on its current distance from the next port, and benchmarks this against the scheduled arrival time to highlight major deviations from plans and provide an the earliest possible warning of potential delays.

¹⁰ <https://www.imarest.org/themarineprofessional/item/2241-ships-avoiding-the-suez-canal> & <http://www.al-monitor.com/pulse/originals/2016/03/egypt-suez-canal-extension-traffic-plans-concerns.html>

¹¹ Resilience360 customer experience

⁹ <https://www.ft.com/content/44777ada-ff5c-11e6-96f8-3700c5664d30>



Source: DHL Corporate Net

As the chemical industry continues to grow explosively, supply chains grow more complex and are therefore more vulnerable to disruption. Many chemical companies are still missing a methodical and digitalized framework that increases the amount of transparency and helps in building resiliency into their supply chain. "Complex global supply chains must stay aware of potential risks that may affect their bottom line," says Tobias Larsson, Head of Resilience360 at DHL. "Today we have the technology to allow chemical companies to visualize their supply chains, understand vulnerabilities, and identify disruptive events. Digitalization allows organizations to shift their focus from identifying risks to proactively managing them."

The recent impact of Hurricane Harvey is a prime example of this. The Houston area is home to many of the world's largest petrochemical producers who manufacture chemicals essential for various industries ranging from automotive and plastics to packaging and life sciences. Within a few hours of Harvey making landfall, DHL Resilience360 was able to provide a holistic overview of the situation for the Chemical industry in the affected areas. Port closures in Texas and Louisiana have reportedly affected 39 per cent of the waterborne chemicals trade. As of September 4, multiple chemical producers still had force majeure in place, telling customers they would not be able to fulfil their contracts because of Harvey, often because logistics were stalled by the storm. This has led to a supply shortage

of up to 68 different types of chemicals in recent days, disrupting for instance more than 33 per cent of US chlorine and caustic soda production as well as 40 per cent of US ethylene capacity. While the former products are used in the automotive and electronics industries, the latter is a major base material used in the plastics and food packaging sectors. Downstream manufacturing supply chains of industrial goods like car parts, rubber tires and medical devices could all also be affected by the shortage. According to industry sources, chemical and plastics buyers will be faced with a supply shortage and higher prices as soon as inventories run out. Given the complexity of the ethylene manufacturing process, it may take many more weeks for production to reach levels prior to the storm's landfall. Shipment delays of petrochemical products could extend to an average of two weeks if transported via rail, creating supply chain bottlenecks which may only be eased by seeking supplies outside the US. Continued disruptions due to road closures, power outages and limited air, rail, truck and sea freight capacity will prolong the recovery time of manufacturing sites and suppliers and extend impacts on supply chains into the next few months.

Digitalization of risk management will ultimately differentiate those businesses in the chemicals industry that simply react to supply chain disruptions as they occur and those who proactively manage risks on their horizon to stay ahead of the competition.

IMPRINT

DHL Resilience360
DPDHL Research & Innovation GmbH

HEAD OF RESILIENCE360

Tobias Larsson
DHL Customer Solutions & Innovation
tobias.larsson@dhl.com

PROJECT LEAD

Ulf Venne
ulf.venne@dhl.com

EDITOR-IN-CHIEF

Shree Dash
shree.dash@dhl.com

WRITER

Dr. Jonathan Ward

DESIGN

Williams Lea Tag

For further information

Contact our supply chain experts:
resilience360@dhl.com

For the latest insight and resources
on supply chain resilience, visit our
website: resilience360.com

