OLIVER WYMAN

IMPROVING CRUDE-BY-RAIL SAFETY THROUGH SUPPLY CHAIN COLLABORATION

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Despite the relative safety of crude oil rail transport, when incidents do occur, they can have catastrophic consequences. As a result, over the past several months, regulators in the United States and Canada have introduced a raft of new regulations and standards designed to improve the safety of transporting crude oil by rail. Encouraging greater focus on routings, inspections, and equipment are a good start to addressing safety challenges, but Oliver Wyman believes that a more holistic approach is warranted – one that involves better coordination and planning to manage risks across all stakeholders in the crude-by-rail "supply chain" (Exhibit 1).

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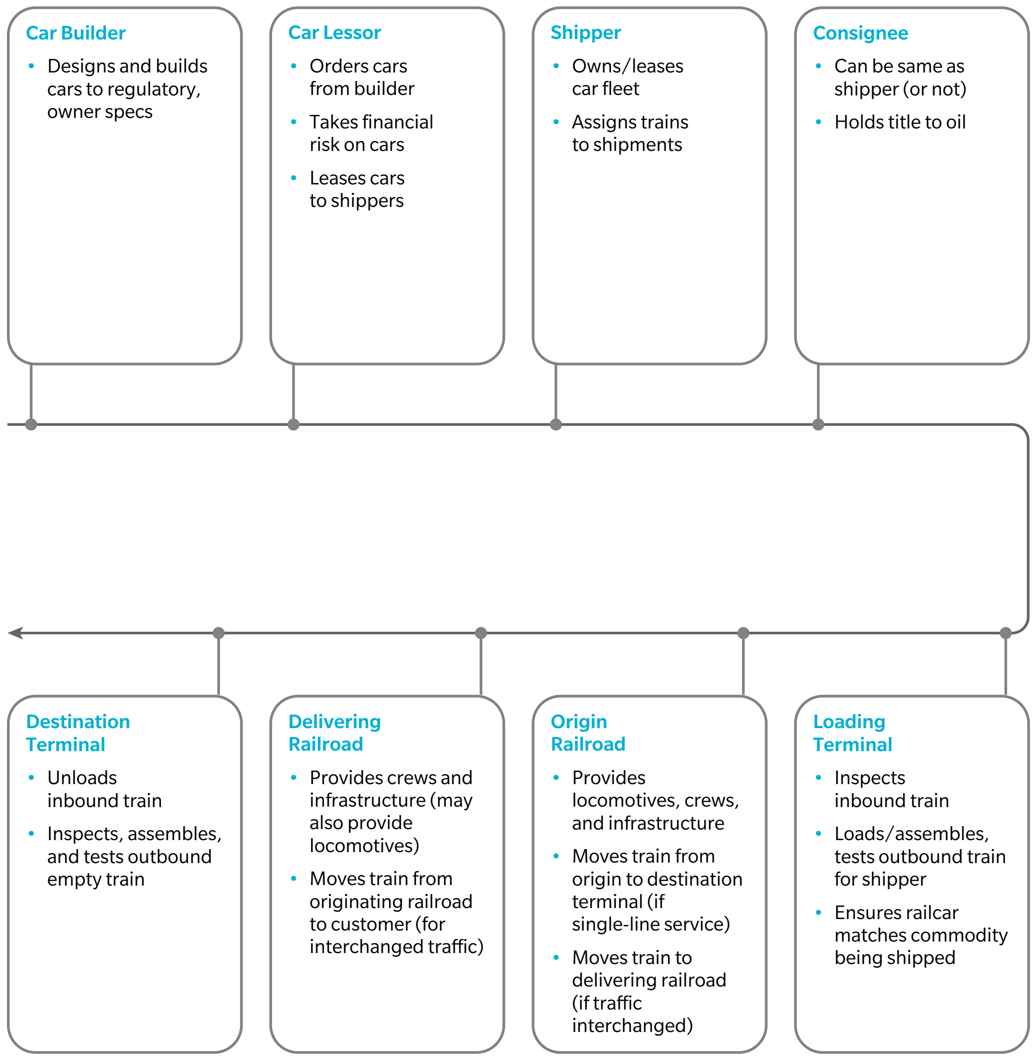
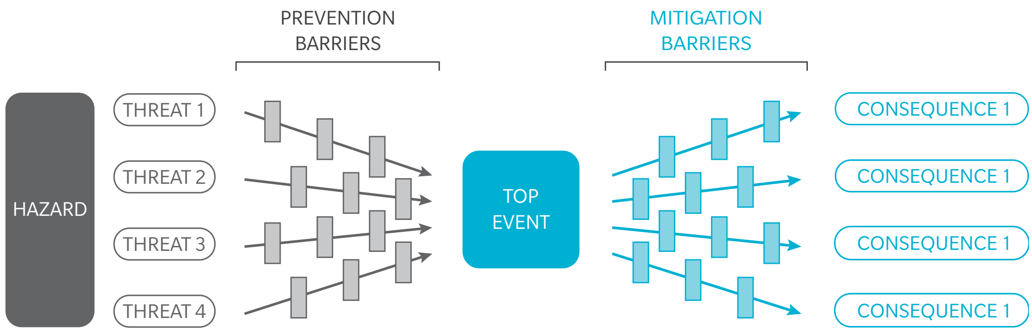
Exhibit 1: The Crude-by-Rail Supply Chain



BARRIER THINKING AND BOWTIES

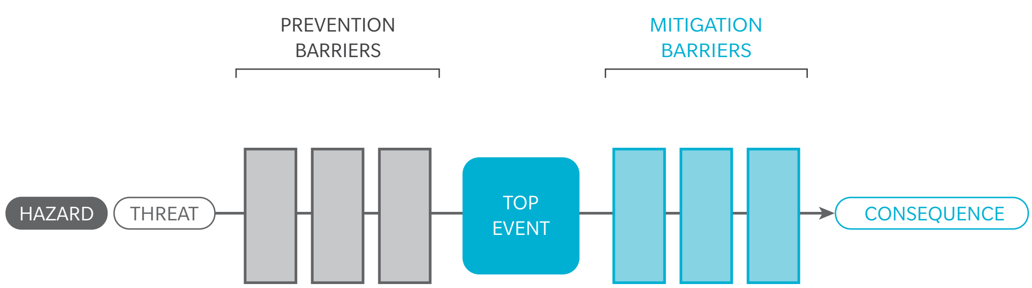
Other industries, such as oil refining and power generation, have faced similar safety challenges and reinvented their approaches to mitigating risk. One organizing principle commonly used for safety management in high-risk industries is called the "bowtie" methodology – this tool can be used to comprehensively identify the potential hazards of shipping crude by rail, consequences, and safety barriers that can prevent or mitigate threats (Exhibit 2). This understanding can then be used to guide the collective development of a risk management strategy for the entire supply chain – from organizational/structural activities to addressing public and regulatory perceptions.

Exhibit 2: The Bowtie Method for Identifying Risks



The bowtie is built up by understanding how a "top event" – such as a tank car explosion – relates to specific hazards (such as the flammable nature of crude oil), the threats that might lead to the event (e.g., a broken rail that causes a derailment), and the consequences of the event (uncontrolled fire, harm to people and property). As shown in Exhibit 3, barriers can then be identified that would either prevent the threat from materializing, or that would mitigate the event and reduce the consequences.

Exhibit 3: Barrier Thinking to Prevent and Mitigate Events



Potential barriers could include operational, design, or behavior/process changes. In the case of a broken rail, for example, track inspection and proper maintenance would serve as a barrier to derailment. On the mitigation side, proper placard display does nothing to prevent an incident, but could help firefighters respond and mitigate consequences. Once barriers are known, they can be highlighted as "safety critical" to ensure sufficient focus. The "bowtie" represents the culmination of the process and provides a roadmap for collective action.

SAFETY ALONG THE SUPPLY CHAIN

A number of recent actions have been taken to strengthen the safety of crude-by-rail movements, including a voluntary increase in track inspections, new hazmat routing assessments, better crude testing, and enhanced tank car specifications. Minimizing the sum total risk of crude-by-rail and the subsequent impacts of that risk (both from a public safety and industry regulatory/reputational standpoint), however, requires consideration of stakeholder roles and the potential for collective action. Given how grave the consequences of an accident can be, no party can afford to be the weak link.

Although a complete "bowtie" assessment will consider many more factors, an initial assessment suggests that there are additional safety barriers that only collaboration can raise across the supply chain (in addition to participants' discrete activities). A few examples follow.

ASSIGN TANK CARS BASED ON RISK

A principle of process safety used in high-risk industries is "design integrity," which means that the fundamental build of equipment will be suitable for the hazards expected. In a refinery, equipment is designed for the temperature, pressure, and corrosive nature of the hydrocarbon it will contain. Rail tank cars similarly must match the hydrocarbons they carry. For example, the US Department of Transportation issued a warning in January regarding the flammability of Bakken crude oil. Utilizing appropriate tank cars (e.g., the FRA-111 and CPC-1232) that can safely handle this oil makes sense, as would reassigning other types of tank cars to less volatile cargos.

From a supply chain perspective, one approach might be to rank all hazardous commodities currently carried in FRA-111 tank cars. Then, based on this ranking, as newer, stronger CPC-1232/P-1577 tank cars come online (29,000 of which exist today, projected to grow to 55,000 cars by the end of 2015), these could be prioritized, through a pooling approach by fleet owners, to ensure they are used for the most hazardous commodities. Once cars were prioritized and assigned, the railroad and shipper could ensure that a unit train hauling Bakken crude, for example, was composed entirely of these stronger tank cars. This approach would require collaboration across the supply chain.

- Shippers would need to test the crude and request CPC-1232 tank cars for loadings prioritized to these safer cars.
- Car owners would have to agree to pool the cars so the best cars could be applied to the most hazardous shipments.
- Railroads would have to work with shippers to coordinate the flows of empty trains to the right loading locations, etc.

Particularly as all crude oil is not the same, it would take coordination across stakeholders to ensure the best possible handling for the most hazardous commodities.

ASSESS THE LAST MILE PROACTIVELY

Final mile analysis ensures that the rail lines have the required structural integrity and safety practices in place to manage the hazards that will be transported over them. In many cases, the Class II and Class III railroads in a supply chain function as contractors for a Class I carrier, handling "last mile" pickup and delivery. While the regulatory system does monitor track condition for Class II and III railroads, increased risk may stretch regulators and be more difficult for these small railroads to address on their own. Shippers and Class I carriers could consider conducting proactive risk and safety audits in conjunction with their Class II and Class III partners to ensure consistent safety practices and conditions across all portions of the routes used for crude rail transport.

MAXIMIZE SAFETY TECHNOLOGY

Another potential area of crude-by-rail supply chain focus could be support for targeted R&D and the adoption of advanced safety technologies. With so many new cars being introduced onto the rail network, and given that most crude oil is being targeted for unit train operations, this may raise opportunities for step changes in fleet safety and performance. One example would be replacing 150 year-old compressed air braking technology with electronically controlled pneumatic braking on the new tank cars now coming online. This would enable braking to be applied faster and more consistently in a unit train in the event of an incident (and allow electronic confirmation of braking capabilities).

A total supply chain review, however, would be needed to address the investment and operational complexity issues involved in the use of electronic brakes:

- Parts suppliers would have to ensure they had the capability to supply ECP components in sufficient quantities.
- Car builders would have to add the parts to new cars.
- Car owners would have to pay the small premium for this technology and schedule retrofitting on existing CPC-1232 tank cars.
- Railroads would have to ensure locomotives were equipped with ECP technology and crews trained to properly handle ECP trains.
- Terminal operators would have to be trained to properly set up and test the system when the trains are assembled.
- Any shortlines involved in "last-mile" services would have to ensure their infrastructure could accommodate the through operation of ECP equipped locomotives from the Class I carrier.

Newer, proven technologies could also be used to harden elements of the system – other heavy industries use tech that provides shippers and carriers with immediate data to notify them in real time of variances in standards. Locomotives are now equipped with GPS technology and fault reporting; these systems could be used to immediately report emergency brake applications and notify emergency personnel to accelerate the response to incidents.

With electronic train lines from ECP braking systems, it might also make sense to equip the trucks on tank cars with sensors that could detect the kind of rough sudden motion that indicates a derailed wheel set and immediately apply the brakes on the train. Seconds count in a derailment event, and this would stop a train far more quickly than waiting for the derailment to progress to the point that the train line was severed or a problem was detected in the locomotive cab. Such a system could notify the train crew of exactly which car triggered the braking event – enabling an immediate inspection of the problem rather than having to check along the entire train – thus minimizing the time lost by false events. Used properly, such technology could strengthen barriers and ensure inspection/maintenance activities focus in on the most immediate and highest risks.

DEVELOP CROSS-INDUSTRY BEST PRACTICES

The petrochemicals industry has developed comprehensive safety practices and Dow, DuPont, and other chemical companies have been brought in by the rail industry to share those best practices in the past. Given the risk profile of crude-by-rail – a risk that is jointly borne by all parts of the supply chain – it may be worth reinvigorating this collaborative model to optimize cross-industry safety with regard to crude. This model could even be extended to communities and first responders to ensure that critical safety issues on both sides of the bow tie – prevention and mitigation – are fully addressed.

A TIME TO BUILD

An estimated 400,000 carloads of crude oil moved by rail in the United States over the past year, and that number is likely to continue to climb for the foreseeable future. Clearly, the safety of crude-by-rail shipping will ultimately depend on the strength of the barriers to risk that get built. Each participant in crude-by-rail movements certainly can work to improve its own practices and try to convince regulators, investors, and other stakeholders that it is leading the charge for safety. But the best results, i.e., identification and implementation of all safety best practices that can lead to the safest crude-by-rail supply chain possible – are likely to come about only if all parties come together to develop a comprehensive understanding and mitigation strategy for crude-by-rail risks.

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