

Find the Weak Link in Your Supply Chain

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A big challenge in today's world of far-flung, complex supply chains is the limited understanding of the impact on your operations of unexpected disruption at one supplier's site. To address this issue, my colleagues William Schmidt of Cornell, Yehua Wei of Duke, and I developed a method to help prioritize the financial or operational impact of risk that lets companies focus their mitigation efforts on the most important suppliers and risk areas. The method was implemented successfully at Ford Motor Company — an effort we described in this HBR article. But since then, we encountered an important problem: Suppliers tend to be optimistic about the information that they provide. In response, we have developed a remedy.

A central feature of the original model was *time to recovery* (TTR): the time it would take for a particular node — a supplier facility, a distribution center, or a transportation hub — to be restored to full functionality after a disruption. By combining suppliers' TTR information with the details of Ford's supply chain, product bill-of-material, volume, and profit margins by product line and pipeline inventory, our method identifies the risk exposure associated with a disruption in each site of Ford's network. This is done by simulating the firm's response to a disruption at a specific site for the duration of TTR.

The TTR values are determined by examining historical experience and surveying the firm's buyers or suppliers. But we then discovered that suppliers tend to be optimistic about their TTR since they know that a long TTR is not going to be accepted by the manufacturer. Therefore, we realized that we needed a way to identify bottleneck suppliers for which it's critical to obtain accurate TTR information and distinguish them from other suppliers where even plus or minus 30% error in TTR information will have very little impact on the supply chain.

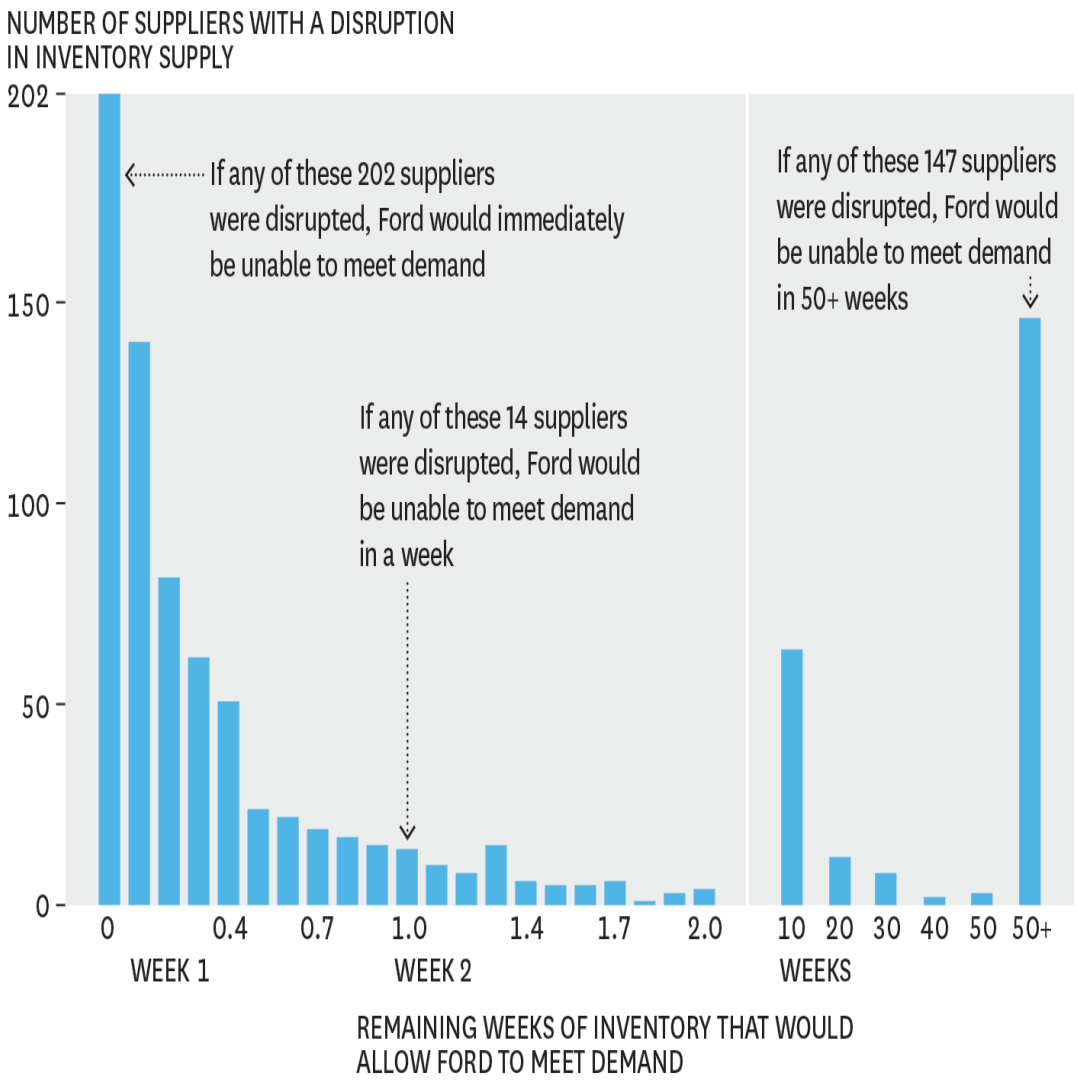
For this purpose, we created a new metric that we call "time to survive" (TTS). It is the maximum duration that the supply chain can match supply with demand after a node disruption. To determine TTS associated with a specific node, we remove the node from

the supply chain and calculate how long — using inventory in the pipeline and other available supply sources — we can serve customer demand without that node. If the TTS of a specific site is greater than its TTR, this site does not expose the firm to any risk since during the time the site is recovering from a disruption, the firm can still match supply with demand. On the other hand, if the TTS of a specific facility is smaller than its TTR, its disruption will expose the firm to financial and operational problems.

As you can see from the chart below (whose data is slightly modified or disguised to protect proprietary information), when the new metric was applied to Ford's supply chain, it revealed that some supplier sites had a TTS equal to just a few days. These are critical suppliers and a careful review of their TTR is necessary. By contrast, there were other suppliers with a very long TTS (greater than 50 weeks). This is an opportunity to cut costs since, in many cases, a long TTS is achieved by building a lot of strategic inventory. Cutting inventory for these suppliers by 50%, for example, will have very little impact on its ability to respond to a disruption.

Time to Survive

A closer look at what a disruption could do to Ford's* supply chain.



*DATA IS SLIGHTLY MODIFIED TO PROTECT PROPRIETARY INFORMATION
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The new metric motivated the development of a model to assess the level of strategic inventory: inventory used to respond to a disruption anywhere in the supply chain. That is, TTS and TTR metrics can be combined to determine how much strategic inventory the firms needs and where to position this inventory so each site's TTS is greater than its TTR. This leads to a robust supply chain, one in which each node has a TTS greater than its TTR and thus a disrupted node will always recover before it exceeds its ability to apply the mitigation strategies the firm has in place.

Ford is monitoring risk exposure using our technology on an ongoing basis and making adjustments based on changes in the environment. For example, as inventory levels

change in the supply chain, the risk exposure changes. When risk exposure is above a certain level, perhaps due to low inventory levels or delayed supply, our technology triggers an alert that requires procurement managers to review the drivers of the increase in risk.

Ford executives recently told us that they are using our method and technology for three levels of decisions:

Strategic: To identify exposure to risk associated with parts and suppliers, prioritize and allocate resources effectively, develop mitigation strategies, and identify opportunities to reduce risk mitigation cost

Tactical: To monitor changes in risk exposure on a daily or weekly basis

Operational: To identify an effective way to allocate resources after a disruption.

As Ford has discovered, *time to survive* complements the *time-to-recovery* metric and makes it possible to develop a deeper understanding of how to manage supply-chain risks effectively. Together, they have allowed Ford to work with its suppliers on mitigation strategies and create a more robust supply chain.

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