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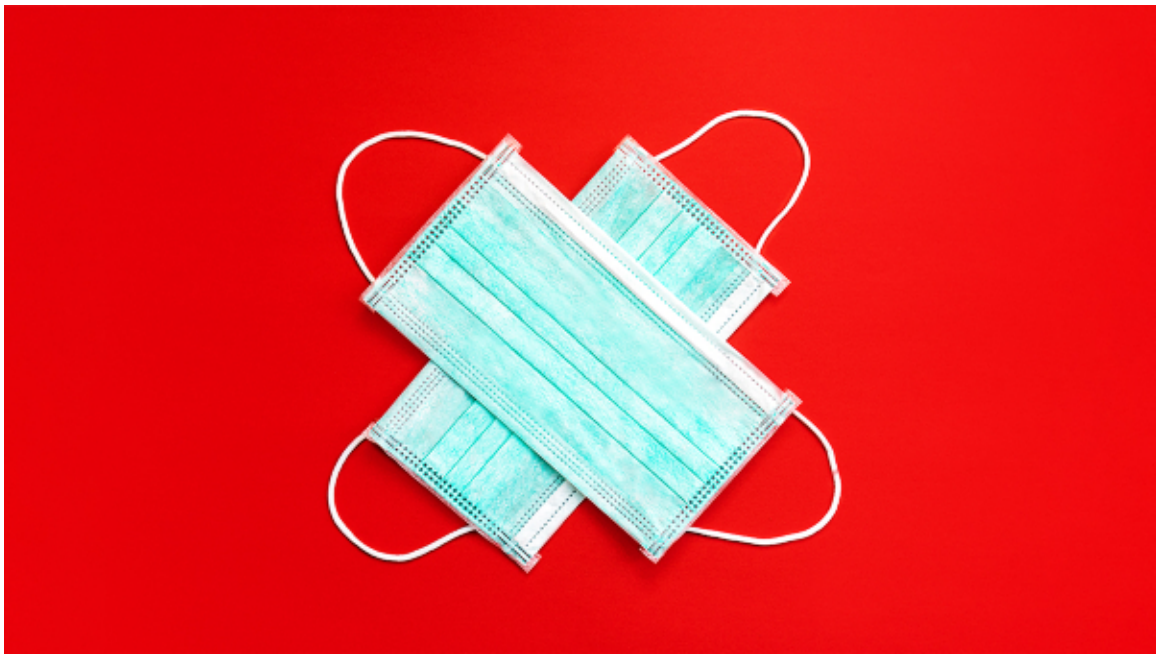

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Reports on how the Covid-19 outbreak is affecting supply chains and disrupting manufacturing operations around the world are increasing daily. But the worst is yet to come. We predict that the peak of the impact of Covid-19 on global supply chains will occur in mid-March, forcing thousands of companies to throttle down or temporarily shut assembly and manufacturing plants in the U.S. and Europe. The most vulnerable companies are those which rely heavily or solely on factories in China

for parts and materials. The activity of Chinese manufacturing plants has fallen in the past month and is expected to remain depressed for months.

Many analyses compare the current epidemic with the 2002-2003 SARS epidemic, which created just a blip in the global financial markets. This comparison is dangerous because the relative importance of China in the worldwide economic ecosystem has increased tremendously in the past 18 years: China has more than doubled its share of trade with the rest of the world between the SARS epidemic and today, and many more industries are now heavily dependent on China. The SARS epidemic started in the Guangdong province in 2002 and led to 8,000 cases in 2003. During that year, the GDP of China represented 4.31% of the world GDP. By contrast, the number of detected cases of Covid-19 has already passed 80,000 and China represents about 16% of the world GDP, an almost four-fold increase.

Equally important, mounting pressure to reduce supply chain costs motivated companies to pursue strategies such as lean manufacturing, offshoring, and outsourcing. Such cost-cutting measures mean that when there is a supply-chain disruption, manufacturing will stop quickly because of a lack of parts. The vast majority of global companies have no idea of what their risk exposure to what is going on in Asia actually is; that's because few, if any, have complete knowledge of the locations of all the companies that provide parts to their direct suppliers.

Given the current efforts by the Chinese government to quarantine almost one half of its population and the negative impact that's having on transportation and manufacturing activities in the country, we can safely conclude that the impact of Covid-19 on Chinese manufacturing is at least an order of magnitude larger than that of SARS.

As a result of events such as the 2002-2003 SARS epidemic, the March 2010 Iceland's volcano eruption, Japan's earthquake and tsunami in March 2011, and the flood in Thailand in August 2011, companies increased the amount of inventory they keep on hand. But they still usually carry only 15 to 30 days' worth of inventory. It is possible that the Chinese New Year week-long vacation motivated some companies to increase their inventory coverage by another week. So, for most companies, the inventory coverage they have will allow them to match their supplies with demand, with no additional supply, for between two to five weeks, depending on the company's supply chain strategy. If the supply of components is disrupted longer, manufacturing will have to stop.

Supply lead times will also have an impact. Shipping by sea to either the U.S. or Europe takes, on average, 30 days. This implies that if Chinese plants stopped manufacturing prior to the beginning of the Chinese holiday on January 25, the last of their shipments will be arriving the last week of February.

All this suggests that there will be a spike in the temporary closures of assembly and manufacturing facilities in mid-March.

Some manufacturers have already had to throttle back production in their plants outside of China, and the list gets longer by the day. For example, Fiat Chrysler Automobiles NV announced on February 14 that "it is temporarily halting production at a car factory in Serbia because it can't get parts from China." Similarly, Hyundai said that it "decided to suspend its production lines from operating at its plants in Korea ... due to disruptions in the supply of parts resulting from the coronavirus outbreak in China." These two examples are consistent with our analysis: Because lead times from China to these countries are significantly shorter than 30 days, the disruption occurs earlier.

The challenge is also significant in the high-tech industry. Indeed, on February 17, Apple announced it expected its quarterly earnings to be lower than previously expected. The company refers to two challenges, a constrained global supply of iPhones and significant drop in demand in Chinese markets.

Other industries are also being hit by this double whammy. One global consumer-packaged-goods manufacturer told us that its sales in China this month are 50% lower than in February 2019. Consider also products such as bridal gowns, many of which are produced in China and sold all over the world. According to this report, the current shutdown of Chinese manufacturing facilities specializing in these products will lead to a significant supply shortage for the upcoming summer wedding season.

The widening coronavirus epidemic is already affecting ports. Allard Castelein, the CEO of Rotterdam harbor said, "The effect of the coronavirus is already visible. The number of departures from Chinese ports has decreased by 20% these days." Activity at the French port of Le Havre is also slowing and could drop by 30% within two months. And the anticipated impact on U.S. ports is starting to be factored into financial analyses.

In summary, we believe we should brace for a major effect on manufacturing worldwide. It will begin to hit full force in two to three weeks and could last for months.

Pierre Haren is the CEO of the fintech start-up Causality Link. He cofounded ILOG, a leading provider of optimization engines and business rules, which was bought by IBM in 2008.

David Simchi-Levi is a professor of engineering at the Massachusetts Institute of Technology. He co-founded LogicTools, a provider of software for optimizing supply chains that is now part of IBM; OPS Rules, an operations consulting company; and Opalytics, a cloud analytics platform company. His latest book is *Operations Rules: Delivering Customer Value through Flexible Operations*.