Making Your Supply Chain Shock-Proof

How a semiconductor shortage rocked the auto industry and how the Altana Atlas could have helped understand hidden dependencies to better mitigate disruptions

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Executive Summary

Amid the COVID-19 pandemic, when seemingly everything paused, so too did large parts of the supply chain. Car-buyers were left perplexed when seeking the freedom of the road was impossible due to a scarcity of cars, caused by a dramatic shortage in the tiny technology that enables modern cars to run.

When the automotive industry shifted to Just in Time manufacturing decades ago, production times were drastically reduced. This novel approach also meant that companies were no longer left with excess supply if there was a lack of consumer demand.

Recently, the automotive industry felt the downside of this strategy when a shortage in the production of automotive semiconductors — due to changing customer demand during the COVID-19 pandemic — left automakers without spare supply and unable to meet the return of demand for vehicles. In the first quarter of 2021 due to a near complete lack of this technology, many major automakers were forced to reduce capacity or completely shut down factories. As a result, according to the Center Automotive Research, it's estimated that 5.2 million less cars will be produced in 2021, as KPMG predicts $100 billion in lost revenue across the industry.

Leveraging the latest AI, manufacturers can now anticipate and avoid these shocks in their multi-tier supply chains by connecting to a living map of the global supply chain using the Altana Atlas.

This paper will focus on the domino effect of how the semiconductor shortage left the automotive industry short-changed using insights from the Altana Atlas and how the Altana Atlas could have helped to see deep upstream into the supply chain network, predict disruptions, and take mitigating actions.
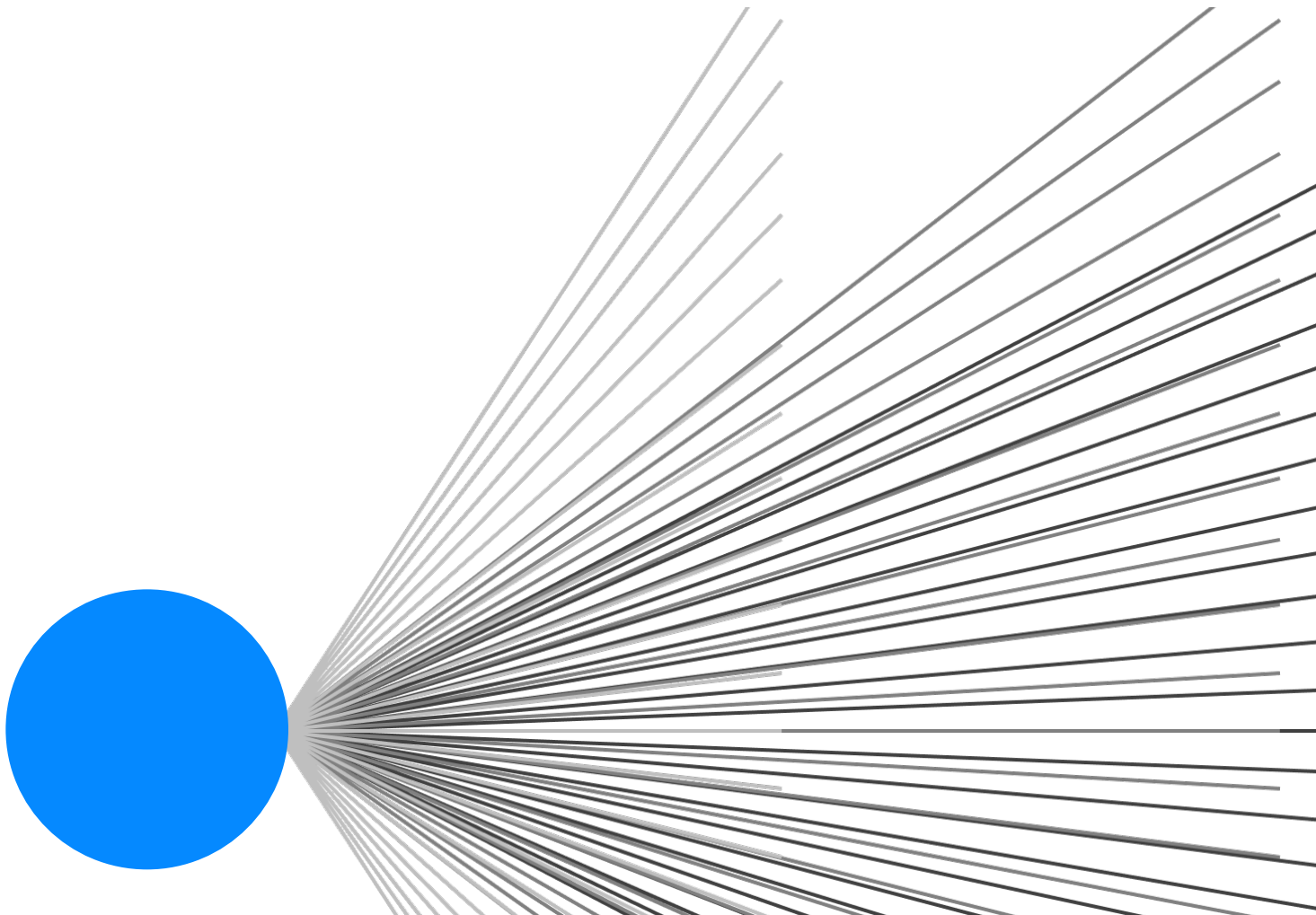
The Origins of Lean Manufacturing and Opaque Multi-Tier Supply Chains

In 1950 Japanese engineer Taiichi Ohno's visit to an American supermarket inspired a sea change in the way manufacturers viewed their production systems. He shifted the paradigm by moving manufacturers away from producing idealistic amounts of inventory aligned with sales goals to a system that was based on *actual* demand, which inspired the well-known Toyota Production System.

The system was designed to produce vehicles as swiftly and efficiently as possible, relying on producing "only what is needed for the next process in a continuous flow," with some manufacturers keeping less than a day of inventory for certain parts assembled on their production lines. Mr. Ohno's innovation is known now as *Just in Time* or *Lean* manufacturing and is not only used by the entire auto industry, but has high-profile converts in companies like Nike and FedEx. **With Just in Time, manufacturing brought lower inventory costs, larger customer bases, and higher profits — along with more supply chain *fragility*, creating downstream risk to suppliers.**

Supply chain disruptions in 2011 and more recently in 2020 and 2021 laid bare hidden inefficiencies in this approach, perhaps most acutely in the automotive industry. There was the earthquake, tsunami and nuclear meltdown in Japan in 2011. 2020 and 2021 brought more disruptions with record low temperatures in Texas, the blockage of the Suez Canal, extreme congestion at the port of Long Beach, and the profound effects of COVID-19.

But more than any singular cause, as the industry's multi-tier supplier base remained largely invisible to manufacturers, automotive manufacturers were left unprepared. **Even with multi-tier visibility, it would have been difficult to predict that a lack of *semiconductors* was the cause of widespread factory closures.** Regardless, with better knowledge of the network, auto manufacturers could have reacted faster and more deliberately, by proactively identifying key sub-tier suppliers and building relationships to better understand capacities, lead times and ultimately influence allocation.

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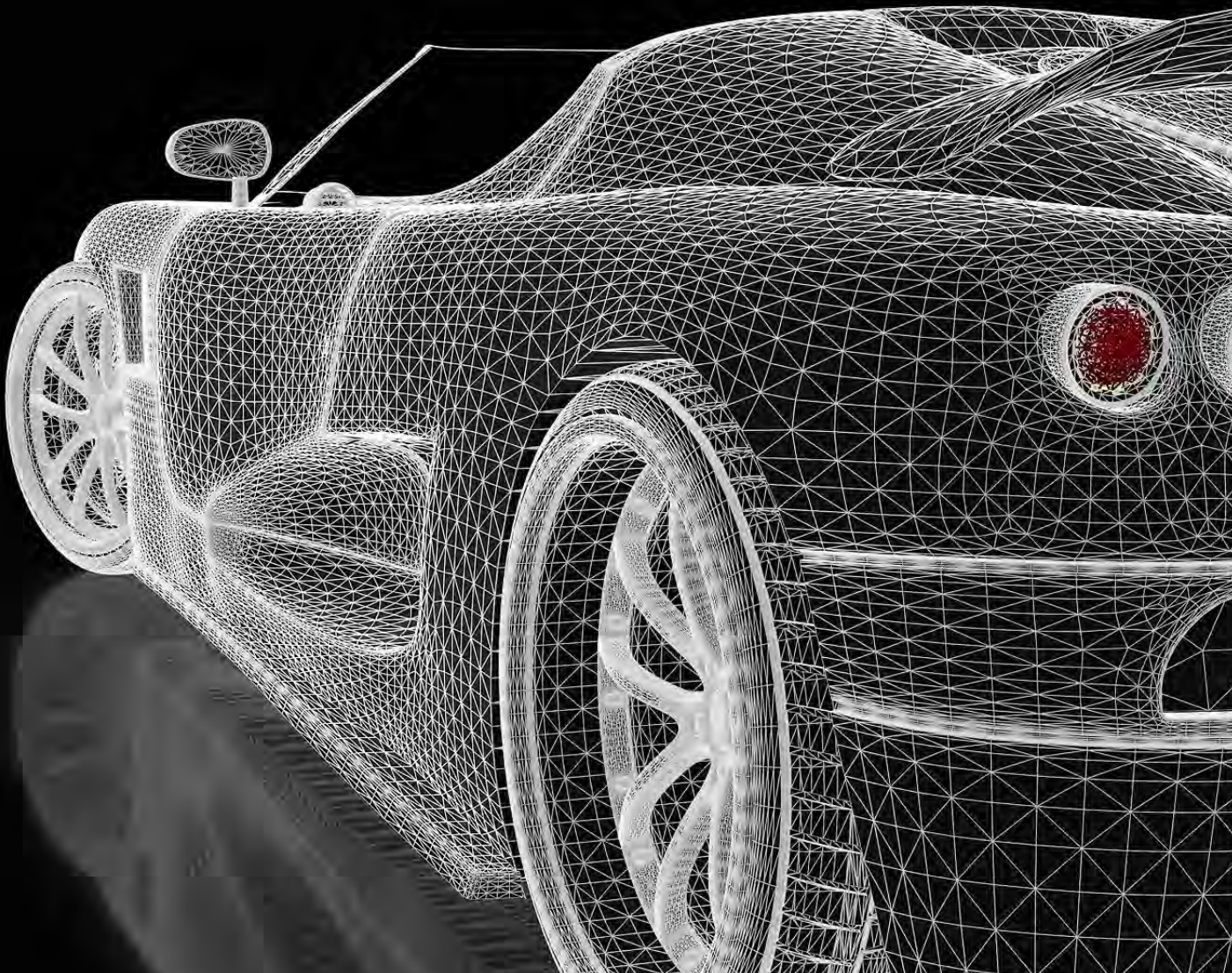
How Fragile Supply Chains Led to Global Mass Shortages

Over the past ten years, cars have heavily relied upon an ever-increasing amount of electronics in order to function. They are in airbags, blind spot sensors, tire pressure sensors, navigation systems, and touch screen displays: electronics now make up 40% of the total cost of cars. At the heart of these electronics are semiconductors — which use small pieces of material such as silicon that are laser-etched with billions of transistors, acting as electronic gateways to generate signals. Up to 3,000 semiconductors are used in the manufacturing of each modern car.

Semiconductors are incredibly difficult to manufacture and modern-day semiconductor plants cost billions of dollars to construct — and not surprisingly, having to switch production lines is exorbitant and time-consuming for semiconductor manufacturers. Therefore when carmakers expected weak sales early in the pandemic, auto-related semiconductor orders were cancelled, which left the industry unable to meet the desires of consumers when demand suddenly rebounded to 97% of pre-pandemic levels in September 2020.

The chip shortage caught many of the world's biggest automakers unaware because it originated several tiers below the top of the supply chain, among the outsourced manufacturers that do not have regular touch-points with auto-makers.

In the fourth quarter of 2020, several auto manufacturers and some of their biggest suppliers began to release statements, raising the alarm that the lack of semiconductors would lead to supply chain bottlenecks. Continental, one of the largest suppliers of electronic car parts released a statement on their inventory, declaring that "additional volumes will only be available in six to nine months." What's more, a surge in working from home caused a spike in demand for consumer electronics, diverting semiconductors away from automotive manufacturers, and a fire at the factory of a major chip manufacturer further compounded the shortage of cars. **"Just" in Time manufacturing became a misnomer.**
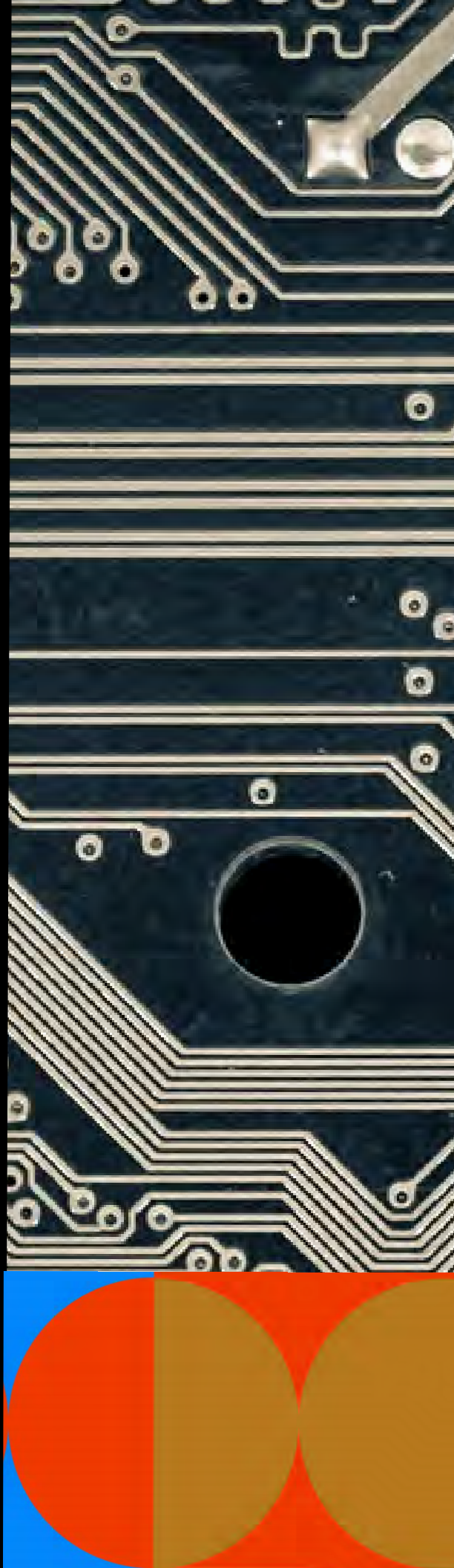
By early spring 2020, dozens of automotive manufacturing plants like Ford, GM, Honda, and Volkswagen had either been forced to shut down or reduced capacity due to the shortage of semiconductors. However, these plant closures were only the last step to be disrupted in the much longer multi-tier, global supply chain.

These companies are part of a network of companies that supply the industry, as well as individual supply chains for specific locations and companies. Examining specific relationships can tell the story of the wider network.

Kostal Group, Huf Group, and Marelli are some of the largest advanced automotive electronic companies in the world. They procure semiconductor components from some of the auto industries largest suppliers, including Murata and Rensas, and supply automotive manufacturers such as Ford, General Motors, BMW, Chrysler and Volkswagen with semiconductor-laden advanced sensors and components.

Supplier Relationships Between Semiconductor Producers and Auto Tier-1s
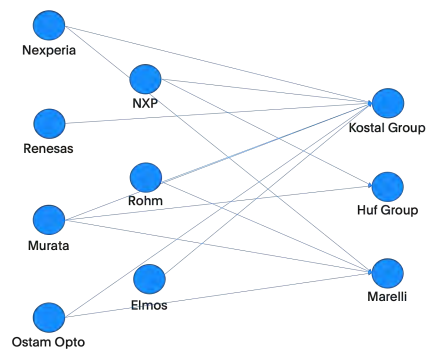

In April 2020 due to COVID-19, Huf, Kostal, and Marelli's global semiconductor imports from manufacturers plummeted by 42% year on year. According to the Altana Atlas, the companies' semiconductor imports maintained negative year on year imports well into the fall of 2020. With time, while the number of semiconductor shipments slowly recovered, the effects of the bullwhip supply chain shock created an inability for manufacturing and the supply chain to meet pre-pandemic demands, which quickly rebounded. This deficit from COVID-19, caused a lag in supply through November 2020, seeding the foundation for supply chain disruption further downstream.

Semiconductor Imports for Huf, Kostal, Marelli

Source: Altana Atlas

Year on Year Changes to Imports
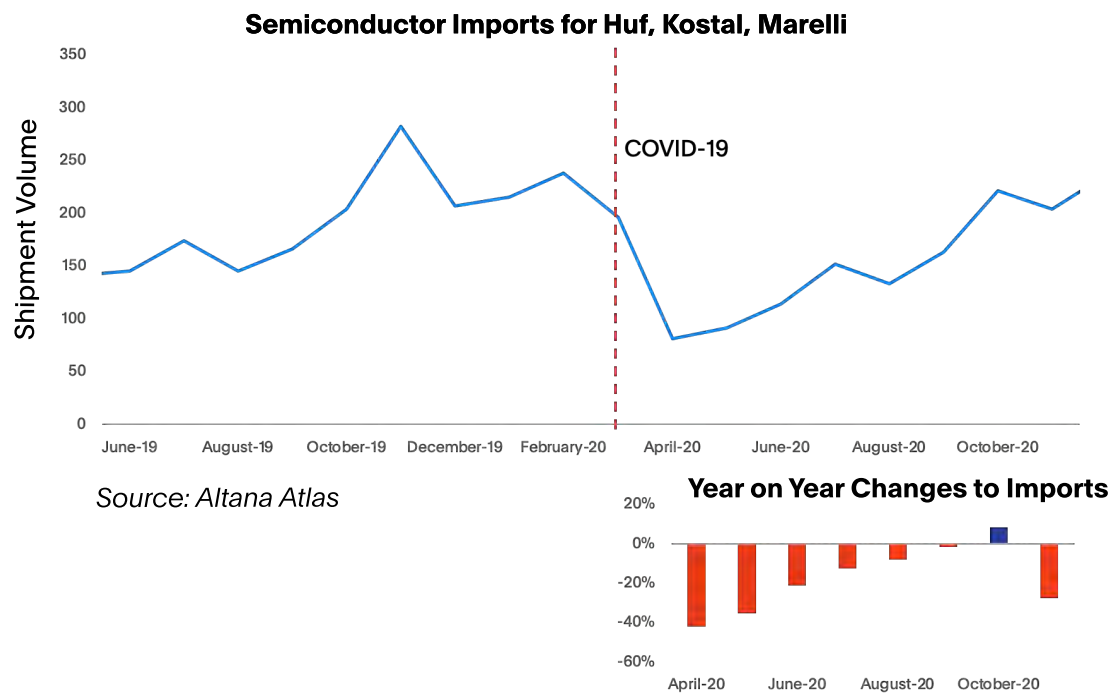
Kostal, Huf, and Marelli play a pivotal role in the production of modern day cars, they produce the electronic control units, switch panels, power application control units, and electric powertrains that have led people to proclaim modern cars to be known as "computers on wheels." **Due to the lack of semiconductor components these companies were unable to supply auto manufacturers with these key components, in May 2020 their shipments to the auto OEMs decreased by 67% year on year according to Altana Atlas.**

Supplier Relationships Between Semiconductor Tier-1s and Auto OEMs
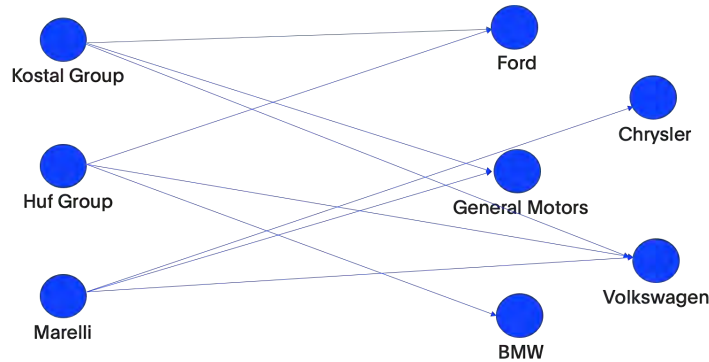

The knock-on effects of the semiconductor shortage and supply deficit from the semiconductor producers to the auto tier ones continued to the next layer of the supply chain. **In August 2020 as people were geared up to buy cars once more, there was still a lag with 34% less shipments from auto tier one's to the auto OEMs compared to the previous year.**


Shipments from Huf, Kostal, and Marelli to Auto OEMs

Source: Altana Atlas
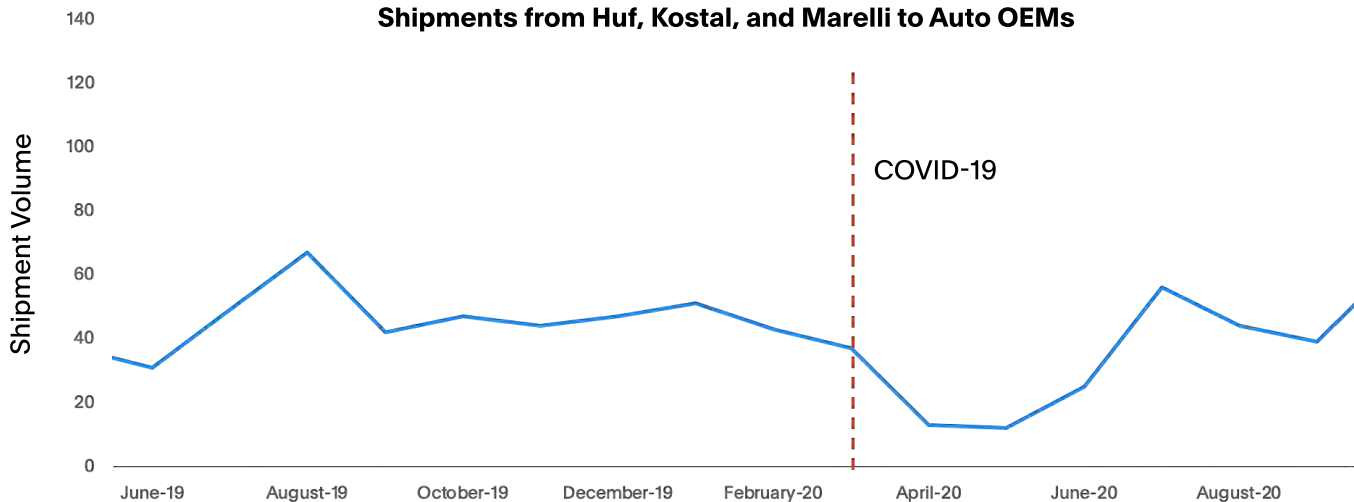
Year on Year Changes to Shipments
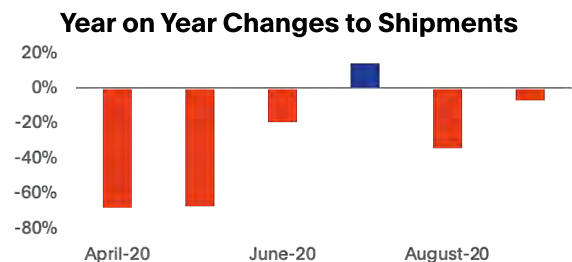
Altana Atlas data reveals the substantial effect of these shortages. Shipments from GM's facilities in Mexico maintained a negative trend for nearly a year after COVID-19 even as demand in the auto industry had mostly recovered by September 2020. **By January 2021 GM's United States production facilities were receiving similar amounts from its Mexican production base, than at the peak of the first wave of COVID-19 in March and April, despite the deficit accumulated from not meeting the strong return of demand.**

Shipments from GM Mexico to GM US

Source: Altana Atlas
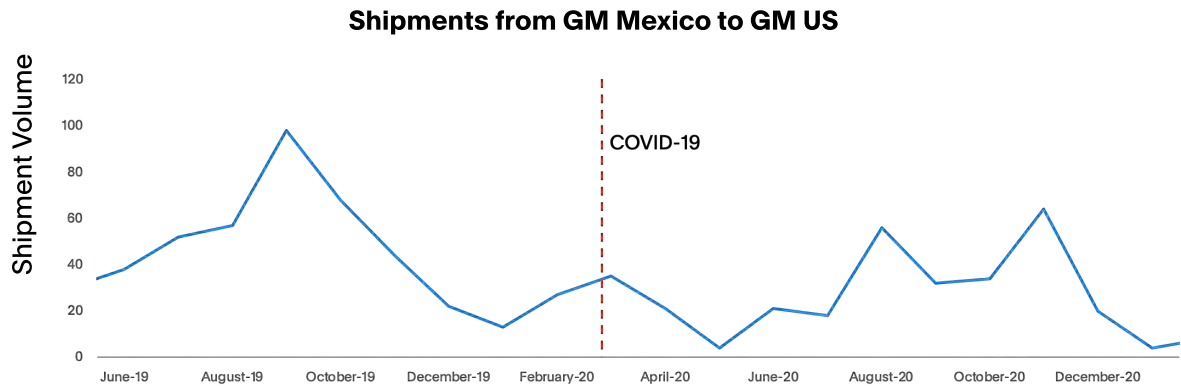
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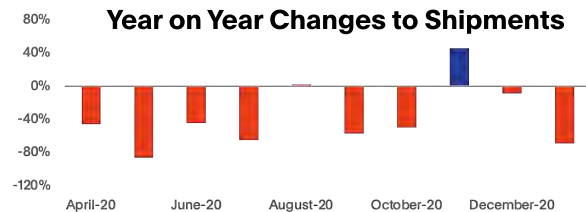
By April 2021, GM had closed down or reduced capacity at plants elsewhere in Spring Hill, Tennessee; Delta Township, Michigan; Ramos Arizpe, Mexico; Lansing, Michigan; Kansas City, Kansas, and Ingersoll, Ontario.

Which car manufacturer weathered the storm of semiconductor shortages well? Ironically, the founders of the Toyota Production System. Armed with the knowledge of how fragile supply chains could be after a devastating 2011 tsunami caused the company to suffer for six months, the company sought to prevent further disruptions. Toyota analyzed their supply chain by working with their tier one suppliers to identify 1500 of their most at-risk parts, many of which were from lower-tier suppliers, that required stockpiling or part alternatives to safeguard them from the risk of shortages. According to a Toyota spokeswoman, this information is kept in a complex database where users can glean information as specific as the names and locations of the companies that make a single headlight that is purchased for one of Toyota's cars, or even the names of the producers of the lubricants used on the rubber pieces of the automotive assembly line. This allowed the company to closely monitor their small suppliers, which warned them if shortages upstream were on the horizon. Since, Toyota has carried almost twice the amount of inventory.

Anticipate the Unknown by Seeing Past Your Tier-1 Supplier with the Altanta Atlas

"The microchip crisis is probably the worst crisis I've seen in the auto industry, at least in my career, in terms of supply chain."
-Mark Reuss, President of General Motors

"We have learned a lot through this crisis that can be applied to many critical components, and it goes far beyond semi chips."
-Jim Farley, Chief Executive of Ford Motor

"The semiconductor crisis is one that everyone in the world could have avoided."
[The problem is many automotive companies didn't rigorously manage their supply chains when it comes to Tier 3 or Tier 4 suppliers.] *"We often don't know the risks down there."* -Ashwani Gupta, Nissan Chief Operating Officer

The auto semiconductor shortages were a large lesson that the inability to have insight into a company's relationships to suppliers throughout their supply chain could have large consequential effects to the financial health of a business. It didn't have to be this way.

In the age of AI, your understanding of the crucial information that affects your business can be brought into sharp focus. McKinsey research shows that 61% of executives said the introduction of AI into their supply chains decreased costs and 53% reported increased revenues. Yet only 12% supply chain professionals are currently using AI.

Toyota's methodical and manual approach to bulking up their database by capturing the information of their suppliers downstream may well be best-in-class, but could still have benefited from the use of AI to automate the multi-tier mapping and create a living map of their supply chain.

The Altana Atlas could have been employed ahead of the automotive semiconductor shortage to connect and extract insights from disparate data across the global supply chain. This living map is the shared source of truth of the multi-tier supply chain network by cleaning, unifying, and enriching data that matters. This portal has enabled governments, financial institutions and global enterprises to utilize billions of data points, stitched together through AI. By connecting to this AI model of the supply chain network, auto manufacturers could have illuminated risks in shipping trends, or seen beyond their direct supplier relationships to pinpoint the suppliers of their suppliers. Monitoring the flows of semiconductors through and away from risky suppliers, they could have been alerted to plan around disruptions upstream and identified alternative suppliers of the same products.

Knowing your network and critical suppliers across multiple tiers in your supply chain provides companies with a first mover advantage. Cultivating trusted relationships with suppliers, whether you source from them directly — or whether they are an important component manufacturer of a sub-unit — is essential during any supply chain crisis. These relationships will foster better collaboration around forecasts, changes in plans, lead times, and ultimately have a higher chance of securing allocation.

How Does it Work?

By connecting to the Altana Atlas, enterprises illuminate and manage their global footprint all the way to upstream raw materials. This visibility is enabled by the world's most complete supply chain knowledge graph - covering 400 million companies, connected by more than 2.5 billion shipments worldwide - which enriches customer data and powers the Altana Atlas. Our "Know Your Network" dashboard creates a multi-tier supply chain view for each product line, pinpoints the facility locations of each link in the supply chain, surfaces risks and recommends mitigation strategies, and harmonizes information on suppliers from both inside the enterprise and from third party sources, such as cyber risk and event risk data providers. In the Altana Atlas "Know Your Network" dashboard, enterprises gain a unified view of their extended supply chains paired with decision support for risk management, planning, and resiliency efforts.

Through a "hub-and-spoke," federated artificial intelligence architecture, we bring our platform to customer data, and not the other way around. Each customer gets its own copy of the Altana Atlas. Through federated machine learning and transfer learning, we provide access to shared intelligence across our client network without the need for pooling or sharing client data. Thus, each client is able to protect their data while tapping into a global network of supply chain intelligence used and informed by the world's largest governments, logistics providers, and enterprises alike.

Be Shock-Proof for Ruptures Beyond Your Borders

General Motors earnings are expected to be $1.5 to $2 billion lower in 2021 due to the shortage of semiconductors. Ford Motor produced 1.1M fewer vehicles during this period, with a loss of $2.5B to their profits. In hindsight, the reasons were obvious — with each step of the supply chain failing to produce the inventory needed at the next tier.

Though predicting the eventual causes of disruption is not always possible, understanding a company's deep supply chain and monitoring for the impact of disruption is not. In 2020, nearly 60% of companies who had non-COVID-related supply chain disruptions reported that the disruptions did not come from their tier 1 suppliers. Yet nearly half of those companies claimed that they did not "analyze the full supply chain to identify the original source of the disruption."

In order for a company to understand its supply chain and manage business continuity risks, it is critical to not only understand your supplier base, but to monitor it in real time in the context of the broader global supply chain network. **Like the innovations that allowed for the introduction of "Just in Time" manufacturing required a deep understanding of engineering and manufacturing processes, tomorrow's innovations will require a similar understanding and visibility into the vast networks of suppliers.** Technology makes this possible. As Mr. Ohno included in his revelatory thesis: "Waste is hidden. Do not hide it. Make problems visible."

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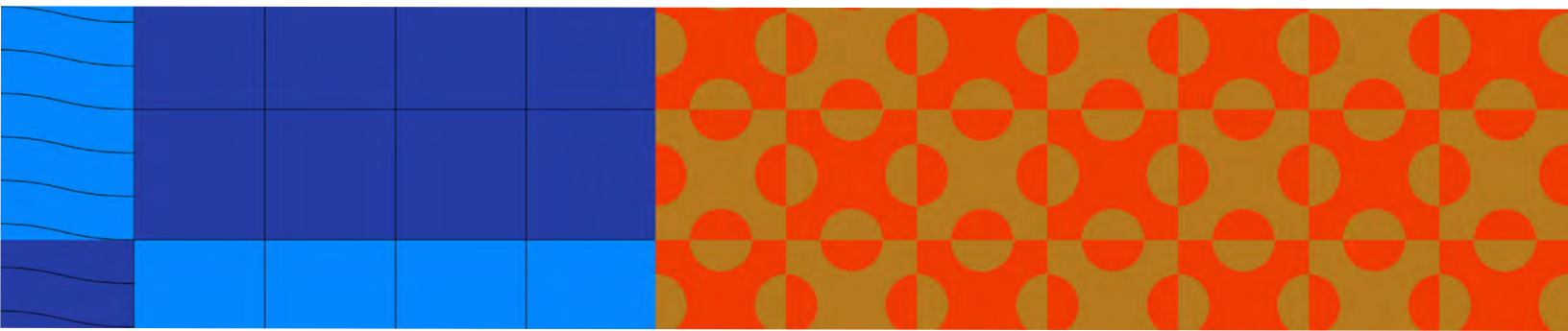
It is time for a better globalization. Our supply chains can be reliable and resilient. We can trust that our goods are produced sustainably. We can prevent security threats and abuses of the international system. We can include more of society in the benefits of trade and capitalism. By creating a shared source of truth on global commerce, we can bring opaque networks into the light, design for resiliency, and build trust.

Altana AI provides a shared artificial intelligence model of the global supply chain to help governments and the private sector build better global commerce. Our platform is a single source of truth on businesses and the flows of goods worldwide.

Learn more at altana.ai or contact us.