



Solving Chip Shortages with **Resilient** **Supply Chains**

Solutions for Automotive, Industrial &
Medical Equipment Manufacturers



Executive summary

Because software-driven architectures touch virtually every industry, there has been an increased need for electronic components, including computer chips, in every industry. The semiconductors market has been volatile over the last two years, and experts predict supply chain challenges across the industry will extend to late 2023 and early 2024.

In the last two years, multiple fires hit several chip factories, Covid interrupted production at existing plants, and the inability to construct new plants has caused massive supply constraints.

Manufacturers that didn't have a direct relationship with chip factories, such as those producing automobiles, heavy industrial equipment, medical diagnostics equipment, and electronics, were greatly affected.

Experts now believe this chip shortage will have a long-term impact on all industries, even those that don't directly relate to the chip manufacturers. There may be relief in sight with the recent passing of the CHIPS Act. This bipartisan law is meant to strengthen manufacturing, supply chains, and national security while investing in research and development, science and technology, and the future of America's workforce.

Tada Cognitive Solutions, along with its partner CGN Global, has helped many customers with short-term and long-term planning to prepare them for supply chain shortages and procure needed electronics components in the most efficient way possible.

The Lasting Impact of Chip Shortages

The semiconductor industry is ever-changing and will continue to evolve. While the status quo never stays the same for long, the ongoing chip shortage crisis shows signs of having a long-term impact on all industries. Demand is growing as quickly, if not more, than planned capacity growth. Demand drivers include 5G, artificial intelligence and machine learning (AI/ML), and internet of things (IoT).

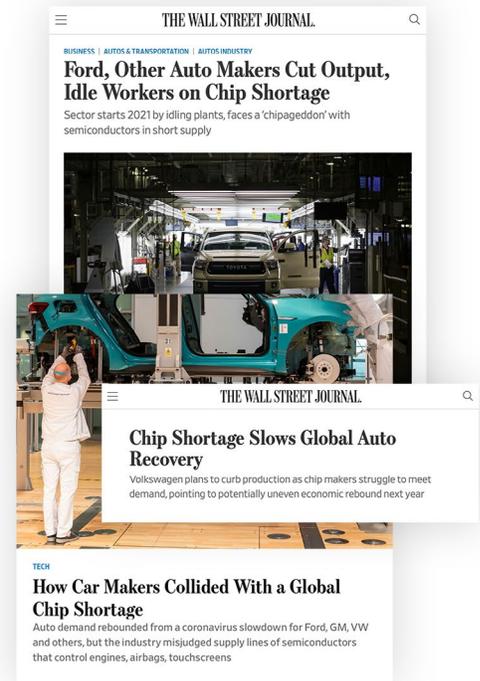
Interestingly, those without a direct relationship with the chip manufacturers, such as automakers, medical device makers, and other industrial manufacturers, are significantly impacted. The chip shortage has an even more considerable influence on the industrial equipment industry since a costly piece of industrial machinery may lie idle because of a few dollars' worth of electronic components.

Chip manufacturing is geographically clustered and needs to be distributed across more regions. Outside parties are also strategizing how they can bring chips to US shores. On January 21, 2022, the White House released a fact sheet that included an excerpt from a Semiconductor Industry Association (SIA) report highlighting that since the beginning of 2021, the semiconductor industry has announced nearly \$80 billion in new investments in the United States through 2025.

Some of the projects listed include a \$17 billion Samsung factory in Texas, \$30 billion in investments from Texas Instruments, and a new \$20 billion Intel factory in Ohio. In 2020, prior to the pledges included in the SIA report, Taiwan Semiconductor Manufacturing Co (TSMC) announced plans to build a \$12 billion semiconductor facility in Arizona.

While these efforts are encouraging, funding and building a new semiconductor fabrication plant is at least a five-year process, indicating this chip shortage will likely plague the industry for many years.

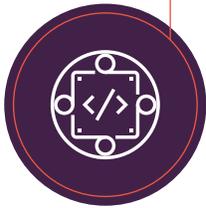
Looking ahead, the chip manufacturing industry and supply chains, as they currently exist, are vulnerable to disruptions again, making shortages inevitable. Continued innovation is necessary to be more adaptive to future supply chain-driven disruptions.



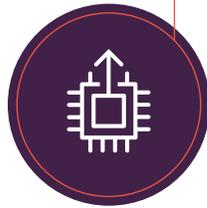
What caused this sudden chip shortage issue?

Many forces shaped the current chip shortage, whether technical, economic, cultural, or political. Here we cover some of the main factors that led to today's crisis.

1 Software Defined Infrastructure



2 Increased Use of Electronics



3 Poor Supply Chain Planning



4 COVID's Unpredictability



5 Strained US/China Trade Relations



Software Defined Infrastructure

Over ten years ago, the legendary entrepreneur Marc Andreessen famously said, "Software is eating the world." He predicted that software companies would take over the economy's future, and he wasn't wrong. . Gartner predicted that more than 20 billion IoT devices would be deployed by the end of 2020, and many of these will be deployed for healthcare applications.

Companies realize they need to think about how to digitally transform their business if they want to stay competitive. Satya Nadella, the CEO of Microsoft, put it best when he said, "To be a software company, you must also think about the chips that run the software."

"Every company is a software company. It's no longer just about procuring one solution and deploying one. It's not about one simple software solution. It's really you yourself thinking of your own future as a digital company."

In a CNBC interview with John Fortt, Mark Fields, ex-CEO of Ford, put it aptly, "Semiconductors are the forks and knives that help you eat the software."



Increased Use of Electronic Components

If you had a chance to replace an older car with a newer model, you would have noticed how every system in the new vehicle is driven electronically, including fuel injection, braking, and entertainment systems. As more and more people start buying electric cars instead of combustion engine automobiles, the number of electronic components per car increases tremendously. In a recent article from Jabil Electronics, they put this problem into perspective,

"Think of today's standard combustion engine car, which as somewhere between 2,000 and 3,000 capacitors. As the electric vehicle gains market share, this creates an overwhelming growth in content with as many as 22,000 multilayer ceramic capacitors required in a single car. This number will continue to grow as more functions become electrified."

This example is merely one area where chip usage will increase exponentially. Software-driven architectures are driving increased use of electronic components for all industries, not just automotive. As a result, the demand for chips is snowballing.



Poor Supply Chain Planning

Manufacturers use lean inventory practices to increase their profitability, but this strategy does not work when demand is upturning. A demand upturn coupled with supply constraints due to chip shortages is a logistical nightmare for automakers, medical device makers, and industrial manufacturers in need of chips.

What makes matters worse for these industries is that most planners only optimize their supply chain around Tier-1 suppliers. Electronic component manufacturers are often Tier-3 and Tier-4 suppliers to industrial equipment manufacturers. Thus, many companies lack visibility into the tiers where chip shortages occur.



Covid's Unpredictable Influence

There has never been an event that has plagued modern-day society like Covid. It has touched every nation and reshaped business operations both locally and internationally. Among many other things, Covid has exposed issues with supply chain planning or lack thereof. Many widely held assumptions have been questioned, forcing manufacturers to rethink how they manage their supply chain.

The chip shortage became a ticking time bomb after a few unrelated supply chain disruptions at the beginning of 2020 and as recently as 2022. These events included a fire in a Japanese microdevices factory, a shortage of shipping containers, and global air shipments combined with another fire in 2021 at a Renesas Electronics Corp. in Hitachinaka, northeast of Tokyo.

When the pandemic caused a precipitous drop in vehicle sales in the spring of 2020, automakers and other equipment manufacturers cut orders for everything, including the chips. When demand for passenger vehicles rebounded, chip manufacturers had already committed to other suppliers.



Strained US/China Trade Relations

The relationship between the US and China is strained at best. The two countries differ on several key issues, one of which is trade laws and regulations. This tension escalated when the Trump administration placed tariffs on Chinese imports, causing China to halt imports of all American agricultural goods. They also put restrictions on exports to Semiconductor Manufacturing International Corporation (SMIC), China's most advanced computer chips maker, a measure that deepened the technology conflict between the tech giants in both countries. Chinese companies started stockpiling chips to prepare for the ban and cut off American companies from chip sources.

Historically, most electronic components are acquired through distributors by original equipment manufacturers (OEMs), and these distributors usually reside in China. Since Chinese distributors have few relationships with US OEMs, they will likely overcharge them for their inventory.

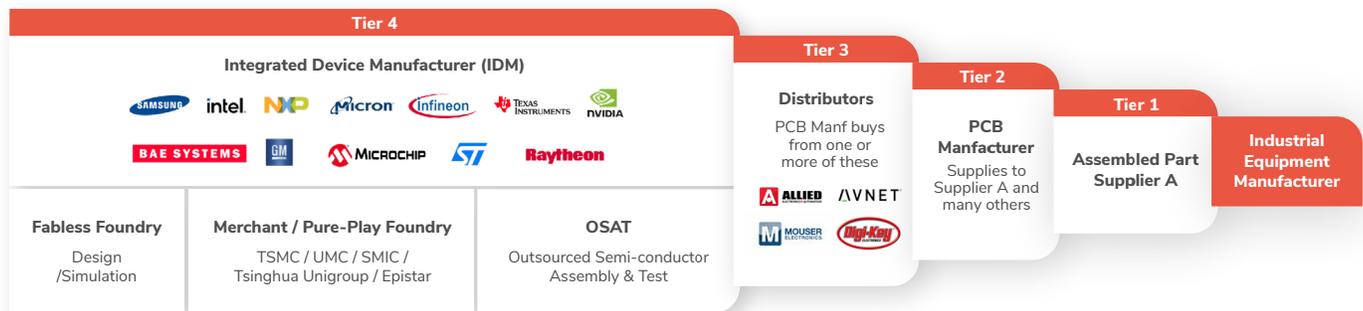
Understanding the Chip Industry

Before looking at solutions to combat chip shortages, it is worth understanding how the chip supply chain works for industrial manufacturers. Learning about the chip manufacturers' perspective can also help chip-removed industries like automotive, medical diagnostics, and industrial manufacturing remodel their supply chain strategy.

Chip Supply Chain Tiers for Manufacturers

Since most industrial equipment manufacturers order assembled components from their Tier-1 suppliers, they have no visibility or relationship with their other Tier suppliers. The following diagram is a typical example of how far removed an industrial equipment manufacturer can be from an integrated device manufacturer. But in some cases, chip suppliers may even be removed 5 to 6 degrees from the equipment manufacturer.

The current lead times for chips vary between 50 to 100 days.



Chip Manufacturer Perspective

Taking Covid out of the equation, the public demand for semiconductor chips is growing so rapidly that chip makers need 4-10 years to expand their capacity adequately. The potential economic downturn in the next decade makes chip manufacturers hesitant to expand at a pace that will meet the short-term demand.

Previously, chip distributors aggregated orders from many customers. With Holt-Winters forecasting, a chip distributor could accurately predict the general chip consumption rate and plan orders for various markets, including customers with just-in-time orders. This process is no longer feasible. Now, distributors aggregate the orders, and chip manufacturers tell them there is no way to meet demand on time. Distributors have no choice but to prioritize real hard purchase orders (POs) over speculative forecasts, leaving companies unwilling to forecast 12-24 months in advance and placing blanket POs in a vulnerable position.

Many auto and heavy industrial manufacturers are unwilling to acknowledge this perspective or its long-term implications. Just-in-time ordering is not feasible when materials and components are in high demand.

Secondary chip markets usually sell chips, and many automakers are not buying chips directly. Instead, they purchase their chips through a multilayer of supplier tiers, each of whom is unwilling to speculate and bear the financial risk associated with customers who refuse to order 12-24 months in advance.

Many companies that consider themselves non-electronic need to start viewing themselves as electronic. If chips are in your products, you are inadvertently a part of the electronics business. Therefore, you must track your chips' lead times and place orders covering your business long term.

Toyota predicted chip shortages would occur in 2011 and moved away from a just-in-time methodology to a stockpile methodology called "RESCUE."

Today's supply chain is complex and requires a detailed strategy warranting the support and input of the company's upper management. Creating a master chip strategy is not a singular solution. To accomplish this, you need to completely rethink and restructure the current state of your business models.

Solution to the Chip Shortages

At Tada, we have been solving shortage-related supply chain issues for many of our customers. Here is the layout of our process that we hope will provide insight into where to start.

Our plan consists of two parts:

- Emergency Corrective Action Plan (ECAP)
- Preventive Corrective Action Plan both Interim and Long Term (PCAP)

Tada's Emergency Corrective Action Plan (ECAP)



Tada's PCA includes many components detailed in the diagram above.

Merging our 25+years of experience working in the supply chain business with our engineering capabilities, we start with an Emergency CAP that includes the following steps:

1. Leverage our multi-tier framework to understand part taxonomy, critical chips, and their multi-tier suppliers
2. Understand demand flow and coverage for the next few weeks
3. Work with Tier 1 suppliers to ensure they are allocating the right capacity for the OEM
4. Find capacity availability of alternative chip revisions and alternative supply sources

After regaining stability, we start to implement our Preventive CAP.

Tada's Preventive Corrective Action Plan (PCAP)

Tada's CAP infrastructure includes many applications. Here are a few that have been used with chip shortages:

Multi-Tier Supply Chain Mapping and Collaboration

Minimizes component stores and their associated costs during normal supply conditions. Our Multi-tier collaboration solution connects processes, companies, and partners, providing much-needed visibility and collaboration to better manage risks in regular and disruptive cycles. Here is how we do it:

- Tada collects data and analytics across the ecosystem in an automated fashion, thus eliminating day-to-day management of excel files and manual report-generation activities
- An ecosystem network map is created to provide end-to-end supply chain visibility and risk resilience at a part number level from OEM to Tier 1 to Tier 2
- Proactive demand coverage analysis considering inventory, PO, and ASN across all partners

Supply Chain Intelligence Services

Provides early problem detection and preventative planning that minimizes risk and cost.

Taxonomy

Minimizes the expense of preventative buffer stock by using Tada's multi-tier framework to understand part taxonomy, critical chips, and their multi-tier suppliers.

Downstream Safety Stock

Minimizes the cost associated with preventative and reactive buffer stock per component

Unleashing the Power of Data with Tada's Digital Duplicate



Tada's leading Digital Duplicate® technology continuously integrates data, people, and process partners to deliver real-time visibility, orchestration, and collaboration across the entire supply chain ecosystem. The no-code platform unleashes the magic of data with unparalleled speed at an unprecedented scale, connecting data silos within their own and their partner enterprises. It then creates a unique data fabric and persona-based command center to increase revenue, and drive efficiency.

Using the patented Digital Duplicate® technology, Tada creates a digital twin of every process, product, part, supply chain persona and supplier, connecting them in a network that replicates your supply chain model.

Tada then binds your digital twins into a data fabric. Instead of replacing existing systems, Tada Now creates a data fabric that is a self-updating network harmonizing over hundreds of their siloed data systems, including CRM, ERP, and some mainframe data sources.

From there, Tada creates workbenches for each supply chain persona. Each workbench has the analytical reporting and collaboration tools needed to sync action planning across personas. These workbenches get blasted to users using our no-code platform.

Tada offers a three-tier data fabric mode connecting, cleaning and consuming data. Built on a microservices architecture, Tada provides various APIs for data integration, domain services, model services, dictionary services, visualization services, business design services and advanced analytics services.

According to Gartner, by 2023, organizations utilizing active metadata, machine learning and data fabrics to connect, optimize and automate data management processes dynamically will reduce time to integrated data delivery by 30%.

“At the stage of maturity, there will no longer be a separation between the digital supply chain twin and the E2E control tower – just becoming digital supply chain twin. Organizations using the integration of these technologies should get ahead in digitizing their supply chain initiatives.” - Gartner

Conclusion

Chip shortages will be around for some time to come, and this problem is only the tip of the iceberg as many other raw materials like steel and plastics will also be constrained.

The demand bullwhip and supply shortages are exposing shortcomings in the way supply chains have been traditionally handled, but supply chain leaders no longer have to struggle to integrate data from various disparate systems and get real-time end-to-end visibility and actionable insights for their teams.

Tada's Multi-Tier Collaboration system has helped many customers with not only chip shortages, but also other supply chain issues. Our cognitive intelligence platform synthesizes your business model, operating model and performance metrics data from disparate sources to create a Digital Duplicate® of your business.