AUTO COMPONENTS

A car not made is a car never sold: inside the chip shortage that has got automakers in a pickle

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People visit Taiwan Semiconductor Manufacturing Company (TSMC) booth on August 27, 2020 in Nanjing, Jiangsu Province of China.

Synopsis

Indian as well as the global automotive industry is losing money in the billions. Reason? Not enough semiconductors to go around satiating the demands of both automakers and the consumer-electronics industry. That's just the start of a bigger trouble. It is possible that the worst is yet to come.

Novelist Arthur Hailey's 1971 bestseller, ***Wheels***, is a thinly disguised take on the lives and times of

executives and workers of **Ford** Motor Company in Detroit of the 1970s. One of the things Hailey brings out about the **auto industry** is its absolute obsession with keeping the assembly lines running, no matter what. Stopping it is not an option.

The reason is simple enough.

A car not made is a car never sold – here, time is quite literally money.

Assembly lines standing idle is horrible news for auto workers, too. Their wage package is made up of shift allowance, overtime, and miscellaneous incentives. For automakers, it also triggers a quality issue — it takes time for assembly lines to rediscover their mojo and buzz once again with that unmistakable humdrum of efficiency.

So, it was obvious that there were plenty of sighs of relief when Ford's Chennai plant reopened on January 21 this year. The gates opened for 1,800 workers and a single shift that day. This after a 15-day long break enforced by a global shortage of semiconductors, which Ford conveniently combined with a five-day break for local festival, Pongal.

Ford might have thought that the crisis was over, but the reality was far from it. Automakers are continuing to lose billions across the world's assembly lines because of a shortage of semiconductors, the smallest of the components. Modern cars have between 50 and 150 electronic-control units that may carry multiple semiconductor chips. All this at a time when the industry has been navigating a shift to electric vehicles (EVs), and just as the demand was recovering after a crippling pandemic.

Analysts have dubbed it the great chip shortage of 2021.

Components affected include microcontrollers and integrated circuits housed inside electronic control units (ECUs) that steer, well, pretty much everything in a vehicle. These include engines, fuel injection, braking, electronic stability control, airbags, automatic

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transmissions, reverse-parking sensors, advanced driver-assistance systems, telematics, in-car infotainment systems, lighting, electric power steering, temperature control, power windows, remote key functions. Whew.

Barnik Chitran Maitra, managing partner, India at management-consultancy company Arthur D Little, says just two companies — **General Motors** and Ford — will lose between USD4 billion and USD5 billion in 2021 due to the chip shortage.

It has also become emblematic of a tug of war between industries — consumer electronics, communication, and automobiles. The mess is influenced by the worsening relationship between the US and China through the Donald Trump era.

Alarmed by the shortage and under pressure from the US tech and auto-industry lobbies, US President Joe Biden signed an executive order late last month that will trigger a 100-day review of supply chains in semiconductors. In January, the White House had put pressure on Taiwan and its heavyweight semiconductor maker, TSMC, to help find a solution.

So how did it all come to this point?

Too fast. Too furious. Too little.

Reason #1 — *Miscalculation:* Much of the mess is self-inflicted.

Automakers, who were less than optimistic of a recovery, massively trimmed orders for microcontrollers and other electronics that they had placed prior to the pandemic. Their belief: recovery of demand would be slow. Volumes would not be high as the sector rebooted, or so they thought. But demand rebounded, and how. Suddenly, automakers found themselves in a desperate scramble for electronics from their tier-1 and tier-2 suppliers, but further down the chain, things had changed by then.

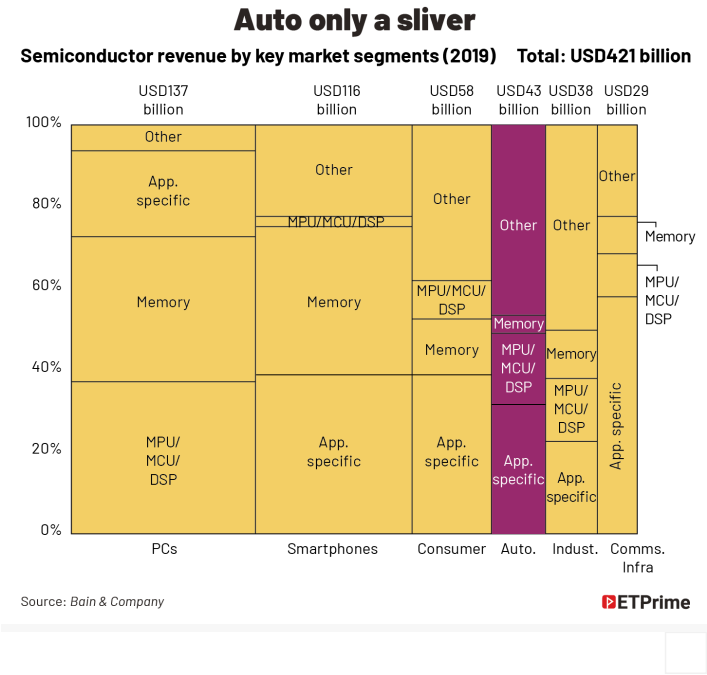
Reason #2 — *Supply diversion:* Semiconductor manufacturing is an extremely complex process, influenced heavily by the state of the global economy.

It is an industry that runs on a four to five-year boom-bust cycle. This industry was coming out of a demand downturn in 2019-20, when Covid-19 hit the world. Even as demand started contracting for auto, a whole host of industries, including communications infrastructure, electronic-device manufacturing, and medical equipment, went into a demand mode. It was at this juncture that order cancellations from the auto industry came flooding in. They were even trying to return products, at one point.

The chipmakers, who form the heart of the electronics-supplier ecosystem, diverted much of the newly opened up capacity to sectors like consumer electronics that never really missed a beat during the pandemic.

This meant that even without the auto industry, chipmakers have been doing just fine while the pandemic was wreaking havoc on the global economy. Global semiconductor sales hit USD439 billion in 2020, up a massive 6.5% from USD412.3 billion in 2019, according to Washington DC based Semiconductor Industry Association.

Auto, which accounts for just 10% of the semiconductor market, has neither the demand heft nor the deep pockets that most electronics manufacturers boast to wrest capacity back. Simply put, automakers are neither high-volume nor high-margin customers for chipmakers, and that means they don't really have the requisite muscle in the electronics supply chain.



Reason #3 — *Fabrication rigidity:* Semiconductors have an extended supply chain. An automaker will work with a tier-1 supplier like Bosch or Continental who contracts out to someone like a TSMC in Taiwan. By late 2020, many foundries were optimised to make semiconductors for phones, laptops, and gaming devices. That has cascaded into a shortage of silicon, especially for microcontrollers that are manufactured on the larger 28 nanometre technology. Reworking foundries, where chips are manufactured, back to suit automotive requirements takes time and is capital intensive.

As a report from consultancy firm Bain & Company points out, “Semiconductors are designed to specific design rules for a single node and foundry. Any change to electronics often requires requalification of the entire system.”

Reason #4 — *An issue of size:* Foundry capacity hasn’t kept pace with demand in 200mm wafers, as cutting-edge high-margin chips are fabricated from 300mm silicon. But while they may not be the bleeding edge, the demand for chips built on 200mm wafers has been growing – think IoT, 5G, analog processors, power-management devices, MEMS (micro-electro mechanical systems) devices, image sensors, RF (radio frequency) components, and more, and capacity for

that has become constrained. Dale Ford, chief analyst, at the Electronics Component Industry Association, wrote in a January 2021 report that "Large foundries like TSMC have been slow to add new 200mm capacity."

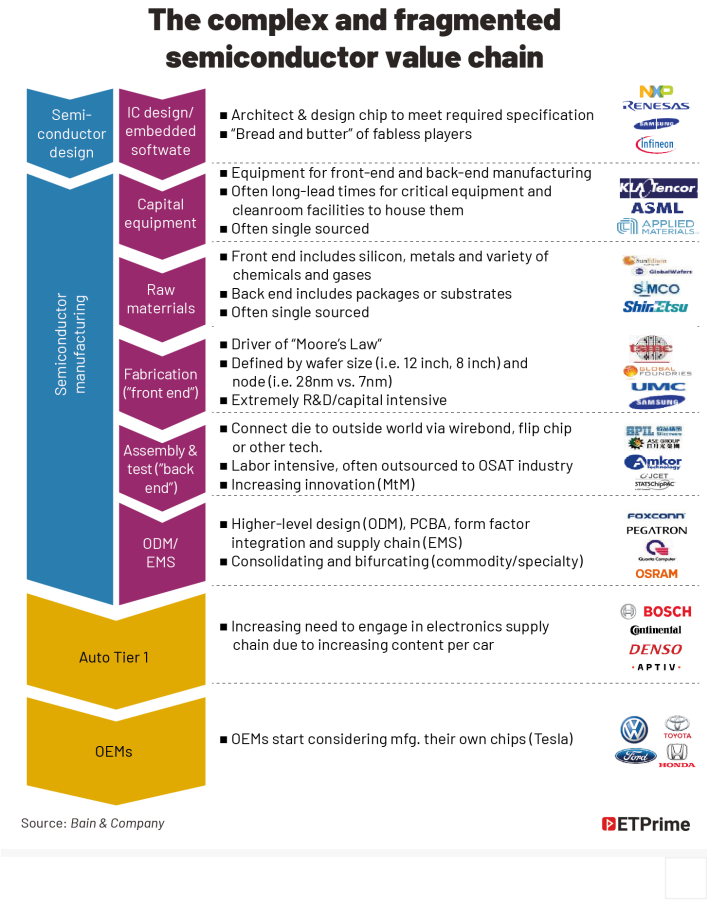
Reason #5 — *Scaling time:* Scaling up and scaling down to suit demand do not come easy in chipmaking. As Peter Hanbury, partner at Bain & Company and the leader of its manufacturing-excellence practice in America, points out: In the semiconductor industry, products take longer to design and build.

In the best of times, Silicon-based designs can have a lead time of 10-26 weeks depending on the complexity of the circuit. If it's a Gallium Arsenide-based circuit, the lead time can be even more.

The low number of suppliers doesn't help. Over time, there has been consolidation and the number of foundries reduced. At 28 nanometre (used to make microcontrollers), there may be just five-six foundries globally. At 7 nanometre and 5 nanometre – the level of microprocessors – there are even fewer.

Even if automakers are willing to pay a premium, capacity addition in chipmaking takes two-three years with a product throughput of two-three months. This, as opposed to days that the automotive industry, many of whom have been bred on a supplier base captive to its zero-inventory model, is used to.

There may be some fundamentals about the semiconductor industry that automakers, who don't necessarily deal with the supply chain beyond tier-1 and tier-2, haven't quite wrapped their heads around. One is the markedly different timelines in the design to manufacturing cycle of chips.



Reason #6 *— Chips reflecting geopolitical uncertainty:* As in much of tech, there's geopolitics involved, too. Former US president Donald Trump's trade war with China has deepened the wedge between the two biggest economies in the world. This has had far-reaching implications.

According to Bain & Company, the Taiwanese TSMC, the undisputed numero uno of semiconductor manufacturing globally, is responsible for 80% of auto microcontroller units. While Taiwan is a US ally, its geographical proximity to mainland China, its problematic relationship with Beijing, and the increasing Chinese military presence in the South China Sea all add to a sense of supply-chain uncertainty.

On its part, the US has also been making moves to become less reliant on other countries for silicon. Much of the global semiconductor foundry industry had consolidated around countries in East Asia, and that made sense in the era of globalisation. But with cracks appearing in that globalisation model,

countries like the United States are trying to rebuild their chip-manufacturing capability at least for some critical functions. This is not just because of the ongoing shortage and the resultant hit on the economy, but also because of worries over cybersecurity.

The worst of fears is that silicon, which is at the core of almost everything, can be embedded with software that can potentially be used to spy or to wrest control in critical systems. Think the West's pushback on Chinese telecom-equipment maker Huawei and now multiply those concerns to everything with a chip. There is also talk of increased scrutiny and testing of silicon that comes from geographies like China.

Meanwhile in its 14th five-year plan, announced earlier this month, China said that over the next half decade, it will focus on building muscle and capability on what it calls frontier technology including semiconductors. USD1.4 trillion has been earmarked with a goal of making sure that in five years, 70% of the chips used in China will be made locally.

Rishikesha T Krishnan, director, IIM Bangalore, says India should make a move as well in this direction and try to encourage local industry to sign joint ventures with global semiconductor companies. Opening facilities for fabricating automobile chips could be a move in this direction, and building on the current global theme of diversification of supply.

"Just two companies - General Motors and Ford - will lose between USD4 billion and USD5 billion in 2021 due to the chip shortage."

— Barnik Chitran Maitra, managing partner, India at Arthur D. Little

A chip-sized hole

The worst of the crisis may be yet to come. As Dale Ford wrote in a January 2021 report, "As demand for electronics and electronics components grows in 2021, it is anticipated that supply-chain pressure will build."

Bain & Company feels the same. “We see multiple additional events on the horizon, with the potential of similar or worse disruption to the industry,” it says in a report.

That is ominous for automakers.

Cars are getting smarter, connected, and more dependent on electronics than ever before. This will be accentuated as the shift to EVs becomes even more pronounced over this decade.

It isn’t as if the industry can wean itself away from electronics. A report by the Automotive Component Manufacturers Association (Acma) and Frost & Sullivan on future of automotive electronics says that with the growing number of sensors and ECUs, the overall cost of electronics in a car is expected to rise from 30% in 2017 to 45% by 2030. It is estimated to be around 40% currently.

There may be a need for a recalibration of how auto companies look at supply chains. Hanbury from Bain says the auto industry typically pushes a lot of its inventory risk onto its supply chain. Because semiconductor components are not unique to the automobile supply chain, such sort of risk sharing becomes much harder to pull off in the new electronics-heavy automobile era.

The times, they are a-changin’.

Part 2: Strategies adopted by automakers to adjust to the new world

(Graphics by Mohammad Arshad)

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Great analysis!

Yatish Rajawat 1 day ago

While auto companies have mismanaged this supply chain, Indian two wheeler companies like hero honda, bajaj seems to have managed better. Their numbers are bigger, ECU are simpler and supplies assured

Ranjith Er 2 days ago

Informative Article.

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