

# RESEARCH ON THE LEVEL OF RESILIENCE OF THE MICROPROCESSOR MARKET FOR THE AUTOMOTIVE INDUSTRY AND WAYS TO RESPOND TO AN UNEXPECTED EVENT

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*ABSTRACT: Most present microchips are found in autovehicles. In present the world is underway of a "microchip shortage". Microchips are made of a set of interconnected electronic components etched, onto a chip of semiconducting material (silicon). COVID-19 started in 30 January 2020, forcing employers to fire/ send home employees and shutting imports. The Automotive Industry underestimated the demand for cars. Cost and demand of silicon skyrockets, as a result of it being needed for COVID-19's vaccine. Majority of manufacturers of microchips are import based. Automakers have to cut back the production at least 20% because of lack of semiconductor chips. Over 10 companies in the Automotive Industry are expected to lose over \$61 billion in earnings and over 6.5 times delay compared to the normal time. The United States president Joe Biden announces a federal relief and meetings with executives of the automotive industry. Hyundai, Toyota and Tesla start making their own microchips.*

*KEY WORDS: micro-chips, automotive industry, COVID-19, CHIP SHORTAGE, \$61 bilion, federal relief.*

## 1. Introduction

Microchips are everywhere now, present in our quotidian lifestyle and indispensable. The most common microchips that you may know about are the ones in our phones and cars. I would like to talk about the microchips in the automotive area. In order to better understand what is happening in the world right now with the famous „CHIP SHORTAGE” we would firstly have to learn about microchips (in the automotive industry).

- **What are Microchips?** Microchips are made of a set of interconnected electronic components such as capacitors, resistors and transistors that are imprinted or etched either onto a tiny, wafer-thin chip or onto a chip of semiconducting material, such as silicon or germanium. Microchips are usually used for the logic component of a computer, known as the microprocessor, or for the computer memory, also known as RAM chips.
- **How are Microchips fabricated?** They are built layer by layer on a wafer of a semiconductor material. The process of building this layers is named „photolithography” which uses different states of aggregation such as: light, gases and chemicals. First a layer of silicon dioxide is applied to the surface of a silicon wafer, then the said layer is covered with a photoresist. A photoresist is a light-sensitive material used to form a patterned coating on a surface using UV light. The light shines through the pattern, and it hardens the areas exposed to the light. Gas is used to etch into the remaining soft areas. Conducting paths between the components are created by overlaying the chip with a thin layer of metal, usually aluminum. The photolithography and etching processes are used to remove the metal, leaving only the conducting pathways.
- **How are Microchips used in the automotive industry?** „Microchip Corporation”, one of the biggest microchip makers in the business of automotive industry describe the automotive microchip use as following: „Modern vehicles are the sum of tens of thousands of components, each one of which has to be designed smart, connected, and secure [2].

- **Microchips could be found in: (the Infotainment, Powertrain/HEV/EV, Body Electronics, Advanced Driver Assistance Systems) systems: Telematics, Audio Amplifier, Head Unit, Cooling fan, DC/DC Converter, HEV/EV Inverter, Car Access, Heated/Cooled Seats, Ambient Lighting, LiDAR, Surround-View Cameras.**

## 2. The Current State

Due to the Covid 19 Pandemic, the automotive industry is projected not only to lose money, but even leave employees jobless. „To put it plainly, the Coronavirus pandemic has been the primary cause of the chip shortage. The reasons why are numerous:

Global-wide shut-downs caused production to freeze up and stock to drain.

The demand for electronics boomed, increasing competition between Tech Giants and Automakers for the dwindling number of chips.

Automakers underestimated consumers' demand for cars in the second quarter of 2020 and decreased production, further spiking demand.

The cost of silicon has risen substantially due to the mass production of the COVID-19 vaccines; the silicon needed to make the vials is the same as the silicon used to manufacture chips and personal computers” [3].

Most of the Automotive Industry companies worked with Asian based companies that would make these microchips, having this in mind we can base this as a factor of the problem as well. At the end of 2020, in the last quarter of the year (Q4) Ford Motor Company wasn't able to make enough cars that resulting in having to cut back the production on different models of the brand's products. In the beginning of the 2021 year (Q1) General Motors Company had to revise their earnings to keep the situation under control because the company realised that they would be unable to make the cars that they needed to sell this year.

This means that the automotive industry companies (manufacturers) can lose money, interests, stock market value, and buyers. Also, all the automotive industry companies are expected to take a Q1 to Q3 (of the 2021) stock market hit because of this inconvenience. (...)” aftershocks of the global shut-down continue to impact businesses significantly. These ongoing issues are numerous, however, one of the most pressing of them all is the shortage of semiconductor chips.” „According to the Semiconductor Industry Association Global semiconductor sales increased 6.5 percent in 2020, demonstrating a rapidly growing demand for chips from Automakers and Tech Giants.” The website also declared this: „Companies like Ford Motor Co and GM are projected to each lose over \$2 billion in earnings and may be forced to reduce production by upwards of 20%. The chip shortage is shaping up to be the first obstacle of many for the Electric Vehicle (EV) industry.” Automotive industry manufacturers that are having the same issues include: Chevrolet, Lincoln, Jaguar, Land Rover, Range Rover, Jeep, Nissan, Dodge, Mercedes Benz.

[4] „ General Motors has shuttered three plants in North America from Feb. 8 to at least mid-March, affecting some compact SUV production. Ford Motor Co. has seen production disruptions in the past several weeks to its popular, highly profitable F-150 pickup, as well as some SUVs and cars. Stellantis, which used to be called Fiat-Chrysler Automobiles, idled plants in Mexico and Canada, building the Jeep Compass and Chrysler 300, Dodge Charger and Dodge Challenger, for much of January. It has been running normal production in February as it closely monitors the supply chain.” [10]( Detroit Free Press, Jamie L. LaReau, „As chip shortage cripples auto production, Biden steps in” 09-May-2021) [7].

The supply chain has been disrupted significantly and in unprecedented ways over the last year, this could make the automotive industry specialists to even speculate that the „The shortage could last two years, according to Pat Gelsinger, CEO of Intel, the largest chip maker in the U.S.” [5].

Due to this unforeseen event, Joe Biden, the president of the United States of America stepped in to help this automotive industry will get a federal relief because of this shortage of chips that had put the vehicle production in jeopardy. Jamie L. Lareau had this to say: „The major manufacturers of the semiconductor chips used in cars are overseas, namely Taiwan-based, Taiwan Semiconductor Manufacturing Company (TSMC) and United Microelectronics Corporation (UMC). The strain on making and delivering the chips comes down to supply versus demand. Data company IHS Markit has tracked the

chip problem since April 2020 and it estimates the deficit will result in 672,000 fewer light-duty vehicles built globally in this first quarter. As part of that total estimate, North America will see about 100,000 fewer vehicles made” [6].

„The White House held a virtual CEO summit where President Joe Biden met with executives from the auto, tech, biotech and consumer electronics industries to focus on the ongoing semiconductor chip shortage. In that meeting, Joe Biden declared: „Chips, like the one I have here, these chips, these wafers, (they) are batteries, broadband.” ... „This is infrastructure. So look, we need to build the infrastructure of today, not repair the one of yesterday.” “Funding the chip manufacturing incentives and research investments called for in the chips for America Act, as President Biden’s infrastructure plan would do, will strengthen U.S. semiconductor production and innovation across the board so all sectors of our economy have the chips they need,” S.I.A. stated [8].

The Boston Consulting Group estimated that the USA needs as much as \$50 billion in a new investment in a new approach to semiconductors. „As government authorities begin the complex logistical process of distributing and administering vaccines to their populations, the global semiconductor industry calls on all governments and authorities to consider prioritizing certain semiconductor industry workers for vaccination. Consistent with guidelines of by public health experts around the world, we fully support the need to prioritize limited vaccine supplies to health care workers, vulnerable populations, and emergency first responders.” ... „The semiconductor industry is committed to taking all necessary steps to ensure its essential workers remain healthy and safe and to use its critical technologies to assist in the effort to battle the global pandemic” [9].

**3. Equations**

$$CT = N^{category} \cdot AD^{category} \quad (1)$$

**4. Tables**

**Current time delays because of the Chip Shortage (Table 1)**

Category	Normally	Determinations	
		Analytical Delay	Current time
Pmc	4 to 8 (N)	6 to 6.5 (AD)	24 to 52 (CT)
Mc	4 to 8 (N)	6 to 6.5 (AD)	24 to 52 (CT)
Cpu	4 to 8 (N)	3 to 2 (AD)	12 to 16 (CT)
Mem	4 to 8 (N)	3.5 to 1.8 (AD)	14 to 15 (CT)
WiFi	4 to 8 (N)	6 to 3.7 (AD)	24 to 30 (CT)
Lcd	12 (N)	1,3 to 1,6 (AD)	16 to 20 (CT)

$CT = N^{pmc} \cdot AD^{pmc} = 4 * 6 = 24$  and also  $8 * 6.5 = 52$ , which  $\Rightarrow$  the CT is 24 to 52

**5. Illustrative Material**

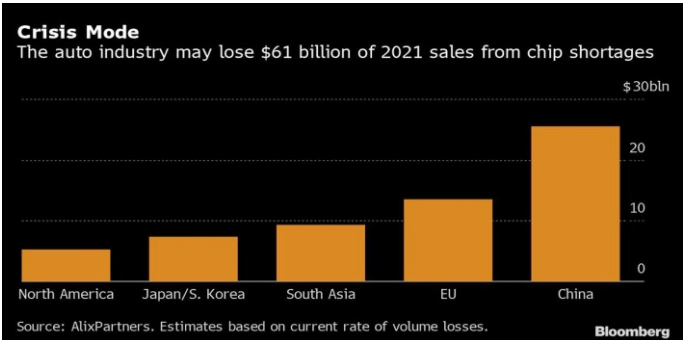


Fig. 1. Economic impact of the chip shortage for the automotive industry [10]

## 6. Conclusions

In conclusion, the semiconductor crisis has happened during the Covid-19 pandemic due to people losing jobs and work from home situations. Having available at least 5 types of COVID-19 vaccines, first of all I would recommend mass vaccination. This way, while everybody is getting vaccinated the need of silicone in the medical area slightly reduces, therefore it might be able to get back to other industries. Export and import might eventually be permitted again.

I think that all the companies should take Hyundai, Toyota and Tesla's example and start making their chips in-house at least for a short period of time while we escape the pandemic. Moving this production in-house temporarily, and with the help of faster vaccinating, getting more silicone and the import being slightly brought back to life, combining these 3 solutions we could solve this problem.

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## 8. Notations

S.I.A = Semiconductor Industry Association;

PMC = Power Management Chips;

MC = Microcontroller Chips;

CPU = Central Processing Unit;

Mem = Memory Chips;