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## Chip Shortage Impacting Supply Chains of Small to Mid-Sized Businesses

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### Abstract

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#### Keywords:

Chip shortage,  
Just in Time,  
Auto industry,  
Supply chain,  
Small and medium  
businesses

Supply chain challenges are ubiquitous and pervasive, with the persistent chip shortage generating ripple effects across numerous industries. The automobile sector is one of the most hit, with chip shortfalls slowing manufacturing and lowering sales. Semiconductors, often known as chips, are essential components in the production of electronics products such as cell phones, cameras, and computers. Due to a manufacturing bottleneck and chips shortage, the auto industry has been compelled to reduce output and delivery targets, resulting in a slew of accounting scandals. Market analysts expect that the chip shortage issue will be active in the market for more than 1-2 years. Small and medium businesses have been affected the most due to chip shortage since they have supply chain and financial constraints. Many small organisations that require chips are already rethinking their long-term buying strategy. Many businesses, particularly those in the automobile industry, are realising that the approach of "just-in-time (JIT)" inventory is no longer sustainable in competitive terms.

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### 1. Introduction

Supply chain disruptions have risen to the top of the threat list across sectors. The semiconductor scarcity has slowed automobile manufacturing, delayed the launch of consumer electronic devices and limited enterprises' capacity to recruit new employees. The global scarcity of semiconductor chips has begun to have an impact on the small and medium-sized company (SME) sector. Smaller businesses are experiencing difficulties as Original Equipment Manufacturers (OEM) reduces output and order volumes deplete [1]. The worldwide chip shortage from 2020 to the current is a continuing global crisis wherein the need for integrated circuits (often known as semiconductor chips) outstripping supply,

impacting over 170 sectors. Global automobile manufacturing fell during the COVID-19 outbreak, but it is expected to rebound to pre-pandemic estimated that by the end of 2023. According to industry analysts, the worldwide chip deficit, which has hampered supply chains in multiple industries, will not ease until 2023. Experts predicted the year before that there will be some respite in the second quarter of 2022.

This study aims to identify the small businesses which have been negatively impacted by the chip shortage in the supply chain. Different businesses have different ways to response to the incident. Therefore, this study will focus on the areas and causes of chip shortage in the supply chain which has impacted different small and medium businesses and how supply chain resiliency can be improved.

## 2. Background

### 2.1 Increasing chip shortage crisis

The shortfall dates back to the second half of 2020, when general consumer interest for automobiles fell due to the lockout. As a consequence, chip manufacturers were forced to shift their focus to other industries, such as electronics components and mobile devices, which witnessed a spike in demand as more employees engage remotely [2]. This is attributable to an increase in the demand for semiconductors in autos, laptop computers, and other electronic gadgets. The major cause of the scarcity is a lack of factories capable of producing the chips. The present chip scarcity is caused by high demand and insufficient supply. This dates back to COVID-19 shutdowns in the 2nd period of 2020, when demands for work-from-home technologies skyrocketed and automakers found themselves vying for semiconductor resources in Asian and European factories. Most people feel that Covid had a significant influence in chip scarcity. Manufacturers anticipated a drop in consumer purchases owing to shutdowns and job losses [3]. Demand surged faster than predicted owing to stimulus finding and at-home demands, resulting in losses for some enterprises. The integration of this and simultaneous closures of chip manufacturing plants had a devastating impact on chip supplies.



**Fig 1: Global chip shortage**

To compound matters, the COVID-19 Delta version had a negative influence on downstream processes in South Asian and some European regions, causing additional bottlenecks within the supply chain. Malaysia, especially, undertakes several "back-end" operations like chip packing and inspection, which are more labour intensive than wafer manufacture processes and hence more susceptible to public health initiatives [4]. Different firms suspended orders at the start of the epidemic, but when manufacturing resumed at the end of 2020, there wasn't any semiconductor availability. This was exacerbated by rising demand, primarily at the top end of the vehicle industry, as low borrowing rates aided affordability.

## 2.2 Distributed Logical Approach

The COVID-19 outbreak prompted a wave of facility closures, effectively halting worldwide manufacturing. People were trapped at home, looking for things to do and ways to entertain themselves and their close relatives at the same time. This resulted in a significant rise in electronic goods demand, but manufacturers were unable to provide it [5]. This sparked a chain reaction of shortages in semiconductor manufacture. As a result, supplies were either constrained or curtailed. Aside from the fundamental issue with microchips, another factor contributing to the scarcity of microchips is the movement of chips from one location to another. Semiconductor chips are the foundational product for industries such as software and technology. Companies have not been operating at their typical speed due to a lack of these chips. The COVID-19 epidemic triggered a large supply chain [6]. When early-in-the-epidemic shipping ports reopened, they confronted freight difficulties, leaving piles of product awaiting delivery.

The distribution network has yet to recover, and long-term global labour issues haven't helped. Given that the chip manufacturing scarcity is expected to last for some time, developing substitutes can be difficult. There are various characteristics and ways that global corporations have begun to align with. Businesses all over the world have begun to recognize infrastructure pieces that would be dramatically affected if a component is not provided soon. Due to the lack, the major strategy for organisations is to concentrate on acquiring a substitute.

## 2.3 Impacts on small and medium businesses

Businesses will be required to prepare for production ramp-up and the long-term effects of the economic downturn when the scarcity subsides. Resolving the chip scarcity and getting back to "normal" entails dealing with a new deficit: manpower. Businesses will be required to prepare for production ramp-up and the long-term effects of the economic downturn when the scarcity subsides. Resolving the chip scarcity and getting back to "normal" entails dealing with a new deficit: manpower [7]. Manufacturers of automobiles have been forced to suspend manufacturing or transport incomplete goods. Since car supply has reduced while customer demand has soared, we are witnessing inflationary pressures that have harmed millions of consumers. Because of the shortfall, the UK administration and businesses have realised their reliance on outsourcing. Digitalisation has still been accelerating, necessitating a considerable increase in chip fabrication. This would take some time for the \$52 billion to have a direct economic impact. The UK will be ready for the surge in demand with impending tech developments, such as the global growth.

## 2.4 Objectives of the Study

The present study's objectives are as follows:

- To examine the reasons behind chip shortage in the supply chain
- To understand how the small and medium businesses are affected by the chip shortage
- To determine how the chip shortage issues in supply chain can be mitigated

## 3. Research Method

The review is qualitative and interpretive, and it draws on the secondary sources. In order to understand the reasons behind the chip shortage in the supply chain which has affected a number of businesses, a secondary research is conducted. Therefore, the main materials for the study are the past published research papers where different authors have focused on the chip shortages issues in the supply chain [8]. Not only in the UK, but also

the global supply chain has been impacted due to shortage of chips. This has impacted a number of small and medium sized companies whose businesses were highly dependent on the chips supply chain. By using the secondary articles, the objectives are achieved. Therefore, the data collection method is purely a secondary method. Online databases that were accessed over the internet have become an important source of data collection. Articles published previous to 2017 were disqualified. The study has only utilised data from the previous five years.

Over the last 2-3years the chip shortage has increased by a huge margin. Starting from the year the pandemic started, the supply and demand curve of chip production has been affected. The lack of semiconductors has hampered the manufacture of computers, tablets, telephones, and other electronics devices. Chip demand is outpacing supply, and numerous vehicle and consumer technology manufacturers throughout the globe have stated that manufacturing may be impacted. The keywords which have been used to search for the appropriate articles are, “reasons for chip shortage”, “chip shortage in supply chain”, “impact of chip shortage in small and medium businesses”, “supply chain chip shortage 2022”, “how small businesses have been affected due to chip shortage”, “sectors affected due to chip shortage”, “expected growth in chip production”, “companies response to chip shortage”, “strategies to build resilient supply chain” and so on.

The research has used a deductive approach to achieve the research objectives. The research is carried out using qualitative study of secondary data gathered from publicly accessible resources. Secondary research is employed for a more in-depth qualitative approach. The statistical findings to be made as secondary data sources should be evaluated honestly. To reach its conclusion, the research has used a deductive technique.

## 4. Results and Analysis

### 4.1 Supply-demand Mismatch

The supply-demand mismatch is rapidly expanding. This disparity has begun to show itself in the rising pricing of technology, greater wait times, and the unavailability of items, among other things. Stockpiling may have rescued cell phones from destruction, but the scarcity has had a significant impact on the small-scale automobile industry. The manufacture of microchips was then retooled to make things for electronic items. As a consequence, automobile manufacturers were left high and dry [9]. The shortage has developed such a void that businesses have been forced to reconsider their distribution network strategy in order to keep up with their rivals. With the commencement of COVID-19 and factory shutdowns, demand for all commodities fell drastically at first. However, huge consumer expenditure has generated a V-shaped rebound in the international economy, resulting in an unparalleled demand for semiconductors. Some consumers may be "double purchasing," or buying more components than they want in case resources run out, misrepresenting the impression of future requirements [10]. This has affected the supply and demand of the semiconductor chips. When the outbreak shut down key chip production factories in Asia and ports became inundated, the repercussions were noticed globally. The scarcity has even slowed automobile manufacture. Unfinished Ford vehicles were sent from the assembly line to parking areas to await chips before being delivered to the dealership.

### 4.2 Small Scale IT Industry

Chips are one of the most required components in the IT and electronics industry. Due to the pandemic, the small IT businesses have been affected a lot. Due to financial

inefficiencies of the small IT businesses, their supply chains were not properly working. The speed decreases over time [11]. This resulted in lack of supply to the organisations even though there was a huge demand. The chip scarcity has been a concern for the technology field since early 2020 and is expected to continue far into 2023. Even with factories working at maximum capacity, increasing system design, personnel constraints, supply challenges, and geopolitical tensions are culminating in product delivery times of 6 months or above [12]. Overall, the IT industry announced in October that it lost \$6 billion due to a semiconductor shortfall in the previous quarter and anticipated an even larger loss due to supply chain concerns in the December quarter. Because corporations are putting additional orders and stockpiling more inventories, the chip scarcity might last for a long time.

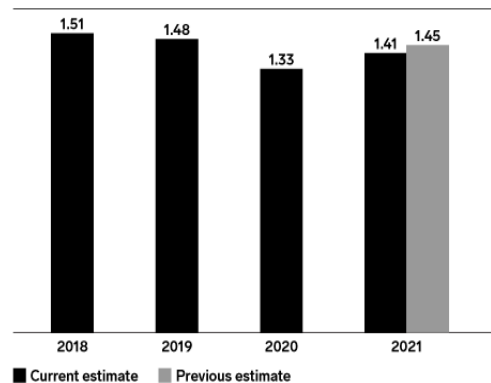


Fig 2: Chip shortage in shipment

#### 4.3 Small Automotive Firms

The automobile sector was initially affected by chip scarcity during the epidemic in 2020, when customers' overall demand for vehicles fell during the shutdown. This had a domino effect, resulting in labour shortages, a scarcity of raw resources, unresolved trade, and the rise of 5G gadgets, which demand additional chips than prior generations of products. This is the newest difficulty in the car business, which began during the early stages of the COVID-19 epidemic, when automotive sales have dropped by as much as 81% in Europe, 75% in China, and almost % in the United States [13]. The consequences of the semiconductor scarcity have spread far beyond the automotive industry, with other industry players battling to get chips. Major automakers, including a US-based OEM, have also already confirmed major producing cuts, decreasing revenue expectations for 2021 by billions of dollars. Because of the escalating chip scarcity, the automobile sector is ordering 10 to 18% more semiconductors than required to assure inventories and manufacturing.

For several years, the "bullwhip effect" has already been reported in a variety of sectors. The pandemic's onslaught has therefore worsened the small auto companies' current issues, producing unprecedented uncertainty amongst market participants. In the last year, the auto industry has lost more than \$60 billion of sales due to chip shortage [14]. Moreover, leading players in the auto industry like Toyota, Ford motors, have started a double ordering system in case the supply dries up. This has increased the overall purchase of the available stock of the chips. As a consequence, the smaller companies were not able to maintain their stocks. The "seasonally adjusted annual rate (SAAR)" for light vehicle sales in the US in June 2022 was 13.20 million, up 3.2% over the previous month but down 13.8% over the preceding year, indicating the industry's troubles. Volumes in the industry fell for the 11th straight month, dropping 10% compared to last year. Volumes, on the other hand, increased 2.5% per month [15].

Incentives for demand have decreased to their lowest point since January. This indicates that consumer desire is robust in the vehicle end market, since shops are not required to give monetary incentives to entice customers.

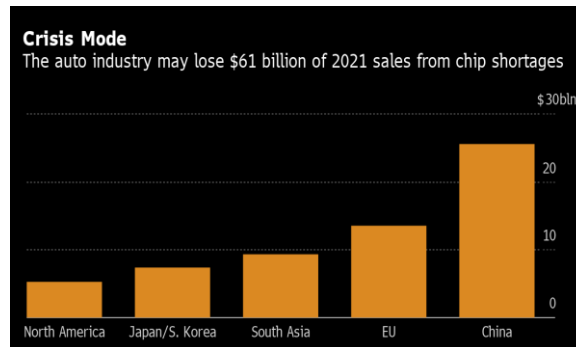


Fig 3: Chip shortage in auto industry in different regions

#### 4.4 Consumer Electronics

Some analysts attribute the automobile chip scarcity to the rapidly rising need for consumer electronics, notably during the epidemic. Desktop PCs were previously dying slowly as sales of laptops and mobile phones increased. Another estimate by Fortune Business Insight for May 2021 predicted that the electronic goods sector will develop at an annual compounded rate of 5.5% until 2027 [16]. Earnings might exceed \$50 billion by then. However, as they become more popular, so does the need for chips and detectors. As a result, CPUs built for autos are not suitable for consumer electronics, and conversely. Additionally, firms predict that resolving the shortage will require numerous years [17]. Likewise, shortages may lower firm profitability or generate customer costs, causing people to struggle to purchase the things. [Referred to Appendix 1]

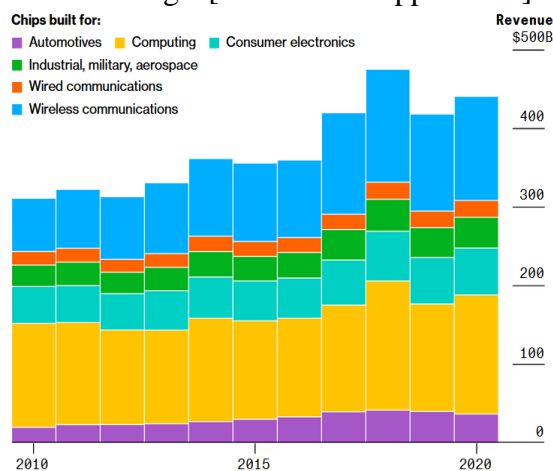


Fig 4: Worldwide semiconductor scarcity harming the manufacture of the PS5 and automobiles

#### 4.5 LED and Lighting Fixtures

Meanwhile, shortage may lower firm profitability or generate customer costs, allowing more people to find it difficult to purchase the goods. As a result, growth of smart homes has decreased marginally. In addition, there is little interest for light-emitting-diode (LED) lighting, which are seen as being a more eco-friendly alternative than halogen, incandescent, and fluorescent. Commodities prices have increased by up to 8% [18]. It destroyed numerous firms' stocks, which harmed their LED supply network. Manufacturers who first made LED chips have gradually increased their ability to make high-value chips. Secondly, even when they do not transmit their own skills, LED chip makers cannot receive sufficient wafer chips under the prevailing circumstances, and the majority of



wafer chips flow to all those high-value chip makers. Third, given the limited chips available, chip makers will prioritise meeting the demands of the LED industry's behemoths. This is why a handful of small Chinese firms have halted accepting orders.

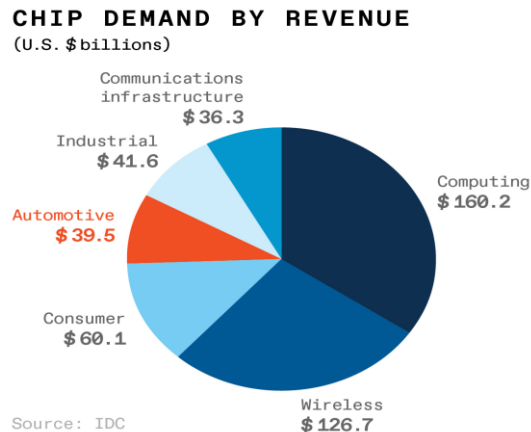


Fig 5: Chip demand in different industries

#### 4.6 Impact on Small Businesses

The worldwide chip shortage is coming close to home, affecting pretty much everything that has a connection or batteries, owing to distribution network issues during the epidemic and rising demand for processors in mobile devices. Small enterprises and chips cross in two different ways. The first method is through their POS terminals [19]. As a consequence of the epidemic, many smaller firms hastened the updating of their POS machines to take mobile payments; therefore any chip scarcity should not have an immediate impact on these enterprises. However, if the chip scarcity becomes a relatively long term problem, which some market analysts believe may last longer than two years; the supply of new POS terminals may be delayed. In such situations, the small businesses which are dependent on the POS terminals will be affected [20]. Small companies rely on electronic payment as well, and they want payment card interactions to be safe, rapid, and dependable. However, if chips become scarce in the lengthy period, it may influence customer card selection, thereby impacting the possibility of fraud in a purchase.

#### 4.7 How companies should respond

Small and medium sized businesses are the most affected due to the chip shortage in the supply chain. Small businesses are partially dependent on the supply chain because of production and transportation of products. Rethinking the long-term planning process with a focus on risk minimisation and supply certainty will help the small businesses to cover up the chip shortage issues. Inventory requirements must be carefully predicted, not simply for the near term, and discussed both internally and with vendors [21]. Stronger diplomatic relationships, a robust supply chain, improved stock planning, greater interactions with vendors, and sometimes even solid economic and commercial policies are all the best ways through which the small and medium businesses can respond to the chip shortage.

#### 4.8 Possible measures taken by Chip manufacturers

Several component makers have increased production in reaction to the worldwide chip shortfall to assist alleviate shortages. Chip designers and producers, as well as the numerous impacted businesses, have taken various steps to reduce the effects of the chip shortage. Expansion of production capability has been an appropriate option for many chip producers [22]. To effectively adapt to market instability and political constraints, some providers in specific regions resorted to stockpile and curb shipments. Similarly, several companies have made investments in increasing yields or increasing the number of chips

produced from a silicon wafer to enhance chip accessibility by a particular margin. It is expected that the chip shortage will not be overcome in any time soon since the production and development of microchips require a lot of time.

#### 4.9 Expected growth in chip production

Demand for semiconductor chips is increasing at an alarming rate. From \$450 billion in 2021 to \$803.2 billion in 2028, the worldwide market is expected to nearly quadruple [23]. Nonetheless, supply chain delays caused by pandemics and climate is generating crucial chip constraints in a variety of sectors, particularly med-tech. This might endanger thousands of individuals throughout the United States who rely on chip-powered technology and gadgets.

Table 1: Chip development and production timeline

	Capacity building		Product development		Production
	New fab build up	Fab ramp	Chip design	Yield and volume ramp up	Production cycle time
<b>Typical time duration (in months)</b>	12-18	6-18	12-36 (Mobile phones have a 12-month life span, while automotive microcontrollers have a 24-36-month life cycle)	6 or more	4 or more
<b>Influencing factors</b>	Building clean room Facilitation (HVAC, gas and electric)	Hook up and qualification Tool lead times	Complexity in product	Complexity in product Fab utilisation	Complexity in product Physical and chemical procedures Fab utilisation
<b>Other considerations</b>		Needed for development and expansion of existing plants		Needed while transferring the existing products between fabs	



In recent years, the semiconductor industry's economic profitability has improved relative to others, and this trend is expected to continue.

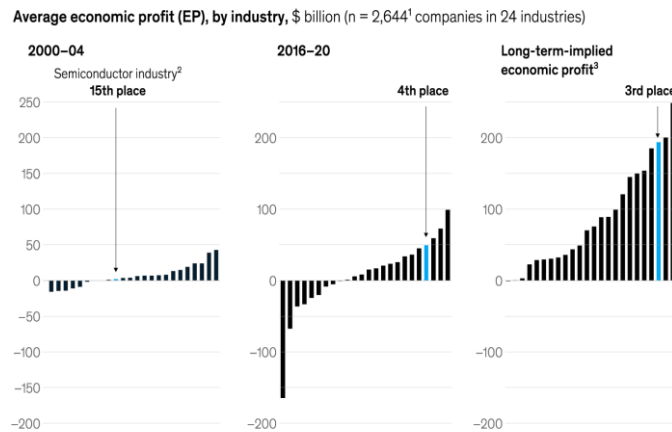


Fig 6: Growth in the semiconductor industry over the years

#### 4.10 Implement logistics improvement

Small brokers frequently lack the quality standards, vendor management solutions, and value-added facilities rendered to assure the integrity of a component and provide integrated stock control. Quality-assurance credentials, financial stability, gross income, market durability, global accessibility, and service range are all factors that influence a distributor's capacity to deliver high-quality products [24]. Many manufacturers, notably those in the automotive industry, are discovering that the “just-in-time (JIT)” inventories strategy is no longer viable in today's market. This type of ad hoc part buying may assist to reduce expense, but it does not give the flexibility required in times of supply chain interruption. When it relates to procurement, today's businesses must be proactive. The present supply-and-demand discrepancy has emphasised the dangers of depending on representing a particular even more. In times of scarcity, when accessibility to other supply sources is important, this procurement paradigm becomes severely restricted [25]. Companies may integrate resilience and some redundancies into their distribution networks throughout this phase to protect against potential shortfalls.

#### 4.11 Collaborating with trusted distributors

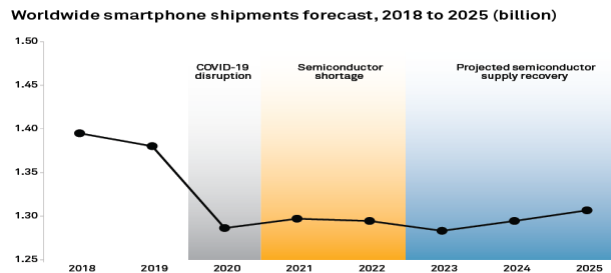
Developing relationships with suppliers is one method for removing unpredictability from logistics activities and preparing the business to deal with disruptions [26]. All across the shortfalls, it is critical to maintain a long-term plan and create long-term partnerships with suppliers that can help one to overcome vulnerabilities and navigate the changing structure of the chip distribution systems. “Vendor-managed inventory (VMI)” schemes are one method distributors help supply chain management. They manage buffers and inventory levels to ensure continuous and smooth delivery. “IT asset disposal (ITAD)” services are another method distributors help firms with long-term managing their supply chains [27]. ITAD is a mechanism for discarding IT gear safely through retargeting or repurposing.

## 5. Conclusion

The most recent worldwide chip shortage has caused major disruptions in the chip distribution network, affecting businesses ranging from automobiles to electronics products, data centres, LED, and renewables. Despite current mitigation efforts, shortfalls will endure beyond 2023. While a complete recovery is unlikely anytime soon, several

chipmakers are confident that they'll increase fabrication to meet demand from their automotive clients. Some viable alternatives include increasing manufacturing capacity, adapting older chip technologies, and utilising software and services to unleash functionalities. Some viable alternatives include increasing manufacturing capacity, adapting older chip techniques, and utilising software and services to unlock processing capability. The worldwide semiconductor chip dilemma is expected to endure until 2023, and maybe beyond. The worldwide semiconductor shortfall shows no indications of abating very soon.

### Appendix 1: Smartphone shipment due to semiconductor shortage



(Source: <https://www.spglobal.com>)

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