

# Four Key Threats to Semiconductor Supply Chains

The Race to Source Contingencies in a Polycrisis World

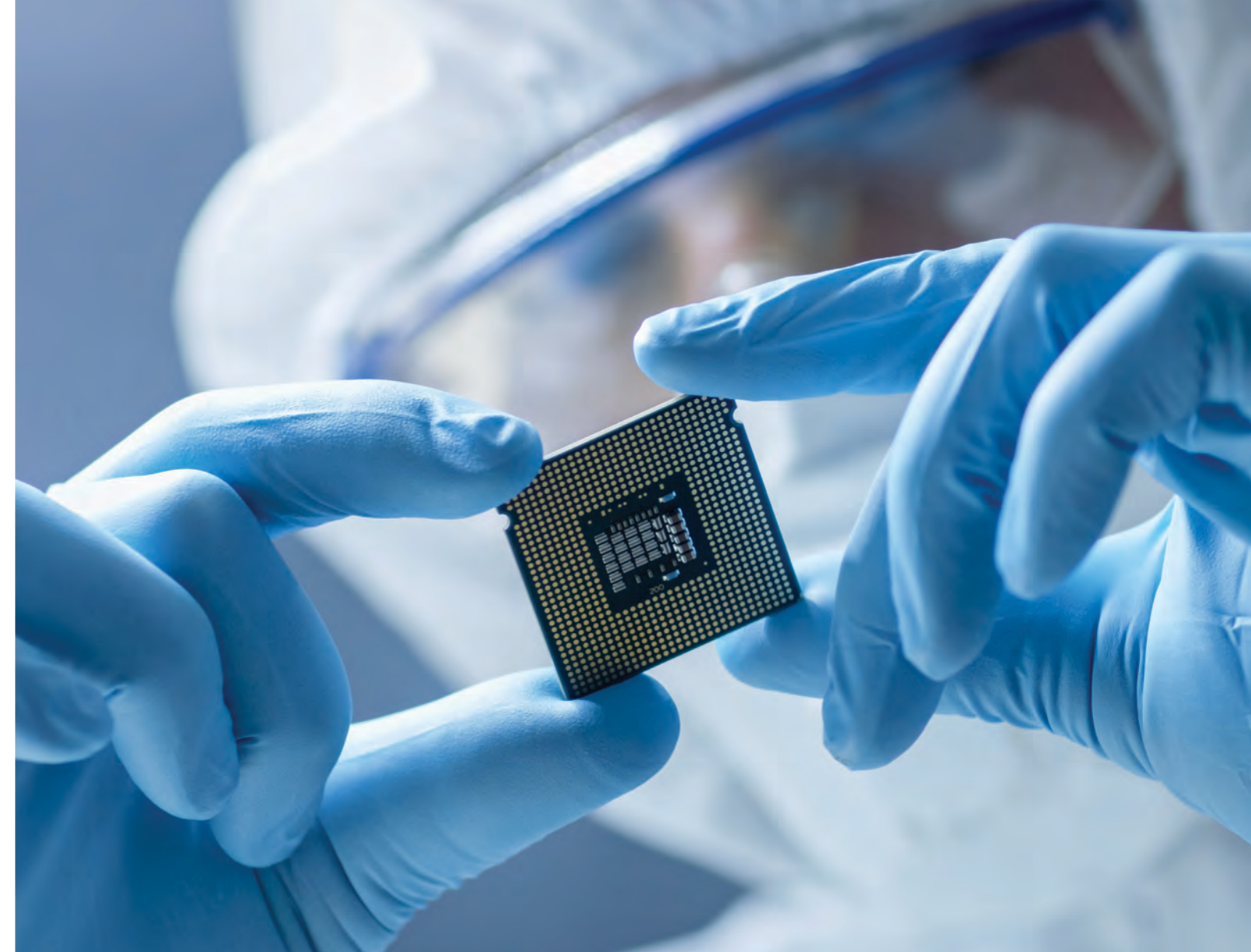
APRIL 2024





## Key insights

- 1 Semiconductors are the **foundation of modern computing**. They are relied upon by a wide range of industries, including electronics, manufacturing, and the military.
- 2 Taiwan currently produces over **60% of the world's semiconductors and over 90% of the most advanced semiconductors**, resulting in a major concentration of risk.<sup>1</sup>
- 3 The semiconductor industry experienced an **acute shortage of supply during the global pandemic**. As a result, manufacturers are actively diversifying suppliers, recycling, and reusing goods.
- 4 From the drought impacting water levels in the Panama Canal<sup>2</sup> to ongoing attacks in the Red Sea, **there are a number of potential shipping chokepoints**.
- 5 Industries dependent upon semiconductors should be prepared for further volatility. This includes **planning for worst-case scenarios**, such as disruption to the flow of goods out of Taiwan.



## Introduction

Semiconductors are an integral part of every device in the digital age, rivalling oil and gas in terms of the sector's importance to international relations.

High dependence on the technology is reflected in revenue figures from the global semiconductor industry, which reached \$47.6 billion in January 2024, marking a 15.2% rise year-on-year.<sup>3</sup> According to McKinsey, it is set to become a \$1 trillion industry by the end of the decade.<sup>4</sup>

The pandemic era saw global demand for semiconductors surge by as much as 17% between 2019 and 2021. Not only did supply not keep up, it slowed due to country lockdowns, a contraction in global shipping, and logjams around major ports.

During the COVID-19 crisis, it became clear that disruptions to the semiconductor supply chain were impacting multiple industries, including electronics, automotive, manufacturing, and defense. Analysis by the US Department of Commerce found that chip shortages shaved an estimated \$240 billion off US GDP in 2021,<sup>5</sup> equivalent to 1% of total US GDP that year. The auto industry alone produced nearly eight million fewer vehicles as a result.

Common sources of bottlenecks include natural disasters, geopolitical conflict, and fluctuations in demand.

Taiwan plays a pivotal role in semiconductor design and manufacturing, with the country producing over 90% of the world's most advanced semiconductors.<sup>6</sup> This is a major source of vulnerability given the country's exposures to natural catastrophes and shifting geopolitics, with the M7.4 earthquake on April 3, 2024, a reminder of the world's dependence on Taiwanese chipmakers.



## Four Sources of Disruption and Bottlenecks

Among the current and future threats to semiconductor supply chains moving forward are growing climate extremes and geopolitical threats. From drought impacting water levels in the Panama Canal<sup>7</sup> to ongoing attacks in the Red Sea, the blockage of any one of seven key marine chokepoints can have a major impact on global shipping and trade flows.<sup>8</sup>

In a world of high volatility, it is almost impossible to anticipate where the next curveball may arise from. From the global pandemic to Russia's invasion of Ukraine, the past three years has seen the sustained bombardment of supply chains.

The complex and interconnected nature of global trade means that a major event in one region can ripple across the world, causing both direct and contingent business interruption. Given existing tensions within the semiconductor space, it is inevitable that volatility in supply will remain a feature, even where well-thought-out contingencies are in place.

The following are four likely sources of external disruption to semiconductor supply chains in the near term. Of particular concern is potential for disruption to trade passing through the Straits of Taiwan. According to current estimates, upward of 50% of global marine trade passes through the South China Sea.<sup>9</sup>



### The Panama Canal water crisis

An extreme drought in Panama, exacerbated by El Niño, has reduced the shipping capacity through the Panama Canal. The channel normally accounts for 5% of global maritime trade and 40% of US container traffic. However, due to record drops in water level, it has been forced to limit daily crossings.

The reduced capacity is causing delays and higher shipping costs. Panama Canal authorities expect the situation to continue until the end of April or the beginning of May, when Panama's rainy season begins.<sup>12</sup>

#### 1. Climate extremes and natural perils

Climate extremes and natural disasters can disrupt transportation networks, damage critical infrastructure, and reduce the availability of raw materials for semiconductor producers.

The past 12 months is a warning of the impact of resource scarcity on the production and flow of computer chips.

Droughts in Taiwan during 2023 affected supplies of ultra-pure water needed to clean silicon wafers, and manufacturing facilities struggled to operate. To minimize the impact, Taiwan Semiconductor Manufacturing Company (TSMC — the largest chipmaker in the world) has set up its own water recycling plant. Additionally, chip factories in Taiwan reduced their water usage by 10%–15%.<sup>10</sup>

Taiwan's exposure to typhoons and earthquakes makes its semiconductor sector particularly vulnerable. The 7.4 magnitude earthquake that struck the country on April 3, 2024, is just the latest event that forced major semiconductor manufacturers, including TSMC and UMC (United Microelectronics Corporation), to evacuate sections of their factories, raising concerns about chip production.<sup>11</sup>

Moving forward, it is likely that climate extremes and natural perils will continue to impact the flow of semiconductors around the world.



#### 2. Geopolitical turmoil

The long-term impact of geopolitical factors on the semiconductor supply chain depends on how events unfold, in particular tensions between China and Taiwan. Geopolitical disputes can result in trade sanctions, tariffs, and civil unrest, all of which influence businesses' ability to access materials and components and fulfill orders.

Currently, the shortest shipping route between Europe and Asia, the Suez Canal, is facing a new threat which is impacting the movement and pricing of goods and components, including the flow of semiconductors.

Since the outbreak of war in Israel and Gaza, the Houthi group in Yemen has been targeting mainly Western cargo vessels passing through the Red Sea. The steady bombardment of attacks from drones and missiles is causing losses and turmoil in one of the world's most important waterways.

A coalition of countries have deployed naval forces to protect commercial ships, but many are opting to reroute vessels around South Africa's Cape of Good Hope. This has knock-on implications for insurance costs, freight rates, and the delivery of goods.

“In terms of the position of Taiwan in the global supply chain, it's so deeply imbedded that it's almost impossible for anyone to know just how impactful it would be if you had a scenario, such as a blockade in the Taiwan Straits.

An organization can probably map out all the critical components of its supply chain, what physical assets it has in Taiwan.

For example, we have some big global technology-manufacturing clients, where 80% to 100% of their manufacturing is done in Taiwan. So that's easy to identify. And then you've got your first order suppliers that you know. For example, if you're a technology manufacturer and you manufacture cars in Europe, but a lot of your components directly come from Taiwan. That's also fairly straightforward to identify.

The problem comes in when you get into the second- and third-order effects. If say for example, you're relying on the import of food and you don't know whether the suppliers that manage that are reliant on Taiwanese technology to carry out fulfillment or to grow the food itself.”

— **Jake Hernandez, Chief Executive Officer at AnotherDay\***

\*AnotherDay, a Gallagher company, is a specialist consultancy firm working with insurers on strategic risk advisory encompassing cyberthreats, geopolitical intricacies, and climate change implications.



“The situation in the Red Sea has underwriters issuing notices, citing heightened risks, and canceling existing insurance coverage. They are also charging higher premiums for shipping through the region.

However, we feel that the market already holds a sufficient war premium to cover potential losses. Speaking from a global standpoint, and considering the potentially devastating impact on our cargo, the market has a substantial or satisfactory premium to cover any potential losses adequately.

Cargo owners, shippers, and ship owners are making the decision on whether to continue shipping through the area, inciting the argument that those who choose to continue without taking precautions should be penalized.”

— Alec Russell, Executive Director, Marine Cargo, Gallagher Specialty

### 3. Industrial fires and maritime accidents

As the Baltimore Bridge collapse in Maryland, US, most recently demonstrates, accidents in and around major ports and shipping channels can disrupt supply chains. When the container ship Ever Given became wedged in the Suez Canal for nearly a week in March 2021, it impacted the flow of an estimated \$9.6 billion in global trade each day.<sup>13</sup>

Accidents on land also have the potential to cause constraints to semiconductor supply chains. The Tianjin explosion in China, in 2015, demonstrated the impact of an industrial disaster on busy ports. Given the sheer concentrations of risk within Taiwan’s semiconductor foundries, one possible threat to near-term trade flows could come from a major fire or accident involving one of these critical facilities.

On January 6, 2023, a fire broke out at the Wuxi Welnew factory in China, a sub-tier supplier for major semiconductor manufacturers. The damage was so severe, the factory had to move its production to the Welnew Shanghai Factory, resulting in an estimated five months of business interruption before normal production could resume.<sup>14</sup>



### 4. Targeted and indiscriminate cyber attacks

The threat from cyber attacks continues to grow for many industry sectors, and it poses a major risk to the operations of semiconductor companies and their suppliers. As chip manufacturing becomes increasingly automated and digitalized, the potential attack footprint continues to grow.

According to Verizon, around 86% of cyber intrusions are motivated by money. In June 2023, TSMC was targeted by the hacker group LockBit, which demanded a \$70 million ransom for stolen data. It was later discovered that the breach had occurred at a TSMC supplier, with data on initial server settings and configurations having been leaked.<sup>15</sup>

As geopolitical tensions rise around the world, it is likely we will see a growing number of state-sponsored cyber attacks targeting the semiconductor industry, with the aim of stealing information and/or causing economic disruption.<sup>16</sup>

Even in instances where companies are not directly targeted, there is the risk of spillover disruption.

One such instance occurred in June 2017, when the world witnessed a new era of state-sponsored cyber warfare, with the unleashing of NotPetya, a highly destructive malware, by Russia. Ukraine was its primary target, but it spread to over 60 countries, causing damages of over \$10 billion.<sup>17</sup>

Among those affected was the global transport and logistics giant Maersk, causing significant shipping delays, and costing the company between \$250 million and \$300 million.<sup>18</sup>

## Rethinking semiconductor supply chains: The COVID catalyst

The global pandemic introduced a perfect storm for semiconductors. COVID-19 spread at a time when shortages in the supply of computer chips were already somewhat constrained. Due to country lockdowns, remote work, and online learning, demand for electronic devices surged.<sup>19</sup>

At the same time, factory closures and reduced production caused further shortfalls in supply, particularly for some of the more advanced chips. With the addition of logistics and transportation hurdles, due to lockdown restrictions, there were further delays and disruptions to global supply chains.

In many ways, the COVID-crisis was a catalyst, intensifying macro trends that persist as challenges to the supply chain today. This includes competition for raw materials, trade wars, and geopolitical tensions.







## Mitigating the Impact of Future Threats

Globally, there is heightened recognition of the importance of semiconductors. Industries are making substantial investments in developing their design and manufacturing facilities.

A major effort is underway to de-risk semiconductor supply chains in a more competitive and polarized world. A number of countries, including China and the US, are in a major push to boost onshore semiconductor manufacturing capabilities, reducing overreliance on specific suppliers and regions.<sup>20</sup>

TCMC is diversifying with new plants under construction in the US (Arizona), Japan, and Germany. Such investments are crucial for ensuring a steady supply of chips and supporting growth in data-centric industries, but will take time to develop.<sup>21</sup>

In February, the US government announced plans to spend \$11 billion on semiconductor-related R&D and announced the launch of the \$5 billion National Semiconductor Technology Center. It followed approval of the CHIPS and Science Act in 2022, which will see \$280 billion invested overall.<sup>22</sup>

Currently the US is responsible for just 12% of global semiconductor production, down from 37% in the 1990s.<sup>23</sup>

The growing investments in domestic semiconductor capacity around the world should go some way to shoring up semiconductors. Circular economy solutions could also help to address current challenges, particularly in light of the finite supply of raw materials.

But these solutions are longer-term commitments and industries reliant on computer chips and microchips remain exposed in the near term.

To improve the resilience of supply chains, firms need to understand where sources of future disruption could arise and implement proactive measures. Businesses should be prepared for further disruptions to the global supply of semiconductors, and prepare contingencies where possible.

This includes planning for worst-case scenarios, such as the flow of goods out of Taiwan being significantly hampered.

Effective supply chain risk management strategies include careful mapping of critical suppliers, particularly within the first and second tier, in addition to:

- Diversifying supplier channels and maintaining feasible contingencies
- Forecasting demand and maintaining safety stock to handle any unexpected demand surges or supply disruptions
- Embracing the latest technologies for real-time data and risk analysis
- Regularly testing and revising business continuity plans

Companies can promote innovation and agility within their supply chains by implementing risk management strategies. This will empower them to navigate future disruptions more effectively, mitigate risks, improve performance, and stay ahead in a competitive marketplace.

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