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Geopolitics of Semiconductor Supply Chains: The Case of TSMC, US-China-Taiwan Relations, and the COVID-19 Crisis

Aditya Sehgal SIT: Banking, Finance, and Social Responsibility Spring 2023 Georgetown University Edmund A. Walsh School of Foreign Service Independent Study Project in Finance Dr. Goran Jovanovic 30 April 2023

Acknowledgments	2
Abstract	2
Introduction & Justification	4
Literature Review & Context	6
Positionality	12
Methods & Ethics	14
Presentation of Results and Findings	16
Consumer Goods	16
Skyrocketing Chip Demand	17
Long Lead Times	19
Logistics Constraints Limit Chip Shipments	
Government Intervention	
Military Technology	25
Future Areas of Research & Conclusion	27
Journal	
References	
Primary Sources	
Secondary Sources	
Media Sources	
Appendix	42
Interview 1: Mr. Tian (Jeffrey) Jing	
Interview 2: Dr. Yazid Debbich	49
Interview 3: SinoAir with 4 Employees (identities protected by request)	56

Table Of Contents

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Abstract

As the demand for more advanced forms of technology continues to grow, so does the global importance and reliance on semiconductors. This research paper examines the impact of

semiconductor shortages on both consumer and military production, as well as the geopolitical implications embedded within the global supply chain.

The paper begins by providing an overview of semiconductors, the global semiconductor market, and the impact of COVID-19 on the industry's supply chain. It also discusses the importance of the Taiwan Semiconductor Manufacturing Company (TSMC) in the industry and its role in addressing semiconductor shortages.

Next, the paper discusses the impact of semiconductor shortages on the production of consumer goods such as smartphones, laptops, and automobiles. The US-China trade war and further geopolitical tensions between the US, China, and Taiwan have significantly disrupted the semiconductor supply chain, leading to shortages and price increases for consumer electronics industries. The paper also examines recent government intervention within high technology industries and specifically the semiconductor sector aimed at addressing the shortages faced during the pandemic and provides case studies of key companies affected by the semiconductor shortage.

The paper then examines the impact of semiconductor shortages on military technology production, such as advanced weapons and communications systems. The disruptions in the semiconductor supply chain have highlighted the importance of semiconductor manufacturing in national security and the geopolitical implications of these disruptions. The paper discusses the impact of US-China-Taiwan geopolitical tensions on the semiconductor supply chain for military technology production, evaluates key national interests and their reactions to shortages, and provides case studies for affected countries.

The paper has an overall lens of focusing on the geopolitical implications of US-China-Taiwan relations on the semiconductor industry and the role of other countries. It also

upholds the sustainability focused value criterion of ensuring fair and reliable semiconductor distribution for fostering a stable and secure global supply chain. It provides future scenarios for the semiconductor industry and how past events and legislation will be either effective or ineffective in managing future supply chain issues. The paper highlights the role and need for international cooperation to address semiconductor distribution and the industry's geopolitical implications.

In conclusion, the following research provides a comprehensive analysis of the impact of semiconductor shortages on both consumer goods and military technology production and their geopolitical implications. It provides an analysis and further recommendations of government policies and interventions to address shortages and their implications and suggests future research in the field of semiconductor geopolitics. As technology continues to advance, the importance of semiconductors will only grow, making the understanding of the global supply chain and the tensions it raises even more critical.

Introduction & Justification

Semiconductors are essential components of modern technology, enabling the development of devices that have transformed humankind's capability, productivity, and security. From smartphones and laptops to automobiles and emerging military technology, semiconductors play a vital role in shaping our society. The increasing demand for technological innovation has led to a complex and globalized high-technology supply chain to secure semiconductor distribution for governments and private companies worldwide. This research paper provides an overview of the semiconductor sector, focusing on the geopolitical tensions surrounding the industry and its implications on consumer goods, military technology, and conflict. The research

will proceed with the sustainability-focused value criterion of ensuring fair and reliable semiconductor distribution for fostering a stable and secure global supply chain.

The paper will begin by discussing the critical role and history of semiconductors in modern technology, exploring the technological advancements that have led to their increased significance. It will then provide an overview of the global semiconductor market and supply chain and discuss its key players.

The COVID-19 pandemic has disrupted the semiconductor industry's supply chain, causing shortages and delays in semiconductor production. This has had a significant impact on various industries, prominently the automotive and consumer electronics sectors. The following discussion will analyze the shortages faced by companies and governments worldwide from the COVID-19 pandemic, and the subsequent measures taken to address these challenges.

The role of the TSMC in the semiconductor supply chain and its significance will be explored. TSMC is the world's largest and most advanced semiconductor foundry, responsible for producing a majority of the world's semiconductors. The company has become an important player in the US-China-Taiwan geopolitical context, and its future business operations will continue to dramatically impact the geopolitical landscape.

Finally, this paper will explore the purpose of the research and its multi-disciplinary significance in understanding the current state of the world. Switzerland, specifically Geneva, is an ideal location to study this conflict, as the diplomatic and neutrality focused capital of the world. The wide breadth of resources available in Geneva through experts at the International Institute in Geneva, nonprofits focused on non-aggressive geopolitical strategy, and conferences about current global events allowed for an unbiased analysis on the state of semiconductor supply chains, as this topic affects every country- not just those involved directly in its

geopolitical implications. The semiconductor industry is not only critical to the global economy but also plays a significant role in national security. Following the Russia-Ukraine crisis, the fragility of the overall supply chain has been realized worldwide. As such, it is important to understand the geopolitical implications of the industry and the challenges it faces in manufacturing and distribution. The following research further aims to provide policymakers and industry stakeholders with insights into the complex interplay between technology, politics, and economics within the semiconductor industry.

Literature Review & Context

The semiconductor industry plays an important role in shaping modern technology. Semiconductors are the building blocks of all technological information and input processing, labeling it as the limiting factor in the capabilities of most modern technologies.

When the first transistor was invented in the state of New Jersey in 1947, putting an end to the usage of bulky, power-hungry, and expensive vacuum processing tubes in lieu of the possibility of a smaller, more efficient, cheaper technology, there became a race around Europe and the United States to take advantage of this opportunity of powerful computing capability (Miller, 2021). Thus began the "Chip War." Semiconductors made their way into the consumer sector only after mass manufacturing of chips was possible and use cases for the average consumer and business were better understood. The Cold War rivalry between Russia and the United States brought an interesting use case: inertial navigation techniques and aviation. *Semiconductors have always been at the center of geopolitics*.

Therefore, companies around the US, most prominently Texas Instruments (TI), attempted to build a "solid circuit" using all semiconductor components to reduce the load on airborne technological equipment, which was eventually achieved by TI engineer Jack Kilby in 1959 (Laws, 2019). Following the success, semiconductors played a critical role in the success of the Apollo program, further securing the American lead in technological innovation during the Cold War. The development of integrated circuits and other semiconductor technologies enabled NASA and its private contractors to build lightweight, reliable electronics for the Apollo spacecraft. This was the first time that a software program was used to control actions that had direct consequences on the lives of humans (Laws, 2019). This helped establish the United States as a global leader in semiconductor development and manufacturing.

The term "Silicon Valley" was subsequently popularized in the early 1970s to describe the Santa Clara Valley in San Francisco where the semiconductor industry had taken root. As the industry grew, it became associated with not just semiconductors but also with the broader technology and innovation industries developed in the region (Anthanasia, 2022).

Taiwan, a small island in East Asia, has played a prominent role in the development and production of semiconductors. In the 1970s, Taiwan was a developing economy rooted primarily in agriculture. However, the government recognized the potential of the semiconductor sector and made significant investments in research, development, and education to help support its growth.

One of the key factors in Taiwan's success was the development of the Industrial Technology Research Institute (ITRI) in 1973. ITRI was tasked with developing and executing the growth of Taiwan's high-tech industries. The government provided significant funding for ITRI, and the institute played a key role in the development of Taiwan's future semiconductor industry by putting Taiwan in the global spotlight as an emerging technology innovation hub along with its financial and technical support to semiconductor companies. Another critical factor in Taiwan's success in the development of its semiconductor sector was the formation of the United Microelectronics Corporation (UMC) in 1980, which was founded by former employees of TI who had acquired the necessary knowledge and expertise to establish a world-class semiconductor foundry in Taiwan, a move that shocked many, especially those in the United States, considering the world's technological leaders at the time. This was a major milestone in Taiwan's industry development route as this now allowed Taiwanese companies to lower manufacturing costs, rendering Taiwanese semiconductors more competitive when compared to their American and Japanese counterparts (Shish, 2009).

The last significant success in Taiwan's semiconductor history was the founding of TSMC in 1987, which is now the world's largest semiconductor foundry, producing the most technologically advanced chips for every industry that utilizes semiconductors from smartphones to military technology. TSMC operates under patents protecting its advanced technology. For example, TSMC is the only semiconductor foundry in the world able to produce 3nm chips, and they plan to open operations to produce 2nm chips by 2025. For perspective, the transistor size in a 3nm node is just 1/20,000th of a human hair (Hille, 2021). Granted, Samsung, Intel, and UMC, TSMCs main competitors, are unable to keep up with TSMC's technological prowess in the industry. In fact, TSMC makes 65% of the world's semiconductors and almost 90% of the most advanced chips in the market. By comparison, China produces a little over 5% and the US produces approximately 10% (Dasgupta, 2022).

The US-China-Taiwan geopolitical rivalry has significant implications for and relations with the semiconductor industry. Taiwan's role as the global leading producer of semiconductors has put it in a sensitive position in the ongoing power struggle between the US and China and further within its precarious role as a territory unofficially independent from China. Taiwan's proximity to China and its deep economic ties with the US have made it a key player in this geopolitical context. The Taiwanese government has sought to balance its relationships with both the US and China, while also safeguarding its interests in the semiconductor industry.

The relationship is particularly complex since Taiwan's semiconductor industry is acting as both a motivator and deterrent for Chinese intervention in Taiwanese affairs. Although China would like to control the global supply of semiconductors, and in turn, secure its supply to promote innovation and to lead technology and electronic market segments, the global reliance on Taiwan for semiconductors also brings about the indirect defense of many large countries around the world, the US in particular. Other motivations China has to secure Taiwan firmly within its domain are due to its strategic location, historical and cultural ties, and other economic benefits. Furthermore, access to Taiwan would secure China a clear opening for other trade routes in the East China Sea, as almost all of the islands directly to the east of China are indirectly controlled by Western nations, again, primarily the US with their military bases in Guam, South Korea, Japan, Australia, among others.

TSMC has been able to maintain a neutral position in the US-China- Taiwan geopolitical context while also protecting the relative sovereignty and affairs of Taiwan through careful diplomacy and strategic planning. The company has maintained friendly relations with the US and has made significant investments into the US mainland semiconductor manufacturing sector, including the construction of a \$12 billion semiconductor factory in Arizona. However, this factory, along with TSMCs other international factories, will not be producing the most advanced semiconductor chips that TSMC manufactures. They are instead staggered by a margin of a few years: for example, the newly announced TSMC factory in Arizona will only start producing 3nm semiconductor chips, the current most advanced semiconductor technology released in the

market, in 2025. This protects TSMC's proprietary technology, maintaining a need for their production foundries on mainland Taiwan, preserving security for Taiwan and Taiwanese citizens, while expanding globally (Interview 3, SinoAir, Personal Communication, April 20th, 2023).

TSMC has lined their various foundries strategically on the narrow plain along Taiwan's west coast nearest to China, some only 130 kilometers away, in areas deemed as likely sites for a Chinese invasion, coined "red beaches" by military strategists (Lee et al., 2021). Although this may seem like a vulnerability, the possibility of a Chinese seafaring invasion may be diminished due to China's reliance on advanced semiconductor technology. Furthermore, placing key foundries in the line of fire further militarizes the world, most notably the US, to protect Taiwan in the case of invasion, as entire global supply chains rely on these foundries' consistent production.

The term "Silicon Shield" refers to Taiwan's strategic development of its semiconductor industry as a means of protecting itself from potential military threats, namely from China. As Taiwan lacks the military strength to deter invasion from large countries, the focus on building up its key technological infrastructure acts, in itself, as a deterrent from conflict. By becoming a critical part of the global technology supply chain, Taiwan has developed a strategic asset that not only drives its economy, as semiconductor manufacturing makes up about 15% of Taiwan's GDP but also serves as a physical and economic "shield" against any potential military action from China. The development of the semiconductor industry has become a cornerstone of Taiwan's economy and its national security strategy.

The Russian invasion of Ukraine in 2022, however, poses significant challenges for Taiwan. Xi Jinping, the president of the People's Republic of China, has been closely monitoring the Russia-Ukraine crisis, specifically the reactions of other global superpowers. Although Xi Jinping is characteristically not "hot-headed," the ability of Russia to withstand sanctions and maintain its economy purely from relationships with allies, provides President Xi Jinping with more information regarding the feasibility of an invasion of Taiwan. US military analysts are on high alert, but due to China's proximity to Taiwan, it remains highly unlikely that foreign militaries will be able to defend the small island if a full-scale invasion were to take place (Hale, 2023).

Lastly, it is necessary to elaborate on the general processes of the semiconductor supply and value chain to understand where TSMC and other semiconductor foundries play a role, and to further understand the impact of shortages from all points in the chain. The semiconductor supply chain typically involves several stages, starting with the sourcing and attainment of raw materials such as silicon, copper, and aluminum from natural deposits from around the world. The next stage involves wafer fabrication, where the materials are turned into small silicon wafers. The wafers are then sent to foundries such as TSMC for processing, where they are embedded with intricate circuits. After the wafers have been processed, they move on to the assembly and testing stage, where the individual components are assembled into final products such as microchips, CPUs, and memory chips. This is where the technology becomes specified depending on clients' needs and their sector of operation. Finally, the distributed products are distributed to end-users or integrated into larger systems, such as automobiles, smartphones, or military equipment.

TSMC plays a significant role in the wafer fabrication and processing stages, which are critical steps in the semiconductor supply chain. As the largest set of semiconductor foundries in

the world, its advanced manufacturing processes and cutting-edge technology have made it a leader in the industry.

Geopolitical tensions often arise at various stages, with the wafer fabrication and processing stage being a particularly sensitive area. This is because the foundries of companies like TSMC are typically concentrated in one or two countries, such as South Korea and Taiwan, making them vulnerable to supply shocks and disruption from geopolitical tension. The recent US-China trade war and tensions between China and Taiwan have highlighted the potential risks of relying on a small number of suppliers for critical components like semiconductors. As a result, countries and companies are now looking to diversify their supply chains and reduce their dependence on a few key players (Masse, 2022).

Positionality

It is important to highlight potential biases I may have in conducting this research on the topic of semiconductor supply chains and their associated geopolitics. I am an American citizen that was born in India, raised in South Africa, Mauritius, and the United States, and who currently goes to school at Georgetown University in Washington, D.C., the capital of the US. I am a student at Georgetown's Walsh School of Foreign Service (SFS), a very politically active institution that regularly invites many types of political discourse.

However, much of the discourse in the SFS centers around the US acting as the central agent in geopolitics worldwide. Subsequently, a Chinese or generally Asian perspective may be discussed, but never truly considered. In hopes to understand my research topic in its entirety from all viewpoints without an overly Western bias, I took it upon myself to generally focus on supply chain issues and how they affect geopolitical relationships, rather than how geopolitical relationships affect the semiconductor supply chain. This proved to be difficult, as most of the

novelty around the semiconductor supply chain compared to other industries stems from its involvement in the geopolitical context between China, the US, Taiwan, Russia, Ukraine, and even the rest of Europe and Southeast Asia. Therefore, I also sought to secure diversity in the backgrounds of my interview candidates, focusing mostly on Chinese, Taiwanese, and generally East Asian supply chain viewpoints, since most of the literature on the topic that is available to me comes from Western media sources and US publications. Although this created some challenges in terms of a language barrier, as most of my interviewees primarily spoke Mandarin, I felt it to be necessary to emphasize their opinions in this analysis. Together, I believe that I have successfully incorporated fact-based, diverse viewpoints into the following research to gain a clearer picture of the semiconductor supply chain and its points of contention. However, it is necessary to disclose my general predispositions to the US perspective regarding this research topic.

As I mentioned briefly, I had significant trouble sourcing documents from other perspectives due to language barriers. Most academic documents related to the semiconductor industry were originally written in Mandarin, Japanese, or German. With translators being unreliable overall, I had trouble extracting information from these sources. Therefore, the textual evidence in this research may have a Western-leaning bias.

Lastly, I would like to mention the overall lack of geopolitical primary and secondary source analysis on this topic. As the new age of geopolitics in the semiconductor industry in relation to Taiwan, China, and the US is a relatively new topic, exacerbated further only recently through the Russia-Ukraine conflict and the COVID-19 pandemic, academic journals and research institutes haven't fully surveyed the geopolitical landscape with this view in mind. Furthermore, the only primary source documents available are recent government bills protecting respective national interests in technology, with only a select few focusing primarily on semiconductors. Therefore, the following analysis is relatively novel and based on conclusions drawn from previous historical, financial, and diplomatic perspectives, in addition to anecdotal opinions from my interviewees.

Methods & Ethics

To conduct the following research, various sources were used to gather information and to gain a holistic view of the semiconductor supply chain and the associated geopolitics surrounding the industry. These sources were academic papers, news articles and other media documents, government legislation, and interviews with experts. The initial literature review and following research were compiled from academic papers using online databases such as JSTOR and Google Scholar. The search items generally used were "semiconductor supply chain," "US-China-Taiwan relations," "Taiwan Semiconductor Manufacturing Company," and "Impact of COVID-19 on supply chains." The selection of papers was based on their relevance to the research question and research objectives, date of publication, the credibility of sources and authors, and potential biases of sources.

To analyze potential problems in the semiconductor supply chain, academic papers, and articles generally focused on supply chain efficiency were also sourced. To narrow down research, academic papers specifically focused on the operations of "high" technology supply chains were further considered. These publications included topics related to supply chain management, risk management, and raw material sourcing considerations.

News articles from reputable sources were used to provide the most up-to-date information regarding the semiconductor industry, and were notably helpful in following the timeline of semiconductor shortages throughout the COVID-19 pandemic in various industries worldwide. The selection of articles was based on their relevance to the research question as well as their reliability.

Although limited, recent government legislation regarding technology industries as well as the manufacturing of localized semiconductor foundries were also considered to further draw a bridge between the private and public sectors' need for semiconductor technology.

The contacts for interviews conducted were sourced through this research project's mentor, Professor Jessie Yan. Professor Yan contacted supply chain specialists and investors in her network and coordinated their involvement in this research. This was a great help throughout the interview process as experts in this field are usually hard to get in touch with, especially for an undergraduate student writing their first research paper.

After being connected with potential interviewees, a summary of the research project was sent to them, along with objectives related to the research that would be relevant given each respective interviewee's industry of focus. Two of the contacts that were sourced believed they didn't have the necessary knowledge to provide thoughts on the topic. All others agreed to be interviewed. A statement was included at the end of each email stating that anonymity could and would be preserved if the interviewee requested it.

Interviews were conducted over Zoom due to interviewees traveling and location constraints. It proved to be extremely difficult to find an industry professional to speak to within Geneva who was willing to be interviewed. All interviews were conducted in English. The interviews were either semi-structured or very structured, depending on the preferred style of the interviewee, an aspect that was decided upon over email before the interview took place. All interviews were transcribed using Otter AI, an AI transcription tool that logs on to Zoom meetings and uses the context of conversations to ultimately transcribe and summarize the conversation using the key talking points mentioned.

An interesting point to consider is that since most of my interviewees were in Beijing at the time of being interviewed, they were generally unresponsive over email when asked about the geopolitical implications of Taiwan's semiconductor industry within China. This is likely due to China's heavily monitored internet services which look into users' communication, but this is not certain. In order to keep interviewees comfortable, these topics were directly avoided in conversation but geopolitical questions were left open-ended to be potentially expanded upon if interviewees saw fit.

None of the interviewees were paid during this research and the interviewees were informed that the transcripts from these interviews would be included in the final research report. Something to consider is that since all interviewees were sourced by my project mentor, interviews may have been agreed upon due to professional or personal expectations in their relationship to Professor Yan. However, all interviews were conducted professionally and no significant problems were encountered.

Presentation of Results and Findings

Consumer Goods

The impact of COVID-19 on the production of specific consumer goods segments such as smartphones, laptops, and automobiles have become a major concern for key businesses responsible for supplying products to consumers worldwide. Although semiconductor companies have experienced supply disruptions in the past, such as the 2011 Fukushima earthquake, tsunami, and subsequent nuclear disaster and flooding later that year, COVID-19 has had many more lasting impacts than these singular traumatic events (Raskob, 2020). According to various economic analysts, the total losses faced by the automotive sector worldwide due to semiconductor shortages from the COVID-19 pandemic totaled \$61B in 2021 with some citing totals of \$210B (Alam et al., 2021). Apple, the world's largest singular private buyer of semiconductor chips, had to delay the launch of the iPhone 12 by two months due to a lack of processing chips (Sweney, 2021). There are estimated to be a total of 169 different consumer sectors affected by the pandemic-driven chip shortage (Howley 2021). The pandemic highlighted key challenges in the semiconductor supply chain's ability to keep up with demand in times of crisis. Before these challenges can be addressed, it is necessary to understand the context of these shortages in specific industries and what caused them.

The perfect storm of skyrocketing chip demand, manufacturing capacity, and logistics constraints caused COVID-19-related semiconductor chip shortages worldwide (Alam et al., 2021). The following section will explore these aspects in more detail.

Skyrocketing Chip Demand

The COVID-19 pandemic has had a profound impact on the way that humans work and learn, with remote activities becoming more prominent. With this shift in consumer behavior, the demand for consumer electronics has unequivocally surged, resulting in the significant increase in the need for semiconductors. The industry today in 2023 is still feeling the effects of the initial shortage caused by the pandemic, with its impact expected to continue with the potential for further price increases and longer wait times for products.

Although the coronavirus pandemic was the original source of this increased demand, the demand for consumer electronics has maintained itself. The average consumer is said to have had a 60% increase in their online video streaming consumption since the pandemic ("Tracking Impact Consumption," 2020). With technology taking more of a central role in the lives of

consumers worldwide, items such as laptops, smartphones, headphones, mics, and TVs are being regarded as necessities for work and leisure, rather than luxuries. Consumers are simply demanding a broader portfolio of product categories that contain chips. For instance, PC sales rose 4.8% in 2020 to 275 million units, the highest annual growth since 2010 (Leswing, 2021).

A study conducted by McKinsey & Company suggests that more industries such as healthcare, grocery shopping, travel, and learning will be permanently affected by new consumer behavior. The prevalence of virtual checkups, grocery delivery services, and remote learning providers in recent months has only confirmed this notion. Even further, the study found that the ubiquity of remote activities is positively correlated with the development of infrastructure. This highlights the importance of government signaling and its effect on consumer behavior (Remes et al., 2021). For example, without adequate internet access during and after COVID, entire communities can be marginalized to a much greater extent than before the pandemic. Therefore, governments and companies are incentivized to develop large scale operations to ensure people are connected, increasing the demand for semiconductors even further. Thus, the surge in semiconductor demand came from both private companies and public institutions.

Another problem in the demand scope is the reliance on primarily TSMC for most general and essentially all advanced chip needs. Automotive companies realized during the COVID-19 pandemic that it's a lower priority than consumer electronics companies at the foundries which are the essential portion of the semiconductor supply chain. In 2020, for example, only 3% of TSMC's sales were to automotive manufactures, compared to 48% for smartphones alone (Reuters Staff, 2021). Distribution decisions from the semiconductor foundry level of the supply chain most directly affect the prevalence of shortages worldwide. Semiconductor foundries heard these complaints, and TSMC specifically, who is

characteristically known to have good communication with all of its major clients, said that it was trying to help auto companies to the best of its ability, and said that it would spend as much as \$28B in 2021 to further increase its capacity for automotive chip manufacturing (Leswing, 2021). However, experts predict that it will take until 2024 or 2025 for industries to see a significant increase in capacity.

Long Lead Times

Imbalances between supply and demand are particularly acute in the semiconductor industry, as it takes approximately 18 weeks to produce a semiconductor chip when all of the components of the supply chain are accounted for. Building additional semiconductor capacities, or building entire new foundries, is a costly venture. It requires six to nine months and billions of dollars in funding. This means that when demand for semiconductors increases rapidly, the industry is unable to respond to meet that demand, leading to even longer lead times. This is the primary reason, along with revenue maximization, that companies like TSMC are expanding globally while still holding on to their proprietary technology, as previously stated. More localized foundries can cut production time, costs, and inefficiencies by a significant amount.

Further, expanding globally protects workers worldwide, as when there is a semiconductor shortage, factories and assembly lines essentially halt the production of units. During the pandemic, companies learned, from experience, that a 10-cent silicon chip can have a dangerous impact on the production efficiencies of multi-million dollar manufacturing hubs and their personnel. As Clarence Brown, the president of the United Auto Workers Local 31 in Kansas City, states, "All I know is, the reason that my plants and other plants in this country are off is because of the semiconductor [shortage] and no fault of the working man. When you run out of those chips, what good is a \$30,000 car?" (Whitley, 2021). A prominent head of one of

Mexico's key automotive sectors believes that one in five Mexican automotive workers had lost their jobs from March to November 2021, when the chip shortage hit its peak (Esposito & Angulo, 2021). The effects from the initial production disruption have remained, however. Key auto plants in the US have further laid off thousands of workers in 2023 (Cao, 2022).

The possibility of innovation of production techniques within the semiconductor industry is still a possibility, however. It is likely that the industry will develop more cost-effective processes and machines to reduce strain on the supply chain. The next cutting-edge technology likely to be utilized is high-NA EUV scanners. These scanners utilize extremely focused ultraviolet light to create the microscopic circuitry needed on semiconductor chips. TSMC states that, by 2024, this technology will be used for both mass production needs and highly specialized, advanced chips (Lee & Nellis, 2022). High NA EUV scanners have the potential to significantly reduce lead times and even increase the performance of semiconductors while reducing their size and power consumption. Production efficiencies and increased spread of semiconductor foundries will likely be the most immediate solution to the problem of long lead times.

Logistics Constraints Limit Chip Shipments

Lastly, due to the pandemic, the reduced number of flights and the closure of airways as well as key transportation hubs has led to further inefficiencies and delays in chip shipments. Furthermore, the unexpected grounding of dozens of Boeing B777 flights due to engine failures and the shipment of critical COVID-19-related items further reduced air cargo capacities by 20% overall in 2020 ("Air Cargo Market Analysis," 2020). These factors led to increased costs and even slower delivery times for the semiconductor industry. Another big problem to semiconductor manufacturers during COVID and beyond was the shortage of substrates. Substrates are the materials that connect chips to the circuit boards; they are crucial elements in the manufacturing process of semiconductors. However, due to other indirect issues with supply chains during the pandemic. However, recent fires at substrate packaging factories in Taiwan have made matters worse (Lapedus, 2021).

As there are essentially no major transnational semiconductor companies with foundries in many different countries, the semiconductor distribution protocols are generally direct to business through air shipments. Therefore, there can be a lot of transactional inefficiencies in the period from the source semiconductor foundry, likely in South Korea, Japan, the US or Taiwan, to the client business. Components for a chip could travel more than 25,000 miles before completion and cross more than 70 borders before the final chip is delivered to the desired business, says Syed Alam, Accenture's global semiconductor practice lead (Joannou, 2020).

These challenges in the semiconductor industry signal the need for robust supply chain management and strategic planning by semiconductor manufacturers, private companies, and governments alike to mitigate the impact of unforeseeable events like COVID-19 in the future. Semiconductor shortages affect many industries, and specifically puts vulnerable workers at risk. *Government Intervention*

The US-China trade war, which started in 2018 under US President Donald Trump's administration, has had various consequences that are still shaping the semiconductor supply chain and overall industry today. On April 4th, 2018, when the US government issued a list of goods that would be subject to tariff increases. This led to a 25% tariff being imposed on 1,333 different Chinese goods worth \$50B exported to the US. The direct "trade war," where countries imposed sanction after sanction on each other, lasted for over a year, where both sides imposed six rounds of successive, mutual tariff increases. The semiconductor industry was hit particularly

hard between the US and China and the rest of the world, and its effects are felt significantly today (Xiao, 2022).

Prior to the trade war, China was reliant on the US for semiconductor manufacturing, design, and for other semiconductor related technologies due to China's large domestic demand for high-technology products. The trade war made it more difficult for China to access this technology, pushing China to build domestic semiconductor foundries to satisfy its own demand in the long run. This allowed China to further strengthen ties with TSMC and support its largest domestic semiconductor company, the Semiconductor Manufacturing International Corporation. However, later in 2020, the US imposed further restrictions on China and SMIC specifically, requiring export licenses in order for US companies to supply certain key equipment to SMIC, citing military concerns. They passed similar restrictions limiting American business ties with the Chinese technology company Huawei. These moves directly challenge China's plans to become self-sufficient in domestic semiconductor manufacturing as, without help from US technology, SMIC was unable to manufacture, on scale, the chips that Huawei needs for its smartphones and other handheld devices (Kharpal, 2020).

Therefore, China's reliance on TSMC has grown significantly over the past few years, as the country aims to end its reliance on US chip technology. In 2020, China accounted for 21% of TSMC's revenue, making it the second largest market for TSMC, next to the US. However, ongoing tensions between China and Taiwan have made it difficult for China to secure all the chips it needs from TSMC, despite TSMC having a foundry located in China producing 16nm chips (Pan, 2022). In fact, TSMC has been known to regularly reduce its orders from Chinese clients in response to pressure from the Taiwanese government. Many experts state that the present state of domestic Chinese chip manufacturing is in its early stages, therefore, making it

unlikely that China would take any action that would jeopardize its relationship with the chipmaker (Cheng, 2022).

A war over semiconductors and geopolitical tensions will likely be a war of ideologies, as history has shown that people tend to value ideology more than economic interests. The recent geopolitical tensions between the US and China demonstrate this, as the conflict is rooted in ideological differences between the two nations, rather than purely economic ones. Similarly, any potential conflict over semiconductors will likely be driven by ideological tensions rather than simply economic ones. The semiconductor industry is highly technological, and it represents a symbol of innovation and modernization for many nations. Therefore, the control and access to this technology will be a source of pride and power for countries. This is why it is important for nations to remain aware of the potential for rapid militarization and escalating tensions over semiconductor shortages, and to work towards diplomatic solutions that prioritize cooperation and mutual benefit over ideological differences (Interview 1, Mr. Tian (Jeffrey) Jing, Personal Communication, April 19th, 2023)

Similarly to China, the US has also been actively looking to boost its own domestic semiconductor industry to reduce reliance on foreign sources, citing national security concerns posed by reliance on foreign foundries. There are a lot of potential risks when a vital industry like semiconductors is outsourced overseas to one or two companies. Access to specific product material competencies may be lost and technologies may be lost domestically, where the knowledge gap is so significant that the dependent country may never be able to become competitive in the industry again. One possible way to mitigate this is by developing, at the same time, risk management and a risk assessment approaches (Interview 2, Dr. Yazid Debbich, Personal Communication, April 19th, 2023).

This has led to the US creating the Creating Helpful Incentives to Produce

Semiconductors and Science Act (CHIPS Act), which was passed into law on August 9th, 2022. The CHIPS Act authorized over \$200B in spending for the US domestic semiconductor industry over the next 10 years to address the semiconductor supply chain's vulnerabilities. The act's key provisions include increasing federal funding for research and development, establishing a new National Semiconductor Technology Center, and providing monetary incentives for semiconductor manufacturing within the US. Following shortages during the COVID-19 pandemic, the act also aims to improve the coordination between federal agencies and the private sector to address critical issues and chokepoints within the semiconductor supply chain (Badlam et al., 2022).

The passage of the CHIPS Act has led Morris Chang, TSMC's now retired founder, to outspokenly criticize President Biden's plans to reinvigorate the US domestic semiconductor industry, stating that Taiwan's chip sector is being "hollowed out" at the expense of its security (Powers-Riggs, 2023).

There is a fine line that the US is currently traversing in semiconductor relations. On one hand, the US is trying to appease TSMC and protect the Taiwanese semiconductor industry due to the domestic need for semiconductors and for national security reasons against China. On the other hand, however, the US is trying to rapidly grow its own semiconductor industry to eventually curb its reliance on other countries. The cause of this dilemma is the fact that the US' need for semiconductors is already well underway, and Taiwan, specifically TSMC, got an early jump to capture global demand, leading to even further innovation and development of intellectual property rights on production processes.

In general, however, it seems that the global fight for semiconductors is being led by governments, not companies. Although this can be argued as effective or ineffective, it is better to think about the overall ethical sustainability of these actions. While companies may fight over every last dollar of revenue, governments are competing for access, allowing their population to further gain access to devices that rely on the semiconductor industry. This intention is not without its perks, however, as governments are looking to outcompete their adversaries in the process. However, governments do have an ethical obligation to work to secure local manufacturing for semiconductors to protect workers, allow industries to maintain operations, and provide access to new technology to foster innovation.

Military Technology

It's not just economies that depend on semiconductors, military capability directly depends on a country's ability to access semiconductors. After the Vietnam War, the US put a lot of effort into developing new military technology, which at the core utilize semiconductors. On the other hand, Russia did not have this hindsight. This is why many military experts regard Russia as a third-tier military power if it weren't for its nuclear weapons. Much of Russia's general military strength can be explained by its relative technological backwardness (Fernández-Villaverde, 2023).

The semiconductor shortage has had a rippling effect throughout the supply chain for military technology production. The military industry is a key market segment for semiconductor companies as advanced weapon systems rely heavily on this technology. Examples of military technology that utilize semiconductors include radar systems, communication systems, and advanced guidance systems for missiles and drones. These systems are also heavily reliant on semiconductor technology in terms of volume: for example, a single Javelin, the anti-tank weapon that the US supplied to Ukraine when Russia invaded, requires over 250 chips. At the onset of the Russia-Ukraine crisis, hundreds of Javelins were requested by Ukraine, but the US had trouble procuring all of the semiconductor chips needed (Hayashi, 2023).

The difficulty of securing semiconductors for military use during times of military conflict has become a significant concern for many countries. Semiconductor shortages can cause severe disruptions in the production of military technology, including advanced weapons systems and communication devices. In response to these concerns, some countries have started to stockpile semiconductors to ensure they have a reliable supply during times of conflict. Additionally, some countries are further militarizing to always be prepared for potential conflicts, such as Poland, which has increased its defense budget and is currently developing its domestic semiconductor industry. However, these solutions come with their own challenges, such as the high costs associated with stockpiling and militarization, and the potential for a destabilizing arms race (Interview 2, Dr. Yazid Debbich, Personal Communication, April 19th, 2023). It is essential for countries to find a balance between being prepared for potential conflicts and maintaining stable and secure supply chains to avoid exacerbating geopolitical tensions.

Poland is one country that has recognized the importance of securing a stable supply of semiconductors for military use. In 2019, the Polish government announced a plan to increase defense spending to 2.5% of GDP by 2030, with the goal of modernizing its military and making it more self-sufficient. This includes investing in domestic semiconductor production and research, as well as stockpiling critical components such as microchips. Poland has also partnered with other European countries, including Germany and France, to establish a joint military cooperation project called the European Intervention Initiative (EI2). The EI2 aims to increase Europe's defense capabilities and promote collaboration on military research and

development, which could include semiconductor technology. In addition, Poland has expressed interest in participating in the European Union's new European Defense Fund, which provides funding for military research and development projects. By taking these steps, Poland is working to ensure its military has access to the critical semiconductor technology it needs, even during times of geopolitical tension or supply chain disruptions. However, it remains to be seen how successful these efforts will be in the face of the ongoing semiconductor shortages and global geopolitical tensions ("Poland's Defense Spending," 2022).

The semiconductor shortages have highlighted the importance of the semiconductor industry for military technology, especially in times of conflict. The geopolitical tensions and military rivalry between countries have made it difficult to secure semiconductors for military use, which has led some countries to stockpile semiconductors and increase their military capabilities. However, this approach could lead to a rapid militarization of Europe and further exacerbate geopolitical tensions in the region. It is crucial for countries to be aware of this potential outcome and work towards a more collaborative and coordinated effort in securing semiconductor supply chains for military technology. This will help prevent the escalation of geopolitical tensions and ensure a stable and secure global supply chain for semiconductors.

Future Areas of Research & Conclusion

The semiconductor industry is a crucial component of modern technology and the global economy. As explored in this paper, the disruptions to the semiconductor supply chain have far-reaching implications, from the production of consumer goods to the development of military technology and the geopolitical tensions between countries. This conclusion will reiterate key findings, discuss the significance of ensuring fair and reliable semiconductor distribution for fostering a stable and secure supply chain, and suggest potential future research areas to further deepen the understanding of semiconductor geopolitics.

The first section of research focused on the impact of semiconductor shortages specifically on the production of consumer goods, such as smartphones, laptops, and automobiles, among other consumer electronics. Specific instances of the COVID-19 pandemic, the US-China trade war, and geopolitical tensions between the US, China, and Taiwan have all contributed to significant disruptions in the semiconductor supply chain. Companies that rely on semiconductors have had to adapt their production processes or engage in the risk of stockpiling semiconductor technology that may be outdated within a short time frame. This has led to delays, price increases, and in some cases, even a decrease in product quality. The scarcity of semiconductors has also led to a shift in power dynamics between companies and suppliers, as well as between nations.

The second section of this paper examined the impact of semiconductor shortages on the overall production of military technology. It is important to remember that the military sectors of governments worldwide are key market segments for TSMC and other semiconductor fabrication facilities. The use of microelectronics in military applications has become a vital component of national security. Disruptions to the semiconductor supply chain can have severe implications for countries' ability to defend themselves, create allies, and maintain their national interests. Government policies and interventions play a crucial role in addressing the semiconductor shortages in the military technology sector.

The paper overall explored the geopolitical implications of previous semiconductor supply chain disruptions. It has been shown that US-China-Taiwan geopolitical tensions are intricately connected to the semiconductor industry. The dependence on Taiwan for semiconductor manufacturing has made the island a pawn in the geopolitical game between the US and China. Taiwan stands in a precarious situation as the US attempts to localize semiconductor foundries to rid itself of its dependence on other countries to secure semiconductors for US companies and the US military. Other countries, such as Japan, South Korea, and the EU are also significant players in the semiconductor sphere and could have impacts on the global supply chain in the future.

The value criterion of this research paper is to ensure fair and reliable semiconductor distribution for fostering a stable and secure global supply chain. We saw that the semiconductor industry's disruptions can lead to power shifts and geopolitical tensions between countries. Therefore, it is crucial to ensure that the distribution of semiconductors is fair and reliable to promote a stable and secure global supply chain. This requires targeted government policies and interventions that prioritize local industries while being aware of the well-being and interests of all countries involved in the semiconductor industry.

Future research on this topic can focus on several areas. One area of research could be examining the role of smaller players in the semiconductor industry and their impact on the global supply chain. While the focus has been on major players like TSMC, SMIC, and Intel, smaller players in the semiconductor industry may have a significant impact on the industry as TSMC's advanced technology protections slowly fade away due to innovation within the sector (Interview 3, SinoAir, Personal Communication, April 20th, 2023).

Another area of research could focus on the impact of the semiconductor industry on emerging economies. As more countries invest in the semiconductor industry, there may be implications for global economic power dynamics. Countries such as India, for example, have already felt the effects of semiconductor shortages on their consumer electronics sector as well as their military sector. During COVID, the global semiconductor shortage led to significant delays, costs, and delays in production affecting the manufacturing of India's advanced weapons systems (Gargeyas, 2022). Understanding these implications can better help policy makers create legislation that not only protects individual national interests, but also those of the countries on the periphery of the global economy.

In addition, the research could also explore the role of emerging technologies such as quantum computing and neuromorphic computing in the semiconductor industry. Creating more use cases for alternate types of information processing could jumpstart innovation and help diversify semiconductor manufacturers' operations. However, current operations and distribution need to be solidified before this venture can be taken. Research into the advantages of semiconductor expansion into new forms of information processing could be extremely useful, however.

Furthermore, the research could delve more deeply into the role of government policies and interventions in ensuring fair and reliable semiconductor distribution. The US government's CHIPS Act is an example of such a policy. Future research can examine the effectiveness of such policies over the long run in addressing the semiconductor supply chain disruptions and their geopolitical implications.

Lastly, research could explore the impact of the semiconductor industry and its potential role in causing geopolitical tensions. If US-China-Taiwan tensions continue to escalate, there may be further implications for the semiconductor industry and its global supply chain. It could transpose into a second "Cold War." Understanding these implications can help policymakers learn from past mistakes to ensure a secure and stable supply chain.

The value criterion of this paper is to ensure fair and reliable semiconductor distribution for fostering a stable and secure global supply chain. This criterion is important because it emphasizes the need for a sustainable and secure semiconductor supply chain, which is critical for the global economy and national security. The semiconductor industry's geopolitics further emphasizes this need. Fair and reliable semiconductor distribution operations can ensure that countries have access to the critical components necessary for the production of consumer goods and military technology. In today's day and age, access to and ability to make technology is a necessity for any community. By ensuring the semiconductor supply chains remain sustainable and secure, policymakers will be more equipped to prevent potential future disruptions to the supply chain.

In conclusion, the disruptions to the semiconductor supply chain have far-reaching implications for the global economy, national security, and geopolitical relations. Ensuring fair and reliable distribution is essential for fostering a stable and secure global supply chain. Government policies and interventions play a crucial role in addressing the shortages and their subsequent geopolitical implications. Future research in semiconductors geopolitically can further explore the industry's impact on the global supply chain and national security interests and uncover the challenges and opportunities of semiconductor geopolitics.

Journal

Week 1: 3/19/23 - 3/25/23

I started this week by reading the book "Chip War" by Chris Miller in order to build a foundation of understanding what semiconductors are, how they were created, and how the key players in the industry today rose to power. I supplemented this by researching the existing academic literature around semiconductors in order to take into account the topics that have already been explored, and which have still yet to be touched upon. I decided my main goal throughout this research was to find something novel to explore. Although this seems to be a daunting task, I think I'm up to the challenge. Lastly, I further read up on semiconductor shortages from a variety of sources throughout the COVID-19 Pandemic in order to review which industries were hit particularly hard so I can better structure my research paper. I have not yet received a mentor, so I'm hoping that I'll have someone to discuss my thoughts with next week.

Week 2: 3/26/23 - 4/1/23

I have thankfully received a mentor, Professor Jessie Yan who works at the International Institute in Geneva. I have sent her an email suggesting that we meet sometime next week. In the meantime, I reviewed the government bills that were passed in various countries around the world regarding "high technology" and semiconductor supply chains. I found some interesting topics that I hope to include in my research paper, but I ended off with even more questions. Since semiconductor supply chains are not an established area of research, as the geopolitics surrounding them recently picked up after COVID, it is tough to answer some pressing questions I have. I'm hoping that after talking to Professor Yan, she can give me a solid plan to go about researching the intricate parts of the semiconductor supply chain. Lastly, I started sourcing interviewees. I want to ensure I interview professionals from all sides of the topic, the Chinese perspective, the Taiwanese perspective, and the American/Western perspective. Although I'm having trouble finding applicable professionals who can provide me with a Chinese or Taiwanese perspective, I have emailed two Georgetown professors specializing in supply chains and geopolitics, respectively, with a request to interview them. I'm hoping Professor Yan can link me with some of her contacts for the remaining interviews.

Week 3: 4/2/23 - 4/8/23

- This was a tough week for my research. Over the past few months, I've been preparing to get certified as a Mortgage Loan Originator in the US. This week, I had my exam. Although I thankfully passed, the stress of the exam led to a distraction from my research. Thankfully, however, Professor Yan asked some of her contacts if they were interested in being interviewed for my research. Four of them said yes! Upon further conversation, one of them didn't feel as if she had much to add to the conversation so she unfortunately had to ultimately decline. The other three were completely on board, however. Although the Georgetown professors I contacted either didn't respond or declined my interview request, I believe these interviews will fulfill my requirement because one of the interviews will be with four professionals from SinoAir, a Chinese logistics company. As long as I can count this as four separate interviews, this will fulfill my six required interviews. Hopefully, I can accomplish more in regards to my research next week.

Week 4: 4/9/23 - 4/15/23:

- This was my busiest week yet. After talking with Professor Yan last week, she suggested that instead of framing the paper as "How do geopolitics affect the semiconductor supply chains," I should instead think about framing it as "How do semiconductor supply chains affect geopolitics." I was a little apathetic at first, but now I am convinced that this is the right way to go. Therefore, I've been reading the main academic literature around generally understanding how supply chains work so I can eventually analyze semiconductor supply chains from an industry perspective. I further started reading articles and papers about how specifically "high-tech" companies structure their supply chains in order to reduce costs and stimulate growth. At the end of the week, however, I'm having trouble finding the direct application of my reading within the overall plan I've constructed for my research paper. There also doesn't seem to be much publicly available, English literature on specifically semiconductor supply chains. I hope that I can get started on writing my paper next week with a clear plan.

Week 5: 4/16/23 - 4/22/23

This week, I conducted all of my interviews. I had all of my interviews within a two-day span so I can thankfully say that I can purely focus on the research and the paper now. There was a significant language barrier with two of the interviewees, but thankfully they provided me with a wide breadth of information and further resources to draw from. After the interviews, I have been compiling them, summarizing them, and thinking of what to extract from them to include in my research paper. This week I also focused on media sources, analyzing how the Russia-Ukraine conflict affected semiconductor supply and distribution, and more specifically how the conflict changes China's perception of feasibility in regards to an invasion of Taiwan. I've also decided on a structure for my
paper, splitting it into two large sections on the supply chain impact on consumer goods and military technology. The consumer goods section will focus more on supply chain difficulties and the military technology section will focus more on concepts related to national security. I started writing my research paper this week as well, but not as much as I would've liked.

Week 6: 4/23/23 - 4/30/23

- It was all writing this week. Thankfully, all my preparation over the past five weeks paid off. The process of writing this paper was essentially just summarizing my plan and my notes on my sources. However, it was a lot of work to complete in a week. Thankfully I got it done and I'm proud of the work I'm submitting!

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Appendix

Interview 1: Mr. Tian (Jeffrey) Jing

Mr. Tian (Jeffrey) Jing

Some of the some of the US, Australia and European and UK schools. So that's basically about myself, I'm still looking at opportunities in shipping. Okay. And we have invested recently a shipping company that operates and owns seven vessels that are going for science exploration missions. Okay. In other words, these ships are designed with scientific and technology, vehicle vehicles laps on the ship, so that they can actually monitor the sea environment and the diversity of biological formation of some of the Sea area. And also, they have facilities to watch the the graph, the actual geographical thing from the bottom of the seat. Yeah, that's really cool. So, so that's a very exciting and interesting business and the ships, one of the ships is going to Antarctica from end of October, this year, and they're going to provide some shipping services for the researchers on board of the vessels that are looking at the melting effect of the iceberg in Antarctica. So that's basically what I'm doing.

Aditya

Yeah, no, that's, that's totally interesting.

Mr. Tian (Jeffrey) Jing

So how about your project, anything you want to discuss? And so I'm really

Aditya

actually really interested to hear about your opinions through I mean, your kind of back end investment perspective, with your external client that's, you know, invest a large sum in these companies. So I guess I would start off with asking if you have any opinions, or if you can kind of explain to me more about TSMC as dominance in the industry, and the implications of their expansion plans in the US on purely an investment perspective.

Mr. Tian (Jeffrey) Jing

Well, dmsc is a great company that are investing for long periods of time in mainland China. And in Taiwan, it is a key semiconductor producer, it's actually making a huge impact of the entire global semiconductor industry. And goal timing, the chairman of that company, obviously, it's been recently expressing some of his early intention to run for presidency of Taiwan. And and haven't see I think the company is making some of the heart dilemma in the last few years. So whether they should leave China, Chinese mainland at the pressure of the Western countries that the US the political intergroup, graphical Chair of political powers, and these influences will continue to make an impact the relationship between Chinese semiconductor factors and Chinese semiconductor users, and its suppliers from Taiwan. And the United States is providing very, very high favorable subsidy for the Taiwan Semiconductor makers MNCs. Obviously, it's one of them to set up their plants in in the United States. And these would create a situation where the United States is picking up. Some of the phones were in business, instead of leaving them to be done by Taiwanese suppliers inside Taiwan. And there is a strategic shift by the United States, decision makers and the Congress key members of Congress to move some of the Taiwan manufacturing capability into the United States and try to build up a bottleneck a technological bottleneck for for PRC, People's Republic of China, mainland China. So that Chinese manufacturer industry will face a very strong challenge from continue to be a world factory because semiconductor is obviously something from your body is something. Once that is we tightened situation for China's entire manufacturing and what we call the advanced manufacture, industry will be difficult and that. But yeah, and the company is obviously standing in this very sensitive middle of the political game, I think we have to look at the election of Taiwan next January, that's going to make a very important impact. Yeah. Between the relationship with China and the Western world.

Aditya

So regarding TSMC, as intellectual property rights over the newest technology, semiconductor chips, chips, and as you just described, the prevalence on mainland China, do you think that right now TSMC is goal is or loyalties, you could say, are to its shareholders to overall growth to revenue maximization? Or to Taiwan's well being? Like, where do you think their current focuses?

Mr. Tian (Jeffrey) Jing

I think overall, you know, when you look at semiconductor and these high tech industries, many of the players are tough entrepreneurs, either in Taiwan, or in the United States, and these guys have very strong value based strategies. And most of the time, they would not only look at their their short term interest, you know, stock price going up and downs, revenues and incomes, they're looking at long term interest and long term benefits of their shareholders. And a lot of their, a lot of times they are making decisions of strategic values instead of short term. So obviously, the value system, I mean, the political values are entirely different between some of these elites, and top entrepreneurs, like the chairman of MC. And I think that is also a reflection of a key disparity of values between China and the United States, obviously, Taiwan is a democratic, you know, a sovereign power. We, you know, to me, mainland China, we cannot call it a nation, but it's actually, by a lot of standards, it is a nation that is existing. It hurts Chinese mainland is failing that to allow, you know, the Taiwanese to, to have very different political and social values towards democracy, and freedom, law based governance, but that's obviously the trend of the world, friend of the civilized world. You know, when you ask some of the top of the elites human in mainland China, they also support the Taiwanese pursuit of democracy, and rule of law, as well as their their market oriented mechanisms and their systems. And he's very strong test and proof of Chinese people's ability, and prove that the Chinese can actually be a democratic governance rather than, you know, what happened in the 1000s of years, you know, a situation where Chinese people are dictated by Imperial and royal families.

Yeah. And Taiwan is a very powerful, indication and very powerful model, that the Chinese people and the people with Chinese origins can actually have very strong, innovative power. And they can also be very innovative in their systems, their social systems, following the trend of the world civilized world, to be a fully democratic society, and a full transparent society that is governed by its own people following the best benefits of his people. And these are very strong terms of values, especially after the four decades of reform and opening up here in China. 10 years people, more and more top elites. And top leaders of companies and social organizations and communities have been more given the concept of the ideas about democracy and the value of a rule based society. So yeah, so given these disparate these these differences, I think the Taiwan entrepreneurs, government leaders, the party leaders, even though they're the parties, the Democratic Progressive Party and coming down, they're fighting against each other on their own Within the framework of democracy, I think that's a very healthy thing. Yeah, so basically, no one supports the system from Chinese mainland. And so that they would actually suffer. Or they would actually be willing to sacrifice some of their business interest, or their values. I think this is normal. The United States, some of the giants in semiconductors of the US, actually, they're they're doing the same. In the West, they have ascension from the United States, Congress LED chip and science act. Most of the time, these top global semiconductor designers, and companies and the foundries Global Foundries and the media, all of these top companies, they're going to lose pieces from China, but they actually have to sacrifice some of their business. Large, larger values.

Aditya

Yeah, I'm just overall mostly surprised with the fact that TSMC is kind of being used as both a physical and figurative buffer between China and Taiwan. Like, if you look at the TSMC boundaries on Taiwan, they're literally on the coast. Right? I mean, they're on the coastline of the East China Sea. And that's to ensure that if an invasion takes place, that the global supply of these vital resources that will

Mr. Tian (Jeffrey) Jing

happen? Yeah, absolutely. That's the situation the entire semiconductor supply chain. Yeah, the world would be disrupted. Yeah, that's going to be a very jeopardized situation of the global production. So no one. I mean, from my personal perspective, I would, the last thing I want to see is a war between men in China. And in time lapse, I don't think the war will heal anything. I don't think that physical war, and the so called physical reunification will make any sense. It doesn't make any sense. When you look over a place by force, by war, when you are more powerful militarily, and you can run his government in a civilized way, and you can't allow His people to follow you from the bottom of their heart. It doesn't make any sense. You know, it Russian fix over key? Do you think that Ukrainian people will follow Russia's odor and their governance? It doesn't make any sense? Yeah. 70 years ago, the Japanese power had taken a majority part of China. But do you think most of the Chinese people actually surrender? Even though physically? They are under the control of the Japanese power? Yeah, no, it's no one here. Temporarily, you know, when some of these more powerful military invasion may happen, that's, that's actually moving to the side of the more powerful ones. But all of this kind of invasion and war in history never ended in in success. Yeah. Because it's people's you cannot do it's the value of people. We cannot take over the hearts of his people. It doesn't make any sense. That's a very stupid Hitler's to take over France. Does that make sense?

Aditya Yeah, I mean,

Mr. Tian (Jeffrey) Jing

that doesn't make any sense. They had so many friends, French, the French were not aggressively fighting.

Aditya

But given your back to them actually super interested to hear about this. So given the COVID-19 pandemic given you said the Russia Ukraine conflict, whatever that highlighted about the fragility of the semiconductor supply chain, and how can we how do you suggest companies take action to mitigate supply chain risks and ensure business continuity?

Mr. Tian (Jeffrey) Jing

I think several points you have to follow and watch very closely. One of the things is the the response from the airline country of the United States towards the sanction against time, like Netherlands, Japan, most controversially career, most of these companies, you obviously have studied the entire science of semiconductor and within its business and value chain, no one, no one single country would actually build up any semiconductor from the very beginning to the end. It is a clear result of you know, global adaptation of technology and production. Yeah. And that's what the world has been through in the last 30 or 40 years, you know, given the help of WTO, given the various strong integration of China into the rest of the world, after 2001, when China entered into WTO, funny two years ago, yeah. And technology wise the world, it's more and more enrollment, countries cannot do without each other. So now we have to look at the response from Netherlands, Japan. Currently, it seems that they are on a very clear step to follow the US choice of section in China on more and more semiconductor products.

Aditya

So are you more there by day organization, they're

Mr. Tian (Jeffrey) Jing

in red, they're increasing, they're actually increasing the level of sanctions against chain. So know, if the United States is doing that alone, they're not going to succeed. Because of globalization, no one in semiconductor, industry can actually ascension China and kill Chinese industry. But if the United States joined forces with these airlines, the situation may be very, very challenging for China and China have to address that situation. Because that's definitely a damage, a clear and visible damage to our industries, to our technology improvements, well make some strategic choices. And that's one of the things that you should look at. The second thing, I think, we should look at the swing countries that are trying to struggle to make decisions and whether funding the United States sanction is trying to or to keep its, you know, moderate relationship with China. And to try to keep a a possible portion of Chinese market in order to have their own benefits either on their shareholders or their national strategic interest. Career is obviously with the South Korea is obviously a perfect example of struggling between the West and China in this complex chip in science, the implementation of this chip and science act. So so these are the things that we need to look at. And overall, you know, Taiwan, South Korea and Japan, they form a major producing capability of world semiconductor industry is making a very small portion, Europe is making a very small portion. I mean, look at this entire eastern Asia, they are actually providing the world semiconductor supply. And another point, very important point, I think that we need to look at is that once we look at the geopolitical impact on the semiconductor supply chain, we have to look at in the larger picture, because semiconductor ban is just one of the twos that's been picked by the United States Congress and its politicians to run against China. I think they have to, they're looking for more tools from their box, you know, and to use them to against China. I think that trend will definitely happen. And that's the biggest geopolitical crisis, I think, in the next decade, or half. Yeah, I think, is obviously the confrontation between China and the United States. Yeah.

Aditya

So given the prevalence of semiconductors and their necessity, in basically virtually virtually every bit of modern technology, do you think that there should be any talks of publicizing the industry meaning that governments can take it over to ensure proper distribution and procurement?

Aditya Sorry, sorry. Yeah. So

Aditya

can can should they be a public industries kind of like water or electricity in order to provide because they're so necessary for all modern technologies? Do you think they should be that government should take it into their hands rather than private companies?

Mr. Tian (Jeffrey) Jing

Oh, I think you mean, the basic infrastructure industry is whether the government should make a control over that. Yeah, I think Highness exemple. You know, I'm a strong promoter of market economy, a private ownership. But I do think that China's example, in running these basic infrastructure with public sector, I think it's not a bad one, it's a good case. Because a lot of times, in a western situation, when everything's run by private companies, the government does not have an overall control over things like National great things like nuclear power plants, and things like your national telecommunication system. And obviously, these will not be conducive to any to the security of any nation. And people need long term stability, a power supply and water supply. And people need long term convenience of transportation like high speed rail train, like good airport, like super highways, I think government needs to government has a role and a function of making these infrastructures available, trying to raise funds from the public or to trying to use some portion of the government's form, and to use some of the debt vehicles from the market to build up this infrastructure so that this infrastructure would in turn, give back a lot of industry and business opportunities, because people would travel in a much faster way. And people would leave in a matched in a much safer and more guaranteed environment in terms of basic supply of food, water, electricity. You know, what we've seen the blackout in, in Texas last year, in winter time is a very dangerous thing, because a lot of great power plants in the United States were run by private companies, when these companies were doing things in a very, you know, disruptive way, or they have kind of broad, you know, people have to suffer. And the same thing happens with the Japanese nuclear plants during the tsunami, and the earthquake, the Tokyo Electric Company was actually not doing well, they have a collection of their own duty, people suffering from the leakage of this wastewater on the nuclear plants. So security wise, once these are controlled by the government, this is beneficial to the society. So, of course, I support private ownership, among other things. Technology is our commercial products and consumption. So transportation to many, many members, but we'd better have these basic infrastructure controls. Yeah. Credible governments, not the payer. Government.

Aditya

Yeah, so some, some academics actually say that they see that in the future that semiconductors will actually slowly become more obsolete, due to the COVID 19 pandemic that are shooting crisis and all the supply chain shortages that have been experiencing across the world that another technology will come along. They say this, particularly in military applications, where long term reliability is the most critical, and countries need to arm themselves if need be. And the US, the US hole in the US Poland, Spain had a big problem with us during COVID. And there are two Korean crisis. So I wanted to hear your opinions about that specifically with military technology. And what role do you think that government policies have in trying to, I guess, drive innovation in this area?

Mr. Tian (Jeffrey) Jing

I think when we look at the technology in advancement in military a lot of time when we see there is a over development and and perhaps much faster than expected development of weapons of mass destruction. You know, before human world entered into a nuclear age, before 1945, when the tool bombs working in Hiroshima and Yokohama. The world was different because the military powers rely on physical strength On the battlefield, on tanks and trailer raising dismissals. And even though we're still seeing this kind of situation going on in Ukraine, at the future world is different in terms of military confrontations, because many, many countries will have abilities to fully ruin the world to bring the world to an end, because when you earn certain amount of weapons of mass destruction, then people could actually fire nuclear bomb from space. That means any point of the ers would be a target of a war. And that could be totally disappear by a weapon or a missile from the outer space, as long as they say, word confrontation. So when when many, many countries in the world multiple times. Yeah. And when countries like North Korea would have access like this. The difference is that the world have to maintain a tolerance on countries like this, rather than just fight and take over, you know, like, what the United States was doing 20 years ago by launching a war in Afghanistan and Iraq. I don't think these would be useful ways of solving international relations. Because when, when you're attacking a country where there is a leader, maybe a dictator, who has the

button of nuclear weapons, and that's going to be a huge disaster. So I think when we look at technology, advancement of weapons, and military capabilities, I think we have to look at a lot of other things.

Aditya

Like, Well, the problem is, though, and I would completely agree with you. But the problem is that, mainly during Russia, the Russia Ukraine crisis, most of the country, kind of most of most of the countries, donated funds, and military technology to Ukraine, if you will, if you ever have that situation, regardless of the side that you're on, where either donations are needed, or I mean, sometimes this these technologies are way too large to be donated. So they're built in another country best secure that? And how would government's other than talking up on semiconductor chips? Which are some are actually doing? How would they best mitigate that for the future? I mean, even if they do stock up with semiconductor chips, that technology is so rapidly evolving, that that wouldn't even be a viable strategy for them.

Mr. Tian (Jeffrey) Jing So it's a very,

Mr. Tian (Jeffrey) Jing

it's a very complicated situation, and I'm unsure how to, I guess, think about it. If you have any opinions on

Mr. Tian (Jeffrey) Jing

this. That's obviously the point I want to make. When you look at the entire picture of a modern war, the physical battleground is perhaps less than 1/3 of it. Okay. We have battlefields in information. We have battlefields in propaganda. We have battlefields in technology, Ban, and sanctions and economic sanctions. We also have battle fills in winning the hearts of the majority of the people that have not interested in it. But that's tenders like the WeChat message that I sent a three days after the war last year WeChat he's like a Chinese leader. Yeah. So by launching this war, Russia has already lost more than two thirds of the Invisible War. Even if it's just the three days past, Russia has already lost. You know, he may actually struggle in the physical battleground. But you'll probably have lost the three quarter of the US war. I lose Losing your you know, the mass support from the people from the internet by losing your tech nology. You know, room of building your own economy, you're losing the value of your currency, you're losing the benefits of your people. And perhaps you're losing the political status of Russia in the long run. So that is an incredible thing. I think no country would think it is a worth the war, just by using the strong military power to take over a piece of land. This is called dated values. These are entirely obsolete values, you know, by showing your powers just to take over a piece of land, given the fact that Russia is the world's largest country, in terms of territory. And in history Russia has taken that's actually invaded, China had took over a huge amount of land a huge area of land from China, I saw this over 1.5 million square kilometers 150 years ago. So making it very simple. Rochus high tech industry is dying. Even if you are smuggling, semiconductor chips, you cannot do anything. Because in modern industries, you must have a full integrated capability of building advanced products, including weapons, and some of the consumer appliances. You can't build anything without the grasp of knowledge of the whole supply chain, extended whole, you know, elements of production, you know, even if you just smuggle in some of the old chips anywhere, for example. If you follow the development of industrial software, I don't if you lose, if you lose the authorization of key software, facilities, okay, you can't you can't design anything. You can't design a ship, an aircraft, a machine, an engine?

Aditya

What do you mean by key software facilities?

Mr. Tian (Jeffrey) Jing

The software? Actually, software given by companies like desktop. In most of the industrial production before you start building something you have to design it makes sense? No engineers, no matter how skillful you are, can actually design anything more than industry without the help of software from the United States or France, from Germany, from Japan, makes sense at least the same situation? I think software is even more critical to China. Yeah. Then the ship chips,

Aditya forces that control everything, right? The provinces of everything. But

Mr. Tian (Jeffrey) Jing

just like when you when you design something when you lose the pen? Oh, can you draw anything on your pen? Exactly. Software? It's like a pen. Makes sense. So this is already happening. This is already happening.

Mr. Tian (Jeffrey) Jing

One last question. I'll have to get home to dinner. Sorry. We're going over a little.

Mr. Tian (Jeffrey) Jing

Half an hour and a half to go before. Okay, that's fine.

Aditya

Yeah. So I wanted to just finalize and ask you, if you were to say there is one problem in semiconductor supply chain distribution that's causing all these problems of the bottleneck supply chain disruption shortages? What would you say that is? And how can we go about fixing that?

Mr. Tian (Jeffrey) Jing

I think if we just see one problem, I don't think it is a technical problem. It is the problem of the fundamental value of differences between China and the Western world. But we have to make sure that these are not the values of Chinese people. This is the differences between Chinese leaders and the Western world when these value differences are there. They're the world we're continuing to send from against China, the Western world. We can't just pick up a single element and say, That's the entire future, either. That is the scenario, the machine, these lasers in this carbon random, this packaging skills, you know, no one could build a chip. Without the full control of this supply chain, big news, one part of it, a tiny element of you can't be a little bit cheap. So we can't say which is the most important. But the fundamental thing is the value system between today's Chinese leader in the western world towards the future, you know, fight, most powerful nation to gain the most powerful nation position, perhaps, I don't think that's the right thing for China to do. China would have to make sure what is the right political agenda for our leader, I think we should continue our reform and opening, continue to be part of the world continue to diversify our opinions and use market economy to create incentive of our entrepreneurs and businesses. And to make sure that China is part of a responsible part of the global community and China.

Aditya

How likely do you think that is? Or do you think that conflict in Taiwan and the fight over semiconductor property rights, is that imminent? or is that coming? Or is that? Or do you think that your opinion is eventually the US and China will figure it out?

Mr. Tian (Jeffrey) Jing

I think I don't think the leaders of today's China is making the right decision. But I think people have the right, Aspire ration towards the right direction. Got it? And there is a huge conflict, even though it is not that visible, but it's obviously there. Yeah, between the top agenda of the people, and the top agenda of our ruling party is a very, very different, I don't think, you know, the one thing that I don't like, is that some of the Western powers are taking China, the entire Chinese people as an end. But I think they're making a huge mistake, and not able to separate our ruling party and our people. Got it. No, they should separate, the Chinese people have done nothing wrong. You know, we're in a situation of making no twice, we're not in a democratic society. So as long as this differences is there, these challenges are admitted. They're just on the table. They're not what we're talking about are not the challenges long into the future, or meantime into the future. They're just right here. They're happening every day, they're escalating. Every day, these confrontations is deepening. And I don't, I'm not a pessimistic person, but I don't remain optimistic about the situation that's going to occur between

Mr. Tian (Jeffrey) Jing

building building building, eventually, it's gonna

Mr. Tian (Jeffrey) Jing

fall because fundamentally, no one is going to lose their value. But you know, we are not in a democratic society. Even to abandon these absolute values, it's beneficial to our people. I don't think our leaders may be able to choose that. No, they're more willing to follow their own system. They're trying to grow themselves militarily. And trying to

make sure they have to take Taiwan physically, which is something that I don't really, really appreciate. Yeah. But long term, you know, in the mainland system and the Taiwan system, with time towards a seamstress stream flowing towards the right direction of civilization. I think sooner or later, we will become a unified country. We don't have to rush for that. I don't. I don't think there's a top agenda. But obviously, our leaders just taking that as a top agenda. I think that's a mistake. Yeah. What does it mean to take that as a top agenda, the world will not allow you to do that. And and they're just fighting, the Chinese leaders are just fighting to defend them. lesion, as this is an internal business of China, but this is actually not. Because this would affect the democracy of the entire civilized the world. So this is not something just between China and Ireland, this is a big thing, obviously a global thing. Well, I'm glad to talk to you. If you want to continue, thank you so much. And actually, we can make an appointment appointment anytime you want. If you have any further,

Aditya

thank you. I really appreciate that topic. And start in touch. I mean, you've had some, I'm really I actually really want to hear more about kind of your, your, is this your business? Correct? The one that you work in currently?

Mr. Tian (Jeffrey) Jing You mean the semiconductor?

Aditya

No, no, not in semiconductors, where you. You invest in many projects. And where you currently work out here at Costco position,

Mr. Tian (Jeffrey) Jing a gold gold endeavor capital and based in Beijing. Yeah, this is

Aditya a you're saying this, your friends,

Mr. Tian (Jeffrey) Jing

some of the partners, some of the partners, but I'm also I'm bored of the many other shipping companies and investments. So I'm still a shipping person I enjoy even though in recent years investment. I do think that one person can just do one thing. Well, for lifetime. Shipping is my fix. Well, where are you originally? You're your friend. Yeah. So

Aditya I was born in India, but now I live in the US. But yeah, moved around quite a bit when I was growing up.

Mr. Tian (Jeffrey) Jing Great. Great. I think it's an Indian name, right. Yeah, exactly.

Aditya It's a it's a North Indian name.

Mr. Tian (Jeffrey) Jing

Great. I like let's let's get talking to each other. Absolutely. Make sure you have anything that commerce comes up to your mind that you think is interesting. And when a sick my opinion just right to me.

Aditya

Okay, perfect. Thank you so much. I really appreciate it. All right. Take care. Have a great rest of your day.

Mr. Tian (Jeffrey) Jing All right. Bye bye.

Interview 2: Dr. Yazid Debbich

Dr. Yazid Debbich

Hi sorry just once again that Hello Can you hear me I cannot hear you for some reasons just trying to see

did you I think you're on mute still on, on Zoom because I see your mic somehow closed

Aditya Hello,

Dr. Yazid Debbich yes now I can hear you. Oh

Aditya yeah, no, it's great to finally talk to you and meet you.

Dr. Yazid Debbich

Yeah, same for me. Hi. Okay. Now everything was well, very good.

Aditya

Great. Yeah. Now just to start off, I just wanted to let you know the other, I guess, participant in this Zoom meeting. It's actually an AI. That'll help me compile our conversation a little bit better. I don't know. It's a new software that just came out. I thought I would try it. Yeah. Yeah. That's okay with you. Of course. Yeah. No,

Dr. Yazid Debbich

no, of course. Of course. It's always very interesting to see now all those AI things, you know? Yeah, I think so fast.

Aditya

If I was the context of the conversation, so like, point to me, like, oh, that you should probably look back at this point. I don't know. I want to try it out. But yeah,

Dr. Yazid Debbich

okay. Excellent. was dropping, you know, to let me know how it went right. If it's something that we can do No, not in terms of you know, result. Very good.

Aditya

Yeah, I don't also transcribe for me, so it's a lot of time. Yeah. But ya know, great to meet you. Thank you for agreeing to help me with my research. Yeah. Welcome. And um, yeah, I just want to I mean, I'm Professor Yan did give me a little brief. I mean, she was very, very impressed with you and all of your experience. She was telling me oh, you should meet Dr. Debbich. You know, he's, he's, um, this, this this, but I would like to hear a little bit about like, what's your current role? And what what are you mostly involved in right now?

Dr. Yazid Debbich

Yeah, so basically, so today I'm working in a company called G vado. So which is a company specialized in the fields of interest reporting in progress, fragrances and play in the flavors. So there is a big component of manufacturing in terms of activities, as well as, you know, a lot of creative and chemistry components in that. So basically, what you bought on us, it's a b2b company. So it doesn't sell directly to consumers. So basically, that's why maybe you were many people haven't heard about whoever it is. But, you know, behind that, I think what they said 25% of every product that you find in the supermarket, there is a bit of dividend side. So they basically create you know, based on the specific requirements, formulas, which are then used in perfumes and, and different products and consumer products. That's that's basically it. Of course there is a diversification of the different activities going more and more on Naturals. The reasons why a product which is more what we call active beauty, linked to a body and skincare, but I would say the core of the business is truly flavors and fragrances and basically its present pretty much all over the world. And and the clients are between locally serve to globally served, which of course touch as well some of the supply chain challenges that we have. So as part of JIRA, actually, I work in something called continuous improvement. So I'm part of a team I don't know if you heard about Lean Six Sigma, but we we help optimize activities, processes, products at company level. So we work a lot with the people on the ground, to understand you know, what they are doing and what are the opportunities for even more effectiveness and efficiency.

So that's, that's basically what what I'm doing. And before that, I was working pretty much in the similar role, but in Nestle is a bigger and bigger company. And any Nestle I've, I've been, you know, doing different roles, always in continuous improvement but but you know, operations and supply chain in r&d in it as well. So that's pretty much where I come from. So this overall continuous improvement, Six Sigma

Aditya

Yeah, as your position and Nestle how you met Professor Yan, because I know she has some history with Nestle as well.

Dr. Yazid Debbich

Professor Yeah, no, no, not like that. Doesn't really ring a bell. But, you know, it's a such a big company, right? Almost 400,000 employees. But, yeah, maybe you never know. Right in the corridors.

Aditya

Yeah. All right. Yeah. And if you don't mind I would love to just jump right into it so I could get your opinion on. Yeah. So would you say you're more involved on so you're more involved on like the actual supply chain side of things, logistics, and that's what you think that you could best kind of comment on in this case, right? Yeah.

Dr. Yazid Debbich

Yes, I think I think you're working on semiconductors, right. Is that the focus or is it Yeah, so I don't have a lot of insights on that because our business is different, but I would assume that you know, in the supply chain path, most of the challenges are pretty similar across across different industries. I mean, macro level, right. So

Aditya

now it makes sense. Um, so what I've really, really been interested in trying to explore further, and I've been trying to understand supply chains more broadly, just to get a better scope of how things work. But what really fascinates me about semiconductors is I feel like it's one of the only industries where there's an extreme bottleneck. I want to use semiconductor manufacturing company in Taiwan, that controls almost 70% of the market share for semiconductors, mostly because they have you know, intellectual property rights on the technology but I was I was really, I was really interested in the fact that how, how would there even be a reconciliation? How would there even be reform in this case? Has this ever been happened in the past? Have you seen any instances of it when it's something so bottlenecked and it's unnecessary product which everybody desperately needs? How would you? I guess, resolving that issue?

Dr. Yazid Debbich

Yes, yes, you pay the price, right. I think that's a very good point. But we have exactly the same issue with a lot of raw material that we source. You take raw material when it was in the sea like cocoa or because a lot of products are cocoa based right with chocolate or you take corinthis Even if you take something like vanilla, for example, or some other raw material, which are critical for many products. We know that over the past years and mainly during COVID. The demand has increased a lot so to put it in a bit of of, you know, a blunt way. I would say you know, you get the resources depending on the power that you have over your competitors. When you are someone like Nestle with the biggest food company in the world. You know, they have enough leverage of power to not only pay for what they need today, but ensure that they would be paying big time for what's coming for the next decades. You know, so they are pretty well positioned so that one way is to say, okay, you know, we pay the price and we guarantee that we're going to be buying good, big volumes from you, in the next decades. And another thing that big companies can do as well is to acquire the local suppliers, right? Or they even acquire the source of the raw materials that they need. Right. So that's that's I would say two ways. The one is using the power that you have as a leverage. And the other one is more what we call upstream acquisition where you look at your overall supply chain, and you will integrate if not even acquire you know, the field the land or the supplier from whom you used to buy.

Aditya

Okay, so control the entire process altogether. Yeah. Okay. Interesting. Yeah. And, I mean, in your experience working with Nestle, what are some of the best practices that you would say, for managing a global supply chain like TSMC? And how would How do you think they could improve operations in the area especially with the lingering threat of China? Not sure if you have any opinions about that?

Dr. Yazid Debbich

But to hear I just I detail you talking about the overall you know, the overall supply chain efficiency and effectiveness right or the overall supply chain integration?

Aditya Yeah, exactly. Yeah. Yeah, that's

Dr. Yazid Debbich

a good question. Right. I think companies like companies like like Nestle, what they usually try to do, at least for the critical material and critical goods is truly to go more from a kind of integration end to one's perspective. So upstream trying to get more control on the source of supply, you know, either by securing agreements with the local supplier or the local supplier to the supplier that they have upstream, or acquiring the sources, and downstream acquiring acquiring as well or taking control of the different networks of distributions, right, until the end customer. This can be done through different things either requiring like buying them so they become part of Nestle or another one is again, to leverage negotiate to have good, good agreements. So I think that's one thing big companies can do is truly tried to integrate from an end to end perspective and increase the power of control across the full supply chain from the source to the delivery. Okay. Now, another thing that that tried to do as well is to leverage new technologies, you know, so basically, new technologies like at my time a few years ago, right, we're talking about implementing RFID chips everywhere, right? So, so in order to have full traceability of the different components of the supply chain and be able in real time to see what are the bottlenecks and take actions accordingly. Now, I'm quite sure, but this is a bit more further away than me today, that with the, you know, artificial intelligence and big data, it opens as well, a lot more opportunities from a control perspective to have a true end to end assessment of how the supply chain is doing on time. Right. So that's maybe one of the new trend how to leverage those new technologies to do so. Obviously, in Java, we're not there yet. You know, in Java, it's much smaller. The the supply chain is not truly integrated, we compile part of it, but on the sourcing we rely on external suppliers. On on the distribution, we rely on carriers like DHL or other transport companies, we don't have hours. So the only product we truly control I would say is from the order entry. Right? Until the moment the good is out of the of the factory. Right, more on after the shipping.

Aditya

Okay, yeah. Makes sense. So in your experience, I mean, obviously, we're talking about a, I guess, complex, complex technology industry, but what are the potential risks associated with it? I mean, I know I kind of saw a bit of the global shortage of semiconductors in I mean, do the COVID due to COVID and due to the Russia Ukraine crisis, and we got a little Easter that the bottleneck that exists because of the company in Taiwan, it can have a lot of effects, but long term, despite COVID and any potential wars in Europe, what are the potential risks associated with relying on that single on a single company for some sort of high technology manufacturing? I guess this is more on the distribution end of things.

Dr. Yazid Debbich

I think there are many risks right that each I think the first one is to lose them right to the first one is basically to lose access to those specific you know, product material competencies, technologies, right and if you get to use it, if you have developed a full system, which is mainly reliable on those but then basically you're a promoter operating model is stopped, right. So I would say, one way to mitigate that is to develop at the same time a risk assessment and risk management approach, where you take a decision, but at the same time you have identified the potential failures, then you have developed mitigation plans. Accordingly, what you try to do in that case, is what we call you know, continuity of operations, whatever happens, but and this you need to do upfront. So I would say that that's one one main risk right not to have access anymore. I think the other risk is that more and more people have access as well. So you know, if having access to some specific technologies or sources is giving you a competitive advantage today, we know that if you haven't secured that access tomorrow, your competitors will have it as well, eventually you lose your competitive advantage. Right. So those will be I would say the two major risks that I would see and those two can create either disruption in the business continuity, which has massive impact, right. But as well loss of competitive advantage and loss of margin in the end, right when it always goes back to money in the end.

Aditya

Yeah. So what the bridge that I'm trying to get right now that I'm trying to understand more of this gets a little bit more to geopolitical so I apologize about that. But is when you have a resource as necessary as semiconductors for

all future processes, all military technology, consumer goods, everything is a competitive advantage. That still be upheld, or like intellectual property rights, if the system isn't being properly managed. So because I mean, TSMC, with all of their geopolitical conflict, I mean, there can't they can't have an adequate distribution at times of crisis. It's just not possible. So I mean, that's kind of what I'm trying to explore in a section of my paper. I mean, do you have any opinions about that?

Dr. Yazid Debbich

So can you just repeat it again, I did. Just want to make sure that what you're saying is like, let's imagine you have that competitive advantage today. So you will have access to that specific good technology, whatever that is, or or raw material, but still, you're not able to perform properly because of different external factors.

Aditya

In an industry where necessary, were very necessary product.

Dr. Yazid Debbich

Yes, no, I think one of the things maybe that that we need to take into account as well is that you know, having access or owning given products and technologies, etc, by itself is not enough, right. I think you need to develop other types of competencies in parallel, you need to have a proper way. I mean, this is where you go to more than the soft skills, right that what I would say you need to have a proper governance in place to drive and and I would say, coordinate the different parts of your supply chain. So all the steps and actors, which are many, they still act together towards the same goal. So if you don't have the right people, the right competency, the right governance in place, even the right performance indicators that you will monitor on the regular basis, even if you have the right tools, the right raw material, etc. You will not be able to be facing what you know the your or meet your your customer expectations, right. This is where agility everybody talks about agility today and flexibility comes into the game because you mentioned we had COVID and then we had Gaddy V, the situation in eastern Europe, but we had a situation this was channeled as well in Egypt. In China, there are situations everywhere, and we can see that in those moments. The only thing which can truly sustain and protect your business is your ability to act fast because you have basically good processes and a good governance model where people can quite quickly change the weather walk, to align and work on different objectives. You know,

Aditya

yeah, that makes a lot of sense, actually. Yeah, okay. All right. So have you ever seen in your, in your, in your career, have you ever seen certain processes get mandated by governments to either I mean, be acquired by public institutions altogether? Or the government has to play a part in supplying depending on the country that is being the company is being operated in? Have you ever seen the government kind of take a role and what were those conditions that led to them doing that?

Dr. Yazid Debbich

Not really a detail. I'm just trying to think officially not so right. Then you never know Right? When you go in some countries in trouble with very rare raw material, you never know right? You might have good access to the right doctors and sometimes you know, politics gets mixed as well with, with with economics and business in general. But yeah, I'm just thinking now, not really nothing which come to my mind where we had to have a kind of political intervention, you know, or, or even you know, get in touch with, with the local governments in order to operate.

Aditya

And where is Nestle's headquarters again? Are they in Lausanne or

Dr. Yazid Debbich

in the next one was on 20 minutes from Rosa.

Aditya

Okay. Okay. And what's his relationship with the Swiss government if you don't mind me asking?

Dr. Yazid Debbich

What I think it's, I think it's a it's one of the major October here in Switzerland, right. So, so I think, yeah, yeah. Yeah, definitely. So it's the one of the biggest I mean, it's the biggest Swiss company. It's the biggest probably Swiss employer in the world. So so now the relationship is very good. Now of course, when you start to enter, you know, situation like we had in Russia and Ukraine, a lot of people started to ask themselves if they should continue the business and and operating, for example, and in delivering in Russia. But what in the end did happen is that most of those companies decided to continue operating in Russia. Right. And in the end, that decision, even if it went against many opinions, didn't have any impact on the business and on the supply chain itself. Right. That was no actions taken by any government, at least not on those big actors. Okay.

Aditya

All right. Yeah. And again, getting back to semiconductors. I know you're just kind of generalists with supply chains. But if you had to comment on like, the role of logistics and transportation in a way that you would say is unique to kind of high technology industries. To optimize processes for like efficiency, cost effectiveness. So is there anything is there anything you can suggest me that I look into if there's any, I guess, opinions or thoughts that you have that they probably do it like this?

Dr. Yazid Debbich

Yeah, I think well, on the semiconductor, of course, and the high technological content is maybe is a bit more tricky. Right. But you know, for most of the products, so usually what we say is that the better way to optimize your logistics part, you know, is to be as close as you can from the final customer right from the client. So what we try to avoid, and is truly to have I would say a centralized distribution approach somewhere in the world and then having to rely on too much long transportation, you know, the transportation we have different means, right? You have by road, but by road, it has a lot of safety risks. You are facing border issues, probably you are facing weather issues. So in the end depending on the content that you will have in the trucks, it might be usable or not right and you cannot send the product from the US to Europe only for truck right you will have to use C as well. Now you can use C C is much more stable is much cheaper, but it takes a lot of time. And you see when we had cases for example, when you bring items from Asia to Europe, and if there is a political crisis in this West channel and you have suddenly to go back from South Africa and do the other way around and Atlantic sea. It adds easily one month and a lot of costs, right so so so then train, same issue. It's not a port to Porat now now playing is always like one of the preferred when it comes to to stability, you know, safety etc. But in the end, it's very costly and is polluting. So I would say you know, there is no right answer when it comes to what's the best way to do logistics. I think you need to take different factors into account the nature of the product, you know, the risk, that you have a cloud, the transportation, the time that you need, that you can take to deliver as well as potentially the impact on the sustainability on the planet, right? This is at least what a lot of companies are doing today. And that's what I would I would look at for semiconductors again with a high level of technology, if there is a way to shorten the supply chain and maybe from from a production perspective to be closer to the customer than being too far away to reduce the logistic part. You know.

Aditya

So the problem with so TSMC just to give you I mean a little bit of background, if you can comment on this. So TSM C is operating in other countries, they actually just signed a deal with the US government. They're opening a factory in Austin, Texas, which would benefit the US government greatly, but all modern I mean most of the developing technologies using the most modern semiconductor chips, which I think is five nanometers now. And TSMC is protecting that technology to make that so the one in the US will only operate on six nanometer and seven nanometer chips, the older versions, but they're keeping the five nanometer production only within Taiwan to because I mean as soon as TSMC outsource that technology, then there's no one protecting Taiwan anymore. That's basically the problem that we're having. Yeah, so it's it's a tricky situation. But yeah, so your suggestion in terms of understanding the supply chain better and how to optimize the processes is to research the modes of transport. Other centralized distribution approaches that are possible on the logistic side. Can you hear me out yourself? Hello? Yeah, I can hear you

Dr. Yazid Debbich

now. Yes. Okay. Now, I think it's about Yeah, I would just say on the logistic part, yes. But you know that the supply chain is bigger than that. So if you want usually to improve the efficiency of your supply chain, you need to look at it as a whole. I don't know if you heard about the score model, but it defines pretty well, what are the components of the supply chain. So you have the first step which is source, then you have make, then you have deliver and then you have manage the return, right? So again, optimizing the supply chain need to be looked at holistically speaking first, where do you source How do you source right? Do you need to integrate your supplier do you need to be closer to the supplier in a way or another? Then you have the planning part which is quite important, right? Because you need

to plan based on your forecast, you know, and a lot of time we know that today having a proper forecast becomes very difficult because the demand is very hectic. But the closer we have the better forecast you have, the less cost and waste you're going to generate into your your process. Right. So I would say you can optimize for the logistics the delivery but it's usually the last part of the supply chain. You know and should maybe look as well upfront. You can look at the score model it will show you a bit those different components. But what can we do at the sourcing level? What can we do at the planning level? What can we do in the manufacturing piece, and then eventually, the logistics but which happens usually in the end?

Aditya

Okay. And I mean if you have any I'm trying to think if you if you had to take a educated guess as to where the supply chain for semiconductors is going how it can be securely distributed, assuming that TSMC still has control of the market because I don't see that going away anytime soon. Where would where would you think it would go in the next 1020 years?

Dr. Yazid Debbich

But do you know where most of the customers

Aditya

most of the customers worldwide but the US and the US China, Germany and France or anything it's hard to shop for?

Dr. Yazid Debbich

Okay, but do you have distribution centers there already? Or is it straight from from the output goes out from Taiwan and then it's shipped to there?

Aditya

The only distribution centers are in Austin, Texas. There's two in China and the restaurant only in Taiwan. So yeah, it's going to Europe. It's coming from Taiwan.

Dr. Yazid Debbich

From Taiwan and you know, how is it by plane or is it by by?

Aditya

Actually what I want to search out for this?

Dr. Yazid Debbich

No? Yeah, I would say I would say again, you know, because again, if it's if it's by by you freight right by playing, then again, it's timely feasible, but then I don't know how much of their budget is dedicated to that but there must have a very high supply chain cost issue. So you know, I would say you know, you look at you know, I don't know if you know, Pareto analysis, etc, but you take the overall customers and then you try to put the rate you know, where are the biggest buckets of the consumer, and then maybe if I would be the big boss, I would reconsider, you know, maybe challenging the distribution center that the only one that I have either in the US or the west coast from Taiwan, maybe to do you know, regional distribution hubs like most of the companies do. Right. Now then I would target the country which is politically stable, but where you know, the taxes and the cost of being there are quite low. You know, think about Hungary for example today. Yeah, Europe. Now.

Aditya

Sounds okay. And there's another topic that I'm considering exploring. And this is a little bit, I guess it's a little bit different what we were talking about already, but what we've been seeing due to semiconductor shortages is countries either stocking up on some like conductors, which is I mean, kind of useless because the technology is evolving so fast. They're going to be obsolete pretty soon the one that they have, or country stocking up on military technology, because in the face of crisis, if you really need to develop military technology, you need hundreds and 1000s of semiconductors, and if you can't get them you're kind of lost. So we actually see countries like Poland militarizing. And part of the reason for that is because of semiconductor shortages, because they just want to have all the materials there just in case anything happens to protect its borders, due to Russia, Ukraine, all that stuff. So I mean, the stocking up of I don't really know what my question is here, but I mean, I guess the stocking up

semiconductors in this context. I don't know. Do you just have any thoughts about that? Any any supply? I guess backend backend ways I can explore this.

Dr. Yazid Debbich

I think you need to I think I was you started to say right I think you know overstocking is something which happened mainly during COVID. Yeah, right. And I think understanding the drivers of that is quite important, right. Usually what you see is that when some resources become scarce, there is an overstock as soon as the situation improves the start to the stock. This is for example, we are struggling today as evident to sell with ourselves in North America because currently, the customers who have bought a lot during COVID Right now they don't buy anymore because they are now stocking, you know. So and usually people will tend to build safety stock all the time. But in crisis situation even more, the safety stock is going to become even bigger. Now. If you are if you are stocking elements which are not reachable, it's okay. Right and you can you can stay like that for years is just going to increase storage costs, maintenance costs, etc. So you know, though the inventory create cost as well. But, but I would say usually when situation goes back to normal that with all kinds of normal that will that will start to the stock as well. So I would just maybe look at based on what you said, you know, why do they do that? You know, is it only and what are the factors? What triggered that? Is it on your scarcity of potential resources? And then you can imagine that once the supply chain gets a bit easier, they're gonna start stocking again. Or or it's because I mean, maybe for military things, it's something that they decide to stop for four years, just in case there is a conflict happening and then of course, you know, the stalking might be a bit more difficult in that area. I don't know it very well, right. But maybe they can still talk part of the weapons, selling them back here and there right. Now, we just look at you know, what is the drivers you know, some companies they are in the model of supply chain model of what we call Make to Stock right, it means that they will make products and elements that that will store to always have a buffer to face the demand, other companies and more and more companies they are what we call make to order. So that will make the product only one they have received the order. But we thought two years ago that the industry trend was going to the make to order with zero stock as a model right? And COVID challenged it again completely and all the companies which are moving to make to order came back to Make to Stock but if situation comes down in one year or two years, I don't know maybe we're gonna go back to this destocking first, and then make two of them again, you know, it's just fluctuations

Aditya

up and down. Yeah. So final question, because I think we're a little bit over time. If you don't mind. So as your students studying, I guess this topic and supply chains in general. If you have any, I guess research papers, any books or any methodologies or tools that you think would be helpful for me? I mean, I would love to hear if you can, I mean, if you want to email me or you can tell me right now, that'd be fantastic.

Dr. Yazid Debbich

Now of course, I determined I can't share with you different either books or, or websites. I don't know if you know, the APICs websites, for example, which is our picks it's AP ICs, which is the international body certifying people on different supply chain topics. So they have quite a lot of content around that even updated content related to supply chain challenges. So I can send you what I have done, I would say it's a very wide topic right? It touches your political it touch technology, touch, logistics, or you know, careers, so maybe, you know, don't hesitate as well to send me emails. If if the what I send you is too broad right? If you have specific demand on a specific sector or technology etc, then I can say look at what I can get even the internal university resources or from people around me and I would be happy to share them with you.

Aditya

Okay. Yeah, no, if you have anything that would kind of explain if there's any overlap between the distribution supply chains for high technology industries, I think that's what I'm missing most right now, because I've been I've been reading a lot just generally about supply chains, but I just don't understand how those specific industries specifically operate differently from I guess commodities. Are there other types of products? So that can be super helpful? Yeah.

Dr. Yazid Debbich

Okay. Yeah. Thank you. You're welcome. I just don't want to thanks for your time. Good luck. And we'll keep in touch. So I look at that and I send you an email. Okay.

Aditya Thank you. So much. Have a great day. Bye.

Interview 3: SinoAir with 4 Employees (identities protected by request) Aditya Sehgal All right, awesome. And okay, yeah. So where are you guys currently located? Are you? Are you both in Beijing? Yes. Yeah,

Speaker 1 we're both engaging.

Aditya Sehgal Got it. What time is it over there? It's six hours. So it's like 5pm

Speaker 1 is Yeah.

Aditya Sehgal Okay, got it. Ya know, great to meet you. And this is what are you guys's names?

Speaker 1 Oh, my name is

Unknown Speaker you can also call me hiring Karina.

Unknown Speaker This thing is

Aditya Sehgal

sorry, say it again? Yes. What was your name? Gloria? Okay. Harkin and warrior. All right. Okay, well, nice to meet you. Yeah. So yeah, I mean, I'm, I'm doing some research on the semiconductor supply chain. And thank you guys so much for meeting with me. It's honestly going to help a lot. Knowing your background in supply chain specifically and specifically within some kind of supply chain. So do you work? Do you work mostly with, with companies? Or do you are you kind of on the investment side of things? Where does how what do you work in with semiconductors?

Speaker 2

You mean, I think I can give you a short introduction about our company and job. Yeah, absolutely. Yeah. And also the position in the semiconductor supply chain. Yeah. You You can see our like, the size of the emails, we have a company is called the sino trans integrated logistics. Yeah. And we are focused on the supplies that specialize in logistics, which refers to several introduction into the industry, like semiconductor manufacturing. That's great. Yeah. And I think is remind you shot the introduction, we always focus our drop to transportation, the goods from the raw material manufacturer to the user, and they are not focused our job on the manufacturing stuff.

Aditya Sehgal

Okay. Yeah, yeah. So logistics logistics wise, kind of back end supply chain, how they can best optimize their processes to, I guess, get their raw materials or source them properly. minimize their costs all of that, right?

Speaker 2

Yes, we are the service of the like, you study the T as MC? Yeah. Yeah. Yeah. That's the introduction about our job and our company. Yeah, sure.

Aditya Sehgal

That sounds great. And I feel like that's exactly what I'm looking forward to get your perspective on. Because I mean, I've been reading a lot about supply chain just generally understand how it works. But I'm not really aware too much about how the semiconductor specific supply chain works. So yeah, so in my paper, what I what I've most want to examine, is the semiconductor supply chain, understand its it, how it works, and identify maybe potential problems that it has for long term sustainability. I mean, given the supply shortages, because of COVID, Russia, Ukraine, all that stuff, and eventually give a recommendation on how if you want to move forward, but possible solution on how we can make it a better process overall, to make sure everyone in the world can receive semiconductors to make sure you know, yeah, so that because it's a pretty, it's a pretty necessary resource, right. I mean, everyone needs it. So, ya know,

Speaker 2

interesting about what you want to study now, and also quite interested in other professionals. major

Unknown Speaker field of study.

Speaker 1

Okay. Yeah. Awesome. Yeah. I mean, it's, it's a really interesting topic. And I think that it's gonna define the future. Because it's going to be a race to control the semiconductors. But yeah, so I think we could start off with that. I'll just be very general, very blunt. Right. As I just explained to you, what are the major challenges that you think are specifically within the semiconductor supply chain? And how have they evolved over the past decade?

Speaker 2

Yes, actually, we have given you some summary about our answer. Sure. Oh, yeah. Yeah. Have you received the

Speaker 1 email? Oh, you have. Oh, okay. Yeah, I

Speaker 2 think You could check it and we can also talk about it in deeply.

Aditya Sehgal Absolutely. That's great. Thank you so much.

Unknown Speaker Factors Yeah.

Unknown Speaker Yeah, maybe we can start

Unknown Speaker opening it up.

Unknown Speaker And

Unknown Speaker one second.

Unknown Speaker Sorry, I have to leave.

Unknown Speaker When when you have to leave

Speaker 2

to go from stuff I need to do now and I will stay in this meeting. Okay. Yeah.

Aditya Sehgal

Just see. Okay. I got your email. Yeah. Okay. Yeah, sure. So do you just want to run through this? Or can I ask you some other questions as well? What

Speaker 2

is they'll be fine. Just to give you some, like, first off, maybe more easy to communicate? Okay. Got it. Yeah. And come back to it. First, the question is about the major changes in something that first supply chain, right?

Unknown Speaker Yes.

Unknown Speaker Actually, if we take

Speaker 2

out to our possession of the semiconductors starting chain, they can also see the overview of the all the supply chain on the semiconductor, or maybe we can just focus on the chip, a supply chain, right. Yeah. So I think as the mind of the semiconductor continues to grow, companies are facing many challenges in keeping up with production. Also, the consume electronic stuff. The increasing demand, is the main chain involved the chip semiconductor supply chain, you're right. Okay. And I think that's the main reason is about the pandemic. We always walk online and study online as to raise the people's demand of the consumer electronic.

Unknown Speaker Okay. Yes.

Speaker 2 And the second, like the challenge is about

Speaker 3 I think that politics that your holiday take hold

Speaker 2

problems. Yeah, the tension between the US and China. Yeah, that may have a significant impact on the semiconductor supply chain as. And this can also include the trade restrictions, tariffs, and other barriers to trade that can disrupt our supply trays, and also increase the cost of the company.

Aditya Sehgal

Makes sense. Just a quick follow up question, if you don't mind. In your opinion, do you see the I guess? I mean, you're talking about general cheap semiconductor manufacturing and distribution. Do you see the power of TSMC kind of being distributed to a lot of companies anytime soon? Or do you see it kind of staying with TSMC?

Unknown Speaker Um,

Unknown Speaker can you repeat your question again?

Aditya Sehgal

Yeah, sure. So, you so right now TSMC controls a majority of the market in the future, do you think that the smaller manufacturers or smaller cheaper manufacturers will be able to not replace but I take some take some of the market away from TSMC? Where do you see that going?

Speaker 2

Okay, I see. I think the TS MC plays a role. Very important. In all, semiconductor, yes, supply chain, and perhaps some small, small scale factory may take some, like

Unknown Speaker some Yeah,

Speaker 2 monkey shares from TSMC but not can't be.

Unknown Speaker Take that much. Yeah. It makes sense.

Unknown Speaker Yes. Maybe just a small person.

Unknown Speaker Okay. Right. Yeah.

Speaker 2

I think not small scale, they will not to influence the development of the technology. Costs. TSMC is not just a to care about what they are making. They are to invoke Hey, something new. Yes,

Aditya Sehgal they have the process to make, like, what is it? What's the newest technologies at five nanometer? Or is it three nanometer?

Speaker 2 I think they have the three, three in American No. Right.

Aditya Sehgal

And I think factory. The new factory in America is only producing I think five nanometer. But I think, yeah, but I think TSMC on in Taiwan, and I think in the, in the so in the fabrication facility in China, are they also producing three? Are they giving China all their technology? The factory? Yeah, I'm

Unknown Speaker quite confused about that.

Aditya Sehgal

Okay, okay. No problem. Oh, great. Yeah. Well, yeah, the I feel like the, the intellectual property, the actual technology, that's the main barrier for small companies. Right. Right. Right. Okay. So yeah, I think we can move on to the second third question.

Unknown Speaker Let me see your

Unknown Speaker question. Because

Speaker 2

the second question is to describe this specific steps involved in the second axis. And I think we can talk about the three answers together, because one is about a reason and one is about the situation. Yeah. And I think the semi conductors wind chain that was staged, we can to start with the raw materials, and the ending of the finished goods. Right. Actually, do you think we need to have a deep discussion in our reports? Or you just?

Aditya Sehgal

Yeah, I mean, not, not necessarily. I think what you wrote, I think, since you wrote it down, I think we could actually just talk generally about it, because I mean, the information is there, which is great. Thank you for writing it. But

Speaker 2

yeah. The first stage of the semiconductor we can talk about the raw materials. Yeah, right. Is potential Balto next stage is available. There's hay and the cost of these materials, which can be affected by factors such as global demand, also, the environmental regulations. And we also work with many buffer fabric fab. And once the raw materials have been sourced, they are processed into buffers, right? Yeah. And which are the links of materials that were all several as the basic base for the semiconductor chips? In this stage? I think one potential bottlenecks is of elbow of manufacturing caps ability, and also the limited number of the buffers that can be

Unknown Speaker produced. Okay,

Speaker 4

and NASDAQ and summit some protector? Precisely once the weather have been how to say the word

Unknown Speaker February

Unknown Speaker cated.

Speaker 4

They can they're subjected to a series of processing steps such as action to topping and the position Yeah, to Cray the individuals medacta. Company comm sorry. Competence. Yeah, governance. I'm sorry, my

Speaker 1 English is no no, no. No, I can completely

Speaker 4 prepare for the interview. Sorry.

Aditya Sehgal

No problem at all. Yeah, no, that's super interesting. So, I mean, in terms of raw materials, well, okay. So there's raw materials and the production of wafers. So, then because of demand events, advancements disruptions, okay. So, in terms of raw materials, is there a specific raw material that is difficult to, to source? The most

Speaker 2 actually make work that much about the manufacturer Oh, yeah

Aditya Sehgal yeah, no, I'm just trying to understand because I mean, there's such small chips, silicon wafers and the transistors on them. That's just what are the transistors made out of you if you know

Unknown Speaker you like silicone, it's

Aditya Sehgal just still silicone. Okay, so it's entirely silicone. Okay interesting.

Speaker 2

I think maybe we can talk some about the semiconductor processing, because during the process me also like for many

Unknown Speaker

equipments,

Speaker 2

which that to produce the semiconductor to create the chips. And we can maybe talk about some of the equipment if there is a major as we always to, like transport from the US. Oh, it's

Speaker 4

our memory row in semi Tractor Supply Chain is to transport the manufacturer equipments, and provide storage warehouse for the fat factory, Magnus. Yes, actually, we have. We have we have the knowledge on how to make cheap step by step.

Aditya Sehgal

Yeah. Just one quick question. And I apologize for coming back to TSMC. But if you know specifically about the distributions of TSMC so I know they have I mean, a lot of factories on mainland Taiwan. I know they have a couple in China, they're building one in the US, how does the district How do their distribution centers work though? Are they only working through the factories and then to the consumer to the business? Or do they have distribution centers throughout Europe throughout America that they send them out to and then they distribute to the business? We have

Speaker 2

no research for the TSMC distribution network.

Aditya Sehgal

Yeah, no problem, but okay, but generally with semiconductors would what mode of transport would be best for efficacy? Not despite I mean, not with TSMC specifically, but would it be by plane freight train, I mean, truck, what boat which one is the most cost effective and safe to maintain the technology? If you know if most semiconductor companies follow one mode of transport?

Speaker 2

I think the the aircraft, okay. Maybe the main, like transportation mode. Okay. And also big, you know, the speed of the air, air flight and also the seeds flight the sea also be used because that's quite cheap. And if the demand is not so urgent, maybe not. So the two quick responses the C is also the another choice. Catherine points yeah. Yeah,

Aditya Sehgal

I know you answered it perfectly. Yeah.

Speaker 2

And also you talking about a distribution network? I think we could talk about some not just just about our major we can also talk about some small chain because the global network is what's the most effect factory they choose the the mode right okay. They can't hurt one that in Chinese could one could all x into one blank blanket. Yeah, yeah. If they have the song like the war of time like barriers and the all things will be blocked okay.

Aditya Sehgal Sorry away what will be blocked what you say at the end?

Speaker 2 I think the most factories they will do choose

Unknown Speaker to post their

Speaker 2

network into the global Internet a different countries like China, or some like the Southeast Asian countries.

Aditya Sehgal

Yeah. You know, the main countries that buy some like inductors I mean, the US and China are definitely two of them. But I mean, I don't think Japan would buy too many because, I mean, they probably have A lot of Samsung manufacturing within the country. Right? Yeah. So what other countries? I mean, in Europe and Asia? What generally are the biggest consumers of semiconductors?

Speaker 2

We have some customers they they said, the best on the German,

Unknown Speaker German.

Unknown Speaker Singapore in the fall. Yeah.

Unknown Speaker Okay. Thank you.

Unknown Speaker All right, great.

Aditya Sehgal Is there anything else you guys want to share about the process? Can we

Speaker 2 get in much ideas about that?

Aditya Sehgal

No, no, no problem. I'm assuming it will be like, you know, Singapore, Germany, France. UK will definitely be big, but mean volumize? Yeah.

Speaker 3 Oh, yeah. That's, I think that's demand on the government sub size. So subsidy subsidies. Yeah.

Aditya Sehgal

Yeah. Yeah. And it's also interesting point, because, I mean, they'll probably go first to where they're where the products are put together, not the final destination, right. So for example, if Apple makes iPhones in China, then semiconductors will go to China and then to the rest of the rest of the world. After they're put it together and iPhones. Okay. Yeah. So question five Yeah.

Unknown Speaker Let me see.

Unknown Speaker Yours

Aditya Sehgal

So, actually, I'm interested have you I mean, I being so close to all the facilities, because of COVID because of, I guess, the conflict happening in Europe. Have you experienced in China a shortage of semiconductor chips? Or has it been has it been okay.

Speaker 2

I mean, a shortage of the semiconductor. Yeah, we have made that I think maybe in during the pandemic like 2020 further than 2010 2019. Yeah. Tend to Yeah, we have some like the automotive factory. Come, they'll reduce the production because of the the shortage of the chips. And also the, the delivery period has been, has been has been more much more longer than normal. Yeah.

Speaker 3 And can you have some light years on also the healthcare, healthcare like and

Speaker 2 healthcare industry and what we used like I watch awesome

Aditya Sehgal technology consumer goods Yeah.

Speaker 4 Well, people to work and people to handling

Unknown Speaker no of course.

Speaker 4 From from the airport to the factory. Yeah, some equipments just put the in warehouse for a month or two months.

Aditya Sehgal Yeah. Okay, got it. All right. Yeah. No, I mean, I think I understand the fifth question what you wrote down pretty perfectly. So maybe you want to move on to Question six Yeah

Unknown Speaker actually, I

Speaker 4 just, I just, oh, sorry. We just graduated from high school last year. Oh, really?

Aditya What did you guys specialize on your experience about? Oh my god yeah,

Unknown Speaker automotive or logistics

Unknown Speaker the Evie if you know your electronic vehicle and

Unknown Speaker can't tamper contemporary management.

Aditya Sehgal And how old are you guys? When do you get when does when do people wouldn't do people graduate in China? Usually what what age Well,

Unknown Speaker you got the master degrees

Aditya Sehgal okay, okay. Very cool.

Unknown Speaker Yeah.

Aditya Sehgal Yeah. People, people in the US graduated at 22. So I'm 21. So I'll be graduating next year. But Speaker 2 so that's the you pay per se for the

Speaker 1

study? No, actually. So this semester I've been studying in Switzerland, as part of a program. And in order to one of the requirements of my course in Switzerland, is that I conduct some sort of financial research. So yeah, this is my topic. I think. I think that this is super interesting to explore. I mean, when I when I mentioned it to the people that work here, they were a little surprised. They were like, what, why would you pick? But I think it's I think it's really interesting. You know? Yeah. How

Speaker 4 did you contact with our company?

Speaker 1

Oh, yes. Okay. Yeah, that's a great point. So. So I'm currently studying in Geneva. And there's an International Institute over here. And I contacted some of the professors. And which would most help me with my research as kind of like a mentor. And I found Professor Yan. I'm not sure if you guys know her, but I think she Oh, shall young.

Unknown Speaker Yeah, yeah.

Speaker 1 Yeah. So I think he's very good friends with her has some relationship with her, because Professor Yan is originally from from Beijing as well. So that's how that's how I got connected. Yeah.

Unknown Speaker Quite interesting. Yeah.

Unknown Speaker No, it's pretty random. I know. Yeah.

Speaker 2 Just to do some paper research. We have no idea to be in the main today.

Aditya Sehgal Yeah. Yeah. I appreciate you guys joining. Yeah. Alright, so TSMC. Meeting?

Unknown Speaker

The we have to Yeah, it's quite sorry for that. They told us to be quite curious.

Aditya Sehgal I'm just happy to be talking to you guys. It's nothing. Nothing crazy. I just want to learn more. So this is great.

Unknown Speaker To get back to the school.

Unknown Speaker Always get back to what?

Speaker 2 Get back to the school. And to have that action like Yeah.

Speaker 1

Yeah, I mean, graduating scares me. It's, I feel like it's getting out of school is it's a big, it's a big, big thing. But yeah, exactly. Yeah. Okay, so manage its relationships with Chinese and US consumers. So, yeah, do you think I

mean, have you seen TSMC MC CES, specifically having a lot of challenges, giving? I guess, the, again, like the tensions between China and the US, and Taiwan. In terms of relationships?

Speaker 2

You mean, the challenge the TSMC meeting?

Aditya Sehgal

Yeah. In terms of relationships with customers because of the problems between China US Taiwan?

Speaker 2

Oh, you go back to the question six. Yeah, question six. Yeah, yeah. I just lost my connection. I think that also to management, the relationship between Chinese and you asked, we could talk about some like the government's relationship or the customers and the, like, TSMC adhere to strict to or rules and regulations regarding export controls and the tree the restrictions. Yeah, right. And TSMC operates in complex compliance with laws and regulations on the countries where it operates. And it has established the internal process and the procedures to ensure compliance with those regulations. That's the first point and also as at the same time TSMC has all So expanded is, presents you as markets in recent years. And it has developed us strong relationships with many of the country's leading semiconductor companies, including Apple and at the end user of the chips. And also the TSMC has a NASA that plans to build a new fab. In Arizona. Yes, which will help to fold the strength is credit since in you as mortgage.

Speaker 1

Okay. Yeah, I get that facility in the US will be, I guess not the most modern technology. Right. So they're keeping the three nanometers in Taiwan specifically, I think. I'm not sure if they're if they gave it to China or not, but the technology to produce?

Speaker 2

Not in China, I can see but we have eight codes. We have no idea. Okay. Okay. Yeah, because that's the main, the main strengths of the TSMC. Yeah, it makes

Unknown Speaker sense. We can hold by themselves.

Speaker 1

Yeah. So I mean, all of your clients and my conductors, are they producing five nanometer? Mostly? Okay. Or do you know?

Speaker 3 24 to 28.

Speaker 2 I think the most of the bats in China are

Unknown Speaker 28.

Unknown Speaker The talk about it.

Unknown Speaker Sorry, sad again.

Unknown Speaker We can't talk about

Aditya

okay, no problem. And it's okay. You know,

Unknown Speaker I think maybe you can research. That.

Speaker 1 Sounds good. No problem. Yeah. So, okay, yeah. So government intervention. For Question seven,

Speaker 2 intervention. The intervention of the government can be a significant role in the semiconductor spine trading. And it's also impacts many different factors like trade policies and investment, also about the development of funding. Right. Yeah.

Unknown Speaker So

Speaker 1

how has I guess? I'm not sure if you could speak to this. But how has China's government been intervening mostly with semiconductors?

Speaker 3 How are we doing in Chinese covered about a role that government in termination? Yeah.

Speaker 4 People money and space?

Aditya Sehgal

So what would you say? Would you say China's government is promoting it, they're like giving money and making sure that more semiconductors,

Speaker 2

they create opportunities for the companies like TSMC. For example, the government's may offer investment incentives to attract semiconductor companies to build new fabs in the mainland, and also can help to extend the Indus industry global footprint and increase production cap cap cities, and also TSMC may have take advantages of such incentives in the past.

Aditya Sehgal But for smaller facilities, has China supported them as well?

Speaker 2 Yeah, I think it depends on the local government.

Unknown Speaker Okay. Yes.

Speaker 2

Most of them want to create some new to develop some new new things or to how good job during the year. So they could if they got the money, they will put them into the new technology development.

Unknown Speaker Got it. Cool. Yeah.

Unknown Speaker Yeah, go ahead.

Speaker 1

Yeah, no, that's I mean, that's all I have questions about and regarding government intervention. And what you wrote is very helps a lot as well. But for Question Eight, you Want to move on?

Unknown Speaker Yeah, it's okay. We can move on and question

Unknown Speaker improve the

Unknown Speaker question. Yeah.

Speaker 1 Sorry, my laptop is just Okay. Question eight in your experiences global supply chain says in transparency

Speaker 4

the managing global supply chain can be challenged. But there are several paths. Practice that companies can, like TSMC can follow improve their operations in this area. Some of these paths include the building recent wrestlers supply chains, or

Speaker 4

trans parents, grandparents and communications. Okay. And implementing as a team technology solutions, and developing talent, and

Unknown Speaker it's just, there's parts

Aditya Sehgal Yeah, okay. Yeah, some questions better.

Speaker 4

T TSMC. Trust of tart in supply chain. I think maybe it's just to do their work. And, you know, they move TSMC to the US. Yeah. Did you know that? Yeah, in my opinion, is not a good decision. Maybe the cost will go ins up going up? And I think is destroy for the cemetery. Supply actually.

Aditya Sehgal Because of the costs on the US or I

Speaker 2

think the manufacturer, manufacturer or the factories, they always rely on themselves, not just rely on the garments. Okay. What they pronounced makes sense. Yeah, but they can lead to you, like give you what kind of bad news from the government?

Unknown Speaker That's not so reliable.

Aditya Sehgal Got it? Alright, yeah, so question nine, how do you see the semiconductor supply chain?

Unknown Speaker Think that's all about

Speaker 1

so, yeah, where do you see semiconductors kind of going? Through? You see, because I mean, I think is there any new technology other than semiconductors that's similar that you think people will switch to? Because I mean,

because of the shortages in Europe and America? I think some military companies are looking to find some other way to I guess not use semiconductors because of the shortages.

Unknown Speaker You mean I mean military? Yeah.

Unknown Speaker Military.

Unknown Speaker We have mentioned before

Speaker 2 about that matter about the military. Okay. And also you have not much idea about military

Aditya Sehgal okay. But is there are there any other technologies that you that you see being developed that are similar to semiconductors are now

Unknown Speaker the instability

Speaker 2 of In China we have someone new technology to be used in factories and like the

Unknown Speaker point to

Speaker 2 the visibility of the supply chain and also they use this on like the automotive

Unknown Speaker CCFP

Unknown Speaker are just to use the Nike new technology tester to replace the human to be on the workplace

Speaker 1

makes sense okay. Yeah, I mean what you wrote is great. And then what are some potential risks associated with heavily relying heavily on a single company? So, have you seen any of those challenges in China relying on TSMC

Unknown Speaker I think we got like some end user

Speaker 3 like equal A equal 10 electric

Unknown Speaker car factories and also

Speaker 3 some apple some t f t factories and some control

Unknown Speaker can do it could logic

Speaker 2

factories and they use the chips from the TSMC but actually due to the policies and the due to the trade tensions, we come to import the chips from the TSMC

Speaker 3 that will be cut the development of these companies okay. And I think I can

Speaker 1 yeah no problem yeah. Logistics and Transport Do you have anything that you would say is specific in the semiconductor supply chain to how it runs as compared to other technology industries? And is there any problems that you immediately see with semiconductor supply chain

Speaker 1

thinking Well can I repeat the cut Yeah. No, no. So compared with other technology industries do you see any problems specifically within semiconductor supply chains that I mean to you? You know, signaled like oh maybe we should focus on this maybe this is a problem anything like that

Speaker 2 you're not other different industries, not just about the semiconductor

Aditya Sehgal Yeah. So any any differences in semiconductors specifically?

Unknown Speaker To me no problem

Unknown Speaker your shooting

Unknown Speaker you been

Speaker 2 Maybe we can talk about some like transportation problems, like exports of the export or import

Unknown Speaker policies.

Aditya Sehgal Sure. Yeah. Yeah.

Unknown Speaker Central call chocolate

Speaker 2 think talk about sunlight get a Jew. political tensions. Yeah. We also to refer to the export and import

Unknown Speaker cost and loss. Okay.

Speaker 2 And if the government's don't to import that, like that the US government don't let the manufacturer of semiconductor manufacturing equipment manufacturer to export the equipment to train China's

Unknown Speaker staff fab, we couldn't to
Speaker 2 produce some high technology chips.

Unknown Speaker Okay, and then the

Speaker 4 call the license of credit first, and the license allow the our customers to use the this this level of technology levels facility

Speaker 2

like the Entity List, right? The teaching them that you ask them inside the Entity List for the Chinese companies. Yeah, that's where I'll be the most challenging. Yeah, for the semiconductor production. Also for like five a company. They can't export export the products to the US or some Europe, European Union countries. And although the farmer have the main technology, and they to produce the goods, good stuffs, good product productions, but we couldn't use it in the European Union.

Speaker 4 The most important factor is the political factor. Make sense? Yeah.

Aditya Sehgal All right. Yeah, I mean, I think we already talked about question 11 In terms of logistics and transportation, I think I already asked you guys about that.

Unknown Speaker Awesome, what are we working is a transport

Aditya Sehgal really? So what specifically in transportation are you working on?

Speaker 2 You mean, what what we are working focused on what we are focused on our daily job.

Unknown Speaker Yeah, exactly.

Unknown Speaker You can help

Unknown Speaker you do.

Speaker 2 We actually do some operations during our day life.

Speaker 2 Mostly ties the equipment imports to China and

Unknown Speaker to walk with some taps

Speaker 2 to give them some logistics solutions about the

Speaker 3

impulse logistics. That's what they do delay. Yeah.

Aditya Sehgal

And question 12 Last one, data analytics visibility, how are they leveraging these tools?

Speaker 3 Question 12 is to talk about the importance of data analyst.

Speaker 2 I think that's the question more refers to the manufactury right?

Unknown Speaker I guess Yeah.

Speaker 2 Also the data and lays analyze

Speaker 4

is also important for us. We use the data Every day. Yeah, I can imagine, you know, the takeoff date of the facilities and? And some some other theaters did. Yeah. To record our crop

Unknown Speaker is quite important for our array.

Unknown Speaker Yeah, of course. Yeah.

Speaker 2 And be with no not working for our manufacturer. And we couldn't to see what the important thing to the right.

Aditya Sehgal Yeah. So have you seen demand? With this? I mean, analyzing the data, have you seen the demand kind of drop after COVID? Or, I mean, sorry, increase after COVID Then drop? Or how has the demand kind of changed in semiconductors in China?

Speaker 2 You mean, did Hanna says change the job?

Speaker 1 For demand? So have people demanded? I mean, I after COVID, I imagine there'll be a larger demand. Right? After COVID-19 Yeah.

Unknown Speaker Or that connection? Yeah.

Aditya Sehgal

Yeah, it's okay. I mean, so, I mean, I was just asking that demand wise with the companies that you work with after COVID There was a lot of demand, right. And then after that, did it go down? Yeah. Or has it stayed the same?

Unknown Speaker type of semiconductor demand, yeah.

Speaker 4 Or the customers demand or their transport demand?

Speaker 2

I think the demand not is getting is not much increase as before, okay. Also, you can see the situation for the fabs, they cut down some the cardones own factories, and also many factories, cut the people job

Unknown Speaker demands also associate needs.

Unknown Speaker Makes sense?

Speaker 2

Hold the money into their own pocket not to buy that much stuff, as before. Yeah. And I think all the demands for the different kinds of consume productions.

Unknown Speaker They are both getting done. Yeah. Okay.

Speaker 1

Makes sense. All right. Well, yeah. I mean, thank you so much for actually, I mean, giving me like the responses to these questions. And that's all the questions that I have. You guys have helped a lot. You given me a lot to think about and analyze in the future. But yeah, thank you so much for meeting with me.

Unknown Speaker We hope more.

Speaker 1

Communication. Absolutely. Not. Actually, yesterday, I had an interview with someone else from Beijing. And for half the interview, they were speaking in Mandarin. And they were just speaking in Mandarin with me. And I had to record it and translate it afterwards to understand it. So yeah, no, your English is perfect. It's more than fine. Yeah.

Unknown Speaker Now ask another question.

Unknown Speaker Yeah, of course. I'm actually like reliever

Aditya Sehgal

outside again. I know your hometown. I'm from New York. I was born in India, but my family moved to New York. Cause

Speaker 2 English is you accent is quite perfect.

Speaker 1

Yeah. My, my English isn't my first language either. So I had to I had to learn this. Before this meeting, you are quite too concerned about it, but can you understand me no problems? Yeah. Oh, I can do it. Yeah, How much makes sense? Makes sense? I feel like I feel like people that learn English as a second or third language, actually have a better accent than people who were born with English. Because when you're when you're is born and you speak the language and you, you don't you don't properly pronounce words, you just kind of speak and it's very hard to follow. But people that learn it, for example, I've had no problem understanding you guys, because whenever you speak, you're properly pronouncing. So it's, it's really good to

Speaker 2

use some easy words. Yeah. Exactly. Yeah. Also, why you choose you major build about the semiconductor also about the case study of TSMC? Yeah. Why

Aditya Sehgal

do you choose? Why did I chose it? Yeah. So I mean, GE. So I'm a I'm a student in the School of Foreign Service at Georgetown University. I'm not sure if you if you know, the university, but it's a

Unknown Speaker it's a New York. Maybe it's

Speaker 1

in Washington, DC. Yeah. Yeah. So I'm really, I'm really interested in geopolitics. But also, I have a business background. So if I, if I take geopolitics, and I take business, and I combine them, semiconductors is the main thing that's happening right now, that has both of those things. Right.

Unknown Speaker Oh, yeah. Case study.

Aditya Sehgal

Exactly. Exactly. Right. So it's just evolving everything. And I think I think it's really cool to kind of write about Yeah.

Unknown Speaker

It's really cool. If you could do some research to put on ici or something. Yeah, maybe we can Google Scholar scholar. You have

Aditya

been maybe I hope so. I hope so. That would be great. Yeah, I'll let you guys know when I'm when I'm finished. If you guys want to read it, but yeah, thank you so much, again,

Speaker 2

I'd like to read can't give you much suggestions about what do you ask daddy? Because we are not in manufacturing? And I think maybe you can ask it you tutor or the professor? Yeah, absolutely. Find somebody who works in the manufacturing, working at TSMC. Perhaps that will be much better for your study. And the only way what we can talk is just about to do logistics. Okay.

Unknown Speaker Yeah,

Unknown Speaker I mean, no problem at all. About

Unknown Speaker the factories actually.

Speaker 1

Yeah, no problem. We knew guys, I was just trying to understand the supply chain more generally. And you guys helped a lot with that. So no problem at all. It really helped a lot. Because, I mean, I didn't. I've been more involved in accounting and finance. But I don't really know how supply chains work. So that was the main problem for me. So you guys helped a lot with that. So thanks. And I'll let you guys get back to your meeting. That you're going straight. Back to me that you appreciate it. All right. Yeah. Well, thank you so much. Have a great night over there. Right. It's like 6pm now. Yeah, have a great night. And yeah, hope to stay in touch. And yeah, thank you. Thank you. All right. Bye. Bye.