

INTERNATIONAL JOURNAL OF LAW
MANAGEMENT & HUMANITIES

[ISSN 2581-5369]

Volume 5 | Issue 4

2022

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The Digital Renaissance of the Semiconductors and The Geopolitical Laws

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ABSTRACT

PURPOSE: *By 2024, the world would cradle in the lap of the "Angstrom" era of the Semiconductors. It is no surprise that the leaders of the veteran and emerging world powers are laying ceaseless emphasis on consolidating a comprehensive and resilient Semiconductors Wafers' capacity. Be it the U.S. President, Joe Biden, who issued the Executive order 14017 on February 24, 2021 called "America's Supply Chain" or the Prime Minister of India saying: "...we can move towards an India that is a hub for Semiconductors for the world in the coming years", it becomes vehemently significant to audit the genome of the laws which govern the simple as well as advanced flow of technology acting as a strengthening/ hindering factor in the designing, manufacturing and downstream uptake of this like-gold-dust backbone of the global economy called the Semiconductors. When the planet was already under the painful pandiculations from the early spasm caused by the pandemic and the climate change, Russia's war on Ukraine squeezed out the last node that felicitated the unremitting supply chain of the Semiconductors, worldwide. What the intercontinental acquaintance suffered as a result was, the disruption in the flow of the supply chain of a commodity which hegemonies the living customs of humanity, ranging from their cell phones to automobiles to bank ATM machines.*

RESEARCH METHODOLOGY: *The method, hence, employed to baste the research around the article, circumferences along the rims of various primary and secondary sources which have been duly recognized and acknowledged throughout the article, in an appropriate manner. The sources include newspaper dailies, profuse number of political as well as apolitical books by authors stemming from diverse fields and statistics are being supported by the mentioning of the news channels which released the data, henceforth*

PRACTICAL IMPLICATIONS: *This article is investigative in nature which aims at opening the floor for substantial critiquing, constructive debating and exploratory to invigorate more awareness about the novel issues at hand. Therefore, this article doesn't advocate any concrete conclusions at the behest of their applicability; rather, it looks forward to set peripheries that could be swelled and pushed forward, further, with more considerable arguments.*

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Semiconductors: The solids which have conductivity and resistivity between metal conductors and insulators are called Semiconductors which are further classified into two broad categories: the elemental (the semiconductors available in natural form) and the compound semiconductors (semiconductors which are made by compounding the metals). The most widely used semiconductor in the semiconductor industry is Silicon, at this moment.²

Why have the chips, as the semiconductors are most commonly known as, have replaced the vacuum tubes in recent times? It's majorly pertaining to their merits which, broadly, includes: Smaller size and less weight, Saves electric power, Does not get heated so no cooling arrangement required. Longer shelf life and Cheaper

Integrated Circuit: Integrated circuit is that circuit in which the circuit components such as resistors, capacitors, diodes and transistors, etc. are automatically parts of a single small semiconductor chip, formulated to perform an obligated complete electronic function³. These integrated circuits (Small scale, Medium scale, Large scale or Very large scale) are widely used in functionaries falling at the both extremes, of imaginable and augmented reality, of the modern world.

As the object under consideration has been translated into basic structural classification, the article would leap forward to explain how the chips are important to us, more after the pandemic gave it an extra eminence to boast about its efficacious nature in our day-to-day conundrums, thrown at us by life. The United States of America was the country which invented the first Silicon chip. It continues to be the biggest producer and researcher of its design. The world became virtual, so was the demand for electronic devices geared up. Today, the semiconductors are the neural thalamus to à la mode electronics handed-down in economic growth, global contestation, computing, healthcare, military systems, clean energy, data centers and sovereign security of various nations: "...we have a global shortage of silicon chips due to the pandemic, trade policy, regulation, and former sourcing decisions. These four factors have combined to disrupt the semiconductor industry..."⁴ This, in furtherance, protected and destroyed the cybersecurity of the parent designing and manufacturing units along with the users of it.

Moore's Law: "states that the number of transistors on a semiconductor would double every two years, thereby rapidly increasing the functionality of semiconductors and the electronic products they enable."⁵ With hitherto rapid evolution experienced by the data networks, cloud

² (Gomber and Gogia, 2016, pp.9/1–9/90)

³ (Gomber and Gogia, 2016, pp.9/1–9/90)

⁴ (aglmmain, 2021)

⁵ (dcadmin, 2015)

computing and smartphones, the foundational factors of the chip industry/ Semiconductor technology, the pandemic buttoned -up the cufflinks of the petaflop compute service operation and petabyte data usage, manifolds. The coalescence of advanced computing technology: “In addition, the computing and semiconductor industry has become a global enterprise, fueled by increasingly competitive overseas semiconductor markets and firms that have made large and focused investments in the computing space over the last decade”⁶, followed by hefty data being transferred to cloud, in line with better connectivity provided by global supply chain and ameliorated: “Artificial Intelligence has significant value-creation potential in the semiconductor industry”.

While, the global technological emporium anticipates supply chain tightness of the Semiconductors by 2023, there is an appalling need for much more nuanced semiconductor manufacturing capacity on a global level, an equal geographically-balanced chain of supply and variegated as well as safe dispersal of opportunity. The digital renaissance, in its very nature, has created an unforeseen thrust on fragile pre-existing supply chains functioning in the global atmosphere. The contemporary civilization asks for a collaborative/ cross-party approach in bidirectional methods of top-to-bottom and bottom-to-top alliances working in a sensitive ecosystem of supply chain manufacturing units. Thus, the second part of the article, appertains to the current geopolitical relations, the individual laws the countries as global players of importance have casted upon the Semiconductor industry and the fallout at the level of the policies *in-effect*.

THE UNITED STATES OF AMERICA: “The U.S. Senate on Tuesday voted to move ahead with a slimmed-down version of legislation to provide billions of dollars in subsidies and tax credits for the semiconductor industry, hoping to ease a shortage that has disrupted production in industries from automobiles to electronics and high-tech weapons.”⁷ Under the CHIPS Act of the United States of America, Biden’s administration instructed the Bureau of Industry and Security (BIS) to use Section 9904 of the CHIPS Act to conduct a mandatory survey among the microelectronics industrial base and know if they have any conditional/ unconditional communications with the People’s Republic of China. Additionally, it announced incentivized provision to provide financial assistance to set up facilities and provide equipment “for semiconductor fabrication” within of the folds of Section 9902.⁸ As the United States of America is a paramount name in the designing world of the semiconductors, contemporarily, it

⁶ (National Research Council (U.S.). Policy And Global Affairs, 2012, pp.05-16)

⁷ (Zengerle, 2022)

⁸ (Semi-Literate, 2021)

is exerting itself to maintain its ascendancy in this arena by also, forming various alliance and passing bills on its territory⁹.

THE PEOPLE’S REPUBLIC CHINA: China plans to invest a massive and whooping amount of some \$150 bn in its, otherwise nascent, semiconductor’s industry from 2014 to 2030¹⁰. China has an eminent role in the global supply chain as it is the world’s largest producer of electronics. Although, China is a leading giant in manufacturing dominion, it lacks the designing and intellectual property rights regarding the semiconductor’s technology and hence, it has to import the same before using it in other electronic items: “Chinese chip firms are notably absent in the market for high-end logic, advanced analog, and leading-edge memory products.”¹¹ June, 2014 China announced guidelines in order to promote ‘National Integrated Circuit Industry Development’. Under the same, China plans to achieve 70% of the domestic demand of semiconductors by domestic production. Along with, China: “created a government fund—the China Integrated Circuit Investment Industry Fund (CICIIF)—to channel an estimated \$150 billion in state funding in support of domestic industry, state-directed overseas acquisitions, and the purchase of foreign semiconductor equipment. In October 2019, China announced a second semiconductor fund with an estimated capitalization of \$28.9 billion.”¹²

THE REPUBLIC OF INDIA: Legal provisions in India related to the semiconductors are not well laid out. ‘The Semiconductor Integrated Circuit Layout-Design Act’ (2000)¹³, which falls under the Ministry of Communication and Information Technology, provides protection to the layout/ design of the semiconductor chip for which the design should be registered first. Therefore, the: “Protection under the Act exists only after the layout-design has been registered. Layout-designs can be registered, if they are:

- original,
- inherently distinctive,
- capable of being distinguishable from any other registered layout-design and
- if they have not been commercially exploited for more than two years before date of application for registration.

Thus, the Act does not require ‘novelty’ but ‘distinctiveness’ for the purpose of registration.”¹⁴

⁹ (Shepardson and Zengerle, 2022)

¹⁰ (Semiconductor Association Industry, 2021)

¹¹ (Semiconductor Association Industry, 2021)

¹² (Congressional Research Service, 2021)

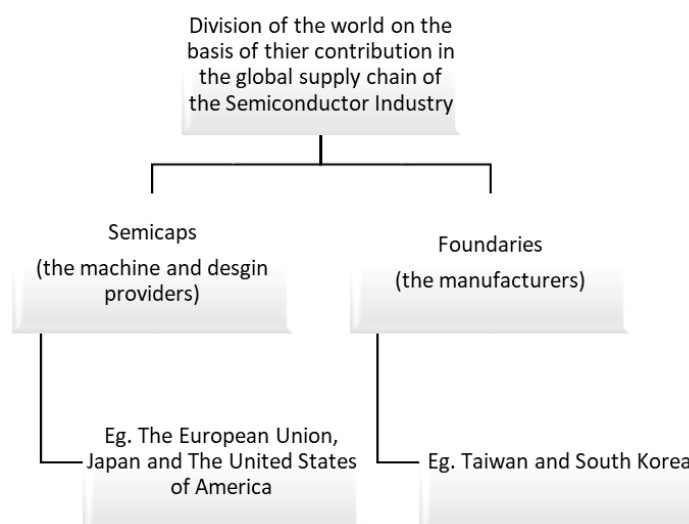
¹³ (Administrator, 2013)

¹⁴ (Banerjee, 2014)

By the end of the year 2021, the Indian Union government announced ‘India Semiconductor Mission (ISM)’ in order to upscale semiconductors, manufacturing and formatting on the Indian land. Under the same mission, the provision has been passed to: “provide attractive incentive support to companies/consortia that are engaged in Silicon Semiconductor Fabs, Display Fabs, Compound Semiconductors/Silicon Photonics/Sensors (including MEMS) Fabs, Semiconductor Packaging (ATMP/OSAT), Semiconductor Design.”¹⁵, for it wishes to compete globally as a rising economy by contributing significantly in the global supply chain.

THE EUROPEAN UNION: Moving along the lines of the U.S.A., the EU Commission has proposed a formulation of a legislation called the ‘EU Chips Act’: “focused on developing a domestic EU semiconductor industry and reducing dependency on foreign imports. The proposal is part of the EC's strategy to incentivize manufacturing in the EU and achieve "strategic autonomy" in the technology sector in particular.”¹⁶ EU has a history of governing the ‘Integrated Circuits’ as it was the one which contrived 1989 Treaty on Intellectual Property in respect of Integrated Circuits (IPIC Treaty). On the contrary, today most of the members of the EU are dependent on other countries to provide them manufacturing units for their semiconductors chips. This led to a recession in its production units of other electronic appliances when there was a global shortage of the chips, as it depended intensively on imports of the same. So it aspires to invest in its laboratory researches as well as onshore manufacturing.¹⁷

THE DIVISION OF THE WORLD INTO TWO CATEGORIES:



(Fig:01/01)

¹⁵ (INDIAai, 2021)

¹⁶ (Alex et al., 2022)

¹⁷ (Cota, 2022)

To explain the above flowchart (Fig: 01/01), it is suggested that the global supply chain has got two parts: the manufacturers and the providers of the technology and design required for that manufacturing. The U.S.A., Japan and the members of the EU form a part of the latter group (The Semicap Countries) while various South Asian countries, especially Taiwan and South Korea, are part of the former group (The Foundaries countries): “According to Trendforce, Taiwan will control 48% of the global foundry capacity in 2022, making it the undisputed leader.”¹⁸ It is of extreme importance to note, that Taiwan is a volatile territory under constant threats of invasion from the escalating dominance of China in the South China Sea and South Korea shares unstable border conditions with the dictator-led North Korea. As a result, nations have become active to inflate their domestic/in-house production of the semiconductor chips so as to safeguard their future stakes against the aggressively rising Chinese hegemony in the global paradigm.

GEOPOLITICAL ALLIANCES: The second Cold-War is in making with the U.S.A and China as the opponents and the rest of the world taking sides. Countries like India, the promoter of strategic autonomy, might not out rightly announce their allegiance to one country. Nonetheless, they always rest towards the one which falls in alignment to a greater level with their national and international interests as well as their values. The U.S.A is also looking for potential partners among the members of the EU and Japan: “The US has proposed forging a semiconductor industry alliance between the United States, Taiwan, South Korea, and Japan in a move to prevent China from gaining dominance over the strategic sector.”¹⁹ In order to rectify the issues related to IP (Intellectual Property) reuse and data theft of the semiconductor chip at both manufacturing and designing level, initiatives such as The GSA Intellectual Property (IP) Interest Group (established in 2020): “Some of the topics that the IP Interest Group has identified for discussion are;

- IP Traceability – Identity and tracing usage of product in end applications
- Industry Consolidation – M&A and the impact to IP
- Open-Source Hardware – Industry trends and impact of open-source hardware
- Monetization of IP”²⁰

With its member parties that would include global powers from North America, Europe and Asia Pacific. The oldest common global consciousness in terms of the semiconductor industry

¹⁸ (Cibean, 2022)

¹⁹ (ANI, 2022)

²⁰ (atomicadmin, n.d.)

has been achieved through the TRIPS Agreement: “The World Trade Organization regulates trade agreements between many nations and establishes rules for the protection of intellectual property rights. Features of a TRIPs agreement protect the work of inventors and provide creators with an incentive to create future works.”²¹ As the latest visit by Nancy Pelosi (Speaker of the United States House of Representatives) to Taiwan had a sub interest of consolidating their strategic partnership over semiconductors chips’ industry, China’s ships and drone simulating attacks on Japan as well as US jets, the condition where Beijing is ready to conduct live fire drills in the Yellow Sea.”²², outlines the urgency in the global diplomacy to bring a balance of power so that there is no repetition of shortages in the coming future and there isn’t a threat monopoly of one nation over the others.

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²¹ (Novinson, 2017)

²² (News18, 2022a)

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