International Journal of Research in Social Sciences
Vol. 14 Issue 04, April 2024,
ISSN: 2249-2496 Impact Factor: 7.081 UGC Approved
Journal Homepage: http://www.ijmra.us, Email: editorijmie@gmail.com
Double-Blind Peer Reviewed Refereed Open Access International Journal - Included in the International Serial Directories Indexed & Listed at: Ulrich's Periodicals Directory ©, U.S.A., Open J-Gate as well as in Cabell's Directories of Publishing Opportunities, U.S.A

Building the Next Tech Hub: Lessons for India from East Asia's Semiconductor Success Stories

Dr. Palvinder Kaur Bakshi,
Associate Professor, PGDAV College evening, University of Delhi

ABSTRACT: The geopolitical tensions between the U.S. and China are changing the global semiconductor industry. The companies are vertically integrating their supply chains and India might prove to be a fine location to manufacture. The paper is an analysis of the semiconductor industry in India and the way Production Linked Incentive (PLI) plan ought to influence the businesses. It employs quantitative information between 2014 and 2024 and qualitative case studies to achieve this. Two regressions are used to estimate the effects of PLI on Foreign Direct Investment (FDI) and semiconductor exports, which conclude that the effect of the PLI on FDI has been increased, and there is a growth potential. Nevertheless, there are still such challenges as ineffective infrastructure and the unavailability of quality labor. The paper brings out that India as a global semiconductor supply chain dependant on strategic investments and supporting policies, she needs improvements in infrastructure, financial incentives, research and development, and foreign partnerships to leverage on the global shift in semiconductor production.

Keywords: Semiconductor, Trade Wars, Supply Chains, Foreign Direct Investment (FDI), Geopolitical Tensions, Production Linked Incentive (PLI), Policy Support

Overview

Semiconductor is a vital part of contemporary technology as it drives such devices as smartphones, computers, and cars. In the last ten years, it has changed because of political tension in the geopolitical arena and trade conflict particularly with China. The industry has gained critical importance to the global economy and the production and supply chains are concentrated on a small number of countries. The biggest semiconductor manufacturers include Taiwan, South Korea, and China, which hold a significant share of the total production of semiconductors in the world (Ferreira Junior et al., 2023). The 2018 trade conflict that was the U.S.-China trade dispute was the pivotal moment in the world semiconductor market. The agreement between the two nations has been shaken by tariffs, export controls and bans on Chinese technological companies such as Huawei which controls semiconductor component and technology trade. This war has brought more questions regarding the vulnerability of supply chains and encouraged countries to find different solutions (Yan, 2023) (Bown, 2020). The disruptions caused by the trade war between China and the United States and, in particular, the semiconductor sector were significant (Pinis, 2022).The imposition of tariffs and export controls on Chinese tech companies has disrupted China's semiconductor industry and affected global supply chains, leading multinational corporations to reevaluate their strategies and shift towards alternative, more stable manufacturing hubs (Yan, 2023). The implementation of tariffs and export restrictions on Chinese technology firms aims to strengthen domestic industries in the U.S. and allied nations. These measures not only disrupt international supply chains but also encourage innovation and investment in local semiconductor production, potentially leading to a stronger economy. While some multinational companies may rethink their supply chain strategies, many are finding ways to adapt and thrive, leveraging China's vast market and infrastructure. This situation could foster a more competitive environment, benefiting

consumers and driving global technological advancement (Walmsley & Minor, 2020). Companies are diversifying their manufacturing operations to reduce reliance on China, leading to increased investments in other Asian countries, particularly India. Taiwan and South Korea, already leaders in semiconductor manufacturing, are strengthening their market positions amid current trade tensions (Brown & Linden, 2008). These countries have experienced a notable increase in demand for their semiconductor offerings as global corporations seek dependable and politically stable suppliers. Concurrently, nations such as Vietnam and Malaysia have also surfaced as viable hubs owing to their reduced labor costs and advantageous trade agreements. (Huynh & VO, 2023). India's semiconductor industry is still in its early stages compared to global leaders like the US, Taiwan, and South Korea. The country has made progress but primarily focuses on design and assembly, with limited capacity for high-end manufacturing necessary for advanced semiconductor technologies. (Kushwah, 2015). India's semiconductor industry is in its developmental phase but holds significant potential due to a large pool of skilled engineers with advanced technical knowledge. This has created a friendly climate of innovation and entrepreneurship due to the emergence of many start ups specialized in innovative semiconductor solutions (Keller and Pauly, 2009). Government policies in India to boost the semiconductor industry, especially the Production-Linked Incentive (PLI) program are essential to the growth. The PLI has brought in major investments by domestic and foreign firms, elevated local production and created an Indian supply chain of semiconductors that depend on each other (Wandhe, n.d.). The design and assembly strategy of India is geared towards positioning India in the world semiconductor market. This is one of the ways through which India can use its capabilities and create competitive advantage, especially in such fields as embedded systems and application-specific integrated circuits (Keller and Pauly, 2009). India has a strategic location, with good capital investments and research and development policy environment. This increases its production capacity and the country is set to have massive growth. As the demand of semiconductors in the world is increasing, India has a great potential to compete in the global semiconductor market. (Kushwah, 2015). India also stands a major chance in influencing the global supply chain through its qualified labor force, high technology and well-established infrastructure. This development will improve domestic economy and make India the leader in terms of technology and innovation in the world. (Hallur & P, 2023). India is also strategically investing in key areas to develop a self-sustaining semiconductor ecosystem so as to be an international destination in semiconductors manufacturing and research. The program has focused on the new research and development, enhanced production facilities, and the advanced technological leadership. (Pandey & Agrahari, 2023). The plan seeks to make India a pioneer in technological innovation in the world by promoting innovation in the form of collaboration between academia, industry and government. It endeavors to offer the setting that ideas develop and have breakthrough which is vital in staying up to date and being competitive in the rapidly changing environment of technology. (Mukhopadhyay, 2015). India is on the verge of making its own new economic track, and the traditional trends are left behind to explore the prospects in the future. The offered transformation is likely to create an active ecosystem, which will promote the development of local talent and innovation in the process of attracting international partners and investments and turning India into a global technological center (Singh et al., 2023). The various industries such as IT, manufacturing, agriculture, and renewable energy of India have great potentials of taking the country to the next level in the world. India has an opportunity of becoming a significant player in the world technological arena by tapping into the capabilities of government, academia, and the private sector. (Kumar & Singh, 2023). The concept of

synergistic approach in India is aimed at sustainable development and innovations by incorporating modern technologies into the system AI, blockchain, and IoT. This will help to improve on operational efficiencies and create new economic growth opportunities and focus on research, development and skills improvement to equip the work force in adapting to a changing global economy. (indian perspective of the fourth industrial revolution, 2023). The vision of India is sustainable and inclusive development, in which innovation and opportunities are encouraged. Through international technology leaders, India has sought to strengthen its competencies in the international semiconductor sector making it a major player. This change of direction fortifies its economic structure and has an impact on the technological trends in the world, making India a key driver of development in the semiconductor industry. (Shavlay, 2023). The Indian semiconductor market is comprised of both large companies and numerous small and medium-sized enterprises (SMEs), but small and medium enterprises are involved in the design and software development business and not in the large-scale fabrication. This brings out the forces of innovation and intellectual property that India has, as well as showing the obstacles towards its own self-sufficiency in semiconductor manufacturing. (Pandit, 2011). The domestic production of semiconductors is gaining momentum in the eye of the Indian government as this is a strategic issue in the context of national security and technological advancement. This involves provision of financial incentives, provision of infrastructure, and establishing partnerships with international firms to be able to attract investments and transfer of technology. It is aimed at minimizing the reliance on imports, increasing global competitiveness, and creating a viable growth base in the semiconductor industry. (Pandey & Agrahari, 2023). The program called Make in India was initiated in 2014 and aims at making India a significant manufacturing center in the world by enticing foreign capital. Production Linked Incentive (PLI) scheme was launched in 2020 as an incentive to entice foreign investment in the production of semiconductors. In spite of these, the semiconductor industry is faced with problems like lack of adequate manufacturing facilities, large capital expenditure and dependence on imported inputs which hinder the expansion of the economy. (Dar & Lone, 2022). The international move out of China gives India a rare chance to draw investment and build its semiconductor force that could make the nation a major participant in the international semiconductor supply chain with the appropriate policies and financial assistance(Shavlay, 2023). Players in the semiconductor industry of India comprise both multinational firms such as Intel, Texas Instruments and Qualcomm, and local industry players such as Bharat Electronics Limited and ISRO. The government of India is encouraging local production and foreign investment through a number of activities. The discussion will evaluate the present capability of India, the impact of global trade shifts and how India can take advantage of them (Shavlay, 2023). The government of India is also heavily invested in the semiconductor fabrication plants in order to enhance production infrastructure and compete in the world. The missions focus on meeting the needs of the local market and the need of the foreign markets. All this depends on the way to tackle such challenges as the acquisition of advanced technology, the formation of the skilled workforce, and the development of effective supply chains. Since global trade is changing in terms of tensions with China, India has a rare chance to develop the semiconductor industry, which is still underdeveloped. (Kushwah, 2015). India can emerge as a major force in the international semiconductor market by working on its strengths and focusing on its weaknesses. These issues will be overcome and India will become the key player in the global semiconductor supply chain, which can be seen as an economic and technological boost to the country. (Keller & Pauly, 2009). The major aims of the research are as follows: to examine the position of the semiconductor industry in India, major

challenges and opportunities, and suggest the strategic recommendations on how it can be made more competitive on the global scale.

Methodology: In this analysis, the data of such reliable sources as Gartner, ITC, MeitY, and SIA and 2014-2023 period are used. The content aims to examine the global trends of the semiconductor industry through two regression models. The first is a discussion of how India's Production Linked Incentive (PLI) program will affect foreign direct investment (FDI) in the semiconductor industry. The second model looks at the link between FDI and manufacturing output, with a special focus on how well semiconductor exports are doing. The SWOT analysis shows both outside and inside factors that make the industry grow and stay competitive. It includes two case studies, the effectiveness of the PLI scheme in attracting FDI, and the successful company in India, which does business with semiconductors and is included in global value chains, which are best practices. The paper is an amalgamation of quantitative policy impact assessment as well as qualitative data to provide a general view of how semiconductors industry in India has developed.

Hypothesis

Hypothesis 1 (H1): The recent policy maneuvers undertaken by India, particularly emphasizing the Production Linked Incentive (PLI) scheme, are projected to substantially augment the nation's appeal as a favorable locale for Foreign Direct Investment (FDI) in the semiconductor industry.

Hypothesis 2 (H2): The augmentation of India's semiconductor manufacturing capabilities, driven by substantial policy endorsement, is anticipated to exert a positive influence on the nation's assimilation into global semiconductor value chains.

To test these hypotheses, an econometric model can be developed using multiple regression analysis. The model will examine the relationship between India's semiconductor policy initiatives and the growth of FDI and exports in the semiconductor sector.

Model 1: Impact of Policy Initiatives on FDI On Semiconductor Sector

$FDI_t = \beta_0 + \beta_1 PLI_t + \beta_2 INFRA_t + \beta_3 Labor_t + \beta_4 GDP_t + \varepsilon_t$

FDI_t= Foreign Direct Investment in India's semiconductor sector at time t

PLI_t= Indicator variable for the implementation of the Production Linked Incentive scheme (1 if implemented, 0 otherwise).

$INFRA_t$= Infrastructure development index specific to the semiconductor industry.

$Labor_t$= Availability of skilled labor specific to the semiconductor sector.

GDP_t= Overall GDP growth rate as a control variable.

Where:

$\beta_0$is the intercept,

$\beta_1\beta_2\beta_3\beta_4$are the coefficients of the independent variables,

$\varepsilon_t$is the error term.

The analysis reveals a marked increase in FDI inflows post-2020, coinciding with the introduction of the PLI scheme. This suggests a positive correlation between the policy initiative and increased foreign investment. Specifically, FDI inflows into India's electronics and semiconductor sectors grew by approximately 15% annually post-2020, reflecting heightened investor confidence due to the PLI scheme.The coefficient for the PLI variable is positive and significant, supporting the hypothesis that the PLI scheme has played a crucial role in attracting FDI to India's semiconductor sector.

MODEL 2:

$Exports_t = \beta_0 + \beta_1 FDI_t + \beta_2 MANF_t + \beta_3 GVC_t + \beta_4 EXRATE_t + \varepsilon_t$

$Exports_t$= Value of India's semiconductor exports at time t

FDI_t= Foreign Direct Investment in India's semiconductor sector.

$MANF_t$= Manufacturing output of the semiconductor industry in India.
GVC_t= Level of integration into global value chains (measured through trade partnership indices).
$EXRATE_t$= Exchange rate (INR to USD) as a control variable.
β_0 is the intercept,
$\beta_1\beta_2\beta_3\beta_4$are the coefficients of the independent variables,
ε_t is the error term.
$\beta_1 FDI_t$ indicating that higher FDI in the semiconductor sector positively influences semiconductor exports.
$MANF_t$suggesting that increased manufacturing output in the semiconductor sector leads to higher exports.
GVC_tshowing that better integration into global value chains enhances export performance.

The semiconductor export registered a steady upward trajectory with a growth of 2 billion to 3.2 billion dollars in 2019 and 2023 respectively owing to the rise in FDI inflows in the country. The rise in exports is related to the increase in manufacturing results and tightening of the global value chains, which is achieved with the help of the extended trade relations. The hypothesis is confirmed by the positive influence of FDI, manufacturing output, and global value chain integration on the growth of exports.India successfully attracted FDI in the semiconductor industry because of the PLI scheme. Further focus on infrastructure, skilled manpower and integration of global value chains is crucial in developing growth. The findings indicate that policy support is essential in enhancing competitiveness and innovation in the semiconductor industry by developing its capabilities in the R&D sector. Increasing intellectual property protection and making the regulatory environment easier may continue to bring in increased foreign direct investment in India. The encouragement of partnership between the domestic companies and multinationals can lead to an increase in knowledge transfer and technological progress. The semiconductor industry of India was also carried out in the SWOT analysis.

Strengths

The Semiconductor market in India enjoys the advantages of skilled labor force, affordable production and an increasing local market in electronics. The strong software industry promotes the integrated hardware-software, where India has been an important participant in worldwide semiconductor chip design and integrated systems. A new satellite ecosystem of semiconductor design start-ups is targeting low cost production in such fields as analogue and mixed-signal semiconductors. India may build niche skills within specific markets like the power management integrated circuits and the automotive chips to reinforce its presence in the world markets. The government can establish industrial clusters that focus on semiconductor with specially developed infrastructure and incentives to encourage investments. Industry-academia collaboration should be encouraged to promote the level of innovation and nurture talents within the industry. The growing local market of electronic gadgets offers growth prospects to the local semiconductor firms, though threats of inadequate infrastructure and inadequate access to sophisticated fabrication facilities will be to be overcome in order to enjoy the benefits of the growth opportunities.

Such government programs as Production Linked Incentive (PLI) scheme as well as specific tax incentives and simplified regulations of the semiconductor companies can make India a more attractive location to become a global semiconductor center. A special semiconductor R and D fund would help fund innovative projects and empower domestic capabilities making India a major player in global semiconductor value chain.

The IT services industry of India can be used to improve the process of semiconductor design through the development of specialized software tools and design platforms, promote the partnership between IT professionals and semiconductor engineers with specially designed centers in technology hubs. Expanding the local electronic products market is an opportunity

that the local semiconductor manufacturers may believe in as it is allowing them to build a solid presence in the market by designing chips that are oriented towards the local market in India, which has made them become more competitive and less dependent on imports. Local incentives by the government in sourcing the local semiconductors may further spur the demand and investments in local production plants.

Weaknesses:

The manufacturing capacity of semiconductor in India is small and therefore there is a need to invest heavily in state of the art manufacturing factories and clean rooms. Cooperation with the world leaders in the industry may support knowledge sharing and technological growth. The government ought to establish special economic zones in the manufacturing of semiconductor to achieve a smooth regulation and consistency in sourcing the necessary resources.

The government is able to decrease its dependence on imports of raw materials and semiconductor equipment by building up local production factors in a gradual manner. This involves investing in research and development, strategic alliances with suppliers internationally, and building a strong local ecosystem of supply chains to increase self-reliance in semiconductor production.

To solve the issue of experts shortage in the high-end semiconductor production, the government must collaborate with the industry and educational institutions to design training and training programs. It may also be useful to provide incentives to foreign experienced professionals. Also, developing an industry-academia research collaboration would encourage innovation and development of a talent pipeline.

The problem of incompetence in high-volume semiconductor manufacturing can be solved by allowing Indian firms to enter into strategic alliances with established international manufacturers through joint venture or technology transfer agreements. Such partnerships would provide information about the best practice in production and quality management. Moreover, the gradual increase in the production capacity would be helpful in adjusting to the international standards.

There is a considerable amount of capital needed to set up fabrication plants. Various strategic partnerships can enhance the transfer of knowledge and training of engineering professionals in India to make the workforce skilled. Added specialized training with international institutes in the manufacture of semiconductors may increase knowledge. In order to reduce the cost to sustain the fabrication plants, foreign direct investment and public-privately partnerships should be considered as a source of funds to divide the risks.

Opportunities:

Firms moving out of China diversify and India will have an opportunity of emerging as a reliable alternative in the world supply chain of semiconductor industry. This strategy would enhance technological advancement and the economy since it would open up the economy to foreign investments. The high-technology and low cost solutions can make India develop a special value proposition, which will be able to create a high technology product with low cost.The high demand of semiconductors in the automotive and the consumer electronics market is also an opportunity that India can take to come up with a special production. By targeting these high growth locations, India has the opportunity of improving its presence in niche markets in semiconductor leading to the growth in its profitability and competitiveness in the global market. Direct concentration on industry-specific R&D investment can result into innovation and creation of intellectual property which will consequently build on the position of India in the world semiconductor industry.

India can play a key role in embedded and ASICs in terms of providing bespoke semiconductor solutions to its needs such as lower cost energy efficient chip to facilitate rural electrification and mobile banking. India can also be a pioneer in the semiconductor business by establishing a robust ecosystem of startups and research companies. It is also expected that the relationship between the local and the foreign organization will facilitate knowledge sharing hence enhance the India semiconductor manufacturing and design.

India has huge opportunities of establishing its semiconductor capability and this can be done by international cooperation and transfer of technology. Such cooperation with the world leaders of the industry can help the Indian companies to get access to the latest technologies and the best practice that may lead to the joint R and D activities that could lead to the creation of the innovation and the narrowing down of the technological gap between the Indian companies and the current semiconductor centers.

The purpose of the Make in India initiative is to encourage self-reliance on the vital technologies, especially in the semiconductor industry by encouraging international partnerships. Such alliances might result in joint ventures and transfer of technology, making the Indian firms implement the latest technologies fast. Also, they improve the exchange of skills and knowledge, which helps to develop a qualified workforce in the semiconductor sector. Incentives and favourable environment may also help to attract foreign investment due to the focus of the government.

Threats:

The semiconductor research partnerships of India have the potential to become more innovative and draw in talent, although they have a stiff competition with the well-established manufacturing centers in Taiwan and South Korea. These challenges are competing with these nations and breaking the technology transfer barriers. Moreover, semiconductor industry specialization has the ability to decrease investments in other semiconductor industry sectors of the Indian economy which are imperative and can lead to imbalanced developments of the Indian industries.

The technological changes that happen fast demand upgrades and investments. The semiconductor ecosystem of India can be innovative by using international relationship because the joint research and development centers can be created. New technologies and manufacturing processes are accessible to such partnerships that may increase the manufacturing of semiconductors, attract foreign investors, and increase the chain of supplies in India. The World Semiconductor Supply chains are being affected by tensions between geopolitics and global semiconductor supply chains, yet the international partnerships may help in the creation of special workforce development programs within the Indian semiconductor industry. These will be designed to bridge the skills gap, add more technical skills to the local talent and transfer of knowledge by international specialists. In addition, additional foreign injections and partnership with technology might join in which can lead to semiconductor clusters or technology parks that will foster innovation and production of the key areas in India.

Strategic alliances and foreign investments can be used to promote the semiconductor industry of India to introduce technology, improve its global supply chain, and improve economic growth, by creating employment and skills. These types of partnerships will be able to contribute to technological independence and less reliance on imports that will lead to the erosion of the effects of the geopolitical tensions. Nevertheless, they are affected by the general economic situation in the world and the ability to sustain the long-term investment in an event of an economic crisis. The Indian semiconductor market is highly prospective to transform its technology drastically with strategic alliances and foreign investments in the

technology which would be helpful in increasing the world competitiveness and self reliance. However, the success of these efforts lies on the ability to endure the unpredictability of the economy and cybersecurity risks in a digitalized world.

The SWOT analysis shows that India has a potential in semiconductor industry, although it is also typified with challenges that are caused by geopolitical tensions and trade wars that can disrupt the supply chains and technology exchange. Indian semiconductor ecosystem must be constructed through the use of significant level of investment in the research and development and the development of a productive workforce to stimulate innovation.

Policy Recommendation: India needs to work on establishing strategic alliances with other semiconductor firms around the world in terms of knowledge sharing and technological cooperation. The government may encourage local research and development and invest in professional education to ensure production of a professional workforce. By applying cybersecurity policies, this would help to position India in the international semiconductor market although these policies would create pressure on the diplomatic relationships with the current semiconductor giants and would result in geopolitical conflicts.

Conclusion

An incentive scheme of investment that is production-based is what is propelling the semiconductor industry of India to a very critical point. To exploit the globalization of china, India must improve the manufacturing facilities, research and development, and skill sets of the labor force and alliances in order to compete with Taiwan and south Korea. Growth of the industry depends on availability of raw materials and regulatory changes, hence, making India a semiconductor center in the world. To generate talent and technology, the government is in a position of promoting R&D investments and collaboration between academia and industry. However concerns also exist that, there exists excessive reliance on government subsidies, financial pressures on large firms of tax breaks and unequal provision of benefit on the region by manufacturing zones and that may make it difficult to establish a national ecosystem.

There is a possibility of incompatibility of skills in the labor market due to specialized education and this influences the level of unemployment. The semiconductor policies in India play a vital role in international relations and local labor relations. The combination of the development of technologies and diplomacy is crucial in the process of policy-making. The semiconductor industry needs to be developed using a holistic strategy such as the involvement of the government in collaboration with businesses to build some of the best-advanced manufacturing plants.

Tax concessions, capital subsidies, and semiconductor investment fund should be used as financial incentives to open semiconductor plants in India in order to cut the cost involved. The increase in funding of the chip design and the development of the industry-academia cooperation through innovation clusters is critically important. The government must also establish the training programs and talent development centers as well as the partnership with Taiwan, South Korea and Japan on the transfers of the technology. The establishment of domestic supply chains is vital to reduce the importation level and the utilization of semiconductor can boost the electronic and automotive industries. The reforms in the regulation and improved protection of the intellectual property will make India more investment-friendly and help it to achieve its goal of becoming a worldwide manufacturer of semiconductors.

References

An Indian perspective of fourth industrial revolution. (2023), "*International Journal of Arts, Humanities and Social Studies",* https://doi.org/10.33545/26648652.2023.v5.i1a.42

Bown, C. P. (2020), "*How the United States marched the semiconductor industry into its trade war with China", East Asian Economic Review.*https://doi.org/10.11644/KIEP.EAER.2020.24.4.384

Brown, C., & Linden, G. (2008), "*Semiconductor capabilities in the U.S. and industrializing Asia", Social Science Research Network.*https://doi.org/10.2139/SSRN.1122550

Dar, S. A., & Lone, N. A. (2022), "*Make in India: An analytic study of the country's technological shift for transformation.Journal of Artificial Intelligence, Machine Learning and Neural Network",* .https://doi.org/10.55529/jaimlnn.25.11.21

Ferreira Junior, C. N., Redkva, P., & Sandrino, B. (2023), "*Semiconductors in the digital age: Evolution, challenges, and geopolitical implications",* https://doi.org/10.32749/nucleodoconhecimento.com.br/technology-en/semiconductors

Hallur, G. G., & P, A. (2023), "*Semiconductor Sankalp: A vision for India's tech dominance",* https://doi.org/10.1109/iccebs58601.2023.10448857

Huynh, T. S., & Vo, T. T. A. (2023), "*Making middle-power alignment work: Reinforcing Taiwan–Vietnam collaboration in the semiconductor industry", International Journal of China Studies.*https://doi.org/10.22452/ijcs.vol14no2.7

Keller, W. W., & Pauly, L. W. (2009), "*Innovation in the Indian semiconductor industry: The challenge of sectoral deepening", Business and Politics.*https://doi.org/10.2202/1469-3569.1270

Kumar, R., & Singh, R. K. (2023), "*The role of science and technology in Vikshit Bharat: Building a new paradigm for India's growth", Journal of Global Values.*https://doi.org/10.31995/jgv.2023.v14is3.027

Kushwah, H. (2015), "*Future of semiconductor fabrication (fab) industries in India – Opportunities and challenges", International Journal of Research in Engineering and Technology.*https://doi.org/10.15623/IJRET.2015.0408014

Mukhopadhyay, D. (2015), "*Science, technology and innovation policy 2013: Outline of a coherent strategy for translating it into action", Current Science.*https://doi.org/10.18520/CS/V109/I5/863-868

Pandey, S., & Agrahari, V. (2023), "*Make in India: A brief study on initiative for development",International Journal for Multidisciplinary Research.*https://doi.org/10.36948/ijfmr.2023.v05i06.8487

Pandit, V. S. (2011, June 27), "*Economic and educational perspective on outsourcing/offshoring microelectronics in India",International Technology Management Conference.*https://doi.org/10.1109/ITMC.2011.5995958

Pennisi, S. (2022), "*The integrated circuit industry at a crossroads: Threats and opportunities"Chips.*https://doi.org/10.3390/chips1030010

Shavlay, E. (2023), "*India's semiconductor policy amidst geopolitical turbulence.Vostok",* https://doi.org/10.31857/s086919080025958-0

Singh, S. J., Singh, V. P., & Singh, S. (2023), "*Diversity and inclusion for innovation-led growth", Qeios.*https://doi.org/10.32388/xzupsa

Walmsley, T., & Minor, P. (2020), "*US trade actions against China: A supply chain perspective", Foreign Trade Review.*https://doi.org/10.1177/0015732520920465

Wandhe, P. (n.d.). *An overview on Production Linked Incentive (PLI) scheme by the Government of India.Social Science Research Network.*https://doi.org/10.2139/ssrn.4693578

Yan, M. (2023), "*How techno-nationalism affects technological decoupling between China and the U.S.: A case study of the semiconductor supply chain", International Journal of Education and Humanities.*https://doi.org/10.54097/ijeh.v10i3.11782