

The Economic Impact and Strategic Significance of the Semiconductor Industry in Malaysia

Nur Aifiah Binti Ibrahim^{1*}

¹ Department of Applied Statistics, Universiti Teknologi MARA, Shah Alam, Selangor, Malaysia

E-mail: nuraifahibrahim90@gmail.com

* Corresponding Author



<https://doi.org/10.31004/jerkin.v4i3.4777>

ARTICLE INFO

ABSTRACT

Article history:

Received: 16 Jan 2026

Revised: 22 Jan 2026

Accepted: 28 Jan 2026

Kata Kunci:

Landasan Kritis,
Pembangunan
Ekonomi, Perangkat
Digital, Perakitan.

Keywords:

Critical Foundation,
Economic
Development, Digital
Devices, Assembly.



Semikonduktor merupakan fondasi penting kehidupan modern dan pembangunan ekonomi di Malaysia, yang memungkinkan berfungsinya perangkat digital, sistem komunikasi, dan teknologi perawatan kesehatan. Seiring kemajuan Malaysia menuju ekonomi berbasis teknologi dan berpenghasilan tinggi, ketergantungan pada sistem berbasis semikonduktor telah meningkat di seluruh aktivitas sehari-hari dan manufaktur. Negara ini memainkan peran penting dalam rantai pasokan semikonduktor global, khususnya dalam manufaktur, perakitan, dan pengujian listrik dan elektronik, yang berkontribusi signifikan terhadap lapangan kerja, ekspor, dan investasi asing. Namun, meskipun penggunaannya meluas, kesadaran akan pentingnya semikonduktor di kalangan masyarakat Malaysia masih terbatas karena perannya yang sebagian besar tidak terlihat dalam produk akhir. Studi ini meneliti signifikansi semikonduktor dalam kehidupan dan ekonomi Malaysia sekaligus menilai pemahaman publik untuk mendukung kesiapan teknologi, inovasi, dan pembangunan nasional yang berkelanjutan.

Semiconductors are a critical foundation of modern life and economic development in Malaysia, enabling the functioning of digital devices, communication systems, and healthcare technologies. As Malaysia progresses toward a technology-driven and high-income economy, reliance on semiconductor-based systems has increased across daily activities and manufacturing. The country plays an important role in the global semiconductor supply chain, particularly in electrical and electronics manufacturing, assembly, and testing, which contributes significantly to employment, exports, and foreign investment. However, their widespread use, awareness of the importance of semiconductors among Malaysians remain limited due to their largely invisible role in end products. This study examines the significance of semiconductors in Malaysian life and the economy while assessing public understanding to support technological preparedness, innovation, and sustainable national development.



This is an open access article under the CC-BY-SA license.

How to Cite: Nur Aifiah Binti Ibrahim, et al. (2026). The Economic Impact and Strategic Significance of the Semiconductor Industry in Malaysia, 4(3). <https://doi.org/10.31004/jerkin.v4i3.4777>

INTRODUCTION

Semiconductors play a crucial role in modern Malaysian life, forming the foundation of many technologies in daily life. From smartphones and laptops to household appliances and transportation systems, semiconductor components enable electronic devices to function efficiently. As Malaysia continues to move toward a digital and technology-driven society, the importance of semiconductors has become increasingly evident in both personal and national development.

In everyday life, Malaysians rely heavily on semiconductor-based devices for communication, education, and entertainment. Mobile phones, internet routers, televisions, and gaming systems all depend on semiconductor chips to process information quickly and accurately. In education, especially after the growth of online learning, semiconductors support computers, tablets, and digital classrooms, allowing students across urban and rural areas to access knowledge more easily.

Semiconductors are also significant in Malaysia's health sector. Medical equipment such as diagnostic machines, patient monitoring systems, and digital health records relies on semiconductor technology to operate reliably. These technologies help improve the quality of health services, enhance efficiency in hospitals, support better patient outcomes, and contribute to an overall improvement in the quality of life for Malaysians.

Economically, semiconductors are crucial for Malaysia's industrial growth. Malaysia is one of the key players in the global semiconductor supply chain, particularly in assembly, testing, and manufacturing processes. This industry provides employment opportunities, attracts foreign investment, and supports the country's goal of becoming a high-income and technologically advanced nation.

In conclusion, semiconductors are deeply integrated into Malaysian life, influencing daily activities, public services, and economic development. As technology continues to advance, the role of semiconductors will become even more significant. Understanding their importance helps Malaysians appreciate how these small components contribute greatly to national progress and a better quality of life.

Despite extensive integration of semiconductors into daily life, public services, and Malaysia's economy, there is still limited awareness and understanding among Malaysians about their overall significance and impact. Semiconductors often operate behind the scenes in electronic devices, healthcare systems, and industrial processes, causing their importance to be overlooked or taken for granted. This lack of awareness can lead to insufficient appreciation of how strongly modern lifestyles and national development depend on semiconductor technology.

Furthermore, as Malaysia advances toward a digital and high-income nation, the increasing reliance on semiconductor-based technologies raises concerns about preparedness, sustainability, and knowledge gaps. Without a clear understanding of the role semiconductors play in education, healthcare, and economic growth, society may face challenges in adapting to rapid technological changes, supporting innovation, and developing skilled human capital in this field.

Therefore, it is necessary to examine and highlight the significance of semiconductors in Malaysian life to address this gap in understanding. By doing so, Malaysians can better recognise the importance of semiconductors in supporting daily activities, improving the quality of life, and strengthening national economic development, ensuring the country remains competitive in a technology-driven global environment. Therefore, the two main research objectives are as follows:

1. To examine the role and significance of semiconductors in Malaysian daily life, public services, and economic development, particularly in sectors such as communication, education, health, and industry.
2. To assess the level of awareness and understanding among Malaysians regarding the importance of semiconductors, and how improving this understanding can support technological preparedness, innovation, and sustainable national development.

Literature Review

This paper contributes a forward-looking and policy-oriented perspective on how Malaysia might evolve its semiconductor and cloud infrastructure toward quantum hardware manufacturing readiness (Othman, 2025). However, the study would benefit from stronger empirical backing, more cautious projections, and deeper engagement with regional conception frameworks and talent development strategies (Othman, 2025). This paper aims to provide a valuable policy-oriented overview of the environmental sustainability challenges and opportunities facing Malaysia's semiconductor industry (Kam, 2025). Thus, there is a limited empirical depth, broad policy prescriptions, and light treatment of industry-economic trade-offs, suggesting that further research would potentially incorporate quantitative assessment and stakeholder consultations for more implementable strategies (Kam, 2025).

This paper contributed to the proposal of having a structural, quantitative ESG-climate risk assessment tailored to the semiconductor industry in Malaysia (Mohamed & Jamaludin, 2025). However, its empirical scope, reliance on available data, and subjective weighing choices limit its broader applicability and robustness (Mohamed & Jamaludin, 2025). This article summarises a useful overview of how AI can transform electronics and semiconductor manufacturing within the Malaysian context (Hafiz et al., 2025). It is descriptive in nature, limited in analytical depth, and lacks detailed empirical or technical insights, reducing its value for specialist researchers and industry technologists in seeking rigorous evidence or actionable implementation frameworks (Hafiz et al., 2025).

It is another comprehensive and accessible overview of the key contemporary forces in semiconductor manufacturing, including Industrial 4.0, material innovation, globalization, and the post-pandemic effects (Musa et al., 2025). Thus, this paper is constrained by descriptive framing, limited empirical grounding, and an underdeveloped analysis of geopolitical, workforce, and sustainability dimensions, which limits its usefulness as a robust research reference (Musa et al., 2025). This article makes a valuable academic contribution by empirically validating some retention drivers in Malaysia's semiconductor industry (Soon et al., 2025). The policymakers and practitioners assigned to its utility may be limited without deeper engagement with broader labour market dynamics and more nuanced employee perspectives (Soon et al., 2025).

This paper makes a meaningful empirical contribution by linking geopolitical tariffs to environmental performance in a critical high-tech sector (Zhang et al., 2025). Thus, scope limitations, measurement nuances, and contextual complexities temper the strength of its conclusion for broader application (Zhang et al., 2025). This book chapter is a conceptually useful strategy that maps sustainability indicators against the Triple Bottom Line for a high-impact sector (Izhan et al., 2025). This study is constrained by limited empirical grounding, borrowing from broader manufacturing contexts, and uneven maturity among indicator sets (Izhan et al., 2025).

It is a valuable contribution by aggregating and organizing the fragmented literature on semiconductor supply chain risk and resilience, highlighting key disruption drivers and possible mitigation strategies (Xiong et al., 2024). Therefore, their review is a useful starting point for scholars entering this space and for industry stakeholders wanting a snapshot of academic discourse (Xiong et al., 2024). This article makes a useful contribution by empirically showing that internal performance benefits are more important than supplier or customer external pressures for SMT adoption among Malaysian manufacturing SMEs (Lee et al., 2024). Therefore, its methodological constraints and relatively narrow scope of drivers mean its conclusions should be interpreted with caution (Lee et al., 2024).

This study offers a baseline understanding of what influences retention among executives in Malaysia's semiconductor sector, emphasising the role of compensation, training, culture, and leadership (Wen et al., 2024). Thus, its impact would be stronger with a larger, more diverse sample, deeper theologian integration, and richer context around external labour market pressures (Wen et al., 2024). It provides a methodologically sound and empirical ground analysis of Southeast Asia's varying capacities to integrate into the global semiconductor supply chain (Wang et al., 2024). Therefore, the study's static data, potential indicator biases, and simplified ranking logic suggest that findings should be interpreted as indicative rather than definitive (Wang et al., 2024).

Overall, the literature demonstrates a growing awareness of the strategic, environmental, technological, and human capital challenges facing Malaysia's semiconductor industry. However, a consistent pattern of limited empirical depth, descriptive framing, and cautious generalizability suggests a clear research opportunity. Future work would benefit from integrating longitudinal data, mixed-method approaches, stakeholder consultations, and deeper engagement with regional and global theoretical frameworks to move from high-level diagnosis toward actionable, evidence-based policy and industry strategies.

METHOD

This study employs a quantitative research design based on secondary data to examine manufacturing project performance within the semiconductor industry. Data were obtained from reputable sources, including industry reports, government publications, and company annual reports, ensuring reliability and consistency. Key indicators related to manufacturing projects, such as production capacity, investment levels, project completion rates, technological intensity, and supply chain efficiency, were extracted and compiled into a structured dataset. The data were cleaned and standardized to address missing values and ensure comparability across firms and regions. Descriptive statistical analyses were first conducted to identify trends and patterns in semiconductor manufacturing projects. Subsequently, inferential techniques, including correlation analysis, were applied to examine relationships among project-related variables. This secondary approach allows for a cost-effective and

comprehensive assessment of manufacturing project dynamics while minimizing respondent bias and enhancing the generalizability of the findings.

RESULT AND DISCUSSION

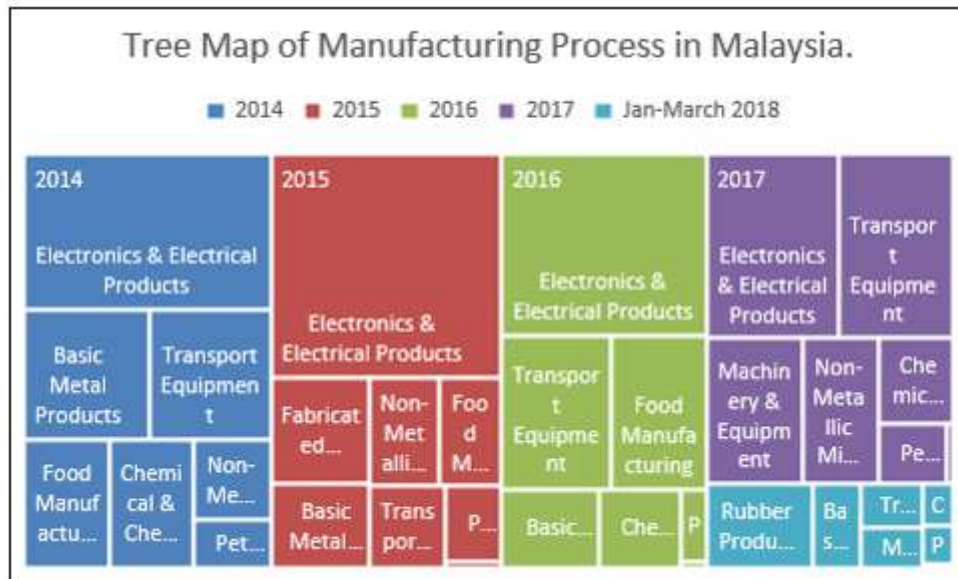


Figure 1. A Tree Map Diagram for The Most Contributions in the Manufacturing Industry of Malaysia.

From 2014 to 2018, the Malaysian manufacturing industry was dominated by several key sub-sectors that consistently contributed the largest share to output, employment, and export earnings. In 2014, the petroleum, chemical, rubber, and plastic products sub-sector was the top contributor to gross output at around RM 307 billion (about 30.4% of total manufacturing output), followed closely by electrical, electronic, and optic products with RM 232.2 billion (23.0%). Together, these two subsectors contributed over half of the country’s manufacturing output in that year. The manufacture of refined petroleum products, vegetable and animal oils & fats, and electronic components were among the specific activities with the highest output within the broader manufacturing sector.

As the decade progressed over 2017-2018, the electrical, electronic, and optical products sub-sector grew further to become the largest contributor to Malaysia’s manufacturing gross output. In the 2017 Annual Economic Survey, this sub-sector accounted for RM 361.8 billion (28.4% of output), slightly ahead of petroleum, chemical, rubber, and plastic products at RM 340.4 billion (26.7%). The continued strength of electric and electronics (E&E) manufacturing reflects Malaysia’s role in global electronics supply chains, particularly in semiconductors and printed circuit boards: these goods helped sustain manufacturing growth and export performance through this period.

In terms of value added and labour engagement, the pattern also underscored the importance of these leading sub-sectors. By 2017, the petroleum, chemical, rubber, and plastic products segment remained the top contributor to value added within manufacturing (about 30.5%), with the E&E industry a close second (26.7%). The E&E sub-sector was also the largest employer in manufacturing, engaging roughly one quarter of the manufacturing workforce, followed by petroleum, chemical, rubber, and plastic products and non-metallic mineral products, and fabricated metal products. This distribution highlights how the manufacturing sector during 2014-2018 was anchored by medium-and technology production, with particularly strong performance in electronics and chemical-related industries.

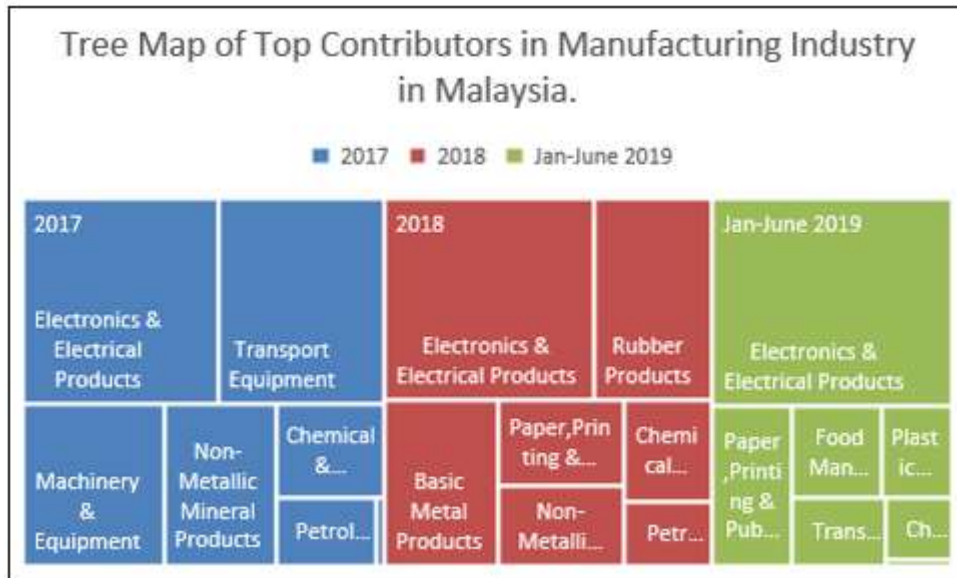


Figure 2. The Tree Map Diagram for All Top Contributors in 2017 Until 2019 in Malaysia.

From 2017 to 2019, the Malaysian manufacturing sector continued to play a central role in the national economy, although its growth trajectory began to moderate toward the end of the period. In 2017, the Electrical, Electronic, Optic products sub-sector was the top contributor to manufacturing gross output, followed closely by Petroleum, Chemical, Rubber, and Plastic products, with both sectors accounting for large shares of total output and employment in manufacturing. The E&E sub-sector alone comprised roughly 28.4% of manufacturing gross output, while petroleum and chemical products made up 26.7% reflecting the sector’s orientation toward medium- and high-technology industries and global value chains. The non-metallic mineral products and basic metal products segment also contributed significantly, ranking third in value added that year.

From 2018 into 2019, these leading industries maintained their importance, even as broader manufacturing growth slowed in response to global trends like weaker demand for electronics and commodity price pressures. Electrical and electronic manufacturing remained a leading driver of sales and output growth through 2018, alongside petroleum, chemical, rubber, and plastic products, and transport equipment also emerged with strong performance in some quarters amid rising motor vehicle and transport part production. Monthly manufacturing data from early 2019 shows that E&E, petroleum, and chemical products, and fabricated metal and mineral products continued to be among the key contributors to overall sector sales, underlining their ongoing centrality to Malaysia’s industrial base.

By 2019, although comprehensive year-end sub-sector output data is less detailed in official releases, broader industrial indicators point toward a moderation in manufacturing growth to around 3% annual expansion, with sub-sectors such as non-metallic mineral products, basic metal, and fabricated metal products, along with E&E and petroleum and chemical products, still prominent contributors. Malaysia’s manufacturing sector continued to attract capital-intensive, high-value projects, reflecting ongoing investor confidence in areas such as advanced electronics and chemicals, despite some global headwinds dampening the pace of output growth.

The results indicate a weak correlation between manufacturing activity and weight from January 2010 until April 2020, implying that the variations in manufacturing explain little of the variation in weight. This weak association suggests that other factors may play a more substantial role in influencing weight trends during this period. Therefore, it is a visual inspection suggests non-linear investment dynamics characterized by periods of acceleration and deceleration.

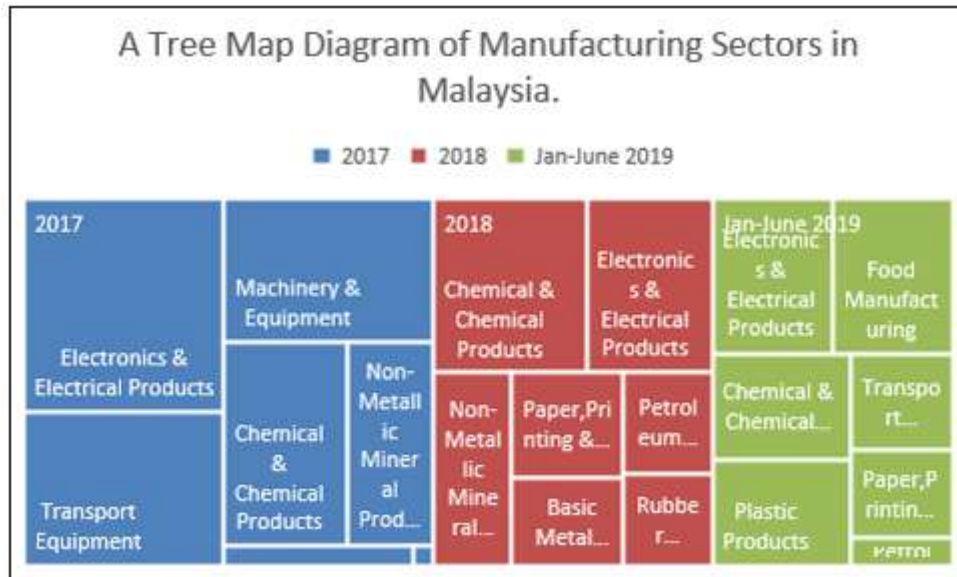


Figure 3. A Tree Map Diagram for the Manufacturing Industries in Malaysia In Terms of Total Investment (RM Million).

In 2017, Malaysia recorded a total of RM 197.1 billion in approved investments across manufacturing, services, and primary sectors. Of this total, domestic direct investment contributed roughly 72.2% (about RM 142.4 billion) while foreign direct investment made up 27.8% (around RM 54.7 billion). Within the manufacturing sector specifically, it attracted total approved investments of RM63.7 billion in 2017, up from the previous year, though detailed disaggregation of domestic vs foreign for manufacturing in 2017 is not the headline release. The manufacturing investments included projects in petroleum products, electrical and electronics, non-metallic mineral products, transport equipment, and chemicals, among others. Approved manufacturing projects in 2017 strengthened Malaysia’s industrial base and helped create significant employment opportunities.

For 2018, total approved investments across all sectors edged up slightly to RM 201.7 billion. Domestic investments continued to dominate about 60.1% (RM 121.2 billion) for the total, while FDI accounted for 39.9% (RM 80.5 billion). The manufacturing sector saw strong growth, with total approved manufacturing investments rising to RM 87.4 billion, which is a 37.2% increase compared with 2017. Foreign investments in manufacturing more than doubled from the prior year to RM 58.0 billion, indicating increased global investor interest in Malaysia's manufacturing capabilities. The detailed number of manufacturing projects in 2018 is not provided in the headline summary, but the industry breakdown highlights continued activity in key sub-sectors such as petroleum, E&E, chemicals, and machinery.

In 2019, Malaysia attracted a total of RM 207.9 billion in approved investments in the manufacturing, services, and primary sectors, with domestic investment contributing about 60.4% (RM 125.5 billion) and foreign investment 39.6% (RM 82.4 billion). The manufacturing sector recorded RM 82.7 billion in approved investments, slightly lower than 2018’s value, but the number of manufacturing projects approved jumped to 988 projects, up 37% from 721 projects in 2018, indicating a notable increase in manufacturing activity. With manufacturing for 2019, FDI made up the majority at about 65.2% (RM 53.9 billion) of the sector’s investment, while DDI accounted for roughly 34.8% (RM 28.8 billion). Key sub-sectors included electrical and electronics, paper and printing, transport technology, and chemical products, and the approved manufacturing projects were expected to generate significant employment.

One limitation is underestimating the challenges of technology depth and talent development. It stresses technological innovation as central to future competitiveness, yet Malaysia still struggles with talent shortages and front-end design ecosystems compared with Taiwan, South Korea, or the U.S. This underscores that policy ambition must be matched with long-term capability building, including design expertise, wafer fab investment, and R&D ecosystems. In essence, this paper delivers a technically rich and forward-looking perspective on semiconductor manufacturing technologies, which is valuable for

understanding where the global frontier is heading. However, it is less effective as a direct guide for countries like Malaysia, whose semiconductor sectors are in a transitional phase, striving to move beyond back-end services into higher value segments.

Across 2014-2019, Malaysia's manufacturing sector was consistently anchored by Electrical, Electronic, and Optical (E&E) products, alongside petroleum, chemical, rubber, and plastic products. From a semiconductor perspective, this is significant because the E&E sub-sector, closely linked to semiconductor assembly, testing, and electronics manufacturing, emerged as either the largest or second largest contributing to manufacturing output, value-added, employment, and exports. By 2017-2018, E&E overtook petroleum and chemical products to become the largest contributor to manufacturing gross output, accounting for roughly 28% to 29% of total output, reflecting Malaysia's entrenched role in global electronics and semiconductor value chains, particularly outsourced semiconductor assembly and testing, electronic components, and printed circuit boards. The sector also employed around one-quarter of the manufacturing workforce, reinforcing its importance not only as a growth driver but as a major source of industrial employment.

CONCLUSION

Overall, the tree map analyses collectively demonstrate that Malaysia's manufacturing structure between 2014 and 2019 was highly concentrated in a small number of dominant sub-sectors, with Electrical, Electronic, Optical (E&E) products playing a pivotal role. The consistent rise of the E&E sub-sector from a major contributor in 2014 to the largest source of manufacturing output in 2017 to 2018 highlights Malaysia's deep integration into global electronics and semiconductor value chains, especially in assembly, testing, and component manufacturing. The dominance was reinforced by substantial domestic and foreign investments, increasing project numbers, and strong employment generation, underscoring investor confidence in Malaysia's manufacturing capabilities. However, despite the scale and resilience of these contributions, the findings also point to structural challenges, including moderated growth toward 2019, weak links between manufacturing activity and broader indicators, and limitations in technology depth and talent development.

Building on the 2014–2019 investment patterns, the future investment prospects from the 2019 baseline suggest both continuity and transition for Malaysia's manufacturing sector. The strong concentration of investment in Electrical, Electronic, and Optical (E&E) products signals that Malaysia entered the post-2019 period with a solid foundation in globally embedded electronics and semiconductor value chains. Sustained domestic and foreign investor confidence—evidenced by high project approvals, employment creation, and capital intensity—positions the E&E sub-sector as the primary anchor for future industrial upgrading, particularly in advanced assembly, testing, and high-value component manufacturing.

However, the moderation of growth observed toward 2019 indicates that future investment momentum cannot rely solely on scale expansion or cost competitiveness. Instead, prospects increasingly depend on Malaysia's ability to deepen technological capabilities, strengthen talent pipelines, and move up the value chain into design, advanced manufacturing processes, and emerging areas such as advanced packaging, automation, and data-driven manufacturing. The weak linkage between manufacturing output and broader economic indicators also suggests that future investments must be more strategically aligned with innovation ecosystems, skills development, and spillover generation to ensure wider economic impact.

Looking forward from 2019, investment opportunities are therefore likely to shift from volume-driven manufacturing toward quality-driven and capability-enhancing projects. This creates scope for targeted incentives, public–private partnerships, and policy interventions that attract technologically intensive investments while addressing structural gaps in human capital and R&D depth. If these constraints are effectively managed, Malaysia's entrenched position in the E&E sector can serve not only as a source of continued investment inflows but also as a platform for long-term industrial resilience and higher-value economic transformation.

ACKNOWLEDGEMENT

The author is very thankful for the contributions that have been made in the same respected field.

REFERENCES

- Othman, Azizi. (2025). Malaysia's Semiconductor and Cloud Infrastructure for Quantum Readiness: Strategic Pathways Toward Quantum Hardware Manufacturing. 10.13140/RG.2.2.14522.25285.
- Kam, Andrew. (2025). Towards a Green Semiconductor Industry in Malaysia https://unctad.org/project/policies-for-green-development-in-asian-bri-partner-countries?fbclid=IwY2xjawJ-j2xleHRuA2FibQIxMABicmlkETFIT05abzB5R3VySmRvcXhvAR6R-FQWHFHehD-n1SDtrxKf0kMwGHZ-1UxXHLjes557U8ltzJgW1qfBXNFclA_aem_snueKAthmfFKFU5HNQrePA.
- Mohamed, Ola & Jamaludin, Nabila. (2025). Development of an integrated ESG and climate risk assessment framework for semiconductors industries in Malaysia. *Sustainable Futures*. 10.101052. 10.1016/j.sftr.2025.101052.
- Hafiz, Muhammad & Azmi, Eisrul & Azlie, Muhammad & Zaki, Muhammad & Mazilan, Muhammad & Mazuki, Muhammad & Nor, Muhammad & A.Ghani, Jaharah & Rahmat, Mohd & Khamis, Nor. (2025). Application of Artificial Intelligence in Electronics and Semiconductor Industries. *Jurnal Kejuruteraan*. 37. 3245-3253. 10.17576/jkukm-2025-37(7)-11.
- Musa, Yasmin & Tantawi, Khalid & Mikhail, Maged & Ma, Jeffrey & Alharthi, Dalal & Flatt, Larry & Potter, Lyn. (2025). Semiconductor Manufacturing Industry: Assessment, Challenges, and Future Trends. 1-5. 10.1109/ICAISC64594.2025.10959347.
- Soon, Shi & Bhardwaj, Rajeev & Zafar, Sayeed & Rahman, Abdul & Haque, Rasheedul & Krishnasamy, Hariharan. (2025). Factors Influencing Talent Retention in Malaysia's Semiconductor Industry. 4. 1-33. 10.62754/joe.v4i3.6191.
- Zhang, Minhao & Liu, Di & Shui, Xiaolong & Hu, Wenjin & Zhan, Yuanzhu. (2025). Examining the Impact of Trade Tariffs on Semiconductor Firms' Environmental Performance. *International Journal of Production Economics*. 281. 109528. 10.1016/j.ijpe.2025.109528.
- Izhan, Khairil & A. Sani, Amiril S.. (2025). Sustainability Indicators for Semiconductor Industry Sectors: A Review of Literature and Maturity Evaluation from a Triple-Bottom-Line Viewpoint. 10.1007/978-981-96-4353-0_33.
- Xiong, Wei & Wu, David & Yeung, Jeff. (2024). Semiconductor supply chain resilience and disruption: insights, mitigation, and future directions. *International Journal of Production Research*. 63. 1-24. 10.1080/00207543.2024.2387074.
- Lee, Mah & Siti-Nabiha, A.K. & Norfarah, Nordin. (2024). Intention of Smart Manufacturing Technologies Adoption among Manufacturing SMEs in Malaysia. *International Journal of Academic Research in Progressive Education and Development*. 13. 10.6007/IJARPED/v13-i4/23566.
- Wen, Cheah & Tan, Ks & Yuen, Yee & Lai, Kim. (2024). Factors Influencing Employee Retention Among Executive Employees in Semiconductor Industry in Malaysia. 10.2991/978-2-38476-196-8_25.
- Wang, Chia-Nan & Nhieu, Nhat-Luong & Chiang, Chen-Te & Wang, Yen-Hui. (2024). Assessing Southeast Asia countries' potential in the semiconductor supply chain: an objectively weighting multi-criteria decision-making approach. *Humanities and Social Sciences Communications*. 11. 10.1057/s41599-024-03768-x.
- Ma, Tao & Wang, Tiantian & Zhang, Jian. (2025). Global Semiconductor Industry Development Pattern and Trends. 10.1007/978-981-95-3332-9_2.
- Opoku, Jochebed & Sefa-Boateng, Yaw. (2025). Advancing Domestic Semiconductor Manufacturing: A Critical Review of Novel Processing Technologies.