MINISTRY OF HUMAN RESOURCES

TalentCorp
GROUP OF COMPANIES

Impact Study of Artificial Intelligence, Digital, and Green Economy on the Malaysian Workforce Volume 2

Sector:
Electrical and Electronics

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Authors
Diyana Azmi
Kamalia Musa

Editor
Nadia Zulkifli

Supported by:
Azura Ahmad

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Preface by the Group Chief Executive Officer of TalentCorp

As Malaysia stands on the threshold of a transformative era, we find ourselves driven by the accelerating forces of Artificial Intelligence (AI), Digital, and Green Economy. These global trends are reshaping industries, redefining the future of work, and challenging us to navigate both the opportunities for job creation and the realities of evolving role redundancies.

With a median age of 31, Malaysia leads a youthful ASEAN region where the median age is just 30. This demographic advantage presents a unique opportunity—a vibrant, dynamic workforce ready to harness the opportunities of a Digital and Green Economy. Yet, it also poses challenges. Youth unemployment and underemployment remain persistent issues across ASEAN, with Malaysia facing a youth unemployment rate of 11% and 36.3% of tertiary-educated employees grappling with skill-related underemployment. These figures demand immediate action. Reskilling and upskilling are not just important—they are imperative as the landscape of jobs continues to evolve.

At TalentCorp, we are honoured to serve as a strategic think tank under the Ministry of Human Resources' (KESUMA) mandate. This critical role allows us to leverage our networks and initiatives, providing data-driven insights that strengthen the government's intelligence capacity and support national policy development, advocacy, and long-term strategic planning.

One of our foremost initiatives in this capacity is the **Impact Study of AI, Digital, and Green Economy on the Malaysian Workforce**. This study is designed to offer key guidance to policymakers and industries, equipping them with the knowledge to prepare the workforce for upcoming shifts. It highlights essential reskilling and upskilling programmes to assist Malaysians affected by job displacement, ensuring they transition smoothly into new roles, fostering sustainable growth, and ensuring no one is left behind.

Through insights gleaned from this study, TalentCorp's MyMAHIR Future Skills Talent Council (FSTC)—an industry-led body dedicated to addressing skills needs—will drive efforts to close critical skills gaps. MyMAHIR's collaboration with industry leaders enables us to identify priority competencies and shape training programmes to meet the evolving demands of their sectors. Aligned with the MADANI Economy framework's focus on lifelong learning and guided by best practices from the International Labour Organization (ILO), TalentCorp will continue working closely with key ministries, agencies, and industry players to develop forward-looking curricula that meet the workforce needs of the future.

As Malaysia navigates this new landscape, the findings from this study will serve as an indispensable resource—providing policymakers, industries, and the workforce with the insights and tools required to stay competitive and resilient in an ever-evolving global economy.

On behalf of TalentCorp, I extend our deepest gratitude to our industry partners, colleagues, and experts for their invaluable contributions to this study. Together, we have crafted a comprehensive and impactful report that will serve as a guide for Malaysia's future of work, ensuring that we are prepared for the challenges and opportunities ahead.

Thomas Mathew
Group Chief Executive Officer
Talent Corporation Malaysia Berhad

“As Malaysia navigates this new landscape, the findings from this study will serve as an indispensable resource— providing policymakers, industries, and the workforce with the insights and tools required to stay competitive and resilient in an ever-evolving global economy.”

Thomas Mathew
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Executive Summary

The arrival of Artificial Intelligence (AI) and Digitalisation is transforming the landscape of the Electrical and Electronics (E&E) sector. The E&E sector's **global market value reached USD3.8 trillion (RM17 trillion)** in 2023, demonstrating a robust **Compound Annual Growth Rate (CAGR) of 6.4% since 2019**. This impressive growth is **projected to continue to grow at 6.6%**, reaching an **estimated market size of USD5.2 trillion (RM23.4 trillion)** by 2028.[1] This positive outlook is largely attributed to an increased demand for hardware that enables AI and Digital, including Internet of Things (IoT) and advanced manufacturing management software.

The positive trajectory of the global E&E market presents an opportunity for Malaysian sector players. The Malaysian E&E sector has a strong global presence, particularly known for advanced testing, assembly, and packaging; **accounting for 13% of the world's back-end semiconductors.**[2] At home, the E&E sector is a key driver of Malaysia's economic growth. The E&E sector **contributes 5.8% of Malaysia's gross domestic product (GDP)**, valued at RM107 billion in 2023[3] and this is forecasted to grow to RM120 billion by the year 2025, with a CAGR of 8.1% since 2015.[4] In line with the global trends of the E&E sector, Malaysia's E&E sector has also experienced a robust growth in both exports and imports – contributing RM575 billion (40.4% of total exports) and RM356 billion (30.4% of total imports) respectively in 2023.[5] It stands as Malaysia's leading sector for both exports and imports.

The rapid advancements in AI, Digital, and Green Economy is expected to make transformative changes to the E&E sector. There are several key challenges within the E&E sector, such as the high investment cost for integrating AI and digital technologies to improve productivity. This alone is a substantial barrier for small and medium-sized enterprises (SMEs). Additionally, there is an insufficient number of skilled talents to support the demand and growth of the E&E sector in Malaysia, making it difficult for Malaysia's sector players to move up the value chain from assembly, testing, and packaging operations.

Initiatives to enhance Malaysia's standing within the value chain are ongoing. The E&E sector has been identified as **one of the priority sectors in Malaysia's New Industrial Master Plan 2030 (NIMP 2030)**. In August 2024, The Malaysia Semiconductor Integrated Circuit (IC) Design Park was launched in Selangor, this initiative involving international semiconductor firms is a strong indication of the government's commitment and ambition to propel Malaysia up the semiconductor value chain. To move up the value chain, an IC Design and Digital Park in Bayan Lepas, Penang will also be set up to solidify Penang's position as the Silicon Valley of the East.

Malaysia's E&E manufacturing sector is exploring and implementing AI, Digital, and Green Economy into processes to improve productivity and quality of products. For example, the AI applications are in visual inspections; smart factory and manufacturing; and predictive maintenance. However, the adoption of new technologies is mainly driven by multinational corporations (MNCs) due to their strong financial capacity and capabilities to maintain business competitiveness as well as adhere to relevant environmental regulations.

On the Digital front, the E&E sector is seeing digitalisation of factories through the digital adoption of manufacturing execution systems (MES), warehouse management systems (WMS), and manufacturing operations management (MOM), smart scheduling, and visualisation. MNCs are more advanced than SMEs in adopting these technological advancements in incorporating digital tools into their operations and processes. It is a common challenge for SMEs as most of them do not have the capability to adopt full digitalisation due to their limited financial capacity. As a result, low adoption of digital tools among SMEs leads to them operating at low efficiency levels.

With a global increasing focus on sustainability, E&E sector may need to adopt and integrate sustainable practices in accordance with the United Nations Sustainable Development Goals (UN SDG). This is particularly relevant for MNCs who export their products globally. The E&E sector may be subject to the Carbon Border Adjustment Mechanism (CBAM), set to be fully operational by 2026, aims to prevent carbon leakage by imposing a carbon price on imports of certain goods from outside the European Union (EU). This measure ensures that the EU's ambitious climate efforts do not create an unfair competitive advantage for foreign producers with less stringent regulations. In accordance with this global development, MNCs and large local corporations (LLCs) are prioritising Green Economy initiatives, with a focus on adopting renewable energy sources and reducing their greenhouse gas (GHG) emissions and carbon footprints.

The impact study for the E&E sector covers Design and Development, Manufacturing and Assembly, Testing and Packing (ATP) segments, within which 50 job roles have been identified as positions essential to maintain sector standards and efficiency. These roles include IC Design Engineer, Hardware Design Engineer, and Package Design Engineer for roles in Design and Development, Product Engineer, Process Engineer, and Quality Assurance Technician for roles in Manufacturing as well as ATP segments.

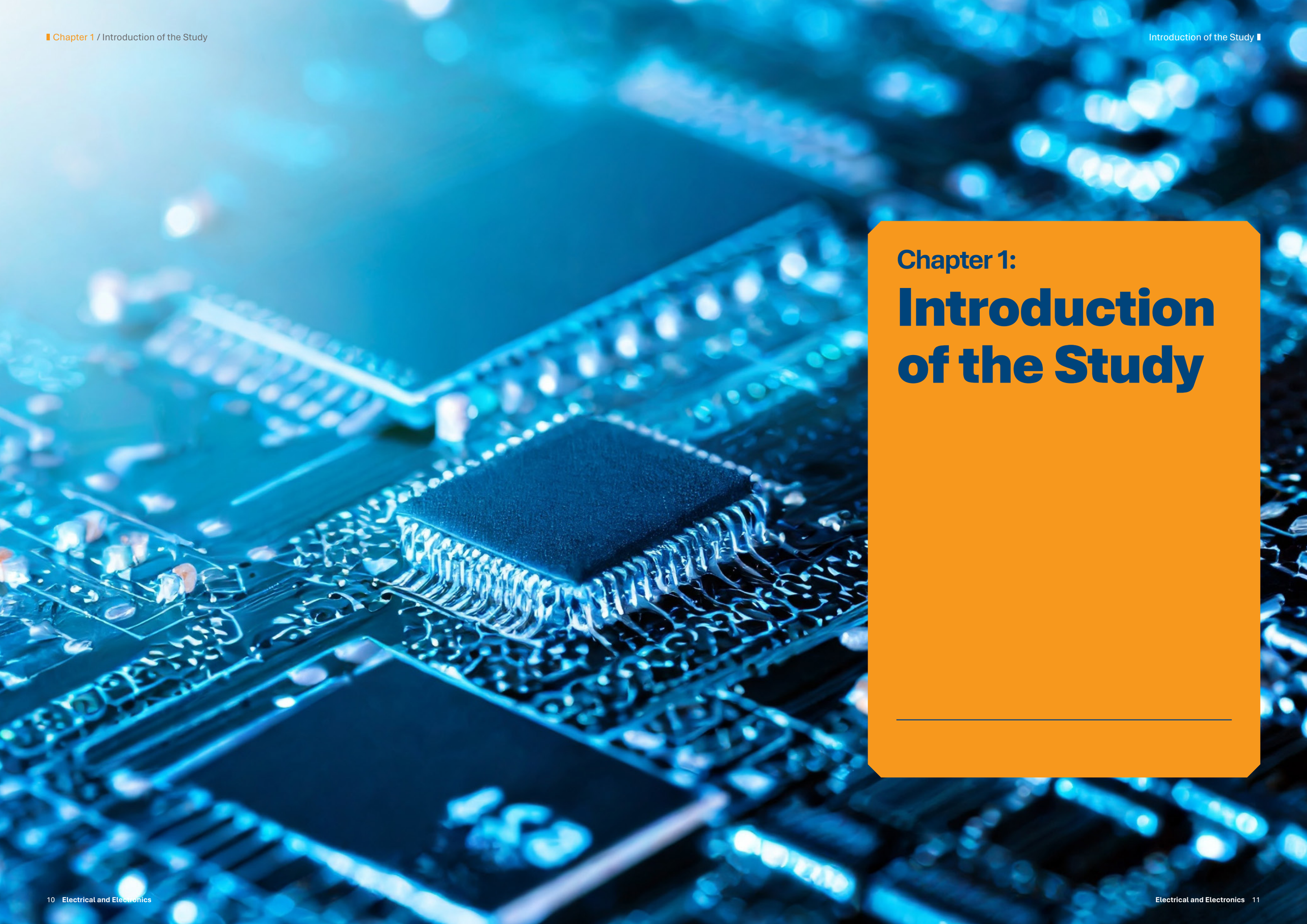
The focal point of the impact study centres on the impacts of growth trends of AI, Digital, and Green Economy on job roles in the E&E sector. Based on the engagements with industry players, it was highlighted that only **two (2) job roles – Production Operator and Planning Officer, are highly impacted** and face the risk of being displaced due to these trends. **A majority of the job roles are medium or low impacted** by these trends as MNCs in Malaysia have taken their own initiative to integrate and implement AI or Digital technologies to maintain their competitive advantages. However, a certain degree of upskilling is necessary to ensure the workforce is prepared to face the evolving landscape in AI, Digital, and Green Economy. Additionally, **nine (9) emerging roles** have been identified to drive future advancements and innovation within the E&E sector, especially in integrating AI and Digital technologies in manufacturing, the management of large-scale data, and the ideation and implementation of environmental, social, and governance (ESG) initiatives.

Through the impact study assessment, **11 initiatives** have been identified across the talent ecosystem of Malaysia's E&E sector to adapt to AI, Digital, and Green Economy trends within the sector. These initiatives aim to address the challenges of the sector, primarily focusing on providing fundings for AI and Digital technologies, developing supporting regulation framework, cultivating a skilful workforce whose capabilities align with real-world sector demands, and facilitating personal skill development. By aligning the needs and aspirations of each stakeholder group of the sector, this will then drive innovation, promote skill development, and ensure sustainable growth of the E&E sector.

These initiatives have been grouped into four (4) categories based on the leading and enabling entities: Government, Industry Players, Academia, and Training Providers:

GOVERNMENT	**IN1** Provide Funding and Incentives **IN2** Develop Supportive Regulations and Policies **IN3** Cultivate Talent to Bridge the Gap
INDUSTRY PLAYERS	**IN4** Collaborate with Government **IN5** Sponsor Industrial Projects by Higher Learning Institutions **IN6** Upskill and Reskill Employees **IN7** Develop Competency Framework
ACADEMIA	**IN8** Promote Micro-credential Courses **IN9** Develop Sector-Relevant Curriculum **IN10** Increase Internship Programme And Work Readiness
TRAINING PROVIDERS	**IN11** Tap on Sector Experts for Specialised Training

1. The Business Research Company, Global Electrical And Electronics Market Briefing 2024; RHB Global & Market Strategy, Malaysia's E&E Sector:Trend, Competitiveness and Strategy
2. Malaysia Semiconductor Industry Association (MSIA), MSIA 2022 E&E Survey, 21 February 2023, <https://msia.org.my/folder_upload/pdf_file/e-Booklet_MSIA%202022%20E&E%20Survey.pdf>
3. Department of Statistics Malaysia (DOSM)
4. Malaysia Investment Development Authority (MIDA), E&E sector presents new key growth areas with the rise of tech and high-value sectors, 27 February 2024, <https://www.mida.gov.my/mida-news/ee-sector-presents-new-key-growth-areas-with-the-rise-of-tech-and-high-value-sectors/>
5. MATRADE, Top 10 Major Import Products 2023, <https://www.matrade.gov.my/en/about-matrade/28-malaysian-exporters/trade-statistics/5821-top-10-major-import-products-2023>



Chapter 1:

Introduction of the Study

Introduction of the Study

Purpose of the Study

The increasing focus and adoption of AI, Digital, and Green Economy call for a transformative shift in global operating models and workforce, supported by the digitally enabled drive beyond Industrial Revolution 4.0. The study aims to help government, industry players, academia, training providers, and the public to prepare for future workforce demands. The output of this study will contribute to the Malaysia National Skills Registry (MyNSR), a skills taxonomy that will be integrated into the MyMAHIR platform. This platform offers comprehensive insights into industry trends, job roles, required skills, career pathways, and available training programmes across all sectors.

These research and studies cover several sectors, namely Information and Communications Technology (ICT); Food Manufacturing and Services; Pharmaceutical Manufacturing; Medical Devices; Aerospace; Electrical and Electronics; Wholesale and Retail Trade; Energy and Power; Chemical; and Global Business Services.

AI will increasingly impact the nature of work and the broader societal progress

Majority of industry players in Malaysia are conscious about AI and the benefits it brings to organisations. While some have leveraged AI to carry out tasks, many organisations have yet to fully embrace AI as it remains difficult for organisations to justify the expense and effort required to implement AI due to the uncertainty of Return on Investment (ROI). Organisations are also wrestling with how to address AI throughout their operations – not just from a technology perspective but also from the human perspective in terms of roles and skills readiness.

This is also consistent with an inaugural Cisco AI Readiness Index in 2023 where 86% of organisations worldwide are not fully ready to integrate AI into their businesses. Malaysia's AI Readiness tracks that of the global level, standing at 87% with only 13% considered as "pacesetters".

With the rise of AI, the Malaysian government has launched the National AI Talent Roadmap 2024–2033 to cultivate a skilled workforce to unlock the potential of AI across various sectors. Adding to this momentum, tech giant Microsoft Corp announced a significant investment of RM10.5 billion in Malaysia's cloud and AI infrastructure. Additionally, global tech firms Google and ByteDance will invest RM9.4 billion and approximately RM10 billion to establish data centres and transform Malaysia into a regional AI hub.

Malaysia's digital transformation is key to enhance national competitiveness, empower industries and local enterprises to progress towards high-value added activities

Digital transformation has been a strategic imperative across many organisations for many years. By continuing to embrace digital technologies, Malaysia can significantly elevate the capabilities of its industries and local enterprises. This technological advancement is not just about automating existing processes to enhance productivity, but also about enabling a shift towards higher value activities.

Digital economy is one of Malaysia's key economic pillars, contributing 22.6% to the country's gross domestic product (GDP).[3] This number is set to rise to 25.5% by 2025. To remain relevant and resilient, the Malaysia Digital Economy Blueprint overseen by MyDIGITAL outlines the efforts and initiatives taken to transform Malaysia into a high-income nation that is focused on digitalisation and a regional pioneer in the digital economy.

Malaysia is also making significant strides in Green Economy

When it comes to Green Economy, most organisations in Malaysia today are still driven by compliance to regulations. However, there has been growing awareness and willingness to drive the Environmental, Social and Governance (ESG) agenda at the forefront with concerted efforts from the government, private sector, and public. While progress is being made, ongoing commitment and collaboration across all industries are necessary to ensure a sustainable future for the country.

This is in line with the Twelfth Malaysia Plan (2021–2025) that outlines the nation's aspiration to achieve net-zero greenhouse gas (GHG) emissions as early as 2050. Complementing this, the National Energy Policy (2022–2040) sets the foundation for transforming the energy landscape towards sustainability. In line with these objectives, the Malaysian Government has also developed the National Energy Transition Roadmap (NETR) to accelerate the shift from a traditional fossil fuel-based economy to a high-value Green Economy. Malaysia's efforts are reflected in its leading position in the World Economic Forum Energy Transition Index, ranking 1st in ASEAN and 35th globally.[4]

It is imperative to future-proof Malaysia's workforce for the impact of AI, Digital, and Green Economy

This study aims to provide transformative and strategic inputs to complement the rapid growth of these areas. It will examine how these trends as a whole will reshape Malaysia's workforce in the upcoming three (3) to five (5) years and assess the impact of current and future trends of AI, Digital, and Green Economy; its implications for current and future job roles and skills; the nation's capacity to cater to future workforce demands and needs; and lastly, policy recommendations that the policy makers and agencies, industry players, academia and training providers as a whole can do in spurring the industry forward amidst flexible changes ahead.

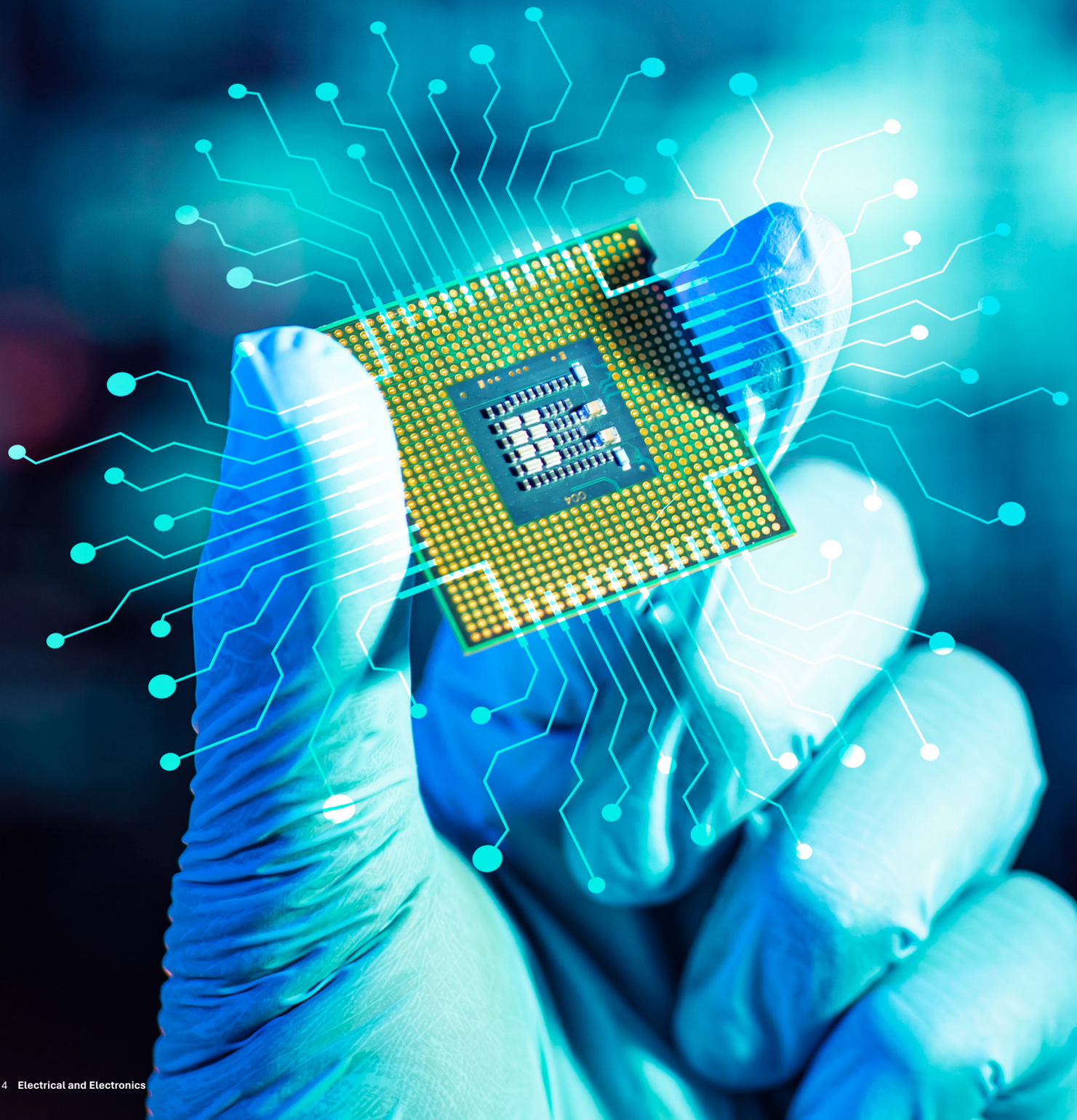
This report will provide an overview of the Electrical and Electronics sector, including its related sub-segments, the key trends and developments relating to AI, Digital, and Green Economy.

More importantly, it will highlight the roles impacted as well as the skills needed to be future-ready for the Electrical and Electronics sector. These findings are based on engagements with industry associations and key players as well as regulators and government agencies.

The report concludes with Recommended Initiatives for four (4) key stakeholder groups, namely: **Government**, **Industry Players**, **Academia**, and **Training Providers**.

> **"Microsoft's investments in digital infrastructure and skilling will help Malaysian businesses, communities, and developers apply the latest technology to drive inclusive economic growth and innovation across the country."**
>
> ***Satya Nadella, CEO of Microsoft***

6. Vanessa Gomes, *Catalysing Malaysia's Digital Economy*, September 2022, https://mdec.my/esg-mdcap/content-hub/catalysing-malaysia-digital-economy
7. MIDA, *Malaysia ranked first place in S-E Asia in WEF energy transition index*, July 2030, <https://www.mida.gov.my/mida-news/malaysia-ranked-first-place-in-s-e-asia-in-wef-energy-transition-index/>



Chapter 2:

Approach and Methodology

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Approach

A six-pronged approach entailed a blend of qualitative and quantitative research techniques that generated insights and met the objectives desired from this study. The study's outcomes reflect what is happening in each sector today and what is expected of each sector in the next three (3) to five (5) years.

Research Techniques

The qualitative and quantitative research techniques were as follows:

Research Methodology

The study focused on three (3) key trends shaping today's workforce: AI, Digital, and Green Economy. Their definition is outlined below:

01 Artificial Intelligence

Development and use of machine learning models capable of performing tasks that would have required human intelligence (deep learning, computer vision, Natural Language Processing (NLP), reinforcement learning, supervised and unsupervised learning).[6]

02 Digital

Activities and transactions driven by the public and various organisations to produce, adapt and innovate digital technologies and services for enhanced productivity and quality of life (big data analytics, cloud, Internet of Things (IoT), and robotic process automation).[7]

03 Green Economy

Employment growth and income driven by investment in low-carbon, resource-efficient, and socially inclusive economic activities, infrastructure, and assets.[8]

To effectively analyse how the key trends impact existing roles, four (4) key parameters have been defined in the assessment process, as stated below:

AI & Digital

1. **Opportunity to automate data-driven or low-creativity activities that are repetitive or rule-based via AI or other technology tools.**

2. **Human intervention is required despite some or most activities being automated or digitalised, as:**
   - Strategic thinking and problem-solving are vital to making decisions
   - Creative thinking is needed to generate new ideas or ways of working
   - Outcomes need to be communicated or socialised and regulated
   - High importance is placed on human emotions or physical involvement in performing the activity
   - Typically performed by a critical role that holds accountability or a role requiring certification

Green Economy

1. **Impact of the environment on jobs that depend on limited natural resources and produce outputs that are polluting or may pollute the environment.**

2. **Opportunity to diversify, requiring new skills to implement the organisation's Environmental, Social, and Governance (ESG) agenda, which includes:**
   - Environment: Areas for improvement in environmental sustainability
   - Social: Diversity, equity, inclusivity, ethics, and community engagement
   - Governance: Risk management, compliance, reporting, and corporate culture

8. World Economic Forum
9. Malaysia Digital Economy Corporation (MDEC)
10. United Nations Environment Programme (UNEP)

Based on the parameters above, the impact assessment of AI, Digital, and Green Economy on roles will result in one of the following outcomes:

HIGH

Roles at risk of convergence or displacement

Need to pivot to adjacent role and reskill

MEDIUM

Roles still relevant

Need to evolve and upskill to deliver beyond what would traditionally be expected

LOW

Roles not severely impacted

Require ongoing self-improvement to stay relevant

The impact assessment results inform individuals and organisations about the levels of risk faced by job roles in the sector. This information can aid in strategising career development and workforce planning, ensuring relevance amidst advancements in the three (3) key trends.

Key Stakeholders Engaged in the Study

Recognising the importance of on-the-ground perspectives, the impact study gathered insights from key stakeholders across the country, including Government, Associations, Industry Players, and Training Providers. The contributions from these four (4) groups enriched and fine-tuned the study's findings.

Stakeholders and their Contributions to the Study

Stakeholder Groups	Government Entities responsible for enforcing industry regulations and ensuring compliance with standards	Associations Organisations facilitating networking, advocacy, and knowledge exchange among industry players	Industry Players Companies actively involved in producing and distributing goods or services within the industry	Training Providers National and state-specific institutions that offer courses to develop skills and knowledge in various fields
Key Contributions	• Share inputs on industry trends • Validate high-level impact assessments • Recommend initiatives	• Identify selected industry players • Share inputs on industry trends • Validate high-level impact assessments • Recommend initiatives	• Validate industry trends • Validate detailed impact assessments • Identify future roles and skills requirement • Provide a view of capacity demand and number of highly impacted workforce • Recommend initiatives	• Recommend training providers and suitable programmes mapped to skills • Suggest new training programmes to close existing and future gaps • Recommend initiatives

Stakeholders' Selection Criteria

Selecting the right stakeholders ensures the impact study benefits from diverse perspectives and relevant expertise. The four (4) criteria used to identify stakeholders for engagement are:

01

HOLISTIC SECTOR COVERAGE

Comprehensive coverage of industry players across all sub-sectors and the entire value chain

02

STRONG BRAND PRESENCE

Widespread visibility and influence within the sector

03

SIZEABLE EMPLOYMENT COVERAGE

Comprehensive coverage and employee counts across all roles included in the assessment

04

SIGNIFICANT TURNOVER

Ensure a diverse mix of industry players, including large firms with high turnover

The study was conducted from April to September 2024, consulting **58** experts from **20** organisations during a workshop, followed by **15** separate engagements with industry stakeholders.

Key Facts and Figures of Impact Study Stakeholder Engagements

In-Depth Interviews

Agencies : 2

Validation Workshops

Associations : 3

Industry Players : 15

Chapter 3:
Sector Overview

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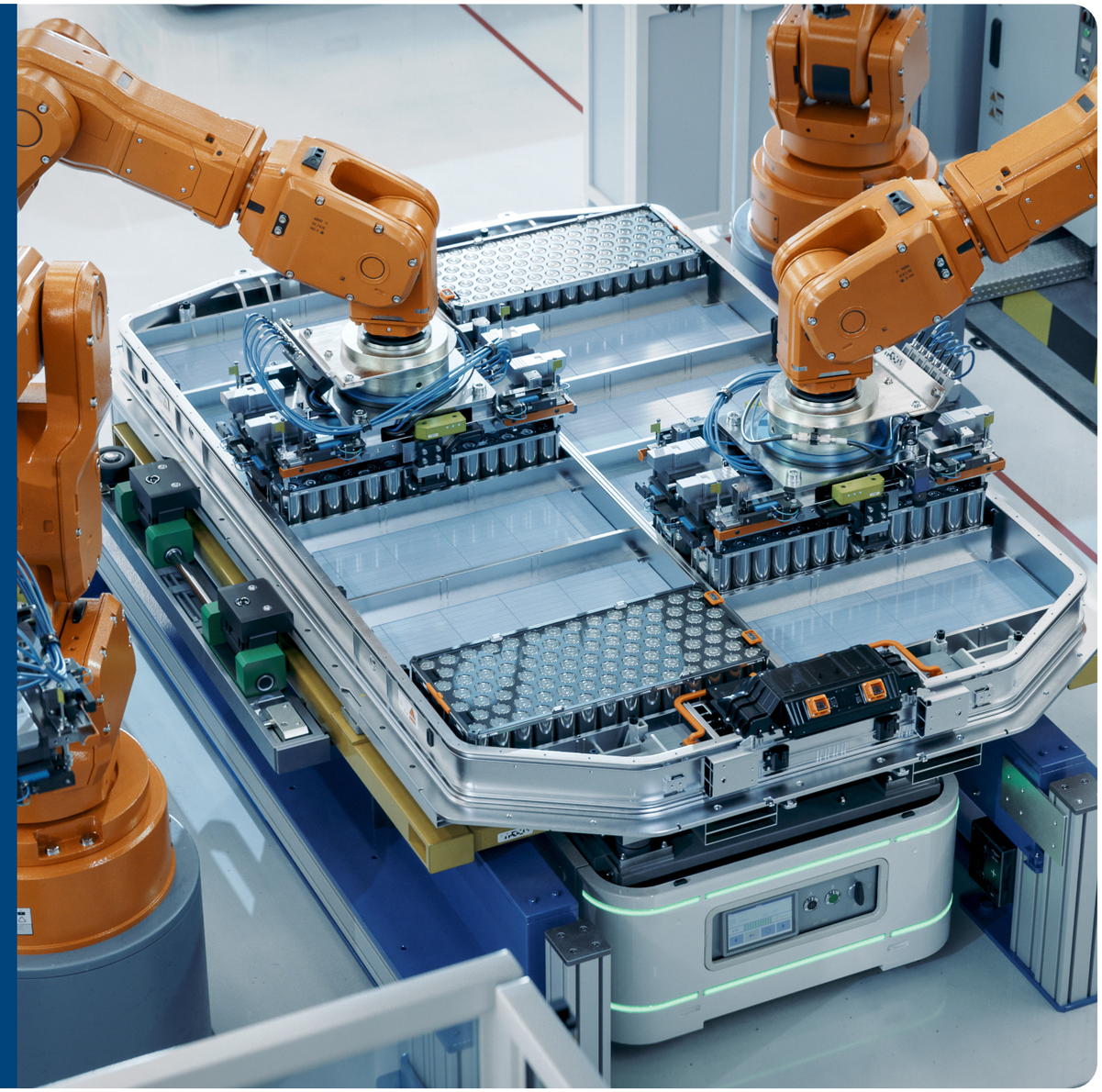
Overview of the Malaysian Trends in the Electrical and Electronics Sector 24

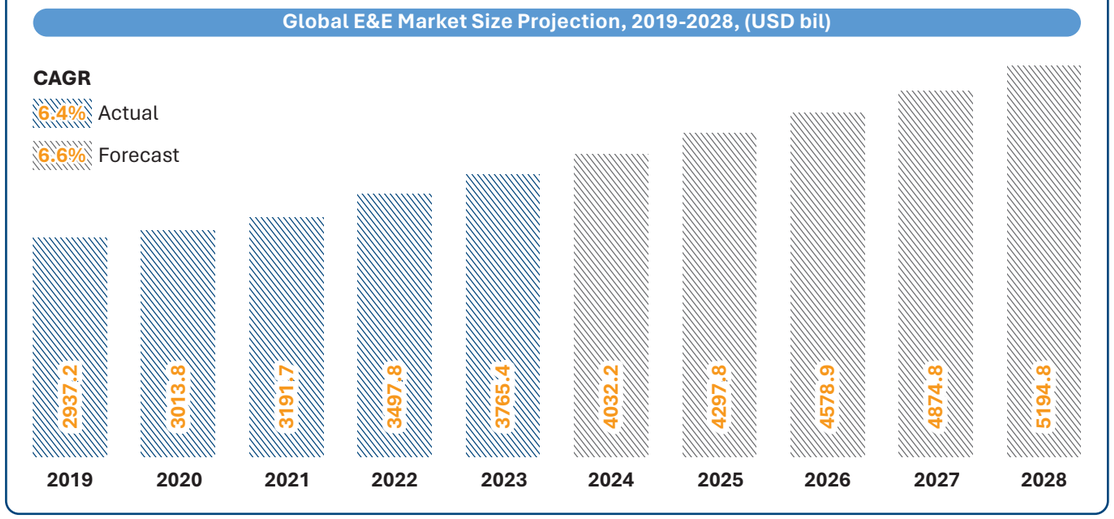
Impacts of AI, Digital, and Green Economy on the Electrical and Electronics Sector 26



This section provides a more detailed overview of a key sector for Malaysia – E&E and the global and Malaysia's macro trends on the sector, particularly the adoption of AI, Digital, and Green Economy. It further explores the challenges and opportunities for the sector players and workforce in the face of the sector's evolving trends.

Overview of the Global Trends in the Electrical and Electronics Sector

A Snapshot of the Global E&E Market Size Projection (USD)[11]



Global Market Projection

The global E&E sector is on an upward trajectory and is expected to present positive prospects for E&E players globally for the next four (4) years. The market has recorded a steady growth from 2019 to 2023, with a CAGR of 6.4% and is projected to continue to grow at 6.6% until 2028.[12]

From household appliances to industrial applications such as IoT and manufacturing software (e.g. Manufacturing Execution System (MES), Enterprise Resource Planning (ERP), Material Requirements Planning (MRP), the accelerating pace of technological advances across a wide range of E&E products are compelling sector players to continuously be innovative in exploring AI and digital tools to maximise the productivity and output.

Although Malaysia's global share in E&E has declined due to rising competition from neighbouring ASEAN countries, such as Vietnam,[13] the positive trajectory of the global E&E market presents an opportunity for Malaysian sector players to capitalise on the global market's growth by advancing local E&E activities up the value chain such as research and development (R&D); advanced packaging and wafer fabrication; and developing local chip design champions.

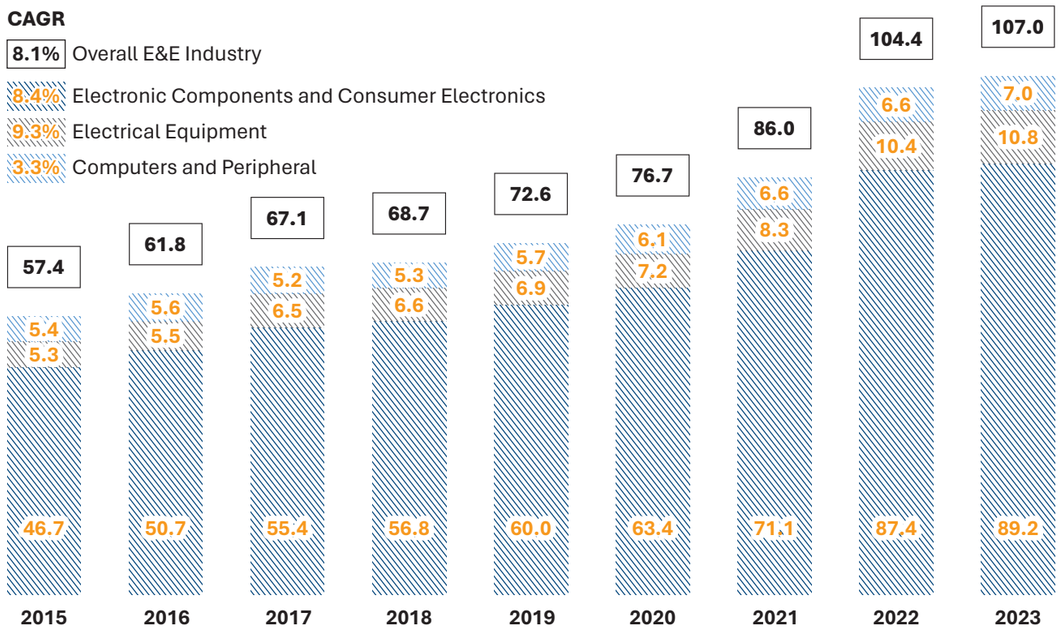
11. The Business Research Company, *Global Electrical And Electronics Market Briefing*, 2024
12. The Business Research Company, *Global Electrical And Electronics Market Briefing 2024*; RHB Global & Market Strategy, *Malaysia's E&E Sector:Trend, Competitiveness and Strategy*
13. RHB, *Global & Market Strategy: Malaysia's E&E Sector: Trend, Competitiveness and Strategy*, April 2024

Overview of the Malaysian Trends in the Electrical and Electronics Sector

GDP Contribution

The E&E sector is a key sector for Malaysia, currently contributing to 5.8% of Malaysia's GDP,[14] valued at RM107 billion in 2023.[15] It is one of the key drivers of Malaysia's economic growth with a strong global presence, ranking as the 12th largest E&E exporter in 2022.[16] Malaysia's E&E sector players are also vital to the global E&E market, contributing 13% of the world's back-end semiconductors.[17]

Malaysia's E&E GDP Contribution, 2015 - 2023, (RM bil)[18]



From 2015 – 2023, the sector's GDP contribution has grown steadily to RM107 billion, with a CAGR of 8.1%, supported by the growth of all its sub-industries.[19] As of 2023, Malaysia's E&E sector comprises 495 sector players[20] who are involved in various stages of the value chain – including design and development, manufacturing, assembly, test, and packaging. The sector's upward trajectory is expected to continue and its GDP contribution to Malaysia's economy is projected to reach RM120 billion by 2025.[21]

14. Malaysian Investment Development Authority (MIDA), *E&E Sector Presents New Key Growth Areas with the Rise of Tech and High-Value Sectors*, 27 February 2024, <https://www.mida.gov.my/mida-news/ee-sector-presents-new-key-growth-areas-with-the-rise-of-tech-and-high-value-sectors/>
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Import and Export Performance

Import / Export

Import **RM355.94 bil**

Export **RM575.46 bil**

The uptick in the global E&E sector has driven Malaysia's robust growth in the exports of E&E products. Malaysia's E&E sector recorded RM575.46 billion in exports in 2023, contributing 40.4% of total exports in the year. The increase in demand in E&E products, driven by global trends, coupled with supportive government policies have strengthened Malaysia's E&E sector. Meanwhile E&E had also recorded an increase in its imports – registering RM355.94 billion in imports and accounting for 30.4% of Malaysia's total imports in 2023; a positive indication of a flourishing domestic E&E economy.[22]

Nature of Business

- Malaysia's E&E sector players mainly comprise of SMEs, MNCs, and LLCs.
- Despite SMEs making up for 89% of the sector players, its contribution only accounts for approximately 9% of the sector's GDP,[23] indicating the dominance of the MNCs and LLCs in the sector even though these players make up only 11% of sector players.
- The majority of the sector's activities are focused on manufacturing and assembly, test, and packaging. Only some MNCs and LLCs are involved in upstream operations in addition to the former.

Four (4) Sub-Sectors within Malaysia's E&E Sector[24]

Electronic Components	Integrated circuit (IC) design, wafer fabrication, LED substrate, epitaxy manufacturing, printed circuit board (PCB), precision plastic parts
Consumer Electronics	Media players, speakers, electronic games, embedded systems, television (TV)/ radio receivers
Industrial Electronics	Computer and peripherals, data storage, office equipment, telecommunication devices, transmitters, and routers
Electrical Products	Electric motors, generators & transformers, solar cells, modules & Balance of Systems (BoS), wire, cables & batteries, lighting equipment & luminaires

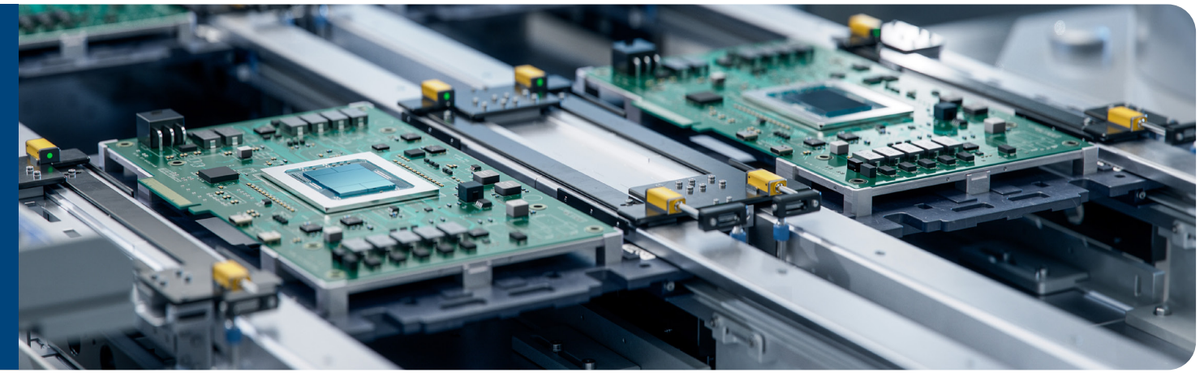
Number of Employees in Malaysia's E&E Sector

469,035 people (2022)[25]

According to the Department of Statistics Malaysia (DOSM)

22. MATRADE, *Top 10 Major Export Products 2023*, 2023, <https://www.matrade.gov.my/en/choose-malaysia/industry-capabilities/trade-statistics/28-malaysian-exporters/trade-statistics/5822-top-10-major-export-products-2023>
23. Ministry of Investment Trade and Industry (MITI), *New Industrial Master Plan 2030: Electrical and Electronics Industry*, 2023
24. DOSM
25. Ministry of Investment Trade and Industry (MITI), *New Industrial Master Plan 2030: Electrical and Electronics Industry*, 2023

Impacts of AI, Digital, and Green Economy on the Electrical and Electronics Sector



Malaysia's E&E sector has seen positive growth in recent years. This is reflected in its growing contribution to Malaysia's GDP. Malaysia's E&E sector must innovate and stay updated with emerging trends in AI, Digital, and Green Economy in order to remain ahead of the curve.

A Challenges and Opportunities

This section explores the challenges and opportunities faced by the E&E sector in Malaysia. By understanding these obstacles, we can effectively overcome them and seize the opportunities that lie ahead.

Challenges

High Financial Barrier to Adoption of AI and Digital Impacting Productivity Rate

E&E sector players are made up of 89% SMEs, and most of them do not have the financial capacity to invest in digitalisation of their business.[26] Short-term return on investment (ROI) is often a concern as adoption of AI and Digital requires significant financial investment.[27] The low digital adoption among SMEs leads to them operating at a low efficiency rate at approximately 35%. Labour intensive manual data input practices are still prevalent among SMEs, posing potential delays and errors in their operations.

Skilled Talent Shortage

Malaysia's Ministry of Investment, Trade, and Industry (MITI) highlighted that between 2025 – 2031, Malaysia's E&E sector would require a total of 50,000 to 60,000 engineers. However, there is a shortage of talent to support the sector as Malaysia currently produces 5,000 graduates yearly.[28] The competition for skilled workers has caused SMEs to refrain from investing in employee training, particularly in Industry 4.0 as SMEs become concerned about losing their talents to larger companies or MNCs upon the completion of training and upskilling.

Emergence of New Competitors Globally

Malaysia is facing fierce competition from the region with similar manufacturing capabilities at lower production and labour costs – Vietnam, Thailand.

26. Ministry of Investment Trade and Industry (MITI), *New Industrial Master Plan 2030: Electrical and Electronics Industry*, 2023
27. Engagement with Industry Players
28. MIDA, *Tengku Zafrul: Proposal to Allow Foreign Graduates to Work a Short-Term Solution to Address Shortage of Skilled Workers*, 3 February 2024, <https://www.mida.gov.my/mida-news/tengku-zafrul-proposal-to-allow-foreign-graduates-to-work-a-short-term-solution-to-address-shortage-of-skilled-workers/>

Opportunities

Expand Activities Higher in the Value Chain (R&D and Design)

- Malaysia's E&E sector already has an established ecosystem, primarily in the Northern and Southern Corridors of the country. It is well positioned to capitalise on its established ecosystem to move up the value chain.
- Shift focus on producing higher value-added products and components – e.g. advanced packaging, Automation and Test Equipment (ATE), IC design, wafer fabrication.
- Cross-collaboration and a holistic ecosystem approach between policymakers, sector players, and academia is essential to enable Malaysia's E&E sector to move up the value chain. (e.g. setting up a wafer fab/ chip manufacturing involves high capital costs and employment of key talent).

Strong Government and Regulatory Support

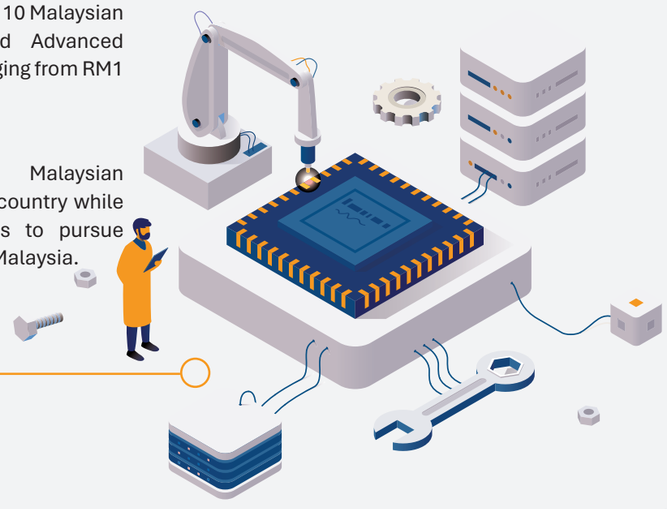
- E&E has been identified as a priority sector in the NIMP 2030. In line with this, the National Semiconductor Strategy (NSS) has been developed to guide the sector to move up the value chain, focusing on IC design, advanced packaging and manufacturing equipment.[29]
- Sector players could align their business strategies with national plans and build relationships with key stakeholders. By engaging with policymakers and supporting the national agenda, they can enhance their competitiveness and innovation while guiding Malaysia towards the government's vision for Malaysia's E&E.

National Semiconductor Strategy (NSS)

Phase 1:
Building the foundations of the E&E sector by modernising outsourced semiconductor assembly and test (OSAT), expanding fabrication plants and developing local chip design champions.

Phase 2:
Pursue cutting-edge logic and memory chip design, fabrication, testing, and integration of local champions into the ecosystem of advanced fabrication companies. It targets to have 10 Malaysian companies in Design and Advanced Packaging with revenues ranging from RM1 billion to RM4.7 billion.[30]

Phase 3:
Develop world-class Malaysian semiconductor firms in the country while attracting technology giants to pursue advanced manufacturing in Malaysia.



29. MITI, *New Industrial Master Plan 2030: Electrical and Electronics Industry*, 2023
30. YAB PM Speech on the National Semiconductor Strategy (NSS)

B Impact of AI, Digital, and the Green Economy

Artificial Intelligence

AI Trends

The rising global adoption of AI tools is transforming industries, including the E&E sector. Companies worldwide are leveraging AI to enhance operational efficiency in manufacturing processes, integrate AI into manufacturing processes to produce better quality E&E products, and improve data analysis and insights generation to drive smarter, more informed decision-making. These trends are mirrored in Malaysia, where industry players are embracing AI to stay competitive and elevate their manufacturing capabilities. This local adoption aligns with the global shift toward AI-driven efficiency and innovation in E&E production.

Adoption of AI tools in the Malaysian E&E sector is on the rise to meet the demanding needs of the wider global E&E supply chain, requiring core roles in the sector to continuously upskill to remain ahead and competitive. Examples include:

- Development of an in-house Generative AI Chatbot
- Image Analytics in visual inspection
- Development of Smart Factory using AI
- Automated and integrated gross failure area (GFA) detection

AI adoption among Malaysian E&E sector players contributes to the improvement of operational efficiency in manufacturing processes, production of better quality and enhanced E&E products as well as enhanced data analysis and generation of insights.

AI Impact

AI adoption would help to meet the increasingly demanding needs for innovative consumer electronics as well as more powerful and smaller semiconductor chips for the global E&E supply chain. The adoption of these technologies and tools, such as predictive maintenance, design and visual inspection, facilitates E&E sector players to improve their productivity.

This technological shift also necessitates core roles within the sector such as engineers, technicians, and production managers to continuously upskill to master AI-related skills. Embracing new AI technologies and methodologies will enable these professionals to stay ahead of trends and maintain their competitive edge. AI would also boost their productivity and contribute to the local sector's growth and innovation.

> **We are still in the early stages of AI adoption, but it is clear that those who endeavour to understand the technology, learn to use it efficiently and responsibly, will thrive and find success.**
>
> ***Datin Anna Baweh, Director of Government Affairs, Malaysia, Intel Corporation***

Adoption of AI Tools for Efficiency

AI is impacting the E&E sector by improving operational efficiency, producing better quality products of E&E, and enabling insights generation through data analysis.

- **Operational efficiency in manufacturing processes**

  By automating and optimising routine processes and tasks, AI solutions can significantly increase productivity and operational efficiencies, improve quality by reducing defects and forecasting unwanted failures, and optimise production parameters, resulting in lower costs and higher yield production.

  Technological advancements in AI, ML algorithms, and large language models have enabled AI solutions to offer more stable and predictable outcomes to drive greater automation and efficiency of processes for companies. Meanwhile, the increased availability of pre-trained AI models and tools play an important role in lowering technical barriers to AI adoption; enabling faster adoption of AI solutions by sector players.

Example: Application of AI-assisted Testing in Automatic Test Pattern Generation (ATPG)

- The Semiconductor automatic test equipment (ATE) market is projected to generate USD36.2 billion (RM158.45 billion) cumulative revenue opportunity from 2024 to 2027, with a CAGR of 14.3%[31]
- AI/machine learning (ML) solutions aim to improve tester times, condition monitoring for equipment performance, and predictive maintenance to reduce operational costs
- Development of Generative AI-based auto-creation test programmes help engineers reduce pattern count while enhancing Design For Test (DFT) for greater test predictability, ultimately lowering test costs
- In 2023, there was an increase in the use of adaptive tests to address the higher costs associated with more extensive testing
- In 2024 and beyond, the emphasis on reducing design and test costs is expected to grow as device complexity and quality requirements for next-gen applications rise
- Consequently, this would push test solution providers to prioritise applying AI/ML solutions for ATPG applications to achieve accelerated growth

> **Inari Amertron embraces AI and digitalisation as catalysts for innovation, enabling us to optimise processes, enhance productivity, and drive sustainable growth in alignment with the principles of the green economy.**
>
> ***Noorazidi Che Azib, Deputy Vice-President, Inari Amertron Bhd***

31. Frost & Sullivan, *Top 11 Growth Opportunities in the Semiconductor Sector 2024*, 16 February 2024, <https://store.frost.com/top-11-growth-opportunities-in-the-semiconductor-sector-2024.html>

- **Production of Better Quality and Enhanced E&E Products**
  The rapid pace of innovation in electronics technology is driving a consistent demand for newer and faster electrical and electronics products. Technological innovation is essential to influence consumer behaviours of individuals as well as business users. It is one of the key factors influencing E&E customers to replace or upgrade their products. Hence, integrating AI into manufacturing processes can help produce more enhanced and better quality E&E products.

Example: AI-based designs – Advanced Packaging

- The market for advanced chip packaging services reached USD44.3 billion (RM193.9 billion) in 2022 and is projected to hit USD78.6 billion (RM371 billion) by 2028, with a CAGR of 10.6%[32]
- Advanced packaging employs new techniques and materials to enhance the performance, power, modularity, and durability of ICs by accommodating an increasing number of transistors by decreasing the size of electrical contacts[33]
- Advantages of AI-based design includes reduced latency, improved bandwidth, enhanced efficiency, and power delivery
- Applications requiring high-performance, low-power chips that can rapidly process massive data, such as 5G, autonomous vehicles, IoT devices, and virtual and augmented reality, will benefit from advanced packaging technology

- **AI-powered tools improve data analysis and insights generation**
  Connected smart manufacturing leverages a variety of technologies, including IoT applications, Big Data Analytics, and robotics, allowing factory personnel to remotely monitor production data from a single access point.[34] This connectivity enhances efficiency and productivity, improving human-machine interactions. Additionally, AI tools facilitate the identification and resolution of performance issues, thereby boosting productivity and reducing costs—potentially by 3.6% annually through IoT applications. The abundance of data collected from smart manufacturing technologies enables AI tools to be used for pattern recognition, grouping, and predictive modelling, empowering E&E players to make data-driven decisions by uncovering hidden insights and relationships within their datasets.

Examples of AI-powered functionalities

- Predictive maintenance
- Predictive quality control
- Predictive fault detection
- AI-optimised inventory management
- AI-based production planning, visual inspection

32. Yole Group
33. Frost & Sullivan, *Top 11 Growth Opportunities in the Semiconductor Sector*, 2024
34. *Acquidista Global Industry Snapshot: Internet of Things (IoT)*

> **Advancements in AI have enabled many new capabilities. Previously, digital tools were primarily used for entertainment. Now, they are used to automate processes and make predictions, which pushes the industry forward.**
>
> ***Datin Anna Baweh, Director of Government Affairs, Malaysia, Intel Corporation***

AI Analytics
AI analytics leverage advanced AI methods, including Natural Language Processing (NLP) and deep learning to analyse large datasets, generate insights and support data-driven decision making for businesses to optimise their operations.[35]

There are four (4) primary types of data analytics leading to AI Analytics.

Level	Type of Analytics	Description
1	**Descriptive Analytics "What happened"**	• Simplest form of data analysis by using current and historical data to identify trends and relationships • Convert raw data into informative visualisations, such as reports, dashboards, charts and tables, to make informed decisions.
2	**Diagnostics Analytics "Why did this happen?"**	• Summarise and examine data to uncover the reasons behind past performance. • Involves more in-depth data analysis techniques such as drill-down, data discovery, correlations, and pattern recognition to investigate the root causes of events and behaviours
3	**Predictive Analytics "What might happen in the future?"**	• Uses historical data to forecast potential scenarios that can help drive strategic decisions • Can be conducted manually or using machine-learning algorithms
4	**Prescriptive Analytics "What should we do next?"**	• The process of using data to determine an optimal course of action • Machine-learning algorithms are often used in prescriptive analytics to parse through large amounts of data faster and more efficiently

35. Coursera; Harvard Business School Online

Global Case Studies

JABIL

The company uses AI algorithms for predictive maintenance by analysing the historical performance data of machines to forecast potential failures, reduce down-time and identify the root cause of issues. The company also employs AI-based tools for **product inspection and quality control**, utilising high-resolution cameras with AI-based recognition software. This advanced system performs quality checks and helps to accurately identify where the products become defective, ensuring higher efficiency and product consistency.[36]

tsmc

TSMC has created an **intelligent manufacturing** environment by integrating AI technologies with process experience, machine tuning, and manufacturing knowledge. This approach includes intelligent advanced equipment control, automated material handling systems (AMHS) and advanced process control to ensure consistency of tool matching, material handling, and process stability.[37]

Malaysian Case Studies

Micron

Micron has adopted **visual inspection** to enable higher accuracy and reliability of products by applying computer vision solutions to analyse images to remove manual visual inspection. Additionally, **Generative AI** has been integrated into in-house chatbots, facilitating communication, and providing recommendations for simple issues. The company has also developed a **yield auto diagnostic application**, utilising data analysis to diagnose production issues and improve production yield.

An E&E Manufacturer for Computer Storage Device

The E&E manufacturer has developed a **Smart Factory** that utilises AI technologies in predictive maintenance and supply chain optimisation to reduce operational costs and down-time. Automation and AI-driven optimisation has accelerated production cycles, minimised waste and increased overall efficiency.

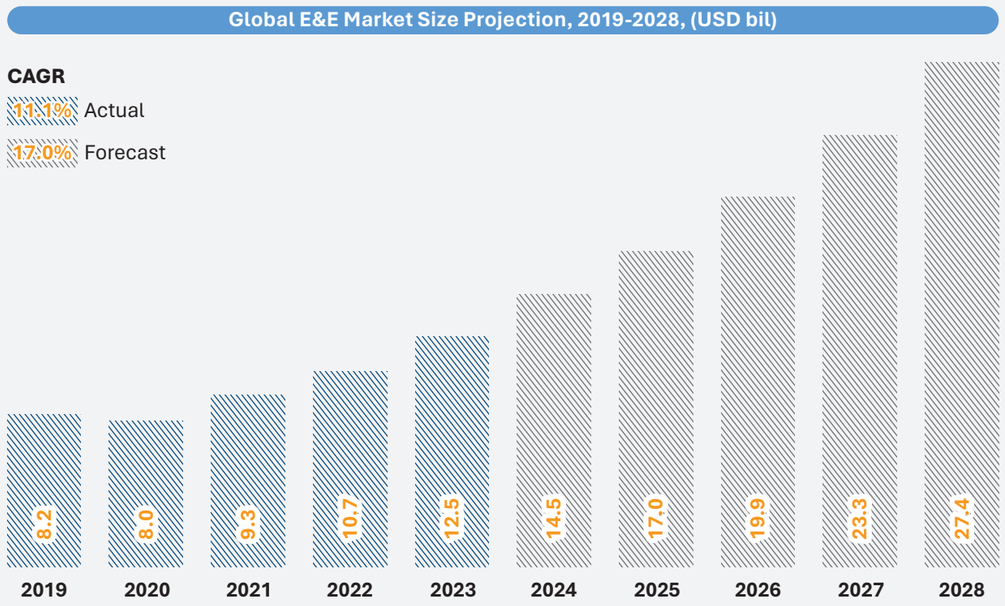
36. Jabil, *The Impact of Artificial Intelligence in Manufacturing*, <https://www.jabil.com/blog/artificial-intelligence-in-manufacturing>
37. Taiwan Semiconductor Manufacturing Company, *Annual Report 2023*, 12 March 2024, <https://investor.tsmc.com/sites/ir/annual-report/2023/2023_Annual_Report_E.pdf>

Digital

The use of digital tools in the Malaysian E&E sector is prevalent and widely embraced, among MNCs. These digital tools are primarily employed to improve operational efficiency and increase productivity. By automating routine tasks (e.g., real-time monitoring and automating production scheduling tasks) and streamlining complex processes, companies are able to achieve higher output levels with reduced manual effort. However, digital adoption is not consistent across the sector as many SMEs have yet to fully digitalise their business operations.

Global Trends

Global E&E Market Projection, 2019 - 2028 (USD bil)



The global rising demand for E&E products and technological advancements have driven significant growth in the global digital manufacturing market for E&E. Adoption of digital manufacturing by large E&E companies in Malaysia is initiated to serve the purpose of maximising productivity, operation efficiency, and minimising cost. Increased competition has driven sector players to enhance their production processes through digital manufacturing solutions in order to remain competitive in the sector. Especially with the advent of Industry 4.0 and IoT.

Digital manufacturing is the process of optimising and automating manufacturing processes through computer-based systems and technology such as robotics, 3D printing, data analytics and computer-aided design. Capitalising on these technologies allow manufacturing processes to become more productive, efficient and high-quality, resulting in shorter turnaround times and reduced cost.

93 of 279 33% **members of Malaysia Semiconductor Industry Association (MSIA) focused on digitalisation and Industry 4.0 initiatives in 2023**[38]

38. Malaysia Semiconductor Industry Association, *MSIA 2022 E&E Survey*, <https://msia.org.my/folder_upload/pdf_file/e-Booklet_MSIA%202022%20E&E%20Survey.pdf>

Digital Impact

Digitalisation improves decision-making, efficiency and accuracy

Decision-making is enhanced through digitalisation as trends, patterns, and anomalies can be quickly identified. This would enable companies to make more informed decisions, thus improving efficiency and productivity and a reduction in cost. Traditional methods of data analysis can be prone to errors, but visualising data in real-time through digitalisation can help to eliminate these mistakes. This results in more **accurate forecasting, planning, and decision-making**.

Digitalisation provides instant access to relevant data that enables companies to identify bottlenecks, inefficiencies, and areas for improvement swiftly. Consequently, this leads to significant time and cost savings, and ultimately **improving efficiency** for manufacturing processes.

Examples of digital manufacturing

- Enterprise Resource Planning (ERP)
- Material Requirements Planning (MRP)
- Manufacturing Execution Systems (MES)
- Warehouse Management Systems (WMS)
- Manufacturing Operations Management Systems (MOM)

> **The integration of AI and digital technologies has revolutionised our work culture at Inari Amertron, fostering agility, collaboration, and efficiency while empowering us to make informed decisions that support our commitment to environmental sustainability.**

Noorazidi Che Azib, Deputy Vice-President, Inari Amertron Bhd

Adoption of Digital in Manufacturing to Improve Traceability and Visibility

Digitalisation in manufacturing processes is an inevitable link for improved traceability and visibility. It acts as a common link between three (3) segments of manufacturing – facility, process/production, and product, to enhance integration and connectivity.

Traceability is the process of verifying systems or products using well-documented historical data. Digital tools in manufacturing collect all data related to the manufacturing process, compare it with production plans, and alert management in case of any inconsistencies for visibility. These tools provide detailed information about the operations performed on specific parts and the products made from those parts, helping sector players to identify issues affecting the product at the root level. Smart scheduling, smart visualisation, and the development of smart factories are some examples of these digital tools.

Adoption of Digital Tools & Technologies in E&E Sector

The use of digital tools in the Malaysian E&E sector is prevalent and widely used among the MNCs, primarily for the purposes of increasing operational efficiency and productivity, reducing costs, and enhancing integration and connectivity.

- **Digital tools and software**, which enable real-time monitoring and access to precise data, are used to assist with day-to-day routine tasks such as Manufacturing Execution Systems (MES), Warehouse Management Systems (WMS), Manufacturing Operations Management Systems (MOM), and Enterprise Resource Planning (ERP).
- **Big Data and Analytics** on the other hand, utilise large datasets to offer insights for predictive analytics and identify E&E trends. This digital technology is particularly relevant for the manufacturing processes and production lines.
- Meanwhile, the use of cloud technology for **Data Storage and Management** has improved data security and provided easy access to information, thus, reducing lag time to information for decision-making.

Global Case Studies

JABIL

- Additive manufacturing (3D printing) is capable of removing latency and waste from supply chain. It compresses design cycle that in the time it takes to make one iteration using traditional practices, 19 iterations can be completed[39]
- Data migration to SAP S/4 HANA Cloud database has improved scalability and business transparency. It also provides visibility into all open sales orders in seconds, which took 1 hour to complete historically.[40]

intel

Intel has transformed its yield analysis process by integrating AI and machine learning to accelerate yield ramp by clustering and classifying manufacturing failure patterns. Previously constrained by manual, reactive approaches, and limited human resources, Intel now employs advanced algorithms for autonomous issue detection, enabling 100% of wafers to be examined and multiple issues identified quickly. This AI-driven system pushes results to engineers for faster investigation, improves yield, supports more products, and enhances knowledge sharing across fabrication sites, propelling Intel's Industry 4.0 journey towards complete automation and greater operational efficiency.[41]

39. Jabil, *Digital Transformation in Manufacturing: 3D Printing*, <https://www.jabil.com/blog/how-additive-manufacturing-enables-digital-transformation.html>
40. SAP, *Global Manufacturer Jabil Transforms and Innovates with SAP S/4HANA Cloud*, 7 June 2023, <https://news.sap.com/2023/06/jabil-transforms-innovates-sap-s-4hana-cloud/>
41. Nitzan Kalvari et al., *IT@Intel: Transforming Manufacturing Yield Analysis with AI, Intel*, December 2021, https://www.intel.com/content/dam/www/central-libraries/us/en/documents/intel-it-manufacturing-yield-analysis-with-ai-paper.pdf

Malaysian Case Studies

Malaysian E&E MNCs are actively leveraging digital tools to improve their overall operations and traceability, highlighting how the local sector has remained competitive. Having legacy machines which could not communicate with each other and unable to access the cloud infrastructure is a common issue within the sector. It is important to integrate these legacy machines into smart manufacturing systems.[42] While the digitalisation of E&E is increasing in line with global trends, there is a need for SMEs to catch up on digitalisation in order for them to stay competitive in the E&E sector globally.

Micron

This company has integrated **Smart Scheduling** into its operations to assist with the utilisation and prioritisation of machines. **Smart Visualisation** technology has also been adopted to help enhance decision-making processes. This technology provides clear visual representation of data through remote control systems, interrelated dashboards and integration of predictive alerts. The use of this digital technology enables quick identification of trends, patterns, and anomalies, resulting in more informed decisions.

Inari Amertron Berhad

This company has adopted the use of the e-Checklist system, a paperless approach to automate and standardise all checklist submission, validation, and approval management. Inari is also using the e-Preventive Maintenance (e-PM) system, which stores information on equipment maintenance operations. The use of this system provides quick access to information, which improves work process, forward analysis, operations, and maintenance costs.

A Producer of Automated Test Equipment and Virtual Instrumentation Software

This company has embraced factory digitalisation through the use of MES, WMS, and MOM. The MES helps to boost production efficiency and overall equipment effectiveness by providing transparency and real-time analyses; WMS optimises and streamlines all warehouse operations from inventory tracking and management to order processing and fulfilment, thus enhancing overall efficiency and accuracy. Meanwhile, MOM streamlines operations, minimises downtime, improves product quality and drives higher levels of efficiency and profitability throughout their manufacturing operations.

42. International Society of Automation, *Making Legacy Machines Smart*, <https://blog.isa.org/making-legacy-machines-smart>

Green Economy

Green Economy Trends[43]

Green economy initiatives are leveraged by Malaysian E&E companies. These initiatives undertaken by players in the Malaysian E&E sector are rooted in compliance with certification standards and international benchmarks. These companies are driven to comply with sustainable practices while ensuring operational performance and efficiency, and reducing operational costs – both of which are supported by compliance with regulations/ certification requirements as follows:

1. Alignment to the UN SDG: MNCs see compliance to the UN SDG as a business case to drive growth and diversify risks. This is also driven by the fact that E&E sector players are more impacted by activities done to the environment (e.g., air, water, land)
2. Zero Waste to Landfill Certification: Companies are driven by the benefits including increased operational efficiency by streamlining business processes, cost reductions for waste operations, and assurance of regulatory compliance
3. The sector may also be subject to Carbon Border Adjustment Mechanism (CBAM) by the European Union (EU), which will be fully operational by 2026. Compliance with these global standards not only ensures that Malaysian E&E companies meet international environmental regulations but also enhances their reputation and competitiveness in the global market.

> **By leveraging AI, digitalisation, and embracing the principles of the green economy, Inari Amertron is transforming the way we work, enabling us to unlock new opportunities, improve operational efficiency, and contribute to a more environmentally conscious business ecosystem.**
>
> ***Noorazidi Che Azib, Deputy Vice-President, Inari Amertron Bhd***

Green Economy Impact

Improvement in Operational Performance and Efficiency

1. **Incorporation of Circular Design in Design Phase** by designing out waste and pollution pathway in product manufacturing, energy efficiency and recyclability of products can be enhanced and carbon footprint can be reduced
2. **Undertake energy-saving projects**, which has benefits of reduce energy consumption, lower energy costs, and improve their bottom line - e.g., installing occupancy sensors, LED lighting upgrades, Heating, Ventilation, and Air Conditioning (HVAC) retro-commissioning
3. **Optimise product packaging** by replacing materials with environmentally preferable alternatives, increasing the use of recycled and recyclable materials, and reducing the amount of material used, resulting in reduction in carbon footprint

43. EY Analysis

Reduced Operational Costs

Adopting Green Economy initiatives enables E&E sector players to reduce operational cost while also committing to greener practices for the environment. The implementation of water management strategies have aided companies to reduce overall costs and water usage.

Examples of Water Management Strategies

- Reusing reverse osmosis water for toilet flushing and plant watering
- Using recycled water
- Installing rainwater harvesting systems

Adoption of Green Economy Practices in E&E Sector

Examples include:

- Use of renewable energy: Companies are integrating electricity generated from renewable energy sources to power their manufacturing operations, reducing reliance on fossil fuels
- Use of recycled water: Treated water is reused within the manufacturing process to minimise overall water consumption
- Waste management/ circular design strategies: Effective waste management strategies are implemented to reduce, reuse, and recycle materials, to promote resource efficiency
- Reduction in carbon footprint: The adoption of energy-efficient equipment and machinery significantly reduces energy consumption and carbon emissions
- Green Data Centres: To address the high energy demands of data centres, companies are implementing the use of energy efficient servers, cooling systems, and other technologies to minimise overall energy consumption
- Sustainable Supply Chain: Companies are prioritising eco-friendly materials and practices throughout their supply chain, ensuring environmental protection and sustainability is maintained from sourcing to production

Global Case Studies

intel

This company has achieved a 43% reduction in Scope 1 and 2 GHG emissions, significantly lowering its carbon footprint. The company has also reached 100% renewable electricity usage across its operations in the United States (US), Europe, Vietnam, and China. In terms of waste management, the company applies circular economy principles to approximately 63% of its manufacturing waste streams via reuse, recovery, and recycling concepts.[44]

44. Intel, *2023-24 Corporate Responsibility Report*, <https://csrreportbuilder.intel.com/pdfbuilder/pdfs/CSR-2023-24-Full-Report.pdf>

Infineon

This company has taken proactive steps to reduce its GHG emissions and overall environmental footprint. It has developed solutions to enable green and efficient computing platforms and reduce power consumption in data centres.[45] To further drive energy efficiency, the company has established an Energy Management System (EMS), maintained by dedicated energy teams responsible for optimising and evaluating energy efficiency across operations. It has also adopted the ISO 50001 Energy Management System in accordance with local requirements.[46]

Malaysian Case Studies

Inari Amertron Berhad

Inari Amertron has embraced sustainability in its Malaysia operations by utilising renewable energy and recycling water. It achieved 100% compliance with local regulatory standards for wastewater discharge, ensuring all discharges are free from harmful chemicals.[47]

Micron

Micron has demonstrated commitment to sustainability through recycling of water to minimise its environmental footprint. It has also transitioned to using 100% renewable energy for its operations in Malaysia.[48]

45. Infineon, *Datacenter and Computing Solutions*, <https://www.infineon.com/cms/en/applications/information-communication-technology/hyperscale-computing/>
46. Infineon, *Sustainability at Infineon Supplementing the Annual Report 2023*, <https://www.infineon.com/dgdl/Sustainability_at+Infineon_2023.pdf?fileId=8ac78c8b8b657de2018c009d03120100>
47. Inari Amerton, *FY 2023 Sustainability Statement*, <https://www.inari-amertron.com/wp-content/uploads/2023/10/FY2023-Sustainability-Statement.pdf>
48. Micron, *2024 Sustainability Report*, <https://my.micron.com/content/dam/micron/global/public/documents/about/sustainability/2024-micron-sustainability-report.pdf>

Chapter 4:
Key Findings

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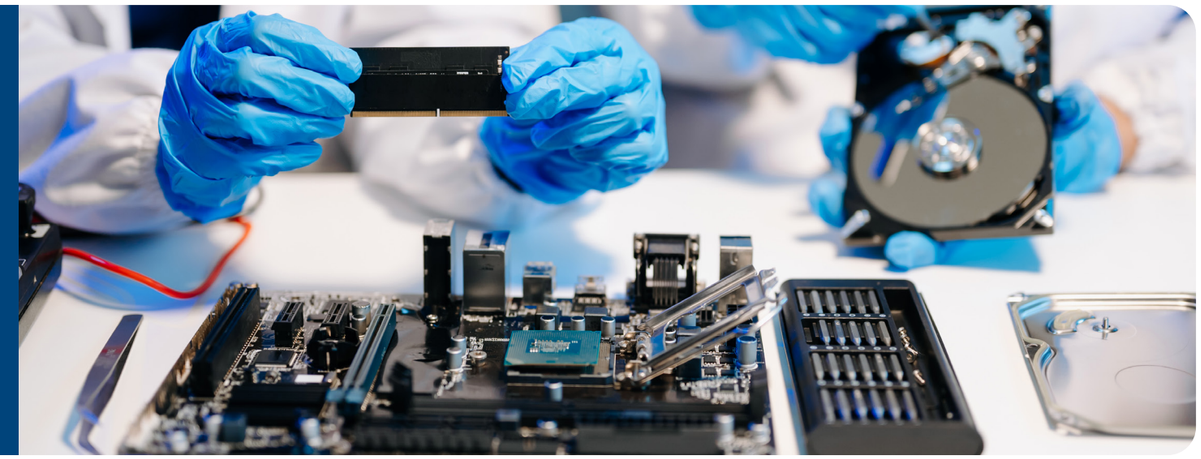
Overview of Roles and Skills



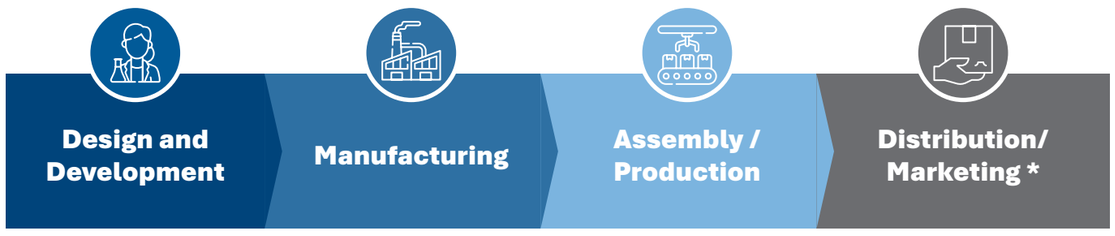
AI's relevance in the sector is becoming more prevalent and it is set to significantly transform certain roles within the sector. AI can execute certain tasks that require human intelligence by learning from data; identifying patterns; conducting troubleshooting; and making recommendations based on insights it derived. This includes tasks such as visual inspection and language translation.

As digitalisation advances in the sector, application of digital tools have been more widespread among industry players. Digital tools are able to automate repetitive tasks and undertake data entry and processing using software robots programmed with predefined rules without the need for machine learning or complex decision-making. Digitalisation has also streamlined incident reporting, enabled real-time monitoring in production processes and streamlined production by leveraging on transport systems for transportation of goods. The application of digital platforms in the E&E sector empowers businesses to maximise their potential by enabling industry players to gain in-depth data analysis to identify hidden trends and realise untapped market opportunities with minimal human intervention.

Environmental awareness in the E&E sector remains a crucial aspect for sustainable development. However, Green Economy's impact on the sector's highly impacted roles is minimal.

AI automates repetitive tasks in production, optimises material cutting patterns to minimise waste, and forecasts demand for more effective inventory management, resulting in smoother production flows and a more resilient business. This however, significantly affects highly impacted roles as it diminishes the need for human intervention for these tasks. The integration of AI will necessitate workers in highly impacted roles to upskill and reskill to enable their transition into other roles.

Value Chain



*Distribution/Marketing is not covered within the scope, as it is considered a supporting function.

Consolidated Job Clusters, Roles, and Skills in E&E Sector

12 Job Clusters

Design & Development* (27 job roles)	**Facilities** (3 job roles)	**Integration** (3 job roles)	**Test** (2 job roles)
Industrial (2 job roles)	**Production** (7 job roles)	**Equipment** (3 job roles)	**Quality** (3 job roles)
Process (3 job roles)	**Product** (3 job roles)	**Environment, Health and Safety** (2 job roles)	**Sustainability*** (1 job role)

59 Job Roles
(*Including Emerging Roles)

18 Skills Clusters
(Categorised into 16 specific skill clusters and 2 basic skill clusters)

Specific Skills

Engineering and Maintenance (8 skills)	**Manufacturing and Production** (12 skills)	**Automation and Robotics** (4 skills)	**Technical Design and Architecture** (23 skills)
Research and Development (8 skills)	**Accounting and Finance Management** (1 skill)	**Technology Management** (3 skills)	**Data Development and Implementation** (5 skills)
Software Development and Implementation (6 skills)	**Quality Management** (13 skills)	**Project and Process Management** (5 skills)	**Health, Safety and Environment (HSE)** (5 skills)
Business Operation Management (1 skill)	**General Business Management** (5 skills)	**Risk Mgmt, Compliance and Governance** (5 skills)	**Customer, Vendor, and Stakeholder Management** (1 skill)

Basic Skills

Innovation and Delivery (9 skills)	**Social Intelligence** (7 skills)

121 Skills
Which comprises 105 Specific Skills and 16 Basic Skills

Job Clusters and Roles

As the E&E sector evolves under the influence of AI, Digital, and Green Economy, it is important to understand how these transformations will impact job clusters and roles within the sector. As the sector continues to evolve, we must explore how job functions are shifting and what new roles are emerging in response to these trends.

While some jobs may be displaced or transformed, new opportunities will emerge, emphasising the need for adaptive skills and continuous learning. Policymakers and sector leaders will need to focus on training and support to effectively navigate this evolving landscape. 12 job clusters have been identified for the E&E sector

Job Clusters	Roles	
Design and Development (D&D)	1. Technology Project/ Programme Manager 2. Senior Software Design Engineer 3. Senior Hardware Design Engineer 4. Senior Firmware Design Engineer 5. Senior IC Design Engineer 6. Senior Package Design Engineer 7. Senior Design Automation Engineer 8. Senior Reliability Engineer 9. Senior Failure Analysis Engineer 10. Senior Physical Design Engineer 11. Software Design Engineer 12. Hardware Design Engineer 13. Firmware Design Engineer 14. IC Design Engineer 15. Package Design Engineer 16. Design Automation Engineer	17. Reliability Engineer 18. Failure Analysis Engineer 19. Physical Design Engineer 20. AI or Machine Learning Application Engineer (Emerging Role) 21. Smart Manufacturing & AI Industrial 4.0 Analyst (Emerging Role) 22. Data Engineer (Emerging Role) 23. AI Integration Engineer (Emerging Role) 24. Data Scientist (Emerging Role) 25. Data Steward (Emerging Role) 26. Analog Mixed Signal / Analog Circuit Design Engineer (Emerging Role) 27. Internet of Things (IoT) Specialist (Emerging Role)

Job Clusters	Roles	
Equipment	1. Senior Equipment Engineer 2. Equipment Engineer	3. Equipment Technician
Facilities	1. Senior Facilities Engineer 2. Facilities Engineer	3. Facilities Technician
Quality	1. Senior Quality Engineer 2. Quality Engineer	3. Quality Assurance Technician
Integration	1. Senior Integration Engineer 2. Integration Engineer	3. Integration Technician
Process	1. Senior Process Engineer 2. Process Engineer	3. Process Technician
Test	1. Senior Test Development Engineer	2. Test Development Engineer
Product	1. Senior Product Engineer 2. Product Engineer	3. Product Technician
Industrial	1. Senior Industrial Engineer	2. Industrial Engineer
EHS	1. Senior EHS Engineer	2. EHS Engineer
Sustainability	1. Sustainability Engineer	
Production	1. Manufacturing Senior Manager 2. Manufacturing Manager 3. Production Supervisor 4. Production Executive	5. Planning Officer 6. Production Operator 7. Assembly, Test & Packaging Operator

Skills Clusters and Skills

Skills Category	Skills Clusters	
BASIC SKILLS Essential skills required for a person to be fit for a job	**Innovation and Delivery**	
	• Adaptability and Resiliency	• Learning Agility
	• Digital and AI Fluency	• Cognitive Skills
	• Change Management	• Business Acumen
	• Innovative Thinking	• Sustainability Awareness
	• Critical Thinking	
	Social Intelligence	
	• Influencing and Negotiation	• Empathy
	• Communication	• Planning and Organising
	• Coaching and Mentoring	• Conflict Management
	• Teamwork and Collaboration	
SPECIFIC SKILLS Skills relating to a specific task or situation. It involves both understanding and proficiency in such specific activity that involves methods, processes, procedures, or techniques	**Automation and Robotics**	
	• Automated Process Control	• Automation System Maintenance
	• Automated Operation Monitoring	• Automated System Design
	Business Operation Management	
	• Production Planning and Scheduling	
	Data Development and Implementation	
	• Big Data Analytics	• Data Literacy
	• Data Engineering	• Data Mining and Modelling
	• Data Science	
	Manufacturing and Production	
	• Good Manufacturing Practices Implementation	• Packaging Process
	• Metrology Management	• Software-Based Solutions for Manufacturing
	• Factory System Management	• Operations Performance
	• Production Shut-down and Re-start	• Production Failure Analysis
	• Manufacturing Process Management	• Production Simulation
	• Operation and Control	
	• Systems-Based Solutions for Facilities	

Skills Category	Skills Clusters	
SPECIFIC SKILLS Skills relating to a specific task or situation. It involves both understanding and proficiency in such specific activity that involves methods, processes, procedures, or techniques	**Accounting and Finance Management**	
	• Financial Planning, Analysis and Forecasting	
	Customer, Vendor and Stakeholder Management	
	• Stakeholder Management	
	Engineering and Maintenance	
	• Computer-Aided Design	• Preventive Maintenance
	• 8 Disciplines Model	• Equipment Maintenance
	• Material Science and Selection	• Facility Maintenance
	• Computer Engineering	• Equipment and Systems Repair
	Project and Process Management	
	• Assembly, Testing, and Packaging	• Continuous Improvement
	• Project Portfolio Management	• Engineering Project Management
	• Project Risk Assessment	
	Technical Design and Architecture	
	• Analog Circuits and Circuit Layout	• Firmware Design and Development
	• Components and Parts Design	• Hardware Design and Development
	• Physical Design Engineering	• Packaging Design and Development
	• Logic/ Register Transfer Level (RTL) Design	• Software Design and Development
	• Logic/ Register Transfer Level (RTL) Analysis and Verification	• System on Chip Support
	• Design Flow and Methodology	• System Simulation and Verification
	• Design of Experiment (DOE)	• Timing Analysis and Verification
	• Design for Manufacturing and Assembly (DFMA)	• Timing Constraints Generation and Management
	• Design Optimisation	• Timing Convergence
	• Digital Operating Hardware and Software System	• Electronic Design Automation
	• Embedded Software Design	• Embedded Systems Integration
		• Process Integration
	General Business Management	
	• Resource Management	• Business Requirement Mapping
	• Cost Management	• Budget Management
	• Technical Presentations	

Skills Clusters and Skills (Continue)

Skills Category	Skills Clusters	
SPECIFIC SKILLS Skills relating to a specific task or situation. It involves both understanding and proficiency in such specific activity that involves methods, processes, procedures, or techniques	**Health, Safety and Environment (HSE)**	
	• Workplace Safety and Health System Management • Emergency Management • Workplace Safety and Health Practices Implementation	• Hazards and Risk Identification and Management • Sustainable Business Practices • Environmental Management System Framework Development and Implementation
	Research and Development	
	• Research and Information Synthesis • New Product Introduction • Product Testing • Firmware Testing and Validation	• Product Crisis Management • Product Development Lifecycle • Product Architecture • Wafer Fabrication
	Risk Management, Compliance and Governance	
	• Enterprise Risk Management • Regulatory Compliance • Waste Water and Gas Emission System • Product Risk Assessment	• Crisis Situations Management • Crisis and Disaster Recovery Management
	Software Development and Implementation	
	• Applications Development • Advanced Programming Language • Programming, Coding and Scripting	• Assembly Language • Cloud Computing • Computational Modelling
	Technology Management	
	• Internet of Things Management • Internet of Things Installation and Maintenance	• Machine Learning
	Quality Management	
	• Quality Systems Management • Audit Management • Material Qualification • Yield Analysis • Quality Control and Assurance • Quality Process Control • Parametric Testing	• Change Control • Measurement System Analysis • Test Development • Process Variation Effect Modelling • Root Cause Corrective Action (RCCA) • Failure Analysis • Process Quality Management

In-Demand Skills

In-Demand Skills are the skills commonly required for the roles within the E&E sector. As the sector continues to evolve with the increasing adoption of AI, Digital, and Green Economy, continuous upskilling and reskilling of the workforce is vital to meet the demands of the E&E sector in its dynamic landscape. The top nine (9) in-demand skills most frequently required across 59 identified roles in the E&E sector include:

Areas	Skills
AI & DIGITAL	• Data Engineering • Programming, Coding and Scripting • Factory System Management • Big Data Analytics • Automated Process Control • Data Literacy
GREEN ECONOMY	• Good Manufacturing Practices Implementation • Waste Water and Gas Emission System • Sustainable Business Practices

Below are the non-exhaustive skills relevant to the E&E sector:

Automated Process Control	Embedded Systems Integration	Product Testing
New Product Introduction	Quality Control and Assurance	Factory System Management
Workplace Safety and Health System Management	Continuous Improvement	Hazards and Risk Identification and Management
Root Cause Corrective Action (RCCA)	Workplace Safety and Health Practices Implementation	Failure Analysis
Technical Presentations		

Role and Skills Analysis by Impact Level

The impact study for the Electrical and Electronics sector has identified 59 critical roles. 50 of which are established roles integral for maintaining sector standards and operational efficiency; and nine (9) additional emerging roles that are set to drive future advancements and innovations.

Impact Assessment on 59 Roles in the Electrical and Electronics Sector

	High	Medium	Low	Emerging
AI/Digital	• **High opportunity** to **automate** • **Low human intervention**	• **High opportunity** to **automate** • **High human intervention**	• **Low opportunity** to **automate** • **High or low human intervention**	
Green Economy	• **Job no longer required** due to impact on the environment • **May or may not** have **opportunity to diversify**	• **Job still required** despite impact on the environment • **Opportunity to diversify exists**	• **Job still required** despite impact on the environment • **No opportunity to diversify**	New job positions created due to technological advancements, sector trends, and societal changes help organisations drive innovation, adopt sustainable practices, and stay competitive and compliant with evolving regulations and market demands.
Outcome	**Roles facing convergence or displacement** Need to pivot to adjacent role and reskill	**Roles are evolving** Need to upskill to deliver beyond what would traditionally be expected	**Roles not severely impacted** Need to continue improving to keep self relevant	
	2 Roles	44 Roles	4 Roles	9 Roles
Proportion of Roles	4%	88%	8%	

Overview of Roles by Impact Level

The impact study focuses on roles affected by the growth of AI, Digital, and Green Economy. It aims to identify viable career pathways and necessary skills for the Malaysian workforce while highlighting emerging roles driven by these trends to enhance the competitive advantage of the sector.

HIGH

2 Roles

1. Production Operator
2. Planning Officer

MEDIUM

44 Roles

1. Senior Software Design Engineer
2. Software Design Engineer
3. Senior Hardware Design Engineer
4. Hardware Design Engineer
5. Senior Firmware Design Engineer
6. Firmware Design Engineer
7. Senior Package Design Engineer
8. Package Design Engineer
9. Senior Design Automation Engineer
10. Design Automation Engineer
11. Senior Reliability Engineer
12. Reliability Engineer
13. Senior Failure Analysis Engineer
14. Failure Analysis Engineer
15. Technology Project/ Prog. Manager
16. Senior Product Engineer
17. Product Engineer
18. Senior Facilities Engineer
19. Facilities Engineer
20. Senior Integration Engineer
21. Integration Engineer
22. Senior Quality Engineer
23. Quality Engineer
24. Senior Process Engineer
25. Process Engineer
26. Senior Industrial Engineer
27. Industrial Engineer
28. Senior Test Development Engineer
29. Test Development Engineer
30. Senior EHS Engineer
31. HSE Engineer
32. Senior Equipment Engineer
33. Equipment Engineer
34. Manufacturing Senior Manager
35. Manufacturing Manager
36. Production Manager
37. Production Executive
38. Process Technician
39. Facilities Technician
40. Equipment Technician
41. Product Technician
42. Quality Assurance Technician
43. Integration Technician
44. Assembly, Test and Packaging Operator

LOW

4 Roles

1. Senior IC Design Engineer
2. IC Design Engineer
3. Senior Physical Design Engineer
4. Physical Design Engineer

EMERGING

9 Roles

1. AI/ Machine Learning Application Engineer
2. AI Integration Engineer
3. Smart Manufacturing and AI Industrial 4.0 Analyst
4. Data Scientist
5. Data Engineer
6. Sustainability Engineer
7. Data Steward
8. Analog Mixed Signal / Analog Circuit Design Engineer
9. Internet of Things (IoT) Specialists

Highly Impacted Roles

AI's relevance in the sector is becoming more prevalent and it is set to significantly transform certain roles within the sector. AI can execute certain tasks that require human intelligence by learning from data; identifying patterns; conducting troubleshooting; and making recommendations based on insights it derived. This includes tasks such as visual inspection, and language translation. AI automates repetitive tasks in production, optimises material cutting patterns to minimise waste, and forecasts demand for more effective inventory management, resulting in smoother production flows and a more resilient business. This however, significantly affects highly impacted roles as it diminishes the need for human intervention for these tasks. The integration of AI will necessitate workers in highly impacted roles to upskill and reskill to enable their transition into other roles.

As digitalisation advances in the sector, application of digital tools have been more widespread among industry players. Digital tools are able to automate repetitive tasks and undertake data entry and processing using software robots programmed with predefined rules without the need for machine learning or complex decision-making. Digitalisation has also streamlined incident reporting, enabled real-time monitoring in production processes and streamlined production by leveraging on transport systems for transportation of goods. The application of digital platforms in the E&E sector empowers businesses to maximise their potential by enabling industry players to gain in-depth data analysis to identify hidden trends and realise untapped market opportunities with minimal human intervention.

Environmental awareness in the E&E sector remains a crucial aspect for sustainable development. However, Green Economy's impact on the sector's highly impacted roles is minimal.

E&E sector empowers businesses to maximise their potential by enabling industry players to gain in-depth data analysis to identify hidden trends and realise untapped market opportunities with minimal human intervention.

Case Studies for Highly Impacted Roles

AI is revolutionising industries by automating routine tasks, freeing up professionals to focus on strategic decision-making and innovation. This transformation necessitates professionals to acquire new skills in AI integration, data interpretation, and advanced analytics to collaborate effectively with AI systems, ensuring continuous improvement while maintaining regulatory standards.

Roles	Impact and Case Studies
Planning Officer	AI-driven simulations and optimisation tools enhance the capabilities of Planning Officers by optimising resource allocation of manpower and materials, resulting in cost savings and improved efficiency in project planning and execution. These officers can leverage on the speed and accuracy of AI algorithms to process vast amounts of data, enabling them to carry out more sophisticated analyses and a more informed decision-making on production planning, resource management, and production process optimisation. Following the integration of AI and Digital tools, Planning Officers are expected to acquire AI-related skills and knowledge such as data analytics, AI algorithm understanding and the ability to interpret complex output from AI systems in order to remain relevant in the job market. • **Intel** incorporates AI in its semiconductor manufacturing processes. Planning Officers at Intel utilise AI to optimise production scheduling and resource allocation in semiconductor fabrication facilities. AI algorithms analyse production data to identify bottlenecks, optimise workflow efficiency, and improve overall manufacturing productivity.[49] • **Infineon Technologies** Kulim has an AI-driven scheduling system to optimise production schedules by considering factors such as machine availability, workforce shifts, and production deadlines. The AI system dynamically adjusts schedules to minimise downtime, balance workloads, and ensure timely delivery of products. This leads to increased production efficiency and reduces operational costs.[51] • **Siemens** has integrated AI into its manufacturing processes through its Digital Enterprise software suite. Planning Officers at Siemens use AI-powered tools to optimise production planning and scheduling. For example, AI algorithms analyse production data in real-time to predict machine failures and optimise maintenance schedules, ensuring minimal downtime and efficient resource utilisation.[51]
Production Operator	AI has transformed production environments by automating a range of repetitive tasks, such as transporting products via the conveyor system on the production floor, thus allowing Production Operators to focus on more complex and value-added activities. In addition, AI robots can fully automate manufacturing processes in factories through Lights-Out Manufacturing, which requires no human presence. AI also enhances operational efficiency by predicting machine failures and scheduling maintenance proactively to minimise downtime in production as well as assisting operators with troubleshooting. Furthermore, digitalisation has enabled real-time monitoring and optimisation of production processes, providing operators with immediate access to insights on production metrics, machine status, and performance, thereby facilitating swift responses to issues during inspections. • **Infineon Technologies** uses smart analytics and operations data in chip manufacturing, for image classification, virtual tests, predictive maintenance, and root cause analysis to support a zero-defect culture. By using AI in their own manufacturing processes, their operators can produce semiconductor solutions faster and more efficiently.[52] • At **Flextronics**, Production Operators utilise AI and IoT technologies in manufacturing operations, enabling them to leverage on real-time data analytics to monitor machine performance, predict maintenance needs, and adjust production schedules accordingly. This has enabled them to improve productivity and operational efficiency.[53] • At **Jabil Circuits**, AI-driven Collaborative Robots (cobots) are capable of working alongside human operators, taking over repetitive and labour-intensive tasks.[54] This complementary task delegation allows human operators to focus on more complex and value-added activities.

49. Andre Ripla, *Leveraging AI in Manufacturing Planning and Scheduling for Manufacturing Excellence, LinkedIn*, 25 April 2024, <https://www.linkedin.com/pulse/leveraging-ai-manufacturing-planning-scheduling-andre-ripla-pgcert-1lobe/>
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Highly Impacted Roles Career Pathways

Roles

PLANNING OFFICER

Key Responsibilities:
Coordinate production for efficiency, including output operations and resource allocation

Additional Skills Required

AI / DIGITAL SKILLS

1. **Big Data Analytics:**
   Ability to utilise advanced techniques to process, analyse and interpret large and complex datasets to generate insights and recommendation to support decision-making
2. **Database Administration:**
   Ability to maintain effective administration of database, including digital and physical copies for safekeeping and recordkeeping
3. **Data Engineering:**
   Ability to design and maintain data infrastructure, creating and managing data pipelines, and ensuring efficient collection, storage, and processing of data accessibility and analysis
4. **Data Visualisation:**
   Ability to employ illustrative and interactive graphics based on understanding of patterns and trends for the intended audience

GREEN SKILLS

1. **Sustainable Business Practices:**
   Application of sustainable business practices provide long-term benefits for organisation as they remain ahead of the curve to capture and comply to ESG principles, including optimisation of production through proper raw materials planning and energy consumption for supply chain

Possible Roles for Transition Within the Sector

ATP Operator
Assemble, test, and pack components or products.

Possible Roles for Transition into Other Sectors

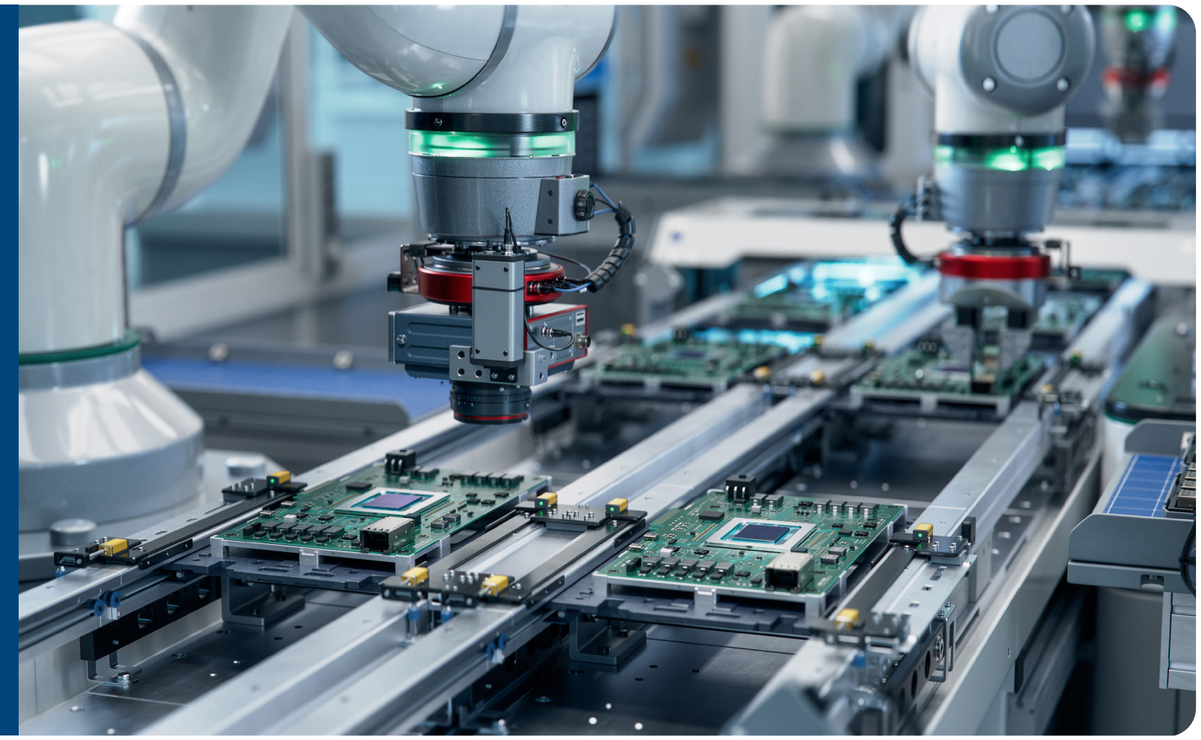
Data Analyst
Analyse data to define business insights.
Sector:
Information and Communications Technology

Supply Planner
Manage inventory, optimise costs, and generate forecast data.
Sector:
Food Manufacturing and Service

Highly Impacted Roles Career Pathways

(Continue)

Roles	Examples of Additional Skills Required and Analysis		Possible Roles for Transition Within the Sector	Possible Roles for Transition into Other Sectors	
	AI / DIGITAL SKILLS	GREEN SKILLS			
PRODUCTION OPERATOR **Key Responsibilities:** Oversee production and perform basic troubleshooting	1. **Big Data Analytics:** Ability to utilise advanced techniques to process, analyse, and interpret large and complex datasets to generate insights and recommendations to support decision-making 2. **Automated Operation Monitoring:** Responsible for maintaining smooth operation of automated systems through regular monitoring and upkeep, ensuring optimal flow within the manufacturing process, including digital processes 3. **Warehouse Automation Application:** Ability to leverage and utilise computer software and automated equipment to enhance warehouse operational efficiency	1. **Sustainable Business Practices:** Application of sustainable business practices provide long-term benefit to organisation as they remain ahead of the curve to capture and comply to ESG principles, including optimisation of production through proper raw materials planning and energy consumption for supply chain 2. **Eco-Design Principles:** Understanding and application of eco-design principles to enable organisations to integrate ESG considerations into their operations, driving efficiency, compliance, innovation, and long-term profitability. By fostering a culture of sustainability, professionals can lead transformative changes that benefit both business and society as a whole	 **ATP Operator** Assemble, test, and pack components or products.	 **Inventory Coordinator** Coordinate warehouse operations and ensure safe equipment operation. **Sector:** Food Manufacturing and Services	 **Supply Planner** Manage inventory, optimise costs, and generate forecast data. **Sector:** Food Manufacturing and Service



Projected Number of Highly Impacted Employees

Based on the TalentCorp Demand Model Projection, the workforce in the E&E sector's core business is projected to reach approximately 363,000 employees by 2029. It is estimated that around 10% of these employees (or 37,300 individuals) could face the risk of job displacement within the next three (3) to five (5) years.[55] MNCs sector players of the E&E sector recognise that adopting AI, Digital, and Green Economy is an essential component for achieving sustainable growth, improving productivity and maintaining their competitive edge in the E&E sector.

Two (2) Highly Impacted Roles Identified

Production	
• Planning Officer	• Production Operator

- With the adoption of smart scheduling tool to automate production planning, industry players indicate that the role of a Planning Officer may potentially require reskilling
- Industry players are increasingly automating troubleshooting tasks to enhance efficiency, of which the role of a Production Operator might be impacted
- Employers with these roles in their organisation and respective employees will need to plan for talent reskilling and pivoting strategies within or across sectors

55. Department of Statistics Malaysia (DOSM) and TalentCorp Demand Model Projection

Medium and Low Impacted Roles

Medium Impacted Roles Analysis

Medium impacted roles arise from technology's capacity to automate repetitive tasks, enabling professionals to take on new responsibility or focus on high-value activities such as overseeing technology automation.

AI will moderately impact various roles through the automation of routine tasks and the use of advanced data analysis and predictive solutions to improve efficiency. Tasks reliant on repetitive data processing and predictable workflows will undergo significant transformation. The emergence of AI will reshape job functions to push employees into acquiring new skill sets while preserving the importance of human qualities in roles demanding technical knowledge, leadership, creativity, and complex decision-making or problem solving. However, roles requiring technical knowledge and expertise such as Test Development Engineers and HSE engineers are less likely to be fully automated.

The key to digitalisation is a lean process. Digital tools revolutionise tasks such as production monitoring, integration and project process tracking through the automation of critical functions such as data collection, analysis, and reporting to enhance efficiency and accuracy. However, as technology is integrated into these roles, human input remains essential for interpreting data, simulation outcomes, and making data-driven informed decision-making.

Meanwhile, Green Economy has an impact on certain medium impacted roles in the E&E sector. Job roles such as Equipment Engineer and Industrial Engineer align their practices with Green Economy principles by integrating sustainable strategies into technological advancements and operational frameworks. By advocating for and implementing green technologies and practices, these roles also play a part in fostering a greener economy through optimising energy usage, adopting sustainable waste management strategies, and incorporating recycling efforts. Their influence lies in integrating sustainable strategies into technological advancements and operational frameworks, thus shaping medium-level impacts on environmental sustainability.

Job Clusters	Medium Impacted Roles	Skills
Design & Development	• Senior Software Design Engineer	**Specific Skills** • Software Design and Development • Advanced Programming Language • Machine Learning • Big Data Analytics **Basic Skills** • Learning Agility • Digital and AI Fluency • Planning and Organising • Teamwork and Collaboration • Coaching and Mentoring

Job Clusters	Medium Impacted Roles	Skills
Design & Development	• Software Design Engineer	**Specific Skills** • Software Design and Development • Advanced Programming Language • Machine Learning • Big Data Analytics **Basic Skills** • Learning Agility • Digital and AI Fluency • Critical Thinking • Innovative Thinking • Sustainability Awareness
	• Senior Hardware Design Engineer	**Specific Skills** • Hardware Design and Development • Computer-Aided Design • System Simulation and Verification • Analog Circuits and Circuit Layout **Basic Skills** • Critical Thinking • Innovative Thinking • Sustainability Awareness • Teamwork and Collaboration • Coaching and Mentoring
	• Hardware Design Engineer	**Specific Skills** • Hardware Design and Development • Computer-Aided Design • System Simulation and Verification • Analog Circuits and Circuit Layout **Basic Skills** • Critical Thinking • Innovative Thinking • Sustainability Awareness • Teamwork and Collaboration
	• Senior Firmware Design Engineer	**Specific Skills** • Firmware Design and Development • Firmware Testing and Validation • Digital Operating Hardware and Software System • Root Cause Corrective Action (RCCA) • Advanced Programming Language **Basic Skills** • Learning Agility • Digital and AI Fluency • Planning and Organising • Teamwork and Collaboration • Coaching and Mentoring

Job Clusters	Medium Impacted Roles	Skills
Design & Development	• Firmware Design Engineer	**Specific Skills** • Firmware Design and Development • Firmware Testing and Validation • Digital Operating Hardware and Software System • Root Cause Corrective Action (RCCA) • Advanced Programming Language **Basic Skills** • Learning Agility • Digital and AI Fluency • Critical Thinking • Innovative Thinking • Adaptability and Resiliency
	• Senior Package Design Engineer	**Specific Skills** • Packaging Design and Development • Computer-Aided Design • Packaging Process • Design Optimisation • Failure Analysis **Basic Skills** • Critical Thinking • Innovative Thinking • Sustainability Awareness • Teamwork and Collaboration • Coaching and Mentoring
	• Package Design Engineer	**Specific Skills** • Packaging Design and Development • Computer-Aided Design • Packaging Process • Design Optimisation • Failure Analysis **Basic Skills** • Critical Thinking • Innovative Thinking • Sustainability Awareness • Teamwork and Collaboration
	• Senior Design Automation Engineer	**Specific Skills** • Electronic Design Automation • Programming, Coding and Scripting • Design Flow and Methodology • Design Optimisation • Computer-Aided Design **Basic Skills** • Learning Agility • Digital and AI Fluency • Planning and Organising • Teamwork and Collaboration • Coaching and Mentoring

Job Clusters	Medium Impacted Roles	Skills
Design & Development	• Design Automation Engineer	**Specific Skills** • Electronic Design Automation • Programming, Coding and Scripting • Design Flow and Methodology • Design Optimisation • Computer-Aided Design **Basic Skills** • Learning Agility • Digital and AI Fluency • Critical Thinking • Innovative Thinking • Adaptability and Resiliency
	• Senior Reliability Engineer	**Specific Skills** • Audit Management • Automated Operation Monitoring • Preventive Maintenance • Test Methodologies • Product Risk Assessment **Basic Skills** • Critical Thinking • Innovative Thinking • Sustainability Awareness • Teamwork and Collaboration • Coaching and Mentoring
	• Reliability Engineer	**Specific Skills** • Audit Management • Automated Operation Monitoring • Preventive Maintenance • Test Methodologies • Product Risk Assessment **Basic Skills** • Critical Thinking • Innovative Thinking • Sustainability Awareness • Teamwork and Collaboration • Communication
	• Senior Failure Analysis Engineer	**Specific Skills** • Automated Operation Monitoring • Failure Analysis • Yield Analysis • Programming, Coding and Scripting **Basic Skills** • Learning Agility • Digital and AI Fluency • Planning and Organising • Teamwork and Collaboration • Coaching and Mentoring

Job Clusters	Medium Impacted Roles	Skills
Design & Development	• Failure Analysis Engineer	**Specific Skills** • Automated Operation Monitoring • Failure Analysis • Yield Analysis • Programming, Coding and Scripting **Basic Skills** • Learning Agility • Digital and AI Fluency • Critical Thinking • Innovative Thinking • Adaptability and Resiliency
	• Technology Project / Programme Manager	**Specific Skills** • Engineering Project Management • Project Risk Assessment • Financial Planning and Budget Management • Project Portfolio Management • New Product Introduction **Basic Skills** • Change Management • Influencing and Negotiation • Stakeholder Management • Conflict Management • Business Acumen
Health, Safety, and Environmental (HSE)	• Senior Health, Safety, and Environmental (HSE) Engineer	**Specific Skills** • Audit Management • Enterprise Risk Management • Hazards and Risk Identification and Management • Regulatory Compliance **Basic Skills** • Critical Thinking • Sustainability Awareness • Conflict Management • Teamwork and Collaboration • Coaching and Mentoring
	• Health, Safety, and Environmental (HSE) Engineer	**Specific Skills** • Audit Management • Enterprise Risk Management • Hazards and Risk Identification and Management • Workplace Safety and Health Practices Implementation • Regulatory Compliance **Basic Skills** • Critical Thinking • Sustainability Awareness • Teamwork and Collaboration • Coaching and Mentoring • Communication

Job Clusters	Medium Impacted Roles	Skills
Equipment	• Senior Equipment Engineer	**Specific Skills** • Big Data Analytics • Good Manufacturing Practices Implementation • Equipment Maintenance **Basic Skills** • Digital and AI Fluency • Critical Thinking • Teamwork and Collaboration • Coaching and Mentoring • Planning and Organising
	• Equipment Engineer	**Specific Skills** • Automation System Maintenance • Equipment Maintenance • Workplace Safety and Health Practices Implementation **Basic Skills** • Digital and AI Fluency • Critical Thinking • Adaptability & Resiliency • Teamwork and Collaboration • Innovative Thinking
	• Equipment Technician	**Specific Skills** • Automation System Maintenance • Equipment and Systems Repair • Good Manufacturing Practices Implementation • Hazards and Risk Identification and Management **Basic Skills** • Learning Agility • Digital and AI Fluency • Communication
Facilities	• Senior Facilities Engineer	**Specific Skills** • Facility Maintenance • Waste Water and Gas Emission System • Systems-Based Solutions for Facilities **Basic Skills** • Adaptability and Resiliency • Planning and Organising • Coaching and Mentoring • Learning Agility

Job Clusters	Medium Impacted Roles	Skills
Facilities	• Facilities Engineer	**Specific Skills** • Facility Maintenance • Workplace Safety and Health Practices Implementation • Hazards and Risk Identification and Management **Basic Skills** • Critical Thinking • Teamwork and Collaboration • Communication • Digital and AI Fluency
	• Facilities Technician	**Specific Skills** • Automation System Maintenance • Continuous Improvement • Facilities Management • Good Manufacturing Practices Implementation **Basic Skills** • Critical Thinking • Teamwork and Collaboration • Communication • Digital and AI Fluency
Industrial	• Senior Industrial Engineer	**Specific Skills** • Operations Performance • Factory System Management • Good Manufacturing Practices Implementation • Production Simulation **Basic Skills** • Learning Agility • Critical Thinking • Planning and Organising • Teamwork and Collaboration • Coaching and Mentoring
	• Industrial Engineer	**Specific Skills** • Automated Process Control • Production Simulation • Operations Performance • Good Manufacturing Practices Implementation **Basic Skills** • Learning Agility • Critical Thinking • Innovative Thinking • Teamwork and Collaboration

Job Clusters	Medium Impacted Roles	Skills
Integration	• Senior Integration Engineer	**Specific Skills** • Continuous Improvement • New Product Introduction • Manufacturing Process Management • Hazards and Risk Identification and Management **Basic Skills** • Learning Agility • Digital and AI Fluency • Conflict Management • Innovative Thinking • Coaching and Mentoring
	• Integration Engineer	**Specific Skills** • Continuous Improvement • Hazards and Risk Identification and Management • Workplace Safety and Health Practices Implementation **Basic Skills** • Learning Agility • Innovative Thinking • Teamwork and Collaboration • Communication
	• Integration Technician	**Specific Skills** • Quality Control and Assurance • Data Collection • Product Testing **Basic Skills** • Learning Agility • Critical Thinking • Communication • Teamwork and Collaboration
Process	• Senior Process Engineer	**Specific Skills** • Manufacturing Process Management • Design of Experiment (DOE) • Production Simulation **Basic Skills** • Learning Agility • Critical Thinking • Conflict Management • Communication • Coaching and Mentoring

Job Clusters	Medium Impacted Roles	Skills
Process	• Process Engineer	**Specific Skills** • Crisis Situations Management • Manufacturing Process Management • Production Simulation • Workplace Safety and Health System Management **Basic Skills** • Learning Agility • Critical Thinking • Coaching and Mentoring
	• Process Technician	**Specific Skills** • Continuous Improvement • Quality Systems Management • Operation and Control **Basic Skills** • Critical Thinking • Learning Agility • Communication • Teamwork and Collaboration
Product	• Senior Product Engineer	**Specific Skills** • New Product Introduction • Manufacturing Process Management • Material Qualification • Continuous Improvement **Basic Skills** • Critical Thinking • Innovative Thinking • Communication • Teamwork and Collaboration • Cognitive skills
	• Product Engineer	**Specific Skills** • New Product Introduction • Manufacturing Process Management • Continuous Improvement • Technical Presentations **Basic Skills** • Learning Agility • Critical Thinking • Adaptability and Resiliency • Communication • Teamwork and Collaboration

Job Clusters	Medium Impacted Roles	Skills
Product	• Product Technician	**Specific Skills** • Continuous Improvement • Factory System Management • Operation and Control • Data Collection • Product Testing **Basic Skills** • Learning Agility • Critical Thinking • Adaptability and Resiliency • Communication • Cognitive skills
Production	• Manufacturing Senior Manager	**Specific Skills** • Crisis Situations Management • Production Performance Management • Resource Management **Basic Skills** • Critical Thinking • Innovative Thinking • Sustainability Awareness • Adaptability and Resiliency
	• Manufacturing Manager	**Specific Skills** • Factory System Management • Good Manufacturing Practices Implementation • Production Planning and Scheduling **Basic Skills** • Critical Thinking • Adaptability and Resiliency • Communication • Empathy
	• Production Manager	**Specific Skills** • Hazards and Risk Identification Management • Process Quality Management • Good Manufacturing Practices Implementation **Basic Skills** • Critical Thinking • Adaptability and Resiliency • Communication • Empathy

Job Clusters	Medium Impacted Roles	Skills
Production	• Production Executive	**Specific Skills** • Production Planning and Scheduling • Production Performance Management • Good Manufacturing Practices Implementation **Basic Skills** • Critical Thinking • Adaptability and Resiliency • Communication • Empathy • Teamwork and Collaboration
	• Assembly, Test and Packaging Operator	**Specific Skills** • Operation and Control • Assembly, Testing, and Packaging Process • Assembly, Testing, and Packaging Practices Implementation **Basic Skills** • Learning Agility • Adaptability and Resiliency • Communication • Teamwork and Collaboration
Quality	• Senior Quality Engineer	**Specific Skills** • Good Manufacturing Practices Implementation • Quality Control and Assurance • Quality Process Control • Quality Systems Management **Basic Skills** • Critical Thinking • Innovative Thinking • Communication • Conflict Management • Coaching and Mentoring
	• Quality Engineer	**Specific Skills** • Quality Control and Assurance • Product Testing • Quality Process Control • Quality Systems Management **Basic Skills** • Learning Agility • Critical Thinking • Adaptability and Resiliency • Communication • Teamwork and Collaboration

Job Clusters	Medium Impacted Roles	Skills
Quality	• Quality Assurance Technician	**Specific Skills** • Automated Operation Monitoring • Automation System Maintenance • Good Manufacturing Practices Implementation **Basic Skills** • Learning Agility • Adaptability and Resiliency • Communication • Teamwork and Collaboration
Test	• Senior Test Development Engineer	**Specific Skills** • Automated Process Control • Root Cause Corrective Action (RCCA) • Test Development • Measurement System Analysis **Basic Skills** • Critical Thinking • Innovative Thinking • Communication • Planning and Organising
	• Test Development Engineer	**Specific Skills** • Automated Process Control • Programming, Coding and Scripting • Test Development • Measurement System Analysis **Basic Skills** • Learning Agility • Critical Thinking • Communication • Teamwork and Collaboration

A Brief Illustration of Medium Impacted Roles

Design Automation Engineer:
This role creates scripts to streamline the design process using industry-standard tools. The engineer also troubleshoots issues that arise during the design process and find creative solutions. It is also responsible for analysing current methods to identify areas of improvement in automating the design process of these components. These processes require critical thinking and technical leadership, while leveraging on digital tools to simulate and optimise design and data sets.

Senior HSE Engineer
HSE engineers play an important part to ensure regulatory compliance with the Occupational Safety and Health Act 1994 (OSHA 1994). They develop and improve environmental programmes and procedures to support sustainability goals of the company. HSE engineers also provide environmental training, conduct audits, inspections, and incident investigations on HSE matters as well as implement corrective actions. While digital tools can automate routine tasks, human intervention is still required to interpret data and make strategic decisions and implement EHS policies.

Industrial Engineer
These engineers design distribution networks, financial and quality control systems, select plant locations, drive LEAN, Automation and Six Sigma projects. They are also responsible for estimating manufacturing times for quotes, coordinating New Product Introduction (NPI) plannings, and reviewing prototype results and sales approaches using simulation tools. Technological advances have complemented rather than replaced their job functions as their input still plays an important role to enhance operational efficiencies and minimise consumption and waste through analysing and interpreting production data.

Low Impacted Roles

Roles with low impact are the least affected by technological shifts. These roles are highly strategic and creative in nature, requiring significant human intervention.

AI-powered tools assist in automating certain tasks such as design, testing, data analysis and providing insights through machine learning and statistical analysis, with applications in the E&E sector such as predictive-based safety, computer vision for collision, arranging components on the chip, performance assessment and reliability of ICs. However, its impact is constrained in areas that demand complex decision-making, creativity, strategic planning, and safety evaluations. Ultimately, human leadership is still essential for interpreting and verifying AI insights, making nuanced decisions, setting strategic directions, and ensuring effective integration of AI into organisational objectives.

Digital tools have revolutionised operations in the E&E sector by improving productivity and accuracy while streamlining processes through real-time data collection, cloud databases, and project management software. Despite these advancements, its effectiveness is limited in areas that necessitate creative architectural design and complex strategic planning where human intervention remains vital.

In the Green Economy context, low impacted roles have indirect and limited contribution to supporting the Green Economy as their primary focus remains on core functions such as IC design. They contribute to the Green Economy through practices and initiatives of reducing water consumption and pollution, building energy-efficient circuits and sustainable IC designs.

Job Clusters	Low Impacted Roles	Skills
Design & Development	• Senior IC Design Engineer	**Specific Skills** • Research and Information Synthesis • System On Chip Support • Computer Engineering • Logic / RTL Analysis and Verification **Basic Skills** • Critical Thinking • Innovative Thinking • Communication • Planning and Organising
	• IC Design Engineer	**Specific Skills** • Big Data Analytics • Embedded System Integration • System On Chip Support • Logic / RTL Design **Basic Skills** • Learning Agility • Critical Thinking • Adaptability and Resiliency • Teamwork and Collaboration
	• Senior Physical Design Engineer	**Specific Skills** • Physical Design Engineering • Embedded Systems Integration • Root Cause Corrective Action (RCCA) **Basic Skills** • Critical Thinking • Innovative Thinking • Sustainable Awareness • Communication
	• Physical Design Engineer	**Specific Skills** • Big Data Analytics • Physical Design Engineering • System On Chip Support **Basic Skills** • Learning Agility • Critical Thinking • Communication • Teamwork and Collaboration

Projected Number of Medium and Low Impacted Employees

Based on assessment and industry feedback, a total of 121 basic and specific skills have been identified for the E&E manufacturing sector. Upskilling is essential for 88% of medium impacted roles to progress and perform beyond traditional expectations of their roles. Although upskilling is not mandatory for the 8% of roles identified as low impacted roles, continuous self-improvement remains essential if employees wish to maintain relevance, adapt to emerging trends, and make informed decisions in a rapidly evolving industry.

In-Demand Skills for AI, Digital, and Green Economy

Training Programmes Available

AI/ Digital Skills

AI/ Digital skills that are essential for roles to adopt for business operations enhancements and overall workforce productivity improvements

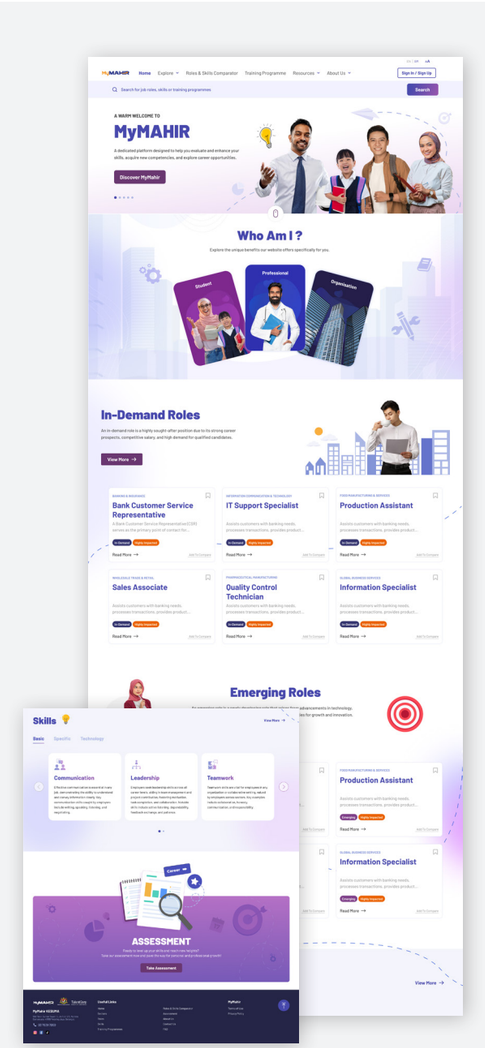
- Data Engineering
- Factory System Management
- Big Data Analytics
- Programming, Coding, and Scripting
- Automated Process Control

Green Skills

Green skills that are needed for roles to integrate sustainability efforts and initiatives into business operations

- Good Manufacturing Practices Implementation
- Sustainable Business Practices
- Waste Water and Gas Emission System

List of proposed training programmes are accessible on the MyMAHIR platform.



Demand Projection for Emerging Roles

Based on the input collected from the industry players during the impact assessment workshop and engagements, nine (9) emerging roles have been identified across AI, Digital, and Green Economy to meet their future needs.

Projected Demand for Emerging Roles for each organisation in the next three (3) to five (5) years

	Multinational Corporations (MNCs) / Local Large Companies (LLCs)	Small and Medium-sized Enterprise (SMEs)
AI / Machine Learning Application Engineer	2 – 30	2
AI Integration Engineer	2 – 30	Insufficient data
Smart Manufacturing and Industrial 4.0 Analyst	1 – 15	Insufficient data
Data Scientist	1 – 15	1
Data Engineer	2 – 15	2
Sustainability Engineer	1 – 3	Insufficient data
Data Steward	1 – 10	Insufficient data
Analog Mixed Signal/ Analog Circuit Design Engineer	25 – 65	30 – 50
IoT Specialist	3 - 5	Insufficient data

The study revealed MNCs / LLCs and SMEs share a common demand for Data Engineers, Data Scientists, AI/ML Application Engineers, and Analog Mixed Signal / Analog Circuit Design Engineers. It also reported that MNCs / LLCs have demand for Sustainability Engineers, Data Stewards, Smart Manufacturing and Industrial 4.0 AI Analysts, and AI Integration Engineers due to their need to meet sustainability goals and manage intricate manufacturing processes.

Despite having extensive operations in Malaysia and a large workforce, MNCs / LLCs may only require a modest number of employees for emerging roles over the next three (3) to five (5) years, with each organisation likely hiring no more than 30 to 65 individuals for these positions.

Case Studies

Emerging roles such as AI/ML Engineer, Data Scientist, Sustainability Engineer, Data Steward, and IoT Specialists have been gaining prominence in the E&E sector globally, including countries like **the US, the UK, Germany, China, India, and Japan**.

AI / ML Application Engineer

These engineers develop deep learning or machine learning algorithms to optimise manufacturing processes, efficiency, quality, and productivity of workers. The role has become crucial as the sector strives to innovate and maintain competitiveness in a rapidly evolving technological landscape. They typically adopt AI through these processes: optimisation algorithms, and statistical process control, optimising production parameters to enhance efficiency, reduce waste, and improve product quality by continuously learning from the process data. Others include adjusting parameters to maximise yield, minimise defects, and enhance overall process efficiency. They work on applications (e.g., automated inspection systems), leveraging on big data and IoT technologies as data collection. This role is thriving in **China**, a global hub for electronics manufacturing, driven by companies such as Huawei, Xiaomi, and Lenovo who are integrating IoT and AI for real-time monitoring and automation of production lines, optimising resource usage and increasing efficiency; as well as in **Germany**, where the pioneer of Industrial 4.0 initiative is placing great emphasis on AI integration in manufacturing and industrial automation.

AI Integration Engineer

These engineers are responsible for developing solutions to incorporate AI models and algorithms into systems to enhance automation, efficiency, and predictive maintenance. **South Korea**, an electronics sector leader and home to major electronics giants such as Samsung and LG, is heavily investing in AI and technologies for consumer electronics such as Smart Manufacturing, Automated Inspection, and Digital Twins. In **Japan**, prominent household names such as Sony, Panasonic, and Hitachi have significantly increased their investment in AI applications within the sector to enhance productivity and efficiency in electronics manufacturing through robotic automation, predictive analytics, and human-robot collaboration.

- **Automated Inspection:**
  Computer vision and machine learning for real-time product quality, monitoring and defect detection in electronics manufacturing
- **Digital Twin:**
  Virtual simulation of the manufacturing visualisation and processes

Smart Manufacturing & AI Industrial 4.0 Analyst

The increasing adoption of Industry 4.0 technologies has given prominence to this role. **Germany's** strong engineering and manufacturing base, coupled with their commitment to innovation, make it a hub for this role. **Japan** and the **US** are actively incorporating AI into their industrial process, driving the demand for this role in their countries.

Data Scientist

There is an increasing demand for this emerging role, especially in countries that have recognised the crucial role of data science in driving efficiency, innovation, and competitiveness in the E&E sector such as the **US** and **Singapore** who are fostering data science roles to support its E&E sector. **India's** booming tech sector and increasing focus on manufacturing is also boosting the demand for this role in their country.

Data Engineer

This engineering role is to support the development of AI. It is gaining increasing importance in the E&E sector globally due to the high rate of manufacturing digitalisation. In the **United Kingdom (UK)**, the data engineering role is emerging; **Canada**, with a growing tech sector centring on innovation, has increasing demands for data engineering roles. Meanwhile **China** has launched the 'Made in China 2025' policy with the aim to be a leader in manufacturing and technology. China has made substantial investments in AI, semiconductors, and other emerging technologies to bolster data engineering in its E&E sector, including USD2.9 billion for the Advanced Manufacturing Fund and USD20.2 billion for the National Integrated Circuit Industry Investment Fund, showcasing China's rapid strides in AI development. [56]

Sustainability Engineer

In **EU countries** like Germany, France, the Netherlands, and Sweden—nations at the forefront of environmental regulations and sustainability practices—there is a significant demand for sustainability engineers within the E&E sector. **Brazil's** focus on sustainable development and green technology in its E&E sector is also creating increased opportunities for sustainability engineers. In addition, growing awareness of environmental sustainability is driving **Australia's** integration of sustainability into its E&E operations as companies strive to minimise their environmental impact and adopt sustainable practices.

Data Steward

This role is responsible for managing data quality, metadata, and governance within organisations. The role is becoming increasingly relevant across various industries including E&E, especially in countries that prioritise data governance and management practices to optimise operations, ensure regulatory compliance, and drive innovation such as **Singapore** and **EU** countries such as Germany, France, the Netherlands, and Sweden. While in **China**, the E&E sector's rapid growth has increased the demand for data stewardship in the sector to manage and ensure data quality, security, and compliance with regulatory standards.[57]

56. Center for Strategic & International Studies (CSIS), Made in China 2025, 1 June 2015, <https://www.csis.org/analysis/made-china-2025>
57. World Economic Forum, The Future of Jobs Report 2023, 30 April 2023

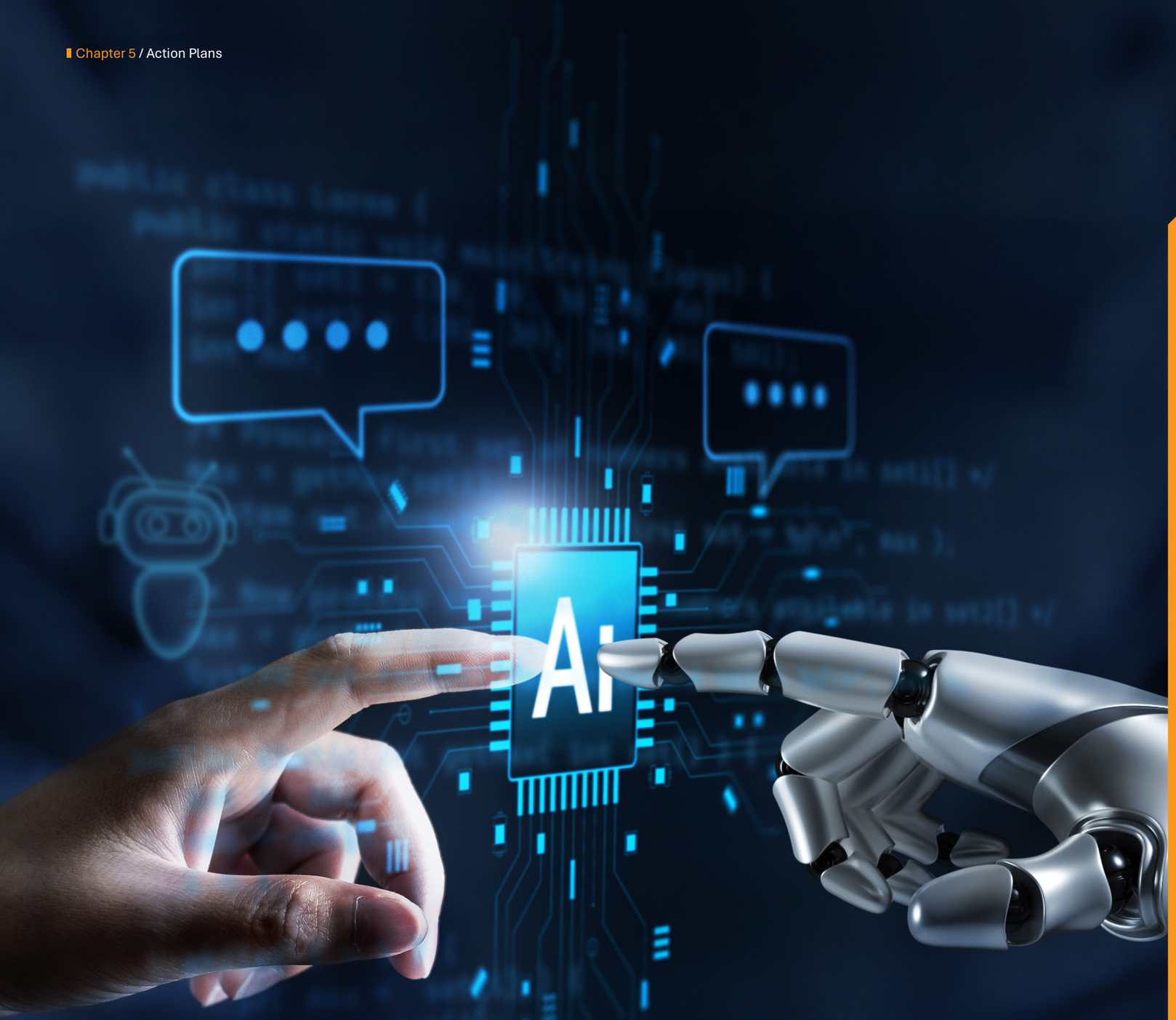
Analog Mixed Signal / Analog Circuit Design Engineer

These engineers play a crucial role in sectors such as semiconductor manufacturing, telecommunications, and consumer electronics. The **UK** specialises in advanced manufacturing and electronics, the UK has opportunities for analog and mixed signals engineers in the E&E sector. **South Korea's** E&E sector, known for its consumer electronics and semiconductor manufacturing, demands Analog Mixed Signal and Analog Circuit Design expertise. **India's** flourishing semiconductor and electronics capabilities is driving the increased investment in Analog Mixed Signal and Analog Circuit Design roles. Meanwhile **Taiwan** is a hub for Analog Mixed Signal and Analog Circuit Design Engineers as it is a home to major semiconductor companies that support this thriving sector in the country.[58]

IoT Specialists

These specialists in the E&E manufacturing sector are at the heart of digital transformation, leveraging the power of connected devices and AI to revolutionise manufacturing processes by collecting and analysing real-time data from sensors and devices. Thus, enabling predictive maintenance, process optimisation, and enhanced decision-making, resulting in increased efficiency and reduced downtime. In developed countries like **Australia**, **Germany**, and the **UK**, the role of IoT specialists is recognised as crucial for the development of Smart Factories by integrating IoT devices with manufacturing systems.[59]

58. World Economic Forum, *The Future of Jobs Report 2023*, 30 April 2023
59. World Economic Forum, *The Future of Jobs Report 2023*, 30 April 2023



Chapter 5:
Recommended Initiatives

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Through the impact study assessment, **11 initiatives** have been identified within the E&E sector's talent ecosystem in Malaysia to adapt to trends in AI, Digital, and Green Economy. These plans are designed to leverage on opportunities and tackle challenges posed by these transformative trends. By aligning the needs and aspirations of various stakeholder groups, the initiatives aim to foster innovation, promote skills development, and ensure sustainable growth of the E&E sector. The initiatives are grouped into four (4) categories based on the leading and the enabling entities – government, industry, academia, and training providers.

Summary of 11 Recommended Initiatives

Government

IN1
Provide Funding and Incentives

IN2
Develop Supportive Regulations and Policies

IN3
Cultivate Talent to Bridge the Gap

Industry Players

IN4
Collaborate with Government

IN5
Sponsor Industrial Projects by Higher Learning Institutions

IN6
Upskill and Reskill Employees

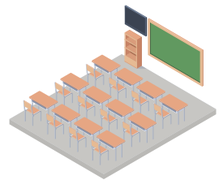
IN7
Develop Competency Framework

Academia

IN8
Promote Micro-credential Courses

IN9
Develop Sector-Relevant Curriculum

IN10
Increase Internship Programme and Work Readiness



Training Providers

IN11
Tap on sector Experts for Specialised Training

> **"The adoption of AI by some industry players is fast, while others are more cautious. To ensure faster adoption across the industry, the entire ecosystem —including the government, businesses, and schools —needs to work together to build a knowledge base and launch adoption initiatives to fully realise the potential of the technology."**
>
> ***Datin Anna Baweh, Director of Government Affairs, Malaysia, Intel Corporation***

Government

IN1 Provide Funding and Incentives

These initiatives are designed to promote funding and support for innovation and growth in the E&E sector, encouraging investments in research, development, and commercialisation of the sector. These incentives are vital for bridging the talent gap and attracting higher-value investments essential for a robust E&E sector.

Initiatives	Case Studies
IN1.1 **Create R&D Grants and secure IP Ownerships:** • Government to offer financial support for companies investing in R&D in new technologies such as AI, IoT, and Robotics. • Government to help secure IP ownership for rights to protect the design, commercialise the technology or product, and prohibit others from making financial benefits without consent.	**Singapore's AI Talent Development Initiatives**[60] foster a collaborative environment for research institutions, start-ups and businesses to work together on use-inspired research, knowledge growth, and development of talents for Singapore's future through the allocation of grants for selected AI research. In Germany, the government is fostering innovation in digital transformation through their '**The German High-Tech Strategy (HTS) 2025**,[61] increasing R&D investments and support for digital transformation. The Strategy offers grants for collaborative projects between sector players and academia, focusing on key technologies such as AI, sustainability, and Industry 4.0.
IN1.2 **Allocate funding and scholarships to incentivise AI and Digital related education and promote sector-academia collaboration:** • Prioritise funding for programmes that integrate AI and digital skills with E&E engineering and scholarships to boost enrolment in these courses. Government grants can act as a catalyst to foster collaboration on impactful research projects between the industry and academia to drive innovation in the E&E sector.	In the US, the **National Science Foundation (NSF)**[62] allocates substantial funding to universities and colleges for AI and digital-related tertiary education programmes. It aims to advance R&D in AI, enhance educational curricula, and support the training of future AI professionals.

Benefits

Accelerating Innovation:
Fundings and incentives by the government would encourage investments in new technologies and processes and consequently accelerate innovation in Malaysia's E&E sector.

Enhanced Access and Affordability to Education:
Fundings and scholarships from the government would improve accessibility and affordability of tertiary education. Increased access to education would consequently address the talent shortage in AI and Digital sectors, thus enabling Malaysia to remain competitive in the global market.

60. AI Singapore, *AI Singapore*, <https://aisingapore.org/>
61. OECD StipCompass, *The German High-Tech Strategy 2025*, <https://stip.oecd.org/moip/case-studies/1?answerId=A1-1>
62. US National Science Foundation, *Funding at NSF*, <https://new.nsf.gov/funding/getting-started>

IN2 Develop Supportive Regulations and Policies

Strategic initiatives aimed at promoting innovation and growth are essential to stimulate investment in R&D and catalyse commercialisation activities to drive technological advancement in the E&E sector.

Initiatives	Case Studies
IN2.1 **Develop AI governance, code of ethics and strategy:** • Government to introduce regulations and clear policies on using the AI technology responsibly and ethically, serving as an essential guideline for the sector's adoption and investment in AI. These measures will also guide the review of the Artificial Intelligence Roadmap 2021-2025 when the strategy document is due for the next update.	**The UK's Government Digital Service (GDS) and the Office for Artificial Intelligence (OAI)** created a guide on using AI for the public sector. This guide is designed to help them to maximise the application of AI for their needs and how to implement it ethically, fairly, and safely.[63] In **Finland, the National AI Strategy** focuses on building an AI ecosystem, promoting research and education, and ensuring ethical AI use. Key initiatives include establishing an AI accelerator and promoting AI education across all levels.[64]

Benefits

Continued relevance and competitiveness:
Aligning Malaysia's AI initiatives with global advancements will ensure the country's E&E sector remains relevant and competitive globally, while also encouraging innovation in the sector and the growth of the sector.

Good AI governance and code of ethics:
Regulations and policies in place will help to ensure AI technologies are used ethically and responsibly. This code of ethics would foster public trust and mitigate risks associated with AI deployment.

> **"Collaboration between enterprises, academia, and government is needed to drive development of responsible AI ethics and to ensure that advancements in AI remain accessible, secure, and inclusive."**
>
> ***Datin Anna Baweh, Director of Government Affairs, Malaysia, Intel Corporation***

63. UK Government, *A Guide To Using AI In the Public Sector*, <https://www.gov.uk/government/collections/a-guide-to-using-artificial-intelligence-in-the-public-sector>
64. European Commission, *Finland's National AI Strategy*, <https://ai-watch.ec.europa.eu/countries/finland/finland-ai-strategy-report_en>

IN3 Cultivate Talent to Bridge the Gap

To address and meet the evolving demands of the E&E sector, it is essential to implement targeted educational programmes and hands-on training initiatives that align with the sector needs.

Initiatives	Case Studies
IN3.1 **Government collaboration with academia and sector players to host awareness programmes:** • Knowledge-sharing sessions on AI, Digital, and Green Economy in school and higher education institutions can spark students' interest in E&E. • Integrate AI and digital skills into existing STEM programmes to equip students with the in-demand skills needed by the E&E sector.	In Germany, the government had launched '**Platform Industry 4.0**' for a strategic collaboration between the government, academia, and sector players with an aim to advance digital transformation of manufacturing in Germany.[65]
IN3.2 **Provide more autonomy to review and revise syllabus of higher learning institutions according to sector demands:** • Government to give higher learning institutions more autonomy and flexibility to revise and adapt its curricula to include TVET, AI, Digital, and Green Economy as core components across all programmes to create a future-ready workforce.	In **Finland**, Aalto University has integrated AI and digitalisation across various disciplines, encouraging interdisciplinary learning and collaboration.[66] **Singapore** has taken similar steps – the National University of Singapore (NUS) has updated its syllabuses to incorporate AI and digitalisation for all students to equip them with the basic understanding of these technologies.[67]

Benefits

Educational Relevance:
The initiative to integrate AI, Digital, and Green Fundamentals into education syllabuses would equip graduates with technical competency, making them more well prepared for practical application of their technical knowledge in the E&E sector.

Workforce Readiness:
The alignment of an up-to-date syllabus will ensure graduates are better prepared for the real world and equipped with skills that are in-demand within the E&E sector.

65. Federal Ministry for Economic Affairs and Climate Action, *Plattform Industrie 4.0*, <https://www.plattform-i40.de/IP/Navigation/EN/ThePlatform/Background/background.html>
66. Aalto University, *Key Research Area: ICT and Digitalisation*, <https://www.aalto.fi/en/research-art/key-research-area-ict-and-digitalisation>
67. National University of Singapore (NUS), *Artificial Intelligence*, <https://www.comp.nus.edu.sg/programmes/ug/focus/ai/>

Industry Players

IN4 Collaborate with Government

The initiatives in this section are designed to promote collaboration and exchange of ideas between sector players, highlighting the importance of these collaborations in order to advance Malaysia's E&E sector.

Initiatives	Case Studies
IN4.1 **Association and key industry players collaborations:** • A proactive initiative to facilitate the exchange of ideas, solutions, and insights among stakeholders in the E&E sector can significantly bolster collective progress and innovation. By cultivating a collaborative environment, industry associations such as 'The Electrical and Electronics Association of Malaysia' (TEEAM) and 'Collaborative Research in Engineering, Science, and Technology' (CREST) can establish a formal platform for knowledge sharing. This platform would facilitate the dissemination of best practices, emerging trends, and technological advancements, empowering stakeholders to tackle challenges more effectively and leverage collective expertise to drive growth and enhance competitiveness within the sector.	**SEMICON Taiwan** is an annual event organised by the 'SEMI International Semiconductor Industry Association' and it gathers sector players, government, academia, and research institutions that acts as a platform to share leading trends in technology and facilitate collaborations between industry players.[68]
IN4.2 **Government to facilitate and encourage open dialogues between the government and sector players:** • Active engagement through open dialogues offers benefits for all stakeholders. The government would provide a platform for sector players to provide valuable feedback to the government on challenges, needs, and suggestions on the E&E sector, enabling the creation of informed actions and supportive policies. • Utilise the existing MyMAHIR Future Skills Talent Council (FSTC) platform will expedite the collaborative exchange.	The Singapore government created the **'Industry Transformation Maps' (ITMs)** as a collaborative framework, co-developed through open dialogues with industry stakeholders, unions, and trade associations, to drive economic growth and enhance sector capabilities.[69] **MyMAHIR Future Skills Talent Council (FSTC)** brings together employers, educations, and policymakers to reimagine the future of work, policy, and education through a global collaboration on sector trends and future needs.[70]

Benefits

Ideate innovation ideas:
Frequent sharing of ideas and solutions between industry players in the E&E sector will maintain Malaysia's competitive edge in the global E&E market.

Reduced time-to-market:
Cross-sharing of knowledge in the sector would reduce the time-to-market for new E&E products.

Industry-driven policies:
Increased open dialogues between industry players and the government would help the government to formulate better policies based on the needs of the sector, thus improving sector conditions, and creating more effective and competitive strategies for the sector.

IN5 Sponsor Industrial Projects by Higher Learning Institutions

Encouraging and supporting a greater number of projects that are closely aligned with evolving market needs and sector demands to ensure E&E efforts yield tangible benefits and remain competitive globally.

Initiatives	Case Studies
IN5.1 **Collaboration between major sector players and associations such as CREST with higher learning institutions in R&D:** • Identifying and sponsoring R&R projects specifically tailored for industrial applications can yield significant benefits. sector players can further enhance this collaborative approach by proposing specific problem statements and case studies for PhD candidates, thereby aligning academic research efforts with challenges faced in the E&E sector. This synergistic partnership not only advances cutting-edge academic research but also ensures that the outcomes are directly relevant, valuable, and impactful for sector sponsors.	**Stanford University's School of Engineering** has a close **partnership with Silicon Valley companies** for mentorship programmes.[71] Through this collaboration, sector experts mentor students on cutting-edge technologies.

Benefits

Improve research dynamics:
Encouraging stronger partnerships between universities and industry players is essential for ensuring that R&D projects are informed by real-world industrial perspectives. By fostering collaboration, these partnerships can provide valuable insights that align research initiatives with the practical needs of the E&E sector. This approach not only enhances the relevance of academic research but also promotes innovation that directly addresses sector challenges.

68. SEMICON Taiwan, <https://semicontaiwan.org/en/about>
69. Ministry of Trade and Industry Singapore, *Overview*, <https://www.mti.gov.sg/ITMs/Overview>
70. Future Talent Council, <https://futuretalentcouncil.org/>
71. Stanford University, *Industry Collaborations*, <https://engineering.stanford.edu/get-involved/industry-collaborations>

IN6 Upskill and Reskill Employees

Core programmes and approaches geared towards enhancing training and upskilling to address the E&E sector needs while providing employees with opportunities for continuous learning and skills development to adapt to the integration of AI, Digital, and Green Economy in the sector.

Initiatives	Case Studies
IN6.1 **Sector players to ensure upskilling and reskilling of employees:** • Providing continuous upskilling and reskilling opportunities for the current workforce is vital to keep pace with emerging technologies and evolving sector demands. This involves regularly assessing technological trends and needs to identify relevant skills for employees to acquire. • Creating clear career paths will guide employees in their professional development and prepare them for future roles' requirements. • Sector players can reach out to HRDC and Department of Skills Development to explore and identify initiatives to upskill and reskill employees.	**Siemens' Training and Development** believes in the assessment of existing skills, knowledge, and training needs and the company's skills development programme is key in attracting and keeping the best people for their company.[72] **Schneider Electric's Open Talent Market** is a one-stop shop internal talent market for career development that leverages AI to match the supply and demand of talents throughout the company. Employees only need to upload a profile to the Open Talent Market to get AI-suggested career development and opportunities based on their skills, competencies, and future ambitions.[73]
IN6.2 **Partnership to Identify Relevant Upskilling Programmes** • Sector players to partner with regulators and training providers to identify relevant AI upskilling programmes. This can be done by conducting a comprehensive sector needs assessment, setting up a joint working committee, initiating pilot projects, sharing industrial data and case studies and qualifications requirements, to name a few.	In Germany, **Siemens has partnered with Fraunhofer Institute**,[74] the leading national training provider in the country to develop AI-related upskilling programmes specifically designed for the needs of their E&E sector.

Benefits

Upskilling and retaining talent:
Providing upskilling opportunities to the current workforce is crucial for strengthening the talent pipeline and retaining valuable employees within the E&E sector. By investing in the continuous development of existing talents, organisations can ensure their workforce remains agile and equipped to adapt to the emerging skills in demand.

72. Siemens, *Effective Skills Development Program*, <https://assets.new.siemens.com/siemens/assets/api/uuid:bb706b28-5270-4d7f-b0f3-c971b4439a08/us-df-cs-workforce-performance-white-paper-en-lo-res.pdf>
73. Schneider Electric, <https://blog.se.com/tag/open-talent-market/>
74. Fraunhofer Institute Partnership, <https://www.fraunhofer.de/en/about-fraunhofer/profile-structure/cooperation-with-universities.html>

IN7 Develop Competency Framework

A well-defined competency framework can significantly enhance organisational effectiveness by ensuring that personnel possess the requisite expertise. By clearly outlining the critical knowledge, skills, and abilities (KSAs) necessary for success, this framework not only aligns individual performance with organisational objectives but also fosters a culture of continuous improvement and professional development within the E&E sector.

Initiatives	Case Studies
IN7.1 **Industry players to perform self-assessment on AI, digital and green economy readiness:** • The assessment will serve as a benchmark for companies to understand where they stand relative to their peers and evaluate key areas such as technology adoption, workforce skills level, process comprehensiveness, sustainability practices, and organisational infrastructure. The initiative will enable companies to stay informed about emerging trends, evaluate their current adoption levels, and gauge their maturity and preparedness. By identifying gaps and developing targeted strategies, organisations can enhance their readiness and ensure long-term sustainability in the evolving sector.	**Siemens**, a global industrial leader, conducted its **AI and Digital Transformations Self-Assessment** to evaluate its AI and digital readiness, focusing on aligning its transformation strategies with sustainable development and green economy goals in line with the UN SDGs.[75] **Siemens AG** conducted a **Future-Oriented Skills Development self-assessment** to identify workforce competency gaps in digitalisation, automation, and sustainability as part of its strategy to remain competitive and innovative in the industrial sector.[76]
IN7.2 **Industry players to undertake the competency framework on the required future skills based on the outcome of the self-assessment:** • Once a competency benchmark has been established, sector players should review current competency framework (if any) and advise on required future skills based on sector emerging trends and future direction of the business. • Conduct self and departmental skill assessment to recommend competency profile highlighting employees' skills gap and development areas. • Develop capability building programmes that will drive upskilling of employees based on the competency requirements.	**Digital Maturity Models** provides organisations with a comprehensive framework to assess and enhance their digital capabilities, guiding them through every stage of their digital transformation journey.

Benefits

Future-proofing the workforce:
A competency framework ensures that personnel have the necessary expertise to meet organisational goals, boost workforce productivity, and align with national economic objectives. This, in turn, supports the country's competitiveness and innovation in the E&E sector.

75. Siemens, *Digital Transformation*, <https://www.siemens.com/global/en/company/digital-transformation.html>
76. Siemens AG, <https://www.siemens.com/global/en.html>

Academia

IN8 Promote Micro-Credential Courses

Promoting micro-credential courses is essential to equip learners with specialised skills that meet current demands of the E&E sector. These short and specialised courses offer flexibility and enable individuals to upskill or reskill in a short period of time, making them more competitive in their careers. Additionally, micro-credential courses also provide a pathway for continuous learning, allowing professionals to build a comprehensive skill set that aligns with current and future sector demands.

Initiatives	Case Studies
IN8.1 **Higher learning institutions to promote micro-credential courses:** • Active promotion of micro-credential courses can address the growing demand for specialised skills in various fields in E&E. By offering these short, targeted courses, institutions can provide students and professionals with the opportunity to acquire specific competencies quickly and efficiently. • Micro-credentials focus on practical skills and knowledge, and help learners to enhance their qualifications and stay competitive in a rapidly evolving job market. Promoting these courses can also foster lifelong learning and professional development, ensuring that individuals remain adaptable and well-prepared for future career challenges.	The **Massachusetts Institute of Technology (MIT)** has a micro-credential initiative. The university offers a variety of micro-credential courses in AI, cybersecurity, and data science through its online platform, edX. These micro-credential courses are developed in collaboration with the sector needs.[77] **Universiti Malaysia Perlis (UniMAP) also offers several micro credential courses**. Among the courses offered are AI, Cloud Computing, Cybersecurity Essentials, Exploring IoT with Cisco Packet Tracer, and Datacom.[78]

Benefits

Improve work-readiness of graduates:
Relevant and up-to-date education, alignment of curriculum with sector needs and exposure to real-world experience results in better prepared graduates when they enter the E&E workforce.

Flexible learning pathways:
Recognition of micro-credentials encourages continuous professional development, and recognition of specialised skills.

77. Singapore University of Technology and Design, <https://www.sutd.edu.sg/>
78. Universiti Malaysia Perlis, <https://tvetcentre.unimap.edu.my/>

IN9 Develop Sector-Relevant Curriculum

Developing an sector-relevant curriculum is essential to prepare students for the rapidly evolving demands of the workforce. Reforms and adjustments are necessary to ensure that technology-focused courses are given more emphasis, providing students with the practical skills and knowledge needed to address real-world challenges in the STEM fields.

Initiatives	Case Studies
IN9.1 **Higher learning institutions to ensure that tertiary education syllabi are aligned with sector needs and emerging roles.** • These institutions should work closely with sector stakeholders to include relevant modules, such as those on Modified Assembly, Testing, Marking, and Packaging (ATMP), to reflect current and future sector needs. This will better prepare students with the expertise required for advanced manufacturing processes. Regular updates and sector feedback mechanisms are essential to maintaining curriculum relevance and preparing students for the evolving workforce.	In Germany, **Dual Study Programmes** are designed to align tertiary education with sector needs by combining academic studies with practical work experience. These programmes are developed in collaboration between universities and sector partners, ensuring the curriculum is regularly updated to reflect the latest sector trends and demands.[79]
IN9.2 **Schools to promote STEM courses at primary and secondary levels:** • Increasing the promotion of STEM programmes at these education levels will inspire and encourage students to pursue careers in engineering. This can be achieved through a multifaceted approach, namely incorporating STEM content and activities into the curriculum, organising awareness and exploration programmes, providing teachers with training and resources to teach STEM, and introducing role models from the sector.	**The Fuji Electric STEM Carnival Kulim Bandar Baharu (KBB) 2024** was designed to instil awareness on the relevance of STEM in relation to SDGs.[80] In another example, the **'Intel® Geek Kids programme'** is a programme by Intel in partnership with the Penang Science Cluster (PSC) to promote STEM education among underserved primary school students in Malaysia.[81]

Benefits

Education syllabus aligned with sector's needs:
Relevant and up-to-date education is essential for producing graduates who are aligned with the needs of the E&E sector. The alignment between academia and sector not only benefits graduates by enhancing their employability, but also contributes to the overall competitiveness and growth of the E&E sector by providing a steady supply of skilled professionals capable of driving innovation in the sector.

79. Germany Academic Exchange Service, *Dual Study Programmes*, <https://www.daad.de/en/studying-in-germany/universities/dual-studies/>
80. Fuji Electric Malaysia, *Fuji Electric Stem Carnival KBB 2024*, <https://www.linkedin.com/posts/fuji-electric-malaysia-sdn-bhd_fem-fujielectric-stemeducation-activity-7154004698990006272-RX6V/>
81. Penang 2030, *Intel Launches Intel® Geek Kids Program in Collaboration With Penang Science Cluster*, 28 June 2023, <https://www.penang2030.com/2023/06/intel-launches-intel-geek-kids-program-in-collaboration-with-penang-science-cluster/#:~:text=Intel%20Malaysia%20has%20launched%20the,primary%20school%20students%20in%20Malaysia.>

Benefits

Instilling ambition in STEM:
Promotion of STEM courses in schools is key for building a steady pipeline of quality STEM talents for Malaysia's E&E sector. By nurturing a passion for science and technology from an early age through engaging educational programmes and exposure to real-world applications, more students will be inspired to pursue STEM-based careers. Thus creating a robust and diverse talent pool that can drive innovation, growth, and technological advancement in Malaysia's E&E sector.

IN10 Increase Internship Programme and Work Readiness

Expanding internship programmes is important for improving students' work readiness by bridging the gap between academic learning and real-world application. By offering more internship opportunities, students gain valuable hands-on experience, develop sector-specific skills, and build professional networks, better preparing them for the workforce upon graduation.

Initiatives	Case Studies
IN10.1 **Universities to increase industrial trainings longer than six (6) months:** • Students require greater exposure to the sector to gain valuable real-world work experience, and this can be achieved through longer internships and sector projects. These opportunities allow students to apply theoretical knowledge in practical settings, develop essential skills, and understand sector dynamics. Internships provide hands-on experience and mentorship, helping students build professional networks and gain insights into career paths.	**Nanyang Technological University (NTU) Industry Research** collaborates with sector leaders to drive cutting-edge research, facilitate technology transfer, align academic programmes with real-world demands, and develop diverse talent pipelines, with partnerships with over 350 companies. Through this collaboration, students are able to upskill and improve their employment readiness by participating in the sector research collaboration.[82] In Singapore, polytechnics and universities offer **Work-Study Programmes (WSPs)** that alternate between school terms and extended partnership, bridging the gap between academic learning and practical application to ensure graduates have relevant sector experience.[83] In another example, in the US, institutions like Northeastern University offer **Cooperative Education (Co-op) Programmes**, where students work full-time in their field of study for six (6) months to a year, gaining substantial work experience and networking professionals. Students often secure job offers before graduation through the help of this programme.[84]

Benefits

Enhanced Employability and Job Readiness:
Enhanced practical skills, improved student engagement, and real-world industry experience can be achieved through carefully designed internship programmes. These programmes provide students with the opportunity to apply theoretical knowledge in a practical setting, bridging the gap between academia and the workforce. Furthermore, these experiences foster greater engagement and motivation among students as they see the direct relevance of their studies to real-world application.

82. Nanyang Technology University, *Industry Research Collaborations*, <https://www.ntu.edu.sg/research/industry-research-collaborations>
83. SkillsFuture, *SkillsFuture Work-Study Programmes*, <https://www.skillsfuture.gov.sg/workstudy>
84. Northeastern University, *Cooperative Education*, <https://careers.northeastern.edu/cooperative-education/>

Training Providers

IN11 Tap on Sector Experts for Specialised Training

Freelance or independent industry experts with specialised knowledge in AI, digital technologies, and the green economy can be appointed by training providers to deliver targeted courses and application skills in the E&E sector. These experts bring practical, cutting-edge insights and real-world experience. By leveraging their expertise, training providers can offer highly specialised content that addresses current industry needs and trends, ensuring that participants acquire the most up-to-date skills and knowledge

Initiatives	Case Studies
IN11.1 **Partnership with sector experts:** • Freelance or independent industry experts with specialised knowledge in AI, Digital, and the Green Economy can be appointed by training providers to deliver targeted courses and application skills in the E&E sector. These experts bring practical, cutting-edge insights and real-world experience. By leveraging their expertise, training providers can offer highly specialised content that addresses current industry needs and trends, ensuring that participants acquire the most up-to-date skills and knowledge.	**Germany's Fraunhofer Institute** provides Industry 4.0 training in smart manufacturing and automation, professional development in AI, robotics, and data science, and collaborates with industry leaders on customised training solutions.[85]

Benefits

Agile and Adept Workforce:
This approach will enable rapid upskilling in critical areas by addressing knowledge gaps through training programmes, allowing workers to quickly adapt to changes in the sector and technological advancements.

Enhanced Employability and Job Readiness:
Training programmes with industrial input are designed to bridge the gap between theory and practice, preparing graduates with the specific skills and experience they need to succeed in the workforce.

> **"The country needs collaboration between government bodies, including the investment committee, and local industry players, to strengthen the foundation and fundamentals, while local talents start to master their own skill sets into IC design, advance process technology design and development know-how."**
>
> ***Cheah Hun Wah, Executive Director and Co-Chief Executive Officer, Oppstar Bhd***

85. Nanyang Technology University, *Industry Research Collaborations*, <https://www.ntu.edu.sg/research/industry-research-collaborations>

Taking into account the Initiatives proposed, moving forward, these are the

Top 5 Initiatives

needed to kickstart the workforce transformation towards AI, Digital, and Green Economy to ensure their successful implementation

1 GOVERNMENT

Provide funding and incentives to encourage investment in research, development, and commercialisation in the E&E sector, which are crucial to bridge the talent gap, and attract higher-value investments for a robust E&E sector.

2 GOVERNMENT

Cultivate talent to bridge the gap to meet the sector's evolving demands through the implementation of targeted educational programmes and practical training that align with sector needs.

3 INDUSTRY PLAYERS

Upskill and reskill employees through enhanced training and upskilling programmes to address sector's needs while providing employees with opportunities for continuous learning and develop skills to adapt.

4 ACADEMIA

Develop a sector-relevant curriculum to place greater emphasis on technology courses, equipping students with the skills needed to tackle real-world challenges in STEM fields.

5 TRAINING PROVIDERS

Engage sector experts with specialised and niche expertise to address specific training needs of the sector.

Conclusion

The **E&E sector stands at a pivotal moment**, characterised by rapid technological advancements driven by AI, Digital, and Green Economy. As the sector evolves, it presents both opportunities and challenges for Malaysian sector players in the E&E sector. The E&E sector recorded the **highest values in exports and imports** for Malaysia in 2023, valuing at **RM575.46 billion** and **RM355.94 billion** respectively.[86] However, it is notable that Malaysia's position as a leading exporter in E&E has dropped amidst the sector's steady growth, indicating increased competition at the global stage for E&E.

This study highlights the importance of adapting to these technological changes through strategic investments in workforce development, skills training, and innovative practices. Professional skills in AI technologies and data analytics will be essential in developing, implementing, and managing AI-driven systems into the operations of E&E, improving product quality and the efficiency of the manufacturing processes. The digitalisation of the E&E sector demands proficiency in computer-based systems and technologies in order to maintain competitiveness. Meanwhile, Green Economy is still driven by compliance to regulations. It mainly has an indirect impact on the E&E sector through the increased efficiency in performance and manufacturing processes. Within the E&E sector, the study projected that **two (2) roles would be highly impacted** from these trends, **44 moderately impacted** and **four (4) roles minimally impacted**. Additionally, **nine (9)emerging roles** and **nine (9) in-demand skills** were identified to drive future advancements and innovations within the E&E sector.

The insights gained from this study underscore the importance of preparing the workforce to adapt to these changes through strategic investments in workforce development, skills training, and innovative practices. As Malaysia seeks to strengthen its position in the global E&E market, it is imperative to align educational programmes and training initiatives with the needs of the sector. This alignment will not only fulfil skill gaps and increase employability of graduates but also ensure that Malaysia's E&E sector remains competitive on the world stage.

Looking ahead, embarking on this journey of continuous adaptation and innovation will be vital in preparing the E&E workforce for ongoing advancements in AI, Digital, and Green Economy. To achieve this, the **MyMAHIR Future Skills Talent Council (FSTC)** will conduct regular needs assessments to identify immediate and future workforce skills gaps, analyse talent demands by sector and educational level, propose strategies, determine essential sector-specific skills, and periodically update these skills in response to technological advancements and evolving operating environments. Additionally, the council will align the educational system with the sector's needs while actively **fostering collaboration among Government, Industry Players, Academia,** and **Training Providers** to enhance Malaysia's competitiveness and promote sustainable growth in the E&E sector.

Import
RM355.94 bil

Export
RM575.46 bil

Key trends impacting existing roles:

- **Artificial Intelligence**
- **Digital**
- **Green Economy**

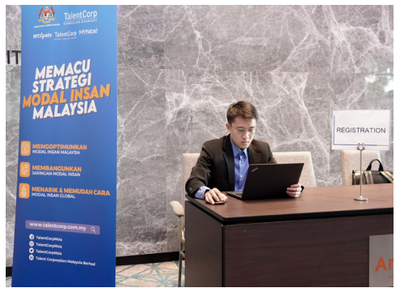
The study identified 2 job roles that will be highly impacted by these trends, along with 9 emerging roles, and 9 in-demand skills essential for future advancements.

MyMAHIR Future Skills Talent Council (FSTC) has been set up to prepare for these changes

86. MATRADE, Top 10 Major Export Products 2023, 2023, <https://www.matrade.gov.my/en/choose-malaysia/industry-capabilities/trade-statistics/28-malaysian-exporters/trade-statistics/5822-top-10-major-export-products-2023>

Validation Workshop

Validation Workshop



Abbreviations

AI	Artificial intelligence
AMHS	Automated Material Handling Systems
ASEAN	Association of Southeast Asian Nations
ATE	Automation and Test Equipment
ATMP	Assembly, Testing, Marking, and Packaging
ATPG	Automatic Test Pattern Generation
BoS	Balance of Systems
CAGR	Compound Annual Growth Rate
CBAM	Carbon Border Adjustment Mechanism
Co-op	Cooperative Education
CPS	Cyber-Physical Systems
CREST	Collaborative Research in Engineering, Science, and Technology
D&D	Designs and Development
DFT	Design For Test
E&E	Electrical and Electronics
e-PM	E-Preventative Maintenance
EHS	Environmental, Health, and Safety
ERP	Enterprise Resource Planning
ESG	Environment, Social, and Governance
EU	European Union
FSTC	Future Skills Talent Council
GaN	Gallium Nitride
GDP	Gross Domestic Product
GDS	Government Digital Services - UK
GPAI	Global Partnership on Artificial Intelligence
HRDC	Human Resource Development Corporation
HTS	German High-Tech Strategy
HVAC	Heating, Ventilation, and Air Conditioning
HVM	High Value Manufacturing
IC	Integrated Circuit
ICT	Information and Communications Technology
IDC	International Data Corporation
IoT	Internet of Things
IP	Intellectual Property
IR4.0	The Fourth Industrial Revolution
ITMs	Industry Transformation Maps
KBB	Kulim Bandar Baru 2024
LIR	Low Impacted Roles
LLC	Local Large Companies
MATRADE	Malaysia External Trade Development Corporation
MDSE	Skill Development and Entrepreneurship (India)
MES	Manufacturing Execution Systems
MIDA	Malaysian Investment Development Authority
MIT	Massachusetts Institute of Technology
MIR	Medium Impacted Roles
MITI	Ministry of Investment, Trade and Industry
ML	Machine Learning
MNC	Multinational Corporations
MOM	Manufacturing Operations Management Systems
MOSTI	Ministry of Science, Technology, and Innovation
MRP	Material Requirements Planning
MSIA	Malaysia Semiconductor Industry Association
MyNSR	Malaysia National Skills Registry
NETR	National Energy Transition Roadmap
NIMP 2030	New Industrial Master Plan 2030
NLP	Natural Language Processing
NSF	The National Science Foundation
NSS	National Semiconductor Strategy
NTU	Nanyang Technological University
NUS	National University of Singapore
OAI	Office for Artificial Intelligence - UK
PCB	Printed Circuit Board
PSC	Penang Science Cluster
PM	Prime Minister
RCCA	Root Cause Corrective Action
R&D	Research and Development
RMKe-12	Twelfth Malaysia Plan
ROI	Return of Investment
SDG	Sustainable Development Goals
SME	Small and Medium-sized Enterprise
STDC	Selangor Technical Skills Development Centre
STEM	Science, Technology, Engineering and Mathematics
SUTD	Singapore University of Technology and Design
TEEAM	The Electrical and Electronics Association of Malaysia
TeSA	TechSkills Accelerator
TPM	Total Productive Maintenance
TSMC	Taiwan Semiconductor Manufacturing Company
TTAS	Tech Talent Attraction Scheme
TV	Television
TVET	Technical and Vocational Education Training
UK	United Kingdom
UN	United Nations
UniMAP	Universiti Malaysia Perlis
UNESCO	United Nations Education, Scientific, and Cultural Organisation
US	United States
WMS	Warehouse Management Systems
WSP	Work-Study Programme
YAB	Yang Amat Berhormat

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Micron Memory

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