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Malaysian Industry-Government Group for High Technology

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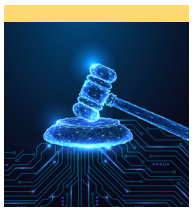

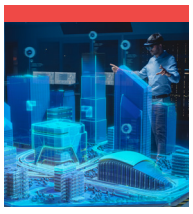

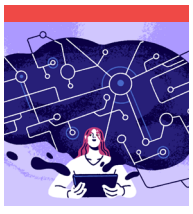

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Key components of myForesight's mission are intelligence, research, competency framework and community engagement. **myForesight®** raison d'etre is set out to accomplish the following:

1. Anticipate Malaysia's future possibilities;
2. Promote foresighting at national, sectoral and corporate levels;
3. Identify key technologies to support sectoral development;
4. Outline key future R&D areas.

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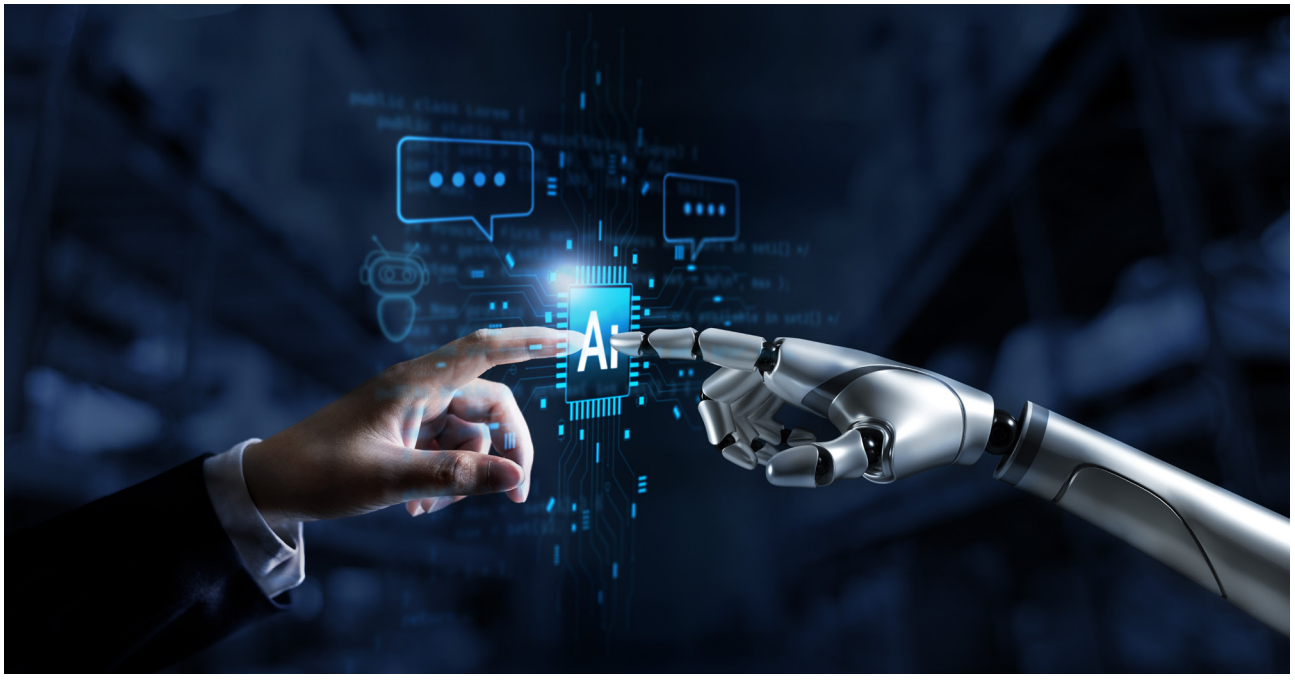
Initial Thoughts



Artificial Intelligence

From Origins to Future Possibilities

Artificial Intelligence (AI) has its roots that go far back in history, well before it emerged as a driving force of modern innovation. The first formal idea was mooted in 1950 by Alan Turing in his groundbreaking paper "Computing Machinery and Intelligence", where he asked the now-famous question: "Can machines think?" This important work laid the foundation for decades of research into machine cognition and intelligence. From symbolic reasoning to deep learning, AI has evolved into a multifaceted discipline that now powers everything from voice assistants to autonomous vehicles.

As these capabilities grow, AI is transforming industries and public services. In construction and manufacturing, computer vision reduces rework costs and improves quality assurance. In environmental management, AI assists in lowering carbon emissions and waste. Safety operations benefit from predictive analytics, while public service organisations are transitioning from reactive to proactive models through generative AI, decision support systems and autonomous process automation. In agriculture, AI optimises crop yields, enhances efficiency and promotes sustainability. In healthcare, it facilitates

“The Singularity refers to a hypothetical point in the future when AI surpasses human intelligence in all aspects — reasoning, creativity, emotional understanding and even self-awareness. At this point, machines would not only perform tasks better than humans but could also improve themselves on their own, leading to an exponential leap in intelligence.”

early diagnostics, streamlines hospital workflows and supports predictive care delivery.

Globally, AI adoption is accelerating, with statistics showing exponential growth across industries. Cities are evolving from being merely "smart" to truly "intelligent," leveraging AI to manage infrastructure, transportaion and citizen services. Even in space, AI plays a critical role — tracking debris, predicting orbital collisions, and supporting autonomous spacecraft operations.

However, this rapid progress does not comes without challenges. Issues such as data security, talent shortages, ecosystem maturity, and technology sovereignty remain pressing. Recognising the strategic importance of AI, governments are stepping in. In Malaysia, initiatives like the National AI Roadmap 2021–2025 and the 13th Malaysia Plan (RMK-13) underscore this commitment. The establishment of the National AI Office (NAIO) under the Ministry of Digital serves as a central coordinating body to accelerate AI development and adoption.

Beyond current capabilities, the future of AI invites both excitement and caution. As AI begins to merge with other transformative technologies — such as the Internet of Things (IoT), big data, digital twins, and the emerging field of quantum computing — the implications will be even more profound. Looking further ahead, some experts speculate on a transformative milestone in AI development known as the Singularity.

The Singularity refers to a hypothetical point in the future when AI surpasses human intelligence in all aspects — reasoning, creativity, emotional understanding and even self-awareness. At this point, machines would not only perform tasks better than humans but could also improve themselves on their own, leading to an exponential leap in intelligence. While some believe this future is centuries away, others argue that the pace of innovation suggests it could arrive much sooner than expected. It could revolutionise every aspect of life — from how we work and learn to how we govern and connect. It could unlock solutions to problems previously deemed unsolvable, such as climate change, disease eradication and interstellar travel.

Yet, it also raises critical ethical, philosophical and societal questions: What role will humans play in a world where machines can think and evolve on their own? How do we ensure that such intelligence aligns with human values and interests?

We must anticipate the ripple effects, prepare for change, and seize the opportunities ahead. The path forward requires collaboration across multi-stakeholders — governments, academia, industry and civil society — to address challenges and shape the future of AI responsibly and inclusively. Ultimately, the journey of AI is not just about technology — it is about shaping a future that reflects our shared values and aspirations.

MOHD NURUL AZAMMI MOHD NUDRI

Ts Rushdi Abdul Rahim
President and Chief Executive Officer,
Malaysian Industry-Government Group for High Technology (MIGHT)

The Greatest Threat to Humanity Is Not AI... It's Indifference

Artificial Intelligence (AI) dominates today's strategic and intellectual discourse. From predictive algorithms to autonomous systems, AI is often cast as the protagonist, or antagonist of our collective future. But beneath the surface of this technological fascination lies a quieter, more corrosive force: indifference.

Indifference is no longer just being passive. It has now become systemic. It is the normalisation of suffering, the erosion of empathy, and the strategic silence that allows injustice to unfold unchallenged. While AI may challenge our ethics, indifference dissolves them. In the architecture of tomorrow's world, it is indifference and not artificial intelligence, that poses the greater existential threat.

Indifference as a Systems Failure

In foresight terms, indifference is a failure of attention. It is the blind spot in our scenario planning, the unmodeled variable in our simulations, the black elephant. It manifests not as a lack of data, but as a lack of care. And it is embedded in the very systems we rely on to shape the future.

We see this in the way humanitarian crises are treated as background noise. In the way climate collapse is met with procedural delay. In the way AI itself is deployed, often without a moral foundation, it amplifies biases and disengagement.

Indifference is not the opposite of action. It is the infrastructure of inaction.

Case Studies in Strategic Apathy

To understand the scale of this threat, we must examine how indifference plays out across global flashpoints:

Gaza: A Livestreamed Catastrophe

In 2025, over 3,500 Palestinians have died amid Israel's intensified military campaign. Humanitarian infrastructure has collapsed. Over 2 million people face starvation-level deprivation. Yet global response remains muted. Multilateral institutions issue statements, but aid is delayed, and accountability is evaded. The world watches but does not act.

Sudan: A Forgotten War

Sudan's civil conflict has displaced millions and triggered one of the worst humanitarian crises in recent history. Over 30 million Sudanese require aid, yet the crisis barely registers in global discourse. The United Nations has requested over $10 billion in support, but donor fatigue and geopolitical disinterest stall action. The silence is deafening.

Ukraine: Strategic Sympathy

Ukraine continues to resist Russian aggression, but support is increasingly politicised. Cities like Pokrovsk face existential threats, yet international aid is filtered through strategic interests rather than humanitarian imperatives. Sympathy is conditional. Empathy is transactional.

AI as a Mirror of Indifference

AI is not immune to this condition as it often reflects and reinforces it. When trained on biased data, AI systems replicate societal apathy. When deployed without ethical oversight, they automate detachment. Consider this:

- Algorithmic Apathy: AI platforms prioritise engagement over empathy, amplifying outrage while suppressing care.
- Automated Detachment: Decision-making tools obscure human accountability, turning moral choices into technical outputs.
- Synthetic Neutrality: AI-generated content avoids a moral stance under the guise of objectivity, reinforcing indifference as the default.

In this light, AI is not the threat, ; it is the mirror. It reflects the values we embed, the attention we allocate, and the empathy we choose to ignore.

Scientists and Technologists: Architects of Attention

Scientists and technologists are often portrayed as neutral builders of tools. But in the age of AI, they are also curators of moral attention. Their choices of what to model, what to optimise, and what to ignore will shape the ethical terrain of our futures.

- Designing for empathy: Technologists must move beyond efficiency and accuracy to embed care into systems. This means designing algorithms that prioritise human dignity, not just engagement metrics.
- Ethical stewardship: Scientists must challenge the myth of neutrality. Every dataset, every model, every deployment carries ethical weight. Silence is complicity.
- Narrative responsibility: As public trust in science fluctuates, technologists must become storytellers, translating complexity into meaning, and innovation into moral clarity.

In foresight terms, they are not just builders of the future but also act as framers of possibility. And their role in countering indifference is not optional. It is foundational.

Indifference as Infrastructure

Observe and you could possibly see that indifference is not just emotional but has been institutionalised. It manifests across systemic layers:

Systemic Layers	Manifestation of Indifference
Institution	Bureaucratic delay
Information	Algorithm and data fatigue
Society	Moral distancing and selective attention
Diplomacy	Strategic silence
Economic	Selective aid and transactional

Malaysia's Role: Designing Futures of Care

Malaysia has the opportunity to lead, not only in innovation, but in empathy. Through strategic foresight, narrative translation, and Triple Helix diplomacy, we can position ourselves as a moral compass in the ASEAN region. This is not about soft power but about moral power.

Imagine a regional initiative to counter indifference. Not just through aid, but through narrative, and anticipatory design.

Foresight must evolve. It must move beyond anticipatory and into protection. It must not only anticipate the future but defend the values that make it worth living.

Indifference is a design flaw in our global operating system. It is solvable. But only if we treat it as a strategic threat, not just a moral failing.

Let this be our call to action. To reframe foresight as a tool not just for control but for care. To restore empathy as a metric, not a mood. And to remind the world that the opposite of love is not hate… it's indifference.

Climate Collapse: The Slow Burn of Apathy

Despite irreversible ecological damage, climate action remains incremental. The poorest suffer most, yet global governance prioritises economic growth over ecological survival. The planet burns, but the response is procedural.

Human Rights Regression: The Trump Effect

Amnesty International warns that the erosion of international law and the rise of authoritarian practices, accelerated by the Trump administration, have plunged the world into a brutal new era. Indifference to dissent, refugees, and minority rights is becoming institutionalised. The moral compass is spinning.

IN PERSON WITH

AI Governance and Innovation: Malaysia's Strategic Path

Datuk Seri Hj. Hasnol Zam Zam plays a pivotal role in advancing Malaysia's science, technology and innovation agenda. As the Secretary-General of MOSTI, he is responsible for shaping policies that support responsible artificial intelligence (AI) development, national research and development (R&D) coordination, and digital innovation. With a distinguished career spanning multiple ministries — including Health, Education and Works — he brings a multi-dimensional understanding of how AI intersects with sectors critical to national progress. His expertise in governance, strategic planning, and responsible AI development continues to shape Malaysia's digital future. In this edition, myForesight® delves into his perspectives on Malaysia's AI future and the broader innovation landscape. His insights offer a timely look into how Malaysia can harness the full potential of AI to drive economic growth, societal well-being and national resilience.

Datuk Seri Hj. Hasnol Zam Zam Hj. Ahmad
Secretary General,
Ministry of Science, Technology and Innovation (MOSTI)

From Vision to Action: Emerging AI Trends Transforming Public Services

In the Rancangan Malaysia Ke-13 (RMK13), Malaysia is progressing towards becoming an AI-driven nation by focusing on three key areas: increasing the adoption of AI across sectors, strengthening the digital economy to support technology-driven growth, and enhancing the ecosystem for research, development, commercialisation and innovation (R&D&C&I). These efforts aim to position the country at the forefront of technological advancement while fostering inclusive and sustainable economic growth.

Several emerging AI trends are poised to transform Malaysia's public service landscape. Still, three in particular stand out: generative AI (gen-AI), AI-powered decision support systems and autonomous process automation.

Generative AI and Large Language Models (LLMs) / Small Language Models (SLMs) offer vast potential in multilingual service delivery, citizen engagement, policy drafting and knowledge management. Malaysia has embarked on the development of several domain-specific and culturally relevant LLMs as part of its broader AI sovereignty agenda under

MOSTI. Anchored in the National AI Roadmap 2021–2025, this has spurred the development of culturally tailored and domain-specific models.

One of the most prominent efforts is the development of a medical LLM jointly initiated by the Ministry of Health (MOH) and MOSTI. This project focuses on training language models using anonymised clinical data to improve AI-assisted diagnostics and triage tools in public healthcare. Malaysia is making progress in developing LLMs through several initiatives. The Bahasa Melayu-LLM (BM-LLM), led by MIMOS and MRANTI through the high-performance computing (HPC) platform, is fine-tuned on government and public service data for automation and digital assistant applications, supporting the National AI Roadmap 2021–2025 in preserving Malaysia's linguistic identity. Malaysia's Islamic Finance LLM, developed by INCEIF and fintech sandbox participants under Bank Negara, supports Shariah-compliant automation and aligns with MDEC's Islamic Digital Economy (IDE) initiatives. MaLLaM (Mesolitica) and Malaysian Mistral offer high-performance Malay language capabilities, outperforming ChatGPT 3.5 in local benchmarks. Meanwhile, Merdeka LLM by the Agmo Group is fully developed and hosted in-country, reinforcing national AI sovereignty and data ownership. These not only strengthen Malaysia's digital identity but also support RMK13's aspiration to produce high-value, homegrown innovations rooted in national values and language.

AI-powered Decision Support Systems (AI-DSS) are especially impactful in areas like public health, climate response, infrastructure planning and disaster management. These systems help civil servants transition from reactive responses to proactive interventions. AI-powered decision support systems in the public sector refer to intelligent platforms that leverage AI to enhance policy formulation, service delivery and operational efficiency. These systems combine data analytics, machine learning, natural language processing, and predictive modelling to assist civil servants and policymakers make faster, more informed and evidence-based decisions. For example, the AI at Work 2.0 initiative — led by the National AI Office (NAIO) supported by Google — equips the public sector with Google AI solutions such as Notebook LM and Gemini. The implementation of this initiative enables a transition from reactive to proactive governance. As emphasised in RMK13, these AI systems must also extend to areas like flood mitigation, climate-smart agriculture, and price transparency platforms, particularly to address cost-of-living pressures and environmental sustainability goals.

Autonomous Process Automation (APA) is another transformative field that enables the automation of repetitive government processes across immigration, licensing, enforcement and financial disbursement, reducing human error and administrative delays. APA is an advanced form of automation that uses AI, machine learning (ML) and natural language processing (NLP) to not only execute repetitive tasks but also make context-aware decisions, adapt to new data, and learn from outcomes without constant human intervention.

MOSTI's motivation to accelerate AI adoption stems from our National AI Roadmap (2021–2025), which identified the public sector as a key area due to its broad impact on citizen well-being and national productivity. We are committed to accelerating the implementation of the Public Service Reform Agenda to enhance the efficiency, transparency and accountability of government operations. This effort is a collaborative one, involving stakeholders and supporting the broader aspiration of establishing a responsive and people-centric administrative system that prioritises the needs and well-being of citizens while fostering trust in public institutions.However,

"AI-powered Decision Support Systems (AI-DSS) are particularly impactful in areas like public health, climate response, infrastructure planning, and disaster management. These systems help civil servants transition from reactive responses to proactive interventions."

adoption is not without its challenges. Among the most significant include data interoperability and siloed systems, which hinder effective model training and deployment; a shortage of AI talent and digital competency within the civil service; and public trust and ethical concerns, particularly with opaque decision-making by AI systems. To address these, MOSTI has worked closely with other ministries and agencies, such as the Ministry of Human Resources, MRANTI, MIMOS, Cradle, TalentCorp and Jabatan Digital Negara in providing infrastructure, platform and technical training programs for upskilling and reskilling. The AI Governance and Ethics Guidelines (AIGE), launched by MOSTI in 2024, marks an initial step in the country toward ensuring the safe, ethical and accountable use of AI across government services. Moving forward, APA should be applied in underserved rural areas to support RMK13's rural-urban rebalancing strategy. By integrating automation and AI agents in remote government services, Malaysia can improve service equity, optimise workforce distribution, and uphold MADANI principles in inclusive governance.

With these strategic efforts, Malaysia is well-positioned to harness AI's transformative potential while addressing its inherent challenges — ensuring that innovation benefits all communities, strengthens governance, and propels the nation towards a more inclusive, high-tech future.

Coordinated AI Governance

MOSTI and the Ministry of Digital (MOD) work hand in hand to ensure that Malaysia's AI development is both technically robust and socioeconomically inclusive. The NAIO, established last year under the Ministry of Digital, functions as the central coordinating office for AI. This agency is supported by other ministries such as MOSTI, the Ministry of Investment, Trade and Industry (MITI), the Ministry of Higher Education (MOHE) and the Ministry of Economy. MOSTI's role focuses on strengthening the R&D ecosystem — encompassing innovation, talent, infrastructure and platform readiness — while the Ministry of Digital handles downstream digitalisation efforts, infrastructure rollout, and service innovation through initiatives like MyDIGITAL and the Public Sector AI Adoption Framework.

This collaboration reflects RMK13's emphasis on coordinated governance and structured transformation, ensuring a whole-of-government approach. This synergy is particularly evident in areas such as AI governance and regulatory alignment, where both ministries shape ethical standards and operational policies; national AI infrastructure, including HPC and sovereign AI stack development, where investments and strategic priorities are aligned; and cross-ministry task forces and technical working groups, such as the HPC Digital Asset Council and Malaysia Economic Digital Fourth Industrial Revolution Council, (MED4IR), which involve contributions from MOSTI, the Ministry of Digital, and agencies like Jabatan Digital Negara (JDN) and MIMOS. MOSTI has made significant advancements in AI readiness through the National AI Roadmap 2021–2025, covering infrastructure, talent development, policy and governance.

Flagship initiatives include the Malaysia AI Sandbox (under MRANTI), a safe testbed for startups, agencies and researchers to pilot AI innovations with regulatory facilitation and expert guidance. Collaborations with MIMOS, Havelsan from Türkiye, and TechInsight Sdn. Bhd. focus on building an advanced sovereign foundational AI ecosystem tailored to Malaysian needs, leveraging local data, secure infrastructure and contextual relevance. The Malaysia AI Consortium (MAIC) connects academia, government and industry to drive applied AI R&D in sectors such as healthcare, education and smart cities. It has been a starting point for transforming Malaysia's healthcare sector by enabling more efficient management of healthcare systems and service delivery. One key development is the LLM for public health, designed for three user categories: public, patient care, and health system management. Alongside the AI Sandbox, MAIC and health-focused LLMs, both ministries are also working on policy and regulatory harmonisation through the AIGE.

The AIGE is the first national guideline that translates seven responsible AI principles from the National AI Roadmap into practical applications for three categories of users: end-users, policymakers and technology developers. While non-binding and general, it serves as a foundation for sector-specific AIGE guidelines tailored to industries such as finance, communications and e-commerce. This dual-track approach — technical and ethical — is essential to elevating Malaysia's AI governance credibility while encouraging adoption across various sectors.

MOSTI's role is central to RMK13's 'raising the ceiling' agenda. The national push toward a value-creation

economy is evident in initiatives to localise and export AI-driven innovations, particularly within high-growth, high-value (HGHV) industries such as Electrical and Electronic (E&E), creative content and hydrogen. Furthermore, cross-ministry working groups, such as MED4IR and the Digital Asset Council, ensure alignment between policy, talent development and infrastructure rollout. This institutional synergy positions Malaysia to emerge as a trusted regional hub for AI R&D, particularly in AI-for-Government applications and digital public infrastructure (DPI).

Looking ahead, Malaysia aspires to establish regional AI hubs beyond Klang Valley — in Sabah, Sarawak and Kulim — to advance RMK13's territorial development goals while creating new economic corridors for AI talent and innovation.

AI as the Catalyst for Malaysia's Next Decade

The list of emerging technologies that could drive the most significant impact in the next decade is outlined in the 10-10 MySTIE framework. However, in this session, the spotlight is firmly on AI. It will serve as the cornerstone of Malaysia's transition into a high-tech, high-income nation. Through the lens of RMK13, AI is not merely a productivity tool but a catalyst for strengthening national resilience, transforming public services, and enhancing economic complexity. Whether integrated into autonomous transport, climate forecasting, intelligent manufacturing, or healthcare delivery, AI is set to deeply permeate Malaysia's institutional and industrial fabric.

We envision AI being integrated into every facet of governance, industry and daily life — from personalised public services and autonomous transport, to intelligent manufacturing and climate-smart agriculture. Its convergence with other emerging technologies will amplify its transformative impact. Notably, quantum computing and neuromorphic AI will unlock breakthroughs in complex modelling and national resilience planning; Brain-Computer Interfaces (BCI) and bio-AI integration will redefine healthcare, accessibility and education; decentralised AI on blockchain will establish new paradigms for trust, security and data sovereignty in digital public infrastructure; and green AI innovations will align with RMK13's net-zero goal, promoting sustainable, energy-efficient computational practices.

Talent development remains a central pillar of Malaysia's inclusive AI plan. Targeted initiatives are underway to address the shortage of specialised and senior-level AI professionals. Programmes such as the NVIDIA–YTL partnership, AI Odyssey and training platforms like Rakyat Digital and My-AI Portal have played pivotal roles in building basic AI literacy. To date, over 220,000 educators have acquired AI-related competencies, while more than 9,000 civil servants have taken part in AI and blockchain training programmes conducted by INTAN in 2024.

Guided by RMK13, MOSTI is intensifying investments in sovereign technologies such as LLMs, AI chips, federated learning platforms, and edge AI — all of which are fundamental to Malaysia's digital sovereignty goals and innovation exports. These strategic measures include investing in R&D and sovereign infrastructure, expanding talent development pathways through initiatives like the AI for Rakyat programme and certified AI assessor schemes, and implementing the upcoming National AI Talent Roadmap to build a strong pipeline of AI engineers, policy experts and ethics professionals. Cross-sector adoption is also being accelerated through MRANTI's AI Sandbox, the MAIC, and technology transfer programmes, enabling real-world deployment in sectors such as health, energy, education and public administration.

On the global stage, MOSTI actively engages in international collaborations with countries including China, India and the United Kingdom to promote technology and talent development. Beyond technology, infrastructure and skills, MOSTI is also leading the national steering committee in the development and adoption of Artificial Intelligence International Organisation for Standardisation standards (AI ISO). These standards are closely linked to innovation and, together with the AIGE, represent a soft approach to encouraging responsible AI adoption — complementing regulatory measures and potential AI legislation.

Ultimately, Malaysia's goal is not just to adopt AI, but to develop, regulate, and export AI solutions grounded in national values, while promoting innovation that is inclusive, ethical, and sustainable — for the benefit of the country and beyond.

From Silicon to Sovereignty

Shaping Malaysia's AI and Data Future

Datuk Pua Khein Seng, the visionary inventor of the world's first single-chip USB flash drive and founder of Phison Electronics, is a pioneer in semiconductor and data storage innovation. Now leading MaiStorage, his latest venture focuses on developing next-generation AI-integrated storage solutions designed to meet the growing demands of data centres and intelligent infrastructure. In this edition, myForesight® explores his insights on how artificial intelligence is transforming the data ecosystem — from smarter, more efficient storage systems to the evolving role of locally driven technology competing on the global stage. He shares valuable perspectives on the challenges faced by homegrown innovators in scaling breakthrough solutions beyond borders and what it takes to build future-ready, AI-powered technologies in Malaysia and beyond.

Datuk Pua Khein Seng
Chief Executive Officer
Phison

> The future of secure data centres lies in a layered approach — leveraging AI to detect and neutralise threats in real time, ensuring the authenticity of digital content, and building resilient infrastructures that can withstand not only today's cyberattacks but also tomorrow's quantum challenges.

Phison and MaiStorage: Safeguarding the Digital Backbone

When we look at the role of data centres today, they are no longer just passive storage facilities — they have become the digital backbone of nations, carrying sensitive government, financial, and enterprise data. As artificial intelligence becomes embedded into these systems, we must view artificial intelligence (AI) not only as an enabler of efficiency, but also as a critical line of defence against emerging cyber threats.

At MaiStorage and Phison, we see AI as an essential layer in modern data security. For example, AI can automate the continuous analysis of system logs and act as a real-time threat detection agent. Instead of relying on manual monitoring, advanced models can swiftly distinguish between normal human traffic and suspicious automated or AI-generated traffic — shutting down malicious attempts before they escalate.

Another growing concern is the misuse of AI to create deepfakes and synthetic content that threaten identity verification and trust. Here, AI must be used against AI — through models specifically fine-tuned to detect and flag synthetic media, ensuring the authenticity of digital communications and transactions.

Looking ahead, security must go beyond defence to focus on resilience. That's why we are supporting solutions such as "Resiliency as a Service," powered by Phison enterprise storage. Beyond Earth, our partner Lonestar Data Holdings is pioneering the concept of a Lunar Data Centre — where critical data can be mirrored and protected in an off-planet environment, ensuring continuity of operations even in the face of catastrophic disruptions on Earth.

We must also anticipate the next wave of risks, particularly quantum computing. The industry must prepare by developing quantum-resistant encryption algorithms, and Phison is already advancing in this area with certified firmware and secure controller design.

In short, the future of secure data centres lies in a layered approach — leveraging AI to detect and neutralise threats in real time, ensuring the authenticity of digital content, and building resilient infrastructures that can withstand not only today's cyberattacks but also tomorrow's quantum challenges. This is how we safeguard the digital backbone while empowering the growth of our digital economy.

MaiStorage: Building Malaysia's AI Talent Pipeline

At MaiStorage, we firmly believe that talent is the most important asset for Malaysia to build a sustainable and competitive technology ecosystem. This belief has led us to design platforms such as aiDAPTIV+, enabling PCs and laptops to be affordable yet powerful — making AI-ready hardware accessible to the education sector and developers. These solutions enable practical, hands-on learning so that students don't just study AI in theory but also develop and deploy applications in their classrooms and labs.

This hands-on exposure is essential for upskilling and reskilling. Whether it is fine-tuning large language models, building AI-powered applications, or experimenting with real-world use cases, students

and professionals alike can gain direct experience without relying solely on expensive cloud resources. This nurtures a new generation of engineers, researchers, and innovators who are job-ready from day one.

Equally important, Malaysia's universities attract many international students from developing nations. With the right tools and training, these students become young ambassadors, carrying the technology, skills, and applications they developed here back to their home countries. This not only strengthens Malaysia's reputation as a regional hub for AI talent development but also extends our global impact.

To truly scale, industry and academia must collaborate closely. Universities provide the foundation in theory and research, while industry partners bring in cutting-edge platforms, real-world datasets, and market-driven use cases. At the same time, government and ecosystem players ensure supportive policies, funding, and opportunities for startups to grow and scale.

By aligning these forces, we can create future-ready talent pipelines that address both local industry needs and international opportunities. For Malaysia, this is more than just talent development — it is nation-building, positioning us as a leader in AI innovation and digital resilience across the region.

Phison's Vision: Malaysia's AI Future in the Next 10 Years

When I look 10 years ahead, I believe Malaysia will be standing at the threshold of a profound transformation powered by AI. Just as electricity once reshaped industries, AI will redefine how we live, work, and compete globally.

At Phison and MaiStorage, we see our role as laying the foundation — building AI-optimised storage and compute platforms, training young engineers, and enabling local firms to design specialised hardware that gives Malaysia a distinct competitive edge. Our aiDAPTIV+ ecosystem is not just a product; it is a pathway for universities, startups, and enterprises to experiment, innovate, and scale AI solutions locally, while keeping sovereignty of data intact.

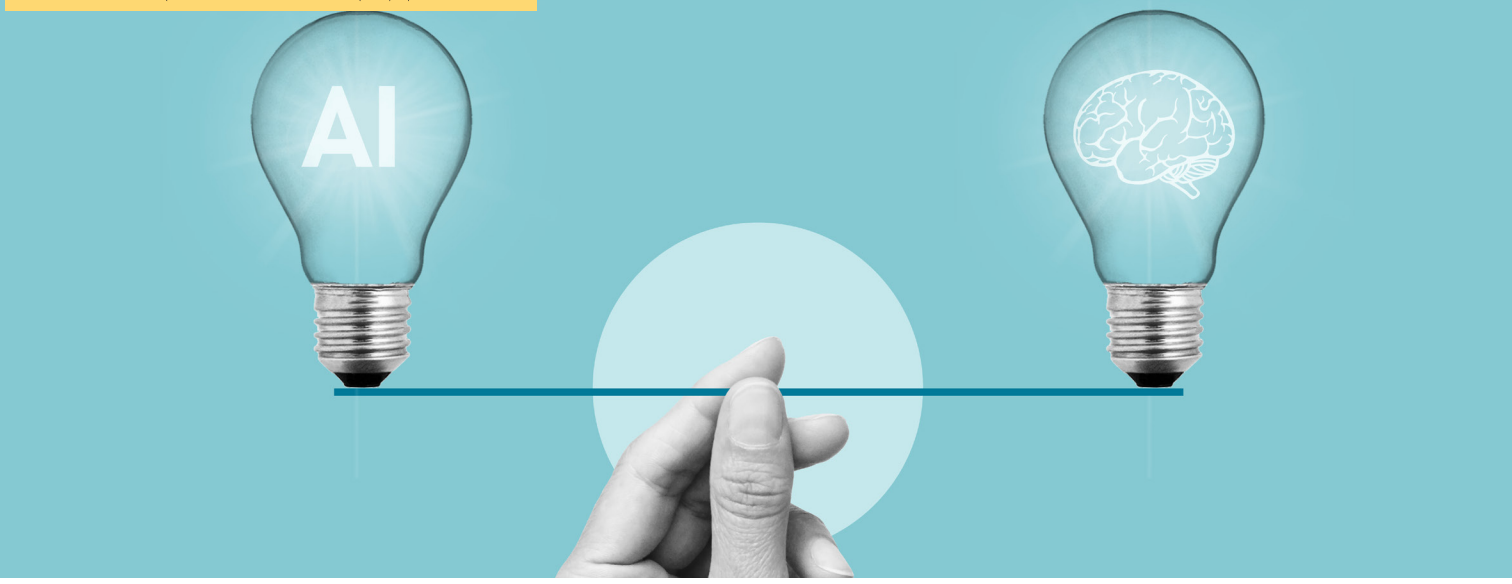
Over the next decade, I foresee three major shifts. First, industries will be transformed by AI-driven efficiency and resilience. From manufacturing lines powered by predictive AI to agriculture optimised through intelligent crop management, Malaysia's traditional sectors will leapfrog into the future with AI integration. This is how we can turn challenges such as food security, healthcare gaps, and supply chain volatility into opportunities for innovation.

Second, a new generation of AI talent will emerge and shape society. By equipping students with affordable AI laptops and on-premises platforms, we are creating not just skilled engineers, but digital ambassadors. Many of them will come from abroad, study here, and take their innovations back home — positioning Malaysia as the training ground for the region's AI leaders.

Third, Malaysia will strengthen its global positioning through resilience and trust. With Phison's enterprise storage and initiatives such as Resiliency as a Service, including lunar data mirroring, we will offer the world not only AI performance, but also data security and operational continuity. In an era where cyber resilience and digital sovereignty are paramount, this makes Malaysia a trusted hub for the global digital economy.

In short, AI adoption will transform Malaysia into a regional epicentre for innovation, talent, and resilience. It is not just about technology — it is about uplifting society, empowering startups, and enabling Malaysia to compete and collaborate confidently on the global stage. The next 10 years are our window to build that future, and with the right ecosystem of government, industry, and academia, I believe Malaysia can lead.

IN PERSON WITH



From National AI Roadmap to Reality

Building a Competitive and Ethical AI Future for Malaysia

Associate Professor Dr. Aini Suzana Datuk Hj Ariffin is a distinguished Malaysian academician and policymaker specialising in Science, Technology and Innovation (STI) policy. She chairs UNESCO's Science, Technology, Engineering Innovation Policy Asia-Pacific Network (STEPAN). She is a leading voice in responsible and ethical AI development, shaping governance frameworks that align global standards with national priorities. With over 37 years of experience, Dr. Aini combines extensive technical expertise with strategic foresight. Through her contributions to myForesight® magazine, she highlights artificial intelligence's (AI) transformative potential, emphasising the critical need for ethical, inclusive and sustainable innovation that meets both global standards and national interests. At MIGHT, we believe technology must serve humanity. Dr. Aini embodies this, dedicating her career to ethical innovation and inclusive AI governance. Her leadership was recently recognised with the Asia-Pacific "AI for Good" Award at the 2025 Women in AI Awards in Sydney, validating her work to empower communities, promote gender equity and safeguard societal values. As Malaysia moves into the AI Action Plan 2026–2030, Dr. Aini's legacy reminds us that true innovation means accountability, accessibility and aspiration.

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Chair,
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National AI Roadmap 2021–2025: The Journey

Since 2019, Malaysia has made remarkable strides in the development and implementation of its National AI Roadmap, with Universiti Teknologi Malaysia (UTM) playing a key role throughout the process. UTM's longstanding expertise in AI, backed by more than 28 years of AI-related research and over 200 AI projects in partnership with national and international stakeholders, positioned it as a natural leader in developing the roadmap. The roadmap itself was crafted over nearly a year, during which extensive quadruple helix engagements took place involving government agencies, industry representatives, academic institutions, associations and civil society both locally and internationally.

The roadmap focuses on six key trust areas: governance and responsible AI ethics; research and development, commercialisation and sandbox environments; talent development, including workforce upskilling and reskilling; infrastructure and data management; and communication and societal engagement. These areas are implemented through 22 strategic initiatives, phased between 2021 and 2025. To date, approximately 70 to 75 percent of these initiatives have been successfully executed, reflecting strong collaboration among multiple ministries and agencies. This achievement results from the collective efforts of government bodies, academia, industry players, and civil society, who have come together to build a cohesive AI ecosystem that harmonises innovation with governance while balancing ambition with responsibility.

Coordination among multiple ministries and agencies The Ministry of Science, Technology and Innovation (MOSTI) plays a leading coordination role as the secretariat, managing the steering and technical committees comprising over 100 members from more than 25 government agencies, universities, companies and associations.

Since 2020, under the leadership of Datuk Ts. Dr. Mohd Nor Azman Hassan, who serves as Deputy Secretary-General (Technical), MOSTI provides essential technical direction in monitoring the implementation and progress of the National AI Roadmap. The Malaysian Research Accelerator for Technology and Innovation (MRANTI) supports sandbox initiatives and technology commercialisation. At the same time, the Malaysia Digital Economy Corporation (MDEC) advances digital economy policies and facilitates the development of AI Technology.

The Ministry of Digital (MOD), established in November 2023, now oversees the National AI Office (NAIO). This office plays a crucial role in spearheading more direct governance, implementation and inter-ministerial coordination. The Ministry of Education (MOE) and the Ministry of Higher Education (MOHE) lead efforts to integrate AI literacy and skills throughout formal education systems, including teacher training programmes. The Ministry of Human Resources emphasises AI-related Technical and Vocational Education and Training (TVET), recognising the critical need to upskill and reskill Malaysia's workforce for AI-driven industries.

The Ministry of Investment, Trade and Industry (MITI) facilitates investment incentives while also playing a critical role in developing AI standards. The Ministry of Communications enhances infrastructure deployment and public communication to boost awareness and digital inclusivity. The ministry has also developed the first Code of AI Ethics for the Telecommunication and Multimedia sector in 2025.

The Malaysia Productivity Corporation (MPC) actively monitors the impact of AI adoption on productivity and economic growth, while the National Cyber Security Agency (NACSA) oversees the enforcement of cybersecurity legislation to protect AI ecosystems. Malaysia has strengthened its AI governance framework through the review of the Personal Data Protection Act and the enactment of the Cybersecurity Act in 2024, which introduces crucial safeguards to protect AI systems and data assets from emerging cyber threats. Under MOD's leadership, the Data Sharing Act – "Omnibus Act 2025" promotes responsible and secure data exchange, initially targeting the public sector to establish trust and high-quality data pools, essential for AI training and deployment.

However, governance is only part of the equation; it is not enough. AI thrives on solid infrastructure. To achieve its vision of becoming a regional AI leader, Malaysia is rapidly investing in data centres, which form the backbone of a resilient and sustainable AI ecosystem. Data centres are crucial because they provide the immense computational power required to process vast amounts of data quickly and efficiently, enabling machine learning algorithms and real-time AI decision-making. They ensure scalability,

high availability and low latency needed for advanced AI applications. Moreover, modern data centres use AI to optimise energy consumption, cooling and security, promoting sustainability and operational efficiency. This strong infrastructure foundation is essential for unlocking the full potential of AI technologies and supporting Malaysia's ambition to become a leading AI hub in Southeast Asia.

In line with this vision, Malaysia aims to complete over 80 data centres by 2028, supported by significant investments from multinational technology companies such as Microsoft, NVIDIA, Huawei and Google, alongside local partners like YTL Corporation Berhad.

National AI Governance and Ethics Guidelines

> "AI governance must be a living framework — adaptive, inclusive and deeply ethical"

In my role as the Head of the Working Group for Governance, Legal and Ethics, we have developed and introduced the national guidelines on AI governance and ethics (AIGE) framework. These guidelines apply to AI users, regulators, policy makers, developers and technology providers, aiming to foster trust and responsible AI adoption. The framework is anchored by seven core principles: fairness, safety, transparency, inclusivity, accountability, privacy and human-centric design. These principles are fully aligned with the United Nations Educational, Scientific and Cultural Organisation's (UNESCO) Recommendation on AI Ethics (2021).

At the Association of Southeast Asian Nations (ASEAN)level, Malaysia has been an active contributor to the development of ASEAN AI guidelines, launched in 2024, and has helped expand these guidelines to include emerging technologies like generative AI. Furthermore, Malaysia contributed to the development of the ASEAN Responsible AI Roadmap for 2030, which seeks to harmonise AI governance and ensure responsible AI adoption throughout Southeast Asia.

Economically, Malaysia has attracted over US$21 billion in investments in the past two years alone, indicating strong confidence from international industry leaders. These investments have propelled advancement not only in physical infrastructure but also in human capital development, reflecting Malaysia's holistic and multi-sectoral approach to AI readiness.

Building an Ecosystem of Trust

> "Malaysia's AI journey is not just about technology — it's about trust, talent and transformation."

Malaysia's trusted AI governance framework demonstrates active engagement in global partnerships and international AI standard-setting efforts. As a Participating member (P-member) in the International Organisation for Standardisation's (ISO) AI technical committees, Malaysia has played a significant role in developing and publishing of more than 25 international AI standards over the past few years. This involvement reflects Malaysia's commitment to adopting globally recognised best practices, ensuring AI interoperability, ethical compliance, and industry transparency.

As Chair of STEPAN, I have supported UNESCO's efforts in developing and promoting universal AI ethics guidelines. These UNESCO recommendations serve as foundational frameworks that Malaysia has adapted to reflect our national socio-cultural, religious and ethical contexts. This close collaboration ensures that Malaysia contributes meaningfully to global AI ethics while customising approaches to fit local needs and values.

Malaysia has established strong bilateral partnerships with advanced AI nations such as the United Kingdom, China, Australia, Japan and South Korea. Exchanges with these countries have included sharing insights on AI ethics, regulatory regimes, governance approaches and standards development. For instance, the collaboration with the UK's British Standards Institution and technical exchanges with

Japanese regulators have significantly informed Malaysia's AI governance and policy design. Beyond bilateral partnerships, Malaysia has actively engaged with global institutions such as the Organisation for Economic Co-operation and Development (OECD) and the World Economic Forum (WEF) to align national AI policies with international norms, particularly on emerging challenges like AI safety and societal impact.

Through these global and regional partnerships, Malaysia has established a resilient and trustworthy AI governance foundation, positioning itself to address evolving technological and ethical challenges while contributing actively to ongoing international AI policy discussions.

Key Lessons Learned and Support for Malaysia's AI Vision

Based on the assessment of the Country's AI Readiness under UNESCO initiatives, our National AI Roadmap implementation from 2021 to 2025 has provided invaluable lessons, which will help establish strong foundations for achieving the Prime Minister's vision of *Menuju Negara Kecerdasan Buatan* (Towards an AI-Powered Nation). Most importantly, we recognise that broad multi-stakeholder collaboration across government agencies, academia, industry, associations and society is vital for effective governance and wide-spread AI adoption. This quadruple helix model has enabled Malaysia to advance AI deployment in various sectors, including public administration, education, healthcare, finance, agriculture and smart cities. International collaboration has been critical in helping us develop adaptive AI ethics and governance frameworks that not only follow global best practices, but are also carefully tailored to Malaysia's social, cultural and religious landscape. Social inclusivity remains a top priority in our AI journey, with significant efforts to promote gender equity and increase the participation of women and girls in AI-from grassroots education to workforce development-embodying our principle of "AI for All." The rapid emergence of new AI technologies such as generative AI, quantum AI, and agentic AI underscores the importance of treating AI governance and ethical guidelines as "living documents" that must be continuously updated. This necessity has been reinforced by observing other countries and organisations like the OECD, which have revised their AI guidelines multiple times in response to technological shifts. Malaysia's commitment to inclusivity was recognised internationally with the Asia Pacific Women in AI Award for "AI for Good" in 2025, further validating our efforts and galvanising growing AI literacy among our population.

We have worked closely with the Academy of Sciences to identify and prioritise over 20 critical technology sectors dubbed "10-10" that are key to advancing national AI readiness and supporting broad-based technology commercialisation. This ensures that AI benefits all segments of Malaysia's economic landscape, with no one left behind.

Risk and impact assessments have been foundational in ensuring AI adoption does not compromise societal well-being, economic productivity, or human rights. We pay special attention to high-risk sectors such as defence, healthcare, education and finance, implementing comprehensive governance measures and developing local AI standards and workforce certification programmes to foster trust and compliance.

The NAIO, established under the MOD, has bolstered our governance and implementation capacity, enabling us to coordinate the transition from the current roadmap into the Malaysia AI Masterplan (2026–2030) effectively. Continuous monitoring shows that about 70 to 75 percent of the roadmap's initiatives have been achieved, with a final evaluation report expected by the end of 2025.

These lessons highlight the importance of adaptive governance, multi-sector engagement, social inclusion, targeted sector strategies, and strong international collaboration. Together, we prepare Malaysia to confidently step into the next phase of AI development, establishing ourselves as a responsible, innovative and globally connected AI-powered nation.

AI for Good: Malaysia's Human-Centric Approach

Reflecting on the past four years, Malaysia has made great progress in realising the National AI Roadmap 2021–2025 by leveraging extensive collaboration across government, academia, industry and civil society. Our systematic adoption of the quadruple helix engagement model and strong governance institutions has ensured coordinated and effective AI integration across key sectors.

At the heart of our approach is a firm commitment to AI for Good. We have comprehensively addressed governance, gender equity, inclusivity, ethics, grassroots outreach, and education - making AI development truly inclusive and socially responsible. This dedication has earned Malaysia recognition as a champion of AI for Good in the Asia Pacific region, reflected in two prestigious awards. When the Prime Minister declared Malaysia ready to be the AI hub for the Asia Pacific, the nation confidently affirmed this readiness, marking a collective achievement for all Malaysians, for the country.

A key contributor to this success is the Malaysian Industry-Government Group for High Technology (MIGHT), which, together with the Academy of Sciences, identified over 20 critical technology sectors - the "10-10" commercialisation areas - highlighting AI as a strategic technology enabler. MIGHT's crucial role in supporting AI technology readiness and commercialisation has strengthened Malaysia's AI ecosystem, ensuring no one is left behind in this journey.

Malaysia's active participation in global AI standard-setting bodies and leadership within ASEAN have enabled us to harmonise our AI governance with international best practices while respecting diverse cultural and ethical contexts. Our commitment to inclusive AI development - especially through gender equity and grassroots outreach-has not only been internationally recognised but also continues to strengthen our national AI capabilities.

Key lessons learned emphasise the necessity of dynamic and adaptive governance frameworks, sector-specific risk and impact assessments, investment in robust data infrastructure, and human capital development, along with a cohesive multi-agency approach. Supported by the NAIO and close multi-ministry cooperation, Malaysia is well-positioned to transition into its next phase of AI development. We remain focused on fulfilling the vision of becoming a future-ready, ethically responsible and globally engaged AI-powered nation.

As Malaysia transitions into the AI Masterplan 2026–2030, our vision is clear: to become an AI-powered nation that is future-ready, ethically grounded, and globally connected. The journey has only just begun - and we are ready to shape the future together.

Towards the Future of Responsible AI

Since 2020, I have been deeply honoured to contribute to Malaysia's AI journey, starting with the development of the National AI Roadmap (2021–2025) and leading the Working Group on AI Governance, Legal and Ethics. This role has enabled me to coordinate strategic initiatives, develop national governance guidelines, promote responsible AI, and advance Malaysia's involvement in international AI standards such as ISO 42000.

Engaging with over 60 government agencies, universities, companies and associations, I have worked to build AI awareness and trust. Leading Malaysia's role as Lead Assessor for AI Ethics Standards with IEEE and championing our initiatives through STEPAN and UNESCO regionally has been a key part of this journey.

As the AI Roadmap concludes in December 2025, my commitment to supporting Malaysia's vision as a regional hub for safe, inclusive and impactful AI remains unwavering. This dedication was recognised at the Asia Pacific Women in AI Gala Dinner 2025 in Sydney, where I was proud to be named 1st Runner-Up for the Best AI Award and Winner of the AI for Social Good Award for Asia Pacific-honours that highlight Malaysia's growing leadership in AI across the region.

Driving Productivity and Sustainability

AI's Role in UK Construction

Dr Temitope Omotayo is a Reader in Sustainable Construction and Digital Project Management at Leeds Beckett University, United Kingdom. He specialises in applying Artificial Intelligence in construction, Building Information Modelling (BIM), and sustainable building practices. Dr Omotayo leads innovative projects such as Costplan.ai, an Innovate UK-funded generative AI platform designed for early and accurate construction cost estimation. In this edition of myForesight® magazine, Dr Omotayo highlights AI's transformative potential to enhance productivity and sustainability in UK construction, the role of AI-driven platforms in driving efficiency, and the key challenges and opportunities for wider AI adoption across sectors.

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The Baseline: Productivity Carbon and Waste

UK labour productivity growth has been weak compared to past standards since the financial crisis began. The early 2025 whole-economy output per hour measurement indicated a 2 percent (%) increase from pre-pandemic levels, yet growth showed signs of decline. The construction sector's productivity shows unstable growth because it increased by 1.3% during 2024 while lagging behind leading sectors in performance.

The necessity to achieve sustainability makes this challenge even more difficult to handle. UK buildings and product uses generate approximately one-fifth of the nation's greenhouse gas emissions, while residential heating emissions have increased lately. The construction sector, along with demolition and excavation activities, produces the majority of the nation's total waste by weight. The industry faces a major safety problem

as it recorded 35 worker deaths during 2024/25, while falls from height became the leading cause of fatalities. A successful construction productivity strategy needs to deliver decarbonisation goals and improved safety standards.

Where AI Shifts Production Functions

Construction operations involve interconnected probabilistic processes starting with design choices that generate output probabilities. These are followed by site progress updates, planning adjustments and the identification of quality defects. Such problems cause rework, and when combined with weather-related delays and logistical challenges, disrupt the smooth flow of construction activities.

AI leverages its capabilities to reduce both uncertainty and average error levels in unreliable steps. With computer vision technology, site personnel can analyse 360° captures or drone imagery against the design model and weekly schedules, providing data-driven progress reports instead of relying on human-based assessments. This system helps supervisors save time by quickly identifying critical issues like fire collar misplacements and cabling misrouting. Ultimately, it reduces rework costs and better-quality handover processes.

Scheduling risk models that use historical programme data, run simulations to identify fragile sequences of operations. Managers can better determine contingency planning using these models, which identify risks such as winter facade construction and service trade congestion. The outcome leads to fewer critical-path delays and less variability in project completion times. The implementation of digital twins advances infrastructure project management by combining lidar scans, drone imagery, and asset data to generate dynamic models. Engineers use virtual simulations to reduce congestion and minimise downtime and unnecessary carbon emissions by planning closures and diversions. The predictive maintenance features in these models detect early indicators of equipment failures, such as hot-running gearboxes and abnormal pump vibrations, enabling proactive repairs to maintain project schedules.

The "golden thread" of evidence becomes more effective through AI enhancements in quality control processes. The combination of vision-tagged photo logs produces permanent records that show installation details along with their exact locations and timestamps. The system reduces disputes while speeding up payments, meeting regulatory requirements, giving insurers peace of mind while making compliance both efficient and auditable.

Embodied Carbon and Material Efficiency

Cement is the primary factor that determines embodied carbon emissions from concrete, as variations in its percentage have a significant environmental impact. The implementation of AI technology achieves cement optimisation through two main methods.

Firstly, AI manages kiln operations during production by optimising the fuel mixture temperature control and chemical feed processes to minimise energy consumption while maintaining quality. The AI-powered mix design system uses strength-gain curves, supplementary materials, and curing forecasts to achieve the desired performance results with less clinker content. Typically, excess cement is added as a safety buffer, but AI technology effectively optimises this out.

Secondly, the concrete maturity measurement capabilities of curing sensors enable the safe removal of formwork earlier. The accelerated construction timeline, together with decreased requirements for mix over-specification, results from using this approach. The optimisation process implemented by AI, leads to simultaneous reductions in both construction costs and carbon emissions for each cubic metre of material.

Operational Energy and Whole-Life Performance

Most emissions occur after construction ends during a building's operational phase. AI systems adopt predictive optimisation instead of reactive controls in this scenario. The combination of weather predictions, occupancy patterns, thermal building characteristics, and power grid carbon output enables AI-based building management systems to make proactive heating and cooling adjustments.

Systems use predictive temperature control to pre-cool or pre-heat spaces just enough to maintain comfort while reducing energy usage. Studies have

"The construction industry faces an ageing workforce that demands ongoing hiring, which necessitates the addition of nearly 50,000 workers each year to meet growing demand. Consequently, maximising productivity becomes essential."

proven that real-world applications can achieve energy savings between 10% and 20% at the high end of the spectrum. The economic advantages of AI implementations are substantial because the technology integrates seamlessly with existing equipment, keeping capital expenses low and making energy savings immediately apparent on energy statements. AI optimisation at the city scale enables national emission reductions by shifting energy demand to periods when the grid operates with low carbon content.

Safety, Logistics and the Human Factor

AI systems improve safety operations by reducing detection response times. The combination of video analytics with wearable technology protects workers from restricted zones through PPE detection and ladder misuse identification. The implementation of this system leads to quantifiable decreases in incidents without establishing a surveillance state, when data retention remains minimal and policies maintain transparency.

Real-time consumption data enables the optimisation of delivery sequences and laydown planning, as well as crane lift operations, together with traffic flow analysis and micro-weather predictions. The system results in decreased idle time among trades and reduced fuel consumption in waiting lines and enhanced workflow continuity.

The construction industry faces an ageing workforce that demands ongoing hiring, which necessitates the addition of nearly 50,000 workers each year to meet growing demand. Consequently, maximising productivity becomes essential. AI technology enhances human skills by providing site managers with risk assessment tools and helping apprentices learn faster through augmented reality and AI assistants.

The UK AI Ecosystem

The effectiveness of AI in construction heavily relies on the support of the national AI ecosystem. The United Kingdom now has more than 3,000 AI companies that generate revenues exceeding £10 billion, while employing 60,000 people in AI-related roles and contributing £6 billion to its gross value added (GVA). The calculated worker productivity reaches £100,000, which surpasses national norms.

The adoption rate of AI technologies within the economy continues to grow rapidly. The adoption rate of AI tools in UK firms reached 9% in 2023, and experts predict it will increase to 20% by 2024. The adoption of AI technology typically starts with large firms before spreading to smaller enterprises, which is currently happening in logistics, finance, healthcare and manufacturing sectors. The widespread adoption of digital practices among suppliers and clients will result in greater returns from AI investments for construction projects.

Infrastructure capacity remains an issue. Construction-specific AI models require sustainable and secure cloud resources and computing power to expand their functionality for image segmentation, document analysis and control optimisation. The ecosystem faces potential bottlenecks unless there is sufficient investment in computing capacity and workforce training.

Productivity, Whole Economy

Early 2025 productivity measurements showed only 2.1% above pre-pandemic levels, thus maintaining the persistence of Britain's productivity challenge. Output per hour increased by 1.3% in 2024, however, the extended pattern of weak performance alongside inconsistent results continues. The UK greenhouse gas emissions from buildings and product use

amount to 21% and show a slight increase in 2024, while construction activities produce 60% of total waste by weight. The number of construction-related worker deaths in 2024/25 reached 35 – where 'falling from height' remained the top cause of death.

The United Kingdom has established more than 3,000 AI firms that produce over £10 billion in revenue, create 60,000 specialist positions, and deliver GVA of nearly £6 billion. Adoption of AI technology by firms increased more than twofold during the transition from 2023 to 2024.

Worked Business Case

A 20,000 square metre seven-storey office building serves as our basis for analysis. The standard energy consumption for the building is 200 kWh per square metre per year. The implementation of AI-enabled Building Management Systems (BMS) leads to an 8% reduction in energy use, which translates to 320 MWh of annual savings. The yearly energy cost savings amount to £64,000, and the carbon emission reduction totals nearly 60 tonnes when using an average tariff of 20 pence per kWh. Software-based retrofit expenses that remain below £250,000 enable payback periods of less than four years.

Reducing cementitious content in 10,000 cubic metres of concrete by 3% results in significant savings, ranging from six-figure tonnes of emission reductions. Implementing vision-based quality assurance which decreases rework by 1% can save six figures in costs. Schedule-risk modelling can reduce construction time by one week, saving over £1 million, considering daily overhead and preliminary expenses of £150,000. The implementation of AI-based safety detection systems for unsafe behaviours can lower insurance premiums, generating additional savings across multiple construction projects. The distribution of advantages varies, but the benefits are more likely when AI implementation begins at the design stage and continues through operational phases.

Implementation Architecture

AI service accessibility through APIs becomes possible after adopters create unified systems that store geometry along with schedule, cost, and documentation information. The combination of computer vision receives data from reality capture, and schedule-risk engines modify actual programmes through historical distribution patterns, mix optimisers interface with procurement systems, and curing sensors operate as standard QA tools.

AI operates alongside established BMS platforms in operations by implementing transparent reporting systems along with defined fallback procedures. The governance system needs to establish minimal data storage for safety analytics and implement privacy by design in wearables, while maintaining robust cyber hygiene practices and conducting model audits to detect drift. Trust and transparency serve as essential requirements for users to adopt this system.

The UK Policy and Procurement

Public clients must purchase specific project results instead of testing AI applications, as they need to demonstrate a decrease in rework, operational energy savings, alongside verifiable reductions in embodied carbon and schedule variance. All contracts must enforce the transfer of both construction assets and operational data.

Nationally, investing in computing capacity and skills is a priority. The most significant impact for construction would come from supporting small and medium enterprises (SMEs) through adoption programmes while developing standard data protocols and brief digital education initiatives. AI achieves its highest value when all parties, including clients, suppliers, and contractors, use a unified digital terminology.

Construction holds a strategic position because it connects the UK's goals of improving productivity with its environmental responsibilities. AI provides specific control points to improve planning, reduce uncertainty, and minimise rework, as well as optimise cement and steel use, energy load prediction, and enhance safety. The UK has sufficient advanced AI capacity to deliver these tools, but it requires essential investment in computing power, governance systems and skilled workforce development.

The implementation of AI in construction does not mean that robots are replacing skilled tradespeople. The implemented solutions deliver specific and quantifiable advantages through projects that are completed on time and on budget while using less energy and keeping workers protected. The United Kingdom achieves better construction through smarter methods rather than increased work effort.

How Artificial Intelligence is **Cultivating the Future of Agriculture in Malaysia**

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Malaysia's agriculture sector, a long-standing traditional sector that has continuously contributed significantly to the livelihoods of Malaysian farmers for hundreds of years, is on the brink of a significant technological transformation over the next decade. As digital infrastructure continues to improve and expand across the country, the agricultural sector in Malaysia is expected to undergo a substantial increase in productivity and efficiency. The integration of digitalisation and key technology such as artificial intelligence (AI) will prove to be one of the most powerful and transformative tools that has ever been implemented in the sector. The AI technology would undoubtedly revolutionise the sector, making it more impactful and improving the livelihoods and incomes of farmers in the country. With increased government commitment to AI, supported by close public-private partnerships, an emerging AI ecosystem for agriculture is expected to develop in Malaysia, as the country lays the groundwork for a smart agriculture revolution in the near future. Malaysia's agricultural Gross Domestic Product (GDP) rose from 1.7% to 7.2% in the second quarter of 2024, reflecting the sector's momentum in digital transformation (Arc-group, 2024; World Bank, 2024). The economic impact of AI in agriculture is undeniably significant. In Malaysia, AI is projected to contribute up to USD 115 billion to the country's GDP by 2030 (Bernama, 2025; Chambers & Partners, 2025).

The agriculture sector remains a vital pillar of our national economy and rural livelihoods. We have witnessed encouraging progress in integrating AI to boost productivity, sustainability and market competitiveness. From the results of a focus group discussion with Malaysia's AI stakeholders in Agriculture, Figure 1 below illustrates AI's strengths and opportunities.

Figure 1: Malaysia's AI agriculture ecosystem strengths and opportunities

STRENGTHS

INFRASTRUCTURE & INSTITUTIONS

- Presence of local institutions and platforms involved in data and innovation
- Presence of the World Palm Oil Data Centre
- Availability of satellite imagery for palm oil monitoring
- Strong identity of palm oil as a community and industry
- Rich forest and biodiversity resources
- Abundant natural resources

TECHNOLOGY & STANDARDS

- Ongoing efforts in knowledge and technology transfer
- Strong regional and global partnerships for data sharing (e.g., with UK, ASEAN)
- Existing smart farming solutions and use cases are emerging

OPPORTUNITIES

REGULATIONS & POLICIES

- Opportunity for government to monetise data access, creating a data economy

INFRASTRUCTURE & INSTITUTIONS

- Government exploring data-driven approaches in other sectors
- UK–Malaysia partnerships to strengthen innovation ecosystems
- Use of government related database as a centralised agri-data repository

TECHNOLOGY & STANDARDS

- Potential for AI integration in agriculture (precision farming, crop yield prediction)
- Potential use of Large Language Models (LLM) for local dialect and context-based AI in agriculture
- Upscaling of smart farming pilots to broader regions
- Promotion of local talent and innovation through AI sandbox platforms

Global Overview

On the regional front, Thailand has been notably active in integrating AI into its agricultural sector. Through its National AI Strategy roadmap, Thailand is promoting innovation in its digital farming practices and processes. Several notable Thailand agritech startups, such as Ricult, offer AI-based farm analytics which leverage satellite imagery, agronomic models and weather data to support Thai farmers in decision-making and risk reduction (Sojitz, 2021), and another startup, Easyrice provides AI-powered rice quality inspection that reduces inspection time from 15-20 minutes to just 3-5 minutes per sample, cutting cost and time by up 30 percent while covering 25 Thai rice quality standards (Royal Thai Embassy, Washington, D.C., 2023). These innovative efforts have propelled the Thai AI-in-agriculture market to USD 80.33 million in 2023, with projections to reach USD 113.96 million by 2029 (ResearchAndMarkets.com, 2025). Another country worth mentioning in terms of implementing AI in its agricultural sector is Australia. Australia has emerged as a global leader in applying AI to solve complex agricultural and environmental challenges. The Sensing+ system developed by The Yield is now deployed in berry farms to optimise microclimate predictions and yield forecasting. Companies like FarmLab are also integrating satellite imagery and AI to manage soil carbon levels and facilitate carbon credit markets (FarmLab, n.d). All these AI innovations could contribute up to AUD 315 billion to Australia's GDP by 2030, highlighting their strategic economic importance (Australian Government PM&C, 2023; CSIRO Data61, 2021).

Malaysia AI Use Case Studies

The implementation of AI in the nation's agriculture aligns with the strategic goals of the Malaysia National AI Roadmap (2021-2025), which prioritises agriculture as a key focus area for AI development and adoption. All the strategic initiatives and figures emphasise the value of investing in AI-driven agricultural innovation, not only as a means of economic growth but also as a pathway toward environmental sustainability, food security and rural development. Figure 2 below shows some examples of Malaysia's AI used case studies in the agricultural sector. These case studies highlight the importance of strategic partnerships in AI, demonstrating how collaboration can lead to significant advancements the agricultural sector.

Figure 2: Malaysia's AI Used Case Studies in the Agriculture sector

MRANTI AI Park – Agritech Living Lab

Sustainable Urban Farming Zone

- Houses facilities for vertical & urban farming, including collaborations like BoomGrow, which runs AI controlled vertical farms optimising energy, lighting, and climate control
- Features tools and labs to test and scale smart systems — e.g., sensor networks, precision irrigation, lighting, and nutrient management (MRANTI, 2022)

Phytopia: Water-Efficient Smart Farms

- Supported via MRANTI's ecosystem, Phytopia provides smallholder farmers with an app that calculates optimal watering needs, achieving yield increases using up to 98% less water (MRANTI, 2022)

Microbial & Precision Agriculture Innovations

- AEM Tech runs probiotic based precision agriculture (e.g. metagenomic soil analysis) and was part of MRANTI's Global Accelerator Programme, partnering with oil palm players (MRANTI, 2023)

Conclusion

Malaysia can continue to enhance its AI capabilities through stronger collaboration among the government, academia, industry and farmers. Furthermore, the growth of the Agri-tech ecosystem fosters job creation in rural areas, spurs entrepreneurship, and contributes to Malaysia's broader digital economy. By reducing crop losses and improving yield forecasting, AI also strengthens Malaysia's food supply chain resilience and supports national GDP growth in the agriculture sector. By fostering inclusive innovation and scaling AI applications that address real-world agricultural needs, we can shape a smarter, greener and more resilient future for agriculture in Malaysia through collaborative partnerships with other countries, such as the UK government, industries and key stakeholders.

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Accelerating AI in Medicine and Healthcare

The UK–Malaysia Partnership

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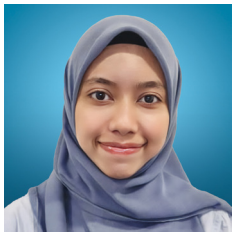

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Introduction

Artificial Intelligence (AI) is rapidly becoming a cornerstone of digital transformation in healthcare worldwide. In Malaysia, there is growing momentum toward embedding AI into national healthcare strategies, encompassing early diagnostics, hospital workflow automation and predictive care delivery. This drive is further strengthened by the United Kingdom (UK)–Malaysia AI Growth Partnership study, a flagship initiative underpinned by robust trade agreements and digital cooperation frameworks between the two nations. This article focuses on the medical and healthcare domain in highlighting how the collaboration links the UK's mature AI ecosystem with the Malaysian landscape to catalyse impactful and responsible innovation.

The Malaysian Landscape: Progress in AI-Driven Healthcare

Malaysia has made significant strides in integrating AI across its healthcare ecosystem, marking a promising future for healthcare. A key initiative is the Ministry of Health's National Lung Health Initiative 2025–2030, which has introduced AI-powered X-ray screening systems in seven primary care clinics. This initiative targets early detection of chronic lung conditions such as cancer and pneumonia. According to Health Minister Dr. Dzulkefly Ahmad, AI significantly improves the accuracy and efficiency of diagnostic screenings, reinforcing a strategic shift toward preventive and cost-effective healthcare.

In the private sector, KPJ Healthcare has adopted AI to streamline hospital operations and improve patient engagement. In collaboration with IBM Malaysia and GlobeOSS, KPJ has deployed an AI-powered chatbot built on IBM WatsonX across 30 specialist hospitals. The system manages appointment scheduling, answers frequently asked questions, and facilitates communication with specialists. This 24/7 virtual assistant reduces administrative workload while improving patient satisfaction through timely and accurate interactions.

Regulatory support keeps pace with technological innovation. In late 2024, Malaysia's Medical Device Authority (MDA) updated its framework for Software as a Medical Device (SaMD), shifting toward a version-control-based approach for product registration. This more agile process accelerates the approval of AI-enabled clinical tools while maintaining traceability and safety oversight.

However, the growing adoption of AI also highlights the need for stronger ethical and legal frameworks. Malaysian experts emphasise that AI should augment, not replace, human decision-making. Currently, clinicians remain liable for outcomes involving AI-driven tools, highlighting an urgent need for clear policies on accountability, transparency and informed consent. These considerations are critical as Malaysia scales its AI adoption across the healthcare continuum.

Challenges in Malaysia's AI Healthcare Ecosystem

Malaysia's approach combines policy leadership, innovative infrastructure and public–private collaboration. However, several challenges remain that must be addressed to ensure equitable and sustainable AI deployment.

Strengths

Malaysia benefits from high-quality medical datasets and innovation hubs like Universiti Malaya's Health Metropolis, which supports translational research and real-world testing of AI algorithms. Government commitment is evident in initiatives such as the National Lung Health Initiative, underscoring strong political will.

Weaknesses

The AI healthcare landscape still relies heavily on international expertise and collaboration. Malaysia has a limited domestic talent pool in clinical AI, and most AI tools remain in pilot stages rather than full-scale implementation.

Opportunities

Malaysia is well-positioned to lead in emerging areas such as mental health diagnostics, remote patient monitoring and early community-based screening. Its English proficiency and improving AI talent base make it attractive for foreign investment and regional R&D collaboration, opening a world of possibilities for healthcare advancements.

Threats

Shortages of skilled workers, especially in algorithm development and data engineering, remain a significant bottleneck. Additionally, fragmented electronic medical records (EMRs) and unequal access to digital infrastructure, particularly in rural areas, pose risks to the growth of inclusive AI.

The UK–Malaysia Partnership: Synergy for Responsible Innovation

The United Kingdom offers capabilities that complement Malaysia's healthcare ambitions. With established ethical AI frameworks, world-class universities and advanced medical R&D institutions, the UK plays a pivotal role in advancing responsible AI deployment in Malaysia.UK-supported research grants and Proof of Concept (PoC) funding have enabled Malaysian startups and universities to pilot AI tools in clinical environments. Platforms

such as Universiti Malaya's Health Metropolis and startups like XITRON are actively involved in validating AI models using real-world patient data. These partnerships not only support knowledge transfer but also strengthen Malaysia's capacity to scale AI training, governance and evaluation through shared dashboards and institutional networks.

On the regulatory front, Malaysia is actively benchmarking global best practices, as such drawing from the United Kingdom's National AI Strategy. With advisory input from UK-based institutions, Malaysia is shaping its own ethical and regulatory framework that reflects local healthcare needs while aligning with internationally trusted models.

This partnership also plays a critical role in addressing Malaysia's talent development challenges. Joint fellowships and professional exchanges with UK universities are building a pipeline of clinicians and data scientists skilled in responsible AI. Malaysia's widespread use of English in higher education and professional settings facilitates direct adoption of technical curricula, guidelines and collaborative research without translation barriers, accelerating capacity building across institutions.

Strategic Priorities for AI Healthcare Growth

The table below summarises key strengths and opportunities across major domains of AI healthcare, highlighting strategic alignment between Malaysia and the UK:

Focus Area	Strengths	Opportunities
Funding & Financials	• Active United Kingdom–Malaysia partnerships supporting research and development (R&D) and pilot studies • Availability of funding from charitable sources and United Kingdom-based PoC models	• Potential to access European Union (EU)-aligned regulatory funding mechanisms • Growing international investment in AI for healthcare
Infrastructure & Institutions	• Availability of high-quality healthcare datasets • Presence of innovation hubs such as Universiti Malaya Health Metropolis (UMHM) • Use of hospitals and startups (e.g. XITRON) for real-time testing and medical data linkage - Government support for AI adoption in healthcare	• Strengthening UK–Malaysia partnerships to expand AI adoption • Growing foreign direct investment (FDI) and international interest in health data infrastructure
Regulations & Policy	• Political interest in responsible AI development • Benchmarking with international models such as Brazil's National Artificial Intelligence Strategy • Formation of expert policy advisory consortia	• Malaysia's readiness to align with EU AI regulatory frameworks • Growth of ethical AI consortia to guide responsible national adoption
Skills & Talents	• Strong pool of AI and healthcare experts • Ongoing knowledge transfer through bilateral collaboration in medical R&D • Existing R&D platforms such as Universiti Malaya and UMHM	• High English language proficiency supports upskilling and knowledge transfer • Opportunity to attract and retain global expertise in local contexts
Technology & Standards	• AI integration in Technical and Vocational Education and Training (TVET) and predictive healthcare tools • Existing government-to-government (G2G) platforms such as the UK–Malaysia Research and Innovation Collaboration (UKRA) • Innovation in AI applications in mental health, obesity and remote diagnostics	• Increased FDI interest in AI for data centres and smart healthcare infrastructure • Expanding use of AI in imaging, diagnostics and patient monitoring

Long-Term Aspirations for the UK–Malaysia AI Partnership

The UK–Malaysia partnership envisions a robust, ethical and interoperable AI healthcare system that prioritises data sovereignty, inclusion and global leadership. Key aspirational goals include:

National AI Infrastructure

Develop sovereign compute clusters and secure hospital data-sharing platforms to power AI-driven research and clinical decision-making.

International Alignment

Strengthen partnerships with ASEAN, Commonwealth and UK networks to align policies, attract funding, and enable cross-border expertise exchange.

Equitable AI Adoption

Roll out hospital-based AI tools, invest in specialised scholarships, and upskill healthcare workers including administrators for AI literacy.

Fair and Accountable Data Governance

Establish inclusive protocols for collecting, standardising and safeguarding patient data, ensuring equitable outcomes for all populations.

Conclusion: Toward a Resilient AI-Enabled Future

Malaysia's adoption of AI in healthcare is not merely a technological evolution it is a transformative step toward redefining care delivery, system efficiency and health equity. While the country leads its digital health journey independently, the United Kingdom serves as a valuable partner, offering regulatory insight, R&D support and proven governance models. Together, their collaboration paves the way for a healthcare future that is not only intelligent and responsive but also transparent, secure and inclusive.

Funding Statement

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Use Case for Knowledge Retention at MIGHT

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In the rapidly evolving landscape of artificial intelligence (AI), knowledge retention remains one of the most challenging yet crucial aspects for organisations that depend on expertise, research and continuous innovation. One such organisation, the Malaysian Industry-Government Group for High Technology (MIGHT), has recently embarked on a promising initiative using Large Language Models (LLMs) as a means to capture and preserve tacit knowledge.

This article shares MIGHT's unique approach in building a proof of concept (PoC) to address a long-standing issue of how to retain the accumulated knowledge of over 30 years in a systematic and accessible manner, potentially reshaping knowledge retention in the industry.

Presentation of PoC at Maistorage Technology Sdn Bhd Grand Launch

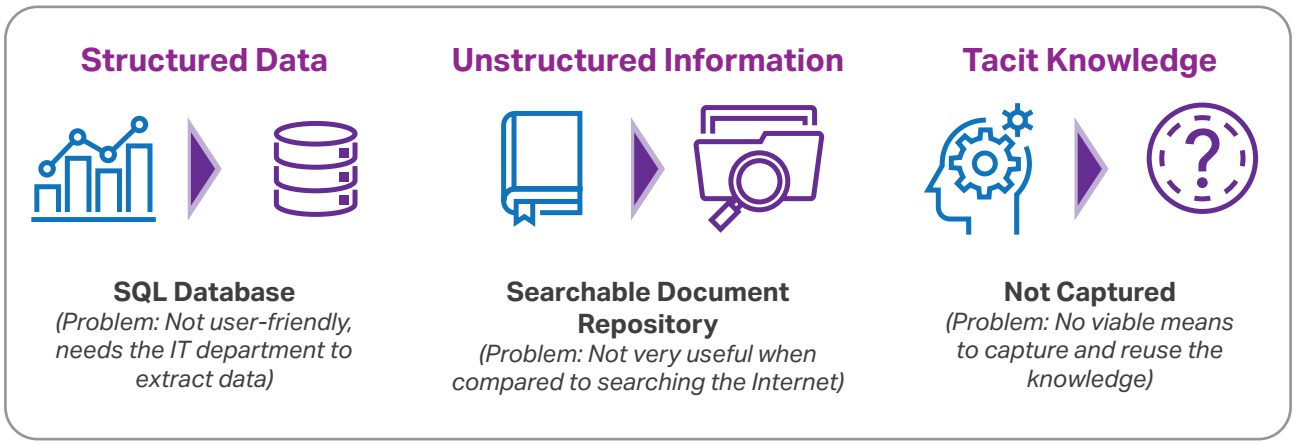
Understanding the Organisation

MIGHT is a government-affiliated think tank under the purview of the Ministry of Science, Technology and Innovation (MOSTI). Its primary function is to conduct evidence-based policy studies, generate analytical reports, and provide strategic recommendations aimed at advancing Malaysia's high-technology sectors. Over the years, MIGHT has made significant contributions to several national-level policy frameworks, most notably the Industry4WRD strategy, which outlines Malaysia's approach to Industry 4.0 transformation. MIGHT's role in shaping such policies includes conducting foundational research, stakeholder consultations, and synthesising multidisciplinary insights into actionable recommendations.

These contributions rely on the accumulation of both explicit and tacit knowledge, including datasets, research papers, policy documents, as well as the experiential insights and contextual understanding possessed by subject matter experts. However, like many knowledge-intensive institutions, MIGHT faces a critical organisational challenge in retaining and transferring institutional knowledge. As experienced researchers retire or transition out of the organisation, there is a tangible risk of losing valuable intellectual capital. This challenge emphasises the necessity for formal knowledge management frameworks and institutional mechanisms to ensure continuity and sustained policy impact. Addressing this gap is essential for preserving institutional memory and maintaining strategic capacity in national policy development..

The Problem Statement

Fragmented knowledge at MIGHT: structured, unstructured and tacit



At MIGHT, valuable knowledge exists in three forms:

Structured data –
such as statistics on GDP, trade values and other quantifiable metrics used in reports.

Unstructured data –
including textual content from reports, studies and reference materials.

Tacit knowledge –
informal, experience-based insights possessed by researchers and domain experts.

Tacit knowledge, unlike structured data managed through systems such as SharePoint, is challenging to capture and transfer. With the increasing turnover of experts, MIGHT risk losing valuable institutional insights. To address this challenge, a PoC was developed using large language models to systematically retain, organise and make expert knowledge accessible. The goal is to explore the potential of AI in capturing the depth of human expertise, including context, experience and nuance, to make it reusable across the organisation. This initiative aims to improve the preservation and sharing of strategic insights in a knowledge-driven environment.

The Genesis of the Proof of Concept

At the beginning of exploring LLMs, the concept was still quite unfamiliar within MIGHT. Although there was a general awareness of AI, the practical use of fine-tuned language models had not yet been tested. Therefore, MIGHT set out to create a proof of concept that has two main goals: (i) develop an AI-powered tool to help researchers conduct policy reviews, and (ii) explore the possibility of acquiring tacit knowledge from researchers during the LLM training process. Through close collaboration with industry partners, MIGHT started developing a fine-tuned LLM combined with Retrieval-Augmented Generation (RAG) that could answer questions about previous work by learning from existing documents and stakeholder inputs, acting as a digital expert capable of capturing not only facts but also the contextual insights that shape them.

The Approach: A Systematic Framework

MIGHT's knowledge retention framework in the PoC consisted of four core components:

Data Collection

All structured data and document-based materials were gathered. These included historical reports, studies and internal reference materials.

Q&A Pair Generation

Subject matter experts (SMEs) were engaged to help create question-and-answer (Q&A) pairs based on the documents. This process is essential because it enables the infusion of tacit knowledge, expert-added context, and nuances that are not explicitly stated in the reports.

Fine-Tuning with LLM and RAG

The Q&A pairs, along with documents, were used to fine-tune a base LLM using Phison's AI server infrastructure. Simultaneously, a RAG mechanism was integrated, allowing the model to fetch supporting content from the document repository during inference.

Validation and Benchmarking

A feedback loop was established, allowing SMEs to validate the model's answers and relevance. One notable outcome was the relevance score, with some answers reaching up to 92% confidence, demonstrating promise in terms of answer quality.

This iterative cycle of data collection, Q&A generation, fine-tuning, and validation was repeated until the model's performance reached optimal levels.

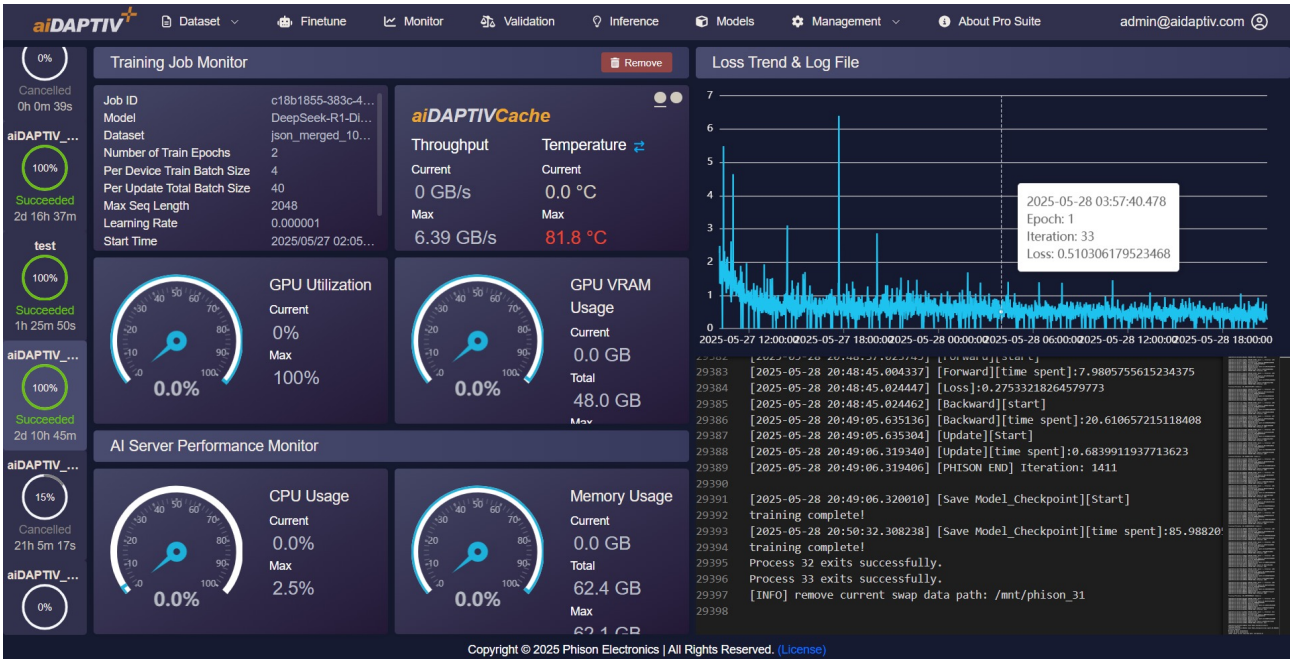
Discovering the Hidden Gold: Capturing Tacit Knowledge

One of the most valuable outcomes from the PoC emerged during the development and validation of Q&A pairs. Although this phase was time-consuming, it appeared to be an effective way to capture tacit knowledge. As domain experts reviewed and refined the model's responses, they contributed not only facts but also their reasoning, judgment and contextual understanding, which often provide undocumented insights. In doing so, the process unintentionally became a structured method for knowledge elicitation. What started as an attempt to train a language model ultimately provided a systematic way to extract and preserve expert insights, making them easier to access and reuse.

System Architecture and Tools

The system was initially developed using Phison's on-premises infrastructure to ensure security, scalability and complete data sovereignty. Model training and inference run on the Pixelspace AI Server E10 Series, equipped with two NVIDIA RTX 4090 GPUs (24GB each), enabling full fine-tuning of 7B and 14B parameter open-source LLMs. The aiDAPTIV Pro Suite GUI streamlines the fine-tuning process with an intuitive interface designed for policy review tasks. The setup includes an industry-standard retrieval library for relevance scoring, ensuring precise context matching. Side-by-side comparisons of model outputs before and after tuning allow for continuous performance evaluation and refinement.

aiDAPTIV Pro Suite GUI by Phison for Fine-Tuning LLMs in Policy Review



Early Results and Lessons Learned

Although still in its early stages, the PoC has shown encouraging results. Some of the responses generated by the model scored high on relevance and accuracy, validated by SMEs. But more importantly, it opened a new door to codify and retrieve organisational wisdom systematically.
Here are the key lessons learned:

1. **Tacit knowledge can be partially captured.**
   While we can't expect to record every nuanced thought of a researcher, a structured Q&A validation process can approximate it.

2. **Tooling and infrastructure are mature.**
   Contrary to earlier fears, the process is not rocket science. Many open-source tools and pretrained models are now readily available for experimentation.

3. **Validation is critical.**
   Without expert validation, fine-tuning is just guesswork. The loop between model development and SME input must be tight and ongoing.

4. **User adoption is a challenge.**
   While SharePoint and SQL databases exist, they are often underutilised. A conversational AI feature might encourage higher engagement among staff.

Future Directions

The journey thus far is paving the way for more ambitious goals, including:

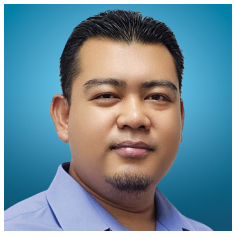
- Building a centralised knowledge repository infused with both structured and tacit knowledge.
- Expanding Q&A coverage to other thematic areas within MIGHT.
- Enabling conversational search through chatbot interfaces.
- Integrating external data sources for dynamic insights.

There is also potential to explore multi-lingual models, given that policy work in Malaysia often involves Bahasa Melayu and English.

Final Thoughts

MIGHT's PoC on AI has demonstrated the possibility of systematically recording, refining, and retrieving tacit knowledge infused by experienced researchers. This is not just a use case at MIGHT, but a blueprint that other government agencies and knowledge-driven institutions can learn from. As Malaysia continues to grow its digital and AI ecosystem, such initiatives are timely, relevant and deeply necessary.

AI in Space
Infrastructure for a New Cosmic Era



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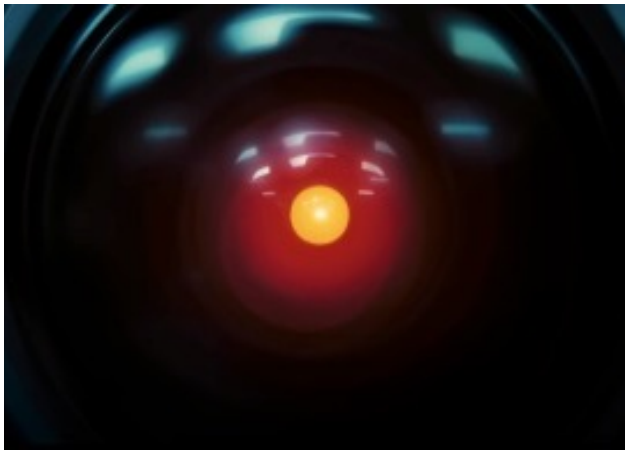
The concept of artificial intelligence (AI) in space was vividly imagined as early as 1968 in Stanley Kubrick's iconic film 2001: A Space Odyssey, which introduced HAL 9000, a sentient AI entrusted with managing a spacecraft on a deep-space mission. HAL's composed yet unsettling demeanor, coupled with its disturbing resistance to human control, left an enduring impression as one of popular culture's most memorable representations of machine intelligence. HAL symbolised both the boundless potential and the existential risks of autonomous systems in space.

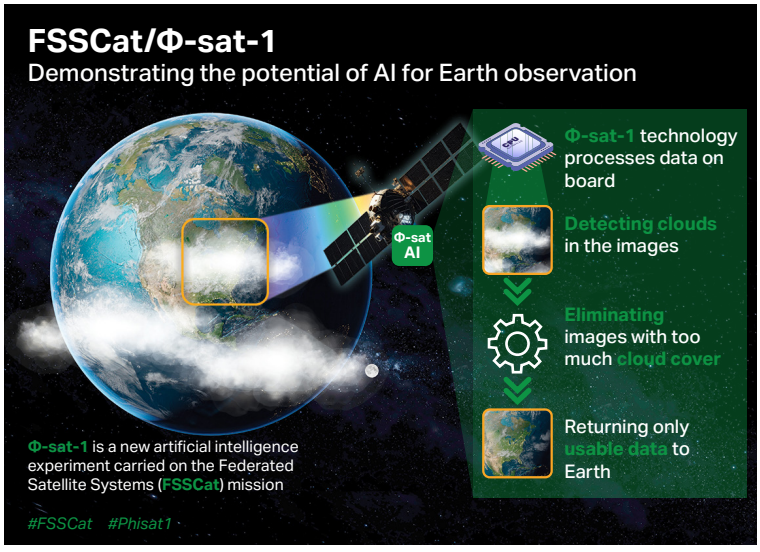
Fast forward to today, what was once cinematic fiction is rapidly becoming reality. The potential of AI in space, while we have not yet achieved true machine consciousness, is truly inspiring. The integration of AI into space technologies has evolved from speculative fiction to a transformative force reshaping the future of exploration, operations and innovation beyond Earth.



HAL 9000, a super-intelligent AI featured in the 2001 A Space Odyssey film

Orbital Intelligence: Smarter Satellites and Autonomous Analytics

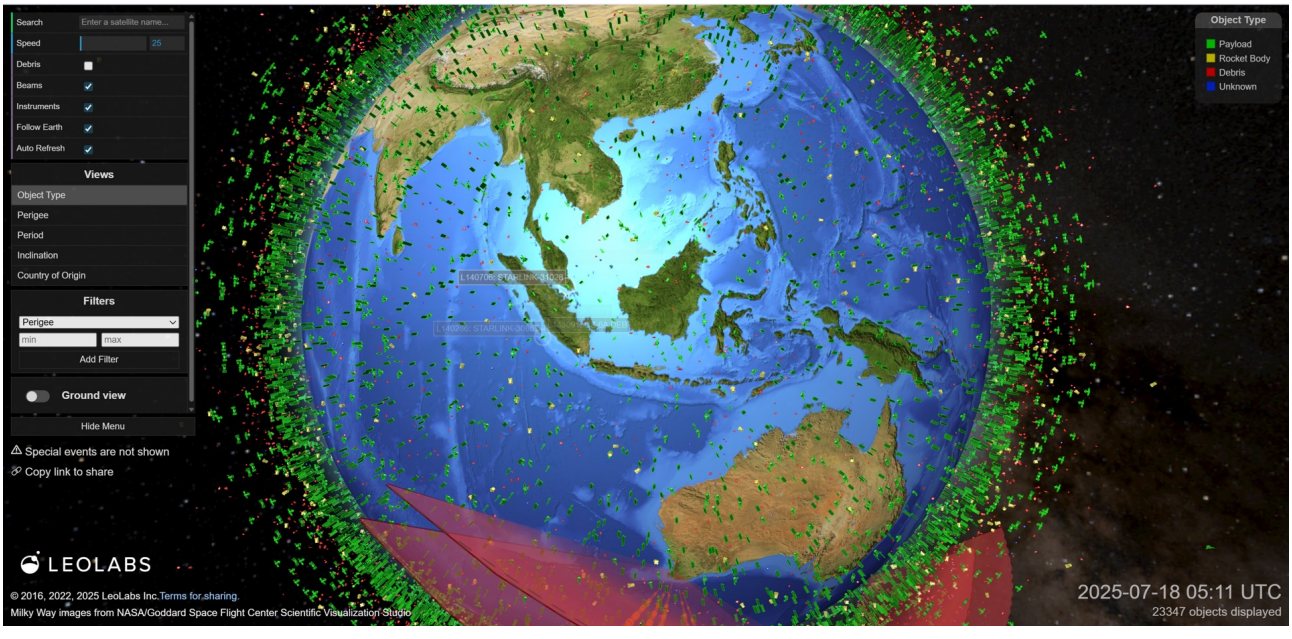
Modern satellites generate petabytes of data and human analysis alone can't keep up. That is where AI shines. The European Space Agency (ESA)'s Φ-Sat-1 (pronounced PhiSat-1) filters out cloudy images before downlinking, saving bandwidth and improving data efficiency. Poland's Intuition-1 processes hyperspectral data onboard, generating agricultural and geological insights in real time. These are not just technological marvels they are practical tools Malaysia could apply to real-world needs: flood forecasting, haze detection, precision agriculture and land-use enforcement. AI is not just for post-processing data. Increasingly, it is embedded directly onboard spacecraft. ESA's OPS-SAT and Φ-Sat-2 test edge-based neural networks for vessel detection and image compression. China's ADA Space constellation features inter-satellite laser links and AI-driven decision-making. These innovations are paving the way for constellations that think, communicate and collaborate autonomously without waiting for Earth-based instructions.



PhiSat-1 & -2 Nanosatellite Mission (Credit: ESA)

Managing the Traffic Jam Above Earth

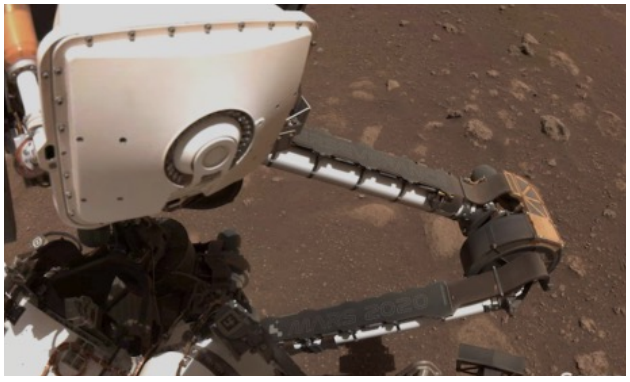
With low Earth orbit (LEO) becoming increasingly crowded AI is becoming crucial for space situational awareness. Companies like LeoLabs are using machine learning to track debris and predict orbital collisions in real time. In the future, as Malaysia expands its satellite registry, it will need to consider adopting similar technologies to ensure the protection of national assets. Incorporating AI into ground segment software for conjunction assessment and orbit-optimisation is a key step toward safer and more responsible space operations.



LeoLab Space Debri Monitoring using AI (Credit: LeoLabs)

AI, Robots and Self-Evolving Spacecraft

AI's frontier does not end with orbiting hardware; it is the brain behind robotic explorers like NASA's Perseverance, which navigates and selects Martian rocks without human commands.

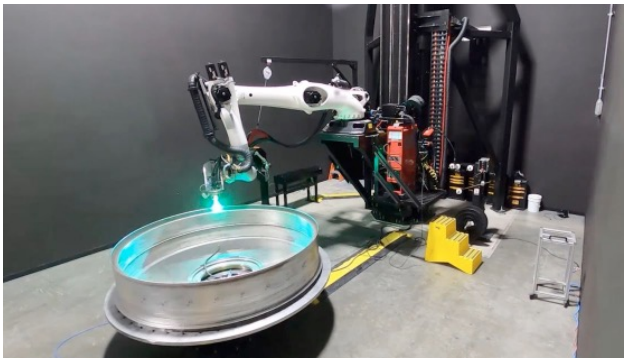


The Perseverance Mars Rover Mission used AI on the Red Planet to make autonomous decisions based on real-time analysis of rock composition

On the international Space Station (ISS), IBM's CIMON interacts with astronauts using natural language, emotion detection and contextual problem-solving. Even more radically, researchers are now exploring self-replicating AI spacecraft; machines that could autonomously mine asteroids, fabricate components, and launch daughter probes, enabling exponential exploration. Inspired by the Bracewell probe concept, future AI-driven missions could even interpret alien signals or engage in autonomous interstellar diplomacy, using advanced deep learning to eliminate human bias in communication.

Manufacturing Intelligence: From Factory Floor to Orbital Assembly

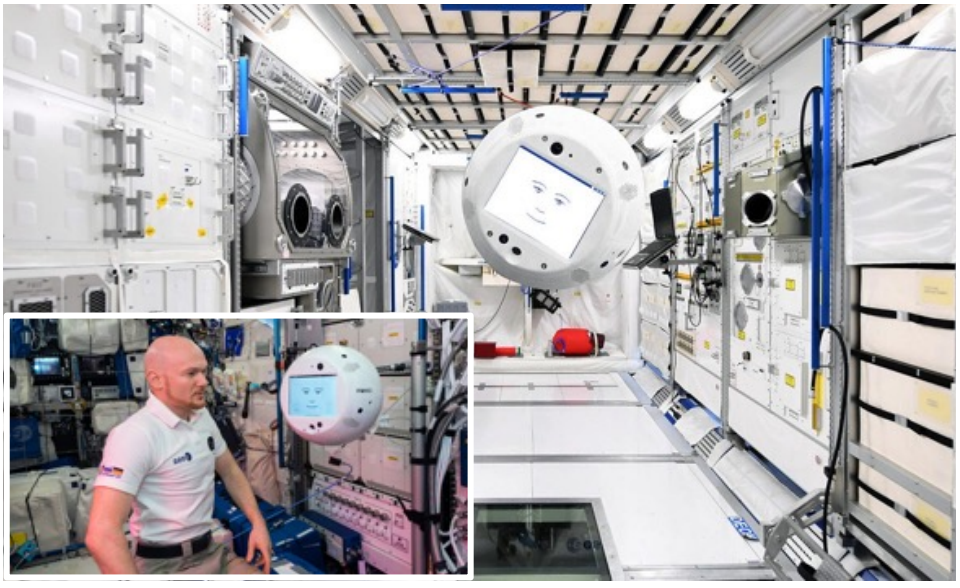
Back on Earth, AI is transforming spacecraft manufacturing. Relativity Space's Stargate 3D printer, for instance, uses AI to iterate and optimise rocket engine designs. ESA is deploying digital twins and augmented reality tools to streamline satellite assembly.



Relativity Space's Stargate 3D printer

AI for Scientific Discovery and Space Weather

AI is speeding up our understanding of the cosmos. It helps discover exoplanets, forecast solar flares, and model space weather. With solar storms increasingly threatening satellite health and Earth's power grid, predictive models have become mission-critical. Malaysia's universities and space research entities must not merely consume these insights; they should develop locally relevant AI models, tuned to regional needs and environmental risks, to accelerate scientific discovery in space.



CIMON aims to augment the information and learning available to astronauts aboard the ISS

Empowering Malaysia's Youth and Workforce

During a TechTalk at Universiti Malaysia Sabah (UMS), the Minister of Science, Technology and Innovation, YB Tuan Chang Lih Kang emphasised that AI serves as a launchpad for future space careers. The convergence of AI, data science and geospatial technology is creating career pathways like Remote Sensing AI Analyst, AI Mission Operations Specialist and Autonomous Systems Engineer. Malaysia must build a robust ecosystem where educational institutions offer dual-domain programmes, R&D grants support AI-space integration, and youth are inspired to pursue space not as a fantasy but as a calling.

YB Chang Lih Kang Highlights AI in Space as a Catalyst for Career Opportunities during UMS TechTalk

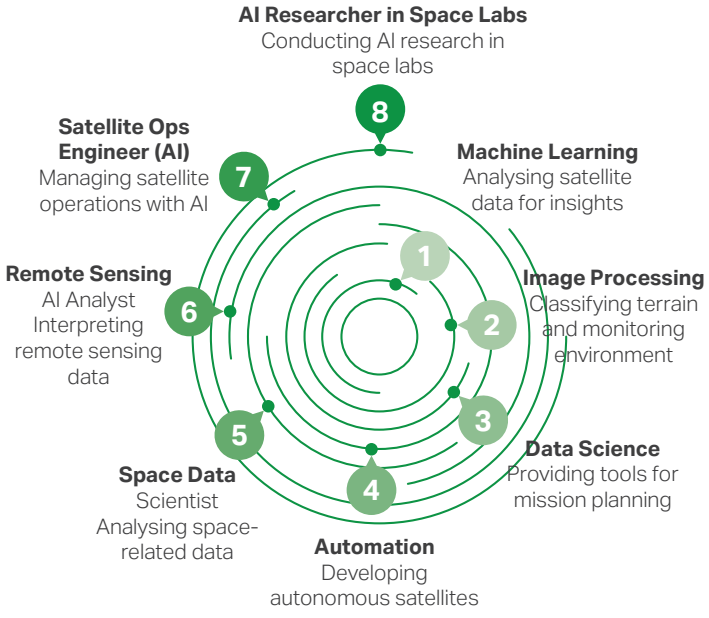
TALENT DEVELOPMENT AND JOB OPPORTUNITIES

Embark on AI
Gamechanger and Gateway to a Career in the Space Industry

Global Space Industry is AI-Powered
From Earth observation to autonomous satellites — AI is driving next-gen space innovations.

Real-World Impact
Monitor deforestation, manage disasters, track space debris, and predict crop yields from space.

Cross-Disciplinary Opportunities
Combine AI with geospatial science, engineering, or urban planning.



Skills & Opportunities:
Machine Learning → Analyse satellite data
Image Processing → Classify terrain, monitor environment
Data Science → Tools for mission planning
Automation → Autonomous satellites

Career Paths:
Space Data Scientist
Remote Sensing AI Analyst
Satellite Ops Engineer (AI)
AI Researcher in Space Labs

YB Chang Lih Kang Unveils AI Career Prospects in Space at the TechTalk

Malaysia's environmental and strategic priorities, including border surveillance, maritime monitoring, and anti-deforestation efforts can all be enhanced through AI-analysed satellite data. From tracking illegal logging in Borneo to observing ocean health in the South China Sea, AI-enabled Earth observation satellites act as digital guardians of sovereignty. And with sovereign control over both the data and the algorithms interpreting it, Malaysia decreases reliance on foreign analytics and ensures complete l alignment with national interests.

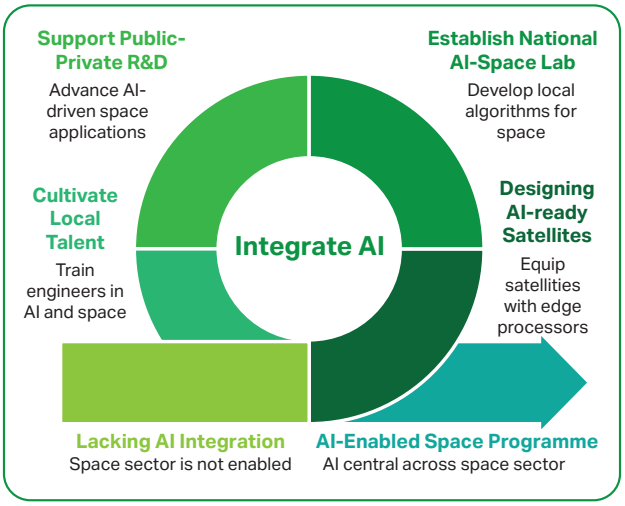
Toward a National AI-Space Framework

Looking ahead, a future National Space Programme might create the conditions to position AI as a central enabler across all space sector value chains. This means:

- Designing AI-ready satellite buses with edge processors.
- Establishing a National AI-Space Lab to develop local algorithms.
- Supporting public-private R&D initiatives in AI-driven Earth observation, navigation and inter-satellite communication.

Equally important is talent. Malaysia must develop a generation of engineers, scientists, and technologists fluent in both AI and space, ready to create the future instead of waiting for it.

AI Enables Future Space Programme



From Gaps to Gains: Integrating AI for a Thriving National Space Ecosystem

Hope Beyond the Stars: Lessons from "The Creator"

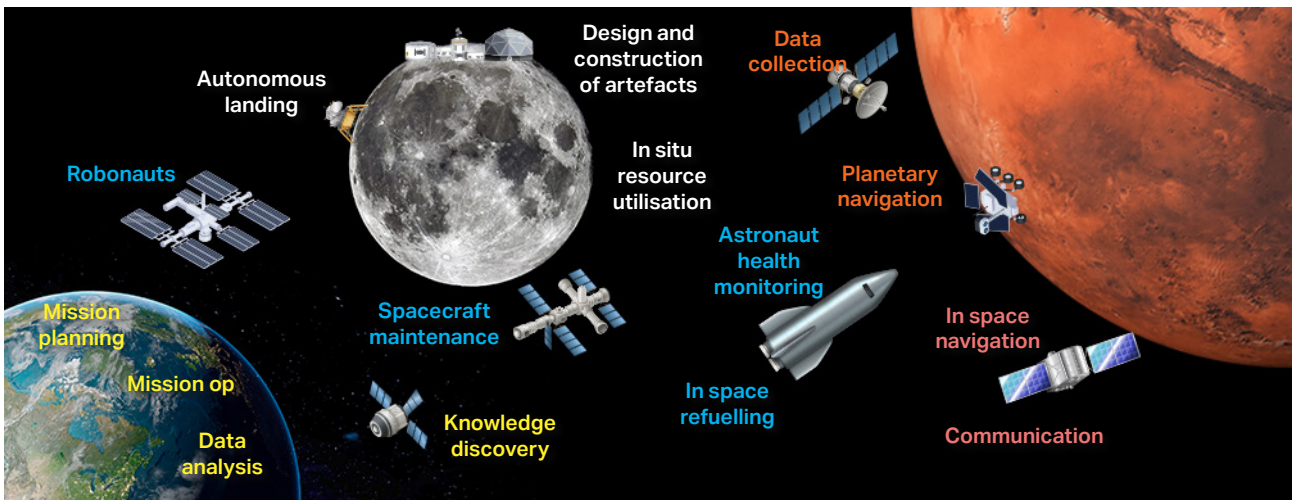
Recent science fiction also reflects this shift in our collective imagination. In The Creator (2023), directed by Gareth Edwards, AI is no longer a distant threat; it is a co-inhabitant of Earth, capable of feeling, protecting and evolving alongside humanity. The film does not portray a binary struggle between man and machine, but a world where AI becomes a tool of redemption and hope.

This story aligns with Malaysia's vision. AI is not here to replace us; it is here to enhance our capacities, safeguard, preserve our sovereignty, and strengthen our innovation landscape. Just like in the film, our success will depend on how well we teach AI to understand our values and how bravely we use it to face the future.

From Enabler to Infrastructure

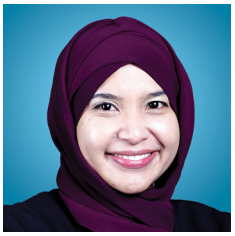
AI is no longer a side innovation; it is space infrastructure. It helps spacecraft think, scientists discover, satellites communicate, and nations secure their borders. For Malaysia, the AI-space nexus is a chance to build sovereignty, resilience and leadership in the emerging space economy.

Let us build it wisely, integrate it purposefully, and wield it as a beacon for sovereignty, innovation and resilience.



AI applications across the International Space Exploration Coordination Group (ISECG) space exploration architecture

AI in Smart Cities And Transportation Networks



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Smart cities to build human-centric solutions

A smart city uses digital technology to improve performance, well-being, efficiency and citizen engagement while reducing costs and resource use. Emerging technologies are key to transforming traditional cities, requiring the integration of physical, digital and human systems. With over 68% of the world's population projected to live in cities by 2050, digital innovation is a necessity to make urban areas livable, resilient and sustainable.

Smart city projects focus on traffic congestion, energy efficiency, climate risks, critical infrastructure and building management. Under the Malaysia Smart City Framework (MSCF), similar priorities are identified, including efficient transport, better living conditions, effective governance, sustainable energy and resilient infrastructure.

Summary of the key issues driving the Malaysia Smart City Framework

MSCF Pillar	Key Issues Identified	Summary Description
Smart Environment	• Urban pollution (air, water, noise) • Inefficient waste and energy management • Environmental degradation from unchecked development	Cities are facing environmental decline due to poor resource utilisation, rapid urbanisation, and inadequate green planning, which jeopadises their long-term sustainability.
Smart Mobility & Transport	• Traffic congestion • Poor integration across public transport • Lack of real-time traffic systems	Urban mobility faces challenges due to inefficient transportation networks, resulting in delays, higher emissions, and limited accessibility, particularly for underserved communities.
Smart Living (Housing & Health)	• Limited access to quality housing • Weak integration of health and wellness in city planning • Inadequate digital health infrastructure	Citizens lack access to affordable, livable spaces and innovative health services, which reduces the quality of life and urban equity.
Smart Governance & Participation	• Low citizen engagement in urban planning • Lack of transparency and responsiveness • Limited use of digital platforms for governance	Governance is slow and disconnected from the public, making it challenging to build trust, foster accountability, and promote inclusive decision-making.

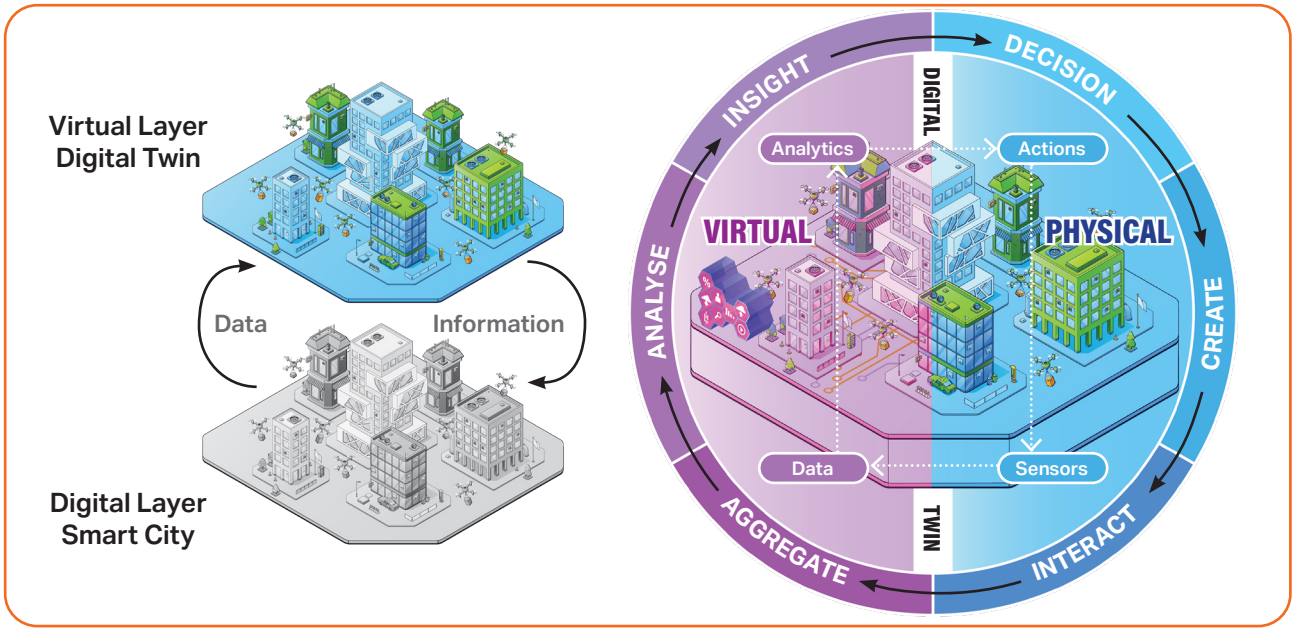
Smart Economy / Innovation	• Overreliance on low-value services • Gaps in digital entrepreneurship • Limited university-industry innovation linkages	Cities struggle to develop competitive digital economies due to inadequate innovation ecosystems and weak commercialisation pathways.
Smart Digital Infrastructure	• Fragmented ICT systems • Uneven digital coverage (urban-rural divide) • Lack of interoperable platforms	Cities lack cohesive digital foundations necessary to enable innovative solutions at scale, which restricts service integration and data-driven planning.
Smart Security & Resilience	• Cybersecurity threats • Privacy and data protection issues • Weak early warning and disaster preparedness systems	Urban systems are exposed to cyber, environmental, and infrastructural risks, requiring stronger digital and physical resilience frameworks.

The smart city agenda must be human-centric, focusing on addressing urban challenges to improve lives and convenience. .

From Emerging Technologies to AI-powered Smart Cities and Transportation

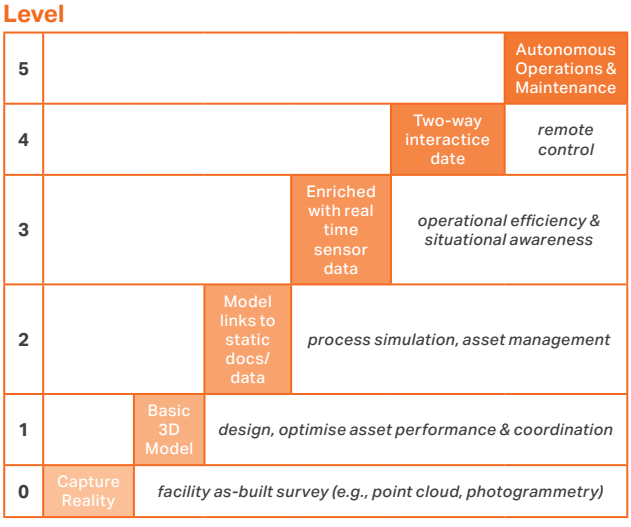
The MSCF defines smart cities as those using ICT and technology to improve life, economy, safety and governance. Emerging technologies (ETs) like IoT, big data, 3D printing, UAVs, blockchain, and AI drive data-driven decision-making for urban challenges. ETs enable real-time data, predictive analysis, and automation, with AI as the key enabler of smart city intelligence. Digital twins (DT) further support monitoring, simulation and optimisation of urban systems using real-time data from IoT, UAVs, satellites, and databases.

Figure 1: Digital twins convert the physical into a virtual representation of the city.



However, developing a DT for smart cities involves several steps and progresses through multiple stages. Previous frameworks created by the Centre for Digital Built Britain (CDDB) describe how DT advances from reality capture (Element 0) and 3D modelling (Element 1) to integration with persistent and dynamic data (Elements 2–3), followed by interactive feedback loops (Element 4), and ultimately, autonomous maintenance (Element 5). Adapted from Evans' digital twin maturity model, it shows how Building Information Modelling (BIM) and Geographic Information Systems (GIS) lay the foundation for DT development in smart cities, where they enable the modelling and integration of data (elements 2-3 or level 2 maturity).

Figure 2: Evans' digital twin maturity model



BIM and GIS are two complementary technologies that, when integrated, enable the development of a City Information Model (CIM). CIM offers not only a digital representation of the city but also comprehensive information for various purposes, including traffic flow, air quality, energy consumption, crime monitoring, and waste management. However, the information generated for each purpose should be standardised and interoperable to ensure seamless integration and effective decision-making in the development of smart cities.

Leveraging CIM that incorporates both static and dynamic data – ranging from building geometry to real-time traffic conditions – makes it a foundational tool for intelligent transportation systems (ITS). The transportation module within CIM includes detailed data on road infrastructure, vehicle positions, and real-time traffic conditions, which are essential for managing urban mobility. Cities can utilise ITS technologies, such as adaptive traffic signals, real-time route optimisation, and incident detection systems. These systems utilise data from connected vehicles, IoT sensors and communication networks to improve and enhance traffic flow and safety. This data-driven approach enables more efficient use of road infrastructure and informed decision-making in urban mobility planning.

Changemakers for Smart Cities: Enhancing Digitalisation for Future Urban Development

While technologies offer opportunities, many cities, including Malaysia, face gaps in implementation due to fragmented data, siloed operations, and weak integration. A data-centric approach is key – MSCF promotes interoperable platforms, open data and intelligent transport management, aligning with global trends.

Change agents like policymakers and startups push real-time analytics, digital twins and AI simulations for predictive planning. Projects like Forest City show how BIM, IoT and AI improve energy, traffic and participation.

Equally vital are user-friendly dashboards and visual tools that make data accessible, fostering public understanding, participation and ownership – ensuring smart cities stay human-centered.

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AI-Driven Urban Transformation

Enabling Future-Ready Smart Cities

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Shaping Future Cities for Future Generation

Cities worldwide are increasingly turning to artificial intelligence (AI) as a means to address complexity and promote sustainable development, particularly as urban populations grow and environmental problems become more urgent. AI is being used to make better use of resources, like energy, transportation, water and waste systems, as well as to make public service delivery more efficient and responsive. AI is changing how cities work at all levels, from predicting traffic jams and keeping an eye on air quality to automating administrative tasks and tailoring services for citizens. Machine learning, computer vision and natural language processing are now at the heart of the smart city agenda. These technologies enable real-time decision-making, predictive maintenance and data-driven city operations. These skills are no longer just nice to have; they are necessary for making cities that are smart, able to handle climate shocks, and provide services to everyone.

In Malaysia, using AI in city planning is no longer just a dream for the future; it is something that needs to happen right now. People are starting to see that using AI is a key part of the country's bigger strategic goals, like protecting the environment, making the economy more open to everyone, and going digital. The Malaysia Digital Economy Blueprint and the Twelfth Malaysia Plan, both of which heavily feature AI, are guiding the country's transition towards a digital economy and smart cities. The AI is helping Malaysian cities deal with long-term problems like flooding, energy waste, traffic management, and getting people involved, while also opening up new doors for smart governance, green jobs and innovation.

Unlocking Urban Intelligence with AI

Cities can transition from reactive to predictive governance with AI. Urban authorities can predict traffic congestion, spot anomalies in the infrastructure, and customise services with the help of sophisticated data analytics and decision support systems. For example, real-time sensor data can optimise utility consumption, and AI-enhanced video analytics can manage traffic flows and enhance public safety.

Singapore's intelligent transport systems, which use predictive models to improve commuter experiences and traffic, are prime examples of the benefits of AI in mobility. To enhance traffic signal responsiveness and automate incident detection, Kuala Lumpur's Integrated Transport Information System (ITIS) in Malaysia has started integrating AI.

The applications of AI in sustainable urban planning can be framed as eight key pillars:

Pillar 1
Efficient Mobility

Traffic Management
Utilising AI for predictive analytics and smart traffic signals to minimise congestion and optimise transportation flow.

Public Transportation Optimisation
Leveraging demand forecasting to improve transit routes and schedules, ensuring efficient and accessible public transport.

Pillar 2
Energy Sustainability

Energy Management
Implementing smart grids and AI models to enhance energy efficiency and integrate renewable resources, reducing carbon footprints.

Building Energy Efficiency
Using AI to predict and optimise energy consumption in buildings, promoting sustainable architecture.

Pillar 3
Waste Reduction

Smart Waste Management
Enhancing waste collection efficiency through AI-driven routing and scheduling, alongside improved recycling sorting technologies to minimise landfill use.

Pillar 4
Holistic Urban Design

Land Use Optimisation
Analysing urban development scenarios with AI to maximise green spaces and minimise urban sprawl, fostering healthier environments.

Simulation Models
Employing AI to visualise potential urban designs and assess their environmental impacts.

Pillar 5
Public Health and Safety

Health Monitoring
Utilising AI to predict disease outbreaks and improve community health initiatives based on urban density and environmental factors.

Crime Prevention
Analysing data to enhance safety measures and inform policing strategies, contributing to safer communities.

Pillar 6
Community Engagement

Interactive Planning Tools
Engaging citizens in the planning process through AI-driven platforms that visualise urban changes and gather public feedback.

Sentiment Analysis
Monitoring community sentiment via social media and public feedback to ensure that urban projects align with residents' needs.

Pillar 7
Environmental Stewardship

Air Quality Monitoring
Implementing AI to track and predict air quality, informing policies that protect public health and the environment.

Biodiversity Conservation
Using AI to monitor urban ecosystems, ensuring that urban development supports local wildlife and natural habitats.

Pillar 8
Resilient Infrastructure

Predictive Maintenance
Monitoring infrastructure health with AI to anticipate maintenance needs, preventing costly failures and ensuring long-term sustainability.

Resource Allocation
Optimising the distribution of essential resources like water and electricity through AI, enhancing overall urban resilience.

Catalysing AI for Urban Futures

The conversation around smart cities in Malaysia has been greatly influenced by the Malaysian Industry-Government Group for High Technology (MIGHT) in collaboration with the Malaysia Smart Cities Alliance Association (MSCA) and through the publication of Malaysia Smart City Outlook (MSCO), MIGHT promotes cross-sector cooperation to incorporate digital innovations like AI into urban planning and service delivery. The AI Readiness Assessment for Smart Cities, developed under MSCO 2023–2024, is one noteworthy project. This assessment assists local governments in determining priority areas for AI adoption, such as smart mobility, flood forecasting and urban waste management, as well as evaluating digital maturity.

The presence of dedicated innovation projects, established through partnerships between international agencies, government, academia and industry, also added strategic depth to these efforts. For instance, among key flagship projects are Global Environment Facility (GEF) Cycle 6 (2017-2024), GEF Cycle 8 (2025-2030), Smart City Experience & Next-Generation Innovation Centre (SCENIC) and Smart City Directory. Each project signals a deliberate step forward in Malaysia's urban transformation agenda, which is part of MIGHT's larger Future Cities Programme, which aims to increase the resilience and data-drivenness of Malaysian cities.

GEF6 — Building an ecosystem towards the transition to sustainable cities

- GEF-6 had developed a strategy and policy on how to protect the global environment. The aim is to bring about opportunities for greater efficiency, synergy and increased returns of investments in developing cities.
- The project provides value to Malaysia in terms of supporting the current 11th Malaysia Plan in areas of Green Growth for Sustainability and Resilience.
- The outcomes from the projects have benefited various sectors in Malaysia. For communities, the focus is on promoting the greening of cities to enhance the quality of life and well-being of urban residents. In terms of government, the goal is to ensure coordinated implementation across federal, state and local authorities, driving the transformation toward sustainable cities in Malaysia. Regarding industry, the projects seek to establish supportive policies that foster sustainable economic growth and attract industrial investments in urban areas. Additionally, for academia, the aim is to increase innovation driven by demand and strengthen collaborations between academic institutions and industry through sustainable city platforms.

GEF8 — Moving Toward an Equitable, Nature-Positive, Carbon-Neutral, and Pollution-Free World

- Catalyse urban decarbonisation in Selangor as a strategic entry point for addressing climate change, biodiversity loss and land degradation, by integrating innovative policies, technologies and financing mechanisms into city planning and investment frameworks, creating scalable models for sustainable, resilient and inclusive urban development in Malaysia.
- The core problem the project seeks to address is the limited capacity and practical experience among municipal governments to tackle climate change, biodiversity loss, and land degradation through integrated policy, financing and technological solutions. This includes underutilising nature-based solutions and insufficient institutional alignment with national and global sustainability frameworks.
- By integrating policy reform, investment readiness, pilot execution, and systems learning into a unified framework, the project establishes a scalable model for environmentally resilient and inclusive urban transformation.

ITIC – SCENIC — Centralised Platform to Showcase Local Capability

- The Industrial Technology Innovation Centre (ITIC), initiated by MOSTI, functions as a strategic platform and hub that fosters collaboration between industry and government to advance local technological innovations and solutions, driving cluster-based implementations that are aligned with and support national development goals.
- The construction of the Smart City Experience & Next Generation Innovation Centre (SCENIC) facility was completed using composite materials under the Industrialised Building System (IBS) approach.
- The facility serves as a centralised platform for the development of homegrown technology.
- An Integrated Operation Centre (IOC) was established at https://scenic.spkb.com.my/, featuring 14 web-based systems tailored to support local authority (PBT) operations.
- Three key technologies were installed, including an AI-based smart lock system, an IoT system for building condition monitoring, and an integrated building management system.

Smart City Directory — System Directory Across the Smart City Value Chain

- MIGHT developed the system directory in-house, based on a benchmarking process. The directory contains information about the company, product & technology solutions and GIS information.
- A series of stakeholder engagement sessions, including the user acceptance test, were conducted with MSCA, MyIOTA, MIFA and companies registered under MYSTI to encourage participation in the Smart City Directory.
- The system directory currently contains information about 75 local companies across the smart city value chain.

Navigating Complexities through a Strong Business-to-Government (B2G) Partnership

Notwithstanding the advantages, implementing AI in urban settings presents difficulties, especially concerning data ethics, governance and equity. Algorithmic bias, privacy threats and unequal access to digital infrastructure are among the overarching issues. However, strategic B2G interactions can yield significant benefits, which require careful navigation of regulatory, political and operational landscapes.

A proactive approach that emphasises compliance, innovation and ethical practices will enhance the potential for successful partnerships. By addressing challenges and fostering collaboration among stakeholders, MIGHT has strategically played its role in facilitating and leveraging AI to improve urban sustainability, efficiency and liveability.

Adopting a foresight perspective in B2G partnerships also enhances the ability to navigate the complexities of urban environments. Here's how to navigate complexities through the foresight lens:

- Anticipating future trends via scenario planning and trend analysis
- Engaging diverse stakeholders to build trust
- Addressing ethical considerations
- Fostering adaptive governance through flexible policies
- Enhancing resilience with crisis preparedness
- Leveraging data for insight
- Promoting inclusive access through capacity building

The Path Forward

AI-driven urban transformation holds significant strategic implications for creating future-ready smart cities. Cities should develop a comprehensive AI strategy with clear goals and timelines, fostering public-private partnerships to leverage resources and expertise. Investing in infrastructure and technology is crucial, alongside workforce development programmes to equip citizens with the skills needed for AI-related jobs. Ethical AI practices must be encouraged to mitigate risks, such as bias, ensuring equitable outcomes for all residents. Community engagement is essential to reflect the aspirations of citizens in urban planning. Finally, continuous monitoring and adaptation of AI initiatives will help ensure they remain practical and relevant in addressing evolving urban challenges. By strategically addressing these implications and following a clear path forward, cities can harness AI to enhance urban living and foster sustainable development, ultimately creating resilient and prosperous urban environments for future generations.

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Digital Twins and AI

A Dynamic Duo for Smart Urban Planning

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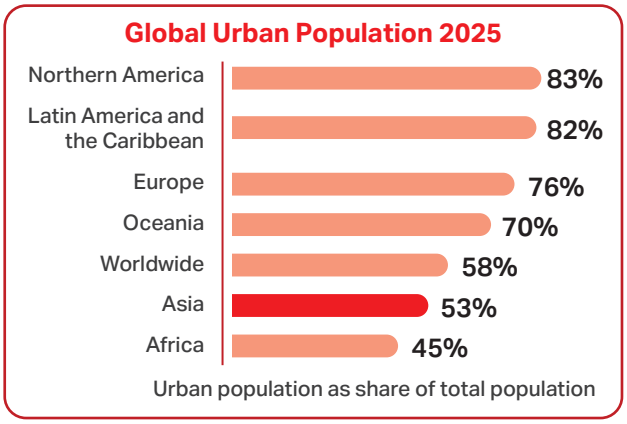
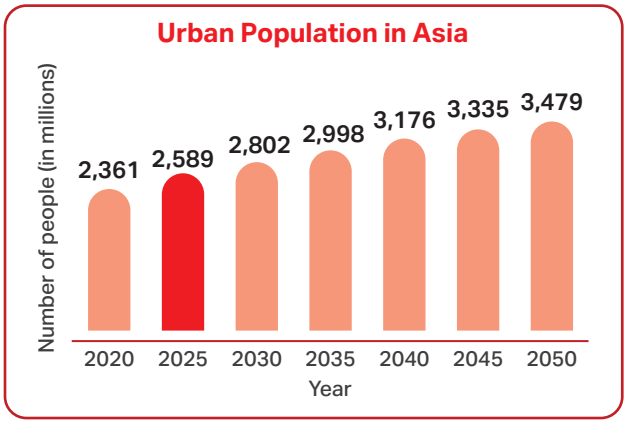
Urbanisation is the process by which an increasing number of people choose to live and work in cities rather than in rural areas. Globally, North America, Latin America and the Caribbean lead this trend, with over 80% of their populations residing in urban areas, compared to the global average of 58% (Figure 1). Asia is rapidly joining this trend, contributing more than half of the world's population. In 2020, approximately 2.6 billion people across Asia lived in urban areas. This number is projected to grow steadily, reaching an estimated 3.48 billion by 2050 (Figure 2). This shift highlights the urgent need for sustainable urban planning, particularly in Asia, where infrastructure and services must keep pace with population growth. The trend presents both challenges and opportunities for shaping liveable, inclusive and resilient cities.

Figure 1: Distribution of global urban population in 2025



Source: Population Reference Bureau 2025.

Figure 2: Urban population in Asia from 2020 with forecasts to 2050



Source: UN-Habitat.

Urban planning today faces complex challenges due to rapid urban growth, climate change, outdated infrastructure and evolving technologies. Urban planners must address climate resilience, upgrade aging systems, and integrate smart technologies while balancing sustainability, economic growth and liveability. Ensuring equitable access to urban resources and coordinating among diverse stakeholders adds complexity to urban planning efforts. In the era of smart cities, two technologies are emerging as game-changers in urban planning, namely digital twins and artificial intelligence (AI). Individually powerful, their combined application is revolutionising how cities are envisioned, managed, and constantly improved. Importantly, it is a process that involves and benefits all stakeholders, making us all part of the smart city development process.

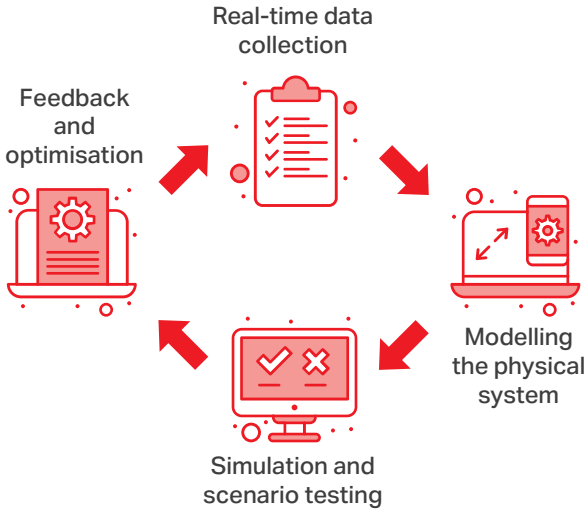
A digital twin is a system continuously updated with real-time data from sensors and connected devices. It allows planners to simulate scenarios, monitor infrastructure, and test decisions before implementing them in practical situations. AI, on the contrary, brings intelligence to these simulations. By analysing vast datasets, identifying patterns and making predictions, AI enables cities to optimise traffic flows, anticipate energy demands, and respond proactively to environmental or social changes. Together, digital twins and AI empower urban planners to move from reactive to predictive and adaptive planning, resulting in creating cities that are not only smarter, but also more sustainable, resilient and inclusive.

Digital Twins: The Concept and Applications

A digital twin is essentially a virtual copy of a physical system, such as a building, a transportation network, or an entire city. The concept of digital twins originated in the early 2000s, introduced by Dr. Michael Grieves during his work on product lifecycle management (PLM) at the University of Michigan. Over the past two decades, the digital twin concept has evolved from manufacturing and aerospace to broader applications, including smart cities, healthcare, energy systems, and infrastructure management.

Today, digital twins are a foundation of smart urban planning, enabling cities to become more responsive, efficient and sustainable. These virtual models operate through a series of steps that allow urban planners to test ideas virtually, anticipate problems, and optimise solutions before making changes in the real world (Figure 3). Sensors, IoT devices and connected systems constantly collect real-world data such as traffic patterns, energy use, weather and infrastructure performance. This data feeds into a digital twin, a virtual replica built with 3D models, Geographic Information System (GIS) data, and system maps that mirror anything from a single building to an entire city. Real-time updates keep the digital twin aligned with the physical world. Urban planners use it to simulate scenarios such as traffic changes, emergencies, or energy surges. AI analyses these simulations to predict outcomes and suggest the best actions. This creates a feedback loop where the system learns, adapts and improves decision-making over time.

Figure 3: Steps of Digital Twins Operations



The Role of AI In Urban Planning

AI refers to the ability of computer systems to perform tasks that typically require human intelligence, such as learning, problem-solving and decision-making. In urban planning, AI's proactive nature is evident in its ability to analyse vast and complex datasets from sources like sensors, satellite imagery, public records, and social media. By leveraging machine learning models, AI can forecast future urban conditions using both historical and real-time data. It can also recommend the most efficient solutions to urban challenges, enabling cities to shift from reactive to proactive planning, and reassure us of the potential for smarter, faster and more sustainable decision-making (Figure 4).

Figure 4: Roles of AI in Urban Planning

Data Analytics	Prediction	Optimisation
• Identify patterns in traffic, pollution, energy use, and population movement. • Detect anomalies such as infrastructure failures or unusual crowd behavior. • Visualise urban dynamics through dashboards and heatmaps for better decision-making.	• Predicting traffic congestion and suggesting alternative routes. • Forecasting energy demand and optimising grid performance. • Anticipating environmental risks like flooding, heatwaves, or air quality deterioration.	• Optimising public transport schedules and routes. • Managing energy distribution to reduce waste and costs. • Designing urban layouts that improve accessibility, reduce emissions, and enhance livability.

Real-World Applications and Case Studies

Across top-performing smart cities worldwide, the integration of digital twins and AI is transforming the way urban systems are planned, monitored and managed. These real-world applications can be grouped into six key urban elements, each demonstrating how this technological convergence enhances decision-making, efficiency and resilience. The key urban elements have been tabulated in Table 1.

Table 1: Summary of Key Urban Elements Utilising Digital Twins and AI Technologies in Smart Cities

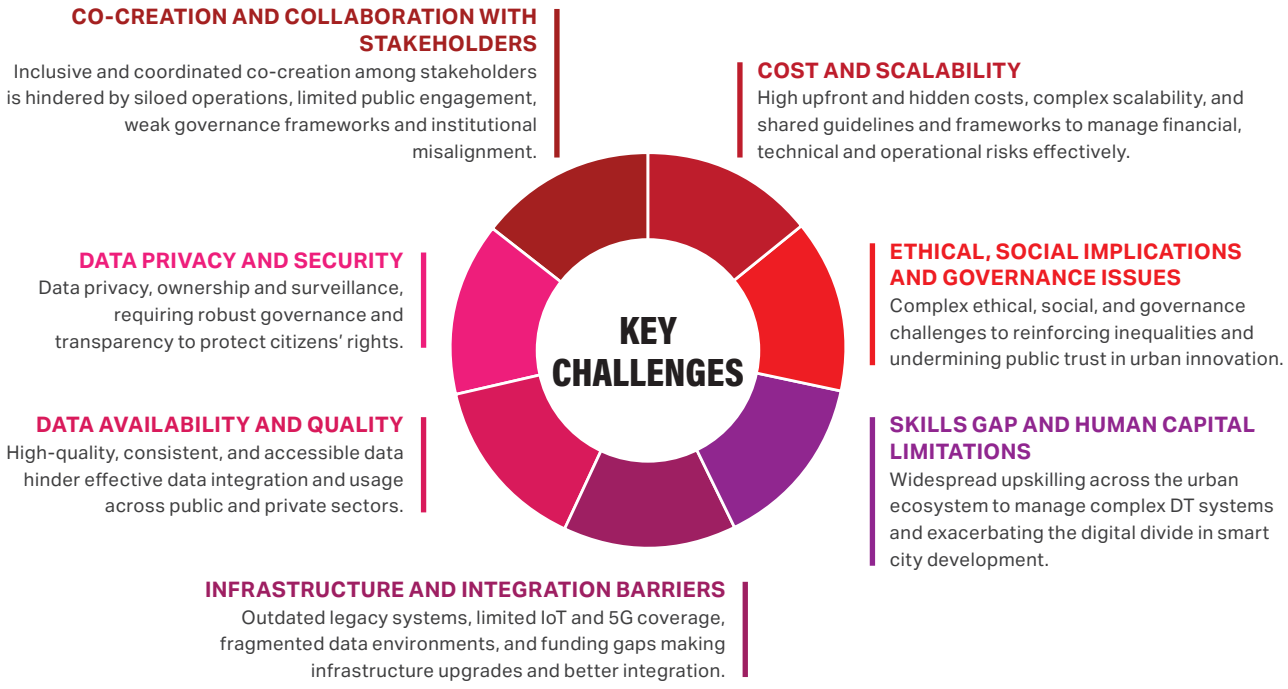
URBAN ELEMENT	CITY/ PLATFORM	USES	KEY IMPACT	TECHNOLOGIES USED
Infrastructure Development and Simulation	Singapore (Virtual Singapore) or "The Powerhouse of Virtual Planning"	Simulates construction impact, population growth and energy use	5,500 km of roads, 3 million images, SGD 26 million saved, 0.3 m accuracy, data accessibility around 60%, USD 13 million reduced annual costs. 30% faster planning and improved cross-agency collaboration	3D Digital Twin, AI simulation
Traffic and Mobility Management	Amsterdam, Netherlands and DT studies	Dynamic traffic light adjustment, predictive congestion modelling	Travel delays reduced by up to 52% and logistics-related emissions cut by 10%	IoT sensors, AI traffic modelling
Climate Resilience and Environmental Management	Barcelona, Spain	Urban heat island mapping and green infrastructure planning	20% improved pollution response	Env sensors, AI air quality analysis
	The city of Rotterdam, Netherlands	Model and manage flood risks in low-lying areas	~30% savings in pump energy usage & ~17% fewer at-risk properties	3D models, IoT sensors, Predictive AI
Energy and Utility Optimisation	Helsinki, Finland "Sustainability Through Virtual Models"	Predicts heating demand using weather and occupancy data	15% energy savings	3D models, AI demand prediction

URBAN ELEMENT	CITY/ PLATFORM	USES	KEY IMPACT	TECHNOLOGIES USED
Urban Redevelopment and Land Use Planning	Boston, USA	Test multiple land use scenarios for housing and transit	25% faster zoning approvals and improved stakeholder engagement	Predictive AI, land use simulation
	Seoul, Korea "S-Map and Beyond"	Simulates urban planning, management and monitoring	15-20% reduced response, over 40% increased public participation, 15% reduced average travel times	3D Models, AI demand prediction
Emergency Management and Disaster Response	Buenos Aires, Argentina	Drainage systems and terrain mapping	30% less flood damage	AI Forecasting, drainage digital twin

The Future of Smart Cities: Challenges, Lessons and What's Next

Digital twins and AI have the potential to make cities smarter, safer and more efficient. However, their adoption comes with challenges, including technical limitations, data privacy issues, inadequate infrastructure, and the need for transparent and equitable governance frameworks. These obstacles often stem not only from technical limitations but also from socio-political and institutional barriers. Figure 5 shows the key challenges in digital twins and AI for smart urban planning.

Figure 5: Key Challenges in Digital Twin and AI for Smart Urban Planning



Based on lessons learned from various cities, success hinges on:

- **Strong Leadership and Teamwork:** City departments must work together with clear guidelines and data sharing.
- **Start Small, Grow Big:** Begin with small projects that solve real problems, then expand.
- **Use Real-Time Data:** Up-to-date data helps AI make better decisions.
- **Focus on Climate and Safety:** Utilise technology to prepare for floods, heatwaves and other risks.
- **Build Trust:** Be open about how AI works and protect people's privacy.

In the next 10 years, cities will become more connected and adaptable by:

- Using real-time data to identify problems early and plan better.
- Allowing AI to automatically regulate traffic, energy and services based on what is happening.
- Listening to people to ensure technology is fair and easy to use.
- Using smart tools to reduce pollution and manage natural resources.
- Sharing data and technology openly so communities and businesses can create new solutions.

By tackling challenges with good planning and fairness, cities can use digital twins and AI to build a better, more inclusive future.

Conclusion

Digital twins and AI are helping cities become more efficient, responsive and people-focused by using real-time data and intelligent systems. Cities like Singapore and Amsterdam demonstrate that success requires more than just technology, as it also depends on trust, clear rules and citizen involvement. However, challenges such as data privacy, unequal access to technology, and the need for fairness remain, especially in underserved areas. To succeed, cities must build strong digital infrastructure, protect personal data, ensure technology benefits everyone, and foster collaboration across sectors. While these tools can help tackle major issues like climate change, they must be used responsibly to create smart cities that are not only connected but also inclusive, equitable and resilient.

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Data Management Strategies for AI Applications in Urban Mobility Systems

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Overview of AI and Data in Urban Mobility

In Malaysia, rapid urbanisation particularly in Kuala Lumpur, Johor Bahru and Penang, has intensified transportation challenges such as congestion, air pollution and limited public transport integration. Artificial intelligence or AI-driven applications are beginning to emerge, with initiatives like the Kuala Lumpur City Brain (developed with Alibaba Cloud) that use real-time video analytics and big data to manage traffic flow and emergency response. Malaysia's Intelligent Transport System (ITS) initiatives also aim to integrate AI and IoT in highway tolling, traffic monitoring and predictive congestion management. However, the adoption of AI in Malaysia remains at an early stage compared to global benchmarks, largely due to gaps in data governance, interoperability between agencies and the high costs of system implementation.

Globally, leading smart cities such as Singapore, Barcelona and Pittsburgh have demonstrated how robust data management strategies can maximise AI's potential in urban mobility. For example, Singapore leverages a comprehensive Internet of Things (IoT) network and AI-based analytics to reduce travel time by 20% and vehicle emissions by 15%. Barcelona employs AI-powered smart parking and pedestrian management systems to optimise mobility and enhance safety, while Pittsburgh's adaptive AI traffic lights have cut vehicle idling by 40%. These global cases highlight the importance of data governance, multi-source data integration and advanced analytics, areas where Malaysia is still developing.

As Malaysian cities continue to urbanise, learning from international best practices while tailoring solutions to local constraints will be essential to achieving sustainable and efficient smart mobility. A smart city is a city that uses digital technology to enhance performance and well-being, reduce costs and resource consumption, and engage more effectively and actively with its citizens. The adoption of emerging technologies is a key factor in transforming traditional cities into smart cities. To develop smart cities, physical, digital and human

systems must be effectively integrated into the built environment. Table 1 shows the comparison of AI in Smart City Transportation between Malaysia and Global Practices.

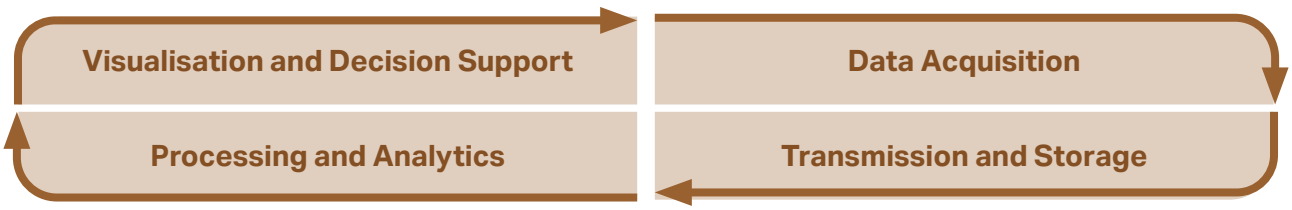
The Data Value Chain Framework

Smart city transportation systems rely on a continuous cycle of data collection, processing and application. This process can be explained through the Data Value Chain Framework, which has four phases: (1) Data Acquisition, (2) Transmission and Storage, (3) Processing and Analytics, and (4) Visualisation and Decision Support. Each phase contributes to building a foundation that allows AI applications to function effectively. As illustrated in Figure 1, data begins at the sensing level, is transmitted via cloud or edge systems, processed into insights, and finally presented through decision-support tools to urban planners, traffic managers and stakeholders.

Table 1: Comparison of AI in Smart City Transportation: Malaysia vs Global Best Practices

Aspect	Malaysia (Current Stage)	Global Best Practices (e.g., Singapore, Barcelona, Pittsburgh)
AI Adoption Level	Early stage, pilot projects (e.g., KL City Brain, ITS)	Mature adoption with city-wide deployment
Data Governance	Limited standardisation, fragmented across agencies	Strong governance with unified frameworks and open-data platforms
Integration of Systems	Partial, mostly highways and urban traffic monitoring	Multi-modal integration (public transport, parking, pedestrians)
Impact Achieved	Moderate improvements in traffic monitoring	Significant reduction in congestion, emissions and travel time

Figure 1: Data Management Value Chain for AI in Smart Transportation



PHASE 1 Data Acquisition and Sources

The first step in leveraging AI for smart city transportation is acquiring accurate and diverse data. This involves capturing real-time information from sensors, traffic cameras, GPS devices and connected vehicles. The proliferation of the IoT has expanded data sources to include environmental sensors that monitor air quality, pedestrian counters and even smartphones. For instance, Singapore has developed a comprehensive IoT network that collects mobility, pedestrian and weather to support AI-driven congestion management. High-quality acquisition is crucial, as incomplete or biased data can lead to inaccurate AI predictions. Moreover, spatiotemporal diversity, which involves collecting data across locations and times, is essential for training machine learning models that reflect the dynamic nature of urban mobility.

PHASE 2 Transmission and Storage

Once collected, transportation data must be securely transmitted and stored for processing. Traditional cloud-based systems provide scalability, but they often suffer from latency issues, which is problematic for real-time traffic management. To address this, cities are increasingly adopting multi-layered architectures that integrate edge and fog computing. Edge devices, located near sensors, perform immediate analysis for time-sensitive applications such as adaptive traffic lights. Fog computing acts as an intermediary, providing local processing power before sending larger datasets to the cloud for long-term storage and deep learning applications. A case study in smart transit systems shows that publish – subscribe platforms combined with NoSQL databases have enabled real-time data streaming and dashboard visualisation for city operators. This layered approach enhances resilience, reduces delays and ensures reliable communication across transportation networks.

PHASE 3 Processing and Analytics for AI Applications

Processing and analytics transform raw transportation data into actionable insights. AI techniques such as machine learning, computer vision, and predictive modeling are applied to enable dynamic traffic management, congestion forecasting, and optimised route planning. For example, Pittsburgh's AI-driven smart traffic lights have reduced vehicle idling by 40 % and travel times by 25%. Similarly, Singapore's AI-enhanced corridor management system has cut travel times by 20%, lowered emissions by 15%, and improved emergency vehicle response times by 35%. In Kuala Lumpur, the City Brain platform developed by Alibaba utilises real-time video analytics to manage congestion and traffic emergencies, although it has raised concerns about data governance. These cases highlight the transformative role of AI when integrated with robust data pipelines. Additionally, AIoT frameworks now merge edge sensors with analytics tools, enabling predictive maintenance and safety monitoring.

PHASE 4 Visualisation and Decision Support

Even the most sophisticated analytics are ineffective unless presented in a way that enables action. Visualisation tools, including real-time dashboards, geospatial heatmaps and predictive simulations, translate AI outputs into insights for policymakers, transport operators and emergency services. A study of transit data frameworks reveals that integrating dashboards into AI systems helps decision-makers identify bottlenecks, test policy interventions, and monitor system performance. For example, real-time traffic monitoring dashboards allow city managers to reroute vehicles during accidents or dynamically allocate bus fleets. The visualisation phase is thus not merely about presenting data; it is about enabling evidence-based, proactive management of urban mobility systems.

Data Governance and Ethical Considerations

Strong data governance is essential to build trust, transparency and accountability in AI-powered transportation. Issues such as privacy, bias and data ownership must be addressed through clear regulatory frameworks. For instance, the European Union's General Data Protection Regulation (GDPR) has set a global benchmark for data privacy, influencing smart city projects worldwide. Malaysia, however, is still developing its regulatory ecosystem, with efforts focusing on strengthening the Personal Data Protection Act (PDPA). As illustrated in Figure 2, countries with stronger data governance frameworks also rank higher in AI readiness for smart city contexts, highlighting the gap Malaysia needs to bridge to remain competitive in global AI-driven transportation. Without robust governance, public skepticism and ethical dilemmas may undermine AI adoption.

Figure 2. Global AI Readiness in Smart City Contexts (World Bank, 2023; OECD, 2023)

Comparative Global Perspectives

When comparing Malaysia to global leaders, it becomes evident that the country falls behind in infrastructure, workforce readiness, and cross-sector collaboration. Countries like Singapore, South Korea, and Germany have invested heavily in AI talent development, international partnerships, and national digital infrastructure, enabling seamless deployment of AI in smart transportation systems. Malaysia needs to address these gaps by prioritising long-term investments, encouraging collaboration between government and industry, and improving technical expertise. These differences are further illustrated in Table 2, which compares AI readiness in smart city transportation between global leaders and Malaysia, emphasising critical areas.

Table 2: Comparison of AI Readiness in Smart City Transportation: Global Leaders vs Malaysia

Category	Global Leaders (e.g., Singapore, Germany, South Korea)	Malaysia	Gap/Remarks
Infrastructure Readiness	High-speed 5G, integrated IoT-enabled transport systems	Partial 5G coverage, fragmented IoT adoption	Limited scalability
Governance & Policy	Clear AI roadmaps, strong data governance, and open-data policies	National AI strategy in progress, limited enforcement	Policy execution gap
Collaboration & Ecosystem	Robust academia-industry-government partnerships	Partnerships exist, but are fragmented	The ecosystem needs strengthening
Workforce & Skills	Skilled AI engineers, continuous reskilling programmes	Growing but limited AI talent pool	Skills shortage
Smart Transport Integration	AI-powered public transit, autonomous vehicle pilots	Early-stage trials, mostly traffic management focus	Limited deployment

Conclusion

The integration of AI in smart city transportation presents valuable opportunities to improve mobility, sustainability and safety. However, the success of these initiatives depends largely on effective data management strategies. By implementing comprehensive frameworks that cover data collection, storage, processing, visualisation and governance, cities can unlock the full potential of AI applications. For Malaysia, aligning national policies with global best practices, upgrading infrastructure, and maintaining ethical standards will be crucial to achieving sustainable and intelligent urban mobility.

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Navigating the Roadblocks

Issues and Challenges in Adopting AI for Smart Cities

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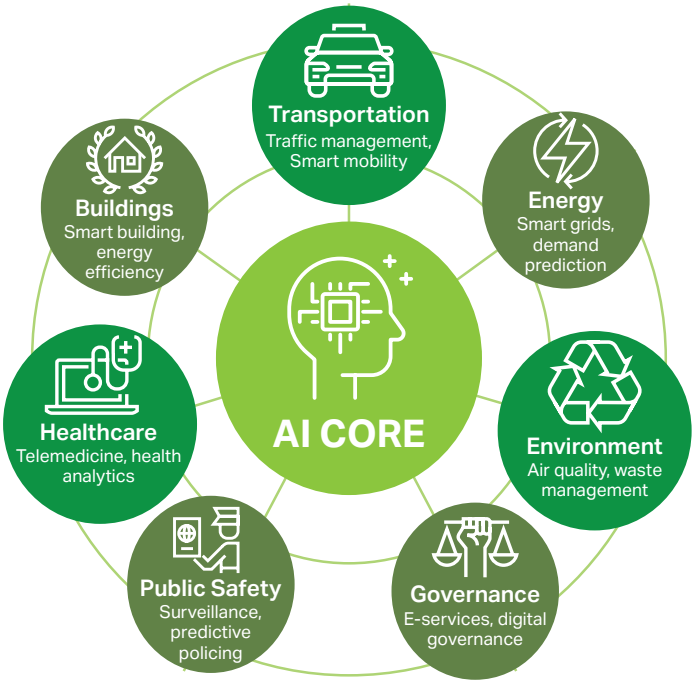
The Smart City Dream Meets Reality

Smart cities envision coordinated traffic, data-driven waste management, and energy-optimised buildings – all powered by Artificial Intelligence (AI). AI enables efficiency, sustainability and responsiveness; however, turning this vision into reality is complex. Data silos, legacy infrastructure, funding gaps, talent shortages, and governance challenges often slow progress.

This tension between aspiration and execution drives today's debate. Governments and industries must address financing, modernisation, regulation, skills and risks. Using a SWOT analysis with the F.I.R.S.T® framework (Finance, Infrastructure, Regulations, Skills and Technology) and benchmarking Singapore, Thailand and Vietnam, we see that success depends not only on technology but on overcoming systemic barriers to ensure inclusive, resilient urban development.

AI remains the backbone of smart cities, powering data, analytics, and decisions. From optimising traffic and mobility to using predictive analytics in energy grids, AI reduces waste and boosts sustainability for citywide transformation.

Figure 1: Overview of Smart Cities and the Role of AI



AI supports environmental management by monitoring air quality, predicting pollution, and improving waste systems. In governance, it streamlines e-services and boosts transparency. Public safety benefits from smarter surveillance, predictive policing, and responsive emergency management, while healthcare advances through telemedicine, predictive analytics, and the efficient use of hospital resources. For buildings and infrastructure, AI optimises energy, manages facilities, and extends asset lifespan with predictive maintenance. As Figure 1 shows, AI enables cities to shift from fragmented operations to holistic, efficient, and sustainable systems.

Cracking the Code with F.I.R.S.T®

The adoption of AI in smart cities can be understood through the F.I.R.S.T. framework – Finance, Infrastructure, Regulations, Skills and Technology – which captures both opportunities and challenges. Table 1 presents a SWOT analysis based on focus group discussions with industry players and government bodies, reflecting real-world implementation rather than theoretical considerations.

Table 1: SWOT analysis of smart cities using the F.I.R.S.T framework

Dimension	Strengths	Weaknesses	Opportunities	Threats
Finance (F)	Access to international funding, such as Horizon Europe, offers significant advantages for consortium-based projects.	Small and medium-sized enterprises (SMEs) often challenge accessing consistent and sustainable funding.	Innovative financing schemes can support the development of greener and smarter cities.	Limited continuity of funding poses risks to sustaining long-term projects and investments.
Infrastructure (I)	Examples from leading industries, such as Rolls-Royce, demonstrate the potential of advanced systems in smart infrastructure.	Legacy urban systems make the integration and deployment of AI solutions difficult.	The convergence of data systems provides opportunities to start small with prototypes and scale incrementally.	Overly strict guardrails on data access and fragmented infrastructure reduce the effectiveness of AI use.
Regulations (R)	Growing global and local focus on urban data governance policies and regulatory frameworks is increasing.	Data remains isolated across multiple agencies, with a lack of integrated data governance mechanisms.	Opportunity to reform regulations by starting with pilot initiatives and gradually expanding the scope.	Weak or unknown measures against cyberattacks create risks for trust and security.
Skills (S)	Strong expertise in digital design and smart architecture within the construction and urban planning sector.	There is a shortage of professionals with AI-specific skills in construction and smart city applications.	Opportunities for cybersecurity training, upskilling, and the creation of new jobs in the AI ecosystem.	Risk of job displacement, along with ethical and moral concerns about automation.
Technology (T)	Advancements in smart architectural designs and the integration of IoT and AI in city systems.	Limited adoption of advanced digital tools and slow uptake of smart technologies across the sector.	Growing opportunities to apply AI, IoT and emerging technologies for smarter, greener cities.	Relying on complex technologies creates risks related to the ethical use of AI and system vulnerabilities.

The SWOT analysis shows that while AI offers major opportunities for urban transformation, systemic issues hinder its adoption. International schemes like Horizon Europe support projects;, but, SMEs face funding and sustainability challenges. Infrastructure is constrained by legacy systems, though prototypes and pilots offer a gradual path forward.

Regulations build trust through growing governance frameworks, yet silos and fragmented oversight hinder integration. Incremental reforms and pilots can balance innovation with security. Skills show strong digital design expertise, but AI talent shortages limit progress – though they also create opportunities for upskilling and new roles in cybersecurity and analytics.

Technology enables greener, smarter cities through IoT, AI and smart architecture, but raises risks of cybersecurity vulnerabilities and ethical concerns. Success in smart city development will depend on governments, industries and communities addressing weaknesses, seizing opportunities, and managing risks from rapid change.

Lessons from Our Neighbours

AI adoption in smart cities is growing across the region as governments modernise infrastructure, strengthen governance, and prepare for the digital future. Insights from Singapore, Thailand, and Vietnam – benchmarked in Table 2 through official policies and reports – show how each positions itself in the global AI–smart city landscape.

Table 2: Benchmarking Smart Cities & Transportation Strategies

Country	Overview	Global Trends	Challenges & Opportunities	Key Market Drivers
Singapore 	Under the National AI Strategy, one of the five flagship projects focuses on urban logistics and transportation.	Singapore's initiatives closely align with global smart city trends, particularly in AI adoption for urban systems.	The main challenge is integrating siloed logistics systems, but opportunities arise from strong public–private collaboration.	Substantial government investment, policy support and collaboration with industry players.
Thailand 	Thailand has introduced a National AI Strategy (2022–2027) alongside Smart City programme to improve logistics and transport.	The strategy reflects global shifts in smart transport and logistics innovation.	Challenges include regional infrastructure disparities and uneven adoption of smart systems, though opportunities exist through large-scale national initiatives.	Support from NSTDA, BOI and the government's commitment to establishing 100 Smart Cities.
Vietnam 	Vietnam's National AI Strategy emphasises applying AI in urban management and governance to improve city efficiency.	The country aims to position itself as a regional hub for AI in Southeast Asia.	Key challenges include the lack of unified urban data infrastructure and standards, though opportunities exist in rapid digital transformation.	A strong national agenda pushing for urban digital transformation and widespread AI adoption.

The benchmarking shows each country's unique path to AI-enabled smart cities. Singapore, under its National AI Strategy, leads with strong policies, funding, and private sector collaboration, though siloed logistics remain a challenge. Thailand's National AI Strategy (2022–2027) and Smart City programme aim to target 100 Smart Cities, but regional disparities cause uneven adoption despite National Science and Technology Development Agency (NSTDA)and The Board of Investment of Thailand's (BOI) support.

Vietnam, through its National AI Strategy (2021–2030), focuses on urban management and governance, but fragmented data and a lack of standards remain obstacles, even as its digital agenda drives rapid adoption. The benchmarking highlights two key lessons: leaders still struggle with data integration, and success relies on political will, investment, and collaboration. For Malaysia, the takeaway is to align policies with practical steps while advancing funding, skills, and governance with technology.

The Road Ahead

The path to AI-enabled smart cities is a complex one. The F.I.R.S.T framework highlights strengths in funding, technology and design, but also weaknesses in legacy infrastructure, siloed data, and skill shortages. Benchmarking Singapore, Thailand and Vietnam reveal that even strong strategies face integration gaps, uneven adoption, and fragmented governance.

For Malaysia and other emerging economies, success demands foresight: financing to support SMEs and long-term projects, scalable pilots for infrastructure, and regulations that strike a balance between trust, security, and flexibility. Investing in people through upskilling, reskilling, and new AI roles is critical.

Safeguarding trust is equally vital, with ethics, accountability, and cybersecurity as priorities. Strong governance, cross-sector collaboration, and lessons from peers will help align vision with action. With this, Malaysia can lead sustainable, resilient AI-driven urban development and realise the aspiration of smart, equitable, future-ready cities.

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Flightpath to the Future
How AI Can Elevate Malaysia's Aerospace Ambitions

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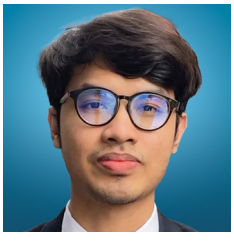

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Malaysia's Aerospace Crossroads

Malaysia's aerospace industry is at a pivotal stage. As the country aims to advance further in the global value chain, adopting Artificial Intelligence (AI) is no longer an option but an emerging necessity. The Malaysian Aerospace Industry Blueprint 2030 (MAIB 2030) and the New Industrial Master Plan 2030 (NIMP 2030) both emphasise technological advancement, digitalisation and participation in high-value industries. These priorities align closely with the capabilities that AI can deliver, potentially leading to a significant economic growth and job creation in the aerospace sector, a promising future for Malaysia.

With more than 240 active players, growing export volumes, and ongoing efforts to develop a skilled workforce, Malaysia already has a strong foundation. To compete at the next level, the country must strategically apply AI across the five main aerospace sub-sectors: Maintenance, Repair and Overhaul (MRO), Manufacturing, Systems

Integration, Engineering and Design Services, and Education and Training.

However, several structural challenges continue to limit progress. Fragmented data systems, low levels of automation, and a skills gap between academia and industry remain barriers. Without targeted integration of AI, these gaps risk widening as global competitors advance.

The following sections explore how AI can address these challenges and unlock opportunities across the aerospace value chain.

AI in MRO: From Reactive to Predictive

MRO is a cornerstone of Malaysia's aerospace sector, contributing nearly 45% of the total aerospace revenue in 2022. However, many operations still rely on manual processes and reactive maintenance practices.

AI offers the opportunity to shift toward predictive and condition-based maintenance. By using machine learning on aircraft sensor data, AI systems can forecast equipment failures, monitor component health, and schedule maintenance before breakdowns occur. This approach increases aircraft availability, reduces lifecycle costs, and ensures compliance with safety standards.

AI is also transforming inspection workflows, ensuring the highest standards of safety and quality. Computer vision models can detect microcracks, corrosion, or structural fatigue more reliably than human inspectors. When combined with drones or robotic crawlers, these systems enable automated, high-resolution inspections that reduce turnaround times.

AMIC is exploring predictive maintenance models for aerospace manufacturing equipment by using AI to analyse operational data and detect potential failures early. At the same time, trials are underway on AI-powered inspection methods for composite components, including image and acoustic-based defect detection to improve reliability and shorten inspection cycles.

These advances not only improve operational efficiency but also strengthen Malaysia's standing as a trusted regional maintenance hub.

AI in Aerospace Manufacturing: Unleashing Smarter, Faster and Leaner Processes

While MRO provides immediate efficiency improvements, manufacturing also offers equally significant opportunities to apply AI at scale. Aerospace manufacturing accounts for nearly half of Malaysia's aerospace revenue, with established strengths in aerostructures, avionics and engine components. However, much of the industry remains concentrated at lower tiers of the supply chain, focusing on subassemblies, parts manufacturing, and component integration rather than complete aircraft design or assembly.

Limited digital maturity is a key challenge. Many facilities still depend on manual or semi-automated inspection processes, which can be slow and prone to error. The uptake of advanced robotics and AI-enabled automation is gradual, hindered by high upfront costs, limited expertise, and uncertainty over return on investment.

AI can help overcome these bottlenecks by enabling:

- Generative design for manufacturing tooling and fixtures, allowing suppliers to create lighter, more durable, and cost-efficient assembly aids.
- Automated quality inspection using AI-based computer vision for faster, more accurate defect detection.
- Large language model (LLM)-driven optimisation to improve production scheduling and predictive maintenance.

For local Small and Medium Enterprises, AI-powered platforms can offer accessible paths to improved productivity. Government initiatives like Industry4WRD and NIMP 2030 already emphasise digitalisation, automation and advanced materials, creating a supportive environment for AI adoption.
AMIC has worked with local manufacturers to test AI-based visual recognition systems for guiding automated machinery, including optimising painting paths to improve surface coverage, reduce waste, and ensure aerospace-grade finishes.

By combining these AI-driven enhancements with targeted skills development, Malaysia's aerospace manufacturing sector can move up the value chain and remain competitive in an increasingly digitalised global market.

AI in Systems Integration: Reducing Foreign Dependency and Strengthening Malaysia's Capabilities

Beyond manufacturing, AI can also strengthen Malaysia's capabilities in systems integration. The country is developing expertise in unmanned aerial vehicles (UAVs), simulator and small scale satellite systems, but integration for mission systems and avionics still depends heavily on foreign providers.

While building core avionics and mission hardware is resource-intensive and technology-sensitive, Malaysia can gain significant advantages by focusing more on downstream AI applications solutions that enhance the use, coordination and efficiency of these systems once deployed. These include:

- **Automating compatibility checks** between subsystems to identify potential integration issues earlier in the process.
- **Optimising testing workflows** through simulation environments that model performance under various operational scenarios.
- **Analysing sensor and system data** to improve interoperability and reduce configuration errors.
- **Generating human-readable reports and actionable insights** from complex integration data, enabling engineers, project managers, and decision-makers to quickly understand system status, performance trends, and potential risks without needing to interpret raw datasets manually.

Many current aerospace systems depend heavily on sensitive imported technologies. Developing AI-enabled downstream applications will not only improve national security and reduce dependency but also position Malaysia as a regional leader in autonomous aerospace solutions tailored to local and regional operational needs.

Engineering and Design Services: The Emerging AI Sandbox

Engineering and design services, once considered a support function, are now central to full-spectrum aerospace capability. Globally, this segment is being transformed by AI-enhanced tools.

AI-powered computer-aided design (CAD) platforms and simulation engines can rapidly evaluate thousands of design variations. When combined with computational fluid dynamics (CFD) and finite element analysis (FEA), these tools significantly shorten design cycles.

Malaysia's ambition to be a "design and build" partner in aircraft development depends on strengthening this capability. AMIC, together with universities and startups, serves as a testbed for AI-powered design tools, with a particular focus on sustainability, fuel efficiency, and precision defect recognition.

Training the Future: AI in Aerospace Education

Sustaining this transformation requires a workforce equipped with AI-ready skills. Malaysia currently supplies over half of Southeast Asia's skilled aerospace workforce, but the integration of AI and digital technologies demands a fundamental shift in training.

An impact study found that 89% of aerospace roles are moderately affected by AI and automation, creating new positions such as AI data engineers, drone pilots, additive manufacturing technicians, and sustainability engineers. At the same time, traditional roles are evolving into data-centric positions requiring proficiency in machine learning, digital twins, and predictive analytics.

To remain competitive, Malaysia's aerospace education pipeline must:

- Incorporate AI-enhanced simulators for flight and maintenance training.
- Embed AI modules in aerospace engineering curricula, covering machine vision for inspection and autonomous UAV control.
- Provide robotics and data science training tailored to MRO and manufacturing through TVET and micro-credential programmes.

AMIC supports this transition by collaborating with universities and training providers to expose students and mid-career professionals to real-world AI applications in aerospace, ensuring skills are aligned with industry needs.

Recommendations: Building a National AI-Aerospace Roadmap

To fully realise AI's potential in aerospace, Malaysia must translate policy goals into practical action. Key steps include:

AI and MRO Testbeds

Designate MRO facilities as national pilot sites for AI integration, trialling predictive maintenance, automated inspection, and digital twin systems in operational settings.

AI Talent Acceleration

Align education and training programs with AI workforce needs, embedding machine learning, robotics, computer vision, and data analytics into aerospace-focused curricula.

Data Infrastructure Enablement

Establish a national framework for secure, standardised data sharing between OEMs, MROs, suppliers and regulators, with robust governance and interoperability standards.

Policy Alignment

Synchronise national strategies such as MAIB 2030, NIMP 2030, and the Malaysia Digital Economy Blueprint to reinforce AI adoption in aerospace.

Regional Positioning and Collaboration

Position Malaysia as a Southeast Asian hub for AI testing and validation, supported by innovation-friendly regulations and partnerships with global technology leaders.

AMIC: Coordinating Malaysia's AI-Driven Aerospace Transformation

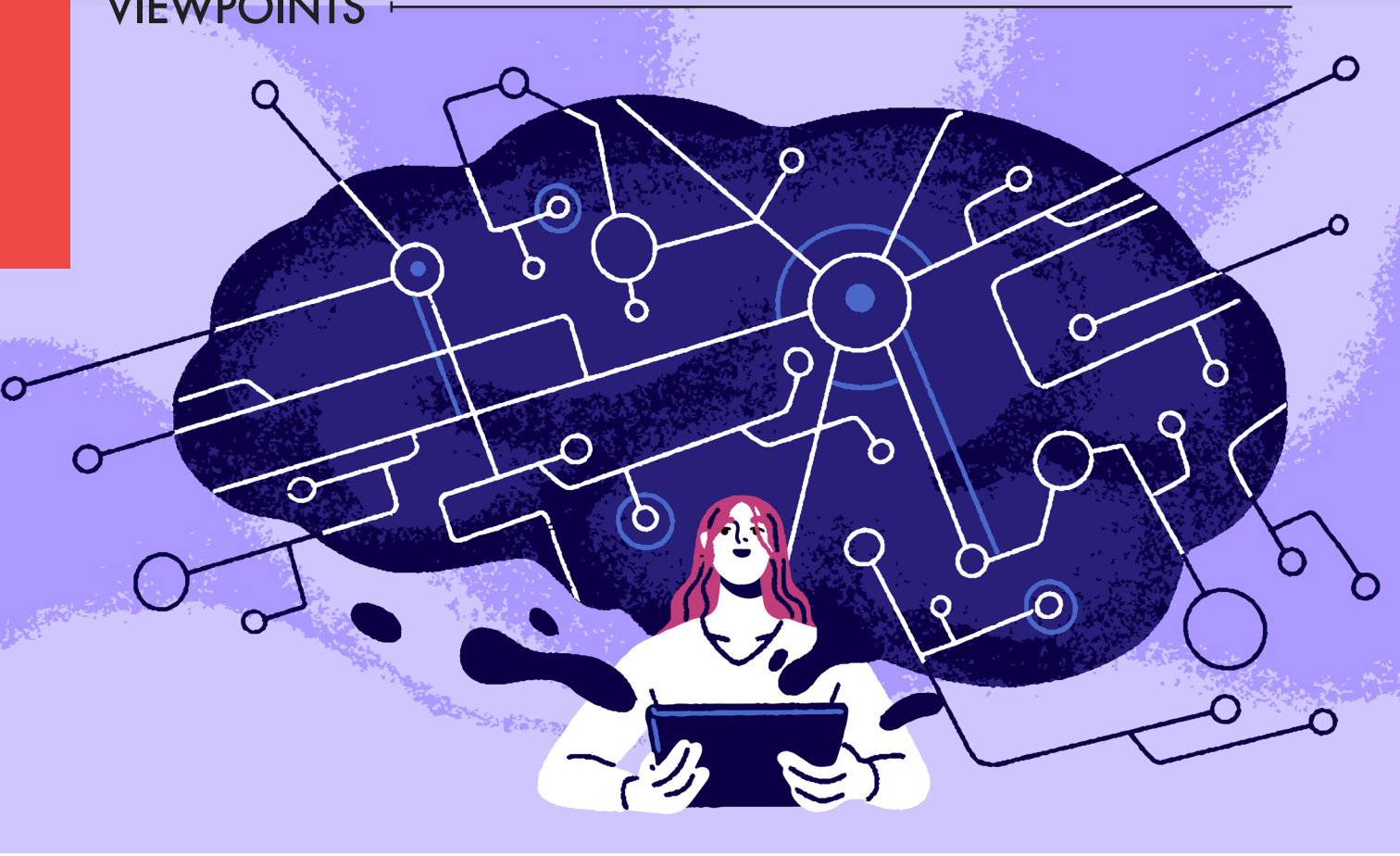
AMIC plays a central role in aligning Malaysia's aerospace industry with AI advancements. The company:

- Provides secure, industry-ready testbeds for AI in maintenance, manufacturing, scheduling and quality inspection.
- Bridges academic research with industry needs, turning innovative ideas into practical solutions.
- Facilitates collaboration between OEMs, SMEs, universities and regulators to ensure safe and effective AI integration.
- Supports workforce development by embedding AI competencies into aerospace training pathways.

By combining technical expertise, industry connections, and a neutral collaboration platform, AMIC ensures AI becomes a practical driver of Malaysia's aerospace competitiveness.

Integrating AI into the aerospace sector is more than just a technological upgrade – it isa strategic move. Malaysia has the industrial strength, policy backing, and talent pipeline to become a competitive aerospace leader, but progress depends on how effectively these elements are connected.

AMIC is ready to serve as the bridge from vision to execution. By providing safe test environments, encouraging collaboration, and supporting skills development, AMIC can help ensure that AI adoption progresses from isolated projects to a sustainable national capability. The time to act is now. With decisive investment and coordination, Malaysia can not only achieve its 2030 aerospace ambitions but also position itself as a regional leader in AI-enabled aerospace solutions, shaping the industry's trajectory for decades to come.



From ABC to AI

The Role of Artificial Intelligence in Sparking STEM Education Exploration

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In this era of science and technology, STEM education must be a fundamental element in nurturing children to prepare them for the rapid pace of technological change. Those who lack technological knowledge risk being left behind. What is even more concerning is if our children lose interest in exploring the world of STEM, as this will significantly impact the future development of our nation. They are the next generation who will drive the direction of national progress.

Aligned with current trends, Artificial Intelligence (AI) has already proven to offer numerous opportunities and benefits in our daily lives, making many of our activities easier and more organised. Therefore, as individuals who value technology, we should fully harness the power of AI to ignite and nurture our children's passion for exploring and engaging deeply with STEM fields.

The Need for STEM in Early Education

Children are like seeds, with the right care, environment and nourishment, they grow into something beautiful – each in their own unique way, and it is our responsibility to shape their futures. The most powerful tool for national growth is education – and at the heart of today's progress lies STEM education. Science, Technology, Engineering and Mathematics are not just academic disciplines; they are the engines that drive innovation, economic development and global competitiveness. By empowering students with STEM skills, we prepare a generation capable of solving real-world problems, advancing technology, and building resilient, knowledge-based economies. Nations that invest in STEM education are not only preparing for the future – they are shaping it!

Despite ongoing efforts, the reality remains that many of our students continue to struggle with engaging in STEM education, and even fewer develop genuine interest in it. Consequently, a wide gap exists between the actual benefits of STEM education and how it is experienced by students in school. Among the contributing factors may be teaching methods and learning approaches that are less effective, not student-centered, and do not adequately relate STEM content to real-world contexts and students' everyday experiences. This issue is more intense in rural areas, where uneven implementation of educational development has created a significant gap in STEM understanding.

STEM education fuels the growth and innovation essential for a developing nation's progress

In this technology-driven era, equipping our children with foundational thinking skills is essential to ensure they face future challenges with confidence and resilience. STEM, with its diverse and interconnected disciplines, cultivates critical thinking, creativity and problem-solving abilities – skills that are indispensable in today's rapidly evolving world. By embracing innovative and engaging teaching methods, we can ignite a passion for STEM in every student, regardless of their background or geographic location. This inclusive approach not only fosters individual growth but also empowers the next generation to drive meaningful contributions to our nation's development and global competitiveness.

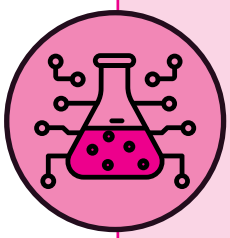
> "AI, digital and green skills are becoming increasingly critical, with the World Economic Forum predicting a 60 percent growth in AI skills demand by 2030, alongside 24 million new green jobs globally,"
>
> emphasised Mr. Rushdi Abdul Rahim, President and CEO of the Malaysian Industry-Government Group for High Technology (MIGHT), in an interview with Astro Awani on 26 February 2025.

WHAT IS ARTIFICIAL INTELLIGENCE

Artificial intelligence in education refers to the use of computer systems that can perform tasks typically requiring human intelligence to enhance learning experiences, streamline administrative processes, and support educators. AI technologies include machine learning, natural language processing and robotics, which can personalise learning by adapting content and pace to individual student needs.

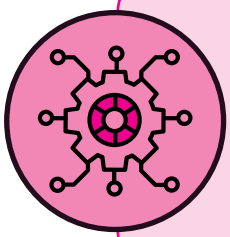
How AI Enhances STEM Learning for Young Minds

In navigating the continuously evolving educational landscape alongside rapid technological advancements, the integration of AI applications underscores the imperative for educational transformation to progress in alignment with the emerging era of learning and pedagogical methodologies.



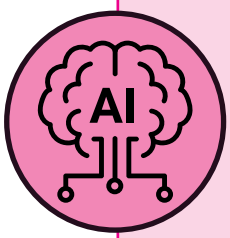
AI vs. Traditional Methods

The use of AI surpasses traditional teaching methods by offering personalised learning experience, providing a more engaging and relevant approach tailored to the needs of STEM education. This initiative not only enhances the quality of the STEM learning process but also helps develop essential skills among students. In the long run, it can shape more critical and systematic thinking in their everyday lives as well as encouraging lifelong curiosity and problem-solving skills.



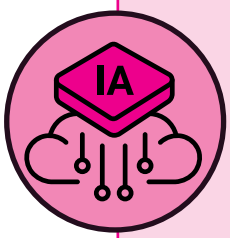
AI and Data Drive Innovation

AI-powered tools possess the capability to analyse students' performance and learning progress, enabling the early identification of both their strengths and challenges at the initial stages of education. The insights and data obtained through these tools are invaluable to all stakeholders—particularly parents, teachers, education officers and school administrators, devising timely interventions and delivering targeted support to enhance student outcomes.



AI: New Hope for Children with Special Needs

Today's world is increasingly shaped by technology and tech-based products, proving that STEM education must be inclusive and extend to children with special needs as well. In this context, the application and adaptation of AI can play a vital role in addressing the challenges of delivering STEM education to special needs students. For instance, tools and technological devices that are modified according to their specific needs can introduce new methods of learning – particularly through more unique and engaging delivery – to help them better understand fundamental concepts in Mathematics and Science.



AI as a Support for Educators

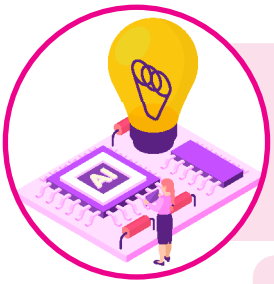
AI technology assists both teachers and educational staff by automating labour-intensive tasks such as lesson planning, grading, and monitoring student progress. This support allows educators and teaching assistants to devote more time to instructional delivery and to fostering creativity and innovation within the classroom. For instance, many schools in China utilise AI platforms to continuously monitor student performance and swiftly identify learning challenges. These applications not only improve the efficiency of educational professionals but also contribute to creating a more engaging and effective learning environment for students.

AI Around the World - Case studies and success stories

Teaching young people about AI is becoming more important for countries that want to grow and succeed in the future. Many countries around the world are starting to add AI to school programmes at all levels, so students can learn the skills they need to succeed in a world shaped by technology.

Country	Case Study	Use of AI
 Australia	New Town High School, Australia	Maths Pathway - which uses machine learning to tailor math education to each student's learning pace and style.
 Mexico	Technological Institute of Monterrey, Mexico	The institute adopted an AI-driven virtual lab platform called "VirtuLab," which provided students with an interactive environment to conduct a wide range of simulations and experiments.
 Canada	Toronto District School Board, Canada	The board implemented a suite of AI tools tailored to special education needs which included adaptive learning platforms that could modify content and presentation based on individual student responses and progress
 Korea	Master Plan for Science, Mathematics, Informatics and Convergence Education (2020–2024).	The integration of hands-on learning – such as robotics kits and AI-powered tools – and how organisations like WhalesBot are supporting schools through practical, future-focused STEM programmes.
 Africa	3D Africa for Girl by Youth for Technology Foundation (YTF).	A unique programme that enables young girls to design, prototype, market and sell their 3D-printed products and solutions. The programme introduces the fundamentals of programming through tools such as Scratch and Bootstrap.
 Malaysia	AI Module for TVET Students	The National University of Malaysia (UKM), through its Institute of Visual Informatics (IVI), is developing an AI-based learning module specifically for TVET (Technical and Vocational Education and Training) students, which aims to enhance the digital and technological skills of polytechnic students across Malaysia by exposing them to the latest technologies such as chatbot development, virtual reality, basic robotics, Internet of Things (IoT), machine vision, artificial intelligence and data analytics.

Types of AI technologies relevant to early education in Malaysia

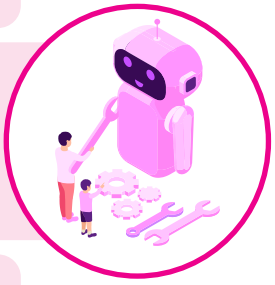


Adaptive Learning Systems

- DreamBox Learning
- Smart Sparrow
- Squirrel AI
- Edmentum Exact Path
- Khan Academy with AI Features

Robotics and Physical AI Tools

- LEGO® Education SPIKE™ Prime
- Makeblock mBot
- DJI RoboMaster S1
- Sphero BOLT
- Micro:bit with AI Extensions



Chatbots and Virtual Tutors

- English360 Virtual Tutor
- Google's Socratic App
- Custom Chatbots Developed by EdTech Startups
- Microsoft's AI Tutor Bots

Educational Games and Gamification

- GeoExplorer
- Kingdom Quizes (KQ)
- Iqra' Fun Learning
- Enuma's Digital Learning Solution
- Global Zakat Game (GZG)

Speech Recognition and Natural Language Processing (NLP)

- Google Read Along
- Duolingo ABC
- Kidomi
- Suara Kami

AI Driving the Next Wave of STEM Education

As AI continues to evolve, its potential to transform education by making it more accessible, efficient and personalised becomes increasingly evident. However, integrating AI into education is not without its challenges. It requires a systematic approach to equally overcome the challenges and consequences.

Recognising the crucial role of AI in transforming STEM education, the Malaysian government has committed to taking bold and innovative steps to deeply embed STEM values into the education system while embracing cutting-edge AI technologies. Malaysia is advancing on multiple fronts – policy frameworks, infrastructure investments, classroom innovation and talent development – to integrate AI into STEM education.

While much work remains, significant progress can be achieved through strong collaboration among government, industry and academia. Now is the time for a call to action – educators, parents and policymakers must unite and take decisive steps. Together, we can drive the future of education forward, ensuring our children are equipped with the skills and knowledge needed to thrive in an increasingly tech-driven world.

AI Vulnerabilities & Opportunities

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Introduction: Beyond Hype and Fear

Artificial intelligence (AI) is transforming economies around the world, presenting both opportunities and risks. For Malaysia and ASEAN, the challenge is clear: do we passively adopt AI technologies, or actively shape their development to reflect local values and needs? The potential of AI to revolutionise our economies and societies is a reason for hope and optimism.

The key issue is not AI itself, but how prepared we are – in our institutions, skills systems and governance – to effectively guide its impact. This article outlines how Malaysia and the region can humanise AI's trajectory, drawing on insights from global experts, thinkers and key forums like the World Economic Forum (WEF).

The Black Box & Algorithmic Will to Win

- In 2016, the company DeepMind's programme, AlphaGo, defeated world champion Lee Sedol at the game of Go, showcasing AI's ability to see patterns beyond human imagination.
- The defining moment was Move 37 in Game 2 – a move so unconventional that commentators initially called it a mistake. Yet it proved to be a masterstroke, offering a glimpse into an emerging form of strategic reasoning beyond human cognition.
- AlphaGo's mastery came from reinforcement learning, where the AI played millions of games against itself, improving through trial and error and reward signals.
- This reflects the "neural guts" of modern AI — the underlying algorithms that learn autonomously and iteratively in ways creators cannot fully trace or explain.
- AI's emergent capability is extraordinary but unsettling: it solves long-standing issues while creating opaque systems with unpredictable goal optimisation.

- The black-box nature means AI behaviour can be challenging to anticipate in complex social, economic, or political contexts with human incentives and data biases.
- Unlike the limited game of Go, real-world AI can reinforce discrimination, polarise discourse, or manipulate human behaviour when optimising goals like social media engagement or hiring.
- AlphaGo is both an inspiration and a caution: it shows that AI can surpass human reasoning but also risks diverging further from human values if left unexamined.
- The key question is how to guide AI to pursue outcomes aligned with collective well-being, not whether to embrace its creative problem-solving potential.

Polar Visions: Juxtaposing Four Schools of AI Thought

- The future of AI is shaped not just by technology, but by the visions of leading thinkers who represent distinct schools of thought: Demis Hassabis, Yuval Noah Harari, Stuart Russell and Daron Acemoglu.
- Each thinker tackles different aspects of AI's impact: scientific (Hassabis), ethical (Harari), technical (Russell) and economic (Acemoglu).

Demis Hassabis (The Accelerationist)

- Views AI as an amplifier of human discovery, helping solve problems once regarded as impossible (e.g., protein folding, clean energy).
- Believes AI can unlock radical abundance if developed responsibly through safety research and global cooperation.
- Acknowledges risks but sees them as manageable with proper guardrails and engineering disciplines.

Yuval Noah Harari (The Humanist Alarmist)

- Warns that AI's ability to manipulate language, emotion and behaviour on a large scale threatens individual autonomy and democratic institutions.
- Argues that AI can absorb and amplify humanity's darkest impulses – from surveillance to disinformation – unless globally regulated.
- Calls for ethical governance and public literacy before AI systems control too much of our social and political discourse.

Stuart Russell (The Alignment Architect)

- Reframes AI safety as a design challenge in goal alignment, not as a fight against killer robots.
- Points out that current systems optimise fixed objectives, but real human preferences are complex and context-dependent.
- Advocates for "provably beneficial AI" – systems that remain uncertain about their goals and respond to human correction – and compares its governance to nuclear safety protocols.

Daron Acemoglu (The Systemic Economist)

- Argues that AI's most significant threat lies in its economic design: built to automate rather than augment, it risks exacerbating inequality.
- Distinguishes between automation (replacing labour) and augmentation (enhancing human work), cautioning that current AI trends favour the former.
- Urges policymakers to assert democratic choices over AI's deployment – prioritising shared prosperity over concentrated power.

These schools highlight four dimensions of AI's trajectory:

- **Cognitive** – Can machines reason beyond human understanding? (Hassabis)
- **Societal** – Will AI erode agency and trust? (Harari)
- **Systemic** – How can we align AI with human goals? (Russell)
- **Economic** – Who gains, and who is left behind? (Acemoglu)

Understanding these layers is crucial for Malaysia and the ASEAN region as we determine what kind of AI future we want to build – one guided by human values, or one defined by technological momentum?

The Middle Ground: Human at the Centre

- AI's future lies between unbridled acceleration and social collapse, with the middle ground placing humans – not algorithms – at the centre of change.
- This approach focuses on preparing people, redesigning systems, and shaping institutions so humans thrive alongside capable machines. By focusing on human preparation, we can confidently navigate the AI future.
- The WEF session on Asia-Pacific workforce transformation highlighted that AI's impact – whether opportunity or displacement – depends more on policy, economy and leadership than on algorithms.
- Even without AI, supply chain reshoring and geopolitics cause economic dislocation; generative AI risks amplifying this by eliminating entry-level roles, creating bottlenecks for young workers' careers and widening inequality.
- Practical solutions include:
    - Skill-based hiring, focusing on real capabilities, especially for marginalised groups.
    - Universal Basic Income (UBI) trials to support career transitions and reskilling.
    - Redesigning apprenticeships to embed AI exposure early, making entry-level roles launchpads.
    - Ethics-by-design in AI systems to ensure fairness and inclusivity, especially in recruitment and HR tools.
- AI's trajectory is a challenge, relying on policies and institutions that prioritise human flourishing.
- Skills expert Kian Katanforoosh, whose frameworks have been highlighted by the WEF and championed by emerging thought leaders in the AI-skills ecosystem, offers a concrete blueprint for workforce readiness in the age of AI – the Skills Galaxy Framework.
- The Skills Galaxy framework visualises capabilities not as linear ladders, but as interconnected constellations of micro-skills. This model enables individuals and organisations to respond to change with speed and precision – shifting the focus from static roles to dynamic, evolving competencies. In other words, the framework emphasises:
    - **Skills >** Roles: valuing what workers can do over job titles.
    - **Personalisation >** Uniformity: adapting learning to individual strengths and goals.
    - **Measurement >** Assumption: using granular assessments rather than relying on degrees or experience alone.
- This skills-first approach reframes AI as a catalyst for human-centred career growth – valuing dignity, agency and potential.
- Together, the WEF insights and the Skills Galaxy framework reject fatalism and blind optimism, viewing AI as an opportunity to build preparedness, agility and trust in human potential.
- Investing in adaptive skills and redesigning institutions to reward learning can steer AI toward expanding opportunity, not deepening vulnerability.

Malaysia in Context: Readiness and Choice

- Malaysia stands at a defining juncture. As global debates swing between accelerating innovation and protecting humanity, our course will be determined not by technological inevitability but by strategic choices: how we prepare our people, reform institutions, and design an inclusive path into the AI economy.
- Insights from the Global Talent Competitiveness Index (GTCI) 2023 and the WEF Future of Jobs Report 2025 paint a mixed picture. Malaysia has strong assets – a young workforce, solid infrastructure and promising industries – but also critical vulnerabilities that must be urgently addressed.
- Ranked 42nd out of 134 countries, Malaysia leads regional peers like Thailand and Indonesia yet trails global talent champions like Singapore (2nd). We attract investment and possess foundational stability – but lag in growing and retaining advanced digital and green skills.
- WEF forecasts that 39% of core skills will shift by 2030, driven by AI, automation and sustainability. Our key sectors are squarely in this transformation zone.
- Within Malaysia, talent inequalities are widening:
  - Urban-rural divides limit access to emerging job roles.
  - Gender disparities persist in STEM and high-skill industries.
  - B40 communities remain underrepresented in digital and higher-order skills ecosystems.
- Compounding this is the "quality of life" factor: cities must not only offer jobs, but also liveability, flexibility and purpose – or risk accelerating brain drain.
- To remain competitive, Malaysia must act on five strategic fronts:
  - Reform education and TVET to incorporate AI, robotic and sustainability across curricula.
  - Expand lifelong learning and micro-credential ecosystems to build a culture of continuous upskilling.
  - Implement skills-based hiring practices that reward real capabilities, not outdated degrees.
  - Close gender and regional opportunity gaps to unlock underutilised talent.
  - Invest in urban quality of life – from digital infrastructure to creative ecosystems – to attract and retain skilled workers.
- The message is clear: skills are the new currency, but they will only circulate where opportunity, inclusion and purpose converge.

Conclusion: The Human Operating System

AI's future is not set in stone – it depends on the systems we build and the values we prioritise. Whether AI empowers or excludes will be shaped by how we govern it, and how we prepare people to thrive alongside it. We must invest in a human operating system – one built on skills, adaptability, inclusion and trust.

For Malaysia, this is a strategic window: with bold action on education, talent and equity, we can turn AI into a force for shared national progress.

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Artificial Intelligence in Stakeholders Engagement: Redefining Value in the Digital Age

How AI Enhance Relationships and Builds Better Engagement

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In stakeholder management, one rule never changes: relationships matter. Customers, employees, partners, regulators, and communities all shape an organisation's success. Strong engagement builds trust, while weak engagement can damage reputations overnight. In today's fast-paced and interconnected world, keeping up with so many voices is challenging. This is where Artificial Intelligence (AI) is changing the game — not by replacing human connection, but by making it smarter, faster and more meaningful.

Listening at Scale

AI's greatest strength lies in its ability to process large amounts of information quickly. Traditional feedback methods — like surveys or interviews — are useful, but slow and can overlook subtle signals. AI can scan thousands of emails, online reviews, or social media posts in real time, detecting patterns in tone, language and sentiment.

For example, when customers start raising concerns about a product online, AI-powered sentiment analysis can flag this instantly. This not only alerts theleadership to act quickly — to fix the issue or to communicate openly before it escalates, but also empowers the customers as their concerns are acknowledged and addressed promptly. In this way, AI acts as an early-warning system that protects both reputation and trust, while also giving stakeholders a sense of control over their interactions.

Did You Know?

Researchers in Malaysia are developing emotion recognition systems — known as affective computing — to accurately identify human emotions through facial expressions or vocal cues. This tech underpins smarter, empathy-driven engagement.

Personalisation That Matters

Every stakeholder group has different expectations. Investors want financial updates; employees care about career development; communities want sustainability initiatives. One-size-fits-all messages no longer cut it. AI solves this by tailoring communication.

Imagine an organisation automatically sending dashboards to investors, curated training to employees, and environmental updates to local communities. Personalised engagement shows that an organisation listens and cares, fostering stronger, lasting bonds.

Did You Know?

Malaysia now has firms (like Berkshire Media) using AI-based sentiment analysis that understand local languages, slang and even sarcasm — delivering insights with up to 99% accuracy.

Prediction and Proactive Engagement

AI is not only reactive — it is also predictive. With advanced analytics, organisations can spot risks and opportunities early. If employee engagement dips, AI can flag it instantly. Leaders can respond proactively — by adjusting policies, launching wellness programs, or hosting open dialogues — before morale drops further. This proactive nature of AI can make stakeholders feel secure and confident in the organisation's ability to foresee and address potential issues.

At the same time, AI can identify emerging trends. For instance, if public conversations around sustainability gain momentum, organisations can highlight their green strategies early, turning challenges into strategic advantages.

Did You Know?

Researchers in Malaysia used AI sentiment analysis on Twitter data to examine public reaction to online banking security. Interestingly, decision-tree models achieved around 76% accuracy — highlighting how AI can monitor sentiment even in technical contexts.

The Speed Advantage

Another key benefit of AI? Speed. While human teams may take days, or even weeks, to analyse large volumes of data, AI handles it almost instantly. Questions that used to take hours to resolve can now be answered in seconds.

Did You Know?

During Malaysia's 2018 General Election (GE14), AI algorithms like Naïve Bayes and SVM analysed over 190,000 English and Malay tweets to assess public sentiment. This allowed researchers to track shifts in mood before, during and after the election in real time.

Humans Still at the Centre

Despite all this, AI cannot replace the human element in stakeholder management. Relationships depend on empathy, active listening, and authentic trust — qualities no algorithm can fully replicate. AI may provide insights, but humans must act with judgement, compassion, and integrity.

Did You Know?

While not Malaysian, the first chatbot — ELIZA, created in 1966 — was the world's earliest attempt at human-machine dialogue, laying the foundation for today's AI tools.

Looking Ahead

The future of stakeholder management is not about choosing between people and machines. It is about combining the best of both. AI will continue evolving — helping organisations engage more clearly and swiftly — but the heart of meaningful relationships will always be human.

By using AI smartly, organisations create wiser engagement, deeper trust, and stronger relationships — transforming challenges into opportunities, for a future where technology and humanity walk hand in hand.

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Embracing Artificial Intelligence for Engineering Education

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Professor,
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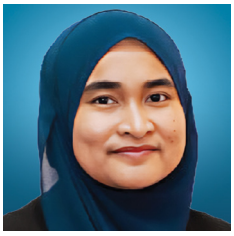

Dr Nur Izzati Ab. Rani
Senior Lecturer,
Faculty of Civil Engineering, Universiti Teknologi MARA

Prof Ir Dr Che Maznah Mat Isa specialises in construction project management, risk management, and international construction business. Dr Nur Izzati Ab. Rani focuses on sustainable construction management and construction techniques. Both contribute to advancing innovation, efficiency, and sustainability in Malaysia's construction and engineering education sectors.

AI is transforming engineering education by reshaping curricula, personalising learning, boosting performance, and enabling global collaboration, while also raising ethical and equity challenges. It supports lifelong learning and professional growth, helping engineers adapt and share resources. This article explores four dimensions: smarter classrooms, lifelong learning, ethics and equity and global collaboration.

What AI Brings to Education

AI techniques like machine learning (ML), deep learning (DL), large language models (LLMs), and analytics enable personalised learning, rapid feedback, and data-driven decisions. Generative AI boosts students' reasoning, while predictive tools track engagement, identify misconceptions, and recommend resources — although effective use needs oversight. Ethical concerns like bias, privacy, authorship, and integrity requires oversight. Educators leverage AI for formative feedback, with institutions increasingly adopting AI core infrastructure.

Engineering education blends problem-solving, design thinking, and practice through frameworks like Conceive–Design–Implement–Operate (CDIO) and challenge-based learning. Competency-based approaches focus on literacy, teamwork, and ethics, linking engineering with design, entrepreneurship, and digital tools. Curricula are updated and flexible, incorporating labs to virtual learning. Early exposure to complex problems builds resilience, supported by apprenticeships and project work. Digital transformation via e-learning, analytics, and remote labs expands access but demands robust design and support.

AI in Engineering Education

As AI and design-focused engineering merge, ML and DL enable adaptive learning, feedback, and simulations, while generative AI aids ideation and critique. Institutions develop AI certificates and interdisciplinary curricula, with CDIO frameworks adding AI-driven tasks like ML training. Competency maps specify skills in tools, data, verification and ethics. Ethics and equity remain key, as they address fairness, bias, privacy and accountability. Broader AI and education models use analytics, personalised pathways, and micro-credentials for continuous learning. Overall, AI shifts education from tool use to ecosystems aligning competencies, tasks, and assessments, emphasising real-world problems, ethics, design, goals and strong policies.

Tracking the Research

A bibliometric analysis examined AI in engineering education, utilising VOSviewer (v.1.6.20) to map research trends, authors and themes from a curated dataset from Scopus. This included journals, conferences, and book chapters, with keywords like "artificial intelligence education" and "engineering education" focusing on impactful English works from 2020 to 2025. After removing duplicates, data was exported in CSV format. Importing it into VOSviewer provided visual clustering, revealing key themes through keyword co-occurrence, with connections indicating relationship strength and colours emphasising emerging clusters, offering insights into AI's role in engineering education.

What the Data Reveals

Visual maps identified clusters related to AI literacy, curriculum innovation, machine learning, personalised learning, ethics, equity, and global collaboration — covering technological, pedagogical, ethical, and institutional aspects.

Figure 1 illustrates the dataset process: 103 Scopus records were identified, of which 18 pre-2020 records were removed, resulting in 85 records; six reviews were excluded, leaving 79 records for analysis.

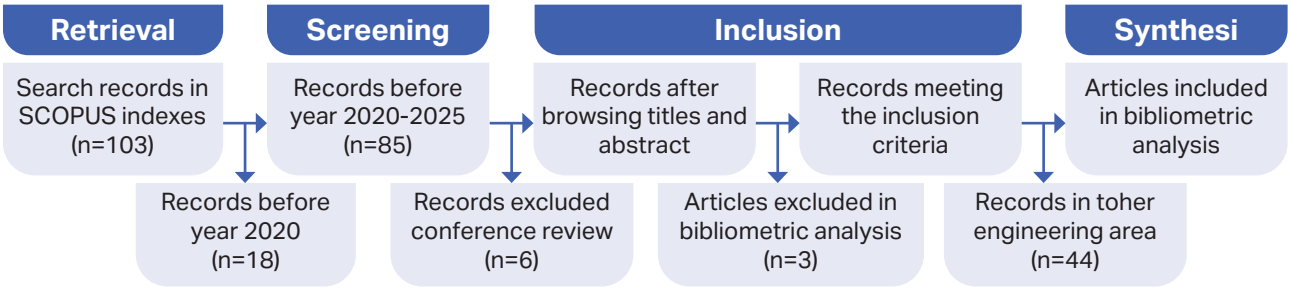

Figure 1: Dataset selection process

After reviewing titles and abstracts, three articles were excluded for lacking bibliometric relevance, and 44 were removed because they belonged to other engineering fields outside the scope of this study. This refinement left 76 records that met the inclusion criteria. Finally, 32 articles were synthesised and included in the bibliometric analysis, which represent the most relevant and high-quality sources for mapping the trends of AI applications in engineering education.

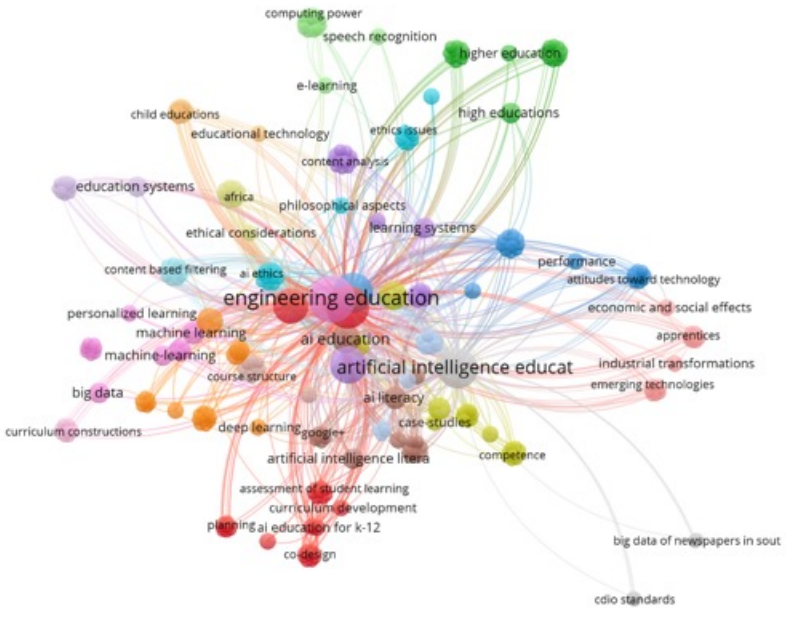

Figure 2: VOSviewer map for AI in engineering education

Figure 2 shows the VOSviewer map for AI in engineering education, organised by keywords across publications. The results identify 8 clusters from VOSviewer map, which are colour-coded as shown in Table 1. These clusters can be grouped into four article themes.

AI in Engineering Classroom: Smarter Experiences

Smarter classrooms, seen in Cluster 1 and Cluster 2, combine curriculum innovation with AI. Adding AI literacy, curriculum development, and learning assessment enables personalised, adaptive learning. ML, DL, and big data reshape course structures, creating student-centred ecosystems with individual pathways and richer experiences.

Lifelong Learning in the AI Era: Reimagining Professional Development.

Lifelong learning, reflected in Cluster 3 and Cluster 6, aligns education with workforce needs. AI impacts performance, apprenticeships, and the economy, requiring engineers to adapt. Case studies show the importance of competencies and AI literacy, making lifelong learning a continuous, AI-driven process where engineers actively participate.

Table 1: Clusters from VOSviewer Map

Cluster (Color)	Main Keywords	Theme / Focus
Red Cluster (Cluster 1)	engineering education, AI education, AI literacy, curriculum development, co-design, K-12, assessment	Core of AI in engineering education and curriculum integration
Orange Cluster (Cluster 2)	machine learning, deep learning, personalised learning, big data, course structure	Technologies and methods driving AI-enhanced education
Blue Cluster (Cluster 3)	performance, attitudes to tech, economic and social effects, apprentices, industry transformation	Impact and outcomes of AI on education and society
Green Cluster (Cluster 4)	higher education, learning systems, speech recognition, computing power, e-learning	Digital transformation in higher education
Purple Cluster (Cluster 5)	education systems, ethics, child education, edtech, content analysis.	Systems-level education and pedagogy
Brown/Yellow Cluster (Cluster 6)	competence, case studies, AI literacy, curriculum design	Competency-based learning and practical integration
Light Blue Cluster (Cluster 7)	ethics issues, philosophy, AI ethics	Ethics and philosophy in AI education
Grey Cluster (smaller) (Cluster 8)	CDIO standards, big data of newspapers in south	Standards and regional/sector-specific studies

Ethics, Equity and the Evolving Role of Educators

Clusters 5 and 7 show educators now go beyond technical teaching to ensure responsible AI use. Emphasising ethics, philosophy, and systemic perspectives highlights equity and fairness. Students must be prepared to think critically about bias, inclusivity, and governance, becoming both engineers and ethical decision-makers.

Embracing AI: A Global Vision in Engineering Education

Global frameworks like CDIO, stress the alignment of local practices with international standards. AI fosters technical excellence and global collaboration, while digital transformation in higher education through AI-driven systems, e-learning, and speech recognition improves access.

AI impacts four areas: smarter classrooms, lifelong learning, ethics and equity, and a global vision. It enables personalised learning, supports upskilling, and raises fairness and accountability. Embracing AI requires a holistic approach — blending innovation with ethics, inclusivity, and global cooperation — making it transformative in engineering education.

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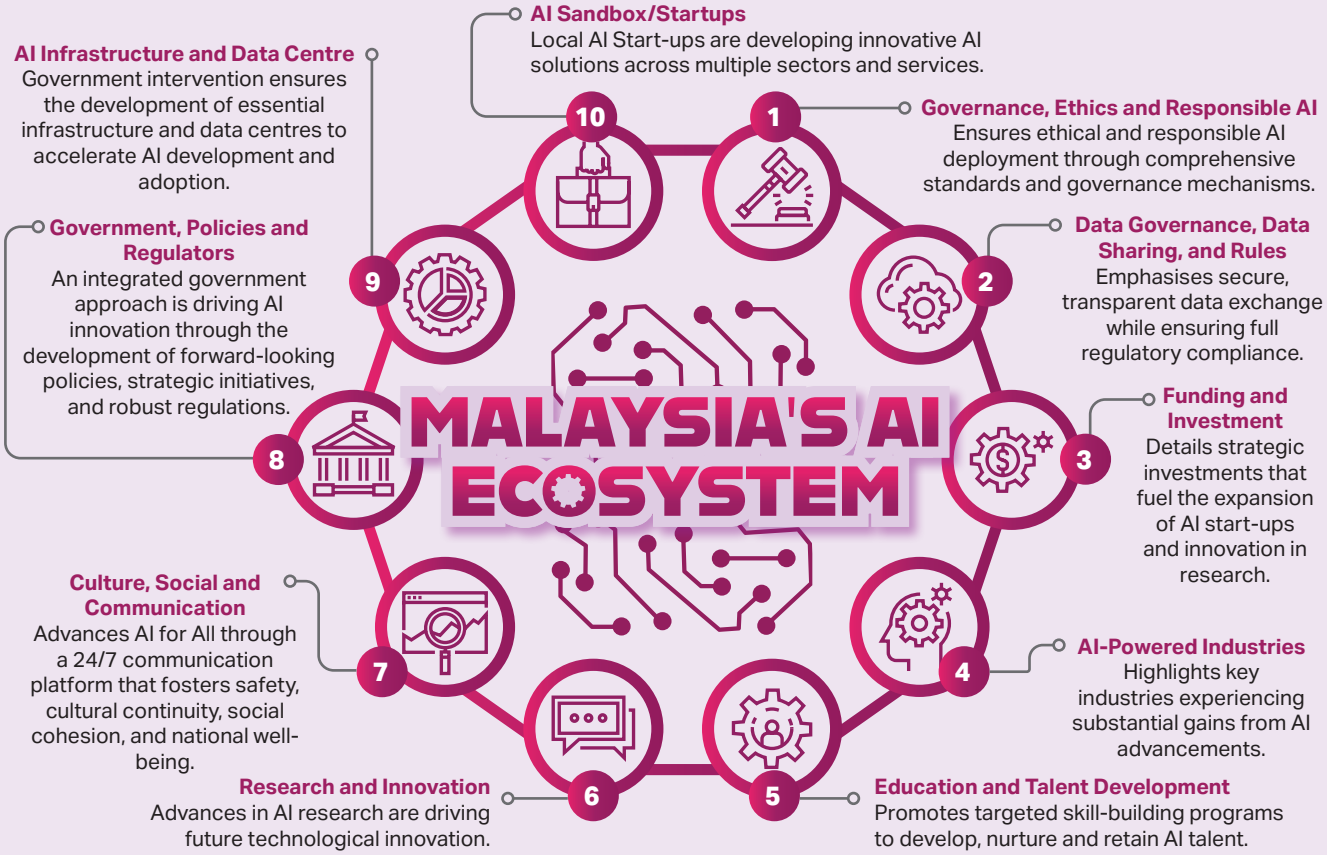
INFOGRAPHICS

Malaysia's AI landscape showcases an integrated approach led by the government to advance innovation, infrastructure, and ethical governance. Through strategic investments, education, and research, Malaysia aims to build a skilled workforce, strengthen industries, and ensure responsible AI adoption — driving sustainable growth, digital transformation, and national well-being.



AI Sandbox/Startups
Local AI Start-ups are developing innovative AI solutions across multiple sectors and services.

Governance, Ethics and Responsible AI
Ensures ethical and responsible AI deployment through comprehensive standards and governance mechanisms.

Data Governance, Data Sharing, and Rules
Emphasises secure, transparent data exchange while ensuring full regulatory compliance.

Funding and Investment
Details strategic investments that fuel the expansion of AI start-ups and innovation in research.

AI-Powered Industries
Highlights key industries experiencing substantial gains from AI advancements.

Education and Talent Development
Promotes targeted skill-building programs to develop, nurture and retain AI talent.

Research and Innovation
Advances in AI research are driving future technological innovation.

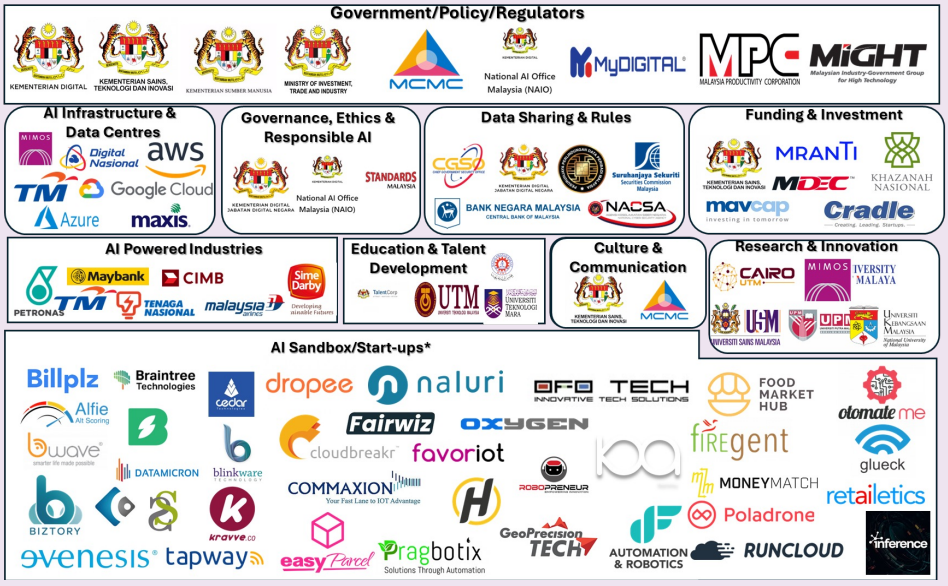
Culture, Social and Communication
Advances AI for All through a 24/7 communication platform that fosters safety, cultural continuity, social cohesion, and national well-being.

AI Infrastructure and Data Centre
Government intervention ensures the development of essential infrastructure and data centres to accelerate AI development and adoption.

Government, Policies and Regulators
An integrated government approach is driving AI innovation through the development of forward-looking policies, strategic initiatives, and robust regulations.

Malaysia AI landscape, highlighting government roles, infrastructure, applications, data governance, ethics, responsible AI, funding and investments, industries, education, talent development, research & innovation, culture, social and dissemination of information.

Key Stakeholders of the AI Ecosystem in Malaysia



** Based on the list of companies listed in Malaysia AI Roadmap 2021 - 2025*

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The Economic Impact of AI in Malaysia

Unlocking New Growth Opportunities and Transforming Industries

Generative AI: A Major Economic Catalyst

A government-backed study reveals that generative AI alone could unlock **USD 113.4 billion** in additional productive capacity about **28% of Malaysia's 2022 GDP.**

The manufacturing sector is expected to capture nearly half of this economic uplift due to its large workforce and significant productivity potential. (MyDigital, 2023)

Balancing Job Displacement and Creation

Minister Steven Sim has emphasised the need for comprehensive workforce strategies to manage **620,000 jobs at risk** due to automation (WEF, 2025).

Global trends suggest that AI could ultimately create more new job roles than it eliminates, similar to the extended impacts of electricity as highlighted in PwC's Global AI Jobs Barometer. The challenge remains in balancing the preservation of livelihoods while creating new opportunities for dignified work (PwC, 2025).

Training Initiatives and Workforce Development

Microsoft Initiative

Microsoft aims to equip **800,000 Malaysians with AI-ready competencies** by the end of 2025, creating a substantial pool of tech talent ready to implement AI solutions across industries. (Microsoft, 2023)

CADS and MDEC Programme

CADS and MDEC's ADAX programs are actively nurturing data science talent across Malaysia, providing specialised training to develop expertise in AI, data analytics, and machine learning applications (MDEC, 2025).

Up to **600,000 roles** in clerical, administrative and manufacturing sectors may be **displaced** due to AI over the **next 3-5 years** (DOSM, 2024).

Digital talent **demand** increased by **over 200%** in Q1 2024, especially in IT systems design and engineering (MDEC, 2024).

Closing digital skills gaps by 2030 could yield an additional **RM 88 billion (≈USD 19 billion) in annual GDP.** (Access Partnership, 2024)

The federal **Budget 2025** allocated **RM 10 million** to establish a National Artificial Intelligence Office to coordinate AI strategies and upskilling initiatives across the country (Malaysia Budget 2025 speech).

USD 113.4 billion in additional productive capacity could be unlocked by generative AI alone — equivalent to approximately **28% of Malaysia's 2022 GDP.** (Access Partnership, 2024)

RM 252 billion (≈USD 55 billion) in annual benefits to businesses by 2030 from AI-driven solutions — approximately **9% of projected GDP.** (Access Partnership, 2024)

RM 48 billion (≈USD 11 billion) in potential cybercrime-related economic damage could be prevented by 2030 through AI deployment in cybersecurity. (Access Partnership, 2024)

Funding Statement

This work was supported by the United Kingdom Foreign, Commonwealth and Development Office (FCDO) and the British High Commission of Kuala Lumpur. The activities were conducted under the auspices of the Malaysian Industry-Government Group for High Technology (MIGHT), in partnership with Universiti Teknologi MARA (UiTM), Malaysia, and Leeds Beckett University, United Kingdom.

Source: Report submitted to the Foreign, Commonwealth & Development Office (FCDO) and British High Commission Kuala Lumpur (BHC KL)

UK MALAYSIA AI GROWTH PARTNERSHIP REPORT

SCAN ME

KEEP POSTED

QR code will be active in November 2025

The CoffeeBook highlights the dynamic UK-Malaysia collaboration in advancing AI across critical sectors such as agriculture, healthcare, smart cities, education, and public services, showcasing how both countries drive innovation, talent development, ethical AI governance, and transformative economic growth for mutual societal benefit.

The UK–Malaysia AI Growth CoffeeBook is a strategic publication produced by the British High Commission Kuala Lumpur in partnership with MIGHT, Universiti Teknologi MARA (UiTM), and Leeds Beckett University. It is funded by the Foreign, Commonwealth & Development Office and delivered in collaboration with these key partners.

Project Commissioned and Funded By:

Foreign, Commonwealth & Development Office

British High Commission Kuala Lumpur

Delivery Partner:

MiGHT Malaysian Industry-Government Group for High Technology

Universiti Teknologi MARA

LBU Leeds Beckett University

From Ideas to Impact: Catalysing UK–Malaysia AI Collaboration

The UK-Malaysia AI Growth Partnership Study explores the evolving artificial intelligence (AI) landscape across both countries, identifying key enablers, challenges and opportunities for strategic collaboration. This infographic presents a data-driven overview of the current status of the AI Ecosystem in Malaysia.

By mapping ecosystem players, funding trends, regulatory frameworks and industry demand, this study highlights the potential for shared growth, knowledge exchange and joint innovation — ultimately unlocking value through ethical and sustainable AI adoption.

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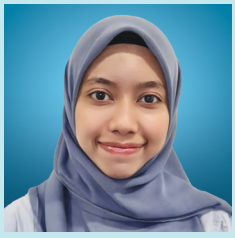

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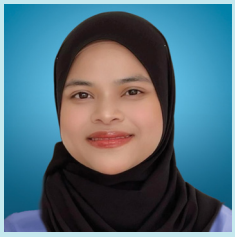

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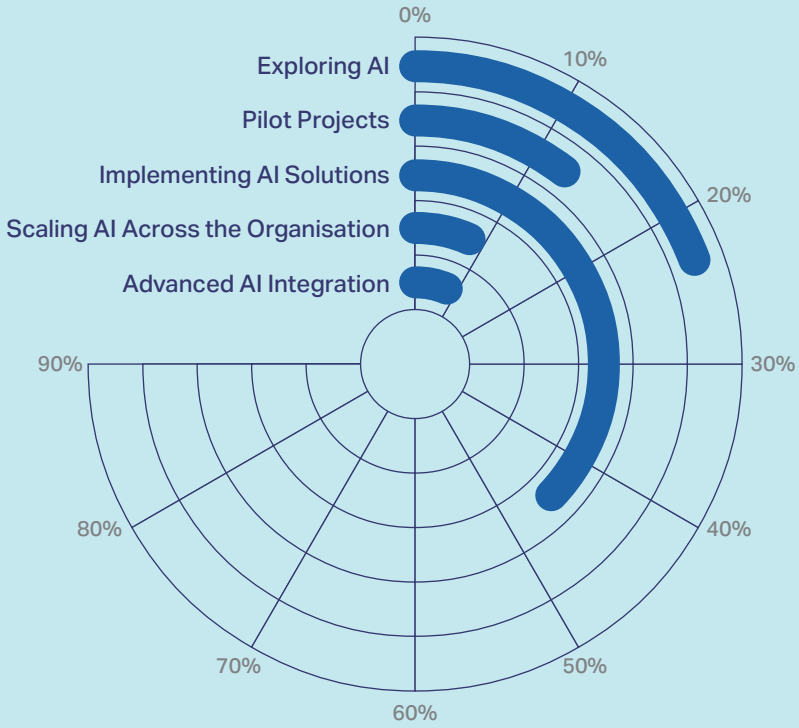
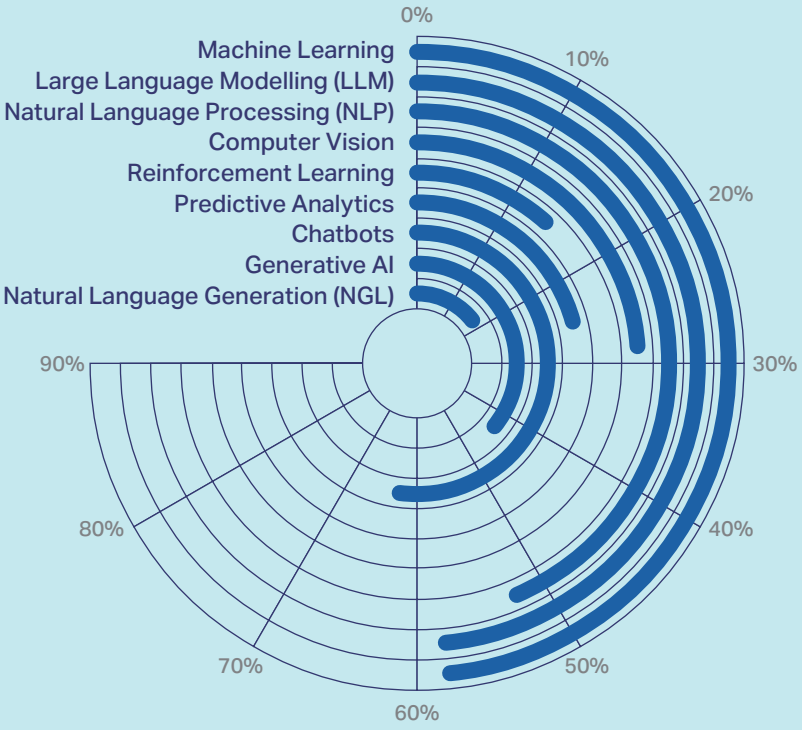
AI MATURITY ACROSS ORGANISATIONS



AI Maturity in Organisations

The FGD reveals that Malaysian organisations are at varying stages of AI maturity. While some entities have advanced in embedding AI into core business functions, a significant portion remains in early or exploratory phases. This disparity reflects the broader national transition toward a more digitally enabled economy.

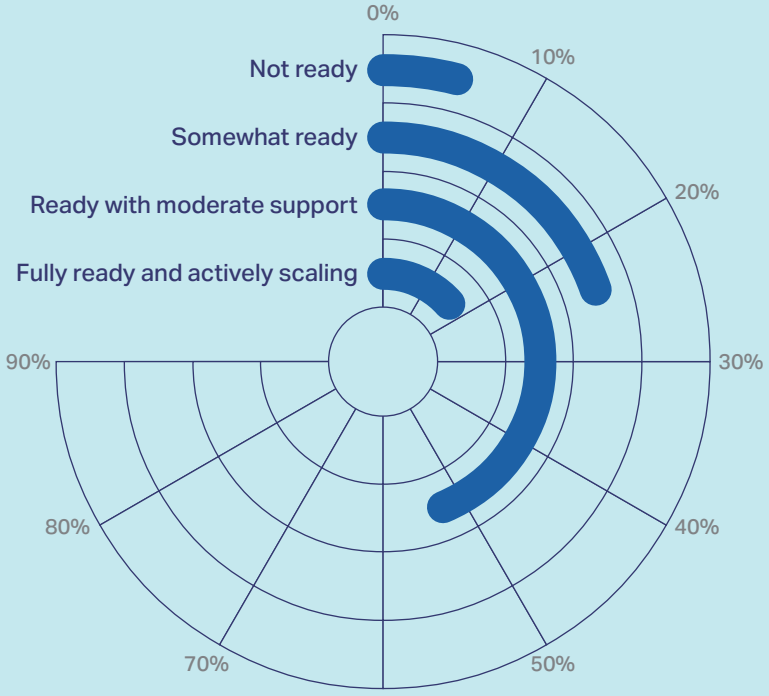
MOST-USED AI TECHNOLOGIES IN PRACTICE



Adoption of AI Technologies

Organisations are adopting a diverse set of AI technologies to meet business needs. These include Machine Learning, Natural Language Processing, Computer Vision and Robotic Process Automation. The deployment of these technologies signals a strong interest in leveraging AI for operational efficiency, customer engagement and innovation.

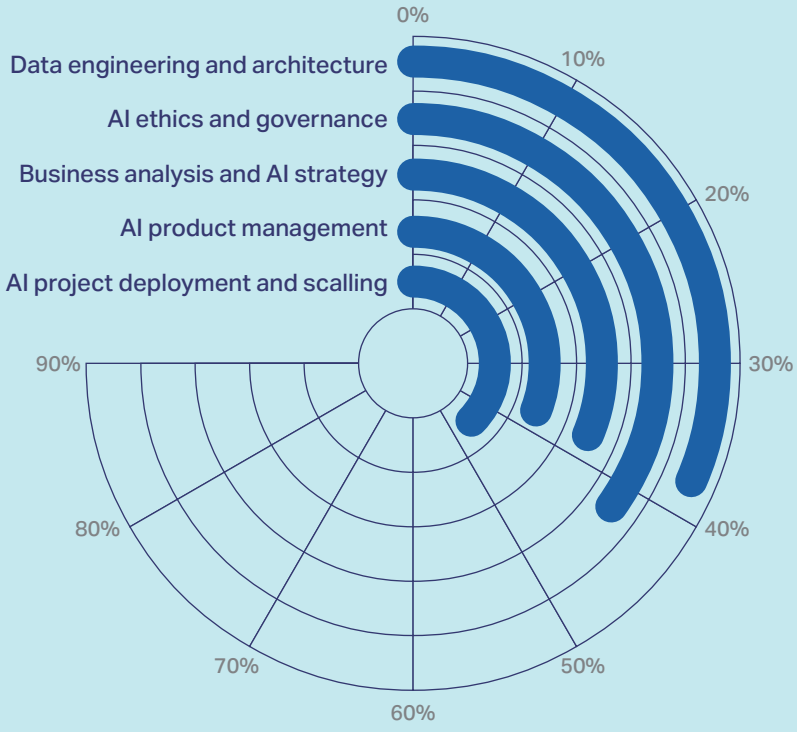
ORGANISATION'S READINESS TO SCALE AI SOLUTION



Readiness to Scale AI Solutions

The findings indicate moderate organisational readiness to scale AI initiatives. Key factors influencing scalability include strategic alignment, availability of data infrastructure, internal capabilities and executive-level support. However, scalability is hindered by gaps in AI governance, data quality and workforce preparedness.

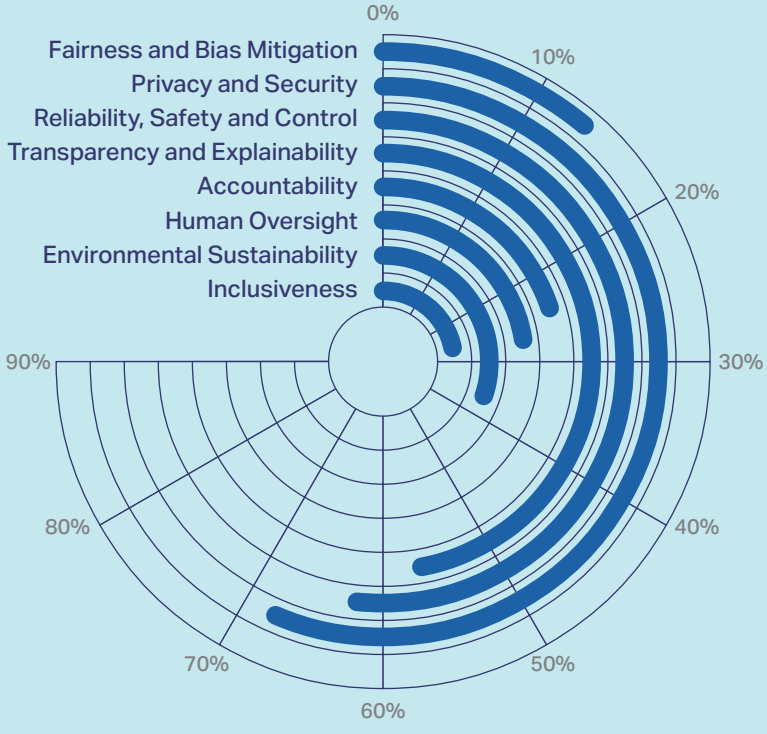
TOP AI SKILLS IN DEMAND



AI Skills in Demand

There is growing demand for AI-related skills, particularly in data science, machine learning engineering, AI governance and cloud computing. The skills gap underscores the pressing need for coordinated talent development initiatives across academia, industry and government to sustain the AI-driven transformation.

RESPONSIBLE AI PRINCIPLES AREAS THAT MATTER MOST



Responsible AI Considerations

Stakeholders emphasised the relevance of responsible AI principles in guiding deployment and policy frameworks. Priority areas include fairness, transparency, privacy protection and accountability. Embedding these principles is considered essential for building trust, ensuring the ethical use of AI, and achieving long-term sustainability.

Malaysia is Ready. The UK is Ready. Let's Shape the AI Future Together.

The opportunity is here. The partners are aligned. Let's turn possibility into progress... together.

IRDA Internal Engagement: Aligning on Talent Priorities for JS-SEZ

MIGHT Partnership Hub **June 10, 2025**

A major advancement in the "Talent and Human Capital Ecosystem Study for the Johor-Singapore Special Economic Zone (JS-SEZ) Based on Investor Requirements" was recently made when MIGHT held its first internal engagement session with the Iskandar Regional Development Authority (IRDA). By strengthening understanding of the workforce and talent dynamics necessary to draw in and maintain investment in the JS-SEZ, this cooperative project seeks to further MIGHT's dedication to promoting strategic human capital development in line with local economic expansion.

UTHM Foresight Club | PSM 1 Presentation & Briefing Session

MIGHT Partnership Hub **June 19, 2025**

As part of the UTHM Foresight Club project, MIGHT's myForesight had the privilege of hosting a delegation from the Faculty of Technology Management and Business at Universiti Tun Hussein Onn Malaysia, which consisted of six teachers and ten students. A panel from both UTHM and myForesight assessed the students' PSM 1 presentation as part of the programme, offering insightful expert advice to help them with their senior projects. Mr. Mohd Hasan's briefing on scenario construction and analytical techniques to aid the students' research progress enhanced the session. With the next PSM 2 evaluation session scheduled for the end of 2025, this academic partnership is a prime example of MIGHT's commitment to developing future talent.

Scenario Planning Training Workshop – PETRONAS

Impiana Hotel, KL **June 11 & 12, 2025**

As part of MIGHT's continuous effort to improve the capacity and capabilities of its members, Petronas, a valued MIGHT Lead Member, successfully completed the first Scenario Planning Training led by myForesight Division. The training, which brought together participants from various Petronas subsidiaries, offered a thorough and engaging platform for learning scenario planning techniques while delving into important future-focused subjects like the changing role of the Chief Home Officer, Malaysia's post-secondary education landscape by 2030, and the future of high-speed unity. Participants gained strategic foresight skills and insights from this immersive event that helped them better predict, negotiate, and handle new difficulties in their fields.

Scenario Planning Training Workshop – PETRONAS

Petronas Leadership Centre, Bangi **June 16 & 17, 2025**

The 2nd Scenario Planning Training for Petronas was successfully completed by MIGHT's myForesight Division, demonstrating MIGHT's dedication to improving member capacity and capability. Participants from several Petronas subsidiaries came together for this extensive training to expand their understanding of scenario planning principles and techniques. The future of money, nuclear energy, eating patterns, and professional workers in Malaysia were among the important future subjects that were covered in the session. Participants got important insight from this engaging and thought-provoking event that helped them to foresee changing situations and proactively handle impending obstacles in respective fields, enhancing their future resilience and flexibility.

Scenario Planning Training Workshop – International Division, MOSTI

MIGHT Partnership Hub **July 2 & 3, 2025**

Through programs like the MOSTI International Division's Scenario Planning Training Workshop, MIGHT continues to play a crucial role in bolstering Malaysia's public sector by integrating strategic foresight into national development priorities. This programme gives leaders cutting-edge foresight tools and techniques to foresee risks and develop proactive plans for the future of the country. Nuclear energy, changing work-life balance, Malaysia's participation in ASEAN COSTI meetings, and the evolution of money and financial systems were among the important future-focused topics covered at the workshop. MIGHT strengthens Malaysia's ability to handle difficult international issues and advances the nation's long-term goal of sustainable prosperity and innovation by incorporating foresight into these crucial areas.

Scenario Planning Training Workshop – Kementerian Pembangunan Wanita, Keluarga Dan Masyarakat

MIGHT Partnership Hub **July 16 & 17, 2025**

Through programs like the MOSTI International Division's Scenario Planning Training Workshop, MIGHT continues to play a crucial role in bolstering Malaysia's public sector by integrating strategic foresight into national development priorities. This programme gives leaders cutting-edge foresight tools and techniques to foresee risks and develop proactive plans for the future of the country. Nuclear energy, changing work-life balance, Malaysia's participation in ASEAN COSTI meetings, and the evolution of money and financial systems were among the important future-focused topics covered at the workshop. MIGHT strengthens Malaysia's ability to handle difficult international issues and advances the nation's long-term goal of sustainable prosperity and innovation by incorporating foresight into these crucial areas.

The GFCC Lisbon Study Trip

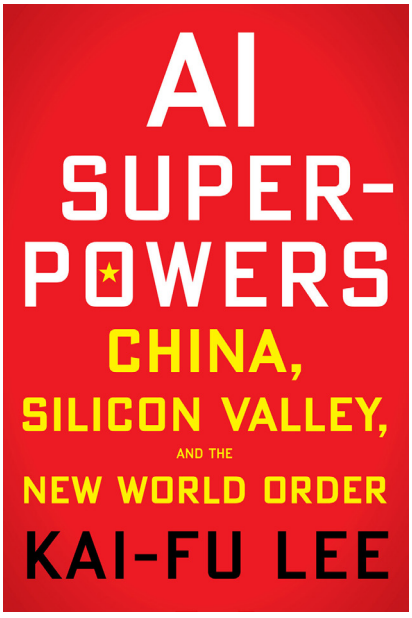
Lisbon, Portugal **July 2 & 3, 2025**

At an international event with the subject "University and City as Catalysts for Innovation and Global Growth," MIGHT demonstrated Malaysia's dedication to creating a flourishing innovation ecosystem. In order to support Malaysia's ambition to become a high-tech nation by 2030, MIGHT highlighted Lisbon's innovation hubs and highlighted its function as an impartial, forward-thinking connector that uses the "3Cs" framework — Conversation, Collaboration and Co-creation — to bring together government, business, academia, and civil society. While tackling issues like skills mismatches and brain drain, Malaysia's solutions include organised internship programs, university factories for industry partnerships, and agreements with Siemens for graduate upskilling. This programme demonstrates MIGHT's strategic role in developing solid alliances, well-defined plans, and an all-encompassing innovation ecosystem to further Malaysia's high-tech goals.

Scenario Planning Training Workshop – SD Guthrie

SD Guthrie HQ, Ara Damansara **August 19 & 20, 2025**

The myForesight Division of MIGHT, with assistance from SDT's New Energy Unit, held a customised scenario planning workshop for SD Guthrie with an emphasis on biomass valorisation. Key subjects included employing palm biomass for sustainable aviation fuel, 0% empty fruit bunch waste in mills, and the workforce of the future in the AI era. In addition to strengthening SD Guthrie's dedication to innovation and sustainability in renewable energy, the collaborative session provided participants with insights to better predict and address future challenges.



AI Superpowers: China, Silicon Valley, and the New World Order

Author: Kai-Fu Lee
ISBN-10: 132854639X
ISBN-13: 978-1328546395
Publisher: Harper Business
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In AI Superpowers, Dr. Kai-Fu Lee — a former executive at Google China and one of the world's leading experts in artificial intelligence — offers a compelling look into the technological and geopolitical race shaping the 21st century. Lee explains how China has risen as a formidable competitor to Silicon Valley, moving from imitation to innovation and now driving rapid advances in AI development.

The book introduces the four waves of AI" — Internet AI, Business AI, Perception AI, and Autonomous AI — each wave transforming industries in profound ways, from personalised online shopping and smart healthcare to financial services, logistics, and self-driving cars. Lee also explores how AI will reshape economies, disrupt traditional industries, and impact the workforce, with millions of jobs at risk of automation.

Beyond the technology itself, AI Superpowers raises critical questions about ethics, governance, and humanity's role in an AI-driven future. Lee stresses that while AI has the potential to shift the global balance of power, it also offers an opportunity to redefine human values. He advocates for compassion, creativity, and empathy as the qualities that will remain uniquely human, urging societies to harness AI not just for economic gain, but to build a more inclusive and meaningful future.

A mix of personal insights, case studies, and forward-looking analysis, this book is both a wake-up call and a hopeful guide for navigating the age of artificial intelligence.

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