Journal of Borneo-Kalimantan

UNIMAS
UNIVERSITI MALAYSIA SARAWAK
INSTITUTE OF BORNEO STUDIES

RESEARCH NOTE

The AI Frontier in Borneo: Balancing Innovation and Human Talent in Kuching's Future

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Received Date: 30 May. 2026 Accepted Date: 22 Jun. 2026 Publish Date: 29 Jun. 2026

ABSTRACT

Under the direction of the Sarawak Digital Economy Blueprint (SDEB) and the Post COVID-19 Development Strategy (PCDS 2030), Sarawak is following a strategic roadmap to become a high-income developed state by 2030. This change transforms Kuching into an AI-powered smart city hence utilizing digital innovation and artificial intelligence (AI) to upgrade industries like healthcare and agriculture. Advanced infrastructure, such as the Irix Tier IV Data Center and a commitment to 60% renewable energy, support this objective. However, the state is dealing with a "Human Capital Paradox" that is typified by a talent gap of 60% between traditional schooling and the quick advancement of technology. Sarawak has entered a "bootcamp" phase in response to this, offering industry-aligned micro-credentialing to guarantee workforce preparedness. A human-centric strategy that gives algorithmic responsibility and data privacy under the Personal Data Protection Act is a top priority necessary for effective implementation. Sarawak's digital frontier prioritizes social inclusivity through rural Digital Community Centers, guaranteeing that technical developments resulting to fair and sustainable prosperity for all residents.

Keyword: regional context; workforce dynamics; small medium enterprises (SMEs); organizational focus; strategic & theoretical; artificial intelligence

INTRODUCTION

As a key component of sustainable innovation and organizational competitiveness, the quick development of artificial intelligence (AI) is currently changing the global economic landscape (Boonmee et al., 2025). AI-powered systems that use machine learning and predictive analytics to find hidden patterns and produce useful insights are revolutionizing industries all around the world (Ramachandaran et al., 2025). It is anticipated that this digital transformation will play a major role in helping Sarawak reach its objective of becoming a developed, high-income state

by 2030. According to the state Sarawak Digital Economy Blueprint 2030 (2023) and Post COVID-19 Development Strategy 2030 (2021), the digital economy, which is largely driven by cutting-edge technologies like artificial intelligence, will generate up to 48,750 new high-paying jobs and contribute about 20% of Sarawak's GDP (RM56.4 billion). Figure 1 illustrates the strategic progression from digital foundations to Sarawak's ultimate socio-economic goals

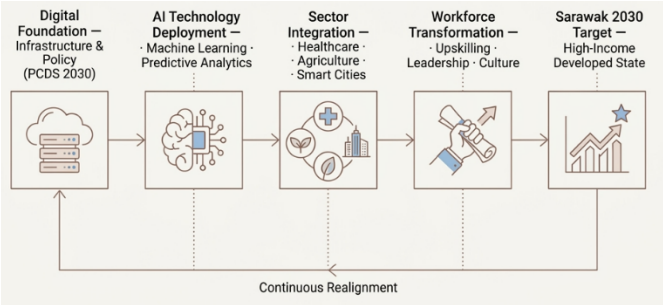

FIGURE 1. *Sarawak State Goverment Target 2030*

This diagram outlines a five-stage journey: establishing a Digital Foundation (Infrastructure & Policy), deploying AI Technology (Machine Learning), achieving Sector Integration (Healthcare, Agriculture, Smart Cities), and executing Workforce Transformation (Upskilling). The final goal is to reach the Sarawak 2030 Target of becoming a high-income, developed state, supported by a cycle of "Continuous Realignment" to ensure the strategy remains effective.

The Digital Transformation of Sarawak

To navigate the post-pandemic era, the Sarawak Government launched the Post COVID-19 Development Strategy 2030 (PCDS 2030) in July 2021. This strategy provides a comprehensive roadmap for transforming Sarawak into a thriving society driven by data and innovation. Central to this vision is the Sarawak Digital Economy Blueprint 2030, which outlines specific actions to establish the state as a leading regional AI and digital economy powerhouse. According to the Sarawak Digital Economy Blueprint 2030 (2023), the state aims to secure its future by strengthening digital foundations and adopting frontier technologies to ensure it is not left behind by the global wave of digitalization (*Post COVID-19 Development Strategy 2030*, 2021; *Sarawak Digital Economy Blueprint 2030*, 2023).

A Socio-Economic Catalyst

AI is increasingly recognized not merely as a collection of technical tools, but as a socio-economic catalyst that will fundamentally redefine how residents of Kuching and the wider Sarawak region work and live. On one hand, it offers a compelling value proposition for businesses by automating repetitive tasks, enhancing operational efficiency, and enabling data-driven decision-making. On the other hand, its implementation serves as a transformative force that impacts social inclusivity and household income. By integrating AI into sectors such as healthcare, agriculture, and smart city management as seen in the Kuching Smart City Master Plan the technology becomes a vehicle for raising standards of living and improving the overall well-being of the community (Islam et al., 2025; *Sarawak Digital Economy Blueprint 2030*, 2023).

The Imperative for a Human-Centric Workforce

The final success of the AI transition hinges more on the deliberate creation of a "human-centric" workforce than on the purchase of technology, notwithstanding Sarawak's ambitious technological goals and extensive infrastructure initiatives under PCDS 2030. A fundamental alignment of organizational culture, leadership commitment, and the ongoing upskilling of those who must interact with these systems effectively are all necessary for realizing the benefits of AI (Boonmee et al., 2025; Islam et al., 2025; Ramachandaran et al., 2025).

KUCHING AS AN AI-POWERED SMART CITY

A crucial aspect of the Sarawak Digital Economy Blueprint 2030 (2023) and the Post COVID-19 Development Strategy 2030 (2021) is the goal of transforming Kuching into a world-class smart city. The goal of this evolution is to establish a "Smart Sarawak" where better governance and increased economic growth are achieved via the integration of cutting-edge systems and skills. According to the Sarawak Digital Economy Blueprint 2030 (2023), the Sarawak government views Kuching as a major regional hub where digital technologies, especially artificial intelligence (AI), function as a catalyst for enhanced efficiency across all economic and social sectors. Figure 2 visual representation details the multi-layered architecture required to transform Kuching into a smart city.

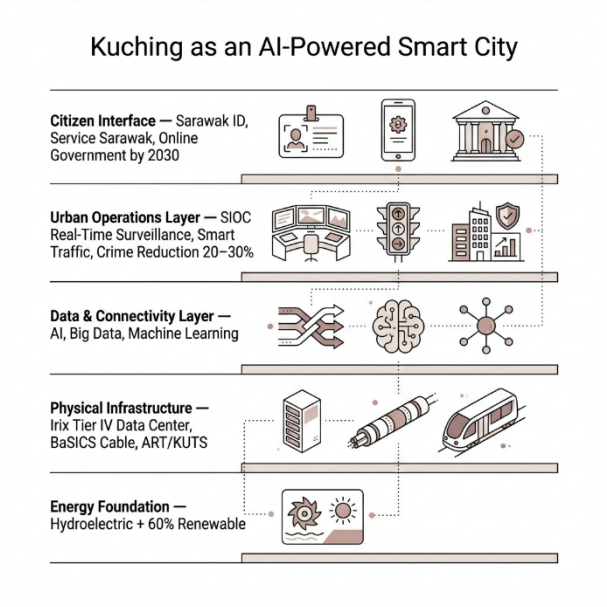

FIGURE 2. *Sarawak State Infrastructure*

The architecture is built on five distinct layers: an Energy Foundation (60% renewable energy), Physical Infrastructure (Irix Data Center and ART/KUTS mobility), a Data & Connectivity Layer (AI and Big Data), an Urban Operations Layer (real-time surveillance via SIOC), and a Citizen Interface (Sarawak ID and online government services).

From Hydro-Energy to Data Centers

A strong and durable infrastructure foundation supports the achievement of this objective. The investment in superior, eco-friendly data infrastructure is a crucial part of this basis. For example, Sarawak developed the Irix Tier IV Data Center, the first of its type in the state, with the goal of supporting huge data processing needs in a carrier-neutral and

environmentally friendly manner. The Batam Sarawak Internet Cable System (BaSICS) ensures worldwide connectivity by offering the fastest latency path between Sarawak and Singapore, enabling quick cross-border data flows necessary for AI applications (*Sarawak Digital Economy Blueprint 2030*, 2023).

To fuel this digital growth, energy sustainability is equally important. Sarawak is a leader in renewable energy thanks to its rich water resources, especially hydroelectric power, which makes up a sizable amount of its energy capacity mix. The state intends to maintain at least 60% renewable energy in its capacity mix by 2030, which includes investigating the production of hydrogen to power the Autonomous Rail Transit (ART) and other green mobility alternatives, according to the PCDS 2030 (2021). Using low-emission technology and digital integration to enhance urban connectivity, the ART project, a component of the Kuching Urban Transportation System (KUTS), represents a significant advancement in smart city mobility (*Post COVID-19 Development Strategy 2030*, 2021; *Sarawak Digital Economy Blueprint 2030*, 2023).

Smart Urban Management

Optimizing urban living through improved operational efficiency and data-driven decision-making is the main goal of integrating AI and digital technology in Kuching. This effort is supported by the Kuching Smart City Master Plan, which focuses on areas like as digital government, safety, and mobility. The Sarawak Integrated Operation Centre (SIOC), a centralized "Operating System" for the city, is at the core of this efficiency (*Sarawak Digital Economy Blueprint 2030*, 2023).

In order to handle vital urban services, the SIOC uses AI, machine learning, and big data analytics in addition to providing round-the-clock real-time surveillance. Smart technology, including smart traffic lights, are being used in traffic management to improve flow and lessen congestion. Additionally, the SIOC is anticipated to improve public safety, with objectives to lower crime in Kuching by 20–30% by integrating sophisticated surveillance into the system (*Sarawak Digital Economy Blueprint 2030*, 2023).

The goal of administrative services is to offer government in a smooth, citizen-driven manner. By 2030, the state wants all government services to be provided online. Platforms like Sarawak ID, which enables a single digital identification for all government transactions, and Service Sarawak, which allows multi-channel access via kiosks and mobile apps, are used to do this. These technologies can produce useful insights that enable the government to implement more focused policies and initiatives by utilizing AI-powered business intelligence (Ramachandaran et al., 2025; *Sarawak Digital Economy Blueprint 2030*, 2023).

Defining the "Digital Sarawak" Ecosystem

The transformation to a "Digital Sarawak" entails a paradigm change in which data becomes an essential resource. However, the existence of external enablers such as "public-private infrastructure partnerships" and "sector-specific pilot programs" is essential to going beyond a stage of mere awareness toward actual implementation, as stated in the Enablers and Barriers to AI Adoption in Regional SMEs report. This means that Kuching's success hinges on getting past the conceptual stage and creating an ecosystem in which government agencies and SMEs actively work together to close the gap between automated, AI-augmented workflows and legacy paper-based procedures. The goal of this digital ecosystem is to provide a unified setting where technology is a daily norm for both trade and governance rather than an isolated experiment.

THE HUMAN CAPITAL PARADOX

A significant dilemma arises from the shift to an AI-driven economy: whereas technology is supposed to propel Sarawak's future development, its successful execution depends solely on the preparedness of the human labor force. This "Human Capital Paradox" contends that human-centric skills like strategic oversight, moral discernment, and innovative problem-solving become increasingly important to the organizational structure as technology advances.

The Skill Gap Reality

A significant barrier to Sarawak's digital ambitions is the acute disconnect between the rapid, "fast-paced" evolution of AI and the slower adaptation cycle of traditional education and Technical and Vocational Education and Training (TVET) curricula. According to the MDEC (2024), the demand for specialized AI talent, such as data scientists and machine learning specialists, outstrips the current local supply by a staggering 60%. This talent deficit is rooted in a curricula mismatch where many computer science and IT programs focus on theoretical knowledge rather than the hands-on, practical skills required to manage AI-driven business intelligence systems (Ramachandaran et al., 2025). Figure 3 visualizes the growing disconnect between technological advancement and human capital readiness.

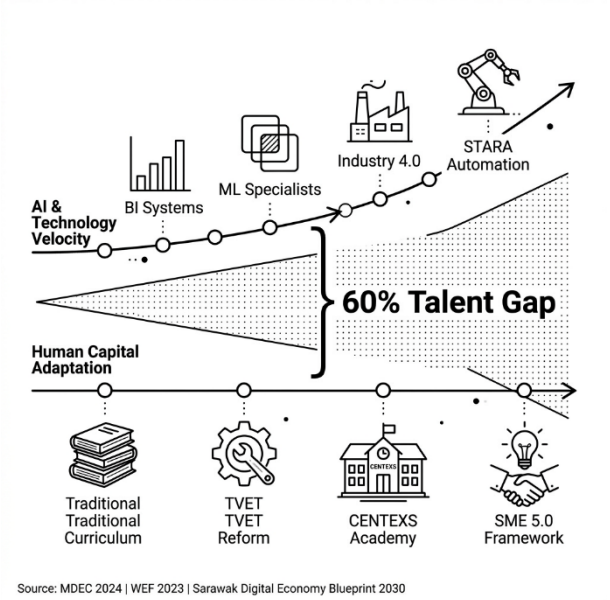

FIGURE 3. *Talent Gap*

It depicts a 60% Talent Gap caused by the "velocity" of AI and technology (including Industry 4.0 and machine learning) moving faster than the rate of human capital adaptation. The figure suggests that traditional curricula and TVET reforms are currently lagging behind the practical skills needed for modern AI-driven business intelligence systems.

Furthermore, the APEC Closing the Digital Skills Gap Report indicates that 75% of respondents identified a significant skills mismatch in the region, noting that government and educational agencies often have a weak understanding of the evolving digital landscape. This mismatch is exacerbated by "brain drain," where skilled professionals are lured away from local industries to higher-wage developed economies, leaving Sarawakian SMEs and government initiatives struggling to source local expertise. To address this, the Sarawak Government has established the CENTEXS Digital Academy to provide industry-relevant

training in frontier technologies like 5G and Industry 4.0, aiming to upskill a workforce that remains "industry-ready" despite technological turbulence (Azizi Othman, 2025; Ramachandaran et al., 2025; *Sarawak Digital Economy Blueprint 2030*, 2023).

The Threat of Displacement vs. Opportunities for Growth

The public is understandably concerned about job security as a result of the shift toward AI and automation; this worry is commonly referred to as STARA (Smart Technology, Artificial Intelligence, Robotics, and Algorithms) awareness (Nguyen, 2025). This concern is well-founded. According to worldwide trends reported by the WEF (2023), the division of labor between people and robots may result in the loss of 85 million jobs by 2025. Roles involving routine, repetitive work are the most vulnerable in Malaysian and regional SMEs (*Sarawak Digital Economy Blueprint 2030*, 2023).

AI-powered applications can efficiently automate tasks like scheduling, routine data entry, and simple customer service questions, claim Islam et al. (2025). AI is progressively streamlining manual labor and inventory management in labor-intensive industries like manufacturing, which is causing organizational opposition among workers who see automation as a direct threat to their livelihood. For smaller businesses that lack the management commitment to support staff during the shift, this impression can show itself as passive resistance or a lack of trust in automated technologies, which impedes the digital transformation process (Boonmee et al., 2025; Ramachandaran et al., 2025).

Sarawak has to change the narrative from replacement to enhancement in order to tackle this issue. AI should be viewed as a socioeconomic catalyst intended to supplement human effort and boost production rather than as a replacement for human labor. AI algorithms are excellent at quickly and accurately identifying patterns in large datasets, but they lack the "emotions and experimental aspects" that distinguish human intelligence (Islam et al., 2025; Ramachandaran et al., 2025; *Sarawak Digital Economy Blueprint 2030*, 2023).

The idea of augmentation highlights how AI can do dangerous and repetitive duties, including regular administrative filing or hazardous industrial procedures, freeing up human workers to work on more strategic, creative, and valuable projects. Value generation in AI projects is closely linked to employee involvement, according to Islam et al. (2025) the technology is only useful when people are given the authority to use AI-generated insights for decision-making. Additionally, human oversight is still an essential component of AI governance, especially when it comes to algorithmic responsibility, ethical issues, and data privacy compliance under the Personal Data Protection Act (PDPA). Sarawak can guarantee that its workforce continues to be the master of the machine by emphasizing a "human-centric" approach, as demonstrated by the SME 5.0 framework, and using AI to improve living standards and reach the high-income status envisioned in Post COVID-19 Development Strategy 2030 (2021)(Azizi Othman, 2025; Boonmee et al., 2025; Islam et al., 2025).

THE "BOOTCAMP" ERA

The Fourth Industrial Revolution's (4IR) quick start has drastically changed Sarawak's educational environment. The state has entered a "Bootcamp" era, characterized by quick, intense, and industry-aligned training intended to generate a workforce capable of navigating an AI-driven economy, as traditional academic systems struggle to keep up with technological turmoil. This change acknowledges that nimble people with specific, provable technical skills rather than merely general theoretical knowledge are needed in the current digital economy

(Boonmee et al., 2025; *Sarawak Digital Economy Blueprint 2030*, 2023). Figure 4 compares the durability of various skill types across the history of industrial revolutions.

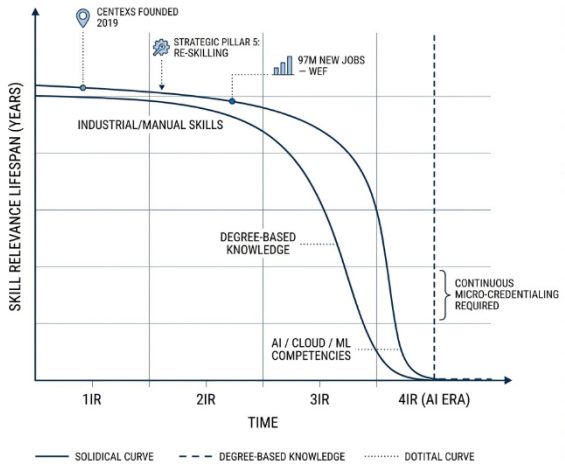

FIGURE 4. *Skill Relevance Lifespan*

The chart demonstrates that while manual skills and degree-based knowledge had long lifespans in earlier eras, the relevance of **AI, cloud, and ML competencies** declines rapidly in the Fourth Industrial Revolution (4IR). This necessitates a shift toward **continuous micro-credentialing** rather than relying solely on a one-time graduationn.

Beyond Conventional Degrees

Organizations like the Centre for Technology Excellence Sarawak (CENTEXS) Digital Academy are at the forefront of this educational shift. Established in 2019, CENTEXS has moved away from the conventional degree-based model toward a system of "skill-based" certifications that prioritize industry readiness. This transition is anchored in strategic partnerships with global technology leaders such as Huawei, Microsoft, Bosch Rexroth, EON Reality, and IBM to ensure that training curricula are developed in accordance with real-world industry standards (*Sarawak Digital Economy Blueprint 2030*, 2023).

According to the Sarawak Digital Economy Blueprint 2030 (2023), 100% Industry Certified Training and the issue of micro-credential certifications are the goals of the academy's cooperation approach. For instance, the cooperation with Microsoft prioritizes data science and cybersecurity, while the partnership with Huawei produced Southeast Asia's first digital laboratory focusing on 5G and telecoms gear. CENTEXS is assisting in the development of a "pipeline of job-ready graduates" who can instantly contribute to the RM56.4 billion digital economy target by concentrating on these particular domains.

From Graduation to Micro-credentialing

The idea of "graduation" is no longer the end of one's education in an AI-powered world. AI, machine learning, and cloud computing abilities have shorter lifespans than earlier industrial

competencies due to the quick speed of technological progress. As a result, continuing education has emerged as a strategic requirement for long-term professional success. Ramachandaran et al. (2025) claim that internal capability development is now a "continuous effort" due to the underutilization of sophisticated AI technologies in the absence of a workforce that continuously refreshes its expertise (*Sarawak Digital Economy Blueprint 2030*, 2023).

Sarawak Digital Economy Blueprint 2030 (2023) promotes a culture of ongoing micro-credentialing in order to remedy this. The "industry-focused re-skilling and up-skilling of the existing workforce" through modular training programs is the specific focus of Strategic Pillar 5 of the strategy. Without going back to a conventional four-year university program, this method enables workers to gain specialized new skills like AI-driven forensics or immersive simulation learning. Sarawakians will be able to take part in the 97 million new jobs that are being created worldwide as a result of the new division of labor between people and robots thanks to this modularity.

Addressing Digital Literacy across Generations

The cultural and digital divide that affects elder generations and rural workers moving to metropolitan areas like Kuching is a major obstacle in this transformation. These groups frequently encounter major obstacles pertaining to language and fundamental internet literacy. For example, many rural migrants may find the language and technical barrier to high-paying jobs insurmountable without targeted intervention, even though the state encourages STEM education in English to ensure global competitiveness (Boonmee et al., 2025; *Post COVID-19 Development Strategy 2030*, 2021; *Sarawak Digital Economy Blueprint 2030*, 2023).

To mitigate these disparities, the Sarawak Government has established 45 Digital Community Centres (DCC) and over 133 PEDis (Pusat Ekonomi Digital) in rural and semi-urban areas. These centers serve as focal points for the Community Digital Literacy Programme, which aims to reduce the "information gaps" and "fear of job displacement" that often cause organizational and cultural resistance to AI. Furthermore, many SME managers in regional contexts exhibit a conservative "risk-avoidance" culture, which can lead to the dismissal of AI as inapplicable to their traditional operations. Addressing these cultural nuances requires more than hardware; it demands a "human-centric" approach that builds confidence and digital ability across all age groups and geographic locations (Azizi Othman, 2025; Boonmee et al., 2025; *Sarawak Digital Economy Blueprint 2030*, 2023).

THE ENGINE OF THE ECONOMY

Sarawak's economy is built on small and medium-sized enterprises (SMEs), which make up the great majority of operating businesses and play a crucial role in social development and employment. The Sarawak government wants 80% of MSMEs to be digitalized by 2030 in order to meet the objectives of the Post COVID-19 Development Strategy 2030 (2021). However, local SMEs frequently fall behind as big multinational firms use artificial intelligence (AI) to gain a competitive edge, creating a digital divide that could worsen economic inequality (Azizi Othman, 2025; Islam et al., 2025; Ramachandaran et al., 2025; *Sarawak Digital Economy Blueprint 2030*, 2023)

The Digitization Struggle

Deeply ingrained structural obstacles make the shift to AI difficult for many SMEs in Kuching. The biggest obstacle is capital restrictions; implementing AI necessitates a large upfront investment in software licensing, hardware (like GPUs), and specialist human expenditures, which are sometimes unaffordable for resource-constrained businesses with narrow profit margins. Cost concerns prevented 68% of SME respondents from investing in AI, according to a poll conducted by the ASEAN Business Council in 2022 (Azizi Othman, 2025).

Additionally, SMEs are unable to manage complicated AI systems due to a severe lack of technical knowledge. The local supply of data scientists and machine learning engineers is significantly less than the demand, which is made worse by "brain drain" the migration of qualified workers to established economies with greater wages. Lastly, a lot of well-established SMEs continue to rely on paper-based procedures and outdated systems. According to Azizi Othman (2025), these antiquated infrastructures frequently provide fragmented, low-quality data that is incompatible with contemporary AI standards. According to Ramachandaran et al. (2025), the cost of maintaining these antiquated systems keeps insurers and small businesses in a "technological status quo," which keeps them from utilizing AI to its fullest.

A Phased Roadmap

Adoption of AI should be a gradual process of incremental innovation rather than a drastic, all-at-once change in order to reduce the risks of failure. Islam et al. (2025) claim that this two-pronged strategy, which strikes a balance between operational improvement and structural renewal, enables businesses to change while being receptive to strategic reinvention. Figure 5 provides a three-step strategic framework for small and medium-sized enterprises (SMEs) to adopt AI.

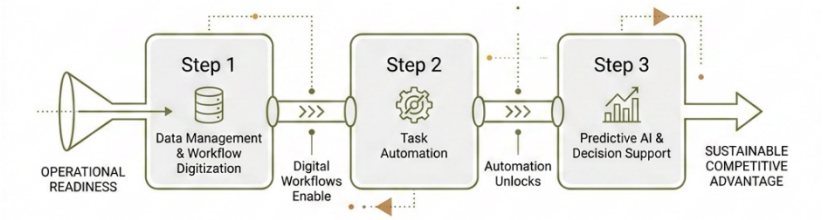

FIGURE 5. *Phased Roadmap*

The roadmap begins with Step 1: Data Management & Workflow Digitization to establish operational readiness. It proceeds to Step 2: Task Automation, which unlocks efficiency by reducing manual labor. The final stage, Step 3: Predictive AI & Decision Support, enables firms to use advanced analytics for a sustainable competitive advantage. In order to ensure that technology is a tool for improvement rather than a cause of organizational upheaval, table 1 outlines a methodical evolution for SMEs.

TABLE 1. *Phase Roadmap Rationale*

Phase	AI Adoption Stage	Rationale
1	Data Management and Workflow Digitization	Successful AI adoption must begin with operational readiness. Boonmee et al. (2025), standardizing internal workflows and documentation is the highest priority for SMEs, as AI-generated insights can only

		be effectively utilized if a stable process foundation exists.
2	Task Automation	Once digital workflows are in place, SMEs can implement AI to automate repetitive, routine tasks such as scheduling, report generation, and basic customer service inquiries. This reduces manual labor and frees up employees for more strategic, creative, and value-added work (Islam et al., 2025).
3	Predictive AI/Decision Support	In the final stage, firms can leverage advanced tools like predictive analytics to forecast market trends, personalize marketing campaigns, and support data-driven decision-making. This enables Kuching-based SMEs to respond swiftly to dynamic market demands and achieve sustainable competitive advantage (Islam et al., 2025; Ramachandaran et al., 2025).

To put it simply, Sarawak's SMEs may adopt AI through a three-step process that strikes a compromise between worker stability and technical advancement. By digitizing internal workflows, it first builds operational readiness and establishes a solid data basis for upcoming solutions. When task automation is available, businesses switch from manual labor to strategic and creative work by automating repetitive tasks. In order to ensure that technology serves as a tool for human augmentation rather than replacement, this stepwise strategy culminates in the application of predictive AI for data-driven decision-making, ultimately assisting local firms in gaining a sustainable competitive advantage in accordance with the state's 2030 goals.

Industry-Academia Partnerships

Overcoming the human capital paradox requires a collaborative model that bridges the gap between traditional curricula and practical industry needs. Industry-academia partnerships are essential; firms provide real-world problems for students and researchers to solve, while the academic side provides the technical solutions and a pipeline of job-ready talent (Ramachandaran et al., 2025).

The Sarawak Government facilitates this through the Industry Linkage Fund, a matching grant scheme designed to support translational research and innovation in partnership between public and private sectors. Additionally, the Digital Innovation Clusters and innovation hubs established across Sarawak serve as platforms where universities and entrepreneurs can accelerate product development and commercialization. According to the Sarawak Digital Economy Blueprint 2030 (2023), these strategic alliances equip SMEs with the "AI expertise and best practices" necessary to compete in a globalized marketplace, ensuring that the local workforce remains the master of the machine (Ramachandaran et al., 2025).

ETHICAL AND SOCIETAL CONSIDERATIONS

As Sarawak pivots toward an AI-driven economy, the technological shift introduces complex ethical and societal challenges that extend beyond simple infrastructure deployment. The state’s vision for a thriving society by 2030 is anchored on the principle that digital transformation must be inclusive and sustainable, ensuring that the integration of Artificial Intelligence (AI) does not compromise the rights or well-being of the population. Figure 6 maps the ethical, legal, and social challenges Sarawak must navigate during its digital transformation.

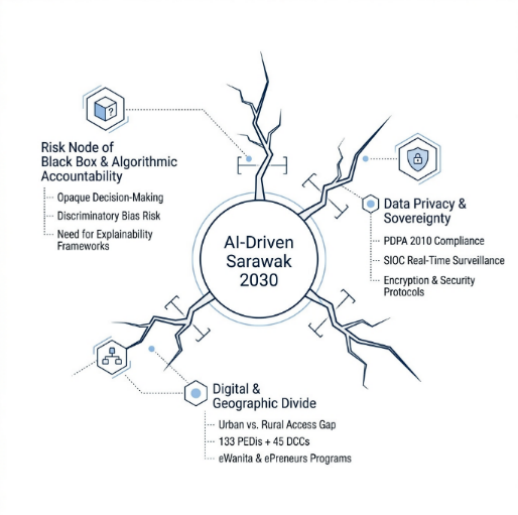

FIGURE 6. *AI-Driven Sarawak 2030*

The diagram identifies critical "risk nodes," such as the "Black Box" Problem (algorithmic accountability), Data Privacy & Sovereignty (compliance with the PDPA (2010)), and the Digital & Geographic Divide (the gap between urban and rural access). It emphasizes that programs like PEDis and Digital Community Centres are essential to ensure the transition is inclusive.

The "Black Box" Problem and Algorithmic Accountability

The "Black Box" problem, or the lack of transparency in how sophisticated algorithms arrive at particular conclusions or predictions, is a major ethical concern in the adoption of AI. To prevent algorithmic bias and system dependency, Sarawakian personnel must comprehend the reasoning behind AI-driven results. Businesses should aim for transparency in AI development and implementation, according to Islam et al. (2025), in order to boost public trust and allay concerns about decision-making fairness.

Workers run the risk of replacing human oversight with mindless adherence to machine logic if they are not trained to properly assess AI-generated insights. This is especially risky in industries like banking and insurance, where discriminatory actions could result from distorted data. To lower perceived liability concerns and guarantee that AI stays a tool for human enhancement rather than an opaque authority, Ramachandaran et al. (2025) claim that a thorough algorithmic governance structure addressing transparency and explainability is required (Azizi Othman, 2025).

Data Privacy in the Borneo Context

The Sarawak Integrated Operation Centre (SIOC) and the Kuching Smart City Master Plan are two examples of the initiatives aimed at creating a Smart Sarawak that need gathering enormous amounts of data from the populace. In this situation, safeguarding digital rights is crucial. Strategic Pillar 5 of the Sarawak Digital Economy Blueprint 2030 expressly names "Data Governance" as a major factor in digital preparedness, highlighting the necessity of controlling data availability, usability, and security to avoid abuse (*Sarawak Digital Economy Blueprint 2030*, 2023)

The main legal framework in Malaysia is the PDPA (2010) which mandates that data be used only for certain, lawful reasons and requires express agreement from individuals. However, the complexity of guaranteeing data security and sovereignty rises as the state employs round-the-clock real-time monitoring through systems like SIOC. Strong security procedures and encryption are necessary to navigate this envronment, according to Ramachandaran et al. (2025), in order to uphold client confidence and adhere to strict regulatory requirements like Bank Negara Malaysia's RMiT framework.

Bridging the Digital and Geographic Divide

A central tenet of the Post COVID-19 Development Strategy (PCDS) 2030 is ensuring that the AI boom benefits all Sarawakians, not just the urban elite in Kuching. One of the seven strategic thrusts of PCDS 2030 is Social Inclusivity, which aims to narrow the developmental gaps between urban and rural areas. According to the Sarawak Government, digital transformation should act as a catalyst to uplift the socio-economic status of the "impoverished segment of the population" by providing equitable access to jobs and business opportunities (*Post COVID-19 Development Strategy 2030*, 2021).

In order to accomplish this, the state has set up programs like 133 PEDis and 45 Digital Community Centers (DCC) to train rural populations in digital literacy and skills. Additionally, initiatives like eWanita and ePreneurs especially target underprivileged populations to make sure they are ready for the demands of a market that is technologically savvy. Boonmee et al. (2025) claim that this human-centered strategy is consistent with the Industry 5.0 paradigm, which emphasizes that digital transformation should promote equitable economic growth rather than favoring those who are already well-prepared. Sarawak hopes to reduce its GINI index and guarantee that technological prowess translates into higher living standards for all communities by emphasizing inclusive digital involvement (*Sarawak Digital Economy Blueprint 2030*, 2023).

RECOMMENDATIONS FOR POLICY

The challenges noted in the earlier sections such as severe skill shortages, organizational resistance, and deficiencies in data infrastructure are translated into practical policy levers in this part. The objective is to give industry players and the Sarawak government a strategic framework to hasten the adoption of artificial intelligence (AI) while guaranteeing that the shift stays human-centric and economically inclusive (Azizi Othman, 2025; Ramachandaran et al., 2025).

Incentivizing Digital Maturity in SMEs

Despite being the backbone of Sarawak's economy, small and medium-sized businesses (SMEs) have the biggest challenges in the digital transformation. Policy must go beyond general awareness to address the unique structural limitations of local businesses in order to meet the PCDS 2030 goal of 80% MSME digitalization (Boonmee et al., 2025; *Sarawak Digital Economy Blueprint 2030*, 2023).

The "technological status quo" brought about by a lack of funding to re-engineer outdated systems is a major obstacle for Kuching-based SMEs. According to Islam et al. (2025), 68% of SME respondents in regional studies cited cost concerns as the primary deterrent to AI adoption. Many well-established SMEs continue to use antiquated, disjointed, or paper-based

IT infrastructures that date back decades. For businesses with narrow profit margins, the expense of integration or a complete system redesign is expensive because these systems are often incompatible with contemporary AI requirements (Azizi Othman, 2025; Ramachandaran et al., 2025).

A "Digital Transformation Grant" that is particularly designated for the technical audit and upgrading of legacy IT infrastructure should be implemented by the Sarawakian government. Although digitalization grants and vouchers are mentioned in the current Sarawak Digital Economy Blueprint 2030 (2023), this new tool ought to be more specific. A "one-size-fits-all" approach to funding is inadequate, according to Boonmee et al. (2025) instead, policy should offer customized subsidies for infrastructure audits and diagnostic tools that assist SMEs in identifying their unique readiness deficiencies.

In order to match public funding with successful adoption outcomes, lead agencies like MINTRED and SDEC might oversee this fund through a risk-sharing structure in which the government co-invests in implementation. Access to "AI starter kits" subsidized cloud-based AI tools and data management systems that lower the entrance hurdle for businesses with limited resources should also be made easier by this funding (Azizi Othman, 2025; Boonmee et al., 2025; *Sarawak Digital Economy Blueprint 2030*, 2023).

Funding the "middle-ware" and data-cleaning procedures required for AI preparedness must take precedence over the acquisition of high-tech hardware. Boonmee et al. (2025)) claim that "Process" maturity, rather than just technology availability, is a more important factor in AI adoption. When policy interventions ignore the underlying data quality in favor of a "superficial embrace" of hardware, they frequently fall short (Azizi Othman, 2025; Islam et al., 2025).

Therefore, the following should be given priority in the Digital Transformation Grant:

- Funding for the transformation of unstructured legacy data into machine-readable formats appropriate for AI training is known as data cleansing and standardization (Azizi Othman, 2025; Boonmee et al., 2025).
- Supporting the creation of software layers that enable new AI modules to interact with current legacy systems, interoperability middleware lessens the requirement for complete infrastructure replacement (Azizi Othman, 2025; Boonmee et al., 2025).
- Grants should support the creation of Standard Operating Procedures (SOPs) and organized documentation in accordance with the SME 5.0 paradigm, since AI-generated insights are only useful when integrated into reliable human workflows (Boonmee et al., 2025).

Establishing a "Human-in-the-Loop" Workforce Pipeline

The Sarawak digital shift is mostly a human-centric activity, even though infrastructure and capital are crucial. Policy must shift from classroom-based learning to immersive, industry-integrated talent development in order to close the growing gap between technological competence and workforce preparation.

The industry's adoption of AI is outpacing the present supply of specialized technical personnel. The demand for data scientists and AI specialists in Malaysia exceeds the local supply by about 60%, according to the Malaysia Digital Economy Corporation (MDEC) (2024). There are two main causes of this deficit. First, there is a clear disconnect between the

"fast-paced" practical requirements of firms using AI-driven business intelligence and traditional university/TVET curriculum, which frequently place an emphasis on theoretical understanding. Second, local SMEs and insurers are finding it difficult to obtain the knowledge required for long-term digital transformation as a result of the "brain drain" problem, which continues to attract competent Malaysian-trained individuals to higher-wage industrialized nations (Azizi Othman, 2025; Ramachandaran et al., 2025).

By creating a "National AI Apprenticeship" program, the Sarawak government should broaden the scope of organizations such as the Centre for Technology Excellence Sarawak (CENTEXS). This project would establish a framework for subsidized on-the-job training that would go beyond the academy's current lab-based teaching, such as its relationships with Microsoft and Huawei (*Sarawak Digital Economy Blueprint 2030*, 2023).

Under this idea, local companies hiring student apprentices in AI roles would receive training vouchers or wage subsidies from the government. According to Boonmee et al. (2025), this "dual-track" approach lowers the financial risk for companies looking to develop internal technical capability while fostering "operational muscle" by enabling students to apply cutting-edge technologies to actual business situations. Sarawak may establish a long-term pipeline of "industry-ready" graduates with verified experience in regional organizational contexts by combining this with the current Industry Linkage Fund.

The focus of legislation must change to micro-credentialing pathways that prioritize AI ethics and "Human-in-the-Loop" (HITL) management in order to guarantee that AI stays a tool for augmentation rather than a cause of displacement. The Sarawak Digital Economy Blueprint 2030 states that skills development should emphasize the "ethical deployment" of AI in both the public and private sectors in addition to coding (*Sarawak Digital Economy Blueprint 2030*, 2023).

To avoid the "Black Box" issue, in which opaque algorithms may result in biased or discriminatory outputs, graduates must be prepared to audit AI judgments. Encouraging micro-credentials in algorithmic governance and ethical data management that are in line with the Personal Data Protection Act (PDPA) will guarantee that workers can offer the strategic supervision and innovative problem-solving that AI systems are unable to. Sarawak may guarantee that its digital economy is driven by mechanisms that continue to be transparent, accountable, and essentially in line with human values by certifying employees as HITL managers (Azizi Othman, 2025; Boonmee et al., 2025; Islam et al., 2025; Nguyen, 2025; Ramachandaran et al., 2025).

Strengthening Industry-Academia Collaboration

Bridging the functional gap between academic research and the realities of business operations is the third strategic pillar for increasing the deployment of AI in Sarawak. Although Sarawak has laid the groundwork for digital research, a more comprehensive strategy is needed to guarantee that technological innovation results in quantifiable increases in productivity for regional businesses.

One of the key issues mentioned in the sources is that academic research frequently stays isolated from the real-world, day-to-day operational difficulties that local businesses encounter. Even when partnerships do exist, Ramachandaran et al. (2025) claim that they frequently fall short of providing the instant "hands-on skills" required to develop and oversee AI-powered systems in high-stakes settings like the manufacturing or insurance industries. Additionally, Boonmee et al. (2025) highlight a major gap in regional contexts where national AI initiatives

frequently fall short of providing local SMEs with practical help, especially those in traditional industries with low levels of digital maturity like agriculture or handicrafts. Research produced by this compartmentalized strategy is theoretically solid but operationally useless for companies with limited resources that are having trouble with aging infrastructure.

The Sarawak government should establish "Regional AI Sandboxes" specialized, industry-specific settings where the government supports direct partnerships between academics and SMEs to overcome this mismatch. Boonmee et al. (2025) claim that these sandboxes enable SMEs to test AI tools in a low-risk, economical setting, hence "de-risking" the investment through pilot projects and professional oversight.

The Center of Excellence (CoE) for Digital Economy, which was founded to do translational research in collaboration with top international and Sarawakian universities, should be expanded upon by this effort. The state can create an ecosystem where businesses supply real-world issues (such supply chain inefficiencies or agricultural yield prediction) and students supply the technical answers by localizing these CoEs into "sandboxes" within industrial zones or rural digital clusters. The Sarawak Digital Economy Blueprint 2030 (2023) states that the business Linkage Fund, a matching grant program created especially to speed commercialization and improve business competitiveness in the global economy, should encourage these partnerships.

The creation of public-private infrastructure partnerships must be an essential feature of these sandboxes. The hefty initial expenses of cloud storage and hardware discourage many small businesses. By giving SMEs access to professional consultation and shared cloud computing resources, policy should lower the "barrier to entry." Sarawak Digital Economy Blueprint 2030 (2023) claim that infrastructure co-investment programs, such AI-as-a-service (AIaaS) platforms or subsidized cloud storage, can offer the "economies of scale" that individual small businesses are unable to obtain on their own.

Additionally, the state ought to broaden programs like the "Go Digital Consultancy Program" to incorporate diagnostic tools tailored to artificial intelligence. The Sarawak Digital Economy Blueprint 2030 (2023) states that offering structured training and consulting funding guarantees that SMEs integrate AI-generated insights into their fundamental business models rather than merely "superficially embrace" technology. Sarawak may develop a distinctive model for "Industry 5.0" ready by fusing academic knowledge with shared digital infrastructure, guaranteeing that its workforce continues to be the master of the machine while promoting sustainable economic growth.

Data Governance and Ethical Oversight

The ethical implications of massive data processing must be taken into consideration as Sarawak expands its digital aspirations, especially through the development of smart city infrastructure. To guarantee that Artificial Intelligence (AI) is a tool for the public good rather than a source of systemic prejudice or privacy infringement, a strong governance framework must be established.

The risk of data mismanagement and algorithmic bias rises dramatically as Kuching expands its Smart City projects, which are centralized through the Sarawak Integrated Operation Centre (SIOC). Large volumes of citizen data are gathered by current systems for emergency response, traffic control, and surveillance. However, the "Black Box" issue in which opaque algorithms may result in biased decisions in delicate areas like public safety or financial services remains a serious threat, as observed by Ramachandaran et al. (2025). Additionally, a

large number of the region's current datasets are incomplete or of low quality, which may result in faulty AI-driven insights that disproportionately impact underprivileged people.

In order to reduce these hazards, the Sarawak government ought to create a "Sarawak AI Ethics Council." In order to guarantee openness, responsibility, and inclusivity, this organization would be in charge of supervising the implementation of all AI algorithms in the public sector. This specialized ethics organization would carry out required effect evaluations for AI projects, building on the current governance framework of the Sarawak Multimedia Authority (SMA) and the proposed Cyber Security Council. The Sarawak Digital Economy Blueprint 2030 (2023) states that a "cyber secure and ethical digital environment" requires the ethical use of technology. As the ultimate arbiter of algorithmic transparency, the Council would make sure that "Human-in-the-Loop" (HITL) standards are adhered to in order to preserve human control over machine judgments.

This Council's main goal must be to create precise data privacy regulations that meet local community requirements and national standards. Specifically, Sarawak's AI policies must be integrated with the PDPA (2010), ensuring that express consent and purpose limitation remain the foundation of all data collection. Islam et al. (2025) claim that if openness is not given priority, societal opposition may result from public concerns about job displacement and safety issues.

Consequently, the Council ought to:

- Localize Data Protection: Create Policy, Procedure, and Guidelines (PPGs) unique to Sarawak that convert national PDPA obligations into practical actions for regional government agencies and SMEs.
- Create Algorithmic Audits: In line with the Industry 5.0 paradigm of human-centricity, conduct routine audits of public AI systems to identify and address algorithmic bias.
- Boost Public Trust: Promote public trust by making the use of AI transparent and establishing channels for citizens to challenge choices made by AI.

Sarawak can guarantee that its high-tech capabilities create a digital society marked by justice, security, and mutual trust by striking a balance between strict data control and the distinct sociocultural background of the area.

CONCLUSION

Technology is only as good as the people who use it, as Sarawak's transition to an AI-driven economy demonstrates. Boonmee et al. (2025) assert that technology tools only produce value when they are integrated into a framework of strategic leadership and human-centric workflows. The development of an agile, "industry-ready" workforce is what will ultimately determine the Post COVID-19 Development Strategy 2030 (2021)'s success, not the purchase of technology. It will need a team effort to realize this vision. To guarantee an ethical digital environment, policymakers must establish data governance frameworks and legislative clarity. To overcome opposition to automation, business leaders must place a high priority on employee engagement and incremental innovation. Lastly, in order to stay competitive, students need to embrace the "bootcamp era" by pursuing ongoing micro-credentialing and STEM education. Advantage: Sarawak may lead the way in developing a distinctive model for digital transformation by fusing its rich cultural legacy and biodiversity with high-tech capabilities demonstrated in programs like AI-driven forest preservation. In addition to being technologically sophisticated, this strategy guarantees that Sarawak's future will be sustainable, inclusive, and essentially human-friendly (Azizi Othman, 2025; Islam et al., 2025; Nguyen, 2025; *Sarawak Digital Economy Blueprint 2030*, 2023).

ACKNOWLEDGEMENT

The authors would like to express their sincere appreciation to fellow researchers and colleagues for their valuable support, constructive discussions, and encouragement throughout the preparation of this manuscript.

Artificial intelligence (AI) tools were used to support selected aspects of the writing process. Google NotebookLM was used to assist in summarising and synthesising research literature, while ChatGPT was used to support language refinement and improve the clarity of the manuscript. Gamma AI was used to assist in developing illustrative figures and visual presentations. All interpretations, analyses, and conclusions presented in this paper were independently reviewed, verified, and take full responsibility by the authors.

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