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*Editorial Note*

# Escaping the Digital Periphery: Toward Technological Sovereignty in Developing Nations

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In recent decades, the worldwide course of technological advancement has been characterized by swift and significant change. Emerging technologies, including artificial intelligence, advanced robotics, cloud computing, and the Internet of Things (IoT), are transforming economies, societies, and governance frameworks (Naeim et al., 2025; Rajalakshmi and Wahab, 2025; Chan and Lau; 2023; Lomakin et al., 2022). Although these advancements present new opportunities, they also introduce significant problems, especially for developing nations attempting to incorporate technology into their development strategies.

Developing nations frequently emerge as late adopters and net importers of technical goods and platforms. This dynamic renders them vulnerable: whereas they gain access to sophisticated tools and systems, they simultaneously face the possibility of prolonged digital dependency (Lambert et al., 2024; Harley, 2022). Technologies are often implemented without adequate localization, adaption, or integration into local innovation ecosystems (Du and Wang, 2024). Consequently, rather than facilitating equitable growth, technologies may exacerbate existing structural imbalances (Talbert-Johnson, 2004).

Digital dependency emerges in various forms: reliance on foreign cloud infrastructure, restricted control over national data flows, dependence on proprietary software and hardware, and inadequate local capability for research and development and technology production. These issues are exacerbated by deficiencies in infrastructure (Glukhov et al., 2023), digital literacy (Reddy et al., 2023; Tinmaz et al., 2022; Santoso et al., 2019), cybersecurity preparedness (Neri et al., 2024; Hasan et al., 2021) and regulatory consistency (Avduevskaya et al., 2023; Shawoo et al., 2023; Pyykkö et al., 2021).

However, reliance is not unavoidable. History provides instances of nations that have effectively transitioned from technology reliance to innovative leadership. South Korea's Heavy and Chemical Industry initiative in the 1970s and China's current "Made in China" plan both exemplify intentional state-directed endeavors to localize manufacturing, stimulate domestic innovation, and establish globally competitive industries (Whulanza et al., 2025).

Currently, some emerging countries are exploring similar pathways. In Africa, initiatives like Rwanda's investment in local technology hubs and Kenya's advancement of mobile payment systems illustrate how local innovation may flourish in conducive environments (Ndubuisi et al., 2021). Governments in Asia and Latin America are implementing policies that emphasize open-

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source technologies, support domestic startups, enhance STEM education, and promote public-private partnership (Banga, 2022)

Nonetheless, such endeavours necessitate more than good intention. They require continuous investments in human capital, infrastructure, and institutional capability. The establishment of comprehensive, forward-thinking, and robust policy frameworks is equally crucial. This entails not just endorsing local industries but also cultivating global relationships that respect local goals and circumvent trends of economic post-imperialism in technical transfer (Lu and Qiu, 2023; Hairong and Sautman, 2023).

Research on digital sovereignty, innovation systems, and technology policy can provide practical methods for countries aiming to address the intricacies of globalization and technological transformation (Moeis et al., 2024; Tan et al., 2023; Mariani et al., 2023). Similarly, interdisciplinary and interregional collaborations might elucidate how varied environments affect the efficacy or ineffectiveness of such initiatives (Whulanza, 2023).

There is an urgent necessity for a more equal framework of international technology partnership (Ezdina et al., 2024). Developing nations require the opportunity and assistance to build their own innovation ecosystems (Sayed and Agndal, 2022; Stahl, 2022). This necessitates a paradigm shift—from perceiving these nations solely as marketplaces for technical goods to acknowledging them as viable hubs of invention and production in their own right.

This issue consolidates several perspectives that directly address these subjects. Through analysis of national innovation systems, case studies of successful localization initiatives, and critical evaluations of global governance frameworks (Babkin et al., 2023; Zagloel et al., 2023; Ramakrishna et al., 2023). The articles presented provide valuable insights for individuals interested in the future of technology in developing contexts.

## This issue

This editorial issue aims to deepen the scholarly conversation on how developing countries can transition from passive adopters to active shapers of technology. This collection includes results that examine the interrelation of processes, materials, and artificial intelligence for humanity. The study highlights the development of a proof of concept that amalgamates industrial applications with environmental sustainability.

The first study, conducted by Lundaeva and Gintciak, focuses on the influence of patent regulation features on the innovative activities of enterprises using a game-theoretic modeling approach. By simulating interactions between intellectual property rights (IPR) holders and followers under varying levels of state supervision. This model highlights the role of regulatory enforcement in shaping innovation behavior and optimizing IP management strategies (Lundaeva and Gintciak, 2025).

The second study, conducted by Orel et al., focuses on developing a multilevel strategic planning methodology to support sustainable development goals (SDGs) within Ukraine's public administration system. Using systemic, comparative, and statistical analysis, the research evaluates progress toward SDGs 1, 3, 4, and 5. The findings reveal that while some strategic frameworks exist, implementation remains fragmented, especially under war-related pressures (Orel et al. 2025).

The third study, written by Purnamasari et al., investigates the spatial practices of working women in third places. It explores their role in supporting urban environmental sustainability, focusing on SCBD Park in Jakarta. The study demonstrates how such spaces foster eco-friendly commuting, social interaction, and reduced energy use, contributing to resilient urban environments (Purnamasari et al., 2025).

Sutriadi et al., in the fourth study, explore on the Regional Development and Empowerment Innovation Program (PIPPK) in Bandung City. It uses a distinctive approach to urban innovation, emphasizing community participation over reliance on Information and Communication Technology (ICT). The study highlights how PIPPK fosters inclusive and equitable urban development, aligning with smart sustainable city principles (Sutriadi et al., 2025).

The fifth study, conducted by Talipova et al., presents a novel methodology using nonlinear optimization and GIS tools to analyse the dependency of road safety indicators on urban environment infrastructure parameters. The study identifies distinct clusters of infrastructure-safety relationships validated through a case study in St. Petersburg. The study provides actionable insights for urban planners to enhance pedestrian safety (Talipova et al., 2025).

Rodionova et al., in the sixth study, investigate the relationship between regional socio-economic development and the spatial distribution of road crashes in the Russian Federation. It uses Moran's I spatial autocorrelation and spatial econometric models. The study finds that higher gross regional product, better road infrastructure, and innovation activity significantly reduce road crash rates, with strong spatial spillover effects across neighbouring regions (Rodionova et al., 2025).

The seventh study, conducted by Berawi et al., presents a machine learning model using linear regression to improve the accuracy of Owner Estimate Cost (OEC) prediction in capital expenditure procurement. The study demonstrates that the model achieves high precision with low error metrics for government projects in Indonesia. It offers a transparent and reliable approach to support better decision-making in public procurement (Berawi et al., 2025)

The eight study, written by Nukeshev et al., presents the design and theoretical justification of a distributor for tiered intra-soil application of mineral fertilizers. This study enables simultaneous placement of differentiated doses at multiple soil depths to match wheat root system development. It demonstrates that the developed deep loosener-fertilizer unit achieves uniform fertilizer distribution with a flap angle of 25–27° and pipe installation parameters optimized for various soil-climatic zones (Nukeshev et al., 2025).

In the ninth study, written by Babkin et al., proposes a structural-functional model for managing digital maturity in clustered innovation-active industrial ecosystems (CIAIE). The model aligns with Industry 5.0 principles such as human-centricity, sustainability, and technological symbiosis. The study emphasizes the model's adaptability and robustness in assessing and improving digital maturity through parameters like technical equipment, organizational structure, human resources, product customization, and cybersecurity (Babkin et al., 2025).

The tenth study, written by Liliana et al., introduces a chi-square weighted oversampling approach to improve dropout prediction in Massive Open Online Courses (MOOCs). It addresses data imbalance by modifying SMOTE-N and SMOTE-ENC techniques. The study demonstrates that the chi-square SMOTE-N method achieves superior predictive performance with an F1-measure of 95.33%, significantly enhancing early dropout detection in MOOCs (Liliana et al., 2025).

The next study, written by Utami et al., examines physicians' acceptance of telemedicine by integrating the expectation-confirmation model (ECM) and task-technology fit (TTF). It identifies factors influencing their satisfaction with telemedicine platforms. The study reveals that perceived usefulness and TTF significantly impact physician satisfaction, while convenience value does not show a notable effect (Utami et al., 2025).

The twelfth study, written by Widjanarko et al., develops an operational performance matrix based on throughput accounting principles. It aims to assess product survivability and guide resource allocation in a service company. The study demonstrates how the matrix helps identify products in danger, alert, comfort, and safe zones, enabling strategic actions to improve operational performance (Widjanarko et al., 2025).

The thirteenth study, written by Sucipto et al., presents the development of an RFID-based traceability system to monitor halal and quality standards in beef distribution. It integrates sensors for temperature, humidity, and GPS tracking for real-time monitoring validated in Malang City, Indonesia. The study demonstrates the system's accuracy and effectiveness in maintaining transparency and ensuring halal compliance throughout the supply chain (Sucipto et al., 2025).

The fourteenth study, written by Van-Hung Le et al., introduces an improved multi-layer fusion framework (MLF-VO-F). It integrates an additional loss function to enhance visual odometry estimation from colour image sequences, specifically for indoor environments with challenging conditions. The study demonstrates that the improved framework significantly reduces estimation

errors on benchmark datasets, offering robust performance for autonomous navigation applications (Le et al., 2025).

The fifteenth study, written by Gan et al., proposes a deep learning approach for detecting lying behaviours by analysing facial micro-expressions using OpenFace 2.0. It extracts Action Units (AUs) and training an Artificial Neural Network (ANN) for classification. The study achieves promising accuracy rates of 80–90% during training and testing, highlighting its potential for real-world applications in law enforcement and security (Gan et al., 2025).

The sixteenth study, authored by Pribadi et al., presents a CNN-LSTM deep learning model combined with wearable sensors to improve the recognition accuracy of six skill levels of Flux-Cored Arc Welding (FCAW) hand welders. It aims to address performance inconsistencies due to fatigue and working conditions. The study achieved a classification accuracy exceeding 95%, highlighting the potential of AI-driven monitoring systems in the shipbuilding industry (Pribadi et al., 2025).

The seventeenth study, conducted by Ishtiaq et al., proposes a hybrid deep learning model for lung cancer classification. The model also combines a novel CNN architecture (LungCFEx24) and VGG16 with entropy-driven feature selection and Support Vector Machine (SVM) classifiers. The study achieved 95.92% accuracy, 98.60% sensitivity, and 99.84% specificity on the IQ-OTH/NCCD lung cancer dataset, outperforming several state-of-the-art methods in detecting benign, malignant, and normal lung cases (Ishtiaq et al., 2024).

The eighteenth study, authored by Dwinovantyo et al, investigates the target strength (TS) of eels using a scientific echosounder (Simrad EK15) and a calibrated fish finder (Furuno FCV-628). It also combines numerical models like the Distorted-Wave Born Approximation (DWBA) and Kirchhoff-Ray Mode (KRM). The study highlights that both instruments provide consistent TS measurements under controlled conditions, demonstrating the calibrated fish finder's potential as a cost-effective alternative for eel monitoring (Dwinovantyo et al., 2025).

The nineteenth study, conducted by Shofinita et al., explores the use of microencapsulation via spray drying to enhance the viability of Lactobacillus casei probiotics in ice cream. It uses maltodextrin and whey protein concentrate as coating materials. The study demonstrates that encapsulated probiotics maintained 80.56% viability after 14 days of storage, nearly doubling the survival rate compared to non-encapsulated probiotics (Shofinita et al., 2025).

The twentieth study, authored by Karina et al., develops a ridership optimization model for Transit-Oriented Development (TOD) in Jakarta. The study uses linear programming and system dynamics to maximize MRT transit passengers by optimizing land-use allocation at the parcel level. The study finds that a land composition of 27% residential, 23% commercial, 11% offices, 12% government, 5% hotels, and 22% other developments could increase daily ridership by up to 6% over current levels (Karina et al., 2025).

The next study, conducted by Widi et al., investigates the preparation and characterization of activated carbon from Cavendish banana peels for ferric ion adsorption. It focuses on the effects of carbonization temperature and acid concentration during activation. The study highlights its potential as a low-cost adsorbent for water treatment (Widi et al., 2025).

The twenty-second study, conducted by Atlaskina et al., introduces an in-situ/operando experimental and analytical system. It explores the carboxylation of epichlorohydrin with $CO_2$, catalyzed by 1-(2-hydroxyethyl)-3-methylimidazolium bromide ionic liquid. The study proposes a detailed reaction mechanism and highlights the system's capability to monitor $CO_2$ conversion into cyclic carbonates, contributing to advancements in carbon capture and utilization (Atlaskina et al., 2025)

The twenty-third study, authored by Markov et al., presents a novel approach to synthesizing $Cu/ZnO/SiO_2$ catalysts for $CO_2$ hydrogenation into methanol. It uses induction flow levitation (IFL) to achieve high nanoparticle purity and enhanced catalytic performance. The study demonstrates superior $CO_2$ conversion and methanol yield at elevated pressures and temperatures,

highlighting the potential of IFL as a sustainable method for catalyst production (Markov et al., 2025).

The twenty-fourth study, written by Putri et al., investigates the effect of wetting-drying cycles on the swelling-shrinkage behaviour. It also covers microstructural evolution of tropical residual expansive soils from West Java, Indonesia, using modified oedometer tests. The study reveals that the soil reaches equilibrium with consistent swelling potential (~10%) and swelling pressure (~300 kPa), highlighting the importance of microstructural changes in long-term soil behavior analysis (Putri et al., 2025).

The twenty-fifth study, written by Tulegenkyzy et al., presents the synthesis of poly(GMA-co-BuA-co-MMA) terpolymers as reactive copolymer diluents. The substituent aims to enhance the mechanical and thermal properties of epoxy resins while reducing viscosity for solvent-free coatings. The study demonstrates that the optimized composition with 20% MMA significantly improves adhesion, tensile strength, corrosion resistance, and impact resistance (Tulegenkyzy et al., 2025).

The last study, authored by Herry Poernomo et al., investigates the effect of using tungsten and lanthanum hexaboride ($LaB_6$) filaments in 250 keV/1 mA electron beam machines on the empirical production capacity of Radiation Vulcanized Natural Rubber Latex (RVNRL). The study concludes that $LaB_6$ filaments significantly increase RVNRL capacity to 36.92 tons/year compared to 20.22 tons/year for tungsten. It offers insights for optimizing EBM performance in industrial applications (Poernomo et al., 2025).

Recent technical innovations and scientific progress have created new options to address intricate issues across several fields. As innovation accelerates, its influence on defining the future becomes increasingly significant. Consequently, IJTech cordially welcomes you to present your research to our audience.

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