

Brain Drain Mitigation Through AI-Driven Workforce Innovation in the Johor-Singapore Cross-Border Corridor

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ABSTRACT

Brain drain is the sustained emigration of skilled professionals from a home economy in pursuit of higher remuneration and career opportunities abroad. It represents one of the most intractable structural challenges facing developing subnational economies. This article investigates how artificial intelligence (AI)-enabled institutional innovations can attenuate brain drain in the context of the Johor-Singapore border region, with specific reference to the Regional AI Hub (RAIH) initiative. Drawing on feasibility data from the Institut Dato' Onn Research Centre encompassing approximately 10,000 Malaysian small and medium enterprises (SMEs) and extensive stakeholder consultation, the study analyses three complementary retention mechanisms. These mechanisms include cross-border joint venture structures, AI-facilitated hybrid work models, and AI-powered workforce management platforms. Approximately 300,000 Malaysian professionals commute daily to Singapore, creating a wage differential estimated at 3.5 times the Johor equivalent. RAIH aims to retain 54,000 skilled professionals, projected to contribute RM27.5 billion to Johor's gross domestic product (GDP) by 2030. This projection is supported by new scenario analyses and quantitative modelling introduced in this study to ensure robust economic forecasting. The article demonstrates that AI-enabled workforce management tools address not only wage gaps but also the non-monetary dimensions of location choice, including career development trajectories, work-life balance, and housing affordability. The study further examines the SME talent ecosystem, identifying systemic barriers to AI adoption that spread skills deficits and constrain the creation of high-quality local employment. Policy implications for border region economies in Southeast Asia and beyond are discussed.

Keywords: Brain Drain, Talent Retention, Artificial Intelligence, Cross-Border Workforce, Hybrid Work, Malaysia, Singapore, Special Economic Zone, SME, Labour Mobility

INTRODUCTION

Brain drain, the selective emigration of educated and skilled labour from lower-income to higher-income economies, has long been recognised as a fundamental impediment to economic convergence in developing countries (Docquier & Rapoport, 2012). Employee retention and talent migration have become increasingly important issues in regional workforce planning, mostly in highly connected economic regions such as Malaysia and Singapore (Chong et al., 2024). Contemporary studies have shown that due to the rapid advancement of artificial intelligence (AI), global challenges and opportunities have been transformed (Chibber et al, 2025).

At the subnational level, cross-border skill migration creates particularly acute development challenges, which, unlike international emigration, where physical distance and legal barriers impose friction costs, cross-border commuting within contiguous economic corridors permits daily labour market arbitrage with minimal relocation costs (Niebuhr & Stiller, 2004). The result is a persistent equilibrium in which skill-intensive workers reside in

lower-cost jurisdictions whilst supplying their labour to higher-productivity economies, depriving the home jurisdiction of both the direct output contributions of skilled labour and the agglomeration externalities generated by concentrated human capital.

The Johor-Singapore border corridor represents the most extreme manifestation of this phenomenon in Southeast Asia. Approximately 300,000 Malaysian professionals commute daily across the Causeway and Second Link to Singapore, attracted by wage differentials estimated at approximately 3.5 times the Johor equivalent for comparable occupational categories (Institut Dato' Onn Research Centre, 2025). This daily outflow encompasses professionals across the manufacturing, engineering, finance, information technology, and healthcare sectors, which are also the sectors in which Johor aspires to build an AI-driven comparative advantage. The paradox is stark in that the very human capital required to transform Johor's economy is systematically redirected to Singapore's labour market each working day.

Conventional policy responses to brain drain have centred on wage augmentation through public-sector salary reform, return-migrant incentive schemes, and diaspora engagement programmes (Clemens, 2011). While these approaches have demonstrated partial effectiveness in specific contexts, they share a common limitation. They also treat brain drain primarily as a wage arbitrage problem amenable to correction through compensation adjustment. This framing neglects the substantial non-wage dimensions of location and employer choice, including career development pathways, workplace flexibility, quality of working environment, and housing affordability, all of which AI-enabled institutional innovations are particularly well positioned to address.

AI-enabled workforce management systems represent a qualitatively new instrument in the anti-brain-drain policy toolkit. Drawing on the RAIH feasibility study and relevant scholarly literature, the article examines how AI platforms can simultaneously address wage gaps through organisational restructuring, enhance non-wage dimensions of employment quality, and create high-value local employment opportunities that alter the relative attractiveness of Johor as a place of work. AI-driven staff management solutions are a qualitatively new instrument in the anti-brain-drain policy toolbox. Recent research also indicates that AI's application has the potential to transform regional labour markets, impacting the nature of work, productivity, and the structure of labour markets, especially in economies characterised by emerging industries and digital transformation (Huang, 2024). Based on the findings from the RAIH feasibility study and literature review, the article explores the potential of the AI platforms to tackle the wage gap issue by reshaping the organisational structure as well as the non-wage aspects of job quality, and to generate high-value local job creation opportunities that will modify the relative attractiveness of Johor as a work destination (Chen et al., 2025; Zhao et al., 2024).

LITERATURE REVIEW

Brain Drain

The economic analysis of brain drain has evolved considerably since the early contributions of Bhagwati and Hamada (1974), who framed skilled emigration as an unambiguous welfare loss for sending countries. Docquier and Rapoport (2012) review extensive evidence that skilled emigration can generate positive diaspora externalities through remittances, knowledge transfers, and the creation of international business networks that benefit the home economy. Mountford (1997) and Stark et al. (1997) develop the concept of the 'brain gain,' whereby the prospect of emigration incentivises skill acquisition among non-migrants, potentially leaving the home economy with a larger skilled workforce despite net emigration. Cross-border commuting is increasingly influenced by friction-reducing spatial integration, especially at the subnational level in adjacent economic corridors, where one can undertake labour arbitrage without relocating permanently (Gounder et al., 2025). This shifting mobility pattern establishes a continuous balance between the home jurisdiction's ability to offer lower-cost skilled workers as it becomes less productive and those skilled workers arriving in the higher-productivity region to provide labour services (Shin & Caywood, 2025; Alvarado et al., 2025).

In the context of cross-border commuting, however, these mitigating effects are substantially attenuated. Unlike international emigrants, who may accumulate human capital and business networks transferable to the home economy over time, daily cross-border commuters maintain residence in the home economy while investing their

productive hours in the host economy. They accumulate workplace experience, professional networks, and tacit knowledge within the host economy's institutional context, limiting positive externalities to their home region (Niebuhr & Stiller, 2004). Research by Borjas (1987) on the determinants of international migration identifies wage differentials, amenity differences, and migration costs as the primary drivers of mobility decisions, a framework directly applicable to the context of cross-border commuting when physical distance costs are negligible.

Non-Monetary Dimensions of Location Choice

A growing body of research demonstrates that location and employer choice decisions are not adequately explained by wage differentials alone. Florida (2002) identifies three key factors, the 'three Ts' of talent, technology, and tolerance, as determinants of where skilled workers choose to live and work. Amenity-based theories of labour mobility (Roback, 1982) demonstrate that workers trade off wages against location-specific consumption amenities, implying that improvements in non-wage aspects of the employment experience can partially compensate for wage gaps.

The rise of remote and hybrid working arrangements, accelerated dramatically by the COVID-19 pandemic, has created new possibilities for location-employer decoupling that are directly relevant to the cross-border context. Brynjolfsson et al. (2020) document rapid adoption of remote work technologies following the onset of the pandemic and estimate sustained productivity maintenance across knowledge-intensive occupations. Barrero et al. (2021) demonstrate that workers place significant value on flexible working arrangements, with the willingness to pay for remote work estimated at approximately 7 to 9 percent of wages, suggesting that employers offering flexible arrangements can sustain competitive compensation packages at lower explicit wage costs.

Special Economic Zones and Cross-Border Labour Market Integration

Special economic zones (SEZs) in cross-border configurations present distinctive opportunities and challenges for talent retention policy. Unlike unilateral development zones, cross-border SEZs can leverage complementary factor endowments and regulatory frameworks across jurisdictions, potentially creating employment environments that offer the productivity of advanced economies alongside the cost structures of developing ones (Farole & Akinci, 2011). The Johor-Singapore Special Economic Zone (JS-SEZ), established under a bilateral agreement between Malaysia and Singapore, is projected to contribute RM117.1 billion to Malaysia's GDP by 2030 and create over 20,000 highly skilled jobs (IDORC, 2025), offering a powerful institutional framework within which talent retention strategies can be embedded.

To contextualise this development, comparative examples from other successful border economies offer valuable insights. The Oresund region connecting Denmark and Sweden provides a compelling comparative example of cross-border labour market integration facilitated by physical infrastructure and policy harmonisation. Similar to the Johor-Singapore corridor, wage differentials historically drove Swedish professionals to commute to Copenhagen. However, bilateral tax agreements and joint economic development initiatives successfully stabilised the talent ecosystem by fostering regional hubs in Malmö. Additionally, the Geneva-France border region demonstrates how harmonised cross-border worker regulations can sustain balanced regional economic growth without causing extreme human capital depletion in the home economy.

Cross-border SEZs also offer opportunities for regulatory harmonisation relevant to talent mobility. Regulatory barriers to cross-border professional practice, including mutual recognition of qualifications, work permit processing, and pension portability, represent significant non-wage frictions that can deter return migration even when wage differentials are addressed (OECD, 2020). AI-enabled automated visa and work permit processing systems can substantially reduce these administrative frictions, lowering the effective cost of cross-border work arrangements.

AI-Enabled Human Resource Management

The application of AI to human resource management has attracted growing scholarly attention. Tambe et al. (2019) review evidence that AI-powered recruitment, performance management, and employee engagement

platforms can significantly improve talent matching quality, reducing turnover and improving worker-job fit. Pan et al. (2022) find that AI-driven career development recommendation systems increase employee tenure by providing personalised development pathways that align individual aspirations with organisational needs. In the context of retention, AI platforms can address a key non-monetary driver of brain drain: the perception that career development opportunities are superior in host economies.

The predictive analytics capabilities of AI platforms are particularly valuable for workforce management at the boundary between jurisdictions. Machine learning models trained on historical workforce data can identify early warning indicators of intent to migrate, allowing employers and policymakers to intervene with targeted retention measures before departure decisions are finalised (Cappelli, 2019). Sentiment analysis of employee communications can provide real-time indicators of job satisfaction and engagement, informing the timing and content of retention interventions.

RESEARCH METHODOLOGY

To ensure transparency and reliability, the research framework adopted a mixed-methods approach to gather comprehensive feasibility data regarding the RAIH initiative. This approach synthesised quantitative data modelling with qualitative insights derived from extensive stakeholder engagements. By integrating these dual data streams, the study established a robust baseline for evaluating the structural challenges of the SME sector and the practical viability of AI-driven talent retention mechanisms.

The quantitative component relied on an extensive longitudinal analysis of approximately 10,000 Malaysian SMEs from 2020 to 2024. The sampling procedure utilised a stratified random sampling technique, drawing enterprise records from the Companies Commission of Malaysia database. The strata were defined by enterprise size, encompassing micro, small, medium, and large SMEs, as well as operational sectors relevant to the AI and knowledge economy transition. Data concerning market share erosion, profitability margins, cash conversion cycles, and technological adoption rates were systematically collected and analysed to determine structural barriers to AI readiness.

The qualitative component involved targeted stakeholder consultations conducted between 2024 and early 2025. A purposive sampling strategy was employed to select participants, which included key government officials, industry leaders, human resource professionals, and technological infrastructure providers operating within the Johor-Singapore corridor. These consultations were structured as expert roundtable discussions designed to uncover systemic challenges and validate the proposed hybrid work and joint venture models. A recognised limitation of these stakeholder consultations is the potential for self-selection bias, as participants who agreed to join the panels may possess a more progressive stance on AI adoption than the broader population. Furthermore, qualitative findings rely partially on self-reported organisational challenges, which introduces a degree of subjective interpretation into the feasibility assessment.

The Johor-Singapore Labour Market Corridor

Scale and Composition of Cross-Border Labour Flows

The scale of daily cross-border labour flows between Johor and Singapore is extraordinary by international comparison. Approximately 300,000 Malaysians cross the Causeway or Second Link daily for employment, representing approximately 7.3 percent of Johor's total population of 4.1 million (IDORC, 2025). This flow encompasses the full spectrum of occupational categories, from construction workers and service industry employees to finance professionals, engineers, and information technology specialists, though the economic development implications of high-skill outflows are disproportionately significant.

According to Tambe et al. (2019), AI enables HR systems to enhance worker job fit, talent acquisition processes and support data-driven workforce planning, thereby reducing turnover intentions and strengthening long-term organisational commitment. Similarly, AI-driven career development and learning recommendation systems have been shown to support personalised career pathways that align employee aspirations with organisational

objectives, contributing to stronger retention outcomes and employee satisfaction (Pan et al., 2022; Budhwar et al., 2023). However, in the context of talent retention, AI platforms may also address important non-monetary drivers of brain drain, particularly employee perceptions that career advancement opportunities, professional development, and workplace flexibility are more attractive in host economies.

The wage differential driving these flows is substantial and persistent. IDORC (2025) estimates that Singaporean compensation packages are approximately 3.5 times the Johor equivalent for comparable roles, a gap driven by multiple factors, including Singapore's higher price level, the strength of the Singapore dollar, and the higher marginal productivity of labour in Singapore's more capital-intensive and technologically advanced production environment. From a household perspective, this differential is sufficiently large to justify significant daily travel costs and time expenditure, implying that marginal wage adjustments are unlikely to substantially alter commuting behaviour.

Sectoral Distribution of Talent Outflows

Talent outflows are concentrated in precisely those sectors that Johor's development strategy identifies as priority targets for AI-driven transformation. The IDORC (2025) roundtable discussions identify professionals across manufacturing, engineering, finance, and technology as primary participants in cross-border commuting. This sectoral overlap creates a structural paradox, the human capital most needed to implement RAIH's AI transformation agenda is simultaneously the human capital most incentivised to direct its productive efforts towards Singapore.

The Johor State Economic Planning Unit estimates that approximately 65 percent of Johor's economic growth potential in knowledge-intensive sectors is affected by talent outflows. This estimate reflects both the direct productivity contributions of absent workers and the indirect effects on innovation capacity, entrepreneurship, and knowledge transfer within Johor's enterprise ecosystem. The cumulative effect over a sustained period has been to suppress Johor's capacity to move up the technology ladder despite its proximity to one of Asia's most advanced innovation environments.

Non-Wage Drivers of Cross-Border Commuting

Wage differentials are the primary driver of cross-border commuting, IDORC's (2025) stakeholder consultations identify several significant non-wage factors. Career development trajectories are perceived as substantially superior in Singapore, where the concentration of multinational corporations and advanced industry clusters provides unmatched opportunities for professional advancement. Working environments in Singaporean firms are perceived as more meritocratic and innovation-supportive, with stronger alignment between performance and reward. Housing affordability, paradoxically, partially favours Johor residents, as Singapore's exceptional housing costs create incentives for professionals to reside in Johor even while working in Singapore. Transport infrastructure quality and commute times are critical friction points, which the RTS Link rapid transit project, scheduled for completion in 2026, is designed to address substantially.

RAIH Workforce Retention Mechanisms

The Joint Venture Model

The centerpiece of RAIH's brain drain mitigation strategy is the creation of Special Purpose Vehicles (SPVs) through joint ventures between Singaporean and Johorean enterprises, structured under a two-thirds to one-third cost-sharing arrangement. Under this model, the SPV employer bears two-thirds of the labour cost through its Singaporean operations and one-third through its Johorean operations, enabling it to offer total compensation packages approaching Singapore-comparable levels while maintaining Johor as the primary operational base. This structure is legally and economically innovative. It reconfigures the employment relationship to reflect the genuinely cross-border nature of the labour market without requiring workers to emigrate.

RAIH aims to establish 100 such joint ventures in Phase 1 (2025 to 2026), scaling progressively to encompass a broader range of sectors by 2030. The Centre of Excellence for M&A and Strategic Partnerships (CMAP),

established under the RAIH framework, provides advisory services to facilitate joint venture structuring, including due diligence planning, valuation methodology, synergy identification, and post-merger integration planning. AI-driven business intelligence tools support the ongoing management of these joint ventures, providing real-time performance analytics and cross-border coordination capabilities.

The economic rationale of the joint venture model draws on established transaction cost economics. Williamson (1985) argues that hybrid governance structures, such as joint ventures, emerge when transaction-specific assets create bilateral dependencies that pure market contracts cannot adequately govern. In the cross-border labour context, worker skills and employers' specific knowledge constitute transaction-specific assets, and the joint venture structure provides the institutional durability necessary for both parties to invest in relationship-specific capabilities.

AI-Facilitated Hybrid Work Models

The hybrid work model proposed under RAIH formalises a split arrangement of two days in Singapore and five days in Johor, leveraging the completion of the RTS Link to make this arrangement logistically viable at scale. The model addresses a fundamental limitation of the wage arbitrage framing of brain drain. It recognises that many professionals cross the border not merely for wages but for the workplace quality, professional networking, and organisational culture advantages that Singaporean employment offers. By preserving access to these advantages two days per week, the hybrid model makes Johor employment significantly more attractive without requiring full wage equalisation.

AI-enabled remote work management tools are central to the feasibility of this model. Research by Brynjolfsson et al. (2020) demonstrates that remote work productivity is substantially enhanced by AI-powered collaboration platforms that maintain communication fidelity, project management transparency, and knowledge sharing across distributed teams. Sentiment analysis of employee engagement in hybrid arrangements enables real-time monitoring of satisfaction and adjustment of work arrangements to individual needs. The IDORC (2025) study targets a satisfaction rate of over 85 percent among professionals in hybrid arrangements as a Phase 2 KPI.

The hybrid model also generates positive externalities for Johor's knowledge economy. Study by Audretsch and Feldman (1996) on knowledge spillovers demonstrates that face-to-face interaction is essential for the transmission of tacit knowledge and that regional knowledge spillovers are substantially attenuated by geographic distance. By ensuring that hybrid workers are physically present in Johor for five days per week, the model maximises the knowledge spillover benefits of exposure to Singapore's advanced innovation environment for Johor's domestic enterprise community.

AI-Powered Workforce Management Platforms

Beyond the structural innovations of the joint venture and hybrid work models, RAIH deploys a suite of AI-powered workforce management tools designed to address non-wage dimensions of the location decision. An AI-driven job-matching platform uses machine learning algorithms to align professional aspirations with Johor-based career opportunities, providing personalised career development recommendations that address perceptions of superior advancement opportunities in Singapore. Predictive analytics tools monitor workforce trends to anticipate shifts in skills demand and align training provision with emerging opportunities. An AI-powered housing and lifestyle recommendation engine addresses the housing decision, providing personalised recommendations that highlight Johor's cost-of-living advantages without sacrificing quality.

Particularly innovative is the cross-border talent mobility tracking system, which provides policymakers with real-time data on talent flows, occupational distributions, and wage trends, enabling dynamic policy adjustment in response to emerging patterns. Cross-border talent mobility agreements, facilitated through automated visa and work permit processing systems, reduce administrative friction costs for professionals participating in joint venture and hybrid arrangements. Table 1 summarises the RAIH workforce retention mechanisms, their target impacts, and relevant Phase 2 (2027 to 2028) KPIs.

Mechanism	Primary Channel	Phase 2 KPI Target
Joint Venture Model (2/3-1/3)	Wage gap reduction through cross-border cost sharing	50,000 professionals returning to Johor
Hybrid Work Model (2+5 days)	Non-wage employment quality enhancement	Over 85%+ satisfaction rate
AI Job Matching Platform	Career development opportunity signalling	25% talent outflow reduction vs 2025
Cross-Border Mobility Agreements	Administrative friction cost reduction	Number of agreements implemented
Housing Recommendation Engine	Cost-of-living advantage communication	Return professional housing uptake rate
Predictive Workforce Analytics	Dynamic policy adjustment	70% Singapore-comparable salaries offered

Table 1. RAIH Workforce Retention Mechanisms and KPI Targets

Scenario Analysis and Economic Projections

To substantiate the projected retention of 54,000 skilled professionals and the subsequent GDP contribution of RM27.5 billion without relying solely on optimistic baseline assumptions, a quantitative scenario analysis was developed. The economic impact is projected using a regional economic multiplier model adapted for the cross-border context. Let the total projected GDP contribution be denoted as GDP_{total} . The model calculates this by multiplying the number of retained workers in sector i , denoted as N_i , by the average annual value added per worker V_i , and applying a regional economic multiplier μ to account for indirect economic benefits within the local ecosystem.

$$GDP_{total} = \sum_{i=1}^n (N_i \times V_i) \times \mu$$

Based on this mathematical framework, three distinct scenarios were constructed to evaluate the robustness of the RAIH initiative under varying degrees of adoption and macroeconomic conditions. Table 2 outlines the assumptions and outcomes for the conservative, moderate, and optimistic trajectories.

Scenario Framework	Retention Target	Average Value Added per Worker (RM)	Regional Multiplier (μ)	Projected GDP Contribution (RM Billion)
Conservative Adoption	30,000	250,000	1.2	9.00
Moderate Adoption	45,000	300,000	1.4	18.90
Optimistic Baseline (RAIH Target)	54,000	339,500	1.5	

Table 2. Scenario Analysis for Workforce Retention and GDP Contribution by 2030

The optimistic baseline aligns with the official RAIH projections. The inclusion of a robust multiplier ($\mu = 1.5$) reflects the anticipated agglomeration externalities and increased local consumption resulting from high-income professionals relocating their primary economic activities back into the Johor ecosystem.

The SME Talent Ecosystem

Structural Barriers to SME AI Adoption

The sustainability of RAIH's talent retention strategy depends critically on the Johor SME sector's ability to create and sustain high-quality employment opportunities that can compete with Singapore's. This requires

systematic AI adoption across the enterprise spectrum. However, the IDORC (2025) longitudinal study of approximately 10,000 Malaysian SMEs between 2020 and 2024 documents substantial structural barriers across all size segments.

Small SMEs with turnovers below RM1 million face existential competitive pressures: 68 percent lost 15 to 20 percent of market share to larger competitors over the preceding two years, with profit margins of only 3 to 5 percent, leaving minimal investment capacity. Approximately 70 percent encounter difficulties accessing capital, and credit assessment models based on traditional financial data systematically undervalue SME creditworthiness. The RAIH response for this segment emphasises AI-powered market analysis to identify defensible niches, AI credit assessment tools that incorporate non-traditional data to improve loan approval rates by 30 to 40 percent, and personalised customer engagement platforms that build relationship-based competitive advantages.

Medium-sized SMEs with turnovers of RM1 to 5 million face a 'valley of death' characterised by working capital shortfalls and financing barriers, where cash conversion cycles of 60 to 90 days constrain operational flexibility, and 73 percent of loan applications are rejected despite evidence of growth potential. AI-enhanced financial management systems targeting this segment are projected to reduce cash conversion cycles by 15 to 30 days, increase the success rate of financing applications by 40 to 60 percent, and generate 25 to 35 percent improvements in investment returns.

Large SMEs with turnovers of RM5 to 20 million demonstrate productivity 30 percent below industry standards, with labour costs constituting 45 percent of operational expenses and automation adoption limited to 25 percent of enterprises. For this segment, AI-powered operational excellence programmes targeting 30 to 45 percent productivity improvements in targeted processes and 20 to 30 percent reductions in operational costs are projected to close the productivity gap and generate productivity levels above industry averages.

Human Capital and Youth Employment Implications

A critical dimension of the SME talent ecosystem is the interplay between AI adoption and youth employment. IDORC's (2025) roundtable discussions identify AI-induced workforce displacement as a significant concern, particularly in visual effects, administrative processing, and routine service occupations, which are disproportionately occupied by young workers. This creates a potential paradox, such as AI adoption that improves SME competitiveness while retaining adult skilled workers. It may simultaneously displace the youth workforce, undermining the social foundations of sustainable talent retention.

Addressing this requires proactive workforce transition strategies. Research by Acemoglu and Restrepo (2019) demonstrates that AI-driven automation tends to displace workers from routine tasks while creating new employment in complementary non-routine activities. The net employment effect depends critically on the pace of new task creation relative to task displacement. The RAIH capacity-building programme targets the annual upskilling of approximately 10,000 workers through partnerships with universities and vocational institutions, with curricula designed to align with the specific AI-enabled industries in each district.

Roundtable Evidence on SME Transformation Challenges

Structured roundtable discussions conducted in 2024 and early 2025 identified seven interconnected barriers to SME transformation, which are (i) resistance to AI adoption driven by outdated mindsets and lack of digital culture, (ii) short technology adoption cycles requiring continuous adaptation, (iii) weak business fundamentals including unclear value propositions and insufficient performance measurement systems, (iv) investor readiness deficits characterised by weak financial records and poor governance structures, (v) limited international expansion capacity, (vi) fragmented and manual ESG compliance processes, and (vii) legacy system inertia in GLCs. These findings are broadly consistent with the international SME digitalisation literature (Nambisan et al., 2019), which identifies absorptive capacity limitations and institutional gaps as primary constraints on technology adoption in smaller enterprises.

AI as a Creator of Employment Quality

A central argument of this article is that AI-enabled institutional innovations can address brain drain through mechanisms beyond wage equalisation, specifically by creating new dimensions of employment quality that alter the relative attractiveness of Johor-based employment. Several mechanisms merit detailed examination.

Career Development Pathway Enhancement

One of the most consistently cited non-wage drivers of cross-border commuting is the perception of superior career development opportunities in Singapore. AI-powered career path optimisation platforms can partially address this by providing Johor-based professionals with personalised development roadmaps that chart advancement trajectories within Johor's expanding AI ecosystem. Machine learning models trained on career trajectory data from comparable regional economies can identify the skills and experiences most predictive of advancement in AI-enabled industries, enabling targeted development investments. The RAIH AI job matching platform uses these models to surface Johor-based opportunities that align with individual career aspirations, making previously invisible career pathways visible and credible.

Workplace Flexibility as a Compensating Differential

Research by Barrero et al. (2021) estimates that workers value flexible working arrangements at approximately 7 to 9 percent of wages, suggesting that employers offering hybrid and remote work options can attract and retain talent at lower explicit compensation cost than rigid office-based alternatives. The RAIH hybrid work model formalises this logic at the institutional level, enabling Johorean employers to offer a genuinely differentiated value proposition, including Singapore career opportunities with Johor's cost-of-living advantages, facilitated by AI-powered remote collaboration tools that maintain productivity and engagement across distributed work arrangements.

Sentiment and Well-Being Analytics

Employee satisfaction and well-being represent increasingly important dimensions of talent retention in knowledge-intensive industries. Research by Brynjolfsson and McAfee (2014) documents a growing premium on worker engagement in innovation-intensive roles, where motivated, committed employees generate substantially higher knowledge output than disengaged counterparts. RAIH deploys sentiment analysis platforms to monitor employee satisfaction in real time, enabling Johor-based employers to identify and address drivers of dissatisfaction before they precipitate departure decisions. These platforms can detect early signals of intent to migrate based on changes in language patterns, collaboration behaviour, and career inquiry activities, enabling timely retention interventions.

Policy Implications

Implications for Regional Development Policy

The RAIH model yields several important implications for regional development policy in cross-border corridors. First, effective brain drain mitigation requires addressing the employment relationship rather than merely the wage relationship. Institutional innovations such as the joint venture model, which restructures the legal and organisational architecture of employment to reflect cross-border realities, are likely to be more effective and fiscally sustainable than wage subsidy approaches that attempt to match Singapore compensation levels through public expenditure.

Second, AI-enabled workforce management tools represent a new generation of policy instruments that operate on multiple dimensions of the location decision simultaneously. Unlike conventional incentive schemes that address single dimensions (wages, housing, or taxation), AI platforms can simultaneously address career development, workplace flexibility, professional networking, and administrative friction, providing a comprehensive retention environment that is more than the sum of its parts.

Third, the place-based dimension of RAIH's implementation, with district-specific workforce development programmes tailored to local economic profiles, is essential to ensuring that talent retention generates inclusive local economic development rather than simply redistributing talent within Johor from rural to urban areas. The district-specific approach aligns with the smart specialisation literature (Foray et al., 2012), which emphasises the importance of building on existing local capabilities rather than transplanting generic innovation models.

Implications for Special Economic Zone Design

The RAIH model offers important lessons for SEZ design in cross-border configurations. The JS-SEZ's combination of regulatory harmonisation (including the 5 percent corporate tax rate for AI industries and 15 percent income tax for knowledge workers), physical connectivity (the RTS Link), and institutional support (through RAIH's capacity building and CMAP advisory services) represents a multi-dimensional approach to cross-border economic integration that goes substantially beyond conventional SEZ design focussed primarily on regulatory and tax incentives.

Particularly noteworthy is the explicit integration of AI-enabled border management into the SEZ architecture. Automated immigration clearance systems, AI-powered customs processing, and digital secure data-sharing platforms reduce the transaction costs of cross-border mobility at scale, enabling the smooth operation of hybrid work arrangements across 300,000 daily commuters. Research by Farole and Akinci (2011) on SEZ success factors identifies streamlined border management as a critical enabler of SEZ competitiveness, and the RAIH model's use of AI to achieve this at low administrative cost provides a replicable model for comparable cross-border configurations.

Transferability to Comparable Cross-Border Contexts

The Johor-Singapore corridor is not unique in its brain drain dynamics. Comparable cross-border labour market asymmetries exist between Mexico and the United States, between Eastern European EU member states and Western Europe, and between various African frontier zone economies and their more prosperous neighbours. The institutional innovations embedded in the RAIH model, including cross-border joint ventures with cost-sharing structures, AI-facilitated hybrid work arrangements, and AI-powered career development platforms, are in principle transferable to these contexts, subject to appropriate adaptation to local institutional, regulatory, and technological environments.

The critical enabling conditions for transferability are physical connectivity infrastructure that makes daily cross-border work viable and a regulatory framework that permits cross-border joint ventures and hybrid employment arrangements. It also enables a sufficient ICT infrastructure base to support AI-powered workforce management platforms and the institutional capacity to implement district-level workforce development programmes aligned with local economic profiles.

CONCLUSION

This article has argued that AI-enabled institutional innovations represent a qualitatively new approach to brain drain mitigation in cross-border labour market corridors, addressing limitations of conventional wage-focused retention strategies by restructuring employment relationships, enhancing non-monetary dimensions of employment quality, and creating high-value local employment opportunities that alter the fundamental calculus of the location decision.

The RAIH model's target of retaining 54,000 skilled professionals and generating RM27.5 billion in GDP contribution by 2030 is ambitious but grounded in coherent economic logic. The three-mechanism retention architecture, combining joint venture cost-sharing structures, AI-facilitated hybrid work models, and AI-powered workforce management platforms, addresses the full spectrum of drivers that sustain cross-border commuting, from wage differentials and career development gaps to administrative frictions and workplace quality perceptions. Previous studies suggest that migration intention is not solely driven by economic incentives but also by broader perceptions of career sustainability and quality of life (Chong et al., 2024).

Critical to the sustainability of this agenda is the parallel transformation of Johor's SME sector, which must become the primary generator of high-quality local employment opportunities that can, over time, substitute for Singapore employment. The IDORC (2025) study documents substantial barriers to SME AI adoption across all size segments, and the RAIH capacity building programme represents an ambitious yet necessary investment to overcome them. The success of talent retention ultimately depends on creating a Johor-based innovation ecosystem that is sufficiently dynamic and well-compensated to retain the very professionals whose skills are required to build it.

The study raises many important questions that merit further investigation. The effectiveness of the specific AI platforms recommended in RAIH in driving measurable employee retention outcomes is not well explored, nor are the mechanisms by which this occurs. Second, the distributional effects of talent retention across occupational groups, such as the non-commuting sector, also need to be investigated more empirically, especially regarding their effects on inequality and segmented labour markets. Third, the effect of hybrid working on knowledge spillovers and innovation dynamics in regional enterprise ecosystems, such as Johor, remains to be determined by new research on hybrid work. Lastly, there is a need for a longitudinal policy analysis of the relationship between institutional innovations in the JS-SEZ and the wider bilateral economic and governance relationship between Malaysia and Singapore, based on regional integration scholarship. The answers to these questions will need to be gathered over time and across multiple levels in the evolution of the RAIH from planning to implementation and will provide ample opportunities for empirical research on AI-based regional development, labour market restructuring, and transborder economic governance.

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