Journal of Economic Growth and Development Review

Vol 2(2). September 2023
https://jostem.professorline.com/index.php/jostem12345/about

Critical Review Article

Reindustrializing Indonesia: Human Capital, Innovation, and Entrepreneurial Growth in a Changing Industrial Landscape

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Abstract

As emerging economies grapple with post-pandemic recovery and long-term development challenges, the call to "reindustrialize" has gained renewed attention. This paper examines how human capital, technological innovation, and entrepreneurship function as core drivers of industrial transformation, using Indonesia as a case example. Drawing on literature review and policy analysis, it highlights how workforce readiness, innovation ecosystems, and entrepreneurial infrastructure interact within national strategies. While Indonesia has launched bold initiatives in industrial downstreaming, vocational education, and SME digitization, its efforts are constrained by institutional fragmentation, skills mismatches, and uneven regional development. The study argues that successful reindustrialization in emerging economies requires an integrated, people-centered approach one that connects talent with technology and local innovation with global competitiveness. It concludes by offering policy recommendations to align human development, technological capability, and entrepreneurship in support of sustainable and inclusive industrial growth.

Keywords: Reindustrialization; Human Capital Development; Innovation Ecosystems; Entrepreneurship; Industrial Policy

1. Introduction

In the 21st century, the idea of reindustrialization has re-emerged as a central strategy in many emerging economies seeking to escape the volatility of commodity dependence, the stagnation of informal labor markets, and the limitations of service-led growth. While industrialization once served as the foundation for economic transformation across much of the Global North, many developing countries have faced premature deindustrialization, a phenomenon where the industrial sector begins to decline before reaching high-income status. As a result, the revival of industrial capacity, this time driven by human capital, innovation, and entrepreneurship is seen not only as a strategy for economic growth, but also to generate sustainable employment, reduce inequality, and enhance national competitiveness.

The term reindustrializing development signals a shift from viewing industry as a legacy of the past to positioning it as a dynamic, future-oriented engine of inclusive growth. Unlike traditional models centered on heavy industry and top-down state planning, contemporary reindustrialization

is increasingly shaped by flexible production, technology-enabled value chains, and people-centered innovation ecosystems [1]. This transformation is particularly urgent in emerging economies like Indonesia, India, Brazil, and South Africa, where demographic dividends, rapid urbanization, and shifting global trade patterns have created both momentum and pressure for industrial renewal [2].

A key foundation of this process is human capital the collective skills, knowledge, and capabilities embedded in the labor force. Without a strong human capital base, efforts to attract investment, adopt new technologies, or improve productivity are likely to falter. In emerging economies, gaps in vocational training, education quality, and skills mismatches continue to constrain industrial upgrading. As digitalization accelerates, the demand for technically skilled, digitally literate, and adaptable workers is rising sharply. Thus, reindustrialization cannot be detached from policies that develop human resources across educational levels and socio-economic classes [3].

Equally important is the role of technological innovation in shaping the nature of industrial growth. Advances in digital manufacturing, automation, artificial intelligence, and green technology are disrupting traditional modes of production and creating new industrial frontiers. While such innovations offer opportunities for leapfrogging and productivity gains, they also pose risks of technological dualism [4], where advanced firms integrate cutting-edge systems while lagging sectors fall further behind. In this context, national innovation systems must be designed not only to stimulate research and development (R&D), but also to enable diffusion of technology, local adaptation, and inclusive access to innovation [5].

Moreover, entrepreneurship has emerged as a critical force in reindustrialization. As state-owned enterprises decline and global corporations automate, the growth of small and medium-sized enterprises (SMEs), startups, and social enterprises has become essential to job creation and localized industrial growth. Entrepreneurial activity in emerging economies is increasingly shaped by digital platforms, informal innovation, and grassroots creativity [6]. However, entrepreneurs often face barriers such as limited access to finance, inadequate regulatory support, and weak linkages to formal industrial clusters. Understanding how entrepreneurship interacts with human capital and innovation ecosystems is thus key to identifying sustainable pathways for industrial renewal.

In Indonesia, for instance, recent policy directions have placed renewed emphasis on industrial downstreaming (hilirisasi), particularly in natural resource sectors such as nickel, palm oil, and fisheries. While these efforts aim to increase value-added and reduce export dependence, they raise fundamental questions [7]:

- Who benefits from industrial transformation?
- Are the technological gains broadly distributed?
- Is entrepreneurship being cultivated at the grassroots, or is it concentrated among urban elites?

Reindustrialization in emerging economies is not a purely economic process, it is deeply shaped by institutional quality, policy coordination, education systems, and entrepreneurial cultures. It requires cross-sectoral collaboration, long-term planning, and adaptive governance structures that respond to global shifts while grounding development in local contexts [8].

This paper aims to explore the dynamic interplay between human capital, technological innovation, and entrepreneurship in shaping reindustrialization in emerging economies, using Indonesia as an implicit reference point. Drawing on relevant literature, policy analysis, and comparative insights, the study will examine [9]:

- How human capital investment aligns with the evolving demands of industrial transformation.
- The extent to which innovation systems support inclusive industrial development; and
- The role of entrepreneurship in bridging gaps between knowledge, production, and market access.

By addressing these interlinked dimensions, the research seeks to contribute to a more nuanced understanding of how emerging economies can pursue industrial growth that is not only competitive, but also inclusive, sustainable, and resilient in the face of global disruption [10].

2. Literature Review

Efforts to reindustrialize emerging economies rest on the assumption that economic development today is not merely a function of resource endowment or infrastructure, but increasingly depends on the knowledge, creativity, and initiative of people [11]. Scholars across economics, development studies, and industrial policy increasingly recognize that the integration of human capital, technological innovation, and entrepreneurship forms a triad that drives modern industrial competitiveness.

2.1 Human Capital and Industrial Development

Human capital broadly defined as the accumulated knowledge, skills, and capabilities of a population is foundational to any nation's industrial advancement. Theories of endogenous growth (e.g., Romer, 1990) have long emphasized that human capital accumulation leads not only to higher productivity but also to spillover effects, such as innovation, firm formation, and adaptive capacity in times of transition. In emerging economies, however, the human capital challenge is twofold: not only must educational attainment be expanded, but the quality and relevance of skills must be aligned with industry needs [12].

A consistent issue in countries like Indonesia is the mismatch between vocational education systems and the skill demands of modern industries. While vocational schools (SMK) have grown in number, many still lack strong partnerships with industries or exposure to digital and green technologies. Moreover, soft skills like problem-solving, collaboration, and entrepreneurship remain underemphasized. Studies have also shown that labor market segmentation and informal employment hinder the optimal utilization of available human capital, especially among youth and women [13].

2.2 Technological Innovation and Value Chain Transformation

Innovation has become a defining element of global industrial competitiveness. According to the World Economic Forum and UNIDO, countries that fail to develop or adopt new technologies risk being trapped in low-value manufacturing or extractive industries. In the context of reindustrialization, innovation is no longer limited to high-tech sectors, but increasingly includes process improvements, digital adoption, and ecosystem-based solutions relevant to local industries.

However, many emerging economies face what has been called an "innovation paradox": despite investing in infrastructure and R&D, the output and uptake of innovation remain low due to weak linkages between universities, research institutions, and firms. In Indonesia, for example, the national innovation system remains fragmented, with minimal collaboration between public research and industrial stakeholders. Moreover, the diffusion of innovation, especially among SMEs is constrained by regulatory complexity, financing gaps, and lack of human capacity [14].

The Fourth Industrial Revolution (4IR) presents both opportunities and risks. On one hand, technologies such as automation, AI, and the Internet of Things (IoT) offer the chance to "leapfrog" traditional stages of development. On the other hand, they may exacerbate labor displacement, deepen digital divides, and widen the productivity gap between large firms and informal enterprises if not carefully managed through inclusive policies [15].

2.3 Entrepreneurship and Industrial Ecosystems

Entrepreneurship serves as a catalyst that links human capital and innovation to tangible economic outcomes. In industrial development, entrepreneurs play a vital role in mobilizing resources, taking risks, introducing innovations, and creating employment. In emerging economies, the growth of micro, small, and medium enterprises (MSMEs) is particularly important, not only for industrial output but also for social inclusion.

However, entrepreneurship in developing contexts is highly heterogeneous. Much of it remains necessity-driven, particularly in informal economies, rather than opportunity-driven or

innovation-based. To support industrial transformation, entrepreneurship must be nurtured within a broader ecosystem that includes access to capital, training, market information, regulatory support, and physical infrastructure [16].

The emergence of digital entrepreneurship in Southeast Asia, including Indonesia, illustrates how technology can enable new forms of industrial participation. Platforms for e-commerce, fintech, and digital logistics have opened new opportunities for small producers and youth-led startups. Yet, scaling up these innovations remains a challenge due to fragmented policy environments and uneven access to digital tools in rural and outer regions. Moreover, scholars argue that fostering inclusive entrepreneurship that is, enabling participation by women, youth, and marginalized communities is critical to ensuring that industrial growth does not replicate existing inequalities [17].

2.4 Integrating the Triad: Toward Inclusive Reindustrialization

The intersection of human capital, technological innovation, and entrepreneurship forms the core of a dynamic, inclusive industrial strategy. However, integrating these three elements requires deliberate policy coordination. Isolated interventions such as funding for startups without workforce training, or R&D subsidies without entrepreneurial networks are unlikely to yield systemic impact [18] . In recent years, the concept of “innovation-driven industrialization” has gained traction, emphasizing the need for synergy between education, research, and enterprise development. This approach aligns with frameworks such as the triple helix model (university–industry government collaboration), and SDG-aligned industrial policy. For emerging economies to succeed in reindustrializing, they must design ecosystems that connect talent with technology and turn ideas into industry [16].

3. Reindustrialization in Practice: The Case of Indonesia

Indonesia offers a compelling case for examining how human capital, technological innovation, and entrepreneurship interact within an emerging economy's reindustrialization efforts. With its large population, diverse resource base, and evolving industrial landscape, Indonesia is strategically positioned to pursue a more inclusive, innovation-led model of growth. Yet, it also faces complex challenges related to infrastructure gaps, institutional fragmentation, skills mismatches, and uneven digital access factors that shape the trajectory of its industrial development.

3.1 From Deindustrialization to Downstreaming

Over the past two decades, Indonesia has experienced what many economists describe as premature deindustrialization a situation in which the contribution of the manufacturing sector to GDP and employment began to decline at relatively low levels of income. This trend has raised concern among policymakers, particularly as the country attempts to shift away from commodity dependence and enter higher-value segments of the global economy. In response, the Indonesian government has prioritized hilirisasi industri or industrial downstreaming, especially in natural resource sectors such as mining, oil palm, and fisheries. By promoting local processing and value addition, policymakers aim to create jobs, attract investment, and strengthen linkages between resource extraction and domestic industries. While this approach has seen some success, especially in nickel smelting for electric vehicle (EV) battery supply chains it also highlights the limits of resource-led industrial strategies if not accompanied by investments in human capital and innovation capacity [19].

3.2 Human Capital and Skills Development

Despite improvements in access to education, Indonesia continues to face significant challenges in aligning its workforce with the demands of modern industry. The World Bank has

noted persistent skills mismatches, particularly in science, technology, engineering, and mathematics (STEM) fields. Vocational schools (SMK), intended to serve as a pipeline for industrial labor, often lack strong partnerships with the private sector and remain outdated in curriculum and equipment.

The government has taken steps to reform the vocational education system, launching initiatives such as link and match programs between schools and industries. However, the success of these efforts depends on broader systemic changes, including teacher training, curriculum design, and coordination between ministries. Moreover, informal and low-skilled workers, who make up a large portion of the labor force, remain excluded from upskilling opportunities, limiting the inclusivity of industrial growth [18].

3.3 Innovation Ecosystems and Technology Policy

Indonesia's national innovation system is still in a formative stage. Although institutions such as BRIN (National Research and Innovation Agency) have been established to consolidate research functions, coordination among stakeholders remains weak, and innovation is still largely concentrated in state-owned enterprises and urban centers. R&D investment remains low compared to regional peers like Malaysia or South Korea [20] .

Technology adoption in industry, especially among small and medium enterprises (SMEs), is constrained by cost barriers, limited digital literacy, and the absence of advisory services. While some advanced manufacturing firms in Java and Batam are embracing automation and digital tools, many others are locked into low-tech, labor-intensive processes. Government programs such as Making Indonesia 4.0 aim to support the digital transformation of industry, but implementation has been uneven and lacks adequate support for ecosystem building at the local level [19].

3.4 Entrepreneurship and MSME Development

Micro, small, and medium enterprises (MSMEs) make up over 99% of businesses in Indonesia and are key to employment generation, especially in rural areas. Yet, many MSMEs operate informally, with limited access to finance, markets, and innovation support. Efforts to formalize and digitalize MSMEs have gained momentum particularly during the COVID-19 pandemic but challenges remain in integrating these enterprises into formal industrial value chains [21].

The rise of digital entrepreneurship, fueled by platforms such as Tokopedia, Bukalapak, and Gojek, has opened new pathways for participation in the economy. However, the digital divide, especially between urban and rural regions, continues to limit access and scalability for many entrepreneurs. Furthermore, entrepreneurship education is still nascent in public education and vocational systems, leading to a gap between entrepreneurial potential and institutional support [22].

3.5 Institutional Coordination and Policy Integration

A recurring theme across Indonesia's industrial development efforts is the need for stronger policy coherence and institutional coordination. Ministries responsible for education, industry, research, and digital transformation often operate in silos, leading to fragmented initiatives and overlapping mandates. Moreover, subnational governments play a crucial role in implementing industrial and innovation policies, yet they often lack the technical capacity or autonomy to do so effectively [23] .

Successful reindustrialization requires more than policy declarations; it demands ecosystem thinking, long-term investment in human capabilities, and the creation of feedback loops between firms, research institutions, and local communities. Without these elements, industrial policy risks becoming extractive rather than transformative [24].

4. Discussion and Synthesis

The case of Indonesia illustrates both the potential and complexity of reindustrializing development through the integration of human capital, technological innovation, and entrepreneurship. While the national agenda reflects a strong political commitment to downstream industrialization and digital transformation, the implementation landscape reveals critical structural gaps that are common across emerging economies [25]. This section synthesizes the findings and situates them within broader theoretical and policy frameworks.

4.1 Human Capital as a Systemic Foundation, not a Secondary Input

Across the literature, human capital is frequently discussed as a key driver of industrial productivity and adaptability. In Indonesia, however, education and skills development have historically been treated as parallel rather than embedded within industrial policy. The lack of synchronization between education institutions and industry demands reflects a broader weakness in policy alignment [26].

Reindustrialization in the context of digital disruption and global competition requires more than workforce availability; it requires workforce relevance. A well-trained, tech-savvy, and entrepreneurial labor force is no longer a by-product of growth but a precondition for it. Countries that have succeeded in industrial upgrading such as Vietnam or South Korea have invested heavily in technical education, dual training systems, and strong public private partnerships in skill formation [27].

Indonesia's "link and match" programs mark a step forward, but to scale impact, they must evolve into multi-stakeholder frameworks that involve industries in curriculum design, offer industry-certified training, and provide lifelong learning opportunities especially for workers in vulnerable sectors.

4.2 Innovation Beyond R&D: Building Inclusive Innovation Ecosystems

Technological innovation is often narrowly equated with R&D spending or high-tech inventions. Yet, in emerging economies, innovation must also include process improvements, organizational learning, local adaptation, and indigenous knowledge systems. Indonesia's innovation performance remains hindered not only by low R&D intensity but also by weak integration between universities, industries, and communities.

The concept of national innovation systems (NIS) highlights that innovation is an ecosystem function, not a firm-level choice. For reindustrialization to succeed, governments must enable systemic linkages between actors through innovation hubs, cluster development, incubators, and regional innovation councils. Moreover, innovation policy must be democratized, ensuring that SMEs and rural entrepreneurs have access to tools, training, and networks not just tech startups in urban areas [28].

Indonesia's Making Indonesia 4.0 roadmap is ambitious, but its transformative potential hinges on whether it can foster innovation capacity beyond Jakarta and Java. This includes bridging digital divides and fostering experimentation in non-traditional sectors such as agriculture, creative industries, and blue economy sectors like fisheries.

4.3 Entrepreneurship as a Bridge Between Innovation and Employment

Entrepreneurship serves as a dynamic link between human capital and innovation. In theory, entrepreneurial ecosystems should absorb talent, convert ideas into products, and scale innovation to markets. In practice, however, emerging economies often face fragmented ecosystems, lack of early-stage funding, and weak support for scaling ventures. In Indonesia, while the MSME sector dominates in size, it is largely informal, necessity-driven, and disconnected from innovation pipelines. Government programs to support digital transformation of MSMEs (e.g., onboarding to e-commerce platforms) are helpful but insufficient to transform them into engines of industrial

productivity [27].

True entrepreneurial dynamism requires a combination of infrastructure, finance, mentorship, legal certainty, and social networks. Lessons can be drawn from ecosystems like Bandung's creative economy clusters or Yogyakarta's digital communities, where informal knowledge-sharing and collaboration play a major role [24].

Importantly, entrepreneurship must be made inclusive and regionally distributed. Current patterns show that high-growth startups are heavily concentrated in Java, leaving outer provinces underrepresented in the digital and industrial transition. A regionally inclusive entrepreneurship strategy must address infrastructure gaps, access to finance, and human capital deficits in Indonesia's eastern and border regions.

4.4 Institutional Capacity and Ecosystem Governance

One of the most consistent barriers to integrated industrial transformation is institutional fragmentation. Ministries operate in silos, regional authorities lack capacity, and public-private coordination remains weak. Effective reindustrialization depends not only on what policies are made, but how they are coordinated, implemented, and monitored.

Indonesia's institutional complexity shaped by decentralization, overlapping mandates, and shifting bureaucratic leadership poses a real challenge. Reform efforts such as the creation of BRIN and the simplification of business licensing are steps in the right direction, but deeper ecosystem governance mechanisms are needed. These include [23]:

- Multi-level policy coordination platforms
- Regional industrial development boards
- Data-sharing and performance tracking systems
- Joint planning between education, industry, and local government

A more integrated governance model would allow for better feedback loops, adaptive learning, and the scaling of successful practices across regions.

5. Policy Recommendations

Drawing from the analysis of Indonesia's industrial transformation and broader trends in emerging economies, this paper proposes a set of strategic policy directions aimed at fostering a more inclusive, innovation-driven reindustrialization process. These recommendations are designed to address the interdependent challenges of workforce readiness, technological diffusion, entrepreneurial development, institutional coordination, and spatial inequality.

First, the integration of human capital planning into industrial strategy must be treated as a structural priority rather than a secondary concern. Vocational training and higher education curricula should be systematically aligned with the evolving needs of industry through co-designed programs involving the private sector. This includes expanding dual education models, internships, and certifications that reflect real-world competencies. In addition, the government should invest in lifelong learning systems to enable continuous skill upgrading, particularly for workers in industries undergoing transition due to automation or policy shifts. Public funding must also be increased for technical and STEM education at both secondary and tertiary levels, ensuring that the next generation of workers is equipped with a more technology-intensive industrial landscape.

Second, there is a need to strengthen innovation ecosystems beyond conventional R&D-centric approaches. While research and development remain important, inclusive industrial growth also requires the promotion of process innovation, frugal innovation, and context-specific technological solutions that respond to regional challenges. To this end, collaboration between universities, SMEs, and larger firms should be facilitated through innovation hubs, applied research grants, and public-private partnerships. Importantly, innovation policies should support not only large corporations but also small enterprises and informal innovators, ensuring that technological advancement does not reinforce existing hierarchies.

Third, expanding the infrastructure for inclusive entrepreneurship is essential to connect innovation with economic opportunity. This involves the creation of regionally distributed incubators, mentoring networks, and startup finance mechanisms particularly in areas beyond major urban centers. Capacity-building programs that promote digital entrepreneurship and the development of local platforms tailored to regional needs can help unlock entrepreneurial potential in underserved regions. Furthermore, entrepreneurship education should be integrated into public education and vocational training systems to cultivate entrepreneurial mindsets from an early age.

Fourth, improving institutional coordination and policy coherence is critical to ensure that fragmented initiatives do not undermine broader development goals. Establishing cross-ministerial coordination platforms that bring together the education, industry, innovation, and finance sectors can foster more aligned and responsive policy implementation. Regional governments should also be empowered through the formation of industrial development boards with mandates to design context-sensitive strategies and allocate resources accordingly. These boards can play a crucial role in monitoring progress, facilitating inter-sectoral collaboration, and ensuring accountability. Additionally, robust monitoring and evaluation systems should be institutionalized to assess the real impact of industrial, educational, and entrepreneurship policies and adapt them based on empirical evidence.

Finally, promoting territorial equity in industrial policy must be a central component of any national reindustrialization strategy. Economic development in Indonesia remains heavily concentrated on the island of Java, while other regions lag in infrastructure, investment, and innovation capacity. To correct this imbalance, the government should prioritize infrastructure investment, innovation funding, and entrepreneurial support in peripheral and underdeveloped regions. This includes encouraging the development of industrial clusters in non-traditional sectors such as agro-processing, creative industries, and the sustainable blue economy. Fiscal incentives, regulatory flexibility, and technical assistance can be used to attract investment into these underserved provinces and foster more spatially inclusive growth.

Together, these recommendations underscore the need for a systemic, integrated approach to reindustrialization one that places people, knowledge, and networks at the center of industrial strategy. Without these structural interventions, emerging economies may continue to experience uneven growth, technological dependence, and limited resilience in the face of future shocks.

7. Conclusions

This study has explored how the reindustrialization of emerging economies exemplified by Indonesia's recent industrial policy shifts relies not merely on physical infrastructure or resource endowments, but on the strategic interplay between human capital, technological innovation, and entrepreneurship. It argues that these three pillars must be treated as interdependent components of a broader transformation agenda aimed at inclusive and sustainable economic development.

The analysis demonstrates that human capital remains both a constraint and an opportunity. Without investments in relevant skills and lifelong learning, industrial ambitions are unlikely to translate into meaningful employment or innovation. Technological innovation, meanwhile, must move beyond isolated R&D efforts and evolve into ecosystem-based processes that enable localized solutions, inclusive participation, and collaboration between sectors. Finally, entrepreneurship should not be viewed solely as a means of self-employment, but as a mechanism for scaling innovation, generating jobs, and embedding industrial activity within diverse regional contexts.

Indonesia's policy landscape reflects growing recognition of these dynamics, as seen in efforts to promote downstream industrialization, vocational reform, and SME digitization. However, institutional fragmentation, spatial inequality, and capacity gaps still hinder the full realization of these goals. This paper emphasizes that reindustrialization must be people-centered and innovative-enabled, requiring not just technical tools but new governance models, coordinated strategies, and long-term commitments.

In conclusion, the future of industrial development in emerging economies will depend on their ability to connect knowledge, technology, and entrepreneurship in inclusive ways. Such a model

offers not only economic gains, but also the potential to reshape development as a process grounded in agency, equity, and resilience.

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