Integrating AI into developing countries supply chains: opportunities and Constraints

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Résumé

Notre recherche aborde l'intégration potentielle de l'intelligence artificielle (IA) dans les chaines logistiques des pays en développement, en examinant les avantages et les obstacles possibles découlant de cette transition technologique. À travers notre analyse, nous avons essayés de répondre sur trois questions clés : Quels sont les bénéfices que l'utilisation de l'IA peut offrir aux pays émergents ? Quelles difficultés spécifiques ces pays doivent surmonter pour adopter cette technologie ? En quoi le déploiement de l'IA pourrait-il améliorer la performance et l'efficience des chaînes d'approvisionnement existantes ? En analysant la littérature existante dans ce domaine, nous avons découvert des possibilités prometteuses pour accroître l'efficacité et réduire les coûts de manière significative des chaines d'approvisionnement des pays émergents, à l'aide des technologies d'IA. Nous avons également identifié les principaux défis à relever, tels que les limitations technologiques et organisationnelles. Il apparaît clairement que l'IA a le potentiel de transformer radicalement les chaînes d'approvisionnement. Pour y parvenir avec succès, des interventions ciblées ainsi qu'un cadre politique adapté seront essentiels. Notre étude révèle comment l'accroissement de l'utilisation de l'intelligence artificielle peut stimuler l'avancement et la compétitivité dans les nations en développement, ouvrant ainsi la voie à de futures recherches empiriques dans ce domaine crucial.

Mots clés: Supply Chain, Intelligence Artificielle, pays en développement, logistique.

Abstract

Our research addresses the potential integration of artificial intelligence (AI) in supply chains in developing countries, examining the possible benefits and barriers arising from this technological transition. Through our analysis, we tried to answer three key questions: what are the benefits that the use of AI can offer to developing countries? What specific challenges do these countries have to overcome to adopt this technology? How could the deployment of AI improve the performance and efficiency of existing supply chains? By analyzing the existing

literature in this field, we discovered promising opportunities to significantly increase the efficiency and reduce costs of supply chains in developing countries, using AI technologies. We also identified key challenges, such as technological and organizational limitations. It is clear that AI has the potential to radically transform supply chains. To achieve this successfully, targeted interventions and an adapted policy framework will be essential. Our study reveals how increasing the use of artificial intelligence can boost advancement and competitiveness in developing nations, paving the way for future empirical research in this crucial area.

Keywords: Supply Chain, Artificial Intelligence, Developing Countries, Logistics.

1. Introduction

The utilization of artificial intelligence (AI) in supply chains has been a major transformative force in the past few years that has a proven potential for improved performance and efficiency. Factors such as regional uplift, the economic slowdown of the Asian economy, and recent policies, such as deregulatory trade measures, have all put pressure on the fragile supply chains in developing countries. In particular, their predictive analytics, automation, and intelligent decision-making capabilities offer the potential to upend these supply chains and, stimulate economic growth and development.

This research is driven by a central research question: **What challenges and opportunities does the integration of AI offer to the supply chains of developing countries?**

To further clarify this question, we will explore three sub-research questions:

- What opportunities is AI creating in developing countries?
- What are the challenges involving AI integration in these countries?
- How can AI transform supply chains for better results?

In this introduction, we aim to highlight general answers to these questions, which will be explored in greater depth in the following sections of this paper.

In this paper, the term “developing countries” refers to economies with lower industrialization and lower human development index scores, as categorized by the World Bank. Although some of these may be considered “emerging markets”, we use “developing countries” consistently for coherence.

In recent research, we see that AI and digitalization are put forward as the same thing which may causes issues of definition. Toorajipour et al. (2021) report that AI is a computer based system that performs functions which are usually for human intelligence such as learning, reasoning, problem solving and decision making. Also digitalization at large includes the conversion of analog processes to digital which in turn enables automation and data based operations. While digitalization is a broad term which covers many tech's, AI is a sub set which is about the simulation of human thought processes.

So, the potential of AI to boost supply chain performance and efficiency is well-researched. In developing nations, AI will provide a once-in-a-lifetime opportunity to integrate into these systems so that past bottlenecks can be addressed. Such countries are frequently plagued by relatively scarce infrastructure, inadequate skill sets, and insufficient high-quality data, stymieing supply chain efficiency. Thus, AI technologies can help fill these gaps and improve supply chain performance. AI-driven predictive analytics can, for instance, improve resource allocation and demand forecasting, leading to a waste decrease and resilience increase in the supply chain (Benzidia, Makaoui & Bentahar, 2021).

As promising as this sounds, implementing AI in supply chains in developing countries is not without difficulties. The Proliferation of technological barriers, like infrastructure gaps and the unavailability of quality data, which is essential for the functioning of any AI solution, hampers the possibility of addressing problems with the most appropriate AI tools. Owing to inadequate digital infrastructure for AI technologies, AI's full potential remains untapped in many developing countries (Lezoche et al., 2020).

Moreover, skill shortages and a lack of organizational readiness hinder the integration of AI within organizations largely, because many supply chain managers and workers may not have had the experience of working with or implementing AI technologies effectively (Rodrik, 2018).

Economic constraints also contribute greatly to the obstacles that face developing countries in integrating AI into their supply chains. Financial constraints and investment in AI technologies can limit the capabilities of companies to implement and adopt AI solutions. In addition, the accompanying high costs of AI technologies may obstruct small and medium-sized enterprises (SMEs) that are widespread in several developing countries (Mangla et al., 2018).

Despite these challenges, the application of AI in supply chains offers many opportunities for developing countries. By enabling countries to compete more effectively in a globalized marketplace, AI can also provide these nations with a significant competitive advantage in their own right, which can lead to increased innovation and decreased costs of services and goods. For instance, AI technologies can enable organizations to streamline logistics operations by optimizing routes, inventory levels, and even monitoring supply chain visibility, ultimately achieving substantial cost savings (Wamba & Queiroz, 2020).

Artificial Intelligence can also catalyze the creation of new business models and revenue streams, supporting overall economic progress. For example, digital marketplaces can be made possible using AI-powered platforms that connect buyers and sellers across regions and improve local businesses' market access (Toorajipour et al., 2021).

Moreover, AI has the potential to facilitate smart supply chains, allowing the connection of all aspects of the supply chain into one network that functions efficiently and effectively powered by data (Wong et al., 2024).

The potential of AI to transform and radically reshape supply chains is profound. AI can transform logistics and operational processes, increasing supply chain flexibility, responsiveness, and resilience while spurring innovation and competitiveness in developing nations. Innovative AI technologies such as demand forecasting, route optimization, and supply chain visibility can improve supply chain performance, minimizing stockouts and improving customer satisfaction (Queiroz, Telles, & Bonilla, 2020).

In addition, AI can facilitate the construction of more sustainable and environmentally friendly supply chains, which is consistent with global trends toward sustainability and corporate social responsibility. When combined with advancing technologies, AI can optimize resource use, reduce waste, and improve energy efficiency, leading to green supply chains that minimize environmental impact (Benzidia et al., 2021).

The remaining parts of this paper are structured as follows: Section 2 outlines the methodology employed. Section 3 then provides the results of this review analysis. Section 4 concludes this paper.

2. Methodology

To answer the main questions of our research, we performed an automated search across “Scopus” research database to select relevant and recent articles related to the opportunities and constraints of adopting Artificial Intelligence (AI) in developing countries supply chains. Initially, 37 publications were obtained from a primary search using the following search string: TITLE-ABS ("artificial intelligence" OR "AI") AND TITLE-ABS ("algorithms" OR "models") AND TITLE-ABS ("developing countries" OR "developing economies") AND TITLE-ABS ("supply chain*"). A secondary selection was then applied, considering the inclusion and exclusion criteria. In our analysis, we only considered journal articles (“review articles” included), excluding all other types of documents. We also limited our research to open-access papers. Considering the rapid advancements in AI applications after 2016 (such as deep learning and reinforcement learning in logistics), we focused on recent literature to reflect current trends and avoid outdated technological references. Additionally, we excluded studies not related to the supply chain management domain. As a result, 15 relevant articles were selected and thoroughly analyzed in this narrative review.

3. Results and discussion

3.1 Emerging opportunities AI presents

Most early studies in AI research in supply chains investigated general benefits like efficiency and cost savings. These studies provided meaningful insights but were rarely granular enough to address the specific impact of AI across diverse sectors in developing countries.

AI applications in logistics, such as AI-powered applications that optimize routes and delivery processes, have the potential to reduce delivery times and costs significantly. According to Benzidia et al. (2021), the combination of AI with Big Data Analytics (BDA) can help support the collaboration and green supply chain benefit by optimizing the efficient utilization of resources while minimizing waste. These technologies enable production efficiency within the manufacturing sector through predictive maintenance and real-time monitoring of machinery (Rodrik, 2018). This results in less downtime and longer equipment life, leading to cost savings

and improved productivity. AI also allows manufacturers to forecast demand more accurately, which helps them schedule production more effectively and manage their inventory to reduce the costs of overproduction and stockouts.

Recent advances have expanded the possibilities for AI applications beyond individual industries and into cross-industry innovations that are built on the properties of AI. For example, AI-based multi-criteria decision-making models have been developed to create resilient supply chains (Belhadi et al., 2022) that unify data across sectors, improving decision-making mechanisms. By adopting that cross-industry approach, companies can gain a more holistic understanding of supply chain dynamics and be better prepared to respond to disruptions and shifting market conditions.

The transformative role of AI in innovation goes far beyond operational enhancements to further strategic shifts in business models and go-to-market strategies. Using AI, organizations from emerging markets can identify new value propositions and improve their competitive positioning. This becomes especially key in countries where supply chain models are limited by infrastructure and resource challenges.

AI technologies allow the creation of intelligent supply chains that are flexible and align with market needs. Another example is the personalization of goods and services, which, when made possible by AI technology, can lead to unique implementations in the current consumer-oriented environment (Lezoche et al., 2020). AI can also help drive the development of data-driven services and solutions that can lead to new revenue streams for manufacturers who expand their product offerings beyond just physical goods.

AI-driven solutions can enhance supply chain visibility and facilitate successful risk management strategies. For instance, Improved demand forecasting (Mangla et al., 2018) can indeed better align inventory levels with market requirements and prevent stockouts. This also applies to logistics and transportation networks, where AI optimizes transportation routes and minimizes the flow of disruptions throughout the supply chain.

It is vital to ensure that AI integration is supported by comprehensive policies to guarantee that its benefits are evenly distributed among industries and regions. Furthermore, international partnerships and awareness-sharing on AI can foster increased adoption between countries and

strengthen innovation in developing nations.

In summary, incorporating AI into supply chains within developing nations offers numerous opportunities to increase efficiency, lower costs, and stimulate innovation. Ongoing research is unpacking AI's potential across various sectors (e.g., health care, education, public services) and geographic contexts (e.g., global north vs. global south). This, in turn, drives economic growth and development in the region, as developing countries can create & access more resilient and competitive supply chains by tackling challenges they currently face while harnessing the capabilities that AI offers. Nevertheless, the realization of these possibilities is contingent on concerted actions from governments, industry players, and the international community to create an environment conducive to AI adoption and innovation.

3.2 Technological, Organizational, and Economic Constraints

Typically, the barriers to AI come in three forms: technological, organizational, and economical. Each of these can be a substantial barrier to the effective implementation of AI solutions. What is important is recognizing these constraints and devising approaches that enable AI adoption and harness its capabilities to enhance supply chain efficiency and performance in these regions.

One of the biggest impediments to incorporating AI into the supply chains of developing economies is the technological divide. A significant hurdle is the infrastructure deficits seen in these regions. Most developing countries suffer from inadequate digital infrastructure, which is an essential requirement for the functionality and deployment of AI technologies. The lack of high-speed internet connectivity and advanced data centers, for instance, may prevent the seamless integration between the AI systems (Benzidia, Makaoui, & Bentahar, 2021). These infrastructure constraints not only limit access to AI technologies but also prevent the collection and analysis of quality data — required for AI to work.

These technical limitations are compounded by data quality issues. As many developing countries have outdated and inconsistent data collection methods, data quality is a major issue. As training AI models requires high-quality data, its absence can hamper the potential advantages of AI (Rodrik, 2018). Another factor restricting AI use is concerns around data privacy and security, as many organizations are afraid of the data being vulnerable to breaches and misuse due to a lack of robust cybersecurity measures.

In response to these issues, there is growing awareness of the need for improved technological infrastructure in emerging markets. As internet connectivity and data management capabilities become crucial, more governments and international organizations are investing in digital infrastructure projects. However, these initiatives must be made faster and broadened to reduce the technology gap and thus allow for wider use of AI (Mangla, Luthra, Mishra, & Singh, 2018).

A further major limitation is the organizational readiness of firms in low-income countries for AI technology adoption. Most organizations do not have the appropriate level of skills and ability to effectively roll out and operate AI systems. The skills gap is often linked to inadequate training and education in fields related to AI, thus restricting the supply of suitable human resources to boost AI initiatives (Wamba & Queiroz, 2020).

Humans and their organizational culture play a major role in AI adoption. Developing economies face an obstacle due to the culture of often resistant organizations, making it difficult to bring new technologies on board. Even though this type of business leaves history for continuous use of traditional systems, it has not yet adopted technology. One of the major (and often hindering) factors behind this resistance is a lack of knowledge about the benefits of AI and a fear of job loss among employees due to the introduction of AI (Lezoche et al., 2020).

This will require some specialized interventions meant to develop AI skills; a different mindset and a company culture that strives to innovate. Technical training and workshops can improve the workforce's technical skills, and awareness campaigns can help eliminate myths about AI to prove its benefits. Also, it encourages organizations to adjust their approach to change management and move towards more flexible and adaptable change management, so they can adapt well and adopt AI effectively in their processes (Toorajipour et al., 2021).

Financial restraints are, to be honest, the most widespread deterrent to AI penetration in developing countries. A lack of financial resources restricts organizations from investing in AI technologies and infrastructure. Moreover, the high costs involved in the acquisition, implementation, and maintenance of AI systems can deter potential adopters, especially SMEs that represent the backbone of many developing economies (Schniederjans, Curado, & Khalajhedayati, 2020).

At the same time, many developing countries are plagued by economic instability and volatility, which are barriers to investment in AI. The erratic fluctuations of currency exchange rates, inflation, and economic policies lead to an uncertain business environment, causing deterrents to long-term investments in AI technologies. And, there are often limited options available for financing in these areas, with numerous organizations unable to procure funding for AI initiatives (Sanders, 2025).

First, we need supportive financial mechanisms to foster investments in AI to overcome these economic challenges. Provide incentives, including tax breaks and subsidies, for organizations to invest in AI technologies. International collaborations and partnerships can aid in obtaining excess resources and funding, contributing to overcoming the financial barriers to AI adoption (Queiroz, Telles, & Bonilla, 2020).

Although the above constraints are enormous, it is also vital to understand the cross-sectoral impacts of AI adoption and the role of policy influences in determining the integration of AI in developing countries. However, machine learning could accelerate the process in several sectors like agriculture, healthcare, and manufacturing, among others, thereby increasing efficiency and productivity. Nonetheless, a coordinated and comprehensive policy framework is essential for the successful integration of AI across various sectors (Wong, Tan, Ooi, & Lin, 2024).

Policies can act as facilitators or barriers to AI adoption in developing countries. Enabling policies — those that promote digital literacy, stimulate research and development, and safeguard intellectual property rights — ensure positive environments where AI can prosper. On the other hand, overly restrictive models, such as those that create excessive restrictions or ignore crucial elements like the protection of information privacy, can reduce new initiatives and preclude the adoption of AI.

Adopting a more holistic cross-sectoral approach to unlocking the true potential of AI and mitigating policy-related constraints will require collaboration at all levels. Working together can create policies that help integrate AI where it is beneficial and tackle the challenges specific to different industries. Moreover, creating an environment of international cooperation enables countries to learn from each other, speeding up AI implementation in developing nations.

4. Conclusion

The advent of AI in the developing world supply chain is, at the same time, a tangled relationship of difficulty and opportunity. These persistent technological, organizational, and economic limits (e.g., lack of infrastructure, inadequate data storage, and dearth of expertise) block the diffusion of AI (Mangla et al., 2018). Closing these disparities will require targeted investment, e.g., increased internet connectivity and/or more computationally intense systems, to truly harness the transformative capabilities achievable with AI. No less significant, is the degree of organizational readiness, depending on organizational flexibility, employee skills, and alignment between AI programs with strategic goals. Indeed, the construction of innovation-oriented cultures as well as technology provider partnerships can lead to a decrease in resistance to change (Wamba-Queiroz, 2020).

Knowledge-sharing initiatives, technical assistance, and educational partnerships conducted in or between high and low-income countries not only reduce skill gaps, they also accelerate capacity-building. These collaborations don't address technological disparities only, but also social ones through employment generation and inclusive growth.

While the current limitations of AI for these applications remain high, the potential for AI to improve supply chain performance, reduce cost, and transform operational processes cannot be ignored. Success hinges on multilayered interventions—spanning infrastructure, organizational restructuring, policy innovation, and global partnerships—to balance risks with sustainable gains. Future research should consider context-dependent solutions, in particular how to address the issue of limited resources and build stakeholder consensus. Through the focus on adaptive and collaborative strategies, countries in development can leverage AI to enhance supply chain robustness to sustain competitiveness in a growing global digital economy.

This review contributes to the literature by identifying under-explored AI applications in developing countries' supply chains, highlighting infrastructure and data limitations as critical implementation barriers, and proposing a research agenda focusing on context-adapted AI models.

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