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THE SHIFTING PARADIGM OF INTERNATIONAL BUSINESS IN THE ERA OF THE INDUSTRIAL REVOLUTION 4.0: A QUALITATIVE STUDY BASED ON RECENT LITERATURE

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Abstract

Background *- The Fourth Industrial Revolution has transformed international business through the integration of technologies such as artificial intelligence, the Internet of Things, big data, cloud computing, and digital platforms. These developments have changed business models, global supply chains, and international competitive strategies. Digitalization enables companies to access global markets more quickly and efficiently, although challenges related to digital skills, human resource readiness, and regulatory differences across countries remain significant.*

Aim *- This study aims to analyze the paradigm shift in international business during the Industry 4.0 era and examine its implications for global business strategies and competitiveness.*

Design /methodology /approach *- his research used a qualitative approach through a systematic literature review and bibliometric analysis. Data were obtained from reputable international journals published between 2020–2025 and Scopus-indexed bibliometric data from 2019–2025. Thematic analysis was applied to identify key themes related to digital transformation in international business.*

Findings *- The results show that international business has shifted from conventional trade-based activities toward an integrated digital ecosystem. Artificial intelligence, digital platforms, and supply chain transformation are key drivers of global competitiveness. In addition, sustainability and human resource management have become important factors in supporting successful Industry 4.0 implementation*

Conclusion *- The paradigm of international business has shifted from traditional cross-border trade to a holistic socio-technical digital ecosystem. Consequently, long-term success in the global market requires companies to synergize artificial intelligence and digital platforms with a strong commitment to sustainable development and flexible human resource strategies.*

Research implications *- Research Implications: This study contributes to international business literature by integrating digital transformation, sustainability, and human resource management perspectives. The findings also provide practical guidance for companies and policymakers in developing adaptive and sustainable global business strategies.*

Research Limitations *- This study is limited to literature review and bibliometric analysis without direct empirical investigation in companies, particularly in developing countries*

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Keywords: *International Business, Industry 4.0, Digital Transformation, Artificial Intelligence, Sustainable Development, Global Supply Chain.*

Abstrak

Latar Belakang - Revolusi Industri Keempat telah mengubah bisnis internasional melalui integrasi teknologi seperti artificial intelligence, Internet of Things, big data, cloud computing, dan platform digital. Perkembangan ini mengubah model bisnis, rantai pasok global, serta strategi persaingan internasional. Digitalisasi memungkinkan perusahaan menjangkau pasar global dengan lebih cepat dan efisien, meskipun tantangan terkait keterampilan digital, kesiapan sumber daya manusia, dan perbedaan regulasi antarnegara masih menjadi kendala utama.

Tujuan - Penelitian ini bertujuan untuk menganalisis pergeseran paradigma bisnis internasional pada era Industri 4.0 serta mengkaji implikasinya terhadap strategi bisnis global dan daya saing perusahaan.

Desain/Metodologi/Pendekatan - Penelitian ini menggunakan pendekatan kualitatif melalui studi literatur sistematis dan analisis bibliometrik. Data diperoleh dari jurnal internasional bereputasi yang diterbitkan pada periode 2020–2025 serta data bibliometrik berbasis Scopus tahun 2019–2025. Analisis tematik digunakan untuk mengidentifikasi tema-tema utama terkait transformasi digital dalam bisnis internasional.

Temuan - Hasil penelitian menunjukkan bahwa bisnis internasional telah bergeser dari aktivitas perdagangan konvensional menuju ekosistem digital yang terintegrasi. Artificial intelligence, platform digital, dan transformasi rantai pasok menjadi pendorong utama daya saing global. Selain itu, keberlanjutan dan manajemen sumber daya manusia menjadi faktor penting dalam mendukung keberhasilan implementasi Industri 4.0.

Kesimpulan - Paradigma bisnis internasional telah bergeser dari perdagangan lintas negara tradisional menjadi ekosistem digital sosio-teknis yang holistik. Oleh karena itu, keberhasilan jangka panjang di pasar global menuntut perusahaan untuk menyinergikan kecerdasan buatan (*artificial intelligence*) dan platform digital dengan komitmen yang kuat terhadap pembangunan berkelanjutan serta strategi sumber daya manusia yang fleksibel.

Implikasi Penelitian - Penelitian ini berkontribusi pada literatur bisnis internasional dengan mengintegrasikan perspektif transformasi digital, keberlanjutan, dan manajemen sumber daya manusia. Temuan penelitian juga memberikan panduan praktis bagi perusahaan dan pembuat kebijakan dalam mengembangkan strategi bisnis global yang adaptif dan berkelanjutan.

Batasan Penelitian - Penelitian ini terbatas pada studi literatur dan analisis bibliometrik tanpa investigasi empiris langsung pada perusahaan, khususnya di negara berkembang.

Kata Kunci: Bisnis Internasional, Revolusi Industri 4.0, Transformasi Digital, Artificial Intelligence, Sustainable Development, Rantai Pasok Global.

INTRODUCTION

The international business landscape has undergone a remarkable transformation between 2021 and 2025, moving from the adoption of a single technology to a complex digital economy ecosystem. This narrative will take us on a journey to explore the paradigm shift of international business 4.0, dissecting what has changed, how it has manifested itself, and uncovering crucial findings from bibliometric-based research conducted by researchers and literature studies to gain a comprehensive understanding of the shift in the international business paradigm. Several studies have shown that the adoption of digital technology positively contributes to international business performance, particularly in terms of operational efficiency, product innovation, and responsiveness to global markets (Autio et al., 2021).

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This paradigm shift demonstrates that digital transformation is no longer solely about adopting physical machines, but rather a reengineering of the global socio-technical order that holistically integrates system intelligence, sustainability, and stakeholder dynamics. The rapid development of digital technology in the Industrial Revolution 4.0 era has significantly transformed the global economic landscape. The concept of Industry 4.0 was first introduced as the integration of cyber-physical systems, the Internet of Things (IoT), and artificial intelligence in industrial and business processes (Schwab, 2020). In the context of international business, this transformation creates new opportunities as well as complex challenges for companies operating across borders. However, not all companies are able to optimally utilize these opportunities due to limited resources, low digital literacy, and the complexity of cross-border regulations (Gereffi, 2020).

This paradigm began in 2021-2022, a time when companies began grappling with the early stages of adopting and establishing new supply chain network relationships. At this stage, numerous driving factors such as market opportunities, customer demands, quality image, and competition often clashed with obstacles such as high investment costs, lack of knowledge, and challenges in training operators' mindsets to adopt Industry 4.0 (Khin & Kee, 2022). Other researchers even explained that operational strategies began to focus on sustainable manufacturing, where the industry 4.0 paradigm has proven to promise operational efficiency while strengthening environmentally friendly practices broadly (Sharma et al., 2021). International business in the previous era was more influenced by cost advantages, access to raw materials, and geographic proximity to markets. However, in the 4.0 era, competitive advantage is increasingly determined by a company's ability to leverage digital technology to create added value and reach global markets more quickly and efficiently (Coviello et al., 2022). Digitalization enables companies, including small and medium-sized enterprises, to internationalize without having a physical presence in the destination country.

On the other hand, these technological changes are fundamentally redefining interactions between companies; buyer-supplier relationships are becoming increasingly intense, while automated technology-driven procedures are forcing companies to centralize and consolidate their supplier base (Veile et al., 2021). In this initial phase, technology acts as a major catalyst, drastically forcing companies to restructure their traditional relationships to become more collaborative, highly integrated, and environmentally conscious.

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Entering the second phase of this paradigm shift, specifically in 2023, the paradigm shifts toward the "mature" stage, where companies intensively evaluate system maturity and reflect on organizational performance. An empirical systemic review found that digital technology integration essentially fosters "enterprise smartness," which then serves as a key capability driving productivity, safety, and customer experience (Abiodun et al., 2023). Conversely, this evaluation also uncovered a surprising fact: early adopters often face very high implementation costs despite achieving improved environmental and work-life quality, while late adopters tend to benefit from the availability of refined business models (Antony et al., 2023). This business model shift is further reinforced by a bibliometric study that demonstrates the strong link between digital transformation and value chain engineering, the emergence of innovative business models, and sustainable human resource management (Teixeira & Tavares-Lehmann, 2023). Elsewhere in the world, for example, in the Italian manufacturing industry, this period demonstrated that despite the widespread adoption of Industry 4.0 technologies to reduce costs and lead times, a lack of competency remains the most crucial barrier to long-term success (Zheng et al., 2023). To address these challenges, companies determined that a focused implementation approach with a shared strategic vision, full management involvement, and adequate resources was essential for Industry 4.0 success across the enterprise (Veile, 2023). The second phase in 2023 emphasized that successful Industry 4.0 implementation does not stem from simply installing technology, but rather requires sustained "systemic intelligence" and careful consideration of the timing of adoption to mitigate competency deficits across operational lines.

The third phase of this paradigm shift occurs in 2024, when the narrative of international business shifts takes on a new dimension, emphasizing institutional aspects and reshaping views on human resources and well-being. This shift is driven by stakeholders who are beginning to voice differing interpretations. Company management consistently frames Industry 4.0 purely from the perspective of industrial and market efficiency, while unions emphasize civic issues, expressing deep concern about potential unemployment and worsening working conditions (Fogaça et al., 2024).

This new paradigm has also resonated with the younger generation of workers, where there has been a drastic shift in expectations regarding work patterns. Instead of pursuing a 100% physical routine from the office or from home, new talent now demands extreme flexibility through hybrid work models to balance institutional

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demands with achieving a better quality of life (Monje-Amor, 2024). Analyzing this phenomenon, it is clear that in 2024 the business landscape will shift from a mechanical technocentric focus to an arena of socio-institutional negotiations, where the compromise between the demands of capital and the flexibility and psychological well-being of workers will determine the stability of the industrial ecosystem.

The culmination will be when companies enter the fourth phase in 2025, a time when technological innovation is no longer seen merely as a tool for corporate operations, but rather as a key driver of macroeconomic development, dual reality models (metaverse), and the democratization of entrepreneurship. Research shows that the adoption of metaverse technology, coupled with high absorptive capacity, plays a central role in accelerating business model innovation and facilitating digital transformation for knowledge-intensive companies (Zeng et al., 2025). This company-level success resonates on a much broader scale thanks to the increasingly democratizing role of digital platforms, creating open collaborative spaces where academia, government, established companies, and startups work together to drive civilizational progress and social progress (Sánchez-García et al., 2025). At a fundamental level, the perfect combination of a proactive orientation in managing entrepreneurial risk and a strong understanding of the Fourth Industrial Revolution has proven convincingly capable of designing effective digitalization strategies, both in lifestyle businesses and hypergrowth companies (Meyer et al., 2025). All these grassroots innovation initiatives have in turn converged internationally; where the seamless interaction between business and science, readiness for digital transformation, availability of human capital, and investment have empirically become key drivers of progressive economic growth in top innovative countries (Eluwole et al., 2025). As the final conclusion of this cycle, the international business 4.0 landscape has now completely metamorphosed into an inclusive digital ecosystem without geographical boundaries, where the synergy between advanced virtual reality, entrepreneurial acumen, and collaborative knowledge creation capacity serves as an irreplaceable cornerstone for the success of future economic civilization.

Based on this background, this study seeks to answer the question: how has the international business paradigm changed in the Industrial Revolution 4.0 era, and what are its implications for global business strategies and models? This study is expected to provide theoretical and practical contributions to the development of international business studies in the digital age.

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THEORETICAL REVIEW

The Concept of Industrial Revolution 4.0

The Industrial Revolution 4.0 is characterized by the integration of advanced digital technologies into production and business systems, enabling automation, connectivity, and real-time data-driven decision-making (Kagermann et al., 2021). Key technologies in Industry 4.0 include artificial intelligence, big data analytics, cloud computing, IoT, and blockchain. According to Schwab (2020), Industry 4.0 is not only revolutionizing industrial processes but also changing how organizations interact with customers, partners, and global markets. This transformation is driving the emergence of a collaborative, cross-border digital business ecosystem.

International Business in the Digital Age

International business fundamentally encompasses all commercial activities that involve cross-border transactions, including foreign trade, cross-border investments, and strategic global alliances (Hill & Hult, 2023). In the contemporary global economy, these cross-border transactions are increasingly mediated and optimized by information and communication technologies (ICTs), which enhance operational efficiency and global coordination. Building on this premise, Coviello et al. (2022) contend that advanced digitalization has dramatically accelerated the internationalization trajectory of firms through "digital internationalization." By leveraging global digital platforms, multinational and expanding enterprises can directly connect with international consumer bases, effectively bypassing the capital-intensive and time-consuming stage-gate processes characteristic of traditional geographic expansion.

Expanding upon the framework of digital internationalization, recent developments in Industry 4.0 technologies—specifically Artificial Intelligence (AI) and big data analytics—have further reconfigured international entry strategies. As demonstrated by Franke et al. (2026), the adoption of these advanced technologies significantly accelerates the internationalization speed, scope, and strategic patterns of startups from early market selection to global collaboration. Central to this transformation is a firm's degree of digital maturity, which serves as both a core enabler and a critical moderating factor. High digital maturity allows entrepreneurial ventures to adopt multi-market entry strategies akin to "born global" firms. Consequently, modern internationalization has shifted away from rigid, linear planning toward more dynamic, network-driven expansion, where virtual visibility and platform network effects often dictate global positioning.

However, while digital platforms and Industry 4.0 technologies provide the external infrastructure for market entry, a

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firm's success across diverse international markets depends heavily on its internal capacity to transform organizational knowledge. Integrating digital channels into global operations requires sophisticated learning mechanisms. In this context, Dayan et al. (2026) highlight the vital role of organizational knowledge transformation in driving omnichannel adoption and international retail performance. Based on comparative empirical evidence from the United Arab Emirates (UAE) and Pakistan, their study reveals that while learning from organizational failure negatively impacts knowledge unlearning, it exerts a direct positive effect on omnichannel retail adoption. Furthermore, knowledge unlearning acts as a robust driver that pushes firms to adopt omnichannel strategies, ultimately boosting e-commerce innovation and market performance. Notably, the firm's level of internationalization moderates this relationship; in advanced institutional environments like the UAE, well-developed infrastructure and institutional maturity facilitate seamless knowledge unlearning, thereby accelerating omnichannel innovation.

Complementing knowledge transformation mechanisms, a firm's sustained competitiveness in foreign markets also hinges on its foundational dynamic capabilities (DCs). Beyond channel integration, enterprises must continuously reconfigure operational assets to withstand volatile international environments. Dayangan and Aykol (2026) emphasize that dynamic capabilities play a paramount role in enhancing export performance, specifically through targeted product development and foreign market adaptation. Their findings indicate that higher-level organizational DCs generate a statistically significant positive impact on export outcomes. Nonetheless, lower-level, task-specific export capabilities remain relatively under-researched, underscoring the need for a more granular understanding of how macro-level variables—such as accumulated export experience and regional geopolitical stability—influence the practical efficacy and deployment of dynamic capabilities across borders.

Finally, contemporary international business extends beyond market entry, digital adaptation, and internal capabilities to encompass the sustainable governance of global value chains. In an era marked by heightened environmental and social accountability, multinational enterprises must extend their strategic capabilities outward toward external partners. Illustrating this imperative, Hautamaki et al. (2026) observe that firms in Nordic countries (e.g., Finland and Denmark) increasingly prioritize their capacity to influence suppliers and distributors as a key contribution

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toward achieving global 2030 sustainability targets. Similarly, private sector actors in markets such as Italy are actively aligning their operations with global sustainability standards. Their findings reveal that sales strategies aimed at driving sustainability transitions across buyer-seller interactions vary significantly according to enterprise scale and the internal sustainability maturity of the organization.

In conclusion, modern international business has evolved into a multi-dimensional paradigm where digital internationalization (Coviello et al., 2022; Franke et al., 2026) serves as a primary catalyst for global reach, while internal knowledge transformation (Dayan et al., 2026) and dynamic capabilities (Dayangan & Aykol, 2026) provide the operational resilience necessary to navigate foreign markets. Ultimately, for international enterprises to secure long-term competitive advantage, these technological and structural capabilities must be aligned with sustainable value chain governance and cross-border stakeholder management (Hautamaki et al., 2026).

Digital Transformation and Global Business Models

Digital transformation is fundamentally reshaping international business by enabling platform-based models—such as global e-commerce and digital services—that cross geographic borders, build data-driven networks, and enhance firm agility in volatile markets (Vial, 2021; Autio et al., 2021). Beyond basic market reach, this evolution relies heavily on upper-echelon leadership and dynamic managerial capabilities, where executives with practical IT experience and high digital literacy directly dictate the quality and scope of organizational change (Merín-Rodriganez et al., 2025; Zahoor et al., 2023; Liu et al., 2026). Furthermore, when guided by digitally mature leadership, adopting advanced technologies like Artificial Intelligence (AI), big data, and Robotic Process Automation (RPA) drives dual-path outcomes: streamlining cross-border operations and boosting brand equity while achieving measurable sustainability performance (Fei et al., 2025; Franke et al., 2026).

However, translating these digital tools into long-term global competitiveness requires deep internal learning and adaptive governance. Rather than following a linear path, digital expansion evolves recursively through phases of experimentation, consolidation, and acceleration, often creating friction between corporate strategy and local business units (Karabag et al., 2026). To sustain performance across foreign markets, multinational enterprises must pair digital channels with robust organizational knowledge transformation—specifically unlearning obsolete practices to facilitate omnichannel adoption (Dayan et al., 2026)—

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and higher-level dynamic capabilities tailored to geopolitical realities (Dayangan & Aykol, 2026). Ultimately, this holistic integration allows international firms to navigate supply chain complexities and meet global sustainability standards, securing market relevance across diverse institutional environments (Hautamaki et al., 2026).

Phases of the International Business Paradigm Shift

Phase 1 (2021-2022): Initial Adoption and Relationship Restructuring: In this initial phase, the literature focused on a basic understanding of the drivers, barriers, and direct effects of technology on business relationships and sustainability. Manufacturing companies' decisions to adopt Industry 4.0 were strongly influenced by factors such as expected benefits, market opportunities, customer demands, quality image, and competition, despite facing crucial barriers such as technical challenges, funding issues, lack of knowledge, and the need to change workforce mindsets (Khin & Kee, 2022). Meanwhile, the sustainable manufacturing paradigm began to gain a strong foothold in the industry 4.0 era, with literature examining the potential for operational efficiency improvements and their impact on environmental sustainability (Sharma et al., 2021). Furthermore, this digital transformation has been shown to change the nature of interactions between buyers and suppliers; future interactions and transactions will rely heavily on automated and digital procedures, forcing companies to consolidate their supplier base with strategically important parties (Veile et al., 2021). This phase becomes the initial foundation where technological disruption is not only seen as an IT (Information Technology) renewal project, but rather a fundamental restructuring of the supply chain and operational model that demands a major commitment of resources and structural adaptation from the company.

Phase 2 (2023): Maturity and "Systemic Intelligence": Entering 2023, the paradigm shifts to evaluating real impacts and establishing "intelligence" within organizations. Digital transformation through Industry 4.0 demands a systemic approach, where the integration of the entire value chain results in information transparency that then forms "enterprise smartness," a key capability that drives productivity, safety, and customer experience (Abiodun et al., 2023). In practice, the performance of early adopters and late adopters shows significant differences; early adopters face high implementation and operational costs, while late adopters benefit from tested and refined business models (Antony et al., 2023). In line with this, a review of the existing literature emphasizes that manufacturing digitalization is closely linked to changes in the value chain, the emergence of new business

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models, and issues of economic sustainability (Teixeira & Tavares-Lehmann, 2023). From an implementation perspective, successful integration of Industry 4.0 across companies requires a shared vision, management engagement, and adequate resources (Veile, 2023). However, empirical studies reveal that despite increasing technology adoption to reduce costs and lead times, the deficit in human resource competencies and expertise remains a major obstacle in the field (Zheng et al., 2023). This second phase, it can be concluded, represents a period of maturity where initial enthusiasm for technology begins to be tested by the realities of human resource competency and financial rationality, making system intelligence and employee readiness key to long-term success.

Phase 3 (2024): Socio-Institutional Negotiations and Welfare: This phase is characterized by the emergence of debates regarding the social, institutional, and psychological impacts of the new work environment. The meaning of Industry 4.0 is no longer uniform, as there are differing emphases among stakeholders. Companies consistently emphasize industrial and market perspectives, while unions are much more vocal about civic issues, such as concerns about working conditions and the potential for worsening unemployment (Fogaça et al., 2024). At the same time, the expectations of younger generations (millennials and Gen Z students) regarding the world of work are shifting sharply. They no longer desire conventional, physically bound work models, but instead demand hybrid or remote work models that provide flexibility to balance institutional demands with their quality of life and well-being (Monje-Amor, 2024). This indicates that by 2024, the international business arena and technology adoption will shift from merely technical discourse to a socio-institutional mediation field, where the compromise between the demands of capitalist efficiency and the human rights, well-being, and autonomy of workers will become a key pillar of industrial stability.

Phase 4 (2025): Inclusive Digital Ecosystem and Macro Innovation: The pinnacle of the paradigm shift occurs when digital technology is integrated into the context of macroeconomic innovation and the creation of a borderless ecosystem. At the knowledge-intensive enterprise level, the adoption of metaverse technology has proven significant in driving business model innovation and digital transformation, with knowledge absorptive capacity playing a central role in facilitating this process (Zeng et al., 2025). This enterprise-level success aligns with the finding that effective digitalization strategies are strongly driven by a combination of entrepreneurial orientation (risk-taking and proactiveness) and technological readiness (Meyer et al.,

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2025). At the broader ecosystem level, digital platforms are recognized for their ability to democratize innovation, facilitating an inclusive and collaborative environment for startups, established companies, academia, and government entities to collectively drive technological and social progress (Sánchez-García et al., 2025). At the macroeconomic level (as in highly innovative developed economies), economic growth is positively correlated with the level of digital technology readiness, the interaction between business and science, and the quality of human capital availability (Eluwole et al., 2025). The conclusion of this final phase shows the fusion of traditional boundaries between industry, the world of education, and government; Industry 4.0 and the post-2025 digital leap are no longer merely supporting corporate operations, but have become the backbone of a global ecosystem that is open, resilient, and highly oriented towards economic prosperity and social civilization of the wider community.

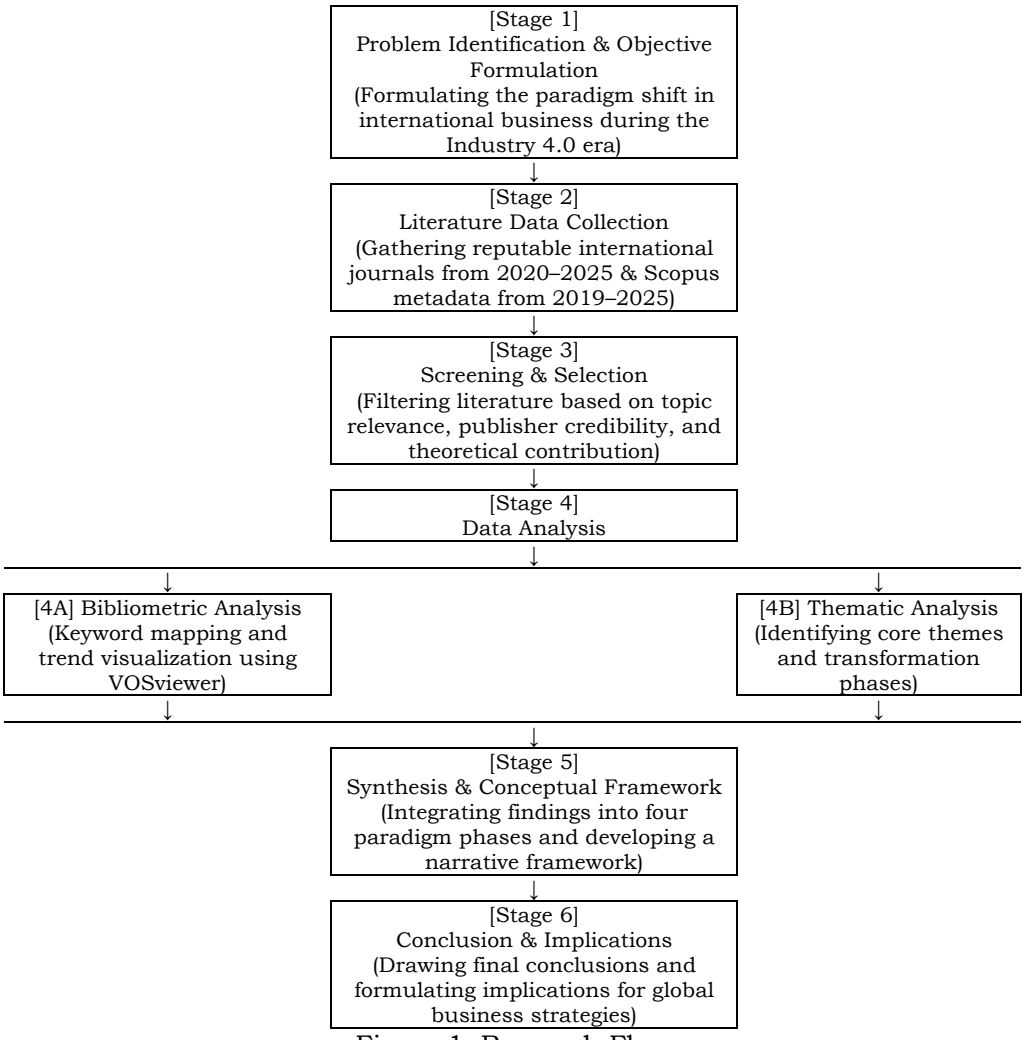


Figure 1. Research Flow

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Overall, the literature indicates that Industry 4.0 does not produce uniform outcomes in international business; its effects depend on the interaction between digital opportunities, organizational capabilities, and institutional contexts. Although digital platforms can accelerate foreign-market access, they do not eliminate the need for experiential learning, local market knowledge, and institutional legitimacy (Coviello et al., 2022; Feliciano-Cestero et al., 2023; Yang et al., 2025). This creates a theoretical tension between the speed of digital internationalization and the gradual learning emphasized in traditional internationalization perspectives. Technology adoption findings are mixed: early adopters may face higher implementation costs, whereas later adopters may benefit from more mature solutions (Antony et al., 2023). Moreover, technological integration can improve productivity and supply-chain coordination, yet skills shortages and limited organizational readiness may prevent firms from realizing these benefits (Zheng et al., 2023; Zahoor et al., 2023). These effects are context-dependent: firms in digitally advanced economies may access stronger infrastructure and institutional support than firms in developing economies, where connectivity, skills, and resources remain uneven. Institutional expectations also differ, as managers may prioritize efficiency while employees and labor representatives emphasize job security, working conditions, and well-being (Fogaça et al., 2024; Monje-Amor, 2024). Cross-country differences in data governance complicate digital operations and data flows (Coche et al., 2024). Unresolved issues concern how digital infrastructure readiness enables dynamic capabilities, how firms balance rapid expansion with local adaptation, and how institutional differences shape the relationship between digital transformation and sustainable international performance. Future research should test these relationships across firm sizes, industries, and national environments.

RESEARCH METHOD

Research Design

This study employed a qualitative research approach combining a Systematic Literature Review (SLR) and bibliometric analysis to examine the changing paradigm of international business in the Industry 4.0 era. The integration of these two approaches was intended to provide both a quantitative overview of the intellectual structure and research trends in the field and a qualitative understanding of the theoretical developments, emerging themes, and unresolved issues in international business. The systematic literature review was conducted to identify, evaluate, and synthesize relevant scholarly publications, while bibliometric analysis was used to map

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the relationships among research topics, keywords, and conceptual developments. The review process was structured according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework to improve transparency and methodological reproducibility.

Data Sources and Search Strategy

The primary bibliometric dataset was obtained from the Scopus database, covering publications from January 2019 to December 2025. Scopus was selected because it provides standardized bibliographic metadata, including publication titles, abstracts, author keywords, affiliations, and citation information, which are required for bibliometric mapping. Additional academic sources, including Google Scholar and relevant national journal portals, were used to identify supporting literature for the qualitative synthesis. However, the bibliometric mapping was restricted to Scopus-indexed publications to maintain consistency in the bibliographic dataset.

The literature search focused on the intersection of international business, Industry 4.0, and digital transformation. The following search string was developed:

TITLE-ABS-KEY

("international business" OR "internationalization" OR "international trade" OR "global business" OR "global value chain")

AND

("Industry 4.0" OR "Fourth Industrial Revolution" OR "digital transformation" OR "digitalization" OR "digital technologies" OR "artificial intelligence" OR "Internet of Things" OR "digital platforms")

The search was limited to publications published between 2019 and 2025. The search strategy was designed to capture studies addressing technological developments, internationalization strategies, organizational capabilities, global supply chains, and institutional challenges associated with digital transformation.

Inclusion and Exclusion Criteria

To ensure the relevance and quality of the selected literature, explicit inclusion and exclusion criteria were applied.

The inclusion criteria comprised: (1) publications addressing international business, internationalization, or global business activities in relation to Industry 4.0 or digital transformation; (2) peer-reviewed journal articles and relevant scholarly review papers; (3) publications written in English; (4) studies published between 2019 and 2025 for the bibliometric dataset; and (5) studies providing relevant theoretical, empirical, or conceptual contributions to understanding digital transformation and international business.

The exclusion criteria comprised: (1) duplicate publications; (2) conference abstracts, editorials, book reviews, and non-

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scholarly materials; (3) publications without accessible titles, abstracts, or sufficient bibliographic information; (4) studies focusing exclusively on technical engineering applications without an identifiable relationship to international business; and (5) publications outside the specified period.

Screening and Selection Process

The literature selection process consisted of four stages. First, records were identified through database searches using the predefined search string. Second, duplicate records were removed. Third, titles and abstracts were screened to assess their relevance to the research objectives. Finally, the full texts of potentially eligible publications were assessed against the inclusion and exclusion criteria.

The number of records identified, duplicates removed, records screened, full-text articles assessed, and studies retained for the final analysis was documented using a PRISMA flow diagram. The bibliometric dataset and the qualitative literature corpus were recorded separately because the latter could also include relevant theoretical publications identified through supplementary academic searches.

Bibliometric Analysis

Bibliometric analysis was conducted using VOSviewer software to identify the intellectual structure and thematic relationships within international business research during the Industry4.0 era. The analysis focused on keyword co-occurrence and network visualization to identify dominant research themes, conceptual relationships, and emerging research directions.

The bibliometric analysis involved the following parameters:

1. Unit of analysis: Author keywords and keywords extracted from publication records, where available.
2. Type of analysis: Co-occurrence analysis.
3. Counting method: Full counting.
4. Normalization method: Association strength.
5. Visualization: Network visualization and overlay visualization.
6. Minimum keyword occurrence: Three occurrences, subject to verification against the final dataset.
7. Data cleaning: Synonymous keywords and variations in terminology were standardized before generating the final network.

The VOSviewer thesaurus file was used, where necessary, to consolidate equivalent terms and improve keyword consistency. The resulting network was interpreted based on the frequency of keyword occurrences, link strength, and cluster relationships. These parameters enabled the identification of major thematic concentrations and the connections between technological, organizational, institutional, and

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sustainability-related dimensions of international business.

Qualitative Thematic Synthesis

Following the bibliometric mapping, a qualitative thematic synthesis was conducted to interpret the substantive meaning of the identified research clusters. The selected literature was analyzed through an iterative process involving familiarization with the studies, coding of relevant findings, categorization of recurring concepts, comparison of theoretical perspectives, and synthesis of emerging themes.

Particular attention was given to four interconnected dimensions: (1) digital internationalization and global market expansion; (2) dynamic capabilities and organizational adaptation; (3) digital transformation and business model innovation; and (4) institutional conditions, human resource readiness, and sustainability.

The synthesis also examined differences in empirical contexts, organizational characteristics, and institutional environments to identify contradictory findings and unresolved theoretical tensions. Finally, the bibliometric results and qualitative insights were integrated to develop a conceptual framework explaining how digital infrastructure readiness, technological capabilities, organizational adaptation, and institutional conditions jointly shape international business competitiveness in the Industry 4.0 era

RESULTS AND DISCUSSION

Bibliometric Analysis for International Business from 2019-2025

Based on the Figure 2, we can define the network visualization of the VOSviewer software projecting the most dominant co-occurrence of keywords in international business literature from 2019 to 2025. This bibliometric map validates the paradigm shift that occurred during the Industrial Revolution 4.0, where the nodes formed representation intertwined research focuses and conceptual trends.

The analysis of this visualization can be grouped into three main thematic clusters that align with the phases of international business transformation:

1. Fundamental Clusters of the Global Ecosystem (Core Nodes)

   The keywords "international business" and "international trade" appear as the largest central nodes, surrounded by "foreign direct investment" and "competition." This configuration emphasizes that the fundamentals of market expansion and cross-border investment remain the primary foundation. The thick connecting lines between these nodes represent the initial global competitive landscape (Phase 1), where operational efficiency and market dominance through international trade

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are the primary drivers before digitalization is fully integrated.

2. Sustainability Convergence Cluster (Sustainability & Development)

   The emergence of a giant hub of "sustainable development" and "sustainability" strongly linked to international business marked a crucial philosophical shift. The literature of this period no longer viewed global expansion solely through the lens of capitalist profitability. This integration of sustainability issues validated the shift toward organizational maturity (Phase 2), where the adoption of Industry 4.0 technologies is mandated to align with green manufacturing practices, energy efficiency, and environmental responsibility to meet the demands of global stakeholders.

3. Techno-Social Cluster and Human Resource Transformation

   The network connecting "artificial intelligence," "human resource management," and "students" to the center of international business is a finding that is very much in line with the socio-institutional dimension (Phase 3 and Phase 4). The "artificial intelligence" node represents "systemic intelligence" and catalytic technology that disrupts traditional operational models. The strong pull towards "human resource management" and "students" (representing the new generation of talent/Gen Z) proves that the main challenges of international business in the 4.0 era are not just software or hardware issues, but rather the availability of digital competencies, adapting to a hybrid work culture, and negotiating workers' psychological well-being amidst automation.

   Overall, the VOSviewer network topology traces the evolution of international business from 2019 to 2025. The focus is shifting from mere cross-border transactions to an economic ecosystem that combines technological sophistication (artificial intelligence) with moral imperatives (sustainable development), and places human resource management as the key driver of successful digital transformation on the global stage.

Changes in International Business Strategy

Literature reviews show that multinational companies are increasingly relying on digital technology as a core component of their international strategies. Digitalization enables companies to coordinate globally more effectively, reduce transaction costs, and accelerate decision-making (Gereffi, 2020). Autio et al. (2021) found that the use of big data and artificial intelligence helps companies understand consumer preferences across countries and adapt

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global marketing strategies more precisely.

Impact on Global Supply Chains

Digital transformation is also having a significant impact on international supply chain management. The implementation of IoT and cloud-based systems increases the transparency and visibility of global supply chains, enabling companies to respond more quickly to disruptions (Ivanov & Dolgui, 2020). In the context of international business, digital supply chains are a crucial factor in maintaining global competitiveness, especially in times of economic and geopolitical uncertainty.

Human Resources and Regulatory Challenges

While offering many opportunities, digital transformation also presents serious challenges, particularly regarding human resource readiness. The digital skills gap is a major obstacle for companies in developing countries in leveraging Industry 4.0 technologies (World Economic Forum, 2023). Furthermore, differences in digital and data protection regulations across countries create complexities in international business operations. Companies are required to adapt their strategies to varying legal frameworks (Hill & Hult, 2023).

Synthesis of Literature Related to International Business in the Era of Industry 4.0

To strengthen the qualitative analysis, this study presents a synthesis of primary literature relevant to the topic of international business in the Industrial Revolution 4.0 era. This synthesis aims to identify the research focus, methods used, and key findings from each study, revealing common patterns, differing perspectives, and remaining research gaps. Based on the synthesis table 1, it can be concluded that most studies emphasize the central role of digital technology as a key driver of change in international business strategies and models. However, there is still relatively limited qualitative research that in-depth examines the implications of digital transformation on strategic decision-making in developing countries. This opens up opportunities for further, more contextual research.

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Table 1. Synthesis of Literature Related to International Business in the Era of Industry 4.0

No	Author & Year	Research Focus	Method	Key Findings
1	Schwab (2020)	The concept of Industry 4.0 and its impact on the global economy	Conceptual	Industry 4.0 is transforming the global business structure through digitalization and automation across sectors.
2	Autio et al. (2021)	Digital affordances and the global entrepreneurial ecosystem	Qualitative	Digital technologies accelerate internationalization and business model innovation
3	Vial (2021)	Digital transformation in organizations	Literature review	Digital transformation requires changes in organizational strategy, culture, and capabilities.
4	Coviello et al. (2022)	Digital internationalization	Conceptual	Digitalization is transforming traditional internationalization stages into faster and more flexible ones.
5	Hill & Hult (2023)	International business strategy in the digital era	Case & conceptual studies	Global competitive advantage is determined by digital capabilities and cross-cultural adaptation.
6	World Economic Forum (2023)	The impact of digitalization on the global workforce	Global report	The digital skills gap is a major challenge in international business

Source: data processed by researchers



source: data processed by researchers

Figure 2. Vos Viewer Output for Articles 2019 – 2025

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Conceptual Framework of International Business Narrative in the Era of Industrial Revolution 4.0

The conceptual framework in this study is narratively structured to explain the relationships between key concepts that shape the dynamics of international business in the Industrial Revolution 4.0 era. This framework was developed based on a synthesis of the latest literature validated by bibliometric mapping (2019–2025), and serves as an analytical foundation in understanding the shifting global business paradigm. At the initial level, macroeconomic foundations such as international trade and foreign direct investment remain the core of the ecosystem. However, the Fourth Industrial Revolution (Industrial Revolution 4.0) has emerged as a major disruptive factor (driving force), characterized by the penetration of advanced technologies, with artificial intelligence (AI), the Internet of Things, and digital platforms acting as key catalysts (Schwab, 2020; Vial, 2021). These technologies create a dynamic, connected, and data-driven business environment.

Furthermore, this technological intervention is forcing the digital transformation of organizations. This transformation is not merely operational digitization, but rather a strategic reengineering that alters internationalization models, market selection, and the configuration of global value chains (Autio et al., 2021; Coviello et al., 2022). International business strategies no longer rely solely on physical presence (assets) but rather on cross-border digital capabilities. Beyond simply pursuing profitability and efficiency, this framework highlights a paradigm shift toward sustainability. In line with the strong emergence of the concept of sustainable development in the bibliometric cluster, digital transformation in the 4.0 era requires companies to align their technological innovations with environmentally conscious and socially responsible business practices.

However, the relationship between digital transformation, sustainability, and global business strategy is strongly moderated by socio-institutional factors, particularly human resource management. The successful integration of artificial intelligence (AI) globally depends heavily on the readiness of human resource capabilities, adapting work cultures to accommodate the next generation of talent (students/Gen Z), and the organization's ability to navigate regulatory differences across countries (Hill & Hult, 2023). Ultimately, the synergy between technological readiness, commitment to sustainable development, and adaptive HR management is what leads to a true increase in company performance and global competitiveness in the 4.0 era. Ultimately, the interaction between Industry 4.0 technology, digital transformation, and international business strategy will lead to a company's global performance and

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competitiveness, which is reflected in increased operational efficiency, product and service innovation, and business sustainability in the international market. This conceptual framework emphasizes that the success of international business in the 4.0 era is the result of a synergy between technological, managerial, and contextual factors.

This narrative conceptual framework can be used as a basis for developing future empirical research models, both through advanced qualitative approaches and quantitative testing, particularly in the context of developing countries.

Theoretical Contributions: Toward an Integrated International Business 4.0 Framework

This study advances international business literature by integrating internationalization, dynamic capabilities, digital transformation, and institutional perspectives into an integrated Industry 4.0 framework. Recent studies demonstrate that digitalization increasingly reshapes organizational structures, international market expansion, and cross-border business activities (Feliciano-Cestero et al., 2023; Yang et al., 2025). Rather than viewing technology as an isolated driver, this study conceptualizes Industry 4.0 as a multidimensional transformation in which digital readiness, organizational capabilities, and institutional environments jointly influence international competitiveness.

First, extending the internationalization perspective through digital connectivity. Traditional internationalization emphasizes experiential learning, incremental resource commitment, and foreign market knowledge. However, digital platforms, artificial intelligence, and data-driven business models enable firms to access international markets more rapidly without necessarily establishing substantial physical presence. Feliciano-Cestero et al. (2023) highlight the influence of digital transformation on firm internationalization, while Yang et al. (2025) identify the need for broader theoretical integration in understanding digital firms' international expansion. This study argues that digital internationalization does not replace conventional mechanisms but complements experiential learning and market commitment through digital connectivity, platform networks, and data-driven knowledge. Consequently, international expansion increasingly depends on firms' ability to combine digital opportunities with market-specific knowledge and institutional legitimacy.

Second, advancing dynamic capabilities through organizational adaptation. Technology adoption does not automatically generate sustainable competitive advantage. Firms must develop capabilities to sense opportunities, seize them through strategic investments, and transform organizational

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resources to respond to changing international environments. Brock and Hitt (2024) emphasize the multidimensional nature of dynamic capabilities in international firms. Similarly, Li et al. (2022) demonstrate that digitalization capabilities enhance firm performance through market-capitalizing and operational-adjustment agility. Building on these findings, this study positions dynamic capabilities as the organizational mechanism that converts digital investments into adaptive responses, operational improvements, and international competitiveness. Differences in managerial competencies, organizational learning, and resource reconfiguration therefore help explain variations in firms' international performance.

Third, extending digital transformation through digital infrastructure readiness. This study emphasizes digital infrastructure readiness as a foundational enabler of cross-border business process integration. Effective digital transformation requires reliable connectivity, interoperable information systems, integrated data management, and cybersecurity arrangements, rather than technology adoption alone. Hodapp and Hanelt (2022) identify interoperability as an essential condition for digital innovation and information exchange. Accordingly, digital infrastructure readiness facilitates cross-border transactions, supply chain visibility, operational coordination, and real-time decision-making. This perspective highlights the importance of infrastructure readiness in translating technological investments into operational value, particularly in developing economies experiencing digital infrastructure disparities.

Fourth, integrating institutional theory into digital internationalization. International business transformation is also influenced by differences in national regulations, data governance, cybersecurity standards, and digital trade policies. Coche et al. (2024) demonstrate that cross-country data governance differences create regulatory complexities for multinational enterprises, particularly concerning data transfers, storage, and international data flows. This study therefore emphasizes institutional alignment as a complementary dimension of organizational digital capabilities. Firms must reconcile their digital strategies with diverse national regulatory requirements to maintain cross-border operational integration and competitiveness.

Research Gaps and Study Novelty

Despite the growing literature on Industry 4.0 and international business, important theoretical gaps remain. First, digital technologies and platforms are increasingly recognized as enablers of faster foreign market access; however, their relationship with the organizational capabilities required to sustain international expansion remains

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fragmented. Reviews show that digital transformation can both facilitate and constrain internationalization, depending on firm-level resources and contextual conditions (Feliciano-Cestero et al., 2023). Recent work identifies digital firms' internationalization as a fragmented research domain requiring integration across drivers, strategies, outcomes, and contexts (Yang et al., 2025). Digital connectivity should therefore be examined alongside experiential learning, market knowledge, and foreign-market legitimacy.

Second, dynamic capabilities research explains how firms sense opportunities, seize them, and reconfigure resources, yet the enabling role of digital infrastructure in cross-border operations requires further investigation. Evidence indicates that digitalization capabilities improve performance through market-capitalizing and operational-adjustment agility rather than technology adoption alone (Li et al., 2022). In international contexts, dynamic capabilities comprise multiple interrelated capability types whose conceptual boundaries and effects require clarification (Brock & Hitt, 2024). Reliable connectivity, interoperable systems, and integrated data warrant attention as conditions supporting organizational adaptation and process integration (Hodapp & Hanelt, 2022).

Third, the interaction between firms' digital capabilities and national institutional environments remains underdeveloped. Differences in data-use rules, cross-border transfers, storage requirements, and data flows create complex regulatory conditions for multinational enterprises (Coche et al., 2024). Digital internationalization therefore cannot be explained solely through firm-level technological readiness.

CONCLUSION

Based on the qualitative analysis and literature mapping that has been carried out, this study produces conclusions that comprehensively describe the metamorphosis of international business in the era of the Industrial Revolution 4.0: First we can see that the Transformation of the Foundation of Global Expansion: Digital technologies such as artificial intelligence, big data, and global platforms have shifted the focus of cross-border expansion. International trade and investment are now facilitated by digital capabilities and data connectivity, drastically lowering geographic barriers to entry and accelerating the internationalization process. Two facts uncovered in this study are: Systemic Intelligence as a Strategic Bridge. Digital transformation is emerging as a central mechanism. Companies that integrate AI into their management structures and platform business models are proven to have superior competitiveness and flexibility compared to conventional operational

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models. The third understanding of Sustainability Convergence (SustainabilityThe paradigm of international business success has shifted. The industry 4.0 ecosystem no longer only demands operational efficiency, but also requires companies to adopt the principles of sustainable development. Competitive advantage today is born from the integration of intelligent technology with sustainable business practices. Fourth knowledge about the Dominance of Socio-Institutional and Human Resource Factors: The success of technology adoption is highly dependent on human resource managementTalent readiness (including the younger generation/Gen Z), managerial capacity, worker welfare, and adaptation to cross-border institutional regulations have proven to be absolute prerequisites, not merely supporting factors. Fifth, there is an understanding of the Need for Re-theorization of International Business: Theoretically, the variables of intelligent technology, economic sustainability, and human resource dynamics must be elevated to become central strategic variables in the scientific literature of international business in the future. Overall, digitalization no longer functions as an operational tool but has metamorphosed into the backbone of an open, inclusive, and sustainable global ecosystem, heavily reliant on collaboration between machine and human intelligence. Thus, this research enriches the conceptual understanding of international business in the digital era while also opening up opportunities for further empirical research.

This study examines the changing paradigm of international business in the Industrial Revolution 4.0 era through a qualitative approach based on systematic literature review. The results show that developments in digital technologies such as artificial intelligence, the Internet of Things, big data analytics, and global digital platforms have fundamentally changed the way companies conduct business across borders. Digitalization is no longer merely a supporting tool but has become a key strategic element in the process of internationalization, business model innovation, and the creation of global competitive advantage. The study's findings confirm that digital transformation is driving companies to adopt more flexible, agile, and data-driven international business strategies. Companies are able to expand their international market reach without relying solely on a physical presence, and increase the efficiency and visibility of their global supply chains. However, the success of implementing Industry 4.0-based international business is heavily influenced by human resource readiness, managerial capabilities, and the organization's ability to adapt to differences in regulations and institutional contexts across countries.

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Theoretically, this research enriches international business studies by integrating digital transformation and Industry 4.0 perspectives into global strategy analysis. Practically, the results emphasize the importance of a holistic approach that combines technological, management, and environmental contexts in formulating sustainable international business strategies in the digital era.

RESEARCH IMPLICATION

Based on the results and conclusions of this research, several implications are proposed. First, international business practitioners should make digital transformation an integral part of global business strategy. Investments in digital technologies need to be balanced with the development of human resource competencies, particularly digital skills, data analysis, and cross-cultural management, to ensure that Industry 4.0 adoption generates strategic value. Digital transformation should also support sustainable development. In addition to investing in artificial intelligence and cross-border platforms, top management should adapt human resource strategies to accommodate workforce flexibility and the digital competencies of younger employees. Firms should also strengthen digital infrastructure readiness through reliable connectivity, interoperable information systems, integrated data management, and cybersecurity to streamline business processes and improve cross-border coordination.

Second, policymakers should promote greater harmonization of cross-border regulations concerning digital trade, data protection, and cybersecurity. Adaptive and collaborative policies can create a conducive international business environment and strengthen corporate competitiveness. Regulatory coordination should also address cross-border data flows, green industry standards, and protections for employees in hybrid work arrangements, thereby supporting a fair and predictable business environment.

Third, future researchers should empirically examine the conceptual framework developed in this study using qualitative, quantitative, or mixed-method approaches. Studies in developing economies and specific industrial sectors would provide context-sensitive insights into international business transformation. Future research should specifically investigate digital infrastructure readiness, digital leadership, dynamic capabilities, digital human capital, institutional quality, and digital supply chain integration. Researchers could also test how AI adoption, managerial capabilities, and younger-generation workforce competencies jointly influence sustainable international business performance across different national and organizational contexts.

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Researchers should compare firm sizes and institutional settings to identify boundary conditions more precisely.

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