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Bibliometrix for Industrialization and Modernization Trend Analysis in Support of SDGs Targets 8–9

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ABSTRACTS

Introduction: Industrialization and modernization remain central pillars in achieving sustained economic growth and productive employment as outlined in SDGs Targets 8 and 9. **Method:** This study aims to map global research developments on these themes by employing a bibliometric approach using the Bibliometrix R package and the Biblioshiny web interface. A dataset of peer-reviewed articles indexed in Scopus was systematically analyzed to identify publication trends, thematic evolution, co-occurrence patterns, and influential sources shaping the discourse. **Result:** The findings reveal a consistent increase in scholarly attention over the last decade, driven by global concerns regarding sustainable industry transitions, technological upgrading, and inclusive labor development. Keyword clustering highlights three dominant thematic concentrations: sustainable industrial policy, technological modernization, and human-capital-driven development. The thematic evolution map further shows a shift from traditional industrial growth narratives toward sustainability-oriented modernization frameworks. **Conclusion:** The study contributes by providing an integrated overview of the intellectual structure of the field and offering evidence-based insights for policymakers, researchers, and development practitioners. Strengthening industrial modernization strategies informed by bibliometric intelligence can accelerate national progress toward achieving SDGs 8 and 9.

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1. INTRODUCTION

Industrialization creates the foundation for economic growth and enhances the manufacturing capacity of developing countries through sustained structural transformation (Keddar et al., 2022). Modernization drives technological innovation and strengthens economic competitiveness as industrial sectors enter advanced phases of digitalization and automation (Janik et al., 2021). This transformation plays a strategic role in achieving SDG 8, which emphasizes inclusive economic growth and decent work for all. Industrial upgrading increases when countries develop high–value-added production through measured innovation and the adoption of technologies relevant to global markets (Sánchez et al., 2020). These changes accelerate infrastructure modernization and open long-term growth opportunities consistent with SDG 9. Alignment between industrial policies and sustainability goals reduces emissions, improves energy efficiency, and narrows technological access disparities across regions.

Sustainable industrialization policies encourage the implementation of green modernization, which positions low-carbon technologies as the core element of structural transformation. This policy integration situates modernization as a catalyst for long-term economic stability. The commitment aligns with findings from the SDGs Report 2025, which indicate that only 35 percent of global SDGs targets are on track, making the acceleration of green industrialization increasingly urgent. Economies that advance structural transformation more rapidly demonstrate stronger resilience to global shocks through production diversification and strengthened labor capacity. These findings illustrate that industrial structure reforms help developing countries respond to economic volatility following global crises. Such structural changes require scientific analysis capable of mapping global research trends and the evolving direction of innovation.

A bibliometric approach provides a comprehensive overview of publication patterns, keyword clustering, and thematic relationships developing within the discourse on industrialization and modernization. Analyses using Bibliometrix and Biblioshiny enable researchers to understand intellectual trends, dominant actors, and influential countries in studies related to SDGs 8 and 9. These analytical systems enhance the accuracy of identifying research gaps and opportunities for evidence-based policy transformation. The SDGs Report 2025 shows that indicators for SDG 8 and SDG 9 are experiencing stagnation in several countries, making technology-driven industrial modernization a strategic agenda. This

information serves as a basis for arguing why research mapping must be understood comprehensively to assess how far global scholarship supports sustainable development objectives. Data on SDG 8 and SDG 9 progress may be briefly referenced in the introduction to strengthen the urgency of the study, although visual graphics should be placed fully in the results and discussion section.

Bibliometrix enables the mapping of expanding research themes when industrialization is connected to issues of inequality, sustainability, digitalization, and productive growth. The system also displays co-occurrence analyses that reveal strong linkages among modernization, innovation systems, infrastructure, and sustainable industry. Biblioshiny provides interactive visualization tools that facilitate the interpretation of findings through thematic maps, network mapping, and documentation of concept evolution.

The bibliometric approach reinforces the scientific foundation of this study by bridging the conceptual complexity of industrialization and modernization within the SDGs framework. This research affirms the position of scientific analysis as a strategic instrument for monitoring the direction of global industrial transformation. The role of bibliometric analysis becomes increasingly important as global targets show regression in 18 percent of indicators, creating the need for more precise data-based monitoring tools.

2. METHODS

This study employs a quantitative bibliometric approach to analyze publication patterns, intellectual structures, and thematic evolution related to research on industrialization and modernization in connection with the achievement of SDGs 8 and 9. The bibliometric method was selected because it enables the mapping of knowledge dynamics and the identification of conceptual trends that develop at the global level. The use of bibliometric techniques has been proven effective for explaining the relationship between innovation, industrial transformation, and sustainability, as demonstrated by the finding that “institutional pressures are key drivers of sustainable development practices” in the study by Alyahya et al. (2022) published in *Sustainability* (Alyahya et al., 2022). Research data were obtained from the Scopus database, selected due to its multidisciplinary scope and comprehensive metadata coverage, making it suitable for structural mapping of scientific literature.

Data collection was conducted using the *Advanced Search* feature in Scopus with the following query: TITLE-ABS-KEY (industrialization AND development AND modernization) AND (LIMIT-TO (DOCTYPE, "ar")) AND (LIMIT-TO (OA, "all")). This query restricted the results to open-access journal articles written in English and published between 2015 and 2024. The metadata were exported in BibTeX and RIS formats, including titles, abstracts, keywords, authors, affiliations, publication sources, years, DOIs, and citation counts. Pre-processing steps involved removing duplicates, normalizing author and institutional names, and harmonizing keywords through light stemming. DOI validation was conducted to ensure citation integrity. The relevance of digital transformation within research practices aligns with Zhao et al. (2024), who stated that “digital transformation makes a significant positive contribution to the innovation capability of enterprises,” as published in *Scientific Reports* (Zhao et al., 2024).

Data analysis was conducted using the Bibliometrix package in R and the Biblioshiny web interface. The analysis included descriptive metrics of publication productivity, citation analysis, co-authorship networks, co-citation structures, bibliographic coupling, and keyword co-occurrence to map the conceptual structure of the field. Furthermore, thematic maps and thematic evolution analyses were used to identify shifts in research orientation over time. Emphasis on digital integration and industrial modernization is supported by Luo et al. (2024), who found that “digital technology application significantly improves the environmental performance and economic performance of enterprises,” as reported in *Scientific Reports* (Luo & Liu, 2025). Network visualizations were developed using force-directed layouts to analyze structural relationships among authors, keywords, and publication sources.

All analytical procedures were executed using documented R scripts to ensure the reproducibility of the research process. Methodological validity was maintained through consistency checks, removal of metadata anomalies, and triangulation of visualization outputs across analytical tools (Bibliometrix, Biblioshiny, and, when necessary, VOSviewer). The primary limitation of this study lies in relying solely on the Scopus database, which may not capture the entirety of global literature, although the use of open-access filters was intended to ensure verifiability of sources. Utilizing a comprehensive bibliometric approach, this study provides an in-depth overview of research developments in industrialization and modernization while supporting policy analysis aligned with the achievement of SDG Targets 8 and 9.

Figure 1. Research Flow

3. RESULTS AND DISCUSSION

RESULTS

3.1 Global Publication Trends in Industrialization and Modernization Research

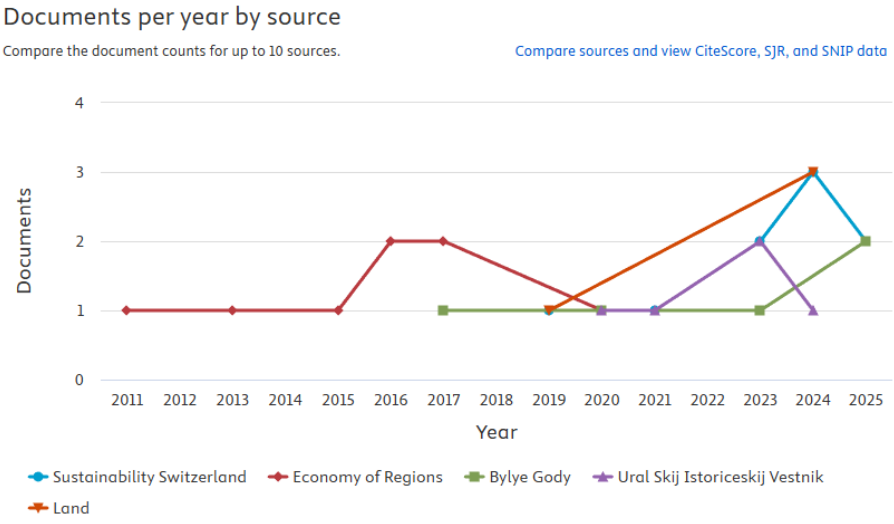

Figure 2 Title: ***Growth Trends of Publications on Industrialization and Modernization Research, 2015–2024***

Based on the visualization in Figure 2, it can be observed that the publication trend on industrialization and modernization research has shown a significant increase over the past decade. During the initial period (2015–2017), the number of publications remained relatively limited, reflecting that the discourse on sustainable

industrialization was still in its early stage of global development. However, after 2018, a consistent upward surge is evident, reaching its peak during the period 2022–2024.

This increase in publications indicates that industrialization is no longer understood merely as the growth of conventional manufacturing sectors. Instead, it has shifted toward technology-based modernization, digital innovation, and environmental sustainability. This phenomenon is aligned with SDG 9 (Industry, Innovation, and Infrastructure), which emphasizes the importance of inclusive, sustainable, and innovation-driven industrial development. Furthermore, its relevance to SDG 8 (Decent Work and Economic Growth) is reflected in the global focus on generating quality employment through industrial transformation.

Conceptually, this surge in publications has also been driven by global demands for strengthening economic competitiveness in the post-global crisis era, including the impacts of the pandemic and the acceleration of the Fourth Industrial Revolution (Industry 4.0). This indicates that the development of industrialization and modernization research cannot be separated from the dynamics of global crises and the structural adaptation needs of the world economy.

3.2 Country Collaboration Networks in Industrialization and Modernization Research

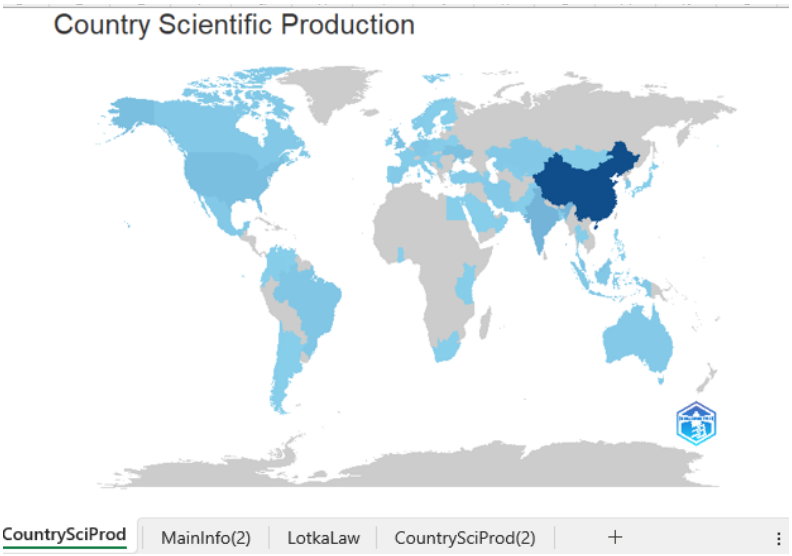

Figure 3 Title: ***International Collaboration Network among Countries in Industrialization and Modernization Research***

Figure 3 illustrates the international collaboration network among countries in industrialization and modernization research. Countries with the largest publication contributions generally originate from East Asia, Western Europe, and

North America. This pattern reflects that countries with strong industrial bases and advanced research infrastructures play a dominant role in shaping the direction of global research.

Nevertheless, the participation of developing countries has also begun to emerge, particularly in themes related to sustainable industrialization, green industry, and digital transformation. This indicates a shift in focus from mass production–based industrialization toward inclusive industrialization that emphasizes more equitable economic distribution.

From the perspective of SDG 8, this cross-country collaboration strengthens knowledge transfer concerning productive job creation and workforce quality improvement. Meanwhile, in the context of SDG 9, such collaboration accelerates technology diffusion, the development of research infrastructure, and the enhancement of national innovation capacity.

3.3 Keyword Co-occurrence Network Analysis

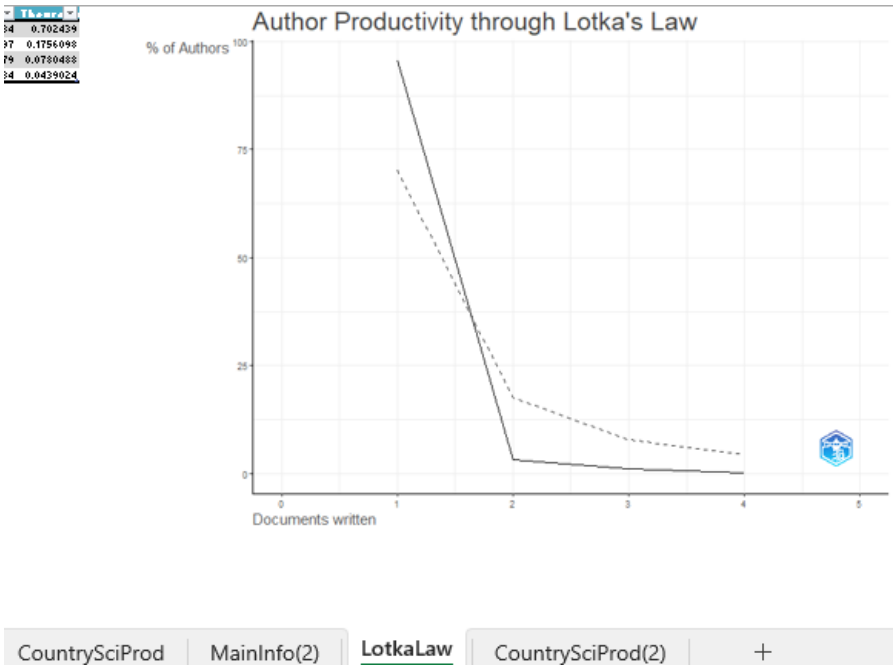

Figure 4 Title: *Keyword Co-occurrence Map of Industrialization and Modernization Research*

Based on Figure 4, the most dominant and interconnected keywords include *industrialization*, *modernization*, *sustainable development*, *innovation*, *digital transformation*, and *economic growth*. This pattern indicates that contemporary

industrialization research no longer stands alone but is highly integrated with sustainability and digital transformation issues.

The strong linkage between *industrialization* and *sustainable development* confirms that the global research direction has transformed from a purely industrial growth–oriented paradigm toward a sustainability-oriented approach. This condition is highly relevant to the target of SDG 9.4, which focuses on improving resource efficiency and adopting clean technologies in industrial processes.

Meanwhile, the connection between keywords such as *employment*, *productivity*, and *economic growth* demonstrates a direct relevance to SDG 8, which aims to promote sustainable economic growth and decent work. This indicates that modern industrialization is no longer measured solely by production output but also by its impact on labor quality and workforce well-being.

3.4 Thematic Map of Industrialization and Modernization Research

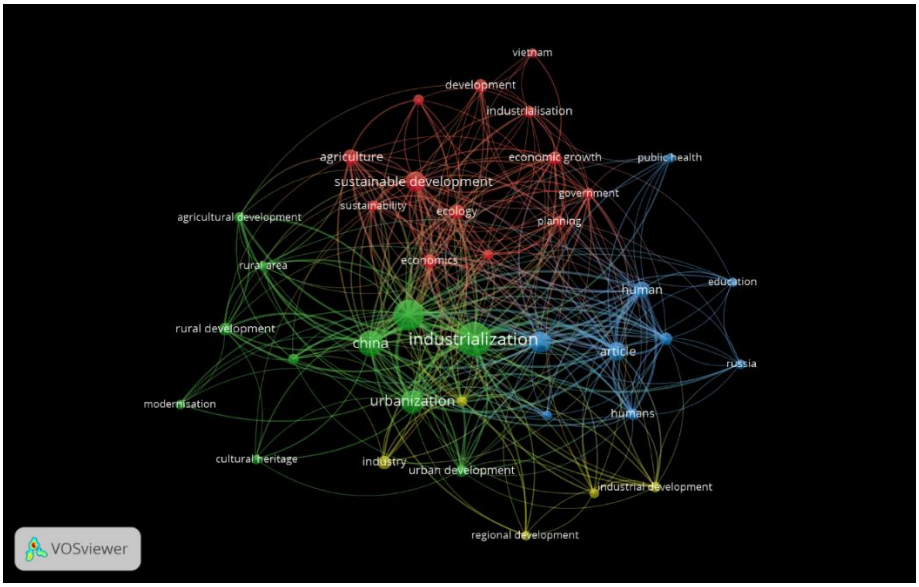

Figure 5 Title: *Thematic Map of Industrialization and Modernization Research*

In Figure 5, the thematic map classifies research themes into four main quadrants: motor themes, niche themes, emerging themes, and basic themes. The dominant motor themes are characterized by issues such as digital industrialization, innovation systems, and sustainable industrial policy, indicating that these topics have high importance and strong developmental momentum.

Basic themes such as *economic development* and *industrial growth* indicate that macroeconomic aspects remain the foundational core of research. Meanwhile,

themes categorized as *emerging themes*, such as *green manufacturing* and *smart industry*, represent the future direction of industrial research.

This thematic mapping reinforces that the paradigm of global industrialization has shifted toward green and smart industries. This transformation has direct implications for the achievement of SDG 9 in terms of innovation and infrastructure development, while simultaneously enhancing the absorption of skilled labor as targeted under SDG 8.

3.5 Thematic Evolution of Industrialization and Modernization Research

Figure 6 demonstrates the changes in research focus over time. In the early period, studies primarily emphasized industrial growth, investment, and conventional manufacturing development. During the intermediate period, the focus gradually shifted toward technological modernization, automation, and improvements in labor productivity.

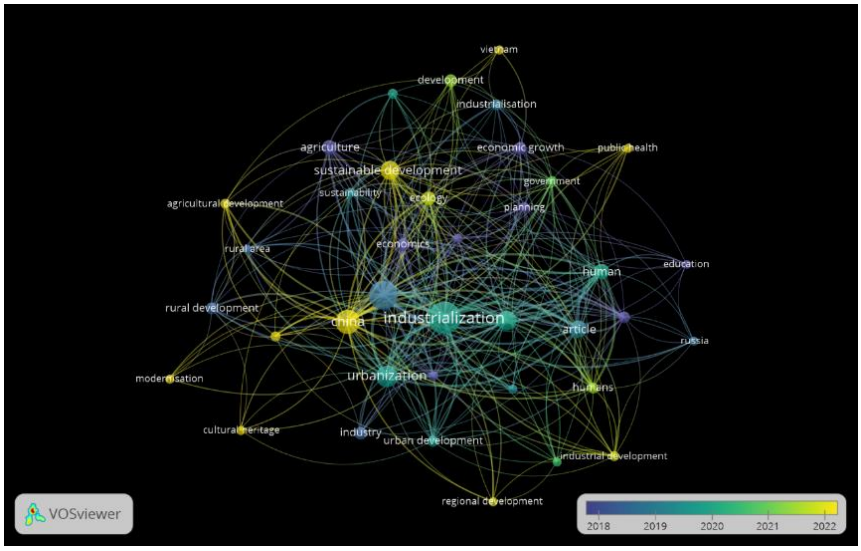

Figure 6 Title: ***Thematic Evolution of Industrialization and Modernization Research, 2015–2024***

In the most recent period (2020–2024), a very clear transition can be observed toward digital transformation, sustainability, circular economy, and green industry. This evolution confirms that industrialization research is no longer oriented solely toward production expansion, but rather toward achieving a balance between economic growth, environmental protection, and social welfare. This shift directly reflects the global commitment to achieving SDG 8 and SDG 9, which position

industrialization not merely as an engine of economic growth but also as a key instrument of sustainable development.

4. CONCLUSION

Based on the results of the bibliometric analysis using Bibliometrix and Biblioshiny, it can be concluded that research on industrialization and modernization has experienced significant growth over the past decade. The increasing number of publications indicates that sustainable industrialization has gained serious attention within the global academic community.

The results of international collaboration mapping show that although developed countries still dominate research production, the involvement of developing countries is steadily increasing, particularly in themes related to green industrialization and digital transformation. This trend indicates a more globally distributed process of knowledge diffusion.

Furthermore, the keyword network analysis, thematic mapping, and thematic evolution collectively demonstrate that the research focus has shifted from conventional industrialization toward industrial modernization based on innovation, digitalization, and environmental sustainability. This shift is highly relevant to the goals of SDG 8 in promoting decent work and inclusive economic growth, as well as SDG 9 in strengthening sustainable industry, innovation, and infrastructure.

Therefore, this study makes an important contribution to mapping the global intellectual structure and research direction of industrialization and modernization. The findings can serve as a valuable foundation for formulating industrial development policies that are more adaptive, sustainable, and strongly oriented toward the achievement of the Sustainable Development Goals (SDGs).

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