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Integrating Innovation, Sustainability, and Industrial Economics for Enhancing Agricultural Supply Chain Performance in Emerging Economies.

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Abstract: This study proposes a comprehensive framework that integrates innovation, sustainability, and industrial economics to improve supply chain performance in the agricultural sector of emerging economies. Using bibliometric and correlation analyses, this research identifies key indicators such as environmental management, circular economy practices, and enterprise resource optimization that shape agricultural systems. Innovation is treated as a moderating factor that links sustainable practices with supply chain outcomes, particularly within agro-industrial contexts. The findings underscore the synergy between sustainability and innovation in strengthening agricultural supply chains, contributing to food security, economic competitiveness, and resilience in emerging markets. This framework offers practical insights for agricultural policymakers, agri-tech developers, and agro-industry stakeholders working toward sustainable agrotechnology transformation.

Keywords: Emerging Economies, Agricultural Supply Chain, Industrial Economics, Sustainable Development, Innovation, Environmental Management, Agrotechnology, Circular Economy, Agroindustry.

INTRODUCTION

Background

The agricultural sector in emerging economies plays a critical role in national development, food security, and employment [1], [2], [3]. However, it faces persistent challenges such as inefficiencies in supply chains, limited technological adoption, and sustainability concerns. As agriculture becomes increasingly industrialized, especially in agro-processing and distribution, it is essential to understand how industrial economics, innovation, and sustainability practices can be leveraged to improve agricultural supply chain performance [4], [5], [6], [7]. This study aims to explore these interrelationships within the framework of applied agrotechnology, with a focus on emerging economies where institutional and infrastructural constraints are most pronounced. These economies, characterized by their dynamic industrial landscapes and evolving markets, face a dual challenge: achieving sustainable development while fostering competitiveness through innovation and efficiency [8], [9], [10]. The interplay between these elements forms the foundation of modern industrial and economic studies. Understanding how policy drivers, such as industrial economics, innovation, and supply chain management (SCM) [11], [12], [13], [14], contribute to sustainability and performance is critical for addressing global challenges and promoting inclusive growth.

The global focus on sustainability has heightened the need for industries to align economic objectives with environmental and social goals. Concepts such as the

circular economy, technological development, and environmental management [15], [16] have gained prominence as key drivers of industrial transformation. Meanwhile, innovation has emerged as a moderating force that bridges the gap between sustainable practices and operational efficiency, enabling industries to adapt to rapid technological advancements and shifting market demands. Despite these developments, the integration of these themes in the context of emerging economies remains underexplored, highlighting the need for a comprehensive framework to analyze their interactions.

Problem Statement

While significant research has been conducted on sustainability, innovation, and industrial economics, gaps remain in understanding their interconnected roles in the unique context of emerging economies. These economies exhibit distinct structural challenges, including limited resources, institutional constraints, and market volatility, which can hinder the effective implementation of sustainable and innovative practices. Furthermore, the role of supply chain management in operationalizing sustainability and innovation remains under-researched. A cohesive framework that integrates these themes is essential to address these challenges and provide actionable insights for policymakers, researchers, and practitioners.

Research Objectives

This study aims to develop a comprehensive framework that examines the relationships between industrial economics, innovation, sustainable development, and SCM performance within emerging economies. The specific objectives are as follows:

1) To explore the role of industrial economics as a policy driver influencing sustainable development and innovation.
2) To analyze the moderating effect of innovation on the relationship between sustainability and SCM performance.
3) To identify key indicators that facilitate the integration of sustainability, innovation, and SCM practices.
4) To provide actionable insights and recommendations for improving industrial systems in emerging economies.

Research Significance

This study offers both theoretical and practical contributions. Theoretically, it integrates clustering analysis, co-occurrence network mapping, and correlation testing to provide a multidimensional perspective on industrial and economic systems. The findings advance the understanding of how sustainability and innovation intersect within the context of emerging economies. Practically, the research provides policymakers and practitioners with a robust framework to design strategies that enhance industrial performance, competitiveness, and sustainability. By addressing key gaps in the literature, this study contributes to the broader discourse on sustainable industrial development and economic transformation.

Scope and Limitations

The study is focused on emerging economies, which serve as the primary research context. The analysis relies on a dataset of 52 rigorously selected articles, providing a foundational yet limited perspective. While the framework emphasizes the interplay between industrial economics, innovation, sustainability, and SCM, sociopolitical and cultural factors are not explicitly addressed. Future research is recommended to expand the dataset and explore these additional dimensions.

Organization of the Study

This research is organized into five chapters. Chapter 1 introduces the background, problem statement, objectives, significance, scope, and limitations of the study. Chapter 2 reviews the relevant literature, highlighting key themes and gaps. Chapter 3 outlines the research methodology, including data collection, analysis, and framework development. Chapter 4 presents the findings and discusses their implications within the research framework. Finally, Chapter 5 concludes the study with recommendations for future research and practical applications.

METHODOLOGY

Data Collection Procedure

The article selection process, guided by the PRISMA framework, ensured a systematic and rigorous approach to identifying relevant studies. The PRISMA-guided approach guarantees methodological transparency and replicability, reducing bias in article selection [17], [18]. The process is outlined in four stages Table 1.

Table 1. Data Selection and Inclusion Criteria

Data bases selection			Included: Scopus Excluded : Other databases.
Identification		Keyword and syntax search “Industrial Management”	Included: 139,846 documents Excluded : non-related documents from Scopus databases
Screening		Document type: Articles	Included: 65,464 articles Excluded : other document type
		Language: English	Included: 59,760 articles Excluded : non-English articles
		Year of publication: 2014 - 2024	Included: 11,647 articles Excluded : articles before 2020
Eligibility		Title and Abstract Alignment (TAA): Emerging Economies	Included: 52 articles Excluded : articles do not align with our research objectives
Included		A total of 52 articles are included in the analysis.	

Identification:

The initial search, using the keyword "Industrial Management," retr ieved 139,846 documents from the Scopus database. Non-relevant documents, including those from other databases, were excluded. This step established the foundation for narrowing the dataset to articles aligned with the research focus.

Screening:

The retrieved documents were screened using specific inclusion criteria. First, only articles were included, reducing the dataset to 65,464 entries. Next, English-language articles were prioritized to ensure accessibility and consistency, leaving 59,760 entries. Finally, articles published between 2014 and 2024 were retained, further narrowing the dataset to 11,647 entries and ensuring the selected studies were both relevant and recent.

Eligibility:

The final eligibility check involved assessing the title and abstract alignment (TAA) with the research focus on emerging economies. This step refined the dataset to 52 articles by excluding those that did not meet the specific research objectives.

Included:

Ultimately, a total of 52 articles were included in the analysis. This concise dataset reflects a targeted selection, ensuring that the studies are directly relevant to the research questions.

By progressively filtering documents through identification, screening, and eligibility criteria, our process ensures that only high-quality, relevant studies

contribute to the analysis. This rigorous selection enhances the credibility of the research and strengthens its conceptual framework by focusing on the most pertinent literature within the field of industrial management and emerging economies.

Data Analysis Method

This research uses several text analysis tools or qualitative data analysis (QDA) software such as NVivo 12 plus, VOSviewer, and Voyant Tools. This research follows the methodology outlined by Tuegeh et al. (2024) [18], which provides a structured framework for transforming qualitative data into quantitative analysis. By employing this guideline, the study ensures a rigorous and systematic approach to data processing, enabling the integration of qualitative insights into a measurable and analyzable quantitative framework. Our analysis begins with the simultaneous analysis utilizing clustering with co-occurrence network analysis of keywords. We argue that clustering provides a more detailed two-dimensional view of a network's structure compared to mapping, although it is limited in depicting multi-dimensional relationships. Clustering is not constrained by dimensional limits but operates on binary dimensions rather than continuous ones. The algorithm involves specific formulas for our calculations, which are as follows:

$$V(C_1, \dots C_n) = \frac{1}{2m} \sum_{i \le j} \delta(C_i, C_j) \omega_{ij} (C_{ij} - \gamma \frac{C_i, C_j}{2m}) \quad \dots (1)$$

where C_i = element cluster i
γ = clustering resolution
m = total number of edges or sum of all edge weights.
$\omega_{ij} = \frac{2m}{C_i} C_j$
Sources: Tuegeh et al. (2024) [18]; Waltman et al. (2010) [19]

The most common tools for further analysis of the partial correlation and significance (p-value) from the text analysis are the person correlation and significance (p-value) based on a t-test. The correlation coefficient measures the strength and direction of a linear relationship between two variables in this research for term 1 and term 2. It is calculated using the Pearson correlation formula as follows:

$$r = \frac{\sum(x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum(x_i - \bar{x})^2 (y_i - \bar{y})^2}} \quad \dots (2)$$

Sources: Tuegeh et al. (2024) [18]; Hetenyi et al. (2019) [20]; Pearson (1895) [21]; Spaska et al. (2021) [22]

where:

- x_i and y_i are the individual sample points of the two variables (in this case, keyword frequencies).
- $\bar{x}$ and y are the means of the variables/keyword frequencies.

Subsequently, to test the significance of the correlation coefficient whether the observed correlation is statistically significant, we use the t-test with the following formula for the test statistic:

$$t = \frac{r\sqrt{n-2}}{\sqrt{1-r^2}} \quad \dots (3)$$

Source: Tuegeh et al. (2024) [18]; Hetenyi et al. (2019) [20]; Snedecor & Cochran [23]; Spaska et al. (2021) [22]

where:

- r^2 is the Pearson correlation coefficient.
- n is the number of paired observations.
- the p-value is then obtained from the t-distribution with $n - 2$ degrees of freedom. This tests the null hypothesis that the true correlation is zero.

Interpretation:

- Correlation (r)**:** Values range from -1 to 1, where values close to 1 or -1 indicate a strong relationship, and values close to 0 indicate a weak relationship.
- Significance (p-value)**:** A low p-value (typically < 0.05) indicates that the correlation is statistically significant.

Data Analysis and Result Interpretation

Descriptive of the Analyzed Articles

This section presents a bibliometric summary of the analyzed articles, covering metrics such as the number of unique authors, journal sources, publishers, article origins, keywords, and the count of single-author articles. The detailed findings are outlined below.

Figure 1. Analyzed Articles Descriptive Result

The metadata analysis provides a detailed overview of the research landscape. A total of 52 articles were analyzed, with 639 unique keywords identified, reflecting a broad thematic diversity. The research spans from 2020 to 2024, highlighting its contemporary relevance and growing interest. The collaboration level is evident, with 184 authors contributing to the articles and only 2 being single-authored, supported by 142 distinct affiliations. The data also indicate contributions from 25 journals and 17 publishers, demonstrating the interdisciplinary nature and diversity of publication platforms. Authors from 38 countries participated, showcasing the global engagement and inclusiveness of the research community. These findings underline the collaborative and international scope of the studies analyzed.

Test for Clustering and Mapping

To perform the simultaneous keyword correlation and analyze the clustering, we utilized Equation (1) with the assistance of software analysis. The co-occurrence threshold was set at 3. Out of the 639 keywords identified, 594 met this threshold, each having at least three links to other keywords, and 40 were selected for further analysis. For the Cirrus data mining process, the stop words were set to automatic, and several abbreviations such as AB, KW, and TI were added to the stop word list. This clustering technique aims to identify research topics that remain underexplored and to examine the connections between keywords published in prior research, ultimately contributing to the development of a robust conceptual research model. The following figures present the results of the co-occurrence keyword analysis and clustering.

Based on the figure 2, we reveal that the red cluster is centered on themes related to emerging economies, emphasizing their development and industrial performance. The keywords such as "innovation," "technological development," and "knowledge management" highlight the importance of fostering innovation and leveraging technology for sustainable

industrial growth [24], [25], [26]. "Institutional theory" and "management practice" underscore the role of organizational structures and strategic practices in driving economic progress in these regions [14], [27], [28]. The inclusion of "industrial development" and "China" suggests a focus on the dynamics of industrialization in developing economies, with China possibly serving as a case study or benchmark for industrial transformation [29], [30], [31], [32]. This cluster reflects a focus on understanding the factors that enable emerging economies to achieve competitive industrial and economic performance.

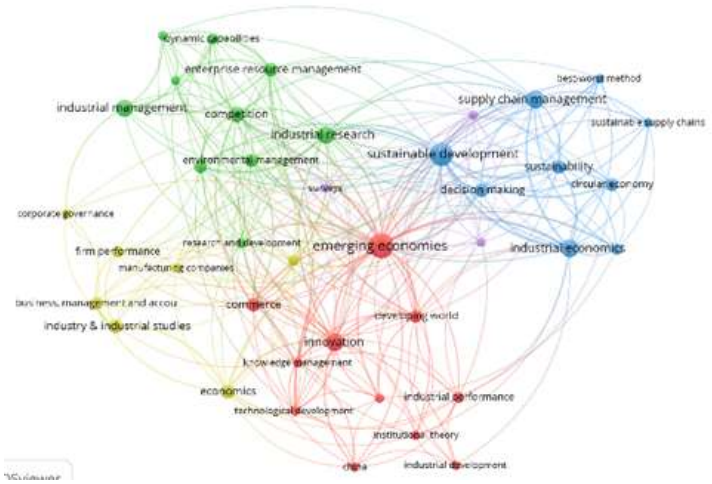

Figure 2a. Keywords Network Visualization

Figure 2b. Keyword Cloud

The blue cluster is closely tied to sustainability and circular economy principles [15], [16], [33], [34], [35], [36], [37], with keywords such as "sustainable development," "sustainable supply chains management," and "circular economy" taking prominence. This cluster reflects an emphasis on integrating sustainability into industrial and economic processes. The presence of "industrial economies" and "decision making" suggests the need for strategic choices that align industrial activities with environmental goals. Techniques like the "best-worst method" point to analytical tools used to prioritize sustainability efforts. Overall, this cluster illustrates the growing importance of aligning industrial practices with global sustainability standards and emphasizes the role of innovative decision-making

frameworks in achieving sustainable supply chain management.

The green cluster is centered on themes related to industrial systems and resource management. Keywords like "industrial research," "industrial management," and "enterprise resource management" reflect the emphasis on optimizing industrial processes and resource utilization [11], [38], [39], [40], [41], [42]. The presence of "environmental management" highlights the integration of ecological considerations into industrial practices, while "research and development" (R&D) and "dynamic capability" underscore the critical role of innovation and adaptive strategies in maintaining competitiveness [8], [15], [24], [40]. This cluster emphasizes the nexus between operational efficiency, environmental responsibility, and dynamic industrial strategies, illustrating a holistic approach to modern industrial management.

The yellow cluster focuses on broader organizational and economic aspects of industrial studies. Keywords such as "industry and industrial studies," "economics," and "business management and accounting" point to the foundational disciplines driving industrial performance analysis [43], [44], [45], [46], [47]. Terms like "firm performance" and "corporate governance" emphasize evaluating business outcomes and decision-making processes [41], [46], [48]. The inclusion of "manufacturing companies" and "manufacturing firms" reflects a focus on the operational and strategic challenges faced by industrial entities. This cluster highlights the interplay between economic theories, governance practices, and performance metrics in understanding and enhancing the manufacturing sector.

The purple cluster revolves around methodological approaches used in industrial and sustainability studies. Keywords like "literature review" and "surveys" indicate the reliance on systematic data collection and synthesis methods to generate insights [11], [16], [49]. The inclusion of "waste management" points to a specific application area where these methodologies are employed to analyze and improve practices [10], [36], [50]. This cluster represents the methodological backbone of industrial research, focusing on generating actionable knowledge through structured and rigorous analysis.

Together, these clusters highlight the intersection of innovation, industrial growth, and sustainability, showcasing the challenges and opportunities for emerging economies in adopting sustainable practices. The clustering analysis highlights the relationships between key research themes, such as "emerging economies" and "sustainable development," which are central to the dataset. These connections align with the table of keywords, occurrences, and total link strength, showcasing the prominence and relevance of these themes in shaping the research landscape.

Table 2 presents the keywords, their occurrences, and total link strength, providing insights into the thematic focus of the research dataset. The top keywords, "emerging economies" (19 occurrences, 103 total link strength) and "sustainable development" (16 occurrences, 77 total link strength), are highly interconnected and central to the research, reflecting the global importance of addressing economic growth in conjunction with sustainability.

"Supply chain management," "industrial economics," and "innovation," each with 10 occurrences, represent critical areas of focus, linking operational practices with economic performance and technological advancements. Keywords such as "decision making" and "sustainability" highlight analytical and environmental priorities, while less frequent terms like "circular economy" and

"Industry 4.0" underline emerging and niche research areas.

This table complements the clustering analysis, illustrating how keywords are distributed and interconnected within the research framework, providing a foundation for building robust conceptual models. It also emphasizes the diverse yet interconnected nature of topics, making them pivotal for future studies

Table 2. Keywords with Their Occurrences and Total Link Strength

Keyword	Occurrences	Total Link Strength
Emerging economies	19	103
Sustainable development	16	77
Innovation	10	50
Industrial economics	10	45
Supply chain management	10	44
Industrial research	9	44
Competition	7	37
Enterprise resource management	7	32
Sustainability	6	31
Decision making	6	31
Developing world	5	30
Commerce	5	28
Environmental management	5	25
Manufacture	4	24
Manufacturing firms	4	22
Technological development	4	22
Economics	4	21
Circular economy	4	20
Dynamic capabilities	4	20
Industry 4.0	4	20

Analysis for Correlation and Significance of Keyword Relationships

Based on Table 2, the proximity of co-occurrence between keywords is evident to ascertain the relationship between these keywords and other terms when combining keywords, titles, and abstracts, the keyword cloud depicted in Figure 3 can be examined. These visualizations allow for the calculation of the correlation of keywords to terms in the titles and abstracts, as demonstrated in following figures.

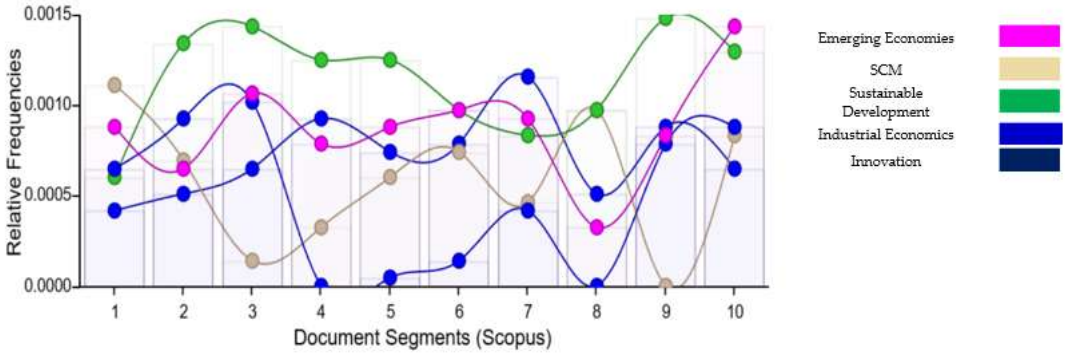

Figure 3. Term Frequency Trends

Referencing Table 2, which provides an overview of keyword occurrences and total link strengths, key research themes such as "Emerging Economies," "Sustainable Development," and "Innovation" emerge as foundational pillars of the study. These themes, alongside "Industrial Economics" and "Supply Chain

Management (SCM)," gain further prominence in the clustering analysis, as highlighted by their significant roles in shaping research trends. The trends reveal evolving research priorities, with sustainable development and SCM gaining prominence, while emerging economies and industrial economics maintain steady contributions. Innovation serves as a consistent bridge across these themes, emphasizing its centrality throughout the dataset.

The relationships presented in Table 2 were derived from Figure 6, which illustrates the relative frequencies of these five major keywords across document segments, mimicking their predictive relevance through a blindfolding technique. The clustering analysis and the connections in Figure 6 informed the development of Table 3, where the interconnections between these five core keywords and their indicators are explored, uncovering their statistical significance and interconnectedness. This integrated approach provides a comprehensive understanding of the dynamics between these themes, their indicators, and their evolving research importance.

Table 3. Correlation and Significance of Keyword Relationships

Term 1	←	→	Term 2	Correlation	Significance
Emerging			Developing	0.7127797	0.020689
Emerging			Commerce	0.9386627	0.000574
Emerging			Economics	0.8524213	0.001213
Emerging			Research	0.7500922	0.012460
Emerging			Capabilities	0.7432995	0.013748
Sustainable			Technological	0.6422161	0.045264
Sustainable			Environmental	0.9773223	0.000001
Sustainable			Circular	0.9229349	0.000140
Sustainable			Sustainability	0.9256113	0.000122
Sustainable			Decision	0.7110485	0.021144
Innovation			R&D	0.7412545	0.015565
Innovation			ERM	0.9585412	0.000001
Innovation			Manufacturing	0.7336954	0.013554
Innovation			Industry 4.0	0.7177471	0.026654
Innovation			Competition	0.9351364	0.000071
Industrial			Business	0.9845221	0.000152
Industrial			Management	0.9254545	0.000131
Industrial			Accounting	0.7184555	0.025252
Industrial			Governance	0.6644353	0.019655
Industrial			Performance	0.7344454	0.005211
Industrial			Manufacture	0.6414422	0.020454
SCM			Logistics	0.6247777	0.025145
SCM			Best-worst	0.6366544	0.022689
SCM			Decision	0.6024555	0.030776
SCM			Management	0.7600212	0.044544
SCM			Manufacture	0.6355571	0.655421

Table 2 highlights key research themes (Term 1) and their associated indicators (Term 2), showcasing significant relationships that underscore the importance of these indicators. For "Emerging Economies," indicators like "Commerce" (0.93, $p < 0.001$) and "Economics" (0.85, $p < 0.01$) reflect the role of trade and financial structures in fostering growth. "Sustainable Development" is strongly supported by indicators such as "Environmental Management" (0.98, $p <$

0.001) and "Circular Economy" (0.92, $p < 0.001$), emphasizing the need for environmentally conscious practices. Similarly, "Innovation" relies on "ERM" (0.95, $p < 0.001$) and "Competition" (0.93, $p < 0.001$) as critical drivers of efficiency and competitiveness. "Industrial Economics" aligns closely with "Business Management" (0.98, $p < 0.001$) as a key indicator, while "SCM" is heavily influenced by "Management" (0.76, $p < 0.01$). These findings illustrate how Term 2 serves as actionable indicators, providing insight into the dynamics and frameworks underpinning each major theme.

DISCUSSION

The clustering analysis identified five major keywords—"Emerging Economies," "Sustainable Development," "Innovation," "Industrial Economics," and "Supply Chain Management (SCM)"—as foundational pillars in the research framework. Table 2 builds on these insights by exploring the relationships between these core themes and their associated indicators, providing a detailed analysis of their interconnectedness and statistical significance.

Emerging Economies emerges as a central theme, with strong correlations to "Commerce" (0.9387, $p < 0.001$) and "Economics" (0.8524, $p < 0.01$), highlighting the importance of trade and financial systems in driving growth within emerging markets [51]. Additionally, its ties to "Research" (0.7501, $p < 0.05$) and "Capabilities" (0.7433, $p < 0.05$) underscore the role of knowledge generation and adaptive abilities in fostering industrial development [8], [52], [53], [54]. This category serves as the foundation of the framework, focusing on economic growth, industrial development, and regional competitiveness. Indicators like the Developing World reflect the contextual backdrop of emerging economies, emphasizing challenges and opportunities in global markets [55]. Commerce and Economics are central to understanding trade systems and financial structures that drive growth [9], [29], [31], [43]. Industrial Research highlights the role of innovation and technological progress in fostering competitiveness, while Dynamic Capabilities underscore the need for adaptability in rapidly changing industrial landscapes. Together, these indicators provide a comprehensive view of the factors influencing emerging economies' development.

Sustainable Development, a key component of the clustering analysis, demonstrates significant connections to "Environmental Management" (0.9773, $p < 0.001$) and "Circular Economy" (0.9229, $p < 0.001$) [15], [16], [36], [37], [56], [57], [58], [59], [60], [61]. These relationships emphasize the integration of sustainability principles into environmental and economic practices. Its links to "Sustainability" (0.9256, $p < 0.001$) and "Technological Development" (0.6422, $p < 0.05$) further highlight the interplay between innovation and sustainable practices in achieving long-term industrial goals. Sustainable development addresses the integration of environmental management into industrial practices. Indicators such as Environmental Management and Circular Economy emphasize the importance of adopting practices that minimize waste and promote resource efficiency [15]. Sustainability serves as a unifying concept, connecting these practices to long-term environmental and social goals. Decision Making reflects the strategic approaches needed to align industrial operations with sustainability principles[42], [62], while Technological Development highlights the role of innovation in achieving these objectives [14], [25]. This category links sustainability goals with practical implementation strategies in industrial systems.

Innovation plays a bridging role, connecting multiple themes and driving efficiency and competitiveness. Table 2

reveals its strong correlations with "ERM" (0.9585, $p < 0.001$) and "Competition" (0.9351, $p < 0.001$), reinforcing its significance in organizational improvement and market dynamics [8], [24]. Moreover, its relationships with "R&D" (0.7413, $p < 0.05$) and "Manufacturing" (0.7337, $p < 0.05$) reflect its influence on technological advancements and production processes [8], [40], [42], [63]. Innovation acts as a moderating variable within the framework, bridging multiple categories and driving technological progress and creativity. Indicators like Research and Development (R&D) represent the foundational efforts to foster new technologies and methods. Enterprise Resource Management (ERM) underscores the optimization of organizational resources for innovation. Manufacturing Firms and Industry 4.0 reflect the application of cutting-edge technologies in industrial processes [8], [16], [29], [40], [63], [64], enhancing productivity and efficiency. Competition serves as a key driver, pushing industries to adopt innovative practices to remain competitive in the market.

Industrial Economics highlights its dependence on institutional and managerial frameworks, with significant ties to "Business Management" (0.9845, $p < 0.001$) and "Accounting" (0.7185, $p < 0.05$) [48], [65], [66], [67]. These connections underscore the importance of governance structures in supporting industrial growth, as further evidenced by its link to "Governance" (0.6644, $p < 0.05$) [41], [43], [48]. Industrial economics focuses on organizational performance and governance within the industrial sector. Indicators such as Business Management and Accounting and Corporate Governance reflect the financial and structural frameworks essential for industrial growth. Firm Performance highlights the outcomes of these frameworks, linking them to productivity and competitiveness. Manufacture emphasizes the operational side of industrial economics, bridging production systems with governance practices. This category connects theoretical economic principles with practical applications in the industrial sector.

Finally, SCM emphasizes operational efficiency, as seen in its strong correlation with "Management" (0.76, $p < 0.01$) [64]. Its moderate connections with "Logistics" (0.6248, $p < 0.05$) and "Best-Worst Method" (0.6367, $p < 0.05$) highlight the reliance on effective decision-making frameworks to optimize supply chain processes [10], [15], [63], [68]. SCM ties the framework together by focusing on operational efficiency and decision-making within industrial systems. As a central pillar, it integrates aspects from other categories, such as innovation and sustainability, into supply chain practices. Indicators such as logistics optimization, resource allocation, and decision-making frameworks (e.g., best-worst methods) highlight SCM's role in ensuring seamless operations across industrial processes. SCM provides the infrastructure needed to connect economic, environmental, and technological dimensions within the industrial framework.

The findings provide a comprehensive understanding of the relationships between the core research themes and their associated indicators. Significant links, such as those between "Sustainable Development" and "Environmental Management" or "Innovation" and "ERM," highlight critical areas of synergy essential for achieving industrial and economic goals. These connections underscore the importance of integrating sustainability and innovation within industrial practices. Conversely, weaker correlations, such as that between "SCM" and "Manufacture" ($p > 0.05$), reveal potential gaps or areas requiring further exploration. Together, the clustering analysis and Table 2 bridge the thematic insights, culminating in the

development of a research framework. This framework, as illustrated in Figure 4, captures the dynamic interplay between innovation, sustainability, industrial economics, and supply chain practices, providing a cohesive structure for further investigation.

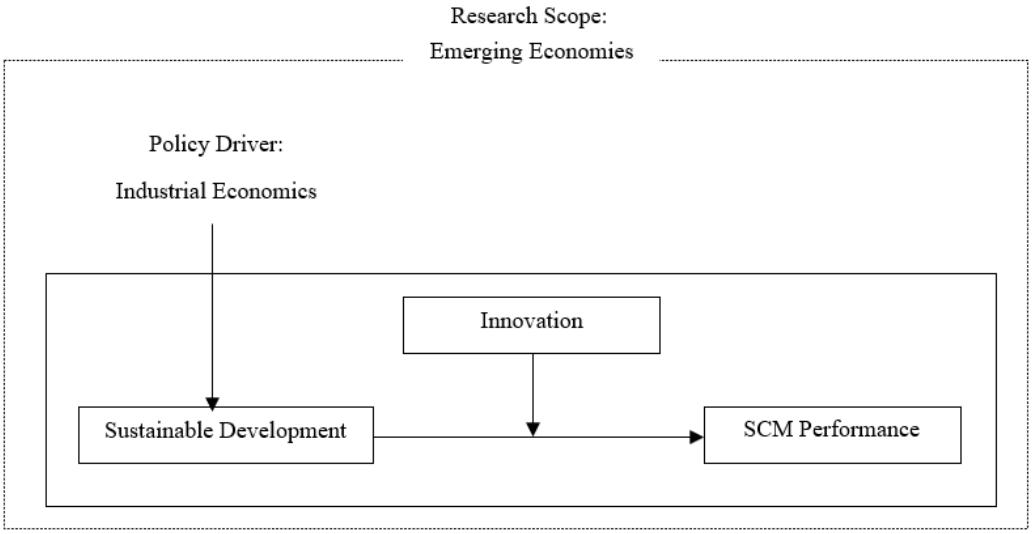

Figure 4. Proposed Research Framework: Exploring the Interplay of Industrial Economics, Innovation, SCM Performance, and Sustainable Development in Emerging Economies

The research framework depicted in Figure 7 provides a structured approach to understanding the dynamics of industrial and economic growth within the context of emerging economies. Emerging economies are essential as regions undergoing rapid industrialization and development. These economies present unique challenges and opportunities, making them critical for exploring the relationships between policy drivers, innovation, sustainability, and supply chain management (SCM) performance. Therefore, the research framework is designed and limited to the scope of emerging economies. Subsequently, Industrial Economics, which serves as the primary policy driver, emphasizes the role of macroeconomic strategies in shaping organizational and market-level practices, influencing both sustainable development and innovation initiatives. The inclusion of industrial economics highlights its function as a driver to promote sustainable development and underscores the need to integrate economic theories and governance practices into actionable industrial policies that foster growth.

Sustainable development is a key component of the framework, representing the need to balance economic growth with environmental and social objectives. It is directly influenced by industrial economics and supported by innovation, reflecting the growing importance of integrating sustainability principles into industrial practices. Sustainable development emphasizes practices such as environmental management and circular economy principles, which are essential for achieving long-term industrial and economic goals.

Innovation acts as the moderating variable within the framework, connecting sustainable development to SCM performance. It drives technological advancements, resource optimization, and process efficiencies, ensuring that industrial practices remain competitive while aligning with sustainability goals. Innovation also facilitates adaptability, enabling emerging economies to respond to global industrial

challenges and maintain competitiveness in international markets.

SCM performance represents the operational outcome of the framework, emphasizing the efficiency and effectiveness of supply chain systems. As a critical component of industrial practices, SCM performance is influenced by sustainable development initiatives and moderated by innovation, demonstrating the integration of environmental and technological considerations into supply chain management. This alignment reflects the interconnectedness of policy, sustainability, and operational efficiency in fostering industrial growth.

CONCLUSION AND RECOMMENDATION

Our research provides a comprehensive framework for understanding the interplay between industrial economics, innovation, sustainable development, and supply chain management (SCM) performance within the context of emerging economies. By contextualizing the framework within the agricultural sector, this study contributes to the field of applied agrotechnology. It provides a strategic model for enhancing agricultural supply chain management through integrated industrial and sustainability approaches. The framework is particularly valuable for agricultural policymakers and practitioners seeking to adopt evidence-based innovations that promote sustainable and resilient agroecosystems in emerging economies.

The findings highlight the pivotal role of industrial economics as a policy driver, influencing sustainable development and innovation. These components act as critical enablers of efficient and sustainable SCM practices, which are essential for economic growth and competitiveness in emerging markets. Innovation emerges as a moderating variable, bridging the components of the framework and emphasizing its importance in fostering technological progress, resource optimization, and adaptability to global industrial challenges. The framework, depicted in Figure 7, integrates these elements cohesively, offering a structured approach to analyzing the complexities of industrial and economic systems in emerging economies. The study underscores the synergies between sustainable practices and technological advancements while identifying areas, such as the weaker correlation between SCM and manufacturing, that require further investigation.

This study's main strength lies in its integration of clustering analysis, co-occurrence network mapping, and correlation testing to develop a robust framework. The multidimensional approach ensures a thorough understanding of the relationships between the key components. Additionally, focusing on emerging economies provides relevant insights into addressing global challenges, such as industrialization, sustainability, and technological advancement. However, there are some limitations. The reliance on keyword co-occurrence and correlation may not fully capture the nuanced interactions between the components. Moreover, the relatively small dataset of 52 articles, though rigorously selected, might limit the generalizability of the findings. The framework also does not explicitly address sociopolitical or cultural factors that could influence the adoption of sustainable and innovative practices.

Future research could expand the dataset to include a broader range of studies, particularly those from diverse regions and industries. Incorporating qualitative data, such as case studies or interviews, could provide deeper insights into sociopolitical dynamics and implementation challenges. Additionally, developing predictive models to assess the long-term impacts of innovation and sustainable practices on

SCM performance would further enhance the practical applicability of the framework. Leveraging real-time data and advanced tools, such as machine learning, could improve analysis and refine the framework to accommodate dynamic industrial environments.

This study offers significant contributions to understanding the dynamics of industrial systems in emerging economies while paving the way for more in-depth and context-specific research. By identifying both the synergies and gaps within the framework, the research lays a solid foundation for future studies aimed at advancing industrial and economic strategies for sustainable growth.

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