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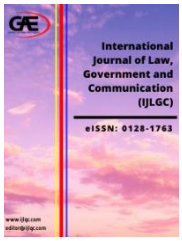

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TWO DECADES OF KPI RESEARCH: A BIBLIOMETRIC MAPPING AND TREND ANALYSIS

Nor Asiah Taib[1*], Izlawanie Muhammad[2], Suhaila Abdul Hamid[3]

[1] Faculty of Economy Muamalat, Universiti Sains Islam Malaysia (USIM) Negeri Sembilan, Malaysia
Email: astaalan6002@raudah.usim.edu.my
[2] Faculty of Economy Muamalat, Universiti Sains Islam Malaysia (USIM) Negeri Sembilan, Malaysia
Email: izlawanie@usim.edu.my
[3] Faculty of Economy Muamalat, Universiti Sains Islam Malaysia (USIM) Negeri Sembilan, Malaysia
Email: suhaila@usim.edu.my
[*] Corresponding Author

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Abstract:

The growing need for transparency, responsibility, and data-driven decision-making has fueled global interest in Key Performance Indicators (KPIs) as key tools for assessing performance across industries. Despite the increasing use of KPIs in business and academia, the extant literature does not provide a thorough overview of their intellectual structure, topic development, or research trends. This study fills the gap by doing a bibliometric analysis of KPIs-related publications over the last two decades, resulting in a systematic map of worldwide scholarly output, collaboration patterns, and conceptual evolution. The dataset was retrieved from the Scopus database and covers the years 2005 to July 2025. A total of 724 documents were detected, cleaned, and standardised using OpenRefine, followed by performance analysis using Scopus Analyser and science mapping with VOSViewer. The analysis looked at publishing trends by year, author, country, and subject area, as well as keyword co-occurrence and international collaboration patterns. The findings show a consistent increase in publication output, with significant contributions from China, the United Kingdom, and the United States. Engineering, computer science, business, and medicine emerged as the most influential disciplines in KPIs research. International collaborative networks were especially prominent in developed economies, demonstrating the global and multidisciplinary importance of KPIs research. This study maps the current state of the KPIs literature and identifies prospects in technology-integrated performance measurement. The findings are an invaluable resource for scholars, practitioners, and policymakers seeking to understand the evolution of KPIs research and propose crucial topics for further exploration.

Keywords:

Key Performance Indicators, KPI, Bibliometric Analysis, VOSviewer, Scopus Database

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Introduction

The study of Key Performance Indicators (KPIs) has received a lot of attention in a variety of sectors because of their importance in performance measurement and management. KPIs are quantitative measurements used by organisations to assess their progress in meeting important business objectives. They are critical instruments for monitoring, measuring, and optimising performance, giving a framework for continuous improvement and strategy alignment (Andonov-Acev et al., 2008; Pekarčíková et al., 2025). The increasing complexity and dynamic character of current business environments necessitate the use of KPIs to ensure that organisations can adapt and thrive in the face of changing circumstances (Ma et al., 2020; Pekarčíková et al., 2025; Zidi et al., 2021). KPIs are fundamental to performance management systems, providing a disciplined strategy to assessing and improving organisational performance. They work in a variety of industries, including as manufacturing, education, healthcare, and supply chain management (Barrett, 2024; Bottani et al., 2023; Kaur et al., 2013; Pekarčíková et al., 2025). In the manufacturing sector, for example, KPIs such as defect rates, yield loss, and productivity measures are used to monitor and improve production processes, resulting in increased operational efficiency and profitability (Li, 2019). Similarly, in the educational sector, KPIs are used to assess the performance of academic personnel and institutions, with a focus on metrics like publication rates and citation indexes to encourage scholarly production and institutional growth (Kaur et al., 2013; Luneva, 2015; Septama et al., 2022).

KPIs are useful for more than just measuring performance; they are also important in strategic decision-making. KPIs help organisations discover areas for improvement, distribute resources more effectively, and connect their operations with strategic goals (Andonov-Acev et al., 2008; Pekarčíková et al., 2025). For example, in the context of supply chain management, KPIs like as reconfigurability and responsiveness are critical for assessing supply chains' ability to adapt with market disruptions and changes (Zidi et al., 2021). This demonstrates the flexibility and importance of KPIs in developing resilience and adaptability in a variety of organisational environments. The landscape of KPIs research is extensive and complicated, with a diverse set of approaches and applications. Bibliometric analysis, a quantitative method for measuring research output, has been useful in tracing the evolution and trends in KPIs research (Domínguez et al., 2019; Herrera-Viedma et al., 2016; Moed, 2009). This method uses statistical analysis of scientific papers to create indicators of research performance, which provides insights into the influence and evolution of KPIs across many domains (Herrera-Viedma et al., 2016; Moed, 2009). For example, a bibliometric study on the food supply chain highlighted major trends and common KPIs related to economic, environmental, and social sustainability, emphasising the growing importance of the triple bottom line in performance assessment (Bottani et al., 2025).

Bibliometric approaches like citation analysis and co-word analysis are frequently utilised to examine the structural and dynamic features of KPIs research. These tools aid in defining study fields, quantifying sub-fields, and visualising the relationships between various research themes (Herrera-Viedma et al., 2016). The combination of bibliometric indicators and other evaluation measures, such as peer reviews, improves the robustness and comprehensiveness of research assessments (Campbell et al., 2010). This technique not only helps to comprehend the existing status of KPIs research, but it also identifies possible topics for further exploration and growth.

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Finally, KPIs are critical in performance management because they provide a systematic strategy to measuring, monitoring, and improving organisational performance. The considerable research on KPIs, as indicated by bibliometric analyses, emphasises their importance across diverse industries, as well as their significance to strategic decision-making and continuous improvement. As organisations manage the challenges of current business contexts, the efficient use of KPIs will remain critical to their success, driving innovation, efficiency, and resilience. The continual examination and development of KPIs through scholarly research will define their use and impact, ensuring their relevance and efficacy in meeting organisational goals.

Figure 1 depicts a conceptual structure for organising the important study subjects in the field of important KPIs research. The central focus of the diagram is KPIs Research divided into three major topic areas: Management Applications, Methodological Developments, and Research Trends. These topical divisions represent the varied character of KPIs studies and demonstrate the diversity of topics that have evolved in academic literature over time. Each theme is then broken down into specific subtopics, providing insights into the changing paths of study and application.

The first theme area, Applications in Management, is on the practical implementation of KPIs in organisational contexts. This covers the creation and implementation of Performance Measurement Systems, which are critical instruments for monitoring efficiency, productivity, and outcomes across business units. Another subtheme, Algorithmic Management, emphasises the increasing reliance on data-driven technology and automated systems to monitor and analyse employee and process performance using real-time metrics. These subtopics focus on how KPIs frameworks are integrated into managerial decision-making processes and operational strategies.

The second theme, Methodological Developments, examines the research approaches and tools used to improve KPIs measurement and interpretation. This comprises Text Mining, which extracts insights from unstructured data to improve performance evaluation, and Quantitative Techniques, which provide statistical and analytical underpinnings for assessing KPIs success.

The final theme, Trends in Research, covers developing directions such as Sustainability Indicators and Digitalisation Trends. These show an increased focus on how KPIs can be used to track environmental, social, and technological transformations. This visual framework organises the various and interconnected strands of KPIs research, providing a platform for methodical analysis and the discovery of future study opportunities.

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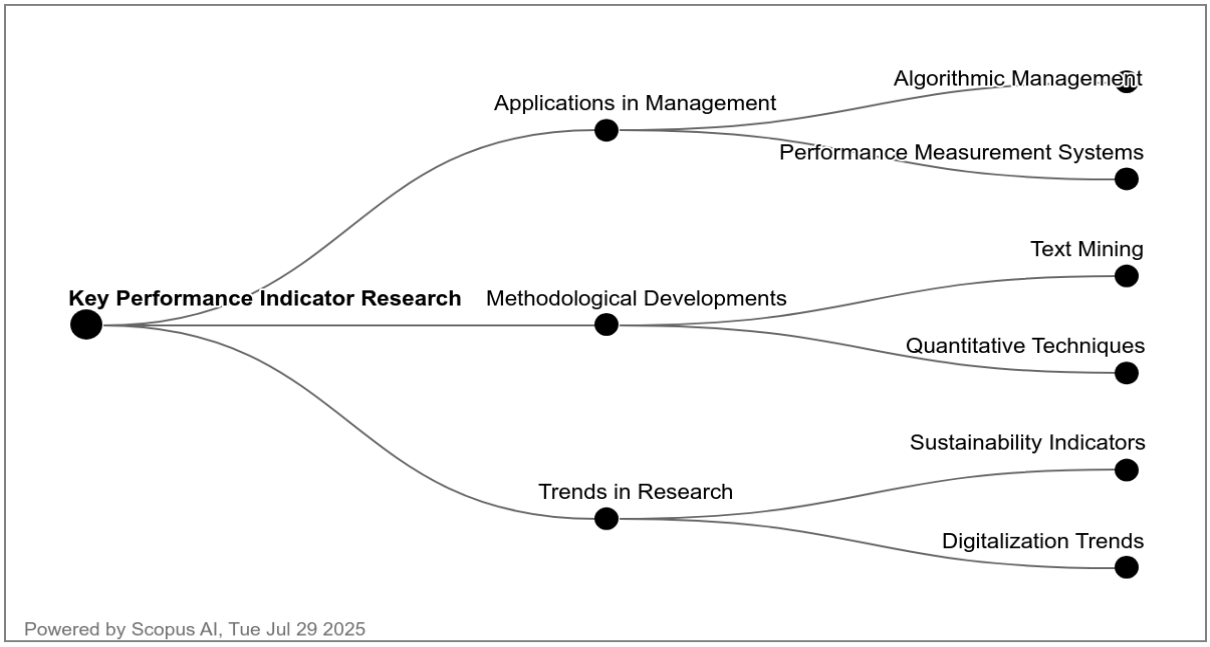

Figure 1: Conceptual Map of KPIs Research Themes

Following a literature assessment, the following research questions were determined to direct the statistical analysis of the KPIs research.

RQ1 : What are the publication trends in KPIs research over the years?
RQ2 : Which articles are the most highly cited in the field of KPIs research?
RQ3 : Which countries are the top contributors to KPIs research based on the number of publications?
RQ4: Which subject area have shown significant growth in KPIs Research over the year?
RQ5 : What are the most frequently occurring keywords in KPIs research studies, and what thematic areas do they represent?
RQ6 : What are the patterns of international collaboration in KPIs research based on co-authorship across countries?

Although KPIs have become critical instruments for performance measurement and strategic management, the current body of research is thematically fragmented and lacks seamless integration across changing contexts. While KPIs are extensively used in a variety of industries, comprehensive research into their application to emergent domains such as digital transformation, sustainability, and algorithmic management remains restricted. This mismatch has hampered the establishment of a shared understanding of KPI evolution and implementation. To address this constraint, the current study uses bibliometric analysis as a structured way to investigate publishing trends, key contributors, subject classifications, and keyword co-occurrence patterns in KPI research. The study provides a comprehensive overview of prevalent research directions as well as underexplored regions by mapping the field's intellectual structure and thematic evolution. The outcomes are intended to guide future research directions, assist evidence-based policy formulation, and improve the design and implementation of KPIs frameworks in a variety of institutional and corporate contexts.

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Methods

The bibliometric analysis used in this study entails the methodical gathering, arrangement, and analysis of bibliographic information from scholarly works. It offers information about the dynamics and organisation of a certain (Assyakur & Rosa, 2022; Olaleye et al., 2021). This procedure explores more sophisticated methods like document co-citation analysis, going beyond simple descriptive metrics like identifying publication sources, annual patterns, and prolific writers (Bernatović et al., 2022). Researchers can find important patterns, significant works, and new research trends by carrying out an extensive literature study. Iterative and structured, the review process necessitates precise keyword selection, focused search execution, and in-depth content analysis. A comprehensive literature evaluation allows researchers to uncover major patterns, influential works, and new research trends. The review was systematic and iterative, using precise keyword selection, targeted searches, and content checks to build a reliable corpus. This strategy ensures the development of a strong bibliographic foundation that is both complete and reliable, setting the way for future research and theoretical breakthroughs (Fahimnia et al., 2015).

This study focusses on high-impact papers because they provide in-depth insights into the theoretical foundations and conceptual evolution of the subject. To ensure the data's accuracy and dependability, articles were only sourced from the Scopus database, which is known for its extensive coverage and rigorous indexing criteria (Al-Khoury et al., 2022) and (Di Stefano et al., 2010). Furthermore, to maintain scientific rigour and assure the trustworthiness of the study, only peer-reviewed journal articles were included, with books, conference proceedings, and lecture notes specifically excluded (Gu et al., 2019). The collection includes papers from 2020 to July 2025, as indexed by Elsevier's Scopus. This comprehensive selection procedure guarantees that the study represents the most current, reliable, and pertinent research, offering a strong foundation for analysing the significance, methodology, and development of KPIs research.

Data Strategy

The Scopus database was used to obtain data for this bibliometric research because it provides broad coverage of peer-reviewed scientific publications across fields. The initial search strategy was created to find publications that were explicitly connected to KPIs by focussing on specified title-level keyword combinations. Both "KPI" and "key performance indicator" were among the carefully chosen keywords that were utilised in the search query as stated in Table 1.

Table 1: The Search String.

Scopus	TITLE ("KPI" or "key Performance indicator") AND PUBYEAR > 2005 AND PUBYEAR < 2025 AND (LIMIT-TO (EXACTKEYWORD , "Key Performance Indicators") OR LIMIT-TO (EXACTKEYWORD , "Kpi") OR LIMIT-TO (EXACTKEYWORD , "Key Performance Indicator")) AND (LIMIT-TO (LANGUAGE , "English")) AND (LIMIT-TO (DOCTYPE , "ar"))

During this first search, 2,442 documents were found. After conducting the first search, a structured screening process was used to assure the quality and relevancy of the documents included in the final dataset. As shown in Table 2, the inclusion criteria were as follows: (i) documents published in English; (ii) publication years limited to 2005–2025; (iii) use of exact

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keywords related to KPIs; and (iv) inclusion of only journal articles, excluding books, book chapters, editorials, conference proceedings, and other non-article formats. Additionally, the keywords "key performance indicators," "KPI," and "Key Performance Indicator" have been selected, and only papers published between 2005 and 2025 were included. Following this adjustment, 724 papers were judged appropriate for the final analysis. This rigorous selection procedure made it easier to create a reliable and targeted dataset for the bibliometric analysis.

Table 2: The Selection Criterion in Searching.

Criterion	Inclusion	Exclusion
Language	English	Non-English
Year	2005-2025	<2005
Keyword	As per Table 1	Others
Document Type	Article	Others

Data Analysis

Van Eck and Waltman (2007;2010) of Leiden University in the Netherlands created the highly praised and easy-to-use bibliometric analysis program VOSviewer. Its extensive features, which include creating network visualisations, clustering similar objects, and creating density maps, make it a popular tool for visualising and analysing scientific literature. VOSviewer is a useful tool for mapping and comprehending complicated research landscapes because it excels at examining networks of co-authorship, co-citation, and keyword co-occurrence. Its user-friendly interface and regular updates guarantee effective study of big bibliographic databases. Furthermore, VOSviewer is a vital tool for novice and seasoned researchers alike due to its capacity to calculate bibliometric indicators, personalise visual outputs, and support a wide range of data types.

VOSviewer's capacity to transform intricate bibliometric data into visually understandable representations is one of its most notable features. The program is quite good at building network-based clusters that let users find and examine connections between publications, authors, and keywords. Researchers of different skill levels may easily identify theme structures and study clusters thanks to its emphasis on visual clarity and user-friendly design. VOSviewer's adaptable architecture and visualisation tools are crucial for identifying patterns, trends, and new study areas as bibliometric analysis gains importance across academic disciplines. Its continuous improvement guarantees that, in a rapidly changing research environment, it remains applicable and flexible.

Bibliographic data for this study were acquired in PlainText format from the Scopus database, including publication year, document title, author names, journal titles, citations, and keywords. The data ranges from 2005 to July 2025. VOSviewer version 1.6.20 was used to analyse and visualise the data through clustering and mapping algorithms. The software uses a visualization-of-similarities (VOS) technique, which arranges elements in a low-dimensional space so that the distance between them represents their degree of similarity (Van Eck & Waltman, 2010). While this method has similarities to the multidimensional scaling (MDS) method (Appio et al., 2014). VOSviewer distinguishes itself by employing association strength

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(ASij) to normalise co-occurrence frequencies, resulting in a more realistic representation of item similarity (Van Eck & Waltman, 2007). This approach enhances the interpretability of bibliometric correlations and enables more in-depth analytical insights.

$$AS_{ij} = \frac{C_{ij}}{w_i w_j}$$

According to Van Eck and Waltman (2007), it is proportional to the ratio of the actual number of co-occurrences of items I and J to the number that would be predicted if the occurrences of I and J were statistically independent.

Results and Discussion

Drawing on the analysis, the following parts offer the findings, which are organised in accordance with the research questions raised in the literature review.

RQ 1: What Are the Publication Trends in KPIs Research Over the Years?

Table 3 shows the annual distribution of publications on KPIs from 2005 to 2025 shows a gradual increase, particularly in the last decade. Between 2005 and 2012, there were less than 10 publications on the issue, indicating a rather low scholarly commitment. This early stage mirrors the initial stages of KPIs conceptualisation in academic discourse. However, beginning in 2013, there was a progressive increase in output, with publications increasing from 13 in 2013 to 50 by 2019, indicating increased academic interest and wider use across sectors.

The period 2020–2025 sees a major increase in publication activity, with annual outputs consistently exceeding 70 papers. Notably, 2023 had the most publications (n=89), followed by 2021 (n=84), 2024 (n=79), and 2025 (n=66), as of the analysis date. This development could be ascribed to increased interest in performance assessment tools because of worldwide shifts in governance, digitalisation, and organisational transparency. The growth in KPIs-related research during this period is consistent with the growing emphasis on data-driven strategies and agile performance frameworks following COVID-19.

Table 3: Publications in KPIs Research from Year 2005-2025

Year	Total Publication	Percentage (%)
2025	66	9
2024	79	11
2023	89	12
2022	76	10
2021	84	12
2020	71	10
2019	50	7
2018	39	5
2017	44	6
2016	23	3
2015	31	4
2014	15	2
2013	13	2

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2012	10	1
2011	7	1
2010	9	1
2009	9	1
2008	5	1
2007	3	1
2005	1	1

These trends can be easily identified in Figure 2, which depicts the amount of KPI-related documents released between 2005 and 2025. For the first few years, especially before 2015, publication output was low and intermittent, with less than 20 documents published each year. Beginning around 2015, there was a considerable surge in research effort, indicating a change towards more scholarly engagement with the topic. The trend accelerated after 2018, with publication numbers growing sharply and peaking in 2023. Although there is a minor fall in 2024 and 2025, the general trend is strongly higher, demonstrating that academic interest in KPIs has grown over the last decade.

The continuing rise in KPIs papers highlights the transition from an operational tool to a strategic research domain. The increasing volume reflects not only the importance of KPIs in academic and professional settings, but also the growth of multidisciplinary studies that use KPIs frameworks. As of 2025, the increasing trend appears to be continuing, indicating strong scholarly involvement and the possibility of deeper theoretical and methodological advances in the discipline.

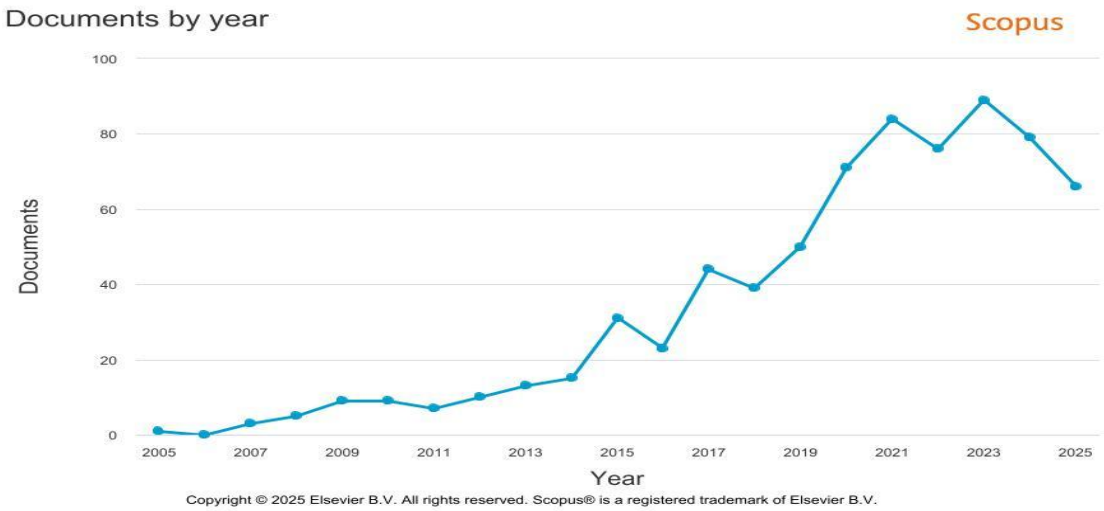

Figure 2: Plotting Document in KPIs Research Publication by Years.

The Table 3 and Figure 2 together offer compelling proof of the increasing scholarly interest in KPIs. A wider understanding of the vital role KPIs play in improving organisational performance, strategic alignment, and accountability across industries is reflected in the publications' consistent rise over time. This increase in scholarly output indicates that KPIs research is picking up steam and is probably going to keep growing, especially in new fields like sustainability measurement, data-driven decision-making, digital transformation, and performance monitoring in complicated institutional settings.

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RQ 2: Which Articles Are the Most Highly Cited in the Field of KPIs Research?

Table 4 lists the most cited authors in KPIs-related research, showing substantial contributions that have shaped the area. The article by Yin et al. (2015) has the most citations (506). This study focusses on improving problem diagnostic systems with enhanced partial least squares models based on KPIs data. Toor and Ogunlana (2010) study on stakeholder views of KPIs in public sector development projects had the second most citations, with 429. These two studies demonstrate how KPIs frameworks are used in both sophisticated industrial analytics and the evaluation of large-scale infrastructure projects. Several more influential articles have made significant contributions to the KPIs knowledge base. Ding et al. (2013) proposed a novel scheme for KPIs prediction and diagnostic application in industrial manufacturing, which received 269 citations. AlWaer and Clements-Croome (2010) who received 277 citations, used a multi-attribute decision-making technique to assess sustainable intelligent buildings. Podgórski (2015), May et al. (2015), and Bai and Sarkis (2014) all provide useful frameworks for implementing KPIs in occupational safety, energy efficiency, and supply chain sustainability. The wide range of citations in these papers indicates great relevance and methodological diversity in KPIs research.

The distribution of highly referenced articles from 2009 to 2021 demonstrates continued academic engagement and a growing cross-disciplinary interest in KPIs research. The existence of more recent publications, such as Si et al. (2021), which has 186 citations, indicates a growing rate of impact, particularly in data-driven and process-monitoring studies. Collectively, the top-cited publications show how KPIs research has evolved into a comprehensive field that incorporates quantitative models, sustainable frameworks, and sectoral applications. These citation patterns highlight the growing complexity and crucial importance of KPIs in improving strategic and operational performance in global research contexts.

Table 4: Most Top Ten Cited Author

Authors	Title	Year	Cited by
Yin et al. (2015).	Improved PLS Focused on Key-Performance-Indicator-Related Fault Diagnosis.	2015	506
Toor and Ogunlana (2010)	Beyond The 'Iron Triangle': Stakeholder Perception of Key Performance Indicators (Kpis) For Large-Scale Public Sector Development Projects.	2010	429
AlWaer and Clements-Croome (2010)	Key Performance Indicators (Kpis) And Priority Setting in Using the Multi-Attribute Approach for Assessing Sustainable Intelligent Buildings.	2010	277
Yuan et al. (2009)	Selection of Performance Objectives and Key Performance Indicators in Public-Private Partnership Projects to Achieve Value for Money.	2009	275
Ding et al. (2013)	A Novel Scheme for Key Performance Indicator Prediction and Diagnosis with Application to An Industrial Hot Strip Mill.	2013	269

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	Measuring Operational Performance of OSH	2015	248
Podgórski (2015)	Management System - A Demonstration of AHP-Based Selection of Leading Key Performance Indicators.		
May et al. (2015)	Energy Management in Production: A Novel Method to Develop Key Performance Indicators for Improving Energy Efficiency.	2015	227
Feiz et al. (2015)	Improving The CO2 Performance of Cement, Part I: Utilizing Life-Cycle Assessment and Key Performance Indicators to Assess Development Within the Cement Industry.	2015	206
Bai and Sarkis (2014)	Determining And Applying Sustainable Supplier Key Performance Indicators.	2014	193
Si et al. (2021)	Key-Performance-Indicator-Related Process Monitoring Based on Improved Kernel Partial Least Squares.	2021	186

RQ3: Which Countries Are the Top Contributors to KPIs Research Based on the Number of Publications?

Figure 3 illustrates the distribution of KPIs-related publications by country, emphasising the top ten most productive nations according to Scopus Analyser. China is the biggest contributor with approximately 90 documents, reflecting its enormous academic production in performance measurement research. The United Kingdom follows with over 70 papers, indicating substantial institutional interest in KPIs-related research. According to the statistics, both countries prioritise performance measures in governance, public sector reform, and enterprise management, resulting in increased research interest in this area. Trailing closely behind are Spain, United States, Germany, and Italy, each contributing between 50 to 60 documents. These countries reflect a strong European and North American academic base focused on KPIs implementation, likely tied to mature performance measurement systems in public administration, health care, and corporate governance. Their consistent output suggests a stable and well-established research ecosystem focused on effectiveness, transparency, and management efficiency.

Emerging contributors such as India, Australia, Canada, and the Netherlands round out the top ten, each with 30 to 45 articles. While its inclusion is slightly smaller in volume, it demonstrates an increasing regional academic interest in KPIs, probably due to the adoption of worldwide performance standards and governance reforms. The global distribution of research reflects KPI's multidisciplinary and cross-sectoral importance, indicating that both mature and emerging economies are committed to performance-based evaluation systems.

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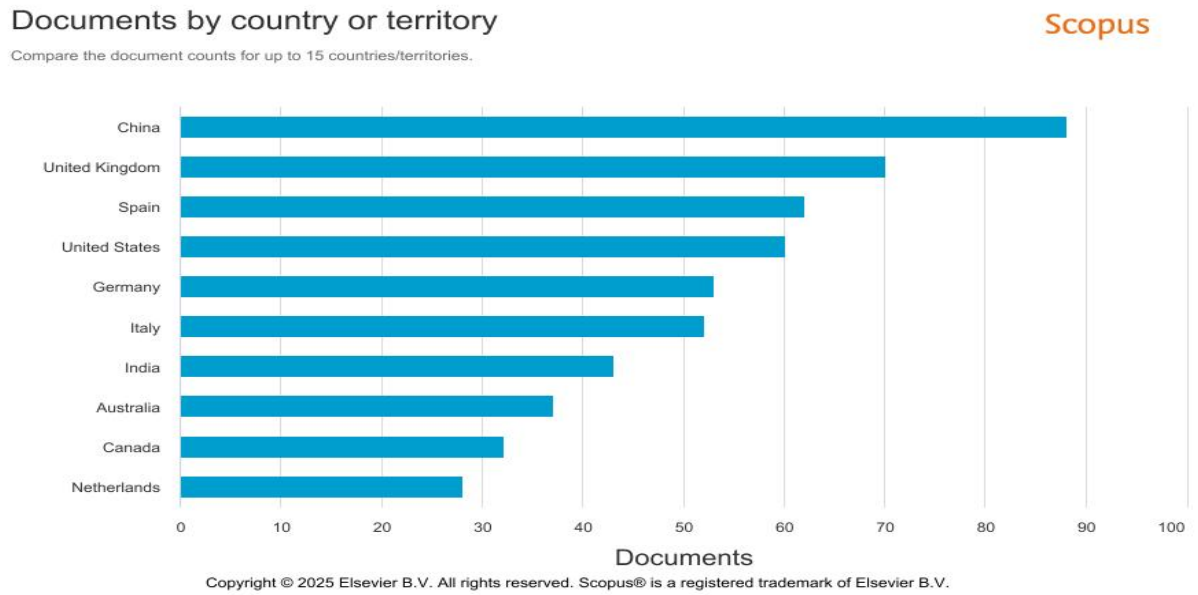

Figure 3: Top 10 Countries Contributors to KPIs Research.

The world map in Figure 4, which shows the geographic distribution of KPI-related research, further demonstrates these conclusions. China, the United States, the United Kingdom, Germany, and Australia have produced significant scholarly output, and the map emphasises concentrated contributions from both developed and rising economies. The broad use of KPIs as instruments for measuring performance across industries and geographical areas is shown in this global distribution. The visualisation highlights the growing significance of KPI research in a variety of institutional, economic, and cultural contexts and supports the existence of active research clusters. Together accompanied by the published data, the map provides a thorough overview of the worldwide environment, demonstrating that KPI research is not limited to a particular area but has instead developed into a recognised topic that is of interest to a wide range of academic disciplines.

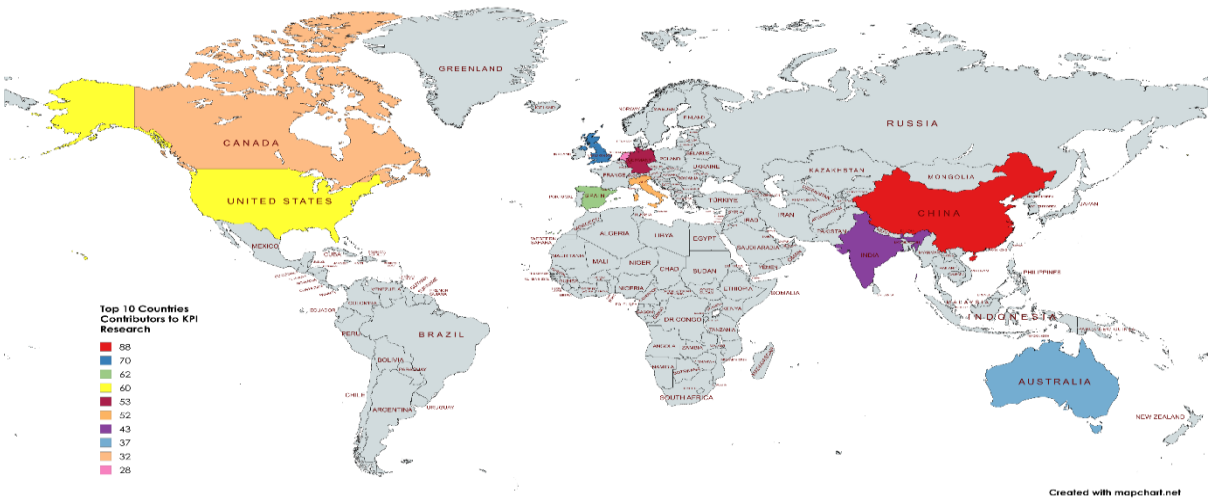

Figure 4: Top 10 Countries Contributors to KPIs Research in World Map

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RQ4: Which Subject Area Have Shown Significant Growth in KPIs Research Over the Year?
Figure 5 illustrate the distribution of KPIs-related articles by subject area, with engineering showing as the most prevalent topic for 346 publications (23.9 % of the total). This reflects the field's emphasis on process improvement, system monitoring, and operational efficiency. Computer Science follows with 179 publications (12.4%), focussing on the use of KPIs frameworks in intelligent systems, data analytics, and software performance. Medicine is the third greatest contributor, with 126 publications (8.7%), demonstrating the growing importance of KPIs in clinical governance, patient care quality, and hospital administration. Other significant subject categories include Business, Management, and Accounting (117 publications, 8.1%) and Social Sciences (113 publications, 7.8%). These numbers demonstrate the importance of KPIs in strategic planning, organisational effectiveness, public sector performance, and social impact monitoring. Environmental Science contributes 86 publications (5.9%), whereas Energy accounted for 80 publications (5.5%), highlighting the importance of KPIs in sustainability, climate policy, and energy efficiency. Mathematics and Decision Sciences contribute 63 (4.4%) and 45 (3.1%) papers, respectively, demonstrating their contributions to performance modelling and evaluation approaches.

Several additional sectors show a wide yet important participation with KPIs research. Materials Science is responsible for 40 publications (2.8%), while Economics, Econometrics, and Finance supply 33 (2.3 %). Other disciplines, such as Chemical Engineering (31; 2.1%), Health Professions (29; 2%), Biochemistry and Physics (26 each; 1.8%), and Agricultural Sciences (21; 1.5%), demonstrate that performance metrics are used in both applied sciences and health-related fields. Though fewer in number, fields such as Arts and Humanities (12; 0.8%), Psychology (7; 0.5%), and Neuroscience (3; 0.2%) demonstrate an increasing acknowledgement of KPIs significance beyond of traditional technological disciplines. Overall, the findings show that KPIs research is transdisciplinary, methodologically diversified, and increasingly integrated into academic and practical contexts.

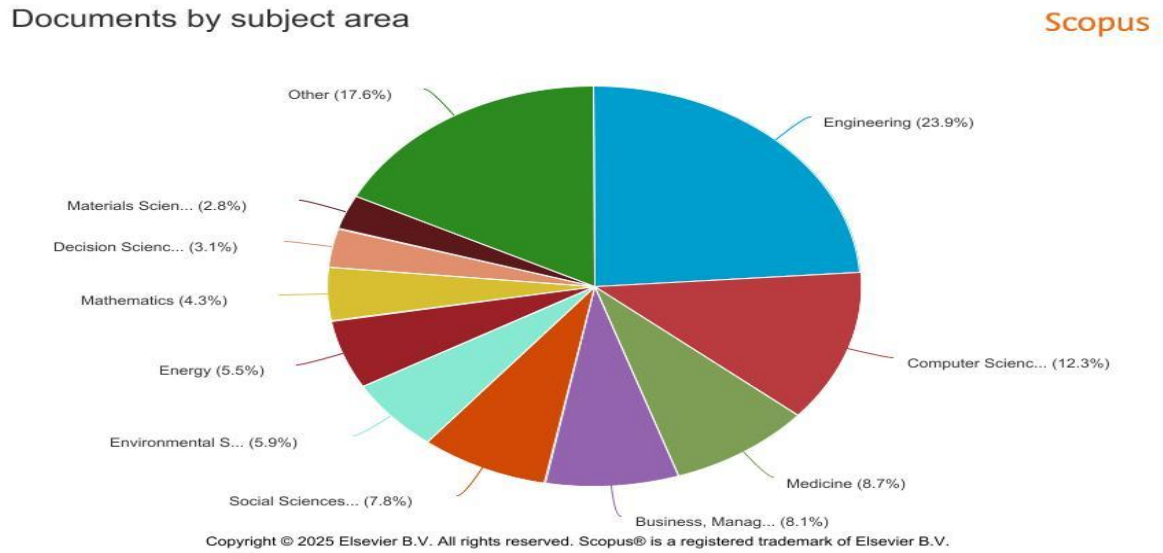

Figure 5: Documents by Subject Area for KPIs Research

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RQ5: What Are the Most Frequently Occurring Keywords in KPIs Research Studies, And What Thematic Areas Do They Represent?

Table 2 lists the most used terms in KPIs-related articles, providing insights into current research issues and conceptual linkages. The term "Key performance indicators" appears the most frequently, with 553 mentions and a total link strength of 2545, indicating its importance in the keyword network and significant co-occurrence with other terms. The variant "Key performance indicator" also appears frequently, with 207 occurrences and 1562 total link strength, demonstrating terminology consistency despite minor differences. The phrase "KPI" appears 97 times with a total link strength of 393, indicating that the idea is discussed under numerous naming conventions throughout the literature.

Other commonly linked terms include "Benchmarking" (342 occurrences with a total link strength of 1976), indicating a strong thematic overlap with KPI in areas such as performance comparison, strategic improvement, and best practice adoption. Keywords like "Article" (131; 1535) and "Human" (127; 1522) appear frequently and with high link strength, which could be due to Scopus' indexing structure or frequent co-mentions in methodological and contextual discussions. The prevalence of both "Human" and "Humans" with a combined total of 206 occurrences indicates an emphasis on the human or organisational factors in KPIs research, such as employee performance, behavioural measures, or health-related assessments.

Additional keywords include "quality indicators" (33; 497), "quality control" (32; 332), and "performance assessment" (56; 330), indicating a high emphasis on measurement accuracy, reliability, and evaluation processes. These phrases imply that KPIs research is intimately related to quality management systems and institutional performance evaluations. The entire network structure reflects a continuous thematic landscape in which KPIs are tightly linked to strategic benchmarking, quality evaluation, and human-centred results. The high total link strength values suggest dense relationships, implying that KPIs research is methodologically diverse and conceptually integrated across fields.

Table 5: Most Top 10 Keywords' Co-Occurrence

Keyword	Occurrences	Total Link Strength
Key performance indicators	553	2545
Benchmarking	342	1976
Key performance indicator	207	1562
Article	131	1535
Human	127	1522
Humans	79	1067
Quality indicators	33	497
KPI	97	393
Quality control	32	332
Performance assessment	56	330

The Keyword Co-Occurrence network visualisation map created with VOSviewer is shown in Figure 7, which highlights the significance of these findings even more. By organising terms into discrete thematic clusters according to their co-occurrence in scholarly papers, this map shows the frequency and connections between keywords in KPIs-related literature. Given its pivotal significance in the sector, "key performance indicators" is the most prevalent and interrelated word at the centre of the network. This centre is surrounded by several

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interconnected clusters that reflect different lines of inquiry. In organisational and industrial contexts, for example, the red cluster is linked to sustainability, performance evaluation, and decision-making. The green cluster places a strong emphasis on healthcare applications, emphasising concepts like clinical efficacy, quality indicators, and health care quality.

Meanwhile, phrases like artificial intelligence, machine learning, data mining, and defect detection that are associated with technology and predictive analytics are included in the blue cluster. The multifaceted character of KPIs research, which spans domains including engineering, healthcare, and data-driven decision-making, is demonstrated by this structure. The graphic highlights the various and changing scope of the discipline by showing how researchers are examining KPIs from a variety of disciplinary perspectives, from healthcare delivery and algorithmic management to operational efficiency and quality control.

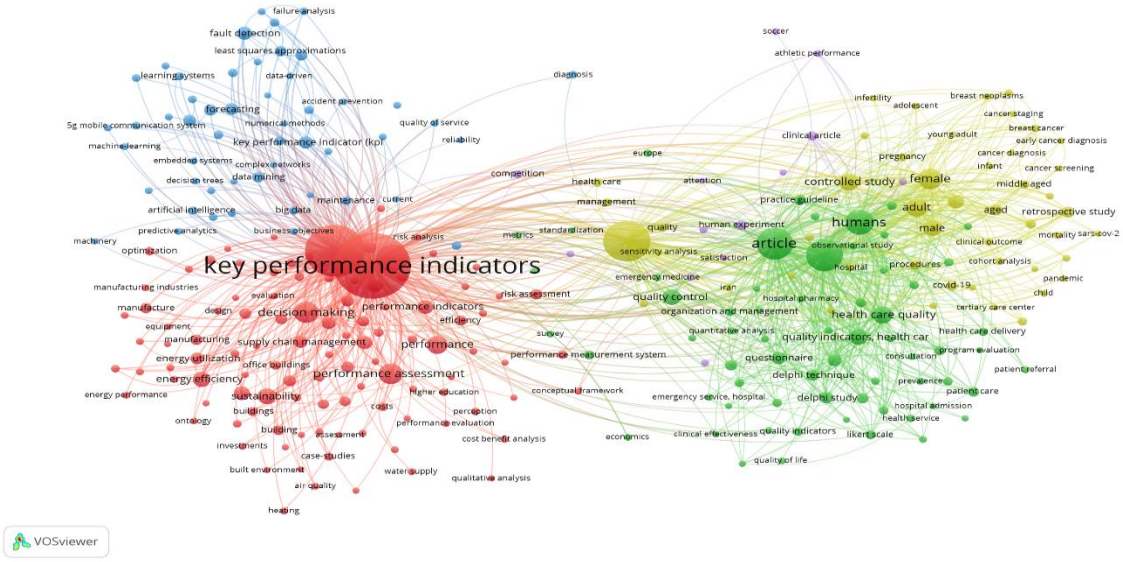

Figure 6: Network Visualization Map of Keywords' Co-Occurrence

RQ6: What Are the Patterns of International Collaboration in KPIs Research Based on Co-Authorship Across Countries?

Table 6 presents the international collaboration patterns in KPIs research based on VOSviewer results. The United Kingdom demonstrates the strongest international linkage with a total link strength of 75, supported by 70 documents and 2031 citations, indicating its central role in global KPIs research. The United States follows with a total link strength of 62, contributing 65 publications and accumulating 1661 citations, suggesting strong academic engagement and international visibility. Germany ranks next with a total link strength of 51, backed by 53 documents and 1509 citations, highlighting its consistent research productivity and collaborative outreach.

China, while having the highest number of publications (89 documents) and citations (3414), records a total link strength of 50, indicating slightly less collaboration despite its significant impact. France and Spain both report a total link strength of 43, with France contributing 22 documents and 474 citations, and Spain 62 documents and 1411 citations. Their equal link

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strength values suggest comparable levels of international engagement, despite differing output volumes. Canada and the Netherlands follow with total link strengths of 35 and 34, respectively. Canada has produced 31 publications with 532 citations, while the Netherlands has contributed 28 publications and 622 citations, reflecting moderate research impact and steady collaboration.

Australia and Switzerland round out the top ten, with total link strengths of 33 and 31, respectively. Australia has produced 37 documents with 1226 citations, showing strong influence in the field and solid collaborative ties. Switzerland, though contributing only 14 documents, has received 403 citations, indicating impactful research and effective engagement with international partners.

Table 6: Most Top 10 Countries of International Collaboration

Country	Documents	Citations	Total Link Strength
United Kingdom	70	2031	75
United States	65	1661	62
Germany	53	1509	51
China	89	3414	50
France	22	474	43
Spain	62	1411	43
Canada	31	532	35
Netherlands	28	622	34
Australia	37	1226	33
Switzerland	14	403	31

As illustrated by Figure 8, the co-authorship network map generated by VOSviewer depicts collaborative relationships between countries, with each node representing a country, the size of the node indicating publication volume, and the thickness of the connecting lines reflecting the strength of collaboration. Significant collaboration ties exist between European countries as well as across Western and Asian regions, highlighting the global scope and significance of KPIs research. The network also emphasises the role of both developed and emerging economies in shared knowledge production.

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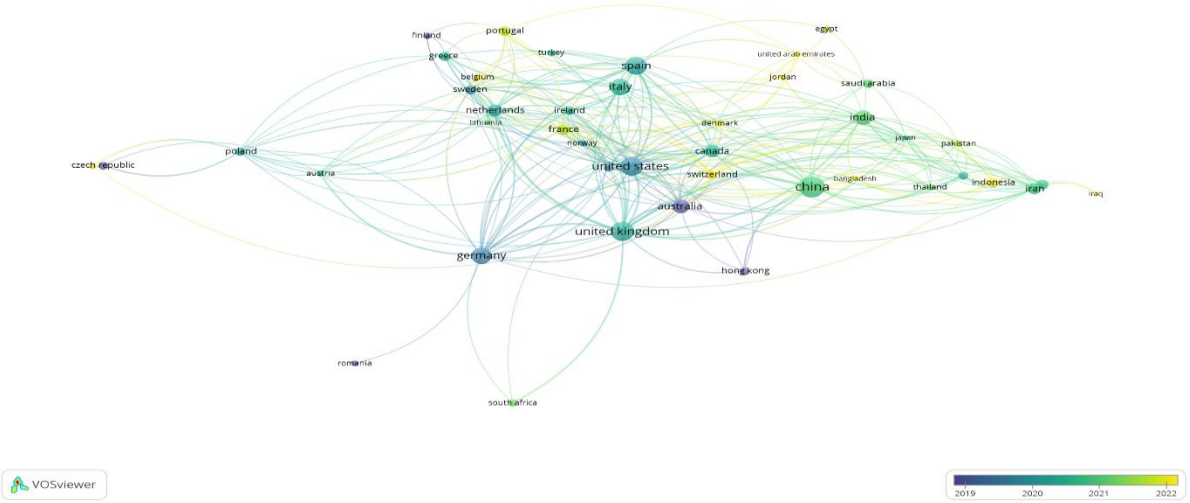

Figure 7: Patterns of International Collaboration in KPIs Research

Together, Table 6 and Figure 7 provide a thorough summary of the international research environment for KPIs studies, emphasising trends in cross-border cooperation. This visualisation affirms the role of international collaboration in advancing the theoretical and practical understanding of KPIs and supports the idea that performance measurement frameworks are being actively explored and implemented in diverse institutional, economic, and cultural settings worldwide.

Conclusions

This bibliometric analysis addressed the structure, evolution, and emerging trends in KPIs research during the last two decades. The main goal was to map worldwide scholarly production, assess citation impact, find theme clusters, and discover collaboration networks across countries and disciplines. The study provides a systematic overview of how KPIs research has evolved from foundational concepts to more complex and multidisciplinary frameworks by analysing a curated dataset of 724 journal articles retrieved from the Scopus database and using tools such as Scopus Analyser, OpenRefine, and VOSviewer. This inquiry also sought to address critical research concerns including publishing trends, subject area concentration, keyword co-occurrence, author impact, and international research collaboration.

The findings indicate a constant increase trend in publication activity, notably between 2020 and 2025. This upward trend indicates the growing importance of KPIs as strategic tools in academic research and practical application. High-impact literature shows a shift away from standalone, sector-specific measures and towards integrated and automated performance frameworks. China, the United Kingdom, and the United States were highlighted as the most prolific producers, with strong collaborative linkages amongst institutions in developed economies. Engineering and computer science topped the subject areas, followed by business, medical, and social sciences, demonstrating widespread interdisciplinary participation. Keyword analysis identified dominating topics such as benchmarking, quality assessment, performance, and human-centered evaluation, indicating that KPIs research is increasingly being conducted in both technological and organisational domains.

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The study makes several significant contributions to the field. First, it provides a bibliometric framework for understanding the intellectual and thematic growth of KPIs research, allowing researchers to track its progression from operational efficiency aids to strategic decision-making instruments. Second, it discusses how KPIs-related research have evolved to address contemporary concerns such as digitalisation, sustainability, and data governance. Third, the data show how international collaboration, particularly among industrialised countries, has influenced the exchange of ideas and approaches in the field of performance assessment. These contributions inform academic academics and practitioners on the current state and future direction of KPIs scholarship.

From a practical perspective, the findings of this study may assist in improving performance evaluation models across public administration, industrial operations, healthcare systems, and digital infrastructures. The growing emphasis on concepts such as automation, text mining, and sustainability in recent literature reflects a movement towards more technology-enabled and value-oriented KPIs frameworks. These advancements can support institutions in refining their KPIs structures to align with evolving strategic priorities and socioeconomic contexts. In the healthcare sector, for instance, KPIs can be employed to monitor patient-centered outcomes, optimise hospital resources, and enhance the quality of care through timely data analysis. Within public governance, KPIs can reinforce accountability mechanisms by assessing the effectiveness of policy implementation, improving transparency, and ensuring that government initiatives respond effectively to societal needs. Collectively, these applications highlight how robust KPIs systems can promote continuous improvement and evidence-based decision-making across various sectors.

However, this study has several limitations. The analysis was restricted to articles indexed in the Scopus database and published between 2005 and 2025, which means that relevant studies from other databases or in non-English languages may not have been included. In addition, relying mainly on bibliometric indicators limits the depth of contextual interpretation. Future research may integrate bibliometric approaches with qualitative content analysis to provide more comprehensive insights into emerging themes and theoretical developments. It would also be valuable to examine regional disparities, particularly between the Global North and the Global South, to better understand how contextual factors influence the evolution and application of KPI frameworks.

In conclusion, this study has presented a comprehensive and systematic view of KPIs research over the last two decades, highlighting its intellectual structure and disciplinary evolution. The application of bibliometric approaches has been successful in mapping this dynamic sector, revealing its evolution from simple performance tracking to complex, data-driven systems. These findings illustrate the strategic importance of KPIs in current performance management, as well as the value of bibliometric techniques for identifying research trajectories. As the world's interest in efficiency, accountability, and innovation grows, KPIs research will continue to play a central role in shaping performance management systems that balance efficiency, accountability, and innovation in the digital era.

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