



## Emerging Trends in Business Intelligence: A systemic Mapping Study

### Tendencias emergentes en Inteligencia de Negocios: Un Mapeo Sistémico

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## Abstract

**Objective:** The study aims to conduct a systematic mapping of emerging trends in business intelligence (BI) by analyzing research published between 2017 and 2024, in order to identify patterns, influential authors, key sectors, and future research opportunities.


**Methodology:** We used the systematic mapping methodology described by Kitchenham, including two iterations of searches in academic databases such as Scopus, IEEE Xplore, and Web of Science. The collected data (1504 studies) were analyzed using tools such as VOSviewer and Microsoft Excel, focusing on network maps, overlays, and density visualizations to interpret key patterns and relationships.


**Results:** The analysis revealed dominant trends such as the use of big data, machine learning, predictive analytics, and real-time BI. Geographically, Asia and the Middle East lead in publications, with strong BI adoption in sectors such as healthcare, education, and retail. Less explored areas were also identified, such as the integration of BI with the Internet of Things, advanced social network analytics, and data ethics.

**Conclusions:** This study concludes that BI continues to evolve towards more advanced and ethically responsible technologies, with a focus on personalization and real-time decision-making. Less explored areas represent opportunities for future research, particularly regarding data governance and the integration of BI in specific sectors. This work provides a comprehensive overview of the current state of BI research and suggests strategic directions for its development.

**Keywords:** business intelligence, emerging trends, systematic mapping, VOSViewer

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## Resumen

**Objetivo:** Este estudio tiene como objetivo realizar un mapeo sistemático de las tendencias emergentes en inteligencia de negocios (BI), analizando investigaciones publicadas entre 2017 y 2024, para identificar patrones, autores influyentes, sectores principales y oportunidades futuras de investigación.

**Métodología:** Se utilizó la metodología de mapeo sistemático descrita por Kitchenham, incluyendo dos iteraciones de búsqueda en bases de datos académicas como Scopus, IEEE Xplore y Web of Science. Los datos recopilados (1504 estudios) fueron analizados mediante herramientas como VOSviewer y Microsoft Excel, con énfasis en mapas de red, superposición y densidad para interpretar patrones y relaciones clave.

**Resultados:** El análisis reveló tendencias predominantes, como el uso de big data, machine learning, análisis predictivo y BI en tiempo real. En términos geográficos, Asia y Medio Oriente lideran en publicaciones, con una fuerte adopción de BI en sectores como salud, educación y comercio minorista. También se identificaron áreas menos exploradas, como la integración de BI con el Internet de las Cosas, la analítica avanzada de redes sociales y la ética en el manejo de datos.

**Conclusiones:** El estudio concluye que BI sigue evolucionando hacia tecnologías más avanzadas y éticamente responsables, con un enfoque en la personalización y la toma de decisiones en tiempo real. Las áreas menos investigadas representan oportunidades para futuras investigaciones, particularmente en la gobernanza de datos y la integración de BI en sectores específicos. Este trabajo ofrece una visión integral del estado actual de la investigación en BI y sugiere direcciones estratégicas para su desarrollo.

**Palabras clave:** inteligencia de negocios, tendencias emergentes, mapeo sistémico, VOSViewer

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## Introduction

In today's business landscape, business intelligence (BI) has become indispensable for strategic decision-making, allowing organizations to adapt to the changing environment through data analysis [1]. BI has undergone a great evolution, driven by emerging trends such as artificial intelligence (AI) and machine learning (ML), with applications in various industries [2].

Despite the growing interest, there are still knowledge gaps regarding the way in which these trends integrate and change business practice. This systematic mapping, which encompasses journal articles, conferences, and books, primarily aims to provide an overview of the current BI research landscape and identify areas of opportunity for future research. Through a bibliometric and geographical analysis, it seeks to answer the following questions:

- What are the main emerging trends in BI?
- Which authors and regions are leading research in this field?
- Which sectors are adopting BI more frequently?
- Which areas of BI research remain unexplored?

The analysis of these questions will identify the most recent advances in BI, the key players, the areas of greatest interest, and the gaps in the current literature, laying the groundwork for future research.

## Methodology

This study identifies literature on emerging trends in business intelligence which were published between 2017 and 2024, using a systematic mapping methodology. Following Kitchenham's framework [3, 4], our work is divided into five stages that cover planning (defining research questions and search strategies), execution (selecting studies), and the presentation of results.

### Definition of research questions

The following research questions were defined to guide this systematic literature review:

- Q1: What are the main emerging trends in BI in recent years?
- Q2: Who are the most influential authors in the field of BI?
- Q3: What is the geographic distribution of BI publications and their emerging trends?
- Q4: What sectors or industries are using BI the most?
- Q5: What are the least explored areas in BI research?

### Search protocol

The literature search was conducted in two iterations using academic databases such as Scopus, EBSCO, Web of Science, IEEE Xplore, Springer, and ScienceDirect. In the first iteration, we searched for articles published in English or Spanish between 2017 and 2024 which included key terms such as *business intelligence* and *emerging trends* in the title, abstract, or keywords. The search string used was:

(TITLE(business-intelligence) OR TITLE-ABS-KEY(emerging-trends-in-business-intelligence) OR TITLE-ABS-KEY(bi-trends)) AND PUBYEAR > 2016 AND PUBYEAR < 2025 AND (LIMIT-TO(LANGUAGE, "English") OR LIMIT-TO(LANGUAGE, "Spanish"))

In the second iteration, the results were refined to focus on the most relevant emerging trends, as shown in the example search string for *cloud-business-intelligence*:

( TITLE ( business-intelligence ) AND TITLE ( cloud-business-intelligence ) ) AND PUBYEAR > 2016 AND PUBYEAR < 2025 AND ( LIMIT-TO ( LANGUAGE , "English" ) OR LIMIT-TO(LANGUAGE, "Spanish" ) ) AND ( LIMIT-TO ( EXACTKEYWORD , "Business Intelligence" ) )

### Inclusion and exclusion criteria

For the first iteration, based on a total of 6832 search results, 1504 potential studies were selected for detailed review using a set of inclusion and exclusion criteria, which are illustrated in [Table I](#) for this first iteration.

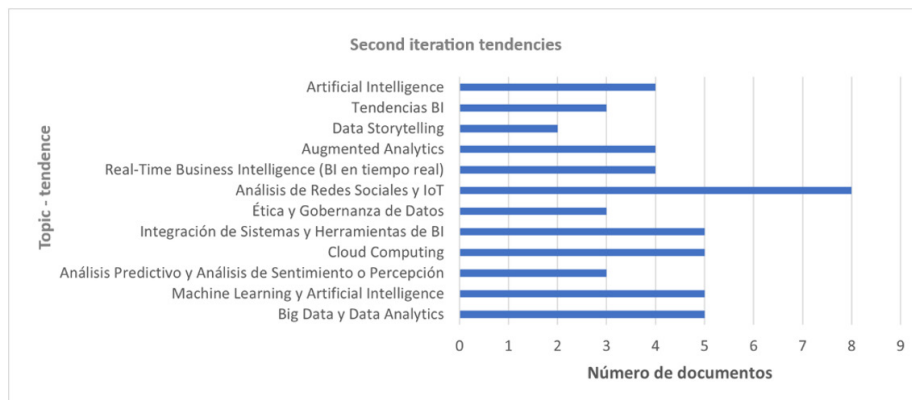
The second iteration focused exclusively on further exploring the most relevant trends identified during the first review phase. As a result of this process, 51 papers were selected which met the specific inclusion criteria.

**Table I.** Inclusion and exclusion criteria for the first iteration

Inclusion criteria	Exclusion criteria
<ul style="list-style-type: none"> <li>• Publications on BI trends in various industries</li> <li>• Studies on the exploration of new technologies in BI</li> <li>• Articles about emerging trends in BI</li> <li>• Articles in English or Spanish</li> <li>• Open-access papers</li> <li>• Articles that have been published in their final version and conferences related to the subject of the study</li> </ul>	<ul style="list-style-type: none"> <li>• Duplicate articles</li> <li>• Opinion articles</li> <li>• Studies not directly related to BI applications</li> <li>• Studies with publication dates outside the 2017-2024 range</li> </ul>

### Classification of studies

The selected studies were classified into emerging technologies, industrial applications, methodologies, and topics related to their implementation (Fig. 1). Social network analysis and the Internet of Things (IoT), along with system integration and BI tools, were the most researched topics (with eight publications each), reflecting the interest in connectivity and real-time data analysis. Predictive analytics, ML, AI, big data, and data analytics were also relevant. In contrast, data storytelling and data ethics and governance had fewer publications, suggesting areas with potential for future research.



**Figure 1.** Analysis of emerging issues in the second iteration

### Results analysis

The results of the two search iterations, exported in RIS files, were analyzed with VOSviewer and Excel. The geographic information in the files was cleaned to analyze the location of the publications.

To identify trends, authors, technologies, and research areas, the data were categorized and visualized with VOSviewer [5, 6], a tool that facilitates the understanding of patterns in the scholarly literature.

## Results

### Distribution of publications in the first iteration

In the first iteration, 1504 studies on BI trends from various academic databases were reviewed. Below is the distribution of publications among the different sources:

- **Scopus.** With 563 publications (37.4% of the total), Scopus represents the main source of information. Its broad coverage makes it a key database for the analysis of trends and emerging topics in BI.
- **IEEE Xplore.** Ranked second with 353 publications (23.5% of the total), its focus on engineering and technology makes it relevant for research linking BI with technological aspects.
- **Web of Science (WOS) and Springer.** Both databases exhibit a similar number of publications, with 236 and 231 articles, respectively (15.7 and 15.4% of the total). They offer a variety of academic studies in multiple disciplines, which brings a diverse perspective to the analysis.
- **EBSCO.** With 81 publications (5.4%), EBSCO can be considered a secondary source in terms of volume, but it is relevant for broadening the academic context.
- **ScienceDirect.** This database offers 40 publications (2.7% of the total). Although its contribution is lower compared to the others, its focus on scientific articles adds value to the review.

Together, Scopus and IEEE Xplore account for more than 60% of the analyzed publications, consolidating their position as the most influential databases in this study on BI trends. Fig. 2 summarizes the total number of publications under analysis and provides a visual representation of their distribution by source, which facilitates the interpretation of the data and the identification of the main sources for future research in this field.

### Analysis of the second iteration

An analysis of the 51 papers selected in the second iteration revealed that emerging trends in BI are being actively explored, particularly those related to network connectivity and advanced data analytics. The growth in the number of publications over the years is evidence of the importance and dynamism of this research area. Likewise, the distribution of publications by type highlights the fundamental role of journals and conferences in the dissemination of knowledge.

## Analysis of publications by year

Fig. 3 shows a steady growth in the number of publications since 2017, with a notable increase between 2021 and 2023. This increase reflects a growing interest in emerging trends in BI. While a decrease in the number of publications is observed in 2024, this may be due to the year not yet ending or a possible stabilization in the field.

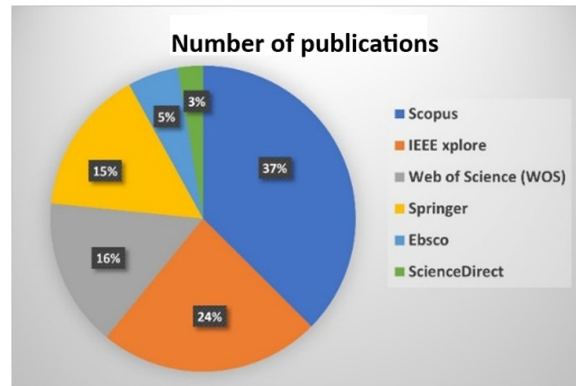


Figure 2. Number of publications per database, first iteration



Figure 3. Publications by year, second iteration

## Distribution of publications by type

Fig. 4 shows that most of the publications correspond to journal articles (30), indicating that academic journals are the main means for disseminating research in this area. Conference papers (16) are also frequent, suggesting that the topic is actively discussed at academic events. On the other hand, books and book chapters are less common, which is usual, as they usually represent compilations or more extensive studies compared to journal or conference articles.



The convergence of big data and BI has allowed companies to analyze and extract value from large volumes of data that were previously inaccessible [11, 12]. Technologies such as Hadoop and Spark are being integrated into BI platforms to handle, process, and analyze big data, enabling more comprehensive and large-scale analysis [13]. At the educational and social level, this is a tool that allows for analysis from various perspectives of great importance, which would be complex with traditional approaches. Thus, with the help of technology, barriers can be overcome, and agile solutions can be found [14].

*ML and AI:* These terms exhibit direct connections to BI, reflecting the growing use of ML algorithms and AI techniques to improve real-time decision making and predictive analytics in enterprises. These technologies are being deployed to extract patterns and trends in data, supporting the digital transformation. The integration of AI and ML into BI has made it possible to automate and improve the accuracy of data analytics [15, 16, 17]. AI capabilities, including those related to natural language processing (NLP) and sentiment analysis, are allowing enterprises to extract deeper insights and process unstructured data, such as text and videos, more efficiently [18, 19, 20].

*Predictive analytics and sentiment analysis:* In the keyword network, the presence of the predictive analytics and sentiment analysis in connection to BI indicates a growing interest in these areas. Predictive analytics is used to anticipate future behaviors, while sentiment analysis provides a better understanding of public opinion and customer satisfaction [21, 22].

*Predictive and sentiment analytics:* This branch of BI uses historical data to predict future outcomes, e.g., in forecasting high-risk events [18]. ML tools and techniques have enabled a greater integration of predictive analytics into BI platforms. This makes it easier for companies to anticipate market trends, demand, customer feedback, and potential operational issues [17, 19].

*Prescriptive analytics:* This area goes a step beyond prediction by suggesting specific actions to obtain the best results [18]. This trend is booming in the BI field since it helps organizations make more informed and optimized decisions.

*Cloud computing:* The presence of *cloud computing* and related terms, such as *cloud business intelligence*, in the keyword network indicates the increasing migration of BI applications to the cloud. This trend offers more flexible access to data and improves organizations' ability to analyze and share information in real time. The rise of cloud computing has driven the adoption of cloud-based BI solutions, which offer flexibility, scalability, and lower costs compared to on-premises solutions [23]. In addition, they allow companies to access data and analytics from anywhere, which facilitates remote working and global collaboration [24], [25]. The COVID-19 pandemic accelerated the adoption of the cloud as a management decision support tool that employs BI tools. The use of BI to analyze market trends and consumer

behavior allowed organizations to adjust their strategies and remain competitive despite the economic constraints and changes [26].

*Integration of BI systems and tools:* The presence of terms such as *information systems*, *dashboards*, and *data visualization* in the keyword network highlights the importance of information systems and visualization tools in the BI ecosystem. These tools are essential to facilitate data interpretation and strategic decision-making [27, 28]. In particular, data visualization tools in BI allow transforming large volumes of information into interactive graphs, maps, and dashboards that facilitate quick and clear understanding [29, 30].

*Ethics and data governance:* Although not among the most prominent topics, the presence of these terms in the keyword network indicates a growing concern for ethics and data governance in the realm of BI. This topic becomes relevant as the intensive use of data raises challenges related to privacy and the responsible use of information. The increased use of data in BI has driven concerns about data ethics and data governance [31]. Companies are adopting more rigorous practices to ensure the ethical use of data and compliance with privacy regulations, such as the General Data Protection Regulation (GDPR) [32]. This trend promotes a greater focus on transparency, data quality, and protection of user privacy [33], [34].

*Social network analysis and IoT:* The presence of these terms in the keyword network signals a trend towards integrating data from social networks and connected devices into BI strategies. This allows companies to gain valuable insights from a wider range of sources. Social networks and the IoT generate a wealth of data that companies are beginning to leverage through BI [35, 36]. Social network analysis enables a better understanding of customers and the prediction of trends [37, 38], while the integration of IoT data into BI provides insights into device behavior and operational processes [39, 40].

*Real-time BI:* The presence of this trend in the keyword network confirms the growing importance of the ability to analyze real-time data in the field of BI. In dynamic business environments, real-time analytics allows organizations to react with agility to market changes, optimize operational decision-making and maintain a competitive edge [41]. This capability is especially valuable in sectors that require rapid responses, such as healthcare [42], e-commerce, finance, and logistics [43]. Real-time BI is supported by streaming data processing technologies and the use of cloud platforms, as seen in the connection with cloud computing nodes. Access to real-time data and analytics is no longer a luxury but a necessity in many industries [44]. Today's BI platforms allow monitoring live data, making it easier for companies to react with immediacy to events and changes in the market [45]. This capability is crucial in industries such as finance, where real-time decisions can have a significant impact [46].

*Augmented analytics:* This is an emerging trend in the keyword network. It combines AI, ML, and NLP to optimize traditional analytical processes. Thus, it helps users to discover insights in an automated way and reduce dependence on specialized data analysts, democratizing access to BI [47]. By automating analytical tasks and generating actionable recommendations, augmented analytics facilitates faster and more accurate interpretation of data, which is crucial for responding to dynamic changes in the business environment [48], [49]. Augmented analytics combine BI with AI and ML to optimize data analysis and decision-making. This trend is characterized by the use of automated tools to clean, analyze, and visualize data, which reduces reliance on data analysts and allows business users to interact directly with information [50].

*Data storytelling:* Although this trend does not appear explicitly in the keyword network, it is a crucial emerging trend in the field of BI, especially in terms of data visualization and presentation [51]. Data storytelling involves the ability to translate complex analytics into understandable and relevant narratives for decision making [52]. This trend is linked to the use of dashboards, data visualization, and information systems (themes present in the network) and is critical to ensure that findings are understood and used effectively at all levels of an organization. Data-driven storytelling is especially useful in business contexts to create compelling, evidence-supported presentations.

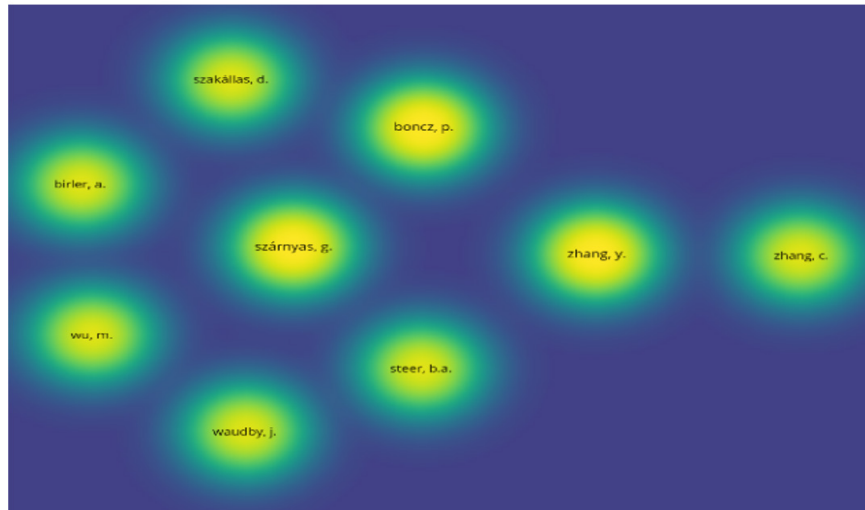
## Temporal evolution of keywords

Fig. 6 presents an overlay visualization [40, 53] that allows analyzing the temporal evolution of keywords. The color bar at the bottom of the figure shows a gradient of years (2019-2022), which facilitates the identification of changes in the popularity of certain keywords. Terms in blue shades represent concepts whose discussion started before 2019, while green and yellow shades correspond to more recent concepts.

For example, terms such as *pharmaceutical supply chain* and *population statistics*, represented in yellow, have become more relevant in recent years, possibly in the context of the pandemic.

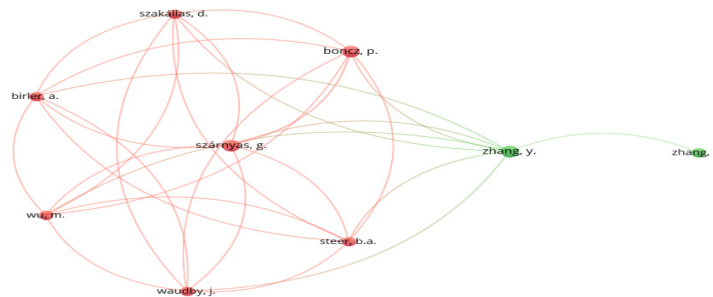
As for emerging trends, terms such as *ethics* and *blockchain* are located on the periphery of the network, which could indicate that they are growing topics but do not yet occupy a central place in BI. Likewise, the presence of *marketing intelligence* and *trend analysis* points to an emerging interest in these subfields.





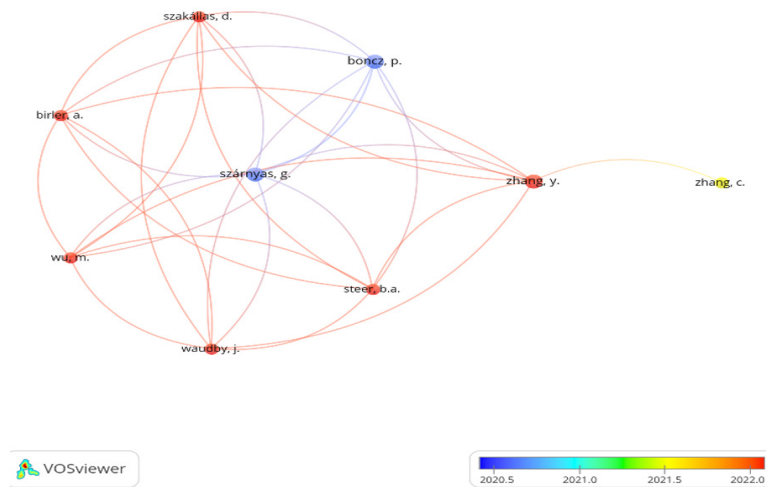
**Figure 7.** Density visualization – authors

*Network collaboration:* Fig. 8 shows a network visualization in which these same authors appear connected to a dense network of co-authorships, evidencing a strong collaboration between them. Their joint work could be a fundamental pillar in recent research and developments in BI.



**Figure 8.** Network visualization – authors

*News and trends:* In the overlay visualization (Fig. 9), Zhang is positioned as one of the authors with recent publications, indicating that he is at the forefront of current research and emerging trends in the field of BI.



**Figure 9.** Co-authorship overlay visualization

In conclusion, the analysis performed with the VOSviewer tool reveals that Szárnyas, Boncz, and Zhang stand out as the most influential authors in BI research, leading both in scientific production and collaboration within the academic community.

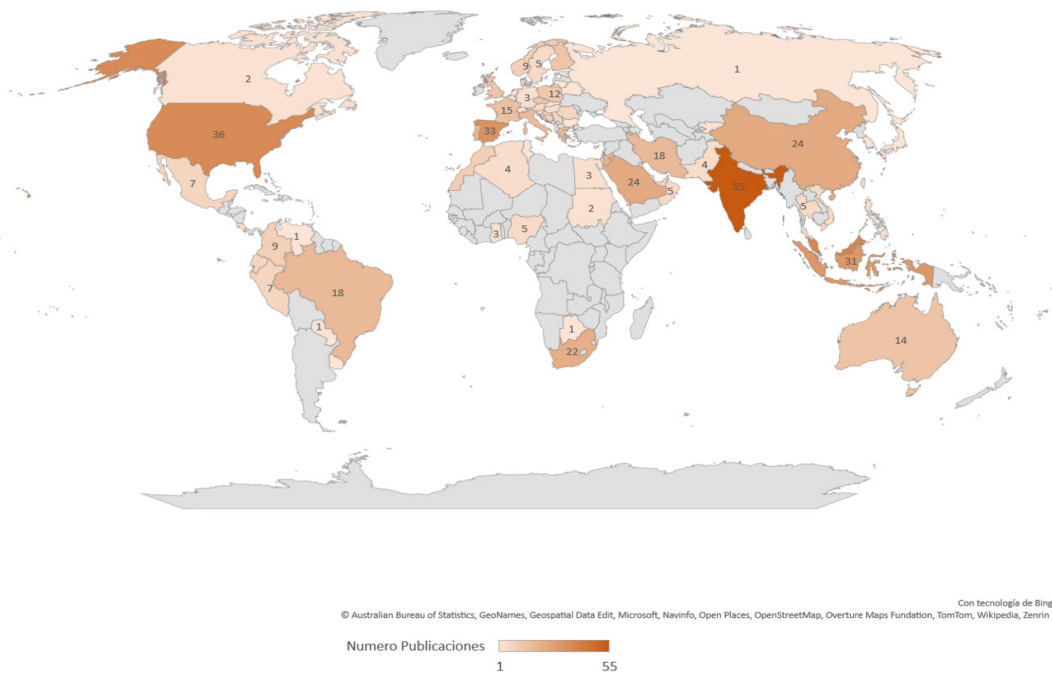
### R3. What is the geographic distribution of BI publications and their emerging trends?

Fig. 10 shows the geographical distribution of publications related to BI and its emerging trends in different countries. An analysis of this distribution is presented below.

The analysis of the geographical distribution of publications (Fig. 10) reveals the following:

#### Leading regions:

- *Asia and Middle East:* India (55 publications), Malaysia (38), Saudi Arabia (24), China (24), and Indonesia (31) lead the list. This suggests a strong interest in BI in these regions, possibly driven by accelerated growth in technology and BI adoption in key sectors such as retail and manufacturing.
- *Americas:* The United States (36 publications) stands out in the Americas, followed by Mexico (7), Colombia (9), and other Latin American countries. This indicates that, although there is considerable interest in BI in the region, its development is concentrated in certain areas.
- *Europe:* Countries such as Spain (33 publications), Portugal (19), Greece (18), England (17), Italy (17), and France (15) show a strong presence, which is evidence of a solid interest in BI in Europe. Nordic countries such as Finland (13) and Norway (9) also contribute, possibly due to their focus on digitization and technology.



**Figure 10.** Geographic distribution of publications

### Emerging countries in BI:

- *Africa:* South Africa (22 publications) leads in the continent, followed by Morocco (10) and Nigeria (5). This suggests that some African countries are embracing BI, especially in sectors such as finance and telecommunications.
- *Latin America:* Countries such as Brazil (18 publications), Colombia (9), Mexico (7), Ecuador (7), and Peru (7) show a growing interest in BI, reflecting the development of data technology in the region.

### R4. What sectors or industries are using BI the most?

The analysis of keywords associated with BI reveals the sectors or industries with high adoption rates. A detailed analysis of these associations is presented below.

### Sectors with the highest adoption of business intelligence

In [Fig. 11](#), which presents a density visualization, the keywords appearing in the highest density region (bright yellow) are:

- Social media (social networking)
- Cloud computing

- Analytics
- Healthcare
- Education

This suggests that BI is most frequently used in these sectors, probably in order to leverage large volumes of data and optimize decision-making.

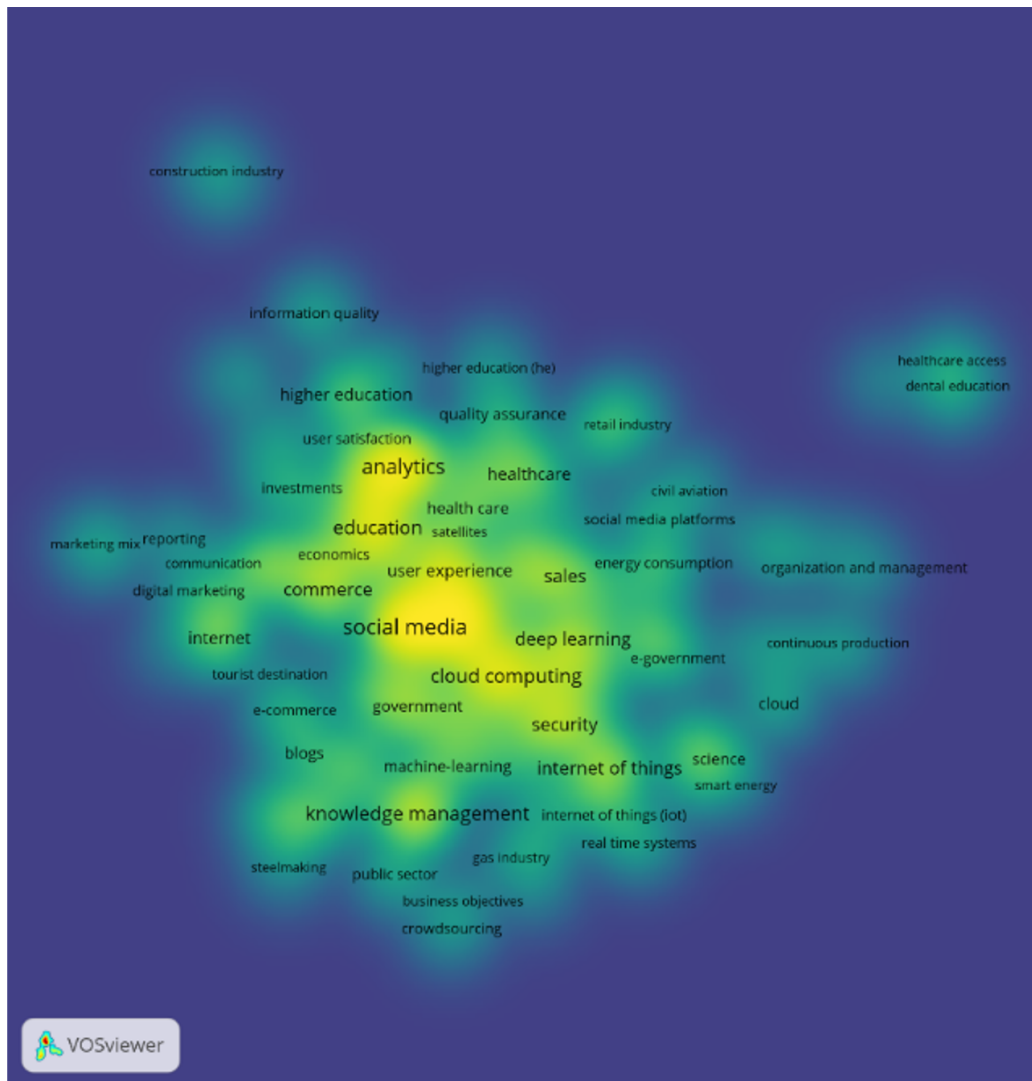


Figure 11. Density visualization, industries with BI adoption

## Relationship between sectors and BI

The network visualization presented in Fig. 12 shows detailed connections between the terms, allowing for the identification of specific sectors and application areas where BI interrelates with other areas. Key sectors connected to analytics and cloud computing include:



- Deep learning
- Smart energy

These terms indicate that, in recent years, BI has become more relevant in sectors such as smart energy and the IoT, where connectivity and advanced data analytics are being used to improve efficiency and sustainability.

## R5. What are the least explored areas in BI research?

To identify the least explored areas in business intelligence research, the network (Figure 12), overlay (Figure 13) (previously presented) and density (Figure 14) visualizations were analyzed.

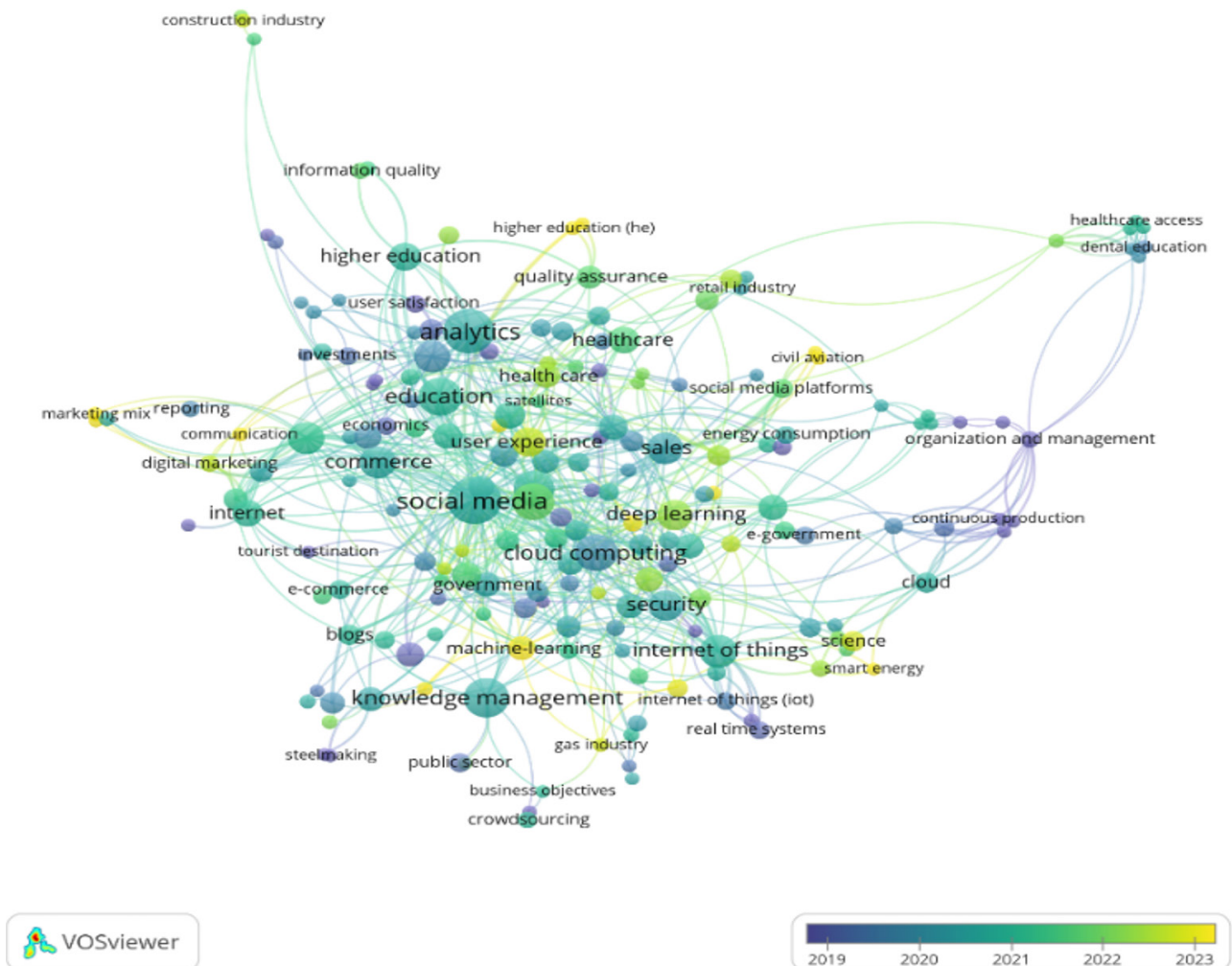


Figure 13. Overlay visualization, industries with BI adoption



Figure 14. Keyword density display

### Analysis of less explored areas

To identify the least explored areas in BI research, network (Fig. 12), overlay (Fig. 13), and density visualizations (Fig. 14) were analyzed.

### Network visualization analysis

Fig. 12, which presents a network visualization, shows a set of connected terms around BI. Among the main concepts, which are in the center of the map, with a high density of connections, *big data*, *data analytics*, *artificial intelligence*, and *cloud computing* stand out. This indicates that they have been extensively researched and that there is a close relationship between them.

On the other hand, terms located in the peripheral areas of the map, with a lower density of connections, include:

- *Decision intelligence*: While this term, which combines BI, AI, analytics, and automation to optimize decision-making, is emerging as an evolution of traditional BI, its lack of visibility and connections in the maps suggests that it has not yet been widely explored or adopted in academic or practitioner research.
- *Pharmaceutical supply chain*: This term appears isolated and with few connections, indicating a limited exploration of BI in this specific sector.
- *User-centered software development*: The relationship between this term and BI does not appear to be a frequent area of research.
- *Ethics*: Although it is a relevant topic, its peripheral position in the network indicates that it is an under-addressed perspective in the context of BI.
- *Bitcoin and blockchain*: While the term *bitcoin* is mentioned, it has few connections, suggesting a limited focus on how these emerging technologies could be integrated into business intelligence.

### Analysis of the overlay display

The overlay visualization (Fig. 13) provides a temporal perspective, with the colors indicating the average year of occurrence of the terms (from 2019 to 2022). Terms in yellow, representing more recent research, include concepts such as *artificial neural networks*, *augmented analytics*, and *sentiment analysis*. In contrast, areas in blue and green show topics that are less explored or are connected to less recent research works.

Areas that have been less researched in recent years include:

- *Association rule mining*: Although a common technique in data mining, its application in BI appears to be limited.
- *User-centered software development and pharmaceutical supply chain*: These continue to appear as peripheral terms with less relevance in recent research.

### Density analysis

The density visualization (Fig. 11) highlights the areas with a high concentration of research. BI, big data, and data analytics appear in bright yellow, indicating that they are widely researched terms.

Terms shown in duller colors or in less dense areas (*i.e.*, less researched areas) are:

- *Pharmaceutical supply chain and association rule mining*: these terms have low density and appear to be areas with less attention in BI research.
- *Ethics and marketing intelligence*: Although these are important areas in practice, they exhibit a lower density, suggesting a lack of significant research at their intersection with BI.

## Discussion

### Summary of findings and scope of the study

This systematic mapping study provides an updated and structured overview of emerging trends in BI research between 2017 and 2024. In contrast to previous bibliometric and scientometric reviews that cover long historical periods, this study deliberately focuses on recent developments, allowing for the identification of current dominant paradigms, emerging application domains, and research gaps that have not yet consolidated in the literature.

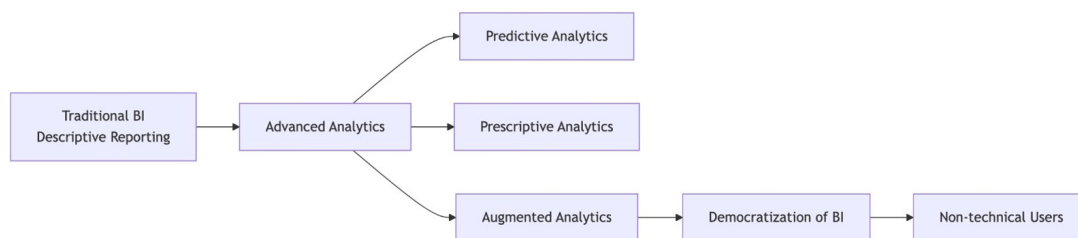
Beyond synthesizing existing studies, this work contributes by structuring the BI research landscape through a multi-dimensional perspective, integrating technological trends, geographic distribution, sectoral adoption, and underexplored research areas within a single analytical framework.

### Discussion of results by research question

#### *RQ1 – emerging trends in business intelligence*

The results confirm a clear shift in BI research from traditional descriptive reporting towards paradigms of advanced analytics, including augmented analytics, ML, AI, and real-time analytics. This evolution reflects a transition from retrospective data analysis to predictive and prescriptive decision-making (Fig. 15).

A key contribution of this study lies in highlighting augmented analytics as a central trend. Unlike earlier reviews that emphasized ML or data mining in isolation, this mapping shows how augmented analytics integrates AI, automation, and NLP to democratize BI, allowing non-technical users to interact directly with analytical systems.



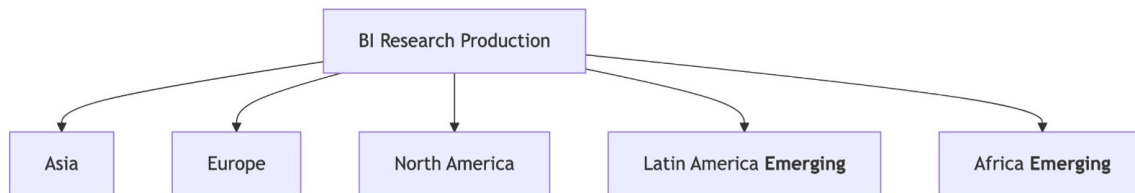
**Figure 15.** Evolution of BI towards augmented analytics and democratization

This study consolidates dispersed evidence to position augmented analytics not as a peripheral innovation, but as a core evolutionary stage of BI, clarifying its role in expanding adoption beyond technical experts.

#### *RQ2 and RQ3 – authors and geographic distribution*

The analysis of authorship and geographic distribution reveals that BI research is primarily driven by institutions in Asia, Europe, and North America, while also showing a growing contribution from emerging economies in Latin America and Africa (Fig. 16).

While previous reviews reported similar regional dominance, this study adds value by demonstrating that recent BI research growth is increasingly global, driven by cloud computing, open-source analytics platforms, and digital transformation initiatives that lower entry barriers.



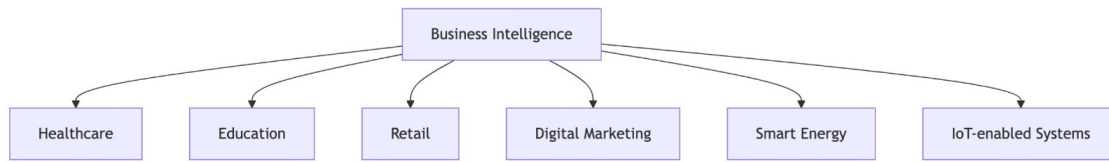
**Figure 16.** Geographic distribution of recent BI research and emerging regions

This study provides updated empirical evidence that BI research is no longer geographically concentrated, but is undergoing a process of global diffusion, which has implications for future cross-regional collaboration and contextualized BI applications.

#### *RQ4 – BI adoption across sectors*

The findings confirm that healthcare, education, retail, and digital marketing remain the sectors with the highest BI adoption. However, a relevant contribution of this mapping is the identification of new and rapidly emerging application domains, particularly smart energy systems and IoT-enabled environments (Fig. 17).

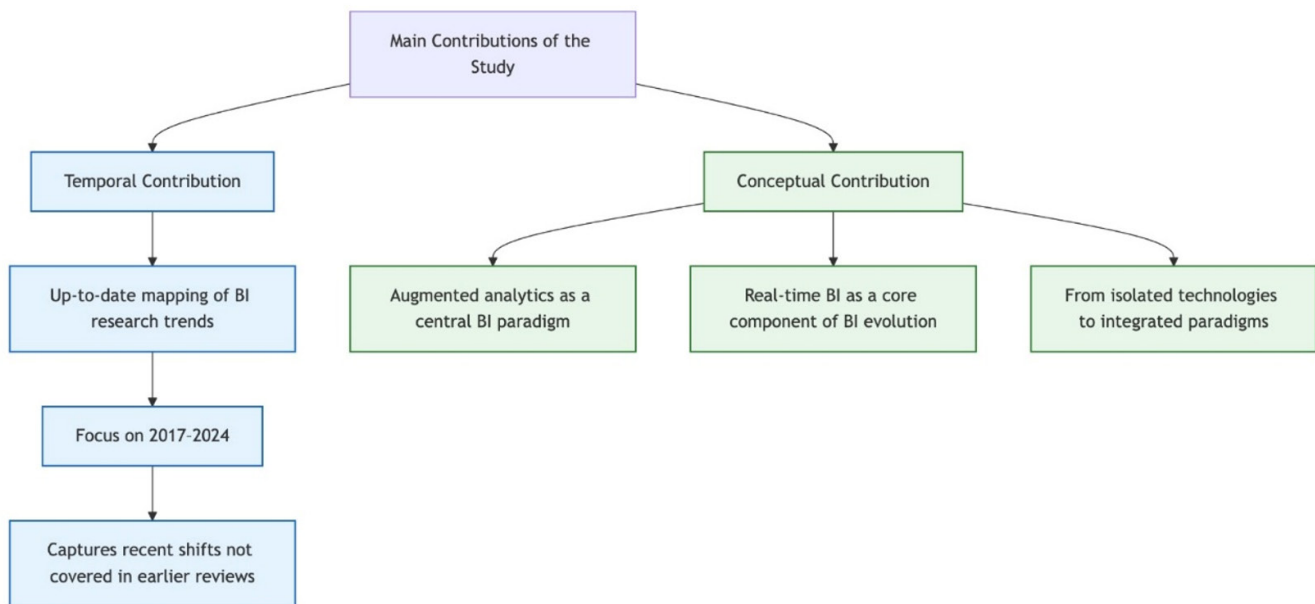
This indicates that BI is evolving from a managerial decision-support tool into a foundational component of cyber-physical and data-intensive ecosystems, where real-time data streams and automation are critical.



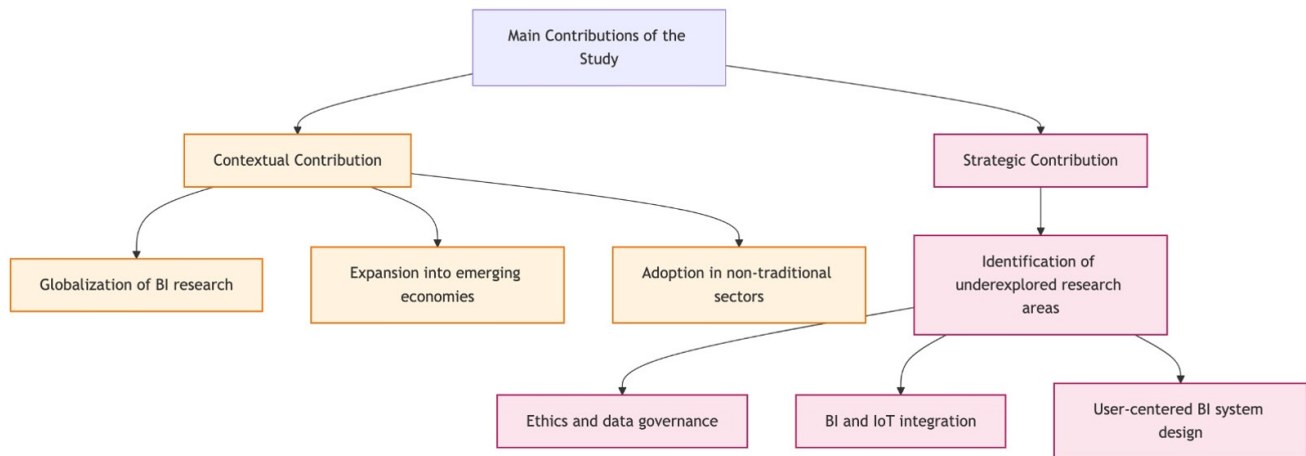
**Figure 17.** Sectoral distribution of BI applications identified in the mapping study

Our work goes beyond descriptive mapping by explicitly framing these gaps as research opportunities, providing a structured agenda for future BI research that balances technological advancement with ethical and human-centered considerations.

Beyond providing a descriptive synthesis of the literature, this systematic mapping makes explicit contributions to the field of BI. These contributions are articulated along four dimensions (temporal, conceptual, contextual, and strategic) that collectively differentiate this study from previous bibliographic reviews. [Figs. 18](#) and [19](#) summarize these contributions and their implications for future BI research.



**Figure 18.** Temporal and conceptual contributions of the study



**Figure 19.** Contextual and strategic contributions and research agenda

## Conclusions

This systematic mapping study provides a comprehensive and up-to-date synthesis of research on BI published between 2017 and 2024, offering a structured view of dominant trends, application sectors, geographic distribution, and research gaps. While technologies such as big data and AI continue to dominate the BI landscape, the results demonstrate that BI is undergoing a clear transformation towards more automated, real-time, and cloud-based analytical paradigms.

One of the main contributions of this study is the identification of real-time analytics, cloud-based BI, and augmented analytics as central drivers of current BI evolution. Unlike previous reviews that focused primarily on historical trends or isolated technologies, this work shows how these paradigms collectively enable a shift from descriptive reporting towards predictive and prescriptive decision-making, fundamentally changing how organizations generate value from data. However, the findings also reveal that adoption across industry sectors remains uneven, highlighting the need for more targeted and context-specific empirical studies.

From a sectoral perspective, this mapping confirms that BI adoption is most prominent in social media and digital marketing, healthcare, education, retail, and e-commerce. At the same time, the study identifies emerging domains such as smart energy systems and IoT-enabled environments, indicating that BI is expanding beyond traditional enterprise contexts into cyber-physical and sustainability-oriented ecosystems. This sectoral synthesis represents a concrete contribution since it clarifies where BI is currently consolidated and where it is still evolving.

In terms of geographic distribution, the analysis shows that BI research is globally distributed, with strong research hubs in Asia, Europe, and the Americas, alongside growing contributions from emerging

economies. This finding reinforces the notion that BI research is no longer geographically concentrated but rather reflects a progressive globalization of data-driven decision-making practices.

A particularly relevant contribution of this study lies in the explicit identification of underexplored research areas. The results reveal a limited number of studies addressing BI integration with IoT, advanced social network analytics, data ethics, and user-centered BI system design. Additionally, the literature shows a strong bias towards large organizations, with small and medium-sized enterprises (SMEs) remaining largely underrepresented. By systematically highlighting these gaps, this work goes beyond descriptive analysis and provides a clear agenda for future research. Furthermore, considering that the mapping identifies data ethics and governance as underexplored areas, the findings suggest that the technical evolution of BI, particularly driven by AI and ML, is progressing at a significantly faster pace than the development of ethical and regulatory frameworks. This imbalance is generating a growing *governance gap* that may expose organizations to risks related to transparency, accountability, bias, and responsible data use, thereby positioning ethical governance as a critical priority for future research.

In summary, the main contribution of this systematic mapping is not only the identification of current BI trends, but also the integrated interpretation of how BI is evolving technologically, sectorally, and geographically. It also sheds light on the aspects where critical research gaps persist. This study offers researchers a consolidated framework to position future investigations and provides practitioners with evidence-based insights into the strategic directions of BI. Ultimately, the findings reinforce the view of BI as an increasingly comprehensive, automated, and ethically responsible platform that supports agile, data-driven decision-making in complex and competitive environments while underscoring the urgent need to align technological innovation with robust ethical and governance mechanisms in order to ensure a sustainable and trustworthy BI adoption.

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