

Business Intelligence and its Development From the Perspective of Publication in Scientific Journals

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Abstract: This article presents a comprehensive analysis of the development and impact of Business Intelligence (BI) between 2018 and 2022. It focuses on examining research articles published in five reputable journals specified in the field of Business Information Systems. The study examines the development and impact of BI. How has the field of BI evolved over these years and what insights can be gained from its impact on decision making? This research delves into the nature of the growth of BI and its implications for modern businesses and offers valuable insights for practitioners and researchers alike. By categorizing the articles into key topics, methodologies, and areas, we reveal the dynamic landscape of BI research. The results highlight significant trends including the dominance of Business Intelligence, the shift towards digital articles, and the dominance of Business Processes and Analytics as the primary focus. These findings contribute to a comprehensive understanding of the trajectory of BI, guiding future research and strategic decisions in an ever-changing business environment.

Keywords: Business Intelligence (BI), analysis, impact, Harvard Business Review, Journal of Business Analytics, Information Systems Research, Journal of Management Information Systems, Data & Knowledge Engineering.

1. Introduction

At the pace of changes and constant improvements, modern businesses and entrepreneurs are facing new challenges - innovations that can impact their competitive advantage and the ability to make crucial decisions. Today's business environment is marked by dynamism and continuous development of new technologies and processes [1]. Although innovations and technological advancements bring new opportunities, they can also create pressures on organizations to quickly adapt and maintain competitiveness. Acquiring and processing pertinent data is critical, yet it can be challenging, particularly in cases where organizations lack the appropriate tools for efficient data collection and analysis. Processing and interpreting data can be complicated, particularly with the increasing volume of available information. These challenges hinder businesses from making critical decisions [2]. The speed of changes and the pressure for innovation restrict managers' decision-making time, often leaving them with incomplete information. And this is where Business Intelligence (BI) comes into play [3].

Moreover, recent statistics underline the growing public trust in artificial intelligence (AI), showcasing a broader trend of embracing technological advancements. As businesses navigate an environment marked by the rapid integration of AI and data-driven decision-making, the relevance of Business Intelligence (BI) becomes increasingly

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pronounced.

Our research seeks to penetrate the complex environment of Business Intelligence (BI) between 2018 and 2022. We have set three primary objectives:

Identifying key themes: Our first objective involves categorizing the field of Business Intelligence into its major themes, namely Business Intelligence, Business Analytics, Data Mining, Data Warehousing, and Big Data. Through this categorization, we seek to uncover the predominant themes that have been explored in the field over the time frame.

Comparison of the use of methodologies: Our second objective focuses on analyzing the methodologies used in BI research between 2018 and 2022. By categorizing articles based on their methodological approaches, namely magazine articles, digital articles, and case studies, we aim to reveal the diversity of research methods and shed light on trends in methodology preference over the period.

Exploring differences in the field: our third objective concerns exploring differences between the different fields in BI-related articles. We have divided the articles into the areas of Business Processes and Analyses, Industrial Applications and Optimization, Financial Analyses and Banking, and Management and Strategic Decision-Making. Through this categorization, we seek to identify how BI concepts have been applied and studied in different industries in a given time period.

By addressing these objectives, our research seeks to provide a comprehensive and nuanced understanding of the developments and trends in the field of Business Intelligence between 2018 and 2022.

2. Literature Review

Business Intelligence (BI) has come a long way since its inception. Since its first formal recognition and the articulation of key concepts by Gartner Research in 1989, BI has continuously grown and adapted to the changing business environment. Howard Dresner [4], an American analyst and consultant, working for Gartner Research, is considered the "father of the term Business Intelligence." His definition for BI was: "Business Intelligence is a set of concepts and methods to improve business decision-making by using fact-based support systems. [5]" Its origins can be traced back even further, to 1958, when Luhn introduced

the term "Business Intelligence System" in an IBM journal article. Even at that time, Luhn's concept shared similarities with the modern understanding of BI, emphasizing the importance of intelligent systems in guiding actions towards desired goals [6]. Gomez and Bautista similarly describe this tool as a means through which various types of organizations can support decision-making based on accurate and timely information [7]. This definition is in line with the viewpoint of Ballard et al., who emphasize the aspect of the essential concept of knowledge, enabling decisions in favor of the company's success and generating competitive advantages based on this generated information [8]. Information is an essential intangible resource that, once processed and analyzed through technological means, contributes to the organization's fundamental strategy and enables effective decision-making. [9] Over time, BI has become a key and essential component of modern business operations, especially with the advent of advanced technology and the continuously increasing availability of large data sources, which further strengthened BI and significantly influenced its implementation for organizations seeking a competitive edge in the market [10]. Today, Business Intelligence brings several types of tools and techniques, including data warehousing, data analysis, visualization, and predictive analytics. Their utilization allows organizations to gather, process, and analyze vast amounts of data from various sources, such as business interactions, customer interactions, market trends, and social media [11]. Insights from these analyses have a significant impact on process optimization, informed decision-making, and the identification of new opportunities [12]. Besides supporting decision-making, BI also finds its relevance in strategic planning and long-term forecasts. Managers monitor BI dashboards to identify risks and align business strategies according to market demands [13].

3. Experimental material(s) and methods

To assess the current state of research and the topicality of Business Intelligence (BI), we conducted a comprehensive literature review. The scheme of the literature review creation process is shown in the following image. (Figure 1).

The aim of the review was to identify and analyze scholarly articles related to BI published in

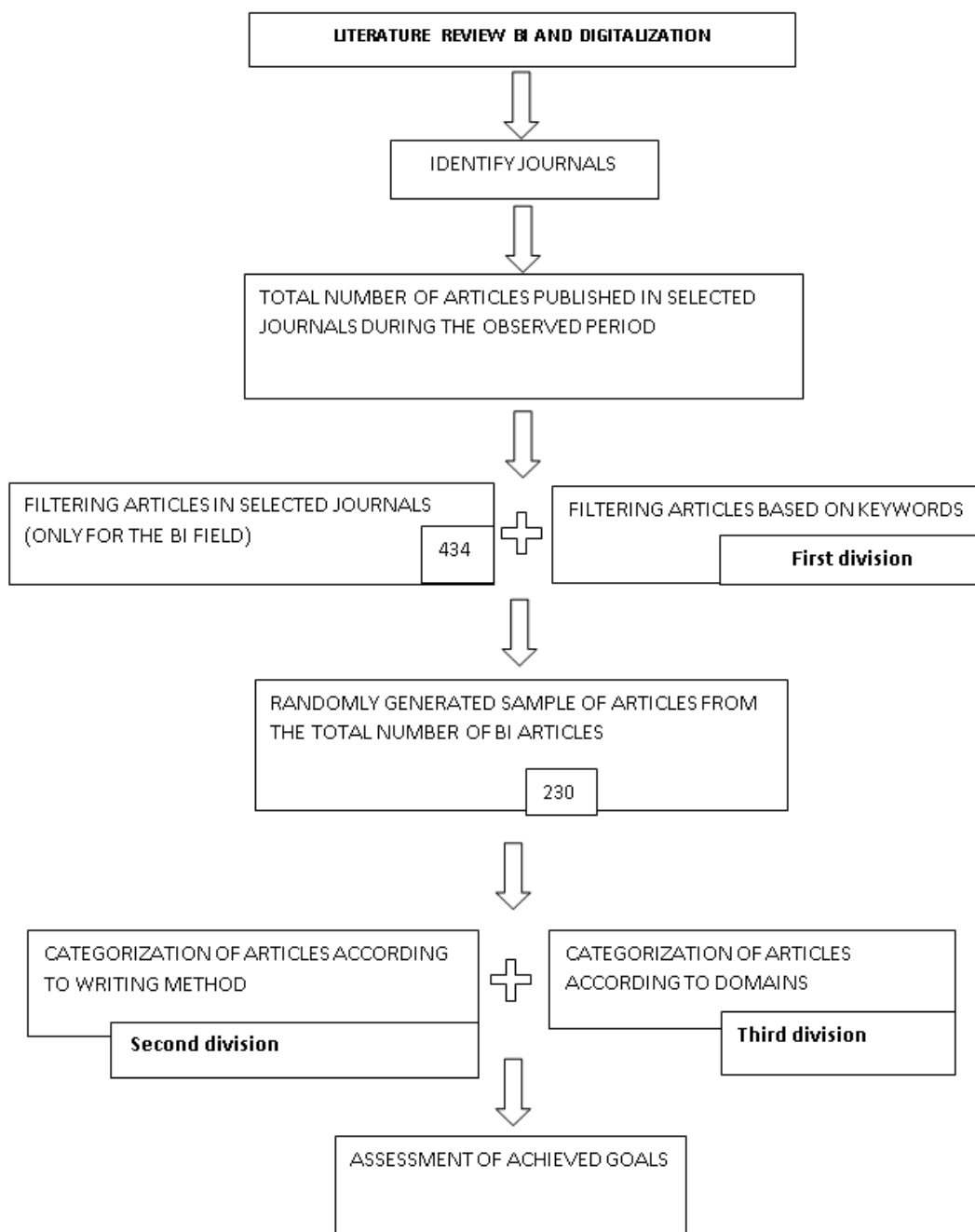


Figure 1: The scheme of the literature review

Table 1: Selected Journals Focused on Business Intelligence (BI)

<i>Journal</i>	<i>Publisher</i>	<i>Abbreviation</i>	<i>Publication Frequency</i>
Harvard Business Review	Harvard Business Publishing	HBR	Monthly
Journal of Business Analytics	Wiley	JBA	Quarterly
Information Systems Research	INFORMS	ISR	Quarterly
Journal of Management Information Systems	Taylor & Francis	JMIS	Monthly
Data & Knowledge Engineering	Elsevier	DKE	Monthly

various academic journals over a specific period. To obtain relevant articles, we focused on five significant journals that have a broad scope in the field of BI research, as listed in Table 1. (First step of the literature review scheme)

3.1 Characterization of Journals

Harvard Business Review (HBR) is a prestigious journal published by Harvard Business Publishing that specializes in entrepreneurship, innovation, and business leadership. With a keen interest in critical analysis of business trends and strategies, HBR actively explores key aspects of Business Intelligence (BI). The magazine presents a wide range of relevant articles authored by renowned experts from the corporate world. Published monthly, the magazine is distinguished by a rigorous approach to research and publication that is based on sound methodologies and validated data. HBR consistently delivers deep insights on new technology solutions, analytical tools, and innovative approaches in BI. Given its prominent position in academia and business, HBR serves as a valuable source of information and research results that provides essential inspiration and perspectives for practitioners, researchers, and managers working in the field of Business Intelligence [14].

The Journal of Business Analytics (JBA) is a major publication in Wiley's portfolio that focuses on business analytics and its applications. Published quarterly, JBA is dedicated to cutting-edge research, methodologies, and real-world case studies in analytics, including business intelligence. The journal attracts contributions from leading practitioners and academics in the field, making it a reliable source of valuable insights and advancements in the field of business analytics. JBA is known for its commitment to empirical rigor, analytical rigor, and practical relevance, ensuring the dissemination of high-quality research results and actionable insights to practitioners and researchers interested in the application of analytics and BI in a variety of

industries [15].

Information Systems Research (ISR) is a highly regarded journal published quarterly by INFORMS. ISR explores the complex interaction between information technology and organizational systems. Although the journal covers a wide range of topics in information systems, it also includes articles that explore the strategic use of BI, data mining, and data warehousing in an enterprise context. ISR focuses on empirical and theoretical research and encourages in-depth exploration of the implications of the adoption, use, and impact of BI on organizational decision making and performance. As a leading journal in the IS field, ISR's articles provide valuable insights and theoretical advances to researchers and practitioners in the area of Business Intelligence and its integration with information systems [16].

The Journal of Management Information Systems (JMIS) is a monthly journal published by Taylor & Francis that is devoted to the study of information systems in a management and organizational context. Although JMIS covers a wide range of topics related to information systems, it also includes research articles that deal with BI, data analysis, and decision models. With a diverse readership of academics, researchers, and practitioners, JMIS bridges the gap between technology and management, offering valuable insights into the strategic use of BI and analytics to make effective decisions and gain competitive advantage. With a monthly publication schedule, JMIS rapidly disseminates research findings and provides readers with timely and relevant information on advances in BI and its implications for management practice [17].

Data & Knowledge Engineering (DKE) is a monthly magazine published by Elsevier that focuses on data and knowledge management in a variety of fields. DKE covers various aspects of BI including data mining, data warehousing and knowledge discovery. With a strong emphasis on

the development and application of advanced data management and knowledge engineering techniques, DKE provides a platform for researchers to present their contributions to the growing field of BI. As a multidisciplinary journal, DKE attracts researchers from the fields of computer science, artificial intelligence, and information systems, thus promoting a holistic approach to BI research. The monthly frequency of the journal ensures rapid dissemination of innovative methodologies, techniques, and case studies, making it a valuable source of information for academics and practitioners interested in the latest developments in the field of Business Intelligence and its applications [18].

The identification of these five major academic journals confirmed their strong focus on BI research, validating the appropriateness of their selection for obtaining high-quality scholarly articles.

3.2 Research Methodology

To ensure a comprehensive and systematic approach to acquiring relevant articles for our literature review, we employed a multi-stage research methodology.

The selection of scientific journals and articles for analysis was conducted with an emphasis on quality, relevance, and the scope of information they provide. Criteria included the reputation of journals in the field of Business Intelligence (BI), their impact factors, and the citation of articles. Simultaneously, we utilized a combination of keywords and phrases in our searches to ensure the inclusion of the broadest range of topics related to BI. These factors aided us in identifying relevant articles that served as the foundation for our systematic analysis and literature review within the specified period from 2018 to 2022.

After selecting and identifying appropriate sources, (Second step of the literature review scheme) we proceeded to conduct searches for articles focused on Business Intelligence. For the search, we carefully selected five key phrases, or keywords, to encompass a wide range of topics related to BI and ensure the inclusion of relevant articles. (Third step of the literature review scheme). These phrases were: "business intelligence," "business analytics," "data mining," "data warehousing," and "big data." Through their combination and the integration of broader concepts, our aim was to obtain a comprehensive selection of scholarly works on BI.

The chosen time frame for the literature review

encompassed the last five years (2018-2022) leading up to the current date. The selection of this period was made with the aim of acquiring the most current and relevant scientific articles in the field of BI. The year 2023 was not suitable for our literature research, and thus, we decided not to include it. Important insights from the authors contributed to this decision. Firstly, we were in the process of preparing our literature review in the middle of the year 2023. This temporal constraint could significantly limit the number of available and already published relevant articles. We believe that such limitations could have a considerable impact on the overall effectiveness and comprehensiveness of our research. Additionally, there was a need to focus on a sufficiently specified and defined time frame to ensure obtaining relevant yet thoroughly analyzed outcomes. By including too broad of a time range, we might encounter an excess of material and lose focus on the most current insights or trends in the studied area - Business Intelligence. We ensured better analyzability and the most relevant information by restricting our review to the years 2018-2022.

Given the significant total number of articles identified (434 articles) in the selected journals, it would be impractical and time-consuming to analyze each article separately. We therefore decided to analyze a representative sample of articles. Considering the principles of statistical sampling, we randomly selected 230 articles out of the total 434 articles for our analysis. (Fourth step of the literature review scheme). This approach allows us to draw meaningful insights and conclusions while maintaining the necessary rigour and ensuring an appropriate workload.

To further categorize the collected articles and provide a structured analysis, we applied the strategy proposed by Neuendorf [19]. We grouped the articles into three main categories:

1. *Division of the Sample According to Topics: Utilizing Neuendorf's strategy [19], we strategically divided the sample of articles based on topics such as Business Intelligence (BI), Business Analytics, Data Mining, Data Warehousing, and Big Data. This ensured that the sample encompasses various aspects and perspectives in the field of BI, allowing us to better understand the applications and utilization of BI in diverse contexts.*

2. *Division of the Sample According to Methods (Fifth step of the literature review scheme): Furthermore, following Neuendorf's strategy, we divided the sample of articles based on the employed*

research methods, including magazine articles, digital articles, and case studies. This division provided us with a better understanding of how BI is investigated, analyzed, and implemented across different research approaches.

3. *Division of the Sample According to Domains (Fifth step of the literature review scheme): Neuendorf's strategy led us to further categorize the sample of articles based on domains, such as:*

- » *a) Business Processes and Analyses: This category includes articles focusing on the development and optimization of business processes using tools for business intelligence. Various aspects of the efficiency of business processes within organizations are analyzed here.*
- » *b) Industrial Applications and Optimization: In this category, articles addressing the implementation of business intelligence in industrial sectors are included. The research is oriented towards optimizing manufacturing processes, monitoring equipment performance, and predicting needs based on analytical data.*
- » *c) Financial Analyses and Banking: This category delves into specific financial aspects within the banking and finance domain. Articles in this category tackle the analysis of financial data, prediction of market trends, and support for decision-making in the banking sector.*
- » *d) Management and Strategic Decision-Making: This category explores articles focusing on the utilization of business intelligence in management and strategic decision-making. It examines ways in which analytical tools assist managers in the process of strategy formulation and decision-making.*

This classification enables us to compare the use of methods in BI research, explore subject and approach differences across various disciplines, and identify key trends in the field over the specified period.

During the analysis and categorization of articles, we utilized appropriate searches on the pages of individual journals, filtering options, and even the "Ctrl + F" function for easier understanding and overview of articles in the selected sample. Following this step, interpretation of the acquired data and findings ensued. To reflect our conclusions and

support our objectives, we adjusted the approach of our results. Detailed discussions were provided for each finding. To ensure a clearer understanding and intuitive comprehension for readers, the results were enriched with relevant tables and graphs. (Sixth step of the literature review scheme)

Overall, a systematic approach to searching, the combination of keywords, and the application of Neuendorf's strategy allowed us to conduct a thorough literature review and identify trends in the field of Business Intelligence within the timeframe between 2018 and 2022. Our results also unveil various percentage distributions, enabling us to closely examine the interest in article writing in this field across individual years, thereby providing a comprehensive view of its development.

4. Results and discussion of achieved results

The Table 2 below represents the original publication of articles on Business Intelligence (BI) from the original total count of 434 articles for the observed period 2018 - 2022.

The Table 2 displays the number of published scientific articles in selected journals during the monitored period from 2018 to 2022. Using this table, we can easily identify the total number of articles published in each year, as well as the overall number of articles for the entire period and their percentage share focusing on the field of Business Intelligence. Additionally, the table provides a summary view of the total number of scientific articles published throughout the entire period, regardless of the journal.

The total number of published articles during the observed period reached 10389. Articles addressing the topic of Business Intelligence accounted for 4.18%, corresponding to 434 articles. The highest number of BI-related articles was recorded in 2018, with 106 such articles published. The overall number

Table 2: Analysis of Published Scientific Articles in Selected Journals (2018-2022): A Focus on Business Intelligence (BI)

Journal Name	2018			2019			2020			2021			2022			2018-2022		
	Total	BI	%	Total	BI	%	Total	BI	%	Total	BI	%	Total	BI	%	Total	BI	%
HBR	1733	49	2,83	1153	43	3,73	2986	31	1,04	1792	36	2,01	1787	32	1,79	9451	191	2,02
JBA	9	7	77,78	10	5	50,00	13	7	53,85	21	7	33,33	13	7	53,85	66	33	50,00
ISR	51	12	23,53	84	14	16,67	81	17	20,99	83	11	13,25	113	12	10,62	412	66	16,02
JMIS	39	21	53,85	47	6	12,77	45	11	24,44	44	20	45,45	43	12	27,91	218	70	32,11
DKE	72	17	23,61	46	15	32,61	36	12	33,33	30	15	50,00	58	15	25,86	242	74	30,58
SUM	1904	106		1340	83		3161	78		1970	89		2014	78		10389	434	4,18

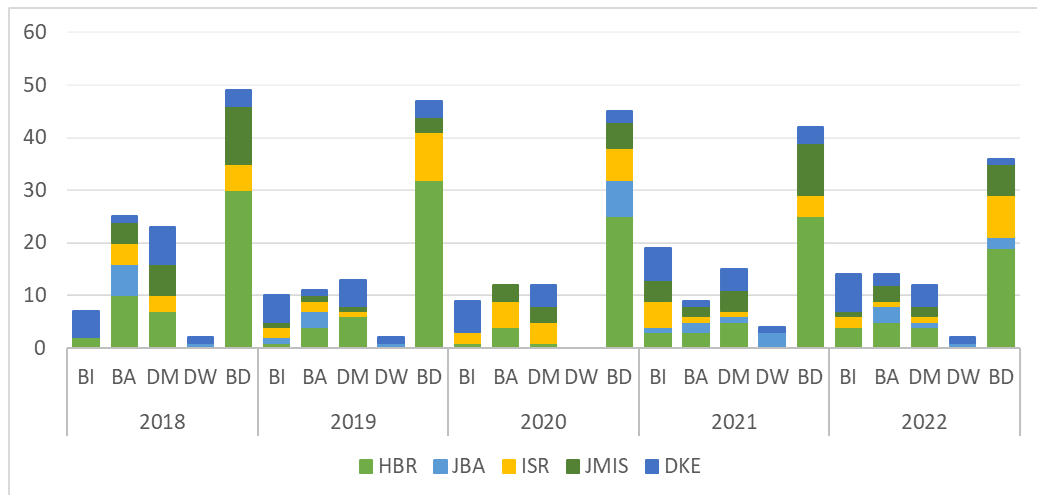


Figure 2: The first category of the distribution of published articles

of articles in that year reached 1904. The year 2020 emerged as the most prolific in terms of published articles, with a total of 3161. Among the individual journals, the highest number of articles focused on the BI topic was observed in the HBR journal, which is published monthly. The total number of BI-related articles in this journal amounted to 191 however, their percentage share of the total number of articles in the journal was the lowest, at only 2.02%. In the JBA journal, a 50% share of BI articles was recorded, with a total of 66 articles published.

The following Figure 2 illustrates the first category of the distribution of published articles in the field of Business Intelligence, based on the Neuendorf's strategy.

From the Figure 2, it can be inferred that the majority of articles focus primarily on Big Data, especially in the HBR (Harvard Business Review) journal. The most productive year in this area within the mentioned journal was 2019, with 32 articles

published on the topic of Big Data. The overall count of articles related to Big Data in the observed period (2018 - 2022) is 219, out of which 131 articles are covered by the HBR journal.

Conversely, the category "Data Warehousing" shows the least number of articles. Only two journals, JBA (Journal of Business Analytics) and DKE (Data & Knowledge Engineering), addressed this area, with a negligible count of 10 articles published over the five-year period. Specifically, JBA contributed six articles, while DKE had four articles related to Data Warehousing.

For the remaining categories, a selected sample of articles was used. Specifically, this sample consists of 230 articles out of the original 434. This sample is detailed in the following Table 3.

For this Figure 3, the same findings apply as illustrated in the previous Table 2. The highest proportion of BI articles was achieved in 2018, accounting for 2.94% of the total of 1904 published

Table 3: Analysis of Published Scientific Articles in Selected Journals (2018-2022): A Focus on Business Intelligence (BI) – the selected sample of articles (230)

Journal Name	2018			2019			2020			2021			2022			2018-2022		
	Total	BI	%	Total	BI	%	Total	BI	%	Total	BI	%	Total	BI	%	Total	BI	%
HBR	1733	26	1,50	1153	23	1,97	2986	16	0,55	1792	19	1,06	1787	17	0,95	9451	101	1,07
JBA	9	4	44,78	10	3	28,79	13	4	31,00	21	4	19,19	13	4	31,00	66	19	28,79
ISR	51	6	12,12	84	7	8,59	81	9	10,81	83	6	6,83	113	6	5,47	412	34	8,25
JMIS	39	11	28,46	47	3	6,75	45	6	12,92	44	11	24,03	43	6	14,75	218	37	16,97
DKE	72	9	12,44	46	8	17,19	36	6	17,57	30	8	26,35	58	8	13,63	242	39	16,12
SUM	1904	56		1340	44		3161	41		1970	48		2014	41		10389	230	2,21

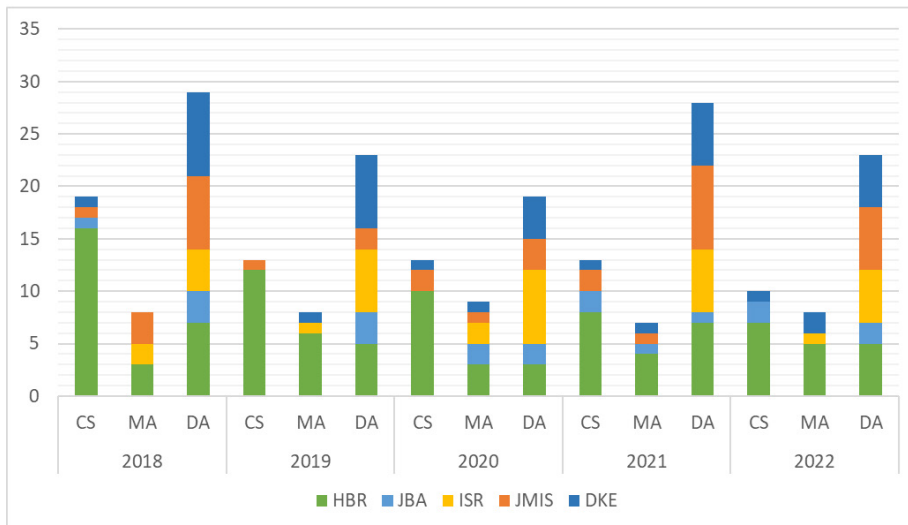


Figure 3: The second category of the distribution of published articles

articles. The weakest years in terms of BI articles were 2020 and 2022, both with the same number of published articles-41. The total number of published articles in the selected journals remained consistent throughout these years.

From the provided Figure 3, it is evident that among the various options (case study, digital article, and magazine article), the digital article prevails. Its peak was reached in 2018, and its lowest point of occurrence is in the year 2020. Within the observed period, the highest number of digital articles in the field of Business Intelligence was found in the DKE magazine, totaling 30 articles. Conversely, the JBA

magazine published the lowest number of digital articles (only 11). Regarding case studies, the HBR magazine dominates with a total of 53 over the five-year period. The graph indicates that the most productive year was the initial year, specifically 2018. Articles published in magazines achieved the highest representation in the HBR magazine, with a total count of 21. The JBA magazine represents the smallest quantity in this context.

During the period from 2018 to 2022, the majority of published articles were strongly focused on the domain of business processes and analyses. This category accounted for nearly 37% of all 230

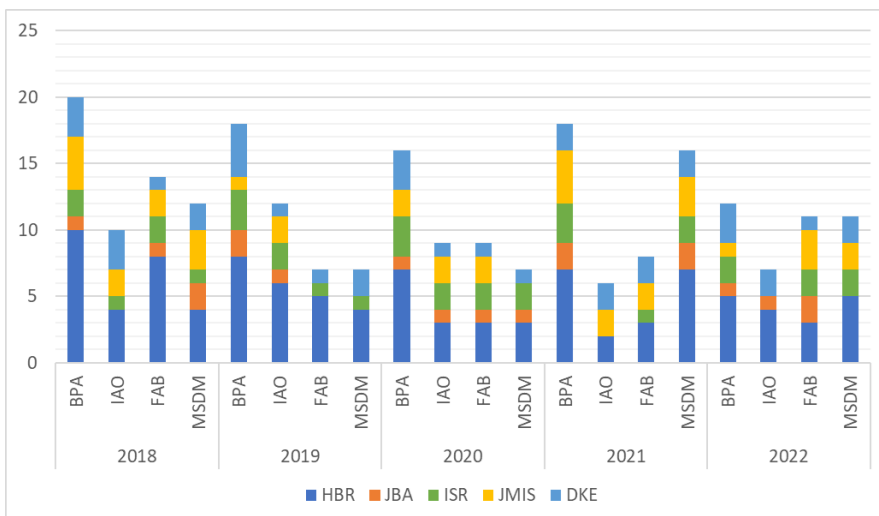


Figure 4: The third category of the distribution of published articles

selected articles. In 2018, it reached the pinnacle of its significance with 20 articles, largely due to the dominance of the HBR journal. Its prominent share was evident in the graph's development throughout the entire observed duration. In contrast, the smallest representation was achieved by the category of industrial applications and optimization, contributing to 19% of the total sample of 230 articles. Here too, a peak was observed in 2018, with the influence of the HBR journal being notable once again. The categories of financial analyses and banking, as well as management and strategic decision-making, shared roughly equal portions. Their highest occurrence was identified in the HBR journal, where they constituted approximately 10% of the total count. The lowest number of articles in these categories was published in the JBA journal, representing a mere 2% of their overall representation.

4. Conclusions

In a rapidly evolving business landscape characterized by continuous technological advancements, the role of Business Intelligence (BI) has become increasingly crucial for organizations seeking to maintain a competitive edge. This study embarked on a comprehensive exploration of the field of Business Intelligence between 2018 and 2022, aiming to decipher its key themes, methodologies employed, and its application across various domains. The significance of BI in facilitating informed decision-making and strategic planning was underscored, as organizations grapple with the complexities posed by the ever-increasing volume of data.

The set objectives of this research were effectively achieved, providing valuable insights into the landscape of BI research during the specified timeframe. The analysis of scholarly articles published in prominent journals yielded interesting results, revealing the prevalence of themes such as Business Intelligence, Business Analytics, Data Mining, Data Warehousing, and Big Data. These themes illuminated various aspects of BI that captured attention, with Big Data emerging as a focal point of investigation. However, it's important to note that among the themes not mentioned by authors in some journals (such as JMIS and ISR), Data Warehousing was also included. This topic had the lowest number of published articles and

seemingly less researcher interest. This revelation points to the diversity of researchers' interests and the significance of tracking even less prominent topics within the realm of Business Intelligence. Simultaneously, it's intriguing that the highest number of published articles was observed in the prestigious Harvard Business Review (HBR). This fact might not only indicate interest and demand for BI-related topics but also likely suggests a frequent publishing frequency of this journal. Such higher frequency could signify a strong responsiveness to current trends and developments within the BI field, which holds substantial implications for the rapidly changing business context.

Methodological preferences in BI research were examined through categorizing articles into magazine articles, digital articles, and case studies. The rise of digital articles as the predominant means of information dissemination underscores the shift towards digital platforms for exchanging information. However, it was noteworthy that case studies, particularly in prestigious magazines like Harvard Business Review, continue to play a pivotal role in illuminating real-world applications of BI.

Furthermore, the investigation into the diverse domains in which BI has been applied demonstrated the adaptability of BI concepts across various sectors. Business Processes and Analyses emerged as a predominant focus, highlighting the emphasis on optimizing operational efficiency and effectiveness. Meanwhile, Industrial Applications and Optimization showcased the utility of BI in manufacturing settings, while Financial Analyses and Banking illuminated the transformative impact of BI on financial decision-making. Management and Strategic Decision-Making underscored BI's role in shaping strategic initiatives and managerial choices, fostering organizational resilience.

This study was inspired by an influential article from 2008 that also focused on the field of Business Intelligence (BI). The significance of this topic is indisputable, particularly considering the rapidly evolving technological and analytical landscape of the present day. In comparison to the original 2008 article, which tracked developments in the BI field over a decade, our research centers on the current perspective and recent advancements in the field. In our study, we adopted a similar analytical approach to the previous research and incorporated several categories to provide a more detailed categorization

of the articles. Remarkably, despite the shorter timeframe under examination, we observed a distinct surge in interest surrounding this topic, implying that BI has evolved into a pivotal element within the contemporary business landscape. Furthermore, our analysis encompassed prominent journals that were also referenced in the 2008 article, such as the Harvard Business Review (HBR). This inclusion enabled us to trace the continuity of interest in this subject across various time periods and publications. Our research has yielded invaluable findings. The volume of analyzed articles expanded to 230, affording us a comprehensive understanding of the current state of the field from multiple perspectives. This contribution enhances the comprehension of dynamics within the Business Intelligence realm and underscores its significance within the modern business environment.

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