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# 20 Years of Scientific Study on Business Intelligence and Decision-Making Performance: A Bibliometric Analysis

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***Abstract***

**Background:** Business intelligence (BI) is an area in which data analytics is applied to generate crucial information supporting business decision-making and has been a significant domain for over three decades. However, there is uncertainty regarding whether investments can effectively improve organizational outcomes.
**Objective:** This study aimed to provide a comprehensive overview of the knowledge generated and disseminated in previous investigations related to the intricate relationship between BI and decision-making performance (DMP) over the past 20 years.
**Methods:** An R-tool namely bibliometrix, which supports suggested workflow for conducting bibliometrics and includes descriptive as well as knowledge structure analysis was used on a dataset containing 1,484 English-language articles published between 2003 and 2023 and indexed in Web of Science databases.
**Results:** The results showed that field study has stabilized over the past three years, signaling a shift in the focus of scholars. However, only a few studies use decision theory and further investigations are required to fully understand how BI impacts DMP both inside and outside organizational boundaries.
**Conclusion:** Based on the results, BI studies tend to be more application-oriented and there is a need to change the emphasis from focusing only on tools to variables such as the role of effective use and competencies that might improve decision quality.

***Keywords:*** Business Intelligence, Decision-Making Performance, Decision Quality, Bibliometrics, R-tool.

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## I. INTRODUCTION

Data-driven decision-making is considered crucial in the current business world, and Business Intelligence (BI) has been proposed as a critical tool for organizations of all scales. BI is broadly defined as an umbrella term comprising the applications, infrastructure, and tools that facilitate access to and analysis of information to improve and optimize decision and performance. It facilitates the transformation of raw data into actionable insights [1], thereby empowering leaders to make informed decision, streamline operational efficiency, and gain a competitive advantage.

The growing importance of BI in organizational decision-making processes has been underscored by numerous scholars and industry experts [1], [2], [3]. The capabilities aim to empower decision-makers with the necessary data and information for effective problem-solving at both individual and organizational levels [4], [5], [6]. This is particularly evident in sectors such as retail and marketing, where data-driven decision directly translate into business value creation [1].

In the current dynamic competitive environment, organizations increasingly recognize the critical role of BI and data analytics competency in evaluating and enhancing decision-making performance (DMP) [7]. This emphasis is supported by well-documented contributions to organizational effectiveness and competitive advantage. Existing studies not only support this claim [7], but [8] have also meticulously reviewed various BI maturity models from the literature specifically to assess BI and analytics (BI&A) capability maturity.

Academic studies on the advantages of BI&A for organizations have often yielded mixed results, showing that the mechanisms linking BI capabilities to organizational performance are still not fully understood [9], [10], [11]. As stated by [12], BI tool effectiveness appears to be highly dependent on context, varying across organizations and presenting both challenges and opportunities for improvement. Another study [6] underscored the existence of various theories and perspectives that offer a diverse range of insights into how decision are conceived and structured.

The capabilities of BI to enhance decision-making are undeniable, but scholars caution against overly simplistic assumptions [13], [14], [15], [16], [17], [18]. Successful use depends on a complex interplay of factors beyond the

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tools. Key intervening variables include the availability of resources and conducive conditions within the firm. Effective tool use [19], [20] and knowledge-sharing practices [7] are crucial examples. Additionally, contextual factors moderate the relationship between BI and DMP. These moderators include the organization data-driven culture [21], the problem space complexity of the space about which decision is made [4], [6], and the broader environment, comprising various aspects [5].

Although numerous theories examining decision-making offer diverse viewpoints and levels of analytical depth [6], most converge on the concept of decision quality (DQ) or DMP as a key indicator of successful decision-making. One perspective, stated in [4], defines DQ as a combined measure of effectiveness and efficiency within decision-making process. Conversely, other studies [7] treat DMP as the dependent variable, reflecting user evaluations of both decision quality and efficiency [22], [23]. Another view defines decision outcomes including accuracy, precision, and reliability as core elements of DQ, while efficiency focuses on speed of decision-making [22].

The vast field of BI demands a more thorough analysis of existing studies. Although previous studies [24], [25], [26] have been valuable in understanding critical success factors (CSFs), such as a clear strategy, defined business needs, and consistency with goals, a comprehensive mapping of the current literature and historical development remains elusive. This knowledge gap impedes the ability to track the maturation of study on BI and DMP, hindering the identification of crucial areas for future exploration. Studies have also consistently shown a positive correlation between BI adoption with improved decision-making [19], [27], [28], [29] but a deeper understanding is needed. Although organizational enthusiasm for solutions remains high, the ability of these technologies to consistently improve organizational outcomes is unclear [10], [30].

Several studies have explored BI in decision-making, such as the absence of decision theory [31], the use of data analysis [32], and intelligence in business [33]. There has been no study that explicitly shows the role on DMP. Therefore, this study aimed to conduct bibliometric analysis to show the specific relationship between BI and DMP. The results will contribute to identifying primary knowledge domains, new trends, and study gaps to provide insight into future study directions in this important area.

## II. Literature Review

Although the preceding sections have established the foundational framework for understanding the intricate relationship between BI and DMP, it is essential to contextualize the study within the broader scholarly landscape. This section presents a comprehensive review of existing secondary studies that have explored similar or overlapping questions. It focuses on the methodological approaches, purpose, and key concerns in the studies. By juxtaposing the present work with previous investigations, the objective is to elucidate the unique value proposition and identify potential avenues for future inquiry. A summary of the study is presented in Table 1.

TABLE 1
Related Studies

| Ref. | Methodological Approach | Purpose/Goal | Key Concerns in Study Questions |
|---|---|---|---|
| [32] | Bibliometric analysis using VOSviewer software on 161 publications (2007-2021) from Web of Science (WoS), Scopus, and Google Scholar. Content analysis used. | Explore the role and potential of data intelligence & analytics (DI&A), big data (BD), artificial intelligence (AI), and human-artificial Intelligence (HAI) in enhancing decision-making processes in the public sector. | A. Mentioned the need for a shift in study focus towards new models of DI&A, AI, BD, and HAI, emphasizing ambidexterity in decision-making processes.<br>B. Identified gaps in understanding the influence of HAI. |
| [31] | Systematic Literature Review based on guidelines by Kitchenham on 111 publications (2000-2019) from multiple databases. Includes identification, search, selection, quality assessment, data extraction, and synthesis. | A. The main goal is to comprehensively report on BI system adoption, use, and success<br>B. To identify key factors, challenges, and knowledge gaps, and suggest future study directions. | A. The study questions focus on the main areas of investigation (adoption, use, success)<br>B. Theories/frameworks/models used<br>C. Key factors identified in previous studies<br>D. Challenges faced by organizations concerning BI system<br>E. Knowledge gaps within the current BI system study |
| [33] | Bibliometric methods and SciMAT software for performance analysis and science mapping. Identified study themes over defined periods. | Analyze the evolution of intelligence models in management and business over 30 years, focusing on bibliometric performance indicators and thematic development. | A. Investigate how intelligence models have been defined and evolved.<br>B. Address the need for a framework incorporating intelligence processes into decision-making for improved organizational competitiveness. |
| [18] | Bibliometric analysis using CiteSpace, VOSviewer, and descriptive statistics. Analyzed publication trends and topic evolutions from 1990 to 2017. | Map the study landscape of BI and BD, and identify future study directions within technology, applications, management, and impact dimensions. | A. Focus on gaps in study regarding the strategic and managerial impact of BD/BI.<br>B. Need for further exploration of security, privacy, and impact on individual and organizational life. |

A systematic literature review conducted by [31] underscores a surprising gap in the existing BI reports namely the absence of decision theory in many related studies. Given the inherent purpose of BI systems to enhance decision-making, this omission is significant. Although previous bibliometric reviews have illuminated the rise of Big Data (BD) and BI [18], the evolving concept of intelligence in business [33], and the potential of data analytics in decision-making [32], a gap persists in understanding the specific relationship between BI and DMP.

A previous study [18] emphasized the expansion and interdisciplinary nature of BI/BD study, while [33] underscored the critical role of intelligence in organizational decision-making. However, neither study directly addressed how BI functions translate into improved decision-making outcomes. Another study [32] investigated data intelligence and analytics (DI&A) in the public sector, underscoring the potential of the human-AI interface for enhanced decision-making, but without explicitly addressing the specific role of BI systems.

In light of the results, this study aimed to provide a comprehensive map of the BI-DMP/DQ domain through the application of bibliometric analysis using the Bibliometrix R Tool. The objective is to deliver valuable insights into the current state-of-the-art within BI-DMP/DQ and to pave the way for future study directions in this critical field.

## III. METHODS

Scholars use different qualitative and quantitative literature reviewing approaches for literature reviews, such as meta-analysis, systematic literature review, content analysis, and bibliometric analysis. Bibliometrics is a widely used method across all fields [34] to understand publication trends, knowledge bases, citation patterns, author networks, reader engagement, as well as the influence and significance of a certain topic or study [18] (e.g., [35]).

This study used a four-step bibliometric analysis framework, following the comprehensive guidelines established by Donthu et al. [36]. These four steps consist of defining the aims and scope of bibliometric study, selecting the method, collecting data, as well as running the analysis along with reporting the results. The workflow incorporated the Visual Science Mapping approach, as shown in Fig. 1 [34]. This methodology comprises two primary approaches namely (1) performance analysis and (2) science mapping (or knowledge structure analysis). Performance analysis provides a descriptive assessment of a specific study field, while science mapping offers a more in-depth analysis, showing the relationships and interconnectedness between various areas [34], [36].

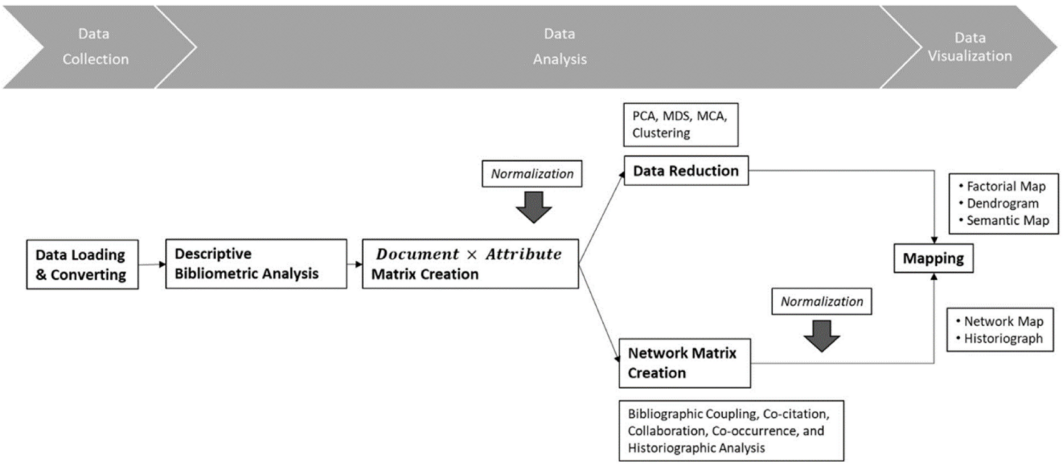


Fig. 1 Bibliometrix and the recommended science mapping workflow [34]

### *A. Step 1: Define the aims and scope of bibliometric study*

This study aims to provide a comprehensive understanding of BI-DMP/DQ through the combined application of performance analysis and science mapping. It is essential to identify the most influential authors and the core body of knowledge used in BI-DMP studies. This will enable to compare and contrast BI-DMP study results as well as create a cumulative knowledge of BI-DMP. Moreover, to conduct an in-depth analysis of the qualitative aspects in the BI-DMP/DQ study landscape, a comprehensive examination of knowledge domains is essential. By identifying key themes, collaborative patterns, and new trends, this study aimed to illuminate the intellectual structure of the field and pinpoint areas requiring further investigation.

The following study question was developed:

*RQ1:* What is the annual trajectory of scholarly output in BI and DMP/DQ study over the past 20 years, as evidenced by years of publications, disciplinary distribution, and major journals, as well as major authors and influential publications?

*RQ2:* What are the primary knowledge domains, themes and new trends, scientific collaborations within BI-DMP/DQ study, and what are the identified study gaps?

### *B. Step 2: Choose the methods for bibliometric analysis*

Bibliometric analysis extends beyond simple statistics and is considered very complex [34]. This complexity arises from the multi-step process, using various analyses and mapping software tools, often accessible solely through commercial licenses [37]. However, numerous existing tools cannot guide scholars through a fully recommended workflow [34]. This study used bibliometrix, an open-source R-tool designed by [34] for conducting comprehensive science mapping analysis. The tool is tailored to support a recommended workflow and numerous bibliometric analysis methods that support the aims of this study.

### *C. Step 3: Data collection for bibliometric analysis*

Web of Science (WoS) and Scopus are the most frequently used bibliographic databases [34]. In this study, WoS was used as it offers well-indexed coverage across various disciplines, particularly relevant to business and management. This database is also renowned for the in-depth citation data [34], a crucial aspect of the study objectives. To examine the evolution of studies and identify seminal works, a robust and detailed analysis of citation patterns is necessary.

In accordance with the recommendations outlined by [34], a 20-year timeframe was selected to achieve a balance between comprehensiveness and in-depth examination. This facilitates the capacity to capture a significant period of growth in the field and guarantees the use of the most accurate and up-to-date data. Furthermore, this timeframe is consistent with the recent advancements in BI and DMP, ensuring the results remain relevant within the context of current trends.

The data collection phase comprises three distinct sub-stages, in the initial sub-stage that entails data retrieval, a systematic approach [38] was used to gather the dataset. This approach adhered to the steps outlined in the PRISMA 2020 flow diagram (Fig.2), aiming to enhance transparency, and the trustworthiness of the results [39], [40].

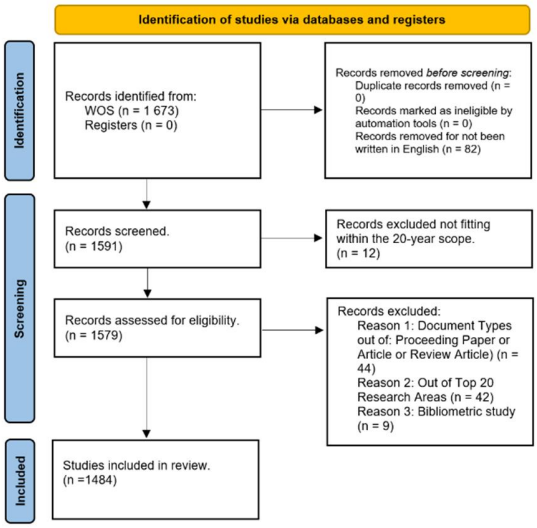


Fig. 2. PRISMA 2020 flow diagram for systematic review (Adapted from [39])

The dataset (publications) was sourced using the following combined query on WoS databases namely *("decision quality" or "decision-making *" or "decision-making quality" or "decision-making performance") and ("Business Intelligence *" OR "Business Intelligence Systems" OR "Business Intelligence & Analytics" OR "Business Intelligence Capabilities")*. This query helped retrieve a total of 1,673 publications, then 82 were eliminated due to the use of non-English language.

Stringent inclusion criteria were applied to ascertain that only publications meeting specific standards were retained for further analysis. First, documents falling outside the categories of Proceeding Paper, Article, or Review Article were systematically removed. This step ensured that the dataset comprised scholarly works conducive to in-depth analysis and critical examination. To streamline the focus and relevance of the study, papers not within the top 20 areas were methodically excluded. Moreover, to maintain the integrity and purpose of the analysis, bibliometric studies were intentionally omitted from the dataset. Despite being valuable, bibliometric studies serve as data sources for

analyses rather than subjects for scrutiny. Due to this process, a total of 1,484 publications were provided in the final list.

The second sub-stage comprised data loading and conversion, where the raw extracted data experienced transformation into a suitable format compatible with bibliometrix for subsequent analysis. Finally, the third sub-stage included data cleaning, where the metadata completeness and quality were assessed. The quality of the metadata ranged between good and excellent, avoiding the need for further supplementation.

### *D. Step 4: Run bibliometric analysis and report the results*

In the fourth and final step, bibliometric analysis was performed and the results were subsequently extracted from the results section. To answer RQ1, performance analysis was carried out related to the extracted data set. Performance analysis was conducted by analyzing the document types, year of publications, disciplinary distribution, and major journals, as well as major authors and influential publications. In addressing RQ2, an examination of knowledge structures was performed using the Sankey diagram, co-word analysis of keywords, co-citation analysis, and scientific collaboration among authors. Subsequently, suggestions were provided for future study directions.

## IV. RESULTS

### *A. Performance analysis of the collection*

#### *1) Document types*

Table 2 shows the breakdown of document types within the dataset, primarily centered on the publication of articles. Among the 1,484 publications, 53.10% comprise proceeding papers, 45.42% were articles, and 2.49% were reviews. The cumulative percentages might surpass 100% and the total count exceeded the publication figure due to instances where WoS categorized a publication into multiple types.

TABLE 2
TYPE OF PUBLICATIONS

| Document Types | Record Count | % |
|---|---|---|
| Proceeding Paper | 788 | 53.10% |
| Article | 674 | 45.42% |
| Review Article | 37 | 2.49% |

#### *2) Year of Publications*

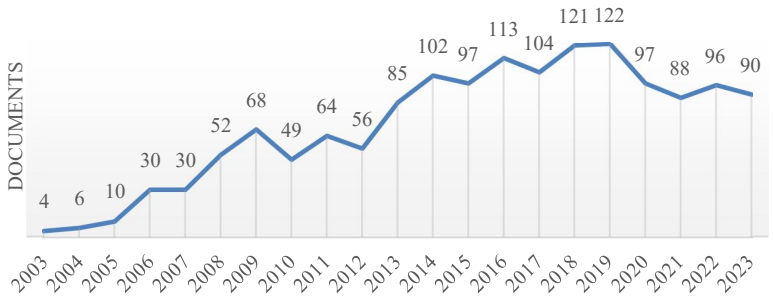


Fig. 3 Annual Scientific Production

The initial analysis was focused on the publication pattern and Fig. 3 shows the yearly scientific output of the selected papers. Before 2008, the number of academic publications remained below 35 then in 2009, this figure surged to 68 and continued to multiply rapidly. In 2019 alone, the count escalated to 122 and since 2020, there has been a relatively modest decrease, leading to an average stability of about 93 papers per year.

Fluctuations in publication counts might stem from several factors, including shifts in technological advancements within the ecosystem of BI platforms [41], alterations in funding priorities, or even changes in academic focus areas within the field of BI and DM. Additionally, the prevalence of "Big Data" as a widely used term in both academic and commercial spheres contrasts with "Business Intelligence" which tends to be more confined to specific business domains. As argued by [18] there is a prevalent inclination among authors to prioritize BD over BI in individual papers.

*3) Disciplinary distribution and major journals*

Another aspect worth exploring pertains to the specific journals and conferences in DM and BI. A descriptive examination was performed regarding the dataset delineating the most relevant sources and related academic fields (Table 3) as well as the most locally cited sources (Table 5) to explore the subject matter comprehensively.

Table 3 presents a list of the 10 most prominent sources publishing the highest volume of BI and DM papers, in descending order. The results showed that "Decision Support Systems" was the most frequently referenced source, with 20 articles, thereby showing the substantial influence and prominence in the scholarly discourse on this subject. In close second place is the ITQM 2019, which has been referenced 19 times, showing recent relevance and contribution to the domain. Three sources, associated with information, management, and environmental, fall beyond the domain of computer science. This observation suggests that computer science stands as the primary discipline driving study advancements in BI and DM.

Table 4 shows the most impactful journals among the 980 sources contributing to the 1,484 BI and DM publications. Local citations measure how many times an author included in this collection has been cited by other authors [34]. MIS Quarterly was reported as the most impactful journal with 1,089 citations. This can be attributed to the inclusion of the highly influential paper by [1], recognized as foundational literature in BI and Analytics (Fig. 7). Following closely behind are Decision Support Systems, Expert Systems with Applications, and the International Journal of Information Management. These esteemed journals are a valuable resource in the field of BI and DM, offering a wealth of seminal literature that serves as a cornerstone of ongoing study efforts.

TABLE 3
MOST RELEVANT SOURCES

| Sources | Counts | Academic Field |
|---|---|---|
| Decision Support Systems | 20 | Computer Science; Operations Study & Management Science |
| 7th International Conference on Information Technology and Quantitative Management (ITQM 2019) | 19 | Computer Science |
| Expert Systems with Applications | 17 | Computer Science; Engineering; Operations Study & Management Science |
| International Journal of Information Management | 16 | Information Science & Library Science |
| 2009 International Conference on Business Intelligence and Financial Engineering, Proceedings | 15 | Business & Economics; Computer Science; Operations Study & Management Science |
| Sustainability | 14 | Science & Technology - Other Topics; Environmental Sciences & Ecology |
| Journal of Intelligence Studies In Business | 13 | Business & Economics |
| International Journal of Advanced Computer Science and Applications | 11 | Computer Science |
| Communications of the Association For Information Systems | 10 | Computer Science |
| Journal Of Computer Information Systems | 10 | Computer Science |

TABLE 4
MOST LOCAL CITED SOURCES

| Sources | N° of local Citations |
|---|---|
| MIS Quarterly | 1089 |
| Decision Support Systems | 1071 |
| Expert Systems with Applications | 759 |
| International Journal of Information Management | 485 |
| Lecture Notes in Computer Science LNCS | 394 |
| Communications of the ACM | 391 |
| Information & Management | 381 |
| Information systems study | 344 |
| Journal of Business Study | 344 |
| International Journal of Production Economics | 333 |

*4) Major authors and influential publications*

Figure 4 shows the most frequently cited local scholars amongst the 1,484 analyzed publications. A rigorous examination of the dataset was then conducted to identify the most-cited articles authored by these prominent local scholars (Table 5). This exploration showed a significant prevalence of co-authorship among the leading figures. A limited number of publications explored the specific relationship between BI and DM through decision theory, an area recommended for further investigation by [31]. This observation suggests a potential gap in the current study landscape, paving the way for future investigations.

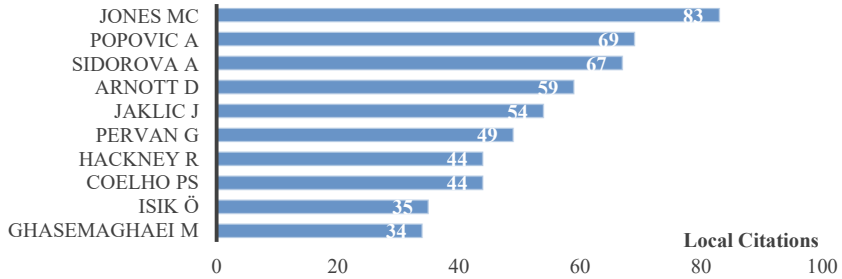


Fig. 4 Local citation analysis: Top 10 most local cited authors

TABLE 5
MOST CITED ARTICLES FROM MOST LOCAL CITED AUTHORS

| Authors from Top 10 | Titles | Year |
|---|---|---|
| Jones, Mary C; Sidorova, Anna ;<br>Işık, Öykü. | The Dynamic Structure of Management Support Systems: Theory Development, Study Focus, and Direction [4];<br>Business Intelligence Success: The Roles of BI Capabilities and Decision Environments [42];<br>Improving Decision Quality: The Role of Business Intelligence [6] | 2007<br>2013<br>2017 |
| Popovic, Ales; Jaklic, Jurij; Hackney, Ray; Coelho, Pedro Simoes | Towards Business Intelligence Systems Success: Effects of Maturity and Culture on Analytical Decision-making [43] | 2012 |
| Arnott, David and Pervan, Graham | A Critical Analysis of Decision Support Systems Study Revisited: The Rise of Design Science [44], [45] | 2016<br>2005 |
| Ghasemaghaei, Maryam | Data Analytics Competency for Improving Firm Decision-making Performance [7];<br>Does Data Analytics Use Improve Firm Decision-making Quality? The Role of Knowledge Sharing and Data Analytics Competency [17] | 2018<br>2019 |

### *B. Examination of Knowledge Structures*

#### *1) Primary Knowledge Domains*

To connect the dots of key three fields in the data set namely references, authors, and keywords, a Sankey Diagram (Fig. 5) was used to visually represent the outcomes relevant to the focus on BI & DM. Furthermore, Biblioshiny App [34] was used to create this visualization, allowing the customization of the fields and the number of vectors.

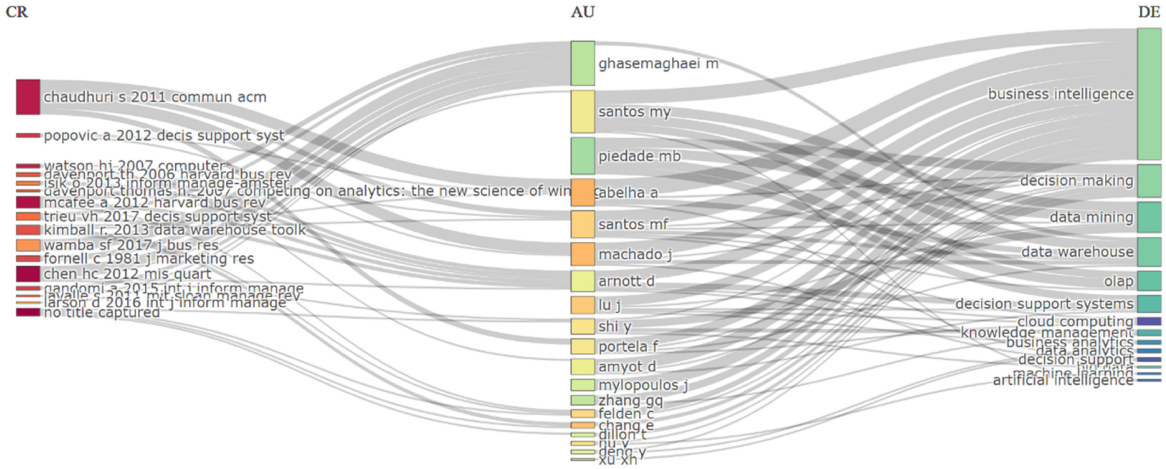


Fig. 5 Sankey diagram of three fields (references, authors, keywords) (vectors set at 20 for each field)

The diagram visual flow is influenced by references including [1], [10], [46], while Ghasemaghaei, and Maryam, matched keywords with data analytics use and competency, diverging from BI [7], [17], [47]. To provide a more nuanced analysis, Piedade, Santos, and Santos emphasized the multifaceted application of BI in various sectors, including teaching-learning, e-government, healthcare, education, and the textile industry. This study emphasized how BI enriches decision-making processes within domains.

The accompanying diagram offers insight into keywords associated with BI and DMP. Artificial Intelligence (AI) is considered a promising area in this domain, with the potential to significantly impact both BI and DMP. The diagram further underscores the importance of cloud computing, which offers several benefits in facilitating the adoption and use of BI [48]. In conclusion, the results illuminate the multifaceted nature of BI and the diverse academic backgrounds represented within the analyzed literature. As shown in Table 3, technical studies rooted in computer science still maintain a substantial presence within this field.

*2) Study Themes and New Trends*

The co-word networks show the conceptual structure, unveiling connections between concepts through frequent co-occurrences. In this study, a co-word network was deliberately constructed to gain valuable insights into the scholarly themes explored within the analyzed publications. The primary objective was to distinguish both critical and new study areas.

Within Bibliometrix analytical capabilities, Fig. 6 shows a star-shaped network spotlighting essential keywords extracted from the 1,484 publications leveraging the Leiden clustering algorithm used on VOSViewer [49].

Starting from the center and proceeding in a clockwise rotation towards the right, crucial keywords are vividly shown, distinguished by the colors representing respective clusters. The intricate connections among these keywords delineate robust co-citation relationships.

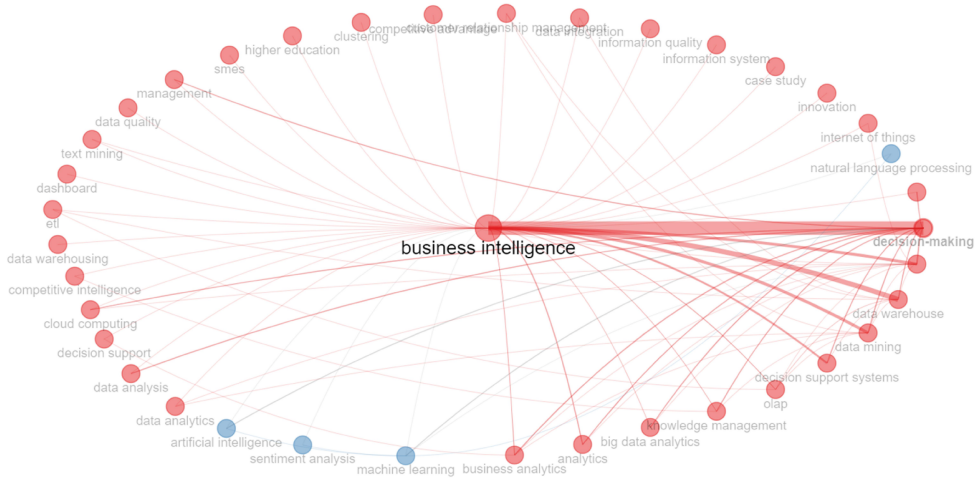


Fig. 6. Co-occurrence Network (Field =Author's Keywords, Layout = Star, Clustering Algorithm =Leiden, Number of Nodes 45).

The analysis of keywords associated with "Business Intelligence" (BI) shows a cluster of prominent terms, including "decision-making," "Big Data," "data warehouse," "data mining," and "decision support systems." These terms collectively paint a comprehensive picture of the landscape, including various facets and essential components. Similarly, a previous study by [18] emphasized the application-oriented nature of BI.

Shifting the focus to decision-making related keywords, a distinct cluster that showed "Big Data," "Business analytics," "management," and "decision support systems" was observed. These terms collectively emphasize the critical factors and components integral to decision-making process, ranging from data analysis and management to supportive systems. The interconnected network of keywords underscores the importance of these elements in facilitating informed and effective decision-making across diverse domains.

The analysis of BI and DM-related keywords provides valuable insights into the core concepts and the interplay within these fields. It shows the application-oriented nature of BI and the fundamental elements necessary for sound decision-making.

*3) Scientific Collaborations*

The examination of co-citation analysis is among the main classic methods in bibliometrics [34], offering a lens into the intellectual landscape of selection. It is crucial to distinguish between bibliographic coupling and co-citation, as articulated by [49]. A bibliographic coupling link shows a connection between two items that both reference the same document. As shown in Fig. 7, the items within these networks are connected through co-citation links. These links signify a connection between two items that are both referenced by the same document. The distinction helps in comprehending the intricate relationships among cited references, delineating the nature of associations within the collection.

This approach offers deeper insights into the intellectual structure and seminal contributions within the field. In the BI & DM network, [1] occupies a central position, with significant contribution to shaping the current understanding of BI and potential within organizations, as also stated by a previous study on the BD and BI landscape [18].

The co-cited works by McAfee and Brynjolfsson (2012) [50], Popovic et al. 2012 [43], and Gandomi et. al (2015) [51] offer valuable complementary perspectives, exploring the broader BD landscape, the organizational context for BI success, and the analytical methods that underpin effective systems.

A scientific collaboration network is characterized by authors and co-authorships as nodes and links respectively, representing one of the extensively documented forms of scientific collaboration [52]. Figure 8 shows a collaboration network that clearly features China, the United States, India, and Australia as leading nations actively participating in collaborative efforts. This observation underscores the presence of a robust and extensive collaborative network that extends across all continents. It emphasizes the significance of fostering increased cross-country cooperation among diverse scholars, as argued by [42].

A significant portion of the study papers originated from China and the United States, suggesting a propensity for collaboration within respective borders, as well as with international partners. This trend can potentially be attributed to the national interests of both countries in the BI ecosystem and the impact on decision-making efficiency [32]. Geopolitical positioning, cultural ties, and shared languages can also serve as influential factors shaping co-authorship preferences [53].

Although this analysis shows the global nature of studies on BI and DM, it is important to acknowledge the need for increased participation from scholars in new markets. The unique perspectives and experiences can offer valuable new insights and contribute to a more comprehensive understanding of BI and DM applications across diverse economic and social contexts.

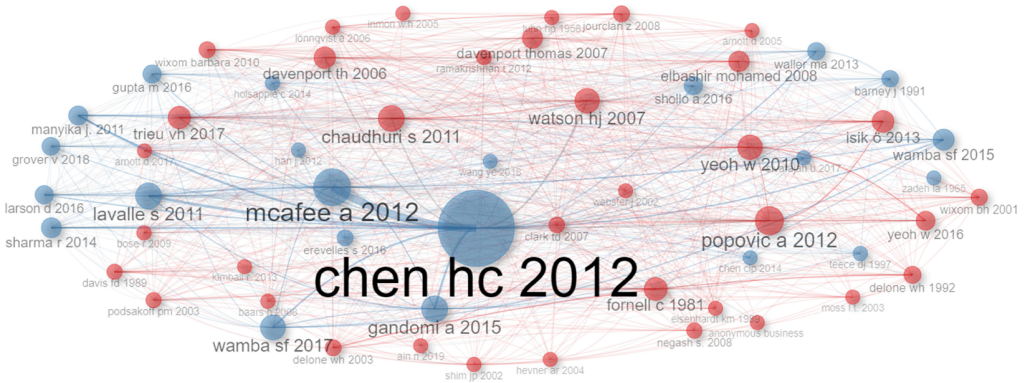


Fig. 7. Co-citation network of cited references (Layout = Sphere, Clustering Algorithm =Leiden, Number of Nodes 50)

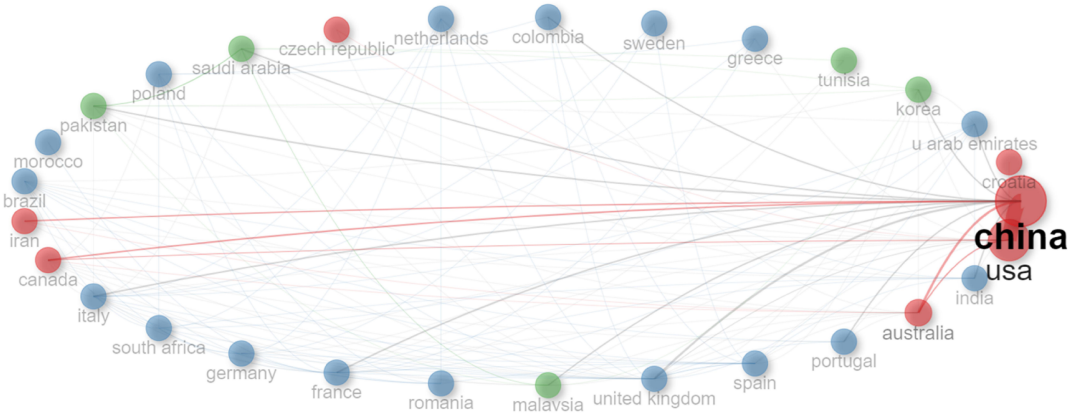


Fig. 8. Country collaboration network (Layout = Circle, Clustering Algorithm =Leiden, Number of Nodes 30).

## V. Discussion

Despite the extensive studies conducted over the past three decades on BI, this technology is still evolving and requires further investigation, analysis, and an in-depth understanding of the effects on decision-making in diverse

contexts. The following discussion section aims to interpret the results of bibliometric analysis, contextualize within the broader study landscape, and identify key study gaps. By examining the descriptive analysis, the intellectual structure of the BI-DMP/DQ field, and specific study gaps, this section contributes to a deeper understanding of the domain. Additionally, the limitations of the study and potential avenues for future study will be explored.

### *A. Performance analysis*

This analysis showed a steady increase in publications on BI and DMPs up to 2020, followed by a slight decline. The fluctuation could be attributed to the growing prominence of "Big Data" as a term, potentially overshadowing "Business Intelligence" in some contexts. BD also presents significant challenges for businesses and decision makers across all sectors. Frequently, businesses are collecting more data than management capacity [54].

Although data acquisition is undoubtedly crucial, the critical question is “Are organizations prioritizing the use of data through BI to enhance decision-making, or simply accumulating data without a clear plan”? This is particularly relevant in light of the high rates of failed implementations or uses [55], [56], as well as the pressure to adopt trendy technologies [30], [57] without a thorough understanding of the impact on decision-making processes. There is a need for a nuanced comprehension of how BI truly translates into enhanced decision-making outcomes.

The evolution of BI has witnessed a dramatic shift from traditional analytical techniques and structured datasets towards data-driven discovery and proactive decision-making [58]. This shift is driven by the need to navigate the dynamic global business environment of the BD era. Advanced analytical methods are used to analyze massive, unstructured datasets, enabling highly creative decision-making approaches [54].

The analysis of sources showed that computer science is the primary discipline driving advancements in BI and DMP. This is evident from the fact that only three of the 10 most prominent sources publishing the highest volume of BI and DM papers belonged to fields outside of computer science.

MIS Quarterly was found as the most impactful journal among the 980 sources. This can be attributed to the inclusion of a highly influential paper considered foundational literature in BI and Analytics [1]. Other influential journals include Decision Support Systems, Expert Systems with Applications, as well as the International Journal of Information Management, offering valuable resources due to the wealth of seminal literature.A significant result was the prevalence of co-authorship among the most-cited authors, suggesting a collaborative study environment within the BI and DM field.

### *B. Examination of Knowledge Structures*

This study aimed to illuminate the intellectual landscape of BI-DMP/DQ study by examining the evolution, core themes, and collaborative patterns. The results derived from bibliometric analysis provide a comprehensive overview of the field, showing both established and new trends.

The co-word analysis unveiled the core knowledge domains within BI-DMP/DQ study. The frequent co-occurrence of terms such as "decision-making," "Big Data," "data warehouse," and "data mining" underscored the centrality of these concepts to the field. The results were also consistent with a previous study [18] showing the application-oriented nature. The development of "artificial intelligence" as a prominent keyword signifies the growing influence on the BI landscape, a trend that warrants further exploration.

The Sankey diagram complemented the analysis by visualizing the flow of study topics. The multifaceted application of BI across various sectors clearly emphasizes the versatility. However, the predominance of technical studies rooted in computer science suggests an opportunity to expand the field scope and address real-world challenges more comprehensively.

Co-citation analysis showed a core group of influential works shaping the field. The highly influential paper by [1] stands as a foundational pillar in BI and Analytics literature. Additionally, prominent references including [43], [50], [51] are significant contributors to the field. The collective works not only delineate the contours of BI but also serve as touchstones for scholars and practitioners aiming to understand and leverage analytics for enhanced DMP. These seminal papers underscore the multifaceted nature of BI, showing technological advancements, managerial implications, and the ethical dimensions of the application. Together, the studies form a comprehensive body of knowledge that continues to shape the field of BI and DMP.

The collaboration network analysis showed the global nature of BI-DMP/DQ studies, with China and the United States as dominant players. Although this shows a robust collaborative ecosystem, the need for increased participation

from scholars in new markets is evident. This participation would enrich the field by introducing diverse perspectives and addressing the unique challenges faced by these countries.

### *C. The identified Study Gaps*

#### *1) Study Gap 1: Reconsideration of Decision-making Theories*

This bibliometric analysis corroborates the results of [31] by showing a critical gap in BI study namely the underrepresentation of decision-making theories. Although the field has made significant strides in technical advancements, a deeper understanding of how decision-making processes and decision types interact with BI systems is absent. The prevailing focus on computer science perspectives has overshadowed the importance of organizational factors that facilitate the effective use of BI.

A rare exception to this trend is the study by Isik [42], which used the Gorry and Scott Morton framework to examine the moderation effect of decision environments on the relationship between BI capabilities and success. This study serves as a valuable starting point but underscores the need for further investigations in the area.

#### *2) Study Gap 2: Towards a Deeper Understanding of BI Use.*

The study by [20] underscores the importance of Theory of Effective Use (TEU) in the context of BI systems. TEU posits that the benefits organizations gain from BI systems are contingent on effective usage. Effective use focuses on leveraging high-fidelity information to make informed decision that enhance work performance.

As BI vendors shift focus toward empowering decision-makers [58], Self-Service BI (SSBI) develops as a promising approach. SSBI environments are designed to "empower casual users to perform custom analytics and derive actionable information from large amounts of multifaceted data without having to engage specialists" [59]. This democratization holds significant potential to considerably enhance effective BI use.

Building on this, a previous study [10] emphasizes the importance of acknowledging and fostering the contributions of both producers and consumers of BI information. Reinforcing BI skills throughout an organization, as underscored by [60], [61], is crucial to maximizing decision-support capabilities inherent within BI tools.

These gaps collectively underscore the need for a more holistic approach to BI study to integrate technical advancements with a deep understanding of human decision-making and organizational behavior. Addressing these challenges will contribute to the development of BI systems that truly deliver value to organizations.

### *D. Limitations of the study*

This study acknowledges the limitations inherent to using bibliographic databases such as WoS, which are subject to regular updates capable of influencing citation counts. Variations in metadata coverage across databases may also introduce bias. Furthermore, co-word analysis has limitations, as some publications might be underrepresented, and the quality of the analysis is dependent on indexing methods.

The scope of this study is sufficiently broad to warrant further consideration. The analysis is confined to publications in English from relevant journals over 20 years focused on BI, DMP, and DQ. Insights gleaned from studies published before 2003 and those conducted in languages other than English are not captured within this analysis. Additionally, the selection of keywords, based on a literature review, as well as the meaning of decision-making and BI, may not fully include the full spectrum of related terms.

### *E. Avenues for future study*

To better understand the impact of BI, future studies should explore several key areas, including the influence on decision-making, new technologies related to decision-making (DM), and the application in various sectors. In particular, the direct impact of BI on DMP should be examined in various contexts by conducting longitudinal case studies and analyzing the factors that contribute to the successful implementation on improving decision outcomes. This approach will provide valuable insights into long-term dynamics and challenges.

Future studies should investigate the potential of integrating decision theory into BI-DM processes, specifically with advanced technologies including AI. This integration can increase business value of BI, provide insight into technology developments, and identify new advances. It is also crucial to extend beyond organizational boundaries, by examining the application of BI in specific sectors such as healthcare, education, finance, and e-Government.

The results offer insights into the relationship between BI and decision-making processes, as well as evolution and practical applications. This will promote progress in both academic and industrial contexts. However, it is important to recognize the limitations of current study and apply conclusions carefully in diverse contexts.

## VI. CONCLUSIONS

In conclusion, this study presented the outcomes of bibliometric analysis conducted on academic papers associated with “Business Intelligence” and “Decision-making”. A comprehensive examination of the time trend, disciplinary

distribution, high-frequency keywords, and knowledge structures, comprising social structures through collaboration analysis and intellectual structures, was presented. Significant results arising from these academic contributions were also reported.

"Business Intelligence" was introduced long before "Decision-making". The combined query interest showed an upward trajectory up to 2019, after which the number of studies stabilized. This trend showed a significant shift in focus over time. Publications on BI and DM were also dispersed across various journals, with the majority of papers being oriented towards Computer Science, showing a strong presence in this domain. Furthermore, the divergence in popular keywords shows variations in interesting topics within the field. Significant keywords linked with "Business Intelligence" and "Decision-making" underscore the diverse landscape of studies. The Sankey diagram further underscored substantial diversity, particularly within keywords. This accentuates the varied applications of BI and the integration of cutting-edge technologies, ultimately aiming to improve decision-making across specialized fields. A few papers have accumulated considerable citations, solidifying the status as knowledge cores in the field of BI and DM. The substantial number of study papers originating from China and the United States showed a distinct tendency for collaboration within and beyond national borders.

This study puts forward several avenues for future investigations in the domain of BI and DM. Further studies can consider exploring the four dimensions identified in this analysis to guide investigations. Journal editors are also encouraged to match accepted papers with the themes when considering publications in this field.

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## REFERENCES

[1] Chen, Chiang, and Storey, "Business intelligence and analytics: From big data to big impact," *MIS Q.*, vol. 36, no. 4, p. 1165, 2012, doi: 10.2307/41703503.
[2] R. Sharda, D. Delen, and E. Turban, *Business intelligence, analytics, and data science: a managerial perspective*, Fourth edi. New York: Pearson, 2014.
[3] W. W. Eckerson, *Performance dashboards: measuring, monitoring, and managing your business*, 2nd ed. New York: Wiley, 2011.
[4] Clark, Jones, and Armstrong, "The dynamic structure of management support systems: theory development, research focus, and direction," *MIS Q.*, vol. 31, no. 3, p. 579, 2007, doi: 10.2307/25148808.
[5] Ö. Işık, M. C. Jones, and A. Sidorova, "Business intelligence success: The roles of BI capabilities and decision environments," *Inf. Manag.*, vol. 50, no. 1, pp. 13–23, Jan. 2013, doi: 10.1016/j.im.2012.12.001.
[6] L. L. Visinescu, M. C. Jones, and A. Sidorova, "Improving Decision Quality: The Role of Business Intelligence," *J. Comput. Inf. Syst.*, vol. 57, no. 1, pp. 58–66, Jan. 2017, doi: 10.1080/08874417.2016.1181494.
[7] M. Ghasemaghaei, S. Ebrahimi, and K. Hassanein, "Data analytics competency for improving firm decision making performance," *J. Strateg. Inf. Syst.*, vol. 27, no. 1, pp. 101–113, Mar. 2018, doi: 10.1016/j.jsis.2017.10.001.
[8] A. S. Divatia, J. Tikoria, and S. Lakdawala, "Dimensions influencing business intelligence and analytics maturity: a critical analysis," *Int. J. Bus. Inf. Syst.*, vol. 37, no. 2, p. 200, 2021, doi: 10.1504/IJBIS.2021.115375.

[9] A. Alzghoul, A. A. Khaddam, F. Abousweilem, H. J. Irtaimeh, and Q. Alshaar, "How business intelligence capability impacts decision-making speed, comprehensiveness, and firm performance," *Inf. Dev.*, vol. 40, no. 2, pp. 220–233, Jun. 2024, doi: 10.1177/02666669221108438.
[10] R. Torres and A. Sidorova, "Reconceptualizing information quality as effective use in the context of business intelligence and analytics," *Int. J. Inf. Manage.*, vol. 49, pp. 316–329, Dec. 2019, doi: 10.1016/j.ijinfomgt.2019.05.028.
[11] V.-H. Trieu, "Getting value from Business Intelligence systems: A review and research agenda," *Decis. Support Syst.*, vol. 93, pp. 111–124, Jan. 2017, doi: 10.1016/j.dss.2016.09.019.
[12] S. Mathrani, "Critical business intelligence practices to create meta-knowledge," *Int. J. Bus. Inf. Syst.*, vol. 36, no. 1, p. 1, 2021, doi: 10.1504/IJBIS.2021.112413.
[13] Á. Szukits and P. Móricz, "Towards data-driven decision making: the role of analytical culture and centralization efforts," *Rev. Manag. Sci.*, vol. 18, no. 10, pp. 2849–2887, Oct. 2024, doi: 10.1007/s11846-023-00694-1.
[14] L. Hurbean, F. Militaru, M. Muntean, and D. Danaiata, "The impact of business intelligence and analytics adoption on decision making effectiveness and managerial work performance," *Sci. Ann. Econ. Bus.*, vol. 70, no. SI, pp. 43–54, Feb. 2023, doi: 10.47743/saeb-2023-0012.
[15] T. D. Oesterreich, E. Anton, and F. Teuteberg, "What translates big data into business value? A meta-analysis of the impacts of business analytics on firm performance," *Inf. Manag.*, vol. 59, no. 6, p. 103685, Sep. 2022, doi: 10.1016/j.im.2022.103685.
[16] M. P. Valadares de Oliveira, K. P. McCormack, M. Bronzo, and P. Trkman, "The effect of individual analytical orientation and capabilities on decision quality and regret," *Int. J. Bus. Anal.*, vol. 9, no. 1, pp. 1–19, Oct. 2021, doi: 10.4018/IJBAN.288510.
[17] M. Ghasemaghaei, "Does data analytics use improve firm decision making quality? The role of knowledge sharing and data analytics competency," *Decis. Support Syst.*, vol. 120, pp. 14–24, May 2019, doi: 10.1016/j.dss.2019.03.004.
[18] T.-P. Liang and Y.-H. Liu, "Research landscape of business intelligence and big data analytics: A bibliometrics study," *Expert Syst. Appl.*, vol. 111, pp. 2–10, Nov. 2018, doi: 10.1016/j.eswa.2018.05.018.
[19] V.-H. Trieu, "Towards an understanding of actual business intelligence technology use: an individual user perspective," *Inf. Technol. People*, vol. 36, no. 1, pp. 409–432, Jan. 2023, doi: 10.1108/ITP-11-2020-0786.
[20] V.-H. Trieu, A. Burton-Jones, P. Green, and S. Cockcroft, "Applying and extending the theory of effective use in a business intelligence context," *MIS Q.*, vol. 46, no. 1, pp. 645–678, Feb. 2022, doi: 10.25300/MISQ/2022/14880.
[21] S. Shamim, J. Zeng, Z. Khan, and N. U. Zia, "Big data analytics capability and decision making performance in emerging market firms: The role of contractual and relational governance mechanisms," *Technol. Forecast. Soc. Change*, vol. 161, p. 120315, Dec. 2020, doi: 10.1016/j.techfore.2020.120315.
[22] S. Jarupathirun and F. "Mariam" Zahedi, "Exploring the influence of perceptual factors in the success of web-based spatial DSS," *Decis. Support Syst.*, vol. 43, no. 3, pp. 933–951, Apr. 2007, doi: 10.1016/j.dss.2005.05.024.
[23] G. P. Huber, "A theory of the effects of advanced information technologies on organizational design, intelligence, and decision making," *Acad. Manag. Rev.*, vol. 15, no. 1, p. 47, Jan. 1990, doi: 10.2307/258105.
[24] T. Ramakrishnan, M. C. Jones, and A. Sidorova, "Factors influencing business intelligence (BI) data collection strategies: An empirical investigation," *Decis. Support Syst.*, vol. 52, no. 2, pp. 486–496, Jan. 2012, doi: 10.1016/j.dss.2011.10.009.
[25] A. N. H. Zaied, G. S. Hussein, and M. O. Grida, "Critical success factors framework for implementing and adapting BIS on organisational performance," *Int. J. Bus. Inf. Syst.*, vol. 38, no. 1, p. 107, 2021, doi: 10.1504/IJBIS.2021.118632.
[26] M. Ranjbarfard and Z. Hatami, "Critical success factors for implementing business intelligence projects (a BI implementation methodology perspective)," *Interdiscip. J. Information, Knowledge, Manag.*, vol. 15, pp. 175–202, 2020, doi: 10.28945/4607.
[27] G. Phillips-Wren, M. Daly, and F. Burstein, "Reconciling business intelligence, analytics and decision support systems: More data, deeper insight," *Decis. Support Syst.*, vol. 146, p. 113560, Jul. 2021, doi: 10.1016/j.dss.2021.113560.
[28] U. B. Chaudhry and M. A. Chaudhry, "Harnessing big data for business innovation and effective business decision making," in *Cybersecurity in the Age of Smart Societies*, Springer, Cham, 2023, pp. 47–60. doi: 10.1007/978-3-031-20160-8_4.
[29] Z. Jaradat, A. Al-Dmour, H. Alshurafat, H. Al-Hazaima, and M. O. Al Shbail, "Factors influencing business intelligence adoption: evidence from Jordan," *J. Decis. Syst.*, vol. 33, no. 2, pp. 242–262, Apr. 2024, doi: 10.1080/12460125.2022.2094531.
[30] A. Kumar, B. Krishnamoorthy, D. Kamath, C. D', and N. A. Lima, "Business analytics adoption in firms," *Int. J. Bus. Inf. Syst.*, vol. 40, no. 4, p. 464, 2022, doi: 10.1504/IJBIS.2022.124928.
[31] N. Ain, G. Vaia, W. H. DeLone, and M. Waheed, "Two decades of research on business intelligence system adoption, utilization and success – A systematic literature review," *Decis. Support Syst.*, vol. 125, p. 113113, Oct. 2019, doi: 10.1016/j.dss.2019.113113.
[32] A. Di Vaio, R. Hassan, and C. Alavoine, "Data intelligence and analytics: A bibliometric analysis of human–artificial intelligence in public sector decision-making effectiveness," *Technol. Forecast. Soc. Change*, vol. 174, p. 121201, Jan. 2022, doi: 10.1016/j.techfore.2021.121201.
[33] J. R. López-Robles, J. R. Otegi-Olaso, I. Porto Gómez, and M. J. Cobo, "30 years of intelligence models in management and business: A bibliometric review," *Int. J. Inf. Manage.*, vol. 48, pp. 22–38, Oct. 2019, doi: 10.1016/j.ijinfomgt.2019.01.013.
[34] M. Aria and C. Cuccurullo, "bibliometrix: An R-tool for comprehensive science mapping analysis," *J. Informetr.*, vol. 11, no. 4, pp. 959–975, 2017, doi: 10.1016/j.joi.2017.08.007.
[35] C.-L. Hsu and C.-H. Chiang, "Electronic commerce research profiles: Comparing e-commerce and information systems journals," *Pacific Asia J. Assoc. Inf. Syst.*, pp. 49–66, 2017, doi: 10.17705/1pais.09303.
[36] N. Donthu, S. Kumar, D. Mukherjee, N. Pandey, and W. Marc, "How to conduct a bibliometric analysis : An overview and guidelines," *J. Bus. Res.*, vol. 133, no. March, pp. 285–296, 2021, doi: 10.1016/j.jbusres.2021.04.070.
[37] A. T. Guler, C. J. F. Waaijer, and M. Palmblad, "Scientific workflows for bibliometrics," *Scientometrics*, vol. 107, no. 2, pp. 385–398, May 2016, doi: 10.1007/s11192-016-1885-6.
[38] B. Kitchenham, "Procedures for performing systematic reviews," *Keele Univ. Tech. Rep.*, vol. 33, no. 2004, pp. 1–26, 2014, [Online]. Available: https://www.researchgate.net/publication/228756057
[39] N. R. Haddaway, M. J. Page, C. C. Pritchard, and L. A. McGuinness, "PRISMA2020 : An R package and Shiny app for producing PRISMA 2020-compliant flow diagrams, with interactivity for optimised digital transparency and open synthesis," *Campbell Syst. Rev.*, vol. 18, no. 2, Jun. 2022, doi: 10.1002/cl2.1230.
[40] M. J. Page *et al.*, "The PRISMA 2020 statement: an updated guideline for reporting systematic reviews," *BMJ*, vol. 372, p. n71, Mar. 2021, doi: 10.1136/bmj.n71.
[41] C. A. Tavera Romero, J. H. Ortiz, O. I. Khalaf, and A. Ríos Prado, "Business intelligence: Business evolution after industry 4.0," *Sustainability*, vol. 13, no. 18, p. 10026, Sep. 2021, doi: 10.3390/su131810026.

[42] J. R. Turner and R. Baker, "Collaborative research: Techniques for conducting collaborative research from the science of team science (SciTS)," *Adv. Dev. Hum. Resour.*, vol. 22, no. 1, pp. 72–86, Feb. 2020, doi: 10.1177/1523422319886300.
[43] A. Popovič, R. Hackney, P. S. Coelho, and J. Jaklič, "Towards business intelligence systems success: Effects of maturity and culture on analytical decision making," *Decis. Support Syst.*, vol. 54, no. 1, pp. 729–739, Dec. 2012, doi: 10.1016/j.dss.2012.08.017.
[44] D. Arnott and G. Pervan, "A critical analysis of decision support systems research revisited: The rise of design science," in *Enacting Research Methods in Information Systems*, Cham: Springer International Publishing, 2016, pp. 43–103. doi: 10.1007/978-3-319-29272-4_3.
[45] D. Arnott and G. Pervan, "A critical analysis of decision support systems research," *J. Inf. Technol.*, vol. 20, no. 2, pp. 67–87, Jun. 2005, doi: 10.1057/palgrave.jit.2000035.
[46] S. Chaudhuri, U. Dayal, and V. Narasayya, "An overview of business intelligence technology," *Commun. ACM*, vol. 54, no. 8, pp. 88–98, Aug. 2011, doi: 10.1145/1978542.1978562.
[47] M. Ghasemaghaei, K. Hassanein, and O. Turel, "Increasing firm agility through the use of data analytics: The role of fit," *Decis. Support Syst.*, vol. 101, pp. 95–105, Sep. 2017, doi: 10.1016/j.dss.2017.06.004.
[48] K. ElMalah and M. Nasr, "Cloud business intelligence," *Int. J. Adv. Netw. Appl.*, vol. 10, no. 06, pp. 4120–4124, 2019, doi: 10.35444/IJANA.2019.100612.
[49] N. J. van Eck and L. Waltman, "Software survey: VOSviewer, a computer program for bibliometric mapping," *Scientometrics*, vol. 84, no. 2, pp. 523–538, Aug. 2010, doi: 10.1007/s11192-009-0146-3.
[50] A. McAfee and E. Brynjolfsson, "Big data: The management revolution," Harvard Business Review. [Online]. Available: https://hbr.org/2012/10/big-data-the-management-revolution
[51] A. Gandomi and M. Haider, "Beyond the hype: Big data concepts, methods, and analytics," *Int. J. Inf. Manage.*, vol. 35, no. 2, pp. 137–144, Apr. 2015, doi: 10.1016/j.ijinfomgt.2014.10.007.
[52] W. Glänzel and A. Schubert, "Analysing scientific networks through co-authorship," in *Handbook of Quantitative Science and Technology Research*, Dordrecht: Kluwer Academic Publishers, 2005, pp. 257–276. doi: 10.1007/1-4020-2755-9_12.
[53] A. Schubert and G. Schubert, "Internationality at university level," *Scientometrics*, vol. 123, no. 3, pp. 1341–1364, Jun. 2020, doi: 10.1007/s11192-020-03443-3.
[54] F. Wang, M. S. Raisinghani, M. Mora, and J. Forrest, "Effective decision support in the big data era," *Int. J. Decis. Support Syst. Technol.*, vol. 14, no. 1, pp. 1–16, Mar. 2022, doi: 10.4018/IJDSST.286683.
[55] M. R. Arizmendi and L. Stapleton, "Failure factors in the control of large-scale business intelligence systems development projects," *IFAC-PapersOnLine*, vol. 52, no. 25, pp. 579–584, 2019, doi: 10.1016/j.ifacol.2019.12.609.
[56] C. M. Olszak, "Toward better understanding and use of business intelligence in organizations," *Inf. Syst. Manag.*, vol. 33, no. 2, pp. 105–123, Apr. 2016, doi: 10.1080/10580530.2016.1155946.
[57] M. Purdy and A. M. Williams, "How AI can help leaders make better decisions under pressure," Harvard Business Review. Accessed: Jun. 03, 2024. [Online]. Available: https://hbr.org/2023/10/how-ai-can-help-leaders-make-better-decisions-under-pressure
[58] S. Jabraoui and A. Charkaoui, "Analysis of Gartner's BI&A capabilities reports over a decade: A systematic review approach," in *2023 IEEE International Conference on Technology Management, Operations and Decisions (ICTMOD)*, IEEE, Nov. 2023, pp. 1–7. doi: 10.1109/ICTMOD59086.2023.10438134.
[59] P. Alpar and M. Schulz, "Self-Service Business Intelligence," *Bus. Inf. Syst. Eng.*, vol. 58, no. 2, pp. 151–155, Apr. 2016, doi: 10.1007/s12599-016-0424-6.
[60] J. Passlick, N. Guhr, B. Lebek, and M. H. Breitner, "Encouraging the use of self-service business intelligence – an examination of employee-related influencing factors," *J. Decis. Syst.*, vol. 29, no. 1, pp. 1–26, Jan. 2020, doi: 10.1080/12460125.2020.1739884.
[61] V. B. Vukšić, M. P. Bach, and A. Popovič, "Supporting performance management with business process management and business intelligence: A case analysis of integration and orchestration," *Int. J. Inf. Manage.*, vol. 33, no. 4, pp. 613–619, Aug. 2013, doi: 10.1016/j.ijinfomgt.2013.03.008.