



Business intelligence and business analytics in tourism: insights through Gioia methodology

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Abstract

Although Business Intelligence (BI) and Business Analytics (BA) have been widely adopted in the tourism sector, comparative research using BI and BA remains scarce. To fill this gap in the literature, the present study explores how BI and BA contribute to strategic innovation, address operational challenges, and enhance customer engagement. To this end, using a dual-method approach that incorporates both quantitative and qualitative methodologies, we first conduct a bibliometric analysis using SciMAT. This sets the stage for the subsequent application of the Gioia methodology. Specifically, we perform an in-depth qualitative examination of a total of 12 scholarly articles on the tourism sector, evenly split between BI and BA. Upon synthesizing the findings on the roles of BI and BA, we outline distinct pathways through which they influence tourism sector management solutions. Based on the obtained evidence, we argue that, while BI focuses on technological advancement and operational integration, BA is more aligned with predictive analytics and data-driven customer engagement. These insights provide managers with a better understanding of the roles of BI and BA, serving as a guide for their strategic applications, from improving service quality to innovating in customer engagement. The novelty of this approach lies in its use of the Gioia methodology, in a comparative analysis to evaluate the separate yet complementarily roles of BI and BA, and in enhancing tourism industry practices.

Keywords Business intelligence · Business analytics · Tourism industry · Gioia methodology · Comparative analysis · Strategic innovation · Operational challenges · Customer engagement

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Introduction

Technological innovation improves efficiency, provides society with new and enhanced goods and services through economic reforms, and improves their living conditions (Wen & Okolo, 2023). In recent decades, the most extensively advancing technological branch is related to digital technologies.

As argued by Rawal et al. (2023), technological advances, in particular digitalization, improve efficiency and quality of service in various sectors. In this context, a particularly important role is played by data analysis and visualization. Rawal et al. (2023) noted the importance of proper data analysis and visualization to enhance customer experiences and decision-making processes, particularly in the service sector. By extrapolating from their conclusions, the transformative effect of Business Intelligence (BI) and Business Analytics (BA) in the tourism sector becomes apparent.

In the tourism sector, digital technology has given rise to the production of large amounts of data. When processed using advanced BA and BI tools, these data transform into key strategic assets for decision making in tourism as a highly dynamic sector. Although complex, this process facilitates the identification of new opportunities and generation of knowledge for tourism companies seeking superior performance and differentiation in the market. In this respect, Saura et al. (2023a) argued that the decision of shifting to these data applications can bring the same results as open innovation models, which are essential for the development of successful innovation strategies.

It can reasonably be expected that BI and BA may become key channels for making this happen, leading the way in turning data into a valuable resource. Tourism industry moves towards a future that relies on data and BI and BA frequently come together in academic discussions. However, how they are used in tourism requires further investigation.

In this connection, available literature posits that, despite BI and BA being subjects examined in academic research, there remains certain ambiguity regarding their application in scholarly research. Indeed, these two terms are frequently used interchangeably, which overlooks the clear differences between BI's traditional focus on descriptive analytics and BA's emphasis on prescriptive and predictive analytics. This is obvious in articles that, despite their titles suggesting a focus on BA, predominantly focus on BI (or vice versa), or discuss both concepts without detailing their differentiations (Chen et al., 2023; Yiu et al., 2021). This impedes theoretical understanding and hinders an accurate use of these data-focused methods in the practical domain of tourism management.

Seeking to connect the theoretical and real-world gap, in this study, we initiate a process of clarification. To this end, we first conduct a deep bibliometric study, which is then followed by applying the Gioia qualitative methodology (Gioia et al., 2013) to distill the essence of BI and BA from secondary data comprising a handpicked selection of 12 research articles. Based on the findings, we identify the core themes and then define the conceptual distinctions between BI and BA within the tourism industry. This innovative approach, which uses real-life data, allows for a thorough synthesis that extends beyond the limited scope of single case studies, and thus provides a broad understanding of the conceptual domain.

Our principal aim in this study is to reveal patterns, follow thematic paths the conceptual mix-up, and obtain a detailed understanding of the roles BI and BA in creating a more knowledgeable, experience-led, and well-managed tourism sector. By addressing widespread conceptual misunderstandings, we aim to develop a structured framework for future research, strengthening the practical impact of BI and BA in building a robust and competitive tourism industry. Accordingly, our main research question can be formulated as follows: RQ1—*In what ways do Business Intelligence and Business Analytics manifest as distinct yet interrelated elements in the tourism sector?*

Our results bridge the gap in extant literature by illuminating BI's role in technological and operational integration and BA's focus on predictive analytics and the enhancement of customer interaction in the tourism sector. Our main findings associate BI's tools with technological and operational integration and BA's with predictive analytics and enhance customer interaction. Our comparative study provides fundamental differences in BI/BA approaches to strategic innovation and operational issues.

The remainder of this paper is organized as follows. In the next section, we thoroughly describe the core concepts of BI and BA, which is followed by sizing the database available for our study. This involves conducting a bibliometric analysis, using the SciMAT software. We then perform a purely qualitative analysis using the Gioia methodology. In our bibliometric research, we identify pertinent research clusters and, following previous studies, detect emerging trends within those clusters (Tanwar & Khindri, 2024). The strength of Gioia methodology lies in its successive phases of exploration that helps to conceptualize the central and intersecting themes emerging from the contextually rich and profound aspects of the phenomena under examination. This process enables us to properly conceptualize the fundamentals related to the individual and synergistic functions of BI and BA.

Next, upon presenting the theoretical framework that encompasses both quantitative and qualitative approaches, the empirical section focuses on describing the experiment conducted using real data and significant findings are outlined. The results are then presented, analyzed and discussed, followed by a review of the study's limitations and an outline of future research directions.

Theoretical framework

In order to establish a robust context for understanding the impact of BI and BA within the tourism sector, which is particularly sensitive to information and data analysis dynamics, the initial step is to explore the convergence and divergence of these two concepts. BI and BA represent a paradigm shift towards data-driven decision-making that marks the evolution of the tourism industry. In this section, we review the theoretical framework that contains the definitions and applications of BI and BA and thus lays a solid foundation for understanding these two constructs in the context of tourism.

A review of the literature suggests that BI has diverse definitions, and a consensual definition has not been established yet (Chee et al., 2009). Yet, a common thread

across these definitions is the perception of BI as a system that assists decision makers in making informed choices about the business' direction. In addition, BI is viewed as a system encompassing technologies, tools, and software designed to gather data, automate processes, and generate information transformed into knowledge for making quality decisions (Nyanga et al., 2020).

According to the definition proposed by Shende and Panneerselvam (2018), BI refers to the application of technologies and practices for collecting, integrating, analyzing and presenting business information. Such transformation of data into knowledge within BI supports enhanced decision making. BI systems, or data-driven Decision Support Systems (DSS), favor gaining business advantages with robust BI tools over decisions based on mere intuition. What is essential here is establishing a data- or fact-based decision-making framework via a strong computer system that instills confidence in any decisions that is being made. According to Shende and Panneerselvam (2018), BI has six major components (see Table 1).

Furthermore, Shende and Panneerselvam (2018) define BA techniques as the exploration of historical data from numerous sources using statistical and quantitative analysis, data mining, predictive modelling, among other approaches, in order to identify trends and understand information that can drive business change and support sustainable practices. In this sense, BA involves the use of statistical tools and technologies for pattern identification, variability analysis, relationship identification, and future insights prediction. Similarly to BO, BA also has six major components that are listed in Table 2.

Therefore, BI and BA are described as the tools supporting process optimization in contemporary organizations. Since both BI and BA enhance data-driven decision

Table 1 Six major Business Intelligence (BI) components

Component	Description	Authors
OLAP (On-line Analytical Processing)	This component pertains to the methods business users use to analyze data using advanced tools, thus facilitating the exploration of dimensions like time or hierarchies.	Mansmann et al. (2007) Pirnau et al. (2010)
Advanced Analytics	This component involves data mining, forecasting, or predictive analytics that are performed using statistical analysis techniques to predict or provide certainty measures on facts.	Bose (2009)
Corporate Performance (Portals, Scorecards, Dashboards)	This provides a framework for various components to integrate and collectively narrate a story.	Chung and Chung (2013); Mishra et al. (2010)
Real-Time BI	This component enables the real-time distribution of metrics through emails, messaging systems, and interactive displays.	Azvine et al. (2006) Dasgupta and Vankayala (2007)
Data Warehouse and Data Marts	This component is necessary for BI, aiding in the physical data transmission for integration, cleansing, aggregation, and query tasks. Data marts store historical operational data for trend analysis and strategy formulation.	Laberge (2011) Power and Sharda (2015)
Data Sources	This component may include diverse data types like operational, historical and external data from market research or existing data warehouse environments.	Berlanga and Nebot (2016) Bures et al. (2012)

Source Adapted from Shende and Panneerselvam (2018)

Table 2 Six major Business Analytics (BA) components

Component	Description	Authors
Data Mining	Creating models to discover unknown trends and patterns in vast data using statistical techniques	Chuah et al. (2016) Leung (2014)
Text Mining	Extracting meaningful patterns and relationships (e.g., social media sentiments) from text collections	Hassani et al. (2020); Sakurai and Ueno (2004)
Forecasting	Analyzing and predicting time-based processes	Bevacqua et al. (2014) Dumas (2018)
Predictive Analytics	Developing predictive scoring models	Doumos et al. (2019) Dumas (2018)
Optimization	Using simulation techniques for best outcome identification	April et al. (2006) Better et al. (2007)
Visualization	Enhancing data exploration and modeling results through interactive statistical graphics	Cook et al. (2016) Dia- mond and Mattia (2017)

Source Adapted from Shende and Panneerselvam (2018)

making and strategic planning, the two diverge in the sharing of data mining, a technique used to extract patterns and insights from data. In addition, both fields emphasize predictive analytics, which aims to forecast future trends based on historical data. Statistical analysis, which involves employing statistical methods to understand the data, is another common thread.

However, the two aspects where BI and BA diverge are their focus and application. The first divergence between BI and BA is observed when examining their specific components. On the one hand, BI primarily analyzes historical data to inform decision making and understand past performance (Chen et al., 2012; Vercellis, 2011); accordingly, BI uses OLAP to analyze data using advanced tools, exploring dimensions such as time or hierarchies. It also focuses on data mining and predictive analytics related to corporate performance, enables real-time distribution of metrics, relies on data warehouses for integration, and collects various types of data.

On the other hand, BA involves forward-looking use of data to forecast future trends and outcomes, thereby supporting strategic decisions (Shende & Panneerselvam, 2018). Furthermore, BA involves exploring historical data from various sources using statistical and quantitative analysis, data mining, and predictive modeling, with a particular emphasis on pattern identification, variability analysis, and a future-oriented approach to sustainable knowledge and practices. The shift from BI to BA is propelled by the growing volume and complexity of data and the need for real-time insights in an ever-evolving business landscape (Iovan & Ivanus, 2014).

The dual methodology approach

After establishing a clear distinction between the two key concepts under examination—those of BI and BA—in this section, we outline the methodology we use to achieve the goals set forth in the present study. As noted in the introduction, we use a dual methodological approach: first, we conduct a bibliometric study that allows for quantification/qualification of scientific publications related to our subject and, second, we perform purely qualitative analysis. Using such mixed methodological

approach, as argued by Matenda and Sibanda (2023) in a study on BRICS economies, makes it possible to gain a more comprehensive understanding of the studied phenomena by combining the numerical depth of quantitative methods and the contextual richness of qualitative analysis, which jointly provide a more holistic understanding of the research topic. In this way, both approaches complement each other by providing a dual perspective, and their fundamentals are described below.

The quantitative-qualitative approach: a bibliometric assessment with SciMAT

In this review, we systematically examine the corpus of literature on BI and BA in tourism, integrating a bibliometric analysis using the SciMAT software to map the intellectual structure and thematic evolution of the field. Using statistical methods to evaluate publication patterns and trends in this field of study provides an understanding of the evolution and impact of research and topics over time. As argued by Ribeiro-Navarrete et al. (2023), a bibliometric study employs bibliographic analysis, co-citation, and co-occurrence of keywords. This approach enables identifying relevant authors, leading journals and key topics in the academic literature related to the phenomenon you want to study.

The SciMAT software tool, as described by Cobo et al. (2012), enables performing science mapping analysis within a longitudinal framework. This approach catalogues existing knowledge and it goes deeper by combining performance analysis with science mapping. This method is also instrumental in detecting and visualizing conceptual subdomains within the research field, be them specific themes or broader thematic areas. The resulting analysis hinges on co-word analysis within a longitudinal framework—a technique that uncovers various themes addressed by the field over a specified period. The richness of this analysis is augmented by incorporating performance measurement. These measures fall into the following two distinct categories: quantitative and qualitative. While the former focus on assessing the productivity of the identified themes and thematic areas, the latter aim to gauge the (perceived) quality based on the bibliometric impact of these themes and thematic areas, as expounded by Cobo et al., (2011).

The tourism industry has a complex structure that consists of the accommodation sector, attractions sector, transport sector, travel organizer's sector, as well as destination organization sector (Middleton & Hawkins, 1998); along with the above, there are also restaurant services, food and beverage activities, and various auxiliary services involved. All these sectors and interconnected, supporting and complementing each other such that without others, the tourism industry will not be complete (Ramayah et al., 2011; Xu, 2010). Accordingly, the main features of BI and BA applied to tourism industry should include data analysis, reports, dashboards, data visualization, performance metrics, key performance indicators, predictive analytics, trend indicators, strategic planning tools, profitability analysis, benchmarking, budgeting, and forecasting (Ibrahim & Handayani, 2022). These tools are essential for decision making in the tourism sector, where the adoption of AI and Big Data analytics can provide a competitive advantage (Stroumpoulis et al., 2022). BI and BA also enable cross-process knowledge extraction and decision support in tourism

destinations (Höpken et al., 2015) and data-driven management for new business in tourism (Ferreira & Pedrosa, 2022; Höpken et al., 2015).

Taking all this into account and for our specific research purposes, we selected the WoS, specifically the Web of Science Core Collection, which includes a collection of high-quality scientific journals within several large-scale databases. Another advantage of this database is that furnishes the essential data required for conducting analysis in SciMAT, including key words and abstract. As highlighted by Shu et al. (2020), the WoS is renowned as one of the most pivotal databases globally, with its significance defined by its inclusion of excellent research spanning together many countries. Similar arguments on using the WoS for its high performance and the breadth of results it yields across multiple disciplines were made by Harzing and Alakangas (2016) and Vera-Baceta et al. (2019).

Our search within WoS was guided by specific criteria, with the terms “tourism,” “Business Intelligence,” and “Business Analytics” forming the core of the search and selection process. This initial search yielded a total of 77 documents. However, following a meticulous refinement and filtering of the database, a total of 50 articles were retained as the primary subject of analysis. The included results came from Social Sciences Citation Index (SSCI), Conference Proceedings Citation Index – Social Science & Humanities (CPCI-SSH), Book Citation Index – Science (BKCI-S), Book Citation Index – Social Sciences & Humanities (BKCI-SSH), and Emerging Sources Citation Index (ESCI). The included articles spanned the years 2000 to 2023, thereby offering a comprehensive view of the evolution of the field. In order to conduct a more nuanced evolutionary analysis, we divided this timeline into two distinct periods: (1) pre-pandemic (2000–2020), with 38 papers found and (2) post-pandemic (2021–2023), with a total of 12 articles. This splitting of the data was essential, as the application of data-driven analysis in tourism underwent a significant transformation in response to the pandemic.

More specifically, Zamyatina (2023) provide critical insights into this transformative shift, highlighting a notable change in consumer preferences. The pandemic period, as Zamyatina (2023) observed, witnessed a dramatic alteration in consumer priorities, with a newfound emphasis on intangible luxury. This reflected a broader understanding where travel was increasingly considered an essential component of a healthy lifestyle. Chen (2021) corroborated this observation, noting that user-generated content during the pandemic predominantly focused on pandemic-related keywords. This shift embodies a profound change in public perceptions, notably marked by increased dissatisfaction among tourism service consumers due to quarantine restrictions and health test mandates.

In another relevant study, Ionescu et al. (2022) addressed the significant compression that the tourism sector experienced since the onset of the COVID-19 pandemic, which destabilized both tourist flows and the economic agents within the industry. As a solution to this situation, Ionescu et al. (2022) proposed a decision support model designed to aid in the recovery of tourism in Europe, with an emphasis on the growing need for data-driven tools within the industry. Rahim et al. (2021) discussed the profound impact of COVID-19 on tourism, noting that the pandemic adversely affected both demand and supply in various aspects. On exploring the increasing use of virtual tourism platforms, such as virtual reality (VR) and augmented reality (AR),

as a response to the pandemic, Rahim et al. (2021) suggested that these technologies would come into wider use for data collection and analysis in the future, indicating a potential shift in how the tourism sector was likely to adapt to and overcome challenges.

The pure qualitative approach: insights from the Gioia methodology

Along with the bibliometric research, we complemented our methodology with a pure qualitative analysis of relevant publications. To this end, we used the Gioia methodology, a renowned qualitative approach in organizational research devised by Gioia et al. (2013). The core of this systematic qualitative approach is theory-building from empirical data. This method is particularly suited for exploring specific contexts, such as the intersection of BI and BA in tourism (Gioia et al., 2013). The Gioia methodology involves a dual-layered coding process, beginning with first-order coding to capture participants' perspectives and progressing to second-order coding for broader, theoretical categorization (Gehman et al., 2018; Gioia et al., 2013, 2022; Magnani & Gioia, 2023). To date, the Gioia methodology has been extensively used in the literature (Lacoste et al., 2022; Niittymies, 2020; Riviere et al., 2018; Visvizi et al., 2022), and many of these were reviewed by Magnani and Gioia (2023).

In the present study, we adapted the Gioia methodology for secondary data analysis, with a particular focus on previously collected and published scientific academic articles. This departure from conventional primary data collection methods, such as interviews or surveys, allowed us to include a wider range of studies for an extensive comparative analysis in the fields of BI and BA. This adaptation also enhanced robustness and validity of our theoretical framework and helped us to better align our results with the findings previously reported by Taquette and Minayo (2017) and Mwita (2022), who highlighted the scientific validity and flexibility of using qualitative approaches with secondary data.

Overall, the Gioia methodology enables transitioning from concrete studies to abstract theoretical insights, enriching qualitative research. Key stages of this methodology as used in the present study are outlined below.

1. *Data Collection*: A distinctive aspect of how we adapted the Gioia methodology was our analysis of secondary data, which involved an exhaustive review and synthesis of available literature. Instead of using conventional primary data collection methods, we thoroughly reviewed a wide range of published studies on the topic. This approach allowed for a broader exploration of information sources, aligning with the flexibility inherent in the Gioia methodology (Taquette & Minayo, 2017; Mwita, 2022),
2. *Data Analysis*: At this stage, which is the crux of the Gioia methodology, we systematically identified, coded, and analyzed qualitative data. Data analysis involved a detailed examination of texts to discover underlying patterns, themes, and dimensions (Gehman et al., 2018).
3. *Conceptual Framework Development*: Based on the insights derived from our data analysis, we created a detailed and data-driven conceptual framework. This

framework was meant to aid in comprehending how BI and BA phenomena are constructed and perceived in the tourism sector (Mugizi, 2019).

4. *Theory Generation*: At this stage, our goal was to generate a rich, well-grounded theory. By interpreting the data within its conceptual framework, we aimed to produce a theory that would provide a deep understanding of the subject matter (Olbrich & Mueller, 2013; Tucker, 2016).

Our use of the Gioia methodology aligned with major principles of qualitative research including purposive sampling and autonomy in sample size determination (Subedi, 2021). Our approach was also consistent with Tipton et al.'s (2014) principles on sample selection, reinforcing the importance of thoughtful sample selection for representativeness.

Our approach facilitated an in-depth exploration of BI and BA in tourism, ensuring that the results are comprehensive, credible, and reflective of current academic research. Our approach also incorporated the insights from Dufour and Richard's (2019) work that underlined the importance of selecting appropriate analytical approaches for specific research contexts. More specifically, in a comparative study that focused on the same dataset, Dufour and Richard (2019) used Grounded Theory Approach (GT) and General Inductive Approach (GIA) to highlight the strengths and limitations of each method and give the researcher the responsibility of selecting the most appropriate methodological framework. A review of the results of this comparison enhanced our methodology by providing alternative data analysis perspectives in tourism research.

Article selection and analysis process

The Gioia methodology integrates principles of sample selection in randomized experiments, emphasizing strategic and thoughtful sample selection in qualitative research. This approach guided our choice of 12 scholarly articles, providing an overview of BI and BA in the tourism industry and allowing for a detailed analysis of each article.

The selected articles were systematically identified from the WoS Core Collection database. Our decision to use the WoS was underpinned by the consideration that I business scholars prefer using the WoS and Scopus as their primary databases, while authors and academic institutions consider the journals, books, and conferences indexed of these two databases as "quality publications" (Rana et al., 2023).

Another important characteristic of the WoS is its multidisciplinary and international coverage (Vieira & Gomes, 2009). After a careful search of different keywords, a total of 25 papers were appraised and carefully read by the authors. We found misinterpretations in literature between Artificial Intelligence (AI) and BI. After several rounds of discussions and readings, a meticulous selection of 12 scientific articles on BI and BA in tourism was found the most relevant for further analysis. The articles were chosen based on their relevance, currency, and presence in high-impact journals, while ensuring a broad spectrum of perspectives.

Criteria for article inclusion

The inclusion criteria that we used in selecting the articles centered on whether the articles addressed six specific research questions; we also examined whether the paper provided definitions of BI/BA and discussed influences, advantages, challenges, contributions of BI/BA to tourism. The articles that did not meet these criteria were randomly replaced, thus ensuring methodological robustness and thematic consistency.

Article selection for this study aligned with the qualitative research criteria set by Laumann (2020) using keywords relevant to BI, BA, and tourism. Our purposive approach was aimed at finding the articles that made meaningful contributions to understanding the intersection of BI and BA in tourism, ensuring comprehensive topic coverage. The process was designed to minimize selection bias, providing a diverse temporal coverage and ensuring that each selected article substantially contributed to our understanding of BI and BA in the tourism sector. This approach underlined the integrity and validity of our research. The very process included identifying, categorizing, and relating themes to our study's research questions, using a systematic approach to ensure comprehensive theme extraction. The findings from the selected articles were then synthesized to provide a holistic understanding of the research topic. This involved integrating insights from different studies, identifying commonalities and differences and linking them to the overarching research question.

Once six articles from each thematic area were randomly chosen, their content was examined to determine if they could address our main research question: *In what ways do Business Intelligence and Business Analytics manifest as distinct yet inter-related elements in the tourism sector?* To this end, the following questionnaire was designed, and each candidate publication was screened on how it addressed the questions. The questions included in the questionnaire are listed below.

1. How is Business Intelligence (BI/BA) defined and used in this specific study within tourism?
2. What types of tourism business decisions are influenced by Business Intelligence (BI/BA) in this case?
3. What are the identified advantages and challenges of using Business Intelligence (BI/BA) in this context?
4. How does this study contribute to the general understanding of Business Intelligence (BI/BA) in tourism?
5. What practical and theoretical implications can be drawn from this study for the implementation of Business Intelligence (BI/BA) in tourism?
6. What are the specific Business Intelligence (BI/BA) tools used in this study, and how do they contribute to the presented results and conclusions?

In instances where any of the selected articles did not address one or more of these questions, it was excluded from the dataset and was randomly replaced by another publication that was further screened as described above. The final sample comprised 12 articles spanning the period 2008–2023, sourced from different scientific journals. Table 3 and 4 lists the selected articles related to BA.

Table 3 Selected articles about BA

BA/Paper Title	Journal	Abstract
Hidden theorizing in big data analytics: With a reference to tourism design research (Mazanec, 2020)	<i>Annals of Tourism Research</i>	The article focuses on the use of Big Data analysis in the context of tourism design and how this impacts theorization in the field of tourism. It discusses how Big Data analysis can influence theory construction in tourism design, as well as potential misunderstandings and hidden theoretical elements in data-based analytical approaches. It addresses the struggles for theory construction in tourism research and the role of inductive reasoning in social sciences.
Creating value from social big data: Implications for smart tourism destinations (Del Vecchio et al., 2018a)	<i>Information Processing & Management</i>	This paper aims to demonstrate how the huge amount of social Big Data available from tourists can nurture the value creation process for a smart tourism destination. Applying a multiple-case study analysis, the paper explores a set of regional tourist experiences related to a southern European region and destination, to derive patterns and opportunities of value creation generated by Big Data in tourism.
A decision support system to analyze: Customer satisfaction applied to a tourism transport service (Ramos et al., 2022)	<i>Multimodal Technologies and Interaction</i>	This paper presents a decision-support system for analyzing consumer satisfaction, based on consumer feedback from the customer experience when transported by a transfer company, in the present case working in the Algarve region, Portugal. The results show how tourists perceive the service and which factors influence their level of satisfaction and sentiment.
Multichannel digital marketing optimizations through Big Data analytics in the tourism and hospitality industry (Sakas et al., 2022)	<i>Journal of Theoretical and Applied Electronic Commerce Research</i>	This study presents key insights into the use of business analytics in tourism sector. It highlights the critical role of emerging technologies, such as mobile social media, in providing personalized customer experiences. The study advocates for a greater investment in Big Data analytics to understand online user behavior and trends, particularly in relation to social media interactions. It also points out the importance of skilled data analysts and AI technology, such as chatbots and voice search, to enhance customer service. Additionally, the article discusses the role of web analytics KPIs in optimizing digital brand presence and analyzing user activity on websites and social media. Finally, it raises privacy concerns associated with the use of personal information in targeted advertising and calls for further research to generalize its methodological framework to other tourism companies. These findings emphasize the increasing importance of business and Big Data analytics in improving customer experiences and digital marketing strategies in tourism and hospitality.

Table 3 (continued)

BA/Paper Title	Journal	Abstract
Why am I satisfied? See my reviews – Price and location matter in the restaurant industry (Kim et al., 2022)	<i>International Journal of Hospitality Management</i>	The main purpose of this study is to identify relationships between customers' service evaluations embedded in online reviews and customer satisfaction and demonstrate the unique role of price and location in the restaurant industry. Approximately 250,000 online reviews of restaurants were analyzed. By incorporating spatial dependency, geographically weighted regression analysis was conducted to identify the pure impact of affective and cognitive evaluations of restaurant services and to develop a sophisticated satisfaction prediction model.
Personalized trip information for E-tourism. Recommendation system based on Bayes theorem (Srisuwan & Srivihok, 2008)	<i>Research and Practical Issues of Enterprise Information Systems</i>	This paper presents the personalized recommendation system for e-tourism by using statistic technique based on Bayes theorem to analyze user behaviors and recommend trips to specific users. The system is evaluated by using recall, precision and F-measure. Results demonstrate that it is possible to develop a personalization recommendation system.

Source Authors' compilation from the WoS Core Collection Database

The systematic approach outlined in this section provides ensures empirical grounding and theoretical framework that aptly reflect the complexity of BI and BA in the tourism sector. Using this methodology, we conduct an in-depth exploration of BI and BA, thus laying the groundwork for a more comprehensive understanding of the strategic, operational, and customer-centric implications of these two constructs.

Results

In this section, we first report the results of the bibliometric study, which is followed by the presentation of the findings obtained using and the Gioia methodology application. To enhance the data analysis and presentation of the results, an exhaustive examination of the findings derived from the Gioia methodology was conducted. Each identified theme was comprehensively detailed, using insights from the selected articles to highlight their significance in understanding the roles of BI and BA within the tourism industry.

The output included visual representations such as thematic maps and comparative tables for clarity. These visual aids were thoroughly interpreted and linked to our research objectives. A thematic map was created to demonstrate the interconnected aspects of BI and BA, while comparative tables were made to delineate their unique and shared applications in the tourism sector. This refined approach to data presentation aimed to elucidate the study's primary findings aligning them with the research objectives, thus providing a holistic and accessible understanding of how BI and BA influence the tourism industry.

Table 4 Provides detail on the selected articles related to BI

BI/Paper Title	Journal	Abstract
Business intelligence for cross-process knowledge extraction at tourism destinations (Höphen et al., 2015)	<i>Information Technology & Tourism</i>	This study introduces a novel approach for enhancing decision-making in the tourism sector using Business Intelligence (BI). It addresses the underutilization of decision-relevant data in tourism destinations. The proposed BI-based method integrates cross-process knowledge extraction and decision support. Key elements of this approach include developing a uniform and comprehensive data model for a central data warehouse, implementing mechanisms to extract data from diverse sources and integrate them into the data warehouse, applying analysis methods to identify significant relationships and patterns across various business processes, uncovering new insights. A prototype was successfully implemented at the Swedish mountain destination Åre, demonstrating the effectiveness of this BI architecture in yielding tangible business benefits for tourism destinations.
BITOUR: A Business Intelligence Platform for Tourism Analysis (Bustamante et al., 2020)	<i>ISPRS International Journal of Geo-Information</i>	Integrating collaborative data in data-driven Business Intelligence (BI) system brings an opportunity to foster the decision-making process towards improving tourism competitiveness. This article presents BITOUR, a BI platform that integrates four collaborative data sources (Twitter, Openstreetmap, TripAdvisor, and Airbnb). BITOUR enables data analysis and visualization to answer questions like the most frequented places by tourists, the average stay length, or the view of visitors of some particular destination.
Tourism demand forecast based on adaptive neural network technology in business intelligence (Wang, 2022)	<i>Computational Intelligence and Neuroscience</i>	In order to improve the effect of tourism demand forecast, the commercial development of the tourism industry and the actual experience of users, this paper uses adaptive neural network technology to conduct tourism demand forecast analysis. Moreover, this paper improves the adaptive neural network algorithm so that it can handle multiple data for tourism demand forecast.
A knowledge destination framework for tourism sustainability: A business intelligence application from Sweden (Fuchs et al., 2013)	<i>Tourism</i>	The work presents an approach to study mechanisms that allow managers to perform the Innovation Management (IM) measurements. The patterns for the design of an integral system of indicators are analyzed. A methodology that integrates the thought process, focusing on the Business Intelligence and the Balance Scorecard, is presented.

Table 4 (continued)

BI/Paper Title	Journal	Abstract
Application of business intelligence in the tourism industry: A case study of a local food festival in Thailand (Vajirakachorn & Chongwatpol, 2017)	<i>Tourism Management Perspectives</i>	This study outlines a way to integrate a business intelligence framework to manage and turn data into insights for festival tourism. This framework combines the architecture of database management, business analytics, business performance management and data visualization to guide the analyst in drawing knowledge from the visitor data. A case study from a local festival in Thailand is conducted to demonstrate the practical validity of the proposed business intelligence framework.
The competitive productivity (CP) of tourism destinations: an integrative conceptual framework and a reflection on big data and analytics (Mariani et al., 2021)	<i>International Journal of Contemporary Hospitality Management</i>	This study elaborates an integrative conceptual framework of tourism destination competitive productivity (TDCP) by blending established destination competitiveness frameworks, the competitive productivity (CP) framework and studies pertaining to Big Data and Big Data analytics (BDA) within destination management information systems and smart tourism destinations. The drivers of TDCP are examined in the context of the ongoing 4th industrial revolution.

Source Authors' compilation from the WoS Core Collection Database

Table 5 Journals with two or more articles analyzed

Journal	N of documents
<i>Tourism And Hospitality Management-Croatia</i>	3
<i>Information Technology & Tourism</i>	3
<i>Tourism Management Perspectives</i>	2
<i>Hotelnictvi, Turismus a Vzdelavani</i>	2
<i>International Journal of Contemporary Hospitality Management</i>	2
<i>Journal of Destination Marketing & Management</i>	2

Source Authors' compilation based on Data from the WoS Core Collection

In-depth bibliometric analysis findings

Despite the relatively modest size of the analyzed sample, we identified a considerable array of themes and concepts, thereby facilitating a thorough analysis using the SciMAT tool. Table 5 and 6 presents the journals where two or more articles on the studied topic were identified.

The results of applying the SciMAT tool yielded a set of clusters that can be understood as conglomerates of different scientific aspects. In the case of co-word analysis, the clusters represented groups of textual information, or semantic or conceptual groups of different topics treated by the research field. Therefore, the detected clusters can be used to quantify the research field by means of a performance analysis. Co-word analysis, a powerful technique for discovering and describing the interactions between different fields in scientific research (Cobo et al., 2011), allowed us to discover the main concepts treated by the field.

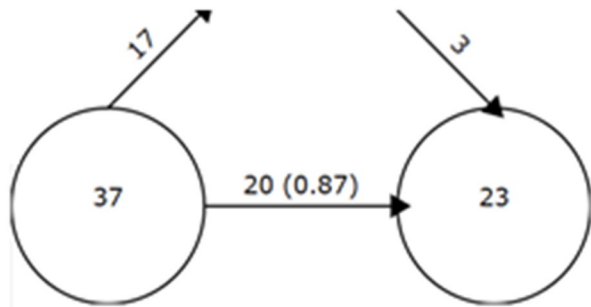
Figure 1 shows the results of our keyword analysis. The circles represent each sub-period, with the number of keywords in that sub-period indicated inside the circle

Table 6 lists ten most cited articles in our sample

Article	N citations	Authors
Analyzing user reviews in tourism with topic models	40	Rossetti et al. (2016)
Using opinion mining techniques in Tourism	36	Bucur (2015)
Network analysis of Big Data research in tourism	31	Li and Law (2020)
A knowledge destination framework for tourism sustainability: A business intelligence application from Sweden	28	Fuchs et al. (2013)
Business intelligence for cross-process knowledge extraction at tourism destinations	25	Hoepken et al. (2015)
Application of business intelligence in the tourism industry: A case study of a local food festival in Thailand	19	Vajirakachorn and Chongwatpol (2017)
Actualizing big data analytics for smart cities: A cascading affordance study	18	Zeng et al. (2020)
The competitive productivity (CP) of tourism destinations: an integrative conceptual framework and a reflection on big data and analytics	16	Mariani et al. (2021)
Enhancing competitiveness in the tourism industry through the use of business intelligence: a literature review	12	Nyanga et al. (2020)
An analysis of the sustainable tourism value of graffiti tours through social media: Focusing on TripAdvisor reviews of graffiti tours in Bogota	9	Seok et al. (2020)

Source Authors' compilation based on Data from the WoS Core Collection

Fig. 1 Overlapping map. Source Authors' compilation based on Data from the WoS Core Collection



(37 in the first period and 23 in the second one). The arrow between consecutive sub-periods represents the number of keywords shared between them (20) and, in parentheses, we also report the Stability Index (overlap fraction, 0,87). The upper-incoming arrow represents the number of new keywords of the sub-period (2) and, finally, the upper-outcoming arrow represents the keywords that are not present (i.e., discontinued) in the next sub-period (17) (Cobo et al., 2011). The significant overlap between the two sub-periods indicates that most concepts remain relevant across both periods.

Figure 2 shows the results of co-word analysis where clusters of keywords (and their interconnections) were obtained. These clusters were considered as themes. Each research theme obtained in this process was characterized by two parameters: “density” (which can be understood as a measure of the theme’s development) and “centrality” (which can be understood as a measure of the importance of a theme in the development of the entire research field analyzed).

Fig. 2 Strategic Diagram period 1. *Source* Authors' compilation based on Data from the WoS Core Collection

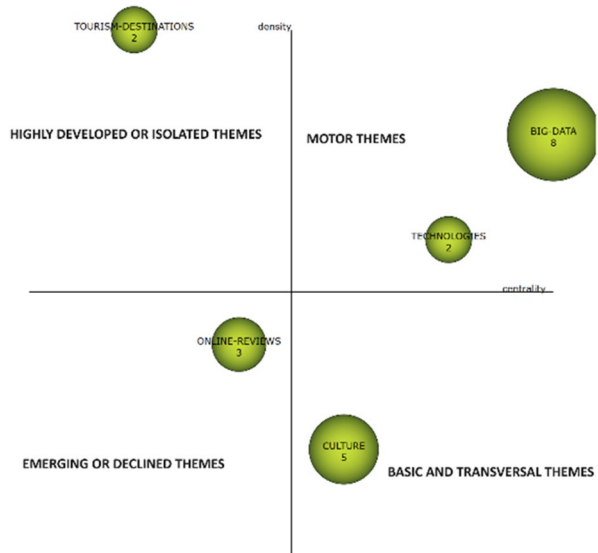


Fig. 3 Big Data–Networks graph (Period 1). *Source* Authors' compilation based on Data from the WoS Core Collection



In Fig. 2, the themes are placed in four groups according to the quadrant where they are located. Overall, a strategic diagram in a two-dimensional space can be built by plotting themes according to their centrality and density rank values. In the present study, strategic diagrams are shown in Figs. 2 and 3 for each period, respectively; the numbers within the circles correspond to the number of articles included in the analysis.

Within a theme, the keywords and their interconnections draw a network graph, called a thematic network. Each thematic network is labelled using the name of the most significant keyword in the associated theme (usually identified by the most cen-

Fig. 4 Technologies–Networks graph (Period 1). *Source* Authors’ compilation based on Data from the WoS Core Collection

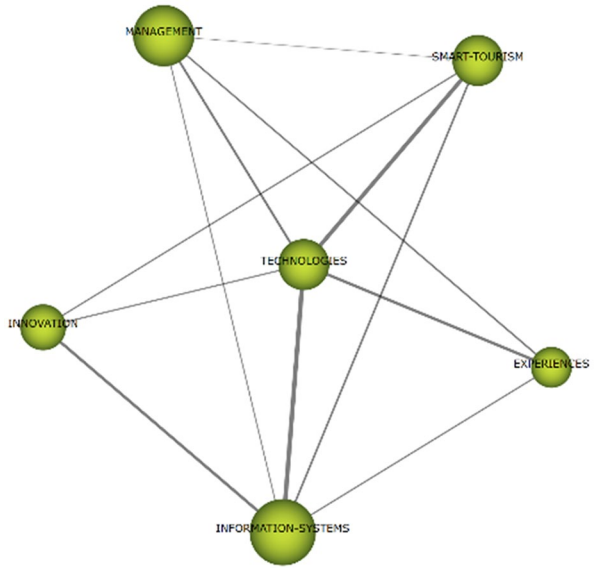
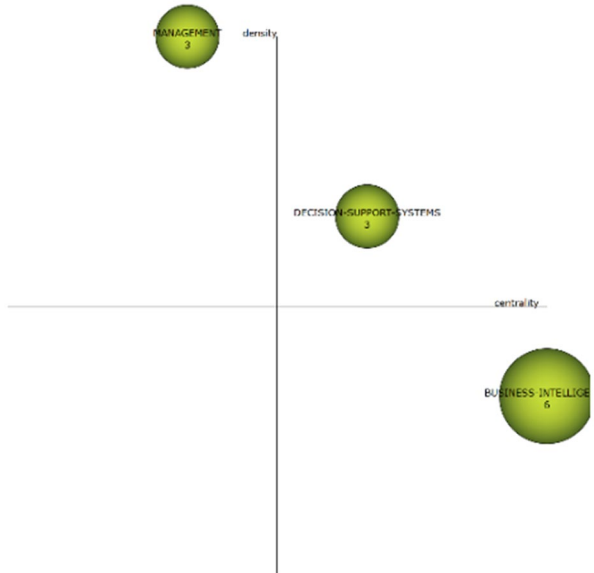


Fig. 5 Strategic diagram (Period 2). *Source* Authors’ compilation based on Data from the WoS Core Collection



tral keyword of the theme). Figures 4 and 5 (Period 1) and 6 (Period 2) show the network graphs constructed with the central themes for each period.

Coming back to Fig. 2, following Cobo et al. (2011), the themes in the upper-right quadrant are both well developed and important for the structuring of a research field. These are generally known as the motor-themes of the specialty, as they present strong centrality and high density. The placement of themes in this quadrant implies that the corresponding themes are related externally to concepts applicable to other

themes that are conceptually closely related. Themes in the upper-left quadrant have well developed internal ties, but unimportant external ties; therefore, they are of only marginal importance for the field. These themes are very specialized and peripheral in character. Themes in the lower-left quadrant are both weakly developed and marginal. The themes of this quadrant have low density and low centrality, mainly representing either emerging or disappearing themes. In the lower-right quadrant, we find themes that can be considered foundational and cross-cutting due to their low density and high centrality.

In Period 1 (2000–2020), Big Data emerged as a central, well-developed theme (Fig. 2), signifying its rise as a key instrument in decision making and business strategy within the tourism industry (Fig. 4). The graph depicts “Big Data” as intricately linked to both BI and BA, signifying its integral role in the development and application of these disciplines in tourism. The observed connections between “Big Data” and other thematic areas such as “Hospitality”, “Decision Making”, and “Smart Destination” imply that the analysis and use of extensive data sets are essential for informed decision-making processes and the enhancement of smart destinations in the hospitality industry. The use of technologies also appears to be a secondary central theme (see Fig. 1), increasingly standing out for its connections to innovation, use of information systems, assessment of consumer experiences and achievement of smart cities (see Fig. 4). Online Reviews also emerged as a relevant theme, which may point to the growing impact of user opinions. As a cross-cutting theme, the influence of culture in the tourism industry remains consistent.

In Period 2 (2021–2023), the results shown in the strategic diagram (Fig. 3) indicate that Decision Support Systems gained prominence, exhibiting an increase in centrality and suggesting a greater reliance on analytical tools for making strategic decisions. Furthermore, Business Intelligence maintained its position as an established theme, reflecting its ongoing impact on deriving actionable insights from large volumes of data. The interconnection between Decision-Support Systems (Fig. 6) and other concepts such as Hospitality, Framework, Experiences and Tourism Industry highlights the integration of advanced analytics across all facets of tourism.

We also constructed a longitudinal theme map by grouping the two periods (Fig. 7). Continuous lines in the map represent a conceptual link, while broken lines represent linked themes that share keywords that differ from their respective names. Finally, the diameter of the sphere corresponds to the number of documents retrieved in each theme.

Figure 7 suggests that, with the transition from Period 1 to Period 2, there occurred a shift from a focus on Big Data and technologies to a greater emphasis on the practical applications of these data through decision support systems and BI strategies. The increasing complexity of networks and the emergence of new nodes depict a tourism industry that is in constant adaptation to the innovations and demands of the more connected and data-driven era. Indeed, tourism gets increasingly informed by personalized experiences and optimized management, guided by the intelligence gleaned from the analysis of complex data and diverse sources of information, including online reviews and cultural factors.

The results of our bibliometric literature review revealed the complexity of BI and BA within the tourism industry, marking out their characteristics and areas where

Fig. 6 Decision-support-systems-Networks graph (Period 2). *Source* Authors' compilation based on Data from the WoS Core Collection

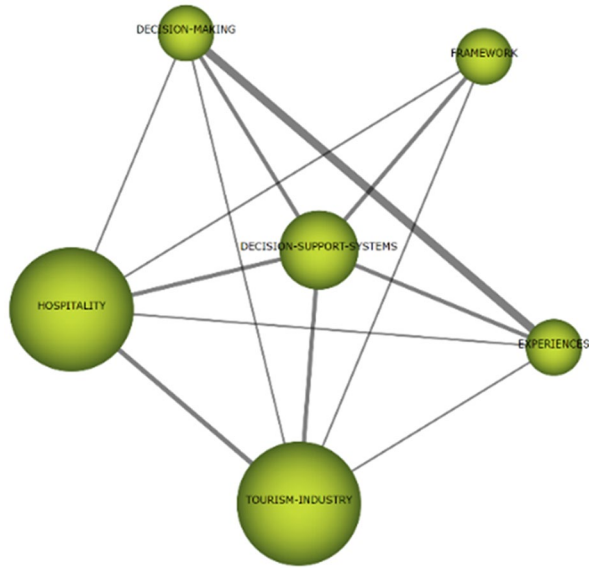
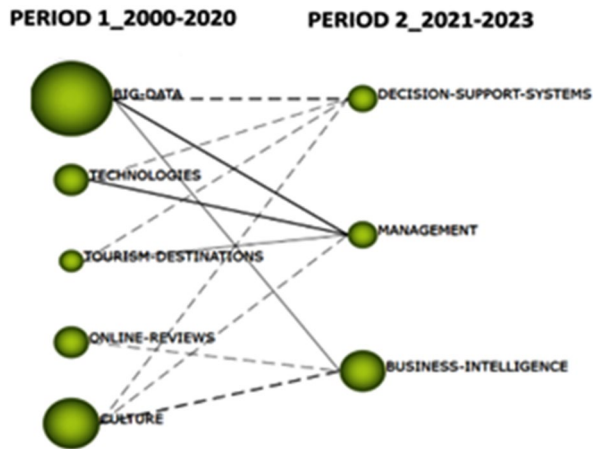


Fig. 7 Longitudinal theme map. *Source* Authors' compilation based on Data from the WoS Core Collection



they converge and complement each other. Upon reviewing the current body of literature on BI and BA in tourism, we observed a shortage of research on the subtle roles of BI and BA in tourism. Seeking to bridge this gap in the literature, we thoroughly analyzed 12 key articles on BI and BA in tourism. The results of our Gioia analysis are discussed in the next section.

Analyzing BI in tourism with the Gioia methodology

Our qualitative analysis of the data using the Gioia methodology revealed a modulation in strategic decision-making processes within the tourism sector attributable to BI. The results indicated a profound impact of BI on strategic, operational, and com-

petitive dimensions of tourism. These findings highlighted how BI facilitates a more dynamic approach to demand forecasting and decision making that accommodates the rapid changes in the tourism environment. Moreover, the results showed how BI promotes operational improvements, placing a premium on customer-centric strategies to enhance the tourism experience. The integrative function of BI emerged as a key driver for knowledge management, fostering competitive practices well aligned with global sustainability goals. The visual representation in Fig. 8 and accompanying analysis provide further detail on how BI acts as a linchpin to drive end-to-end growth, equipping the travel industry with the tools for strategic foresight, operational optimization, and a sustainable future.

Figure 8 shows the data structure as the result of the application of the Gioia methodology to BI in tourism and demonstrates BI's substantial impact on strategic planning, operational enhancements, and sustainable competitive practices.

Based on these findings, it can be inferred that BI is instrumental in refining tourism demand forecasts and shaping adaptable decision-making processes. BI streamlines operations, placing customer preferences at the forefront, thus optimizing the overall tourist event experience. Furthermore, BI's integrative capabilities contribute to knowledge management, aiding the tourism industry's progression towards more responsible and sustainable practices. In summary, our qualitative results allow us to conclude that BI is a pivotal element in steering the tourism industry towards comprehensive growth, underlining its critical role in operational optimization, strategic foresight and sustainability.

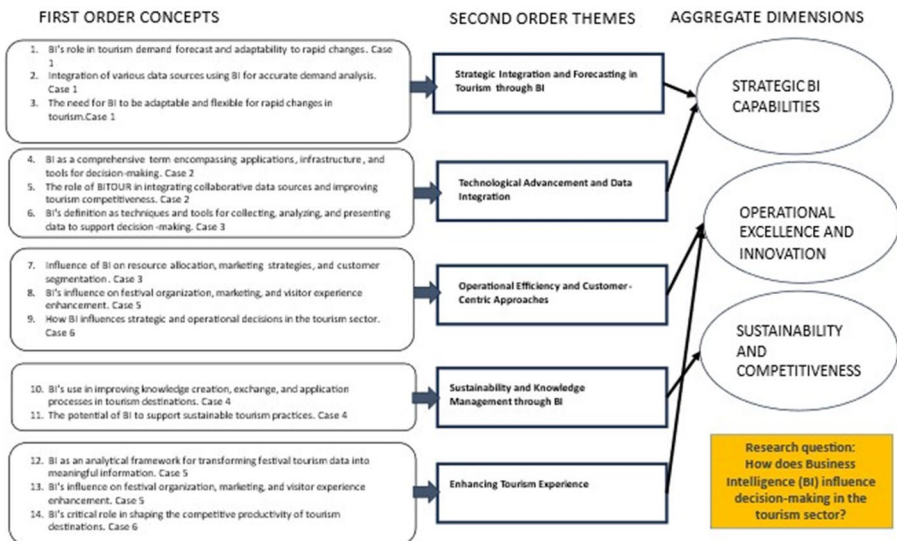


Fig. 8 Data structure for BI obtained using the Gioia methodology (Gioia et al., 2013) *Source* Authors' compilation from selected articles

Analyzing BA in tourism with the Gioia methodology

Our qualitative analysis on the influence of BA on decision-making in the tourism sector using the Gioia methodology was somewhat more extensive due to the increased complexity of the articles included in the sample. The results of this analysis unraveled the intricate web of applications and implications of BA in the tourism sector (see Fig. 9). The identified aggregate dimensions provided a multifaceted panorama of how BA reshapes tourism.

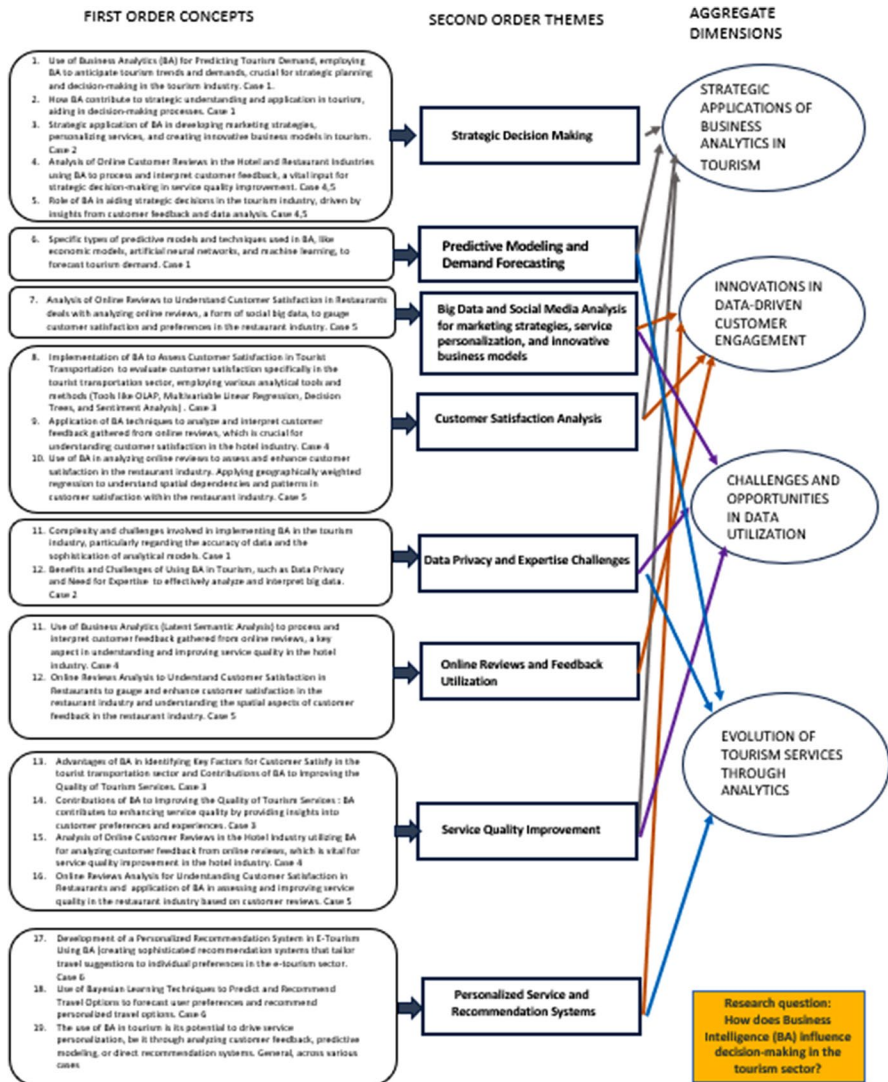


Fig. 9 Data structure for BA obtained using the Gioia methodology (Gioia et al., 2013). Source Authors' compilation from selected articles

The strategic application of BA is the cornerstone supporting innovation and addressing challenges within the sector. Adapting BA strategically improves decision making and paves the way for significant advancements and effective management of challenges. This strategic foundation drives innovation in customer engagement, which emerges as a key outcome.

By leveraging data to enhance interactions and experiences, BA enables a more personalized and dynamic approach to customers. Furthermore, with regard to challenges and opportunities in data use, the path to innovation is marked by both. These critical elements directly influence how tourism organizations strategically apply BA and make progress in customer engagement. Paramount aspects centrally implied in the efficacy of BA are the successful management of data privacy and the development of specialized skills. The culmination of these dimensions is observed in the evolution and continuous improvement of tourism services. The successful integration of BA strategies, coupled with innovation in customer engagement and overcoming challenges, leads to a tangible transformation in the services offered, reflecting the vital role of BA in the tourism sector's ongoing innovation. Together, these intertwined dimensions highlight a narrative of progress and adaptation in tourism, where BA acts as a catalyst for strategic change, customer-centered innovation, challenge overcoming, and service evolution. Taken together, the results of our qualitative analysis of BA using the Gioia methodology reflect the significant and multifaceted influence of BA in tourism, paving the way for greater personalization, enhanced engagement, and more informed decision making, all within the context of a constantly evolving and adapting tourism sector.

Discussion

In recent years, surpassing their status as mere technological tools, BI and BA have emerged as strategic assets. In the present study, we conducted an in-depth exploration of the intersection of BI and BA within the tourism sector, and the results of our analysis contribute to the current understanding of distinct yet complementary roles of BI and BA in enhancing strategic orientation, customer engagement, operational efficiency and sustainability within the tourism sector.

Our results are largely consistent with the findings previously reported in the literature on the use of digital technologies for efficiency, innovation, and sustainability. For instance, similarly to our conclusions, Lyulyov et al.'s (2024) study on the integration of e-governance and e-business in sustainable development argued that enhancing efficiency and fostering innovation are key areas that need be pursued. Both e-governance and e-business leverage digital technologies to optimize processes, improve decision-making, and promote sustainable practices. This synergy is evident in their alignment with global sustainability goals and in contributing to a more informed, efficient, and customer-centric approach in their respective sectors.

Furthermore, in our analysis on BI and BA in tourism using the SciMAT tool, we found a significant change in publications before 2020 and from 2020 onwards, reflecting the tourism's adaptation to digitalization. This result is broadly similar to Ribeiro-Navarrete et al.'s (2023) observations on the evolution in academic produc-

tion, with a significant change happening in pre-pandemic and post-pandemic publications in the literature on digitalization of cooperatives.

Applying BI and BA in the tourism sector opens new avenues to enhance service quality and customer interaction. The proposed perspectives suggest a more tailored approach, where BI and BA are used not just as tools for data processing and analysis, but rather become integral to creating a dynamic, responsive, and customer-centric tourism experience. By integrating these technologies, tourism businesses can gain deeper insights into customer preferences and behaviors, allowing for a more personalized service delivery and a more engaging customer journey. Furthermore, the use of BI and BA can lead to the development of innovative strategies to attract and retain customers, offering a competitive edge in an increasingly digital marketplace. Therefore, the implementation of these technologies should be viewed not just as a technical upgrade, but as a strategic move towards a more informed, agile, and customer-oriented tourism industry.

Furthermore, if we compare the results of the present study with Saura et al. (2023b) study on advances in digital technology, data-driven decision making, combination of methodologies, improvement of interaction and customer satisfaction, we find that, despite the fact that the central themes in both studies are the use of digital technologies and data analysis in the improvement of services, our article focuses specifically on the tourism sector, with a particular emphasis on the roles of BI and BA, while Saura et al. (2023b) has a broader perspective on digital service models in various industries. In addition, the present paper on BI and BA focuses more on distinguishing the roles and impacts of BI and BA in tourism, while Saura et al. (2023b) analyzes the broader application of digital technologies in improving the customer experience in services. Finally, the present study incorporates and details in a novel way the use of the Gioia methodology for the qualitative analysis applied to BI and BA in the tourism sector.

Our results reveal that BI is focused on technological integration and operational enhancement and thus is concerned with the systematic merging of various technological tools and platforms to streamline data collection, analysis, and reporting. This integration, as also demonstrated in several previous studies (e.g., Khan & Quadri, 2012; Viitanen & Pirttimaki, 2006), involves harmonizing disparate systems, including but not limited to customer relationship management (CRM) software, booking engines and social media analytics tools, in order to create a cohesive BI framework. In its turn, BA excels in predictive analysis and direct customer engagement through data, using the insights gained from BI to improve the efficiency and effectiveness of operational processes in tourism. As also indicated in previous research (DuttaRoy & DuttaRoy, 2016; Vahn, 2014), this could include optimizing resource allocation, enhancing customer service, tailoring marketing strategies based on customer data, and improving the overall business performance. Accordingly, our findings reinforce extant literature while providing new insights into the strategic application of BI and BA in tourism.

Specifically, we identified that strategic orientation in both fields emphasizes the importance of long-term development and market adaptation, with BA focusing more on strategic decision-making and innovation. This aligns with previous studies emphasizing the importance of strategic planning in the evolution of tourism

(e.g., Vukotić & Vojnović, 2016). With regard to customer engagement, BA stands out for its ability to personalize customer experiences through detailed data analysis, whereas BI focuses on optimizing systems that influence customer service—an approach also observed in previous research (Shende & Panneerselvam, 2018).

Regarding operational and service enhancement, BI and BA share the common goal of improving service quality, albeit with a different focus: while BI focuses on operational processes, BA prioritizes data-driven service development. This reflects trends noted in previous studies on the importance of operational efficiency and service innovation in tourism (Hollebeek & Rather, 2019; Jiménez-Zarco et al., 2011).

Furthermore, sustainability emerges as a critical issue in the current industry, with BI facilitating sustainable practices through effective knowledge management. While none of the papers included in our dataset directly refers to sustainability in conjunction with BA, our results may suggest that BA advocates for more dynamic and innovative sustainable innovations. In this context, very few other publications are currently available. However, some articles would confirm these conclusions, as was the case of the few publications suggesting that the vast amount of data generated on social media by tourists regarding their travel experiences could serve as a valuable source of open innovation (Saura et al., 2023a). For instance, the use of social Big Data might facilitate innovation processes supporting the development of sustainable tourism experiences in a destination (Del Vecchio et al., 2018b).

Overall, an increasing number of publications point to the relevance of advanced data analysis technologies for understanding and responding to complex challenges, whether they study the economic impacts of extreme weather phenomena, as in Saura et al. (2023c), or the evolution of practices in the tourism sector, as we did the present study. In both cases, the ability to process and analyze large volumes of data becomes an essential tool for innovation and strategic adaptation in an ever-changing world.

Conclusions

In the present study, we used a dual research methodology to explore how BI and BA serve as distinct yet interconnected facets in the tourism industry. The major research question addressed in this study was as follows: *In what ways do Business Intelligence and Business Analytics manifest as distinct yet interrelated elements in the tourism sector?* Through an in-depth analysis of 12 scientific articles extracted from the WoS Core Collection database, significant insights were garnered. The selected papers were subjected to a comprehensive bibliometric analysis that was initially conducted to determine the current landscape of the field. The findings presented here offer a deep understanding of the roles and interplay between BI and BA in tourism.

While sharing common goals, BI and BA differ in their approaches to those goals. While BI integrates and optimizes systems for improved efficiency and decision support, BA is dynamic and focuses more on leveraging data for direct customer engagement and innovative service transformation. These results highlight a complementary relationship, where BI provides a robust infrastructure and BA offers agility and responsiveness in the data-driven landscape of tourism. The selected methodological

framework allowed us to draw upon a broad and diverse range of existing academic insights, enhancing the understanding of the current state of BI and BA in tourism.

The results of the present study advance the theoretical framework of tourism management by integrating and differentiating the roles of BI and BA. Our findings also add depth to existing management theories by showcasing how data-driven approaches can be applied to improve decision making, strategic planning and customer relations in tourism.

Furthermore, in the present study, we addressed the gap in the literature—namely, the scarcity of a comparative analysis of BI and BA within the tourism sector. On exploring the unique and combined effects of BI and BA, we highlighted areas previously unexamined in academic research. Accordingly, our findings provide a more holistic understanding of how data-driven strategies shape tourism industry practices. Viewed from this perspective, several key components regarding methodological aspects should be noted. Regarding data-driven inquiry, we used an inductive approach, which allowed themes and theories to naturally emerge from the data; with regard to narrative analysis, our data were organized into a coherent narrative, transitioning from raw data to more abstract themes and theoretical constructs; dealing with systematic thematic coding, several initial themes were directly identified from participant terms and then developed into broader themes; besides, methodology application supported detailed descriptions of phenomena, capturing the complexity of the qualitative data. In addition, our analysis was rooted in the perspectives of the original scientific studies. Accordingly, before moving to researcher-driven interpretations, we engaged in reflexivity, critically examining our role and potential biases in the data analysis process; visual models were extracted to illustrate the relationships between concepts and themes; and finally, this approach facilitated the development of new theoretical insights by organizing data into themes and dimensions.

Through a detailed exploration of the role of BI/BA in tourism decision-making using the Gioia methodology, we identified key themes that are presented in the Results section with visual aids such as thematic maps and comparative tables for clarity. These tools directly linked our findings to our research objectives, so that in our analysis of BI, we observed its notable influence on strategic and operational decision making in the tourism sector. According to our results, BI enhances demand forecasting and adaptability, especially in response to rapid changes in the tourism environment. The data also revealed the important role of BI in promoting operational improvements and customer-centric strategies, which is essential for enhancing tourism experience. Of note, BI's integrative function emerged as a key factor in knowledge management, supporting sustainable and competitive practices within the industry.

Similarly, the results of our analysis of BA highlighted its strategic application in fostering innovation and effectively managing challenges in the tourism sector. Indeed, BA enables a more personalized approach to customer interaction, leveraging data to improve customer experiences. Identifying challenges and opportunities in data use proved critical in influencing BA's strategic application in tourism organizations. Accordingly, the successful integration of BA strategies results in a continuous service improvement, thereby underscoring BA's vital role in the ongoing innovation and transformation of tourism services.

Taken together, the results of the present study highlight the multifaceted and significant impact of BI and BA in shaping the strategic, operational, and customer-centric aspects of the tourism industry.

Practical implications

A major distinction between the use of BI and BA tools in the tourism sector concerns their different focus on both management and the organization's strategy. To start with BI helps to understand past performance and manage the present one based on concrete facts; accordingly, using BI, one can better understand past trends and obtain indicators such as sales performance, customer behaviors, hotel occupancy, and forth. These indicators can meaningfully inform decision making to optimize hotel operations or improve marketing. As for the tools used within BI, these typically include structured data and software allowing one to create dashboards, reports, and data visualizations. In its turn, BA uses both structured and semi-structured data, such as customer reviews and social media comments, with more emphasis on complex analyses, be them predictive and prescriptive. BA is essential for anticipating changes in the market and strategical planning—for instance, it can predict the demands of certain tourist destinations, or market trends, thereby facilitating proactive and strategic decisions. BA also incorporates advanced tools such as statistical analysis, data mining, and machine learning.

Hence, for industry practitioners, an integration of BI and BA offers a comprehensive approach: BI for foundational data management and technological infrastructure, on the one hand, and BA for dynamic, data-driven decision-making, on the other hand. Tourism businesses can leverage BI for operational efficiencies and BA for customer-centric strategies and service innovation. Our findings also suggest, in order to fully leverage BI and BA for effective tourism management, there is a need for investment in technological infrastructure. In this respect, our findings offer a strategic roadmap for tourism professionals to effectively integrate BI and BA, offering a guide for implementing these technologies to maximize service quality and innovation in customer strategies.

Furthermore, Gioia's methodological diagram for BI in tourism reveals a structured approach through which BI empowers the tourism sector. It highlights how strategic integration and forecasting, driven by BI, are critical to adapting to the dynamic nature of tourism, with the integration of data from various sources so as to improve demand analysis and agility in decision making. Technological advancements facilitated by BI are a breakthrough in data integration and a means to promote operational excellence through customer-centric strategies, allowing tourism companies to stay competitive. The operational efficiency improvements highlighted in the model reflect the role of BI in streamlining processes, optimizing resource allocation, and overall enrichment of visitor experiences. BI's contribution to sustainability and knowledge management indicates its potential to foster sustainable tourism practices, improving the overall competitiveness of the sector. Said differently, BI acts as a conduit for innovation, strategic foresight, and sustainable development within the tourism industry, which makes its applications far-reaching, beyond mere data analysis, and capable of re-shaping the very structure of tourism sector management solutions.

Likewise, the concept diagram resulting from applying the Gioia methodology in the study of BA in the tourism sector clarifies the channels through which BA influences management solutions within it. Specifically, it shows how BA facilitates strategic decision-making, enabling predictive modelling and demand forecasting that support robust marketing strategies and service personalization. Data gleaned from online reviews and comments is key to refining customer satisfaction analysis, thus leading to improvements in service quality. In addition, the diagram indicates the importance of addressing data privacy and the need for expertise in handling it to effectively use and manage Big Data. Collectively, these pathways contribute to the evolution of tourism services through data analytics, which manifests itself in more personalized service offerings and recommendation systems. This progression shows BAs as analytical tools and as integral components in creating a more responsive and data-driven tourism industry that prioritizes customer engagement and operational excellence.

Theoretical implications

The present study contributes to the theoretical understanding of how BI and BA intersect and complement each other in the tourism sector, offering novel insights into their distinct yet synergistic roles. Our results broaden the scope of tourism management theories to include data-driven approaches for both operational and strategic planning. A new contribution to the theoretical understanding of BI and BA in the tourism sector is that, via clearly delineating the distinct roles and applications of BI and BA, the present study existing theoretical models of tourism management.

Yet another novel aspect of this study is the innovative use of secondary data from scientific articles in the Web of Science database, applied through the Gioia methodology. This approach extends the traditional use of this methodology by setting a precedent of using extensive academic databases to synthesize and analyze existing knowledge.

Collectively, our findings emphasize the importance of BI and BA in strategic orientation, customer engagement, and sustainability, thereby enriching the theoretical framework within which tourism management operates. Furthermore, our methodological innovation of data use adds a new dimension to academic research, offering a robust, comprehensive approach to understanding complex interdisciplinary phenomena in the tourism industry.

As argued by Saura et al. (2024), the adaptability and flexibility of small- and medium-sized enterprises, coupled with technology, enables enterprises to quickly respond to unforeseen challenges, emphasizing the importance of cybersecurity, government support, and digital tools to improve business processes. If we consider these conclusions in the context of the present study, we can reveal the following broader theoretical implication: in the modern business landscape, regardless of the specific industry, the effective use of technology and data analysis is an indispensable tool needed to manage complexity and implement innovation. This idea translates into the need for continuous adaptation and integration of digital tools into business strategies to improve efficiency, customer engagement, and overall resilience. These insights suggest a growing trend towards reliance on data-driven decision making and tech-

nological advancements in different sectors, reshaping theoretical frameworks and business practices alike.

Similar theoretical implications concerning the key role of advanced data analytics and technology in revolutionizing business strategies were made by Saura et al. (2024) in a study on data-mining analytics of Twitter-based user-generated content in operations management (OM), suggesting a transformative impact of digital innovation in this field. These conclusions resonate with the present study's focus on the synergistic roles of BI and BA in improving tourism management through data-driven approaches. Both studies highlight how the new digital technologies can revolutionize operational and strategic planning, from automation and forecasting to customer engagement and sustainability in tourism. The use of various data sources, such as Twitter UGC and academic databases, also reflects a broader business trend: the imperative to use technology and data analytics to manage complexity and drive innovation across various industries. This convergence suggests a shift towards data-driven decision-making and technological advancements, reshaping theoretical frameworks and business practices.

Limitations and future research

The present study has several limitations. First, our reliance on secondary data analysis may compromise generalizability of its findings. Accordingly, future research should focus on empirical validation of these findings through direct research methods, including detailed case studies conducted in diverse geographical and business contexts. There is also another gap to be bridged in future research—namely, the direct association of BA with sustainable practices in tourism. Similarly, deeper insights into the practical application of BI and BA would be obtained from exploring the challenges of technological implementation and resistance to change within the tourism industry.

The second limitation of the present study concerns the limited scope of the data available in the selected academic databases. In addition, there may also be an inherent bias in the published literature, which tends to report positive findings over negative or null results. This characteristic of published research analyzed in the present study could have affected our conclusions drawn from the bibliometric analysis. Accordingly, future research could explore the evolving landscape of BI and BA in tourism, focusing on the incorporation of cutting-edge technologies like AI and machine learning after a certain period of implementation. Another interesting venue of future research is post-pandemic tourism trends, particularly how BI and BA can aid in recovery and adaptation strategies.

Third, while being a robust methodology, the Gioia methodology has its limitations when applied to secondary data. Specifically, the interpretation of qualitative data is inherently subjective and may reflect the researchers' perspectives, which could have affected our analysis and subsequent theory generation.

Fourth, regarding implementation delay, the challenges associated with the adoption of BI and BA in tourism, such as resistance to change and technological integration, were not explored in-depth in the present study. These are practical aspects for understanding the feasibility and impact of BI and BA applications in the industry.

In the context of BI and BA in tourism, the focus on strategic and operational advantages might downplay the complexities involved in implementing these technologies in the tourism sector. Accordingly, there is a risk of assuming that technological solutions are universally applicable, which may minimize the unique cultural, economic, and social contexts of different tourism destinations.

The same holds for sustainability-related practices. While the present study briefly reviews the role of BA in sustainable tourism practices, we do not establish a direct association. To attend to this limitation, future research could provide a more detailed examination of how BA contributes to sustainable tourism development. Similarly, in the present study, there is a lack of output related to innovative practices in the post-pandemic period, which warrants further research on how BI and BA can support recovery and adaptation strategies.

This having been said, despite the limitations briefly reviewed above, the present study bridges a vital gap between theory and practice in tourism management. By highlighting the unique and synergistic roles of BI and BA, it enriches academic discourse and offers practical guidelines for industry practitioners, marking a significant step forward in the understanding and application of data analytics in tourism.

Along with the potential benefits that BI and BA bring to the tourism sector, future research should address the challenges and risks they pose in terms of data management and protection. In this respect, key aspects that must be considered when applying these analytical tools, both from the point of view of suppliers and customers, are confidentiality, security, and ethics. Therefore, future research should carefully analyze the risks associated with the use of BI and BA, as well as strategies to mitigate them and ensure compliance with current regulations. Finally, in order to promote sustainable and inclusive development, it would also make sense to explore possible social and environmental implications that may arise from the implementation of BI and BA in the tourism sector.

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