



## Research Article

© 2021 Belias et al.  
This is an open access article licensed under the Creative Commons  
Attribution-NonCommercial 4.0 International License  
(<https://creativecommons.org/licenses/by-nc/4.0/>)

Received: 3 July 2021 / Accepted: 19 August 2021 / Published: 5 September 2021

# The Use of Big Data in Tourism: Current Trends and Directions for Future Research

**Dimitrios Belias**

*PhD, Assistant Professor, Department of Business Administration,  
School of Management and Economics, University of Thessaly,  
Larissa, Geopolis, 41500, Greece*

**Sawsan Malik**

*PhD, Tutor in Business and Management,  
University of Stirling, FK9 4LA, Stirling, United Kingdom  
Corresponding Author*

**Ioannis Rossidis**

*PhD, Lecturer in Management,  
University of the Peloponnese, Tripolis, Campus, 22100, Greece*

**Christos Mantas**

*PhD, Lecturer, Athens Metropolitan College,  
Sorou 74, Maroussi, Athens, Greece*

DOI: <https://doi.org/10.36941/ajis-2021-0144>

### Abstract

*The aim of this research is to examine the new landscape that is taking shape in the tourism economy, due to the adoption of technological innovations. The technologies and systems used to make the most of the resulting interdisciplinary and multilingual big data, the methods by which heterogeneous elements from different sources are incorporated to bring new knowledge, and the modern services that are ultimately implemented and provided to the public, as well as the people involved in this process, and those who benefit from the new services are among the issues analyzed. The work is not limited to a simple mapping of space but concludes with an evaluation of the systems already implemented and the various methods of analysis and exploitation of large-scale data for this industry, which is based on detailed research of the current literature to identify the potential gaps for future research. This is a literature review. The authors have identified the content of this research on well-known online databases which include scholar, google and Scopus. They used the appropriate keywords such as "big data" & "tourism innovation" to reach the publications used in this research, also given attention on using recent papers which are derived from reliable journals. The research has concluded that the use of big data in the tourism sector is a rising trend. Big data creates expectations for a better understanding of tourism demand and the adjustment of supply by tourism companies to meet the demands of tourists and the profitable activity of tourism businesses. There is a need to examine how can big data help the hotels to deal with Covid-19 pandemic, which can be a topic for future research. Big data is one of the most recent trends on innovation, Information Communication Technologies (ICT) and knowledge management. Hence, there is a need to gather and analyze the existing publications which concern the tourist industry. The originality of this research stems from making an analysis of the current situation as well as it is a bridge to the future by making suggestions on how future research can be shaped. The key limitation of this research resides on that it focuses on the existing literature and used secondary data. However, it gives directions for the future research which can take place with primary data collection.*

**Keywords:** big data, knowledge management, tourism, innovation, current trends

## 1. Introduction

In today's fully digitalized world, people are exposed to all kinds of technological means on a daily basis, while individuals are communicating, buying, sharing thoughts, images and experiences which results on leaving behind huge amounts of data available for exploitation (Li et al., 2020). Devices such as sensors, cameras, computers, mobile phones and even tracking systems (GPS) that are integrated into human daily life, become sources of data production and transmission through internet technology. The outcome is that businesses today have access to millions of zettabytes of data relating to customers, suppliers, business operations, and competitors. The volume of this data is generated in real time, accumulates rapidly, without a specific structure, usually without any homogeneity and is summarized in the term "Big Data" (De Mauro et al., 2015).

Developments in data production and collection have led to significant developments in data storage and analysis technologies. Today, access to Big Data is just the beginning on the road to the search for and acquisition of essential knowledge. The use of Big Data is not limited to business, but also it extends on every day's life including the health sector and governmental agencies (Gandomi & Haider, 2015). Hence, it is understood that Big Data can be used on all short of operations and sector, including the tourist sector.

When it comes to the Tourism Industry and regardless of the type or size of business, applying Big Data analysis is probably the easiest way to better understand the needs and desires of the visitor/tourist (Li et al., 2018). In an industry with a purely anthropocentric nature and businesses focusing on the human being, the monitoring and in-depth interpretation of the Internet traces left by the tourist before, during and after the end of the travel experience can guide and enhance business initiatives. Also, it can help in making decisions to create and provide better services, meet the needs of tourists, and even achieve higher profits (Chareyron et al., 2014).

According to Li et al., (2018), Big Data in tourism is still in the early stages, despite of the fact that tourism is one of the sectors where Big Data could generate competitive advantage. While Mariani, (2019) claims that the tourist industry is increasingly adopting Big Data, however there is lot of space of improvements in the use and interpretation of Big Data, especially in Big Data analytics. Indeed, there is a growing use of Big Data in the tourist industry and some related research, the academia and practitioners are very far from claiming that they have fully understood the use of Big Data in the tourist industry (Centobelli & Ndou, 2019). From what is mentioned on the previous lines there is a need to better understand the notion of the use of Big Data in tourism but also to better give directions for future research since there is a research gap on this issue. For this reason, the purpose of this research is to analyze the current trends from the use of Big Data in tourism, also to give directions for future research.

## 2. The Definition of Big Data

According to a report by the McKinsey Global Institute (2011, p. 1), the term "Big Data" refers to "*data sets whose size is beyond the ability to understand, store, manage and analyze standard data. database software tools*". This definition is rather purely technical and general. Depending on the field in which Big Data appears, there may be differences in how large a set of data must be to be considered real and not manageable by conventional tools. For this very reason, Mc Kinsey Institute does not specify the size of the data in terabytes (thousands of gigabytes). Theoretically, as technology evolves over time, so does the size of Big Data datasets (Press, 2014).

The Big Data scenario is generally summarized in the three V's which represent specific features and following the scientific and technological developments, are enriched with new elements. The "core" consists of 3 basic elements (Chen et al, 2012; Buchholtz et al., 2014) which according to the existing literature are:

- Velocity which is related to the nature of the data flow and their production speed
- Volume refers to the large size of this data, which requires filtering, compression or special

conditions for its storage and processing.

- Variety that symbolizes the heterogeneity of data sources and their structure, both in terms of the forms in which they appear and in terms of their semantics.

In the past, the focus was on structured data that fit perfectly in tables or relational databases, such as sales by product or by area (Li et al., 2020). Today, 80% of the data generated is unstructured, and therefore cannot easily be placed in tables (e.g., photos, videos, or social media updates).

### 3. Methodology

The authors have identified the content of this research on well-known online databases which include scholar, google and Scopus. They used the appropriate keywords such as “big data” & “tourism innovation” to reach the publications used in this research. On the aspect of which publications to use for this research, the authors have assessed the selected papers based on their relationship with the examined subject, on the credibility of the publishers and on the quality of the data and information that they provide.

### 4. The Contribution of Big Data in Tourism Marketing

Marketing, being a key function of the tourism business, is the ideal basis for the application of Big Data Analytics, with results that enhance the reputation, customer loyalty, financial performance, and the position of the company in relation to the competition. In the last decade, the traditional tools were based on a predetermined strategy timeline and supported the mass market mentality, keeping the focus of interest on the person and his needs. Recently, the rapid development of technologies and the consolidation of the Internet as a key gateway to markets have brought about drastic changes in balances and gave greater power and control to the consumer (Middleton et al., 2009). Big Data have enriched the ability to connect directly with consumers/tourists and facilitate maximum personalization in any communication effort (Fan et al., 2015).

The new trends on tourism marketing focus on "marketing intelligence" through the use of data to make marketing-related decisions. Recent data show that the 5Ps (people, product, promotion, price, and place) of the marketing mix can be used to manage Big Data creating the conditions for innovations that involve significant changes in product design, promotion, and price adjustments (Fan et al., 2015).

Tourism is a phenomenon characterized by variability, where planning, programming, spontaneity, risk, adventure, and expectations is affected by the changing desires of tourists. The immediate and targeted adaptation of approach strategies acquires thanks to Big Data a personal and unique character (WTTC, 2014).

While Big Data technologies are flooding the tourism industry worldwide, with large companies making the most of the data dynamics (Zhang et al, 2019). British Airways (BA) is one of the most prominent examples of internationally active tourism organizations, which in recent years have undertaken actions and actions for the integration of Big Data technologies. This airline has developed and integrated in its operations, applications and technologies that allow the individualized approach of the Tourist and the understanding of the internal and external factors that influence the decisions of all stakeholders (Towerdata, 2018).

BA collects and integrates information generated during real-time customer interactions even during a simple check-in or in waiting areas. Even on airplanes, the company's staff has iPads that display customer status and all possible offers. Recently, it has developed a program ("Know Me") that aims to reach its customers more directly (Towerdata, 2018). An example of the applications of this program includes sending messages about specific customers to the cooperating travel agencies, informing those responsible for the characteristics of travelers, whether they are business executives, or frequent travelers, even "beginners" in Business Class. If a traveler is new, the app informs a flight attendant to explain to the customer the benefits of a business class cabin. If, on the other hand, a

traveler has recently experienced delays or other frustrations during their trip, the information encourages staff to understand the problem and provide appropriate services (Towerdata, 2018). The first results are particularly positive with customers to express their satisfaction that one understands their travel needs (Davenport, 2013).

So, starting from the data provided by Tourists through the various transactions carried out, any Tourist Unit could benefit from the options offered by Big Data in the management and understanding of its customer base, and better configuration of advertising its campaigns.

## 5. The Current Trends on Big Data in the Tourist Industry

The emergence of the term "Big Data" has become a hot topic of discussion in scientific, social, and political publications, to the extent that it is related with some of the most important movements in the history of computers - e.g., the development of personal computers in 1970s, the World Wide Web in the 1990s and social media in the 2000s (Emami et al., 2015).

The existing literature clearly covers the theoretical background and scope of operations of Big Data but is quite limited to the most specialized in relation with the application of Big Data in tourist industry. In academia, the number of related studies (Alaimo & Kallinikos, 2015), the writing of scientific and non-scientific journals (such as "The Economist" and "Forbes"), workshops, conferences, private initiatives (Davenport, 2013; McKinsey Global Institute, 2011) and publications on the subject, reveal an ever-increasing trend. Judging by the availability of reports, which is made from business research and articles, as well as sources available mainly through the Internet, there is evidence of a rapidly increased popularity on this topic.

On the existing publications there seem to be different approaches and trends. For example, Fuchs et al., (2014) have examined the case of Big Data and how it can be used as a strategic tool for obtaining knowledge over a destination. More precisely, Fuchs et al., (2014) regard the Big Data analytical tools as a tool to better understanding the tourists' behavior for a destination. The authors have examined the case of Sweden as a tourist destination and how Big Data systems (in this paper is the DMIS-Åre application) have operated as a Business Intelligence tool. Fuchs et al., (2014) have concluded that Big Data tools can provide real-time knowledge on how tourists are behaving in the online environment in relation with a destination. This means that the Big Data tools can provide knowledge which will help the destination's decision makers to better understand what the expectations are and needs of potential tourists of a destination, while the same outcome was noted from Fuchs et al., (2015).

A similar research has occurred from Marine-Roig & Clavé, (2015) for the case of Barcelona as a tourist destination. In this research the authors have highlighted the use of Big Data analytics in developing smart destinations. For this reason, their research has gathered data from over 100.000 travel blogs and OTR (online travel reviews) made on social media from tourists who have visited Barcelona over the last years. Their research has relied on use-generated content while the authors have also used business intelligence tools. The outcome of the research indicated that the use of Big Data analytics to create new knowledge in relation with the tourist behavior can contribute for the development of a smart destination, while it may have a strategic role for the development of the destination.

Furthermore, Höpken et al., (2015) have developed a knowledge-based approach for the use of business intelligence gathered for a destination. On this case, the authors have used the example of Åre, which is a leading Swedish mountain destination. Höpken et al., (2015) indicated that the factors which will determine the appropriate use of Big Data tools to obtain critical information regarding tourist behavior is related with the use of a central data warehouse which will store comprehensive and homogenous data. The development of data collection mechanisms and analytical tools will help to develop new knowledge. Those are the requirements to optimize the use of Big Data analytics to create new knowledge for destinations.

Another trend is the development of databases based on data retrieved from Big Data analytic

tools. According to Gandomi & Haider, (2015) companies are relying their operation on the selection and use of structured, semi-structured and unstructured data. Only the 5% of all existing data seems to be in a tabular data form which is used from a database. Hence, for Gandomi & Haider, (2015) it is especially important to create databases with updated and well-structured data which will allow them to better understand the market and its potential.

Stylos et al., (2021) have examined the use of Big Data analytics and of databases in tourism. The research conducted an ethnographic study which employed 35 database professionals who participated in five online focus groups. The outcome indicated that the use of Big Data and mostly the creation of databases contribute to better understanding of issues related with the destination, including consumer behavior and information which can be used for the marketing of the destination. The empirical research also indicated that the use of Big Data analytics to develop databases can help the destinations to make tailor-made propositions to their potential tourists. Nonetheless, despite of the usefulness of the use of Big Data analytics to develop databases which will contain well-structured data that will be used from decision makers, still this trend has some technical limitations.

Irudeen & Samaraweera, (2013) have examined the case of Sri Lanka as a destination. The outcome of their research was despite of the fact that the use of databases is overall recognized from tourist experts, still there are several obstacles for its implementation including the lack of funds to develop such systems and the lack of skills and knowledge from the tourist professionals to develop such systems. However, it is noted that despite of those technical limitations, the use of databases seems to be an interesting topic. The latest input is the development of databases with the contribution of cloud computing (Lin & Wei, 2020).

Another trend is the use of Big Data analytics as a strategic tool. Li et al., (2018) have indicated that today there is a plethora of resources that a tourist destination or a tourist business can retrieve the related data. Those include UGC data (user generated data), online photo data, GPS data, mobile phones roaming data, transaction data, webpage visiting data, online booking data, reviews, weather reports etc. What is important for a destination is to get together all this data. According to Li et al., (2020) the use of Big Data as a strategic tool can become one of the future trends, but still there is a need to have more research on this field and to develop the necessary applications which will be tailor-made for the tourist industry.

On the other hand, there are several publications which indicate that the Big Data already has a strategic value. For example, Varelas et al., (2020) have retrieved that Big Data can be used for better understanding the socio-economic profile of tourists so that the decision makers can take the appropriate decisions. Furthermore, Miah et al., (2017) report that Big Data analysis can provide useful information which will help the tourist companies and destinations to take marketing decisions made on psychographic profile of tourists, while at the same time Big Data provides accurate data for the segmentation and targeting of the market. Furthermore, the extensive use of mobile phones provides more data which can be used to take strategic decisions (Emmer & Holešinská, 2020), while the data gathered from Big Data analytics provides the necessary information for the transformation of a tourist destination to a smart destination.

Overall, Big Data can have a major contribution as a tool which will provide the necessary data for taking critical decisions. The trend is that Big Data analytics can be used as a knowledge creation tool and the use of business intelligence approaches (Fuchs et al., 2014, 2015; Marine-Roig & Clav, 2015; Höpken et al., 2015), or for the creation of databases (Gandomi & Haider, 2015; Stylos et al., 2021). The most important trend, however, is that Big Data Analytics can become a useful strategic tool (Varelas et al., 2020; Miah et al., 2017; Li et al., 2018; Li et al., 2020). However, there is consensus that this is a new trend in tourism and there is a need for further research on this. For this reason, there are going to be some directions for future research.

## 6. Directions for Future Research

Authors such as Li et al., (2018) have noted that the academia and practitioners have not fully understood the value of Big Data analytics nor its potentials. To a large extent this is due to the lack of empirical research which will help to better understand the potentials of Big Data. Furthermore, Big Data is related with the understanding of new technologies and topics such as databases and Artificial Intelligence, which is still not understood well. This means that a future research must rely on the understanding of those technologies.

Mariani, (2020) argues that the tourist scholars have understood the value and contribution of Big Data, but there is a need to better understand how the Big Data analytics can be analysed and used from the decision makers, while there is a need to relate the concept of Big Data analytics with Artificial Intelligence and the Internet of Things. Therefore, a future research must investigate the above-mentioned relationship.

Nonetheless, besides the above-mentioned direction there is a need to investigate how the Big Data analysis can be used from the hotel industry. This means to investigate how its applications can be understood and used from the tourist professional. This is a weak point of Big Data analytics since many individuals perceive Big Data as something overly complex and difficult to be used (Alaei et al., 2019). Despite of the fact that there are solutions which can simplify the Big Data analysis, still there is a majority of tourist professionals who do not possess the appropriate knowledge to understand and use those applications (Centobelli & Ndou, 2019; Xiang & Fesenmaier, 2017) which brings the need for more research in this field to find ways to make the Big Data analytics easier to use for the average tourist professional.

To sum up, Ardito et al., (2019) have made a number of questions to be answered from future research. The key research topics which are emerging from Adito et al., (2019), and other researchers (Li et al, 2018; Varelas et al., 2020) are the following:

- How the digitization of Big Data in the tourist industry will be shaped in the future?
- What are the key challenges (cultural, technological, organizational) which may affect the operation of Big Data in the tourist industry?
- What are the skills and the capabilities that someone may possess to deal with the Big Data analytics in the upcoming years?
- Which are the emerging best practices and models for optimizing the performance of tourist organizations based on the use of Big Data analytics?
- What are the critical success factors from the use of Big Data analytics?
- How the Big Data can become a core competence which can lead to a strategic competitive advantage?
- What investments the companies need to make to facilities Big Data applications?

All the above are some critical questions which have to be addressed in a future research. The answers given on those questions will contribute to the better understanding of Big Data in the tourist industry and subsequently on its optimization.

## 7. Conclusions

The research examined the case of how the tourist industry can use Big Data analytics through the related literature. The findings of the research indicated that the current trend is to use the Big Data analytics as a mean to obtain a competitive advantage, also how to use it to produce new knowledge and to optimize the benefits from using databases which contain the Big Data. However, there are several limitations which need to be addressed such as that many scholars and tourist professionals are not able to understand the content of Big Data and how to use it, while other deficits are related with lack of practical examples of how the Big Data contributes to the competitive advantage of tourist companies.

For this reason, the research has made several suggestions and recommendations for future research on this field.

## References

- Alaei, A. R., Becken, S., & Stantic, B. (2019). Sentiment analysis in tourism: capitalizing on big data. *Journal of Travel Research*, 58(2), 175-191.
- Alaimo, C. & Kallinikos, J. (2015) *Encoding the Everyday: Social data and its media apparatus*. Big Data is not a Monolith: Policies, Practices, and Problems, Cambridge: The MIT Press
- Ardito, L., Cerchione, R., Del Vecchio, P., & Raguseo, E. (2019). Big data in smart tourism: challenges, issues and opportunities. 22(15), 1805-1809.
- Buchholtz, S., Bukowski, M., & Sniegocki, A. (2014). Big and open data in Europe: A growth engine or a missed opportunity. *Warsaw Institute for Economic Studies Report Commissioned by demosEUROPA*, 10, 116.
- Centobelli, P., & Ndou, V. (2019). Managing customer knowledge through the use of big data analytics in tourism research. *Current Issues in Tourism*, 22(15), 1862-1882.
- Chareyron, G., Da-Rugna, J., & Raimbault, T. (2014, October). Big data: A new challenge for tourism. In 2014 IEEE International Conference on Big Data (Big Data) (pp. 5-7). IEEE.
- Chen, H., Chiang, R. H., & Storey, V. C. (2012). Business intelligence and analytics: From big data to big impact. *MIS quarterly*, 1165-1188.
- Davenport H. T. (2013). *At the Big Data Crossroads: turning towards a smarter travel experience*, Amadeus IT Group, <http://amadeusblog.com/wpcontent/uploads/Amadeus-Big-Data-Report.pdf> [accessed 16/04/2021]
- De Mauro, A., Greco, M., & Grimaldi, M. (2015, February). What is big data? A consensual definition and a review of key research topics. In AIP conference proceedings (Vol. 1644, No. 1, pp. 97-104). American Institute of Physics.
- Emani, C. K., Cullot, N., & Nicolle, C. (2015). Understandable big data: a survey. *Computer science review*, 17, 70-81.
- Emmer, F., & Holešinská, A. (2020). Big data: a Source of Mobility Behaviour and a Strategic Tool for Destination Management. *Czech Journal of Tourism*, 8(2).
- Fan, S., Lau, R. Y., & Zhao, J. L. (2015). Demystifying big data analytics for business intelligence through the lens of marketing mix. *Big Data Research*, 2(1), 28-32.
- Fuchs, M., Höpken, W., & Lexhagen, M. (2014). Big data analytics for knowledge generation in tourism destinations—A case from Sweden. *Journal of Destination Marketing & Management*, 3(4), 198-209.
- Fuchs, M., Höpken, W., & Lexhagen, M. (2015). Applying business intelligence for knowledge generation in tourism destinations—A case study from Sweden. In *Tourism and leisure* (pp. 161-174). Springer Gabler, Wiesbaden.
- Gandomi, A., & Haider, M. (2015). Beyond the hype: Big data concepts, methods, and analytics. *International journal of information management*, 35(2), 137-144.
- Gandomi, A., & Haider, M. (2015). Beyond the hype: Big data concepts, methods, and analytics. *International journal of information management*, 35(2), 137-144.
- Höpken, W., Fuchs, M., Keil, D., & Lexhagen, M. (2015). Business intelligence for cross-process knowledge extraction at tourism destinations. *Information Technology & Tourism*, 15(2), 101-130.
- Irudeen, R., & Samaraweera, S. (2013, December). Big data solution for Sri Lankan development: A case study from travel and tourism. In 2013 international conference on advances in ICT for emerging regions (ICTer) (pp. 207-216). IEEE.
- Li, H., Hu, M., Li, G., (2020). Forecasting tourism demand with multisource big data. *Annals of Tourism Research* 83, 1-13. 102912.
- Li, J., Xu, L., Tang, L., Wang, S., & Li, L. (2018). Big data in tourism research: A literature review. *Tourism Management*, 68, 301-323.
- Lin, Q., & Wei, W. (2020, June). Design and Research of Intelligent All-area-advancing Tourism Cloud Platform in the Era of Big Data. In *Journal of Physics: Conference Series* (Vol. 1575, No. 1, p. 012145). IOP Publishing.
- Mariani, M. (2019). Big data and analytics in tourism and hospitality: a perspective article. *Tourism Review*.75(1), 1-7.
- Mariani, M. (2020) Big data and analytics in tourism and hospitality: a perspective article. *Tourism Review*, 75 (1), 299-303.
- Marine-Roig, E., & Clavé, S. A. (2015). Tourism analytics with massive user-generated content: A case study of Barcelona. *Journal of Destination Marketing & Management*, 4(3), 162-172.

- McKinsey Global Institute, (2011), Big data: The next frontier for innovation, competition, and productivity, McKinsey & Company, <http://www.mckinsey.com/business-functions/business-technology/ourinsights/big-data-the-next-frontier-for-innovation> [accessed 12/25/2021].
- Miah, S. J., Vu, H. Q., Gammack, J., & McGrath, M. (2017). A big data analytics method for tourist behaviour analysis. *Information & Management*, 54(6), 771-785.
- Middleton, V. T., Fyall, A., Morgan, M., & Ranchhod, A. (2009). *Marketing in travel and tourism*. Routledge.
- Press, G. (2014), 12 Big Data Definitions: What's Yours?, <http://www.forbes.com/sites/gilpress/2014/09/03/12-big-data-definitions-whatsyours/> [accessed 30/4/2021].
- Stylos, N., Zwiegelaar, J., & Buhalis, D. (2021). Big data empowered agility for dynamic, volatile, and time-sensitive service industries: the case of tourism sector. *International Journal of Contemporary Hospitality Management* retrieved from [http://eprints.bournemouth.ac.uk/35221/1/Big%20odata%20and%20Agility%20Volatile%20sensitive%20industries\\_Stylos%2C%20Zwiegelaar%2C%20Buhalis%202021.pdf](http://eprints.bournemouth.ac.uk/35221/1/Big%20odata%20and%20Agility%20Volatile%20sensitive%20industries_Stylos%2C%20Zwiegelaar%2C%20Buhalis%202021.pdf) [20/05/2021]
- Towerdata, (2018), "Making Big Data Work for You: Lessons from British Airways", <http://www.towerdata.com/blog/bid/205316/Making-Big-Data-Work-for-YouLessons-from-British-Airways> [accessed 21/4/2021].
- Varelas, S., Kopanaki, E., & Georgopoulos, N. (2020). A strategic tourism knowledge base for socio-economic and environmental data analytics: The role of Big Data analysis. *Zeszyty Naukowe Małopolskiej Wyższej Szkoły Ekonomicznej w Tarnowie*, 45(1), 69-76.
- World Travel and Tourism Council, (2014), Big Data - The Impact on Travel & Tourism, [http://www.wttc.org/-/media/files/reports/special-and-periodicreports/wttc\\_big\\_data\\_report\\_final.pdf](http://www.wttc.org/-/media/files/reports/special-and-periodicreports/wttc_big_data_report_final.pdf) [accessed 22/04/2021].
- Xiang, Z., & Fesenmaier, D. R. (2017). Big data analytics, tourism design and smart tourism. In *Analytics in smart tourism design* (pp. 299-307). Springer, Cham.
- Zhang, K., Chen, Y., & Li, C. (2019). Discovering the tourists' behaviors and perceptions in a tourism destination by analyzing photos' visual content with a computer deep learning model: The case of Beijing. *Tourism Management*, 75, 595-608.