Digital Tools Empowering Tourism Development: A Business Intelligence Platform for the Basilicata Regional Growth

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Abstract. One of the key factors in fostering the development of weak territorial contexts is tourism. The first step in improving this sector is to obtain deeper understanding of it, in order to implement the right strategies and actions, through knowledge acquisition and analysis.

With this aim, in this paper, a Business Intelligence platform developed for the Basilicata Region (Italy) is shown. This case study falls under one of the Priority Axes of European Regional Development Fund (ERDF), within the framework of the Cohesion Policy, aimed at supporting and stimulating the growth of less developed areas.

Keywords: Digital tourism · tourism analysis · Basilicata · tourism management

1 Introduction

During the last ten years, thanks also to the rapid advancement of information technology (IT), Tourism has seen a big growth and it has become a key factor for regional and national economic development [1]. Specifically, digital tools have transformed the travel and tourism sector by improving visitor experiences, marketing strategies, and driving regional development through technological innovations [2], digital transformation [3–5] and the development of business intelligence and analytics. As a result, over the past two decades, the notion of digital tourism has been increasingly referenced in both real-world scenarios and scientific literature [6–9]. Some of the digital instruments today more used in the tourism sectors are all the technologies related to the Internet, the big data, and all the analytical methods AI related.

These tools assume that there is a good digitalized knowledge base of the sector or that in any case the use of big data provides a comprehensive knowledge of the sector.

Confirming the importance of knowledge acquisition and representation, a series of laws, documents and initiatives at the national, European, and global levels that are trying to raise awareness and address data management and digitization of data in general, but in the tourism sector too since around 2010.

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Between these, the most important are (i) the Global Guidelines to Restart Tourism from the World Tourism Organization [10], the United Nations' Sustainable Development Goals [11], at the global level, the United Nations' Sustainable Development Goals [11], at the global level; (ii) the Digital Market Strategy (DSM) initiative [12], the Digital Agenda for Europe [13], the European Data Strategy [14], and the INSPIRE Directive [15] (which is not specific for tourism data, but involves also them), at the European level; (iii) the National Recovery and Resilience Plan (NRRP) which includes projects and investments for the intelligent use of data in various sectors (including the tourist one), at the Italian level.

Unfortunately, there are still territories that have lack with underdeveloped digital tourism precisely because of the lack of this basic data and knowledge.

For what concerns data needed in the tourism sector, they can be of different types, depending on the digital technology they are designed for; these last, in tourism can be oriented to three different aims, depending on the subject they are created for. Thus, three aspects can be distinguished [16]:

1. The tourism perspective, with the aim to use digital tourism products and services.
2. The operators' perspective, where the target is to produce digital transformations within the tourism sector, including the creation of digital tourism goods digital services and the digitation of business processes and tourism information.
3. The social development perspective, where the aim is tourism development.

In this paper, we used the last perspective to develop a digital framework for knowledge acquisition and representation of tourism data for the Basilicata Region, a fragile context chosen, where there be allocated the European Regional Development Fund (ERDF), within the framework of the Cohesion Policy. The aim is to offer to policy makers an instrument useful to gain a deeper understanding of the dynamic and complex nature of the tourism sector in Basilicata and the numerous interconnected factors that influence it.

2 Methods: Business Intelligence for Tourism

According to [17], business intelligence (BI) refers to a set of methodologies, processes, tools, and technologies that enable the acquisition, analysis, and presentation of data related to a specific topic or industry. Its purpose is to support informed decision-making, identify growth opportunities, solve problems, and assist in strategic planning. BI has gained significant traction in the tourism sector in the past decades to manage and improve the destination-related aspects, accommodations, and transportation [18–20]. Several case studies have showcased successful BI platforms developed for the management and analysis of tourism data [21–25].

Key aspects developed within the realm of BI include:

1. Data collection, data warehouse structuring and data cleaning: data are extracted from diverse sources (surveys, interviews, focus groups, external databases, big data sources such as textual data or digital footprints related to photos uploaded on various sites and social media [26], data with tags, date, time, coordinates, and user profiles [27], data from mobile devices, Bluetooth and transaction data, search engine research

or online bookings [28]), cleaned and transformed, in order to ensure data consistency and quality.
2. Data Analysis by means of different methods: statistical techniques [29], data mining algorithms [30], algorithms based on artificial intelligence [31], spatio-temporal data analysis [32] and other methodologies to identify patterns, trends, correlations, and meaningful insights [33].
3. Creation of User Interfaces for Reporting and Dashboards with graphic visualizations to explore data intuitively and monitor performance, key metrics, and trends over time [34]. The information and analyses resulting through BI are distributed and shared within the organization, in order to make informed decisions.

3 The Basilicata Case Study: Cultural Tourism System and Development Policies/Governance

Basilicata is an Italian Region that falls under the objectives of the European Community's cohesion policy. It has socio-economic indicators lower than a large part of the other Italian regions, along with Calabria, Campania, Molise, Puglia, Sardegna, and Sicilia, such as a per capita GDP lower than 75% of the EU average, higher unemployment, and lower accessibility to services.

As a result, however, Basilicata benefits from programs aimed at bridging the structural and infrastructural gap, such as the Operational Program (OP) of the European Regional Development Fund (ERDF). The ERDF is a key financial instrument used to reduce disparities and improve the quality of life in disadvantaged regions of the European Community. It strives to narrow the development gaps among European regions, particularly those facing natural or demographic disadvantages. This is achieved through 11 thematic objectives focusing on research, technological development, innovation, information and communication technologies, competitiveness, sustainability, social inclusion, education, and efficiency.

In this context, the project Basilicata Heritage Smartlab (BHSL) is co-financed under the Axis which emphasizes research, technological development, and innovation. This project aims to revitalize the Region's economy through collaboration between public entities, research institutions (3), and enterprises (42), as well as through targeted actions in the sector of the Cultural and Creative Industries to improve some key drivers of the economy. Between these, cultural heritage and tourism, each with its own identity, structure, and characteristics, while also sharing common aspects. One component of the BHSL project is the Intelligent Tourism Analysis Smartlab; it aims to develop a platform for managing tourist phenomena. Currently, no such instrument exists in Basilicata, highlighting the need for a tool capable of collecting, analyzing, and aggregating data to provide structured information for guiding public entities in building predictive models and supporting decision-making processes.

In Basilicata, Tourism and Cultural and Creative Industries (CCIs) are leading sectors of the local economy. The serious effects caused by the Covid-19 pandemic come after a strong growth trend in tourist flows until 2019 achieved thanks to the nomination of Matera, one of the main cities in Basilicata, as "European Capital of Culture 2019". Some small signs of recovery begin in 2021. In 2022, however, thanks also to the 'Basilicata free to move' promotional campaign (focused precisely on the end of restrictions and

constraints on mobility), important and positive data are recorded: +32% in arrivals compared to 2021 and + 23% in presences compared to 2021 [35].

The objectives of the ERDF 2021–2027 programming (which provides resources for new opportunities for Tourism and Cultural and Creative Industries (CCIs) development), are strengthening the competitiveness of the most important tourism destinations (Matera, the Ionian Coast, and Maratea), the improvement of the fruition of the historical-cultural heritage, and the development of the tertiary system [36].

The territory of Basilicata is suitable for tourism that is not linked to pre-packaged itineraries: the tourist offer proposes a set of tourist places, small towns to visit, rich in cultural heritage, and natural habitats almost unknown both nationally and internationally, which demonstrate high resilience, i.e. flexibility, inclusiveness and integration [37]. Regional tourism governance has led CCIs to invest, for example, in sustainable development supported by a strong identification with the territory [38], or by the geo-touristic approach [39] and in innovation for a rural, 'green' and welcoming destination, suitable for different audiences and with memorable experiential involvement, also in synergy with local communities [40]. Congress Tourism, Village Tourism, Holiday working for Smart Working Families, Outdoor Tourism, Beach Tourism, School Tourism, Luxury Tourism, Food and Wine Tourism and Return Tourism for those who want to visit the places of their family history, are the main types of tourist activities successfully planned in Basilicata. However, more targeted analyses of the current situation and development trends would greatly assist tourism governance in the development of the cultural tourism sector.

To address all these needs, in this paper we present BasilicataTourism, a BI framework useful for knowledge acquisition and data visualization and analysis.

4 The BasilicataTourism Web-Environment

4.1 BasilicataTourism Architecture

BasilicataTourism is composed by the following elements summarized in Fig. 1:

1. A Virtual Machine level (in Fig. 1 WIFIBAS-ANALYT1–2-3) which is the infrastructure used to improve effectiveness of the system, by ensuring a simplified management of resources, flexibility and scalability.
2. A container orchestration level, (DOCKER SWARM) used for the execution and management of containers.
3. Three macro-components: a data warehouse, a user view and a metric and monitoring component. For each of them, in Fig. 1, the different elements are present with all the products used for each scope.

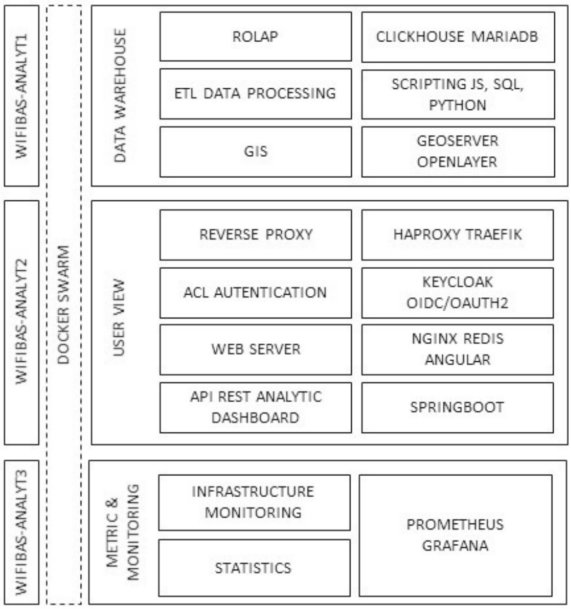


Fig. 1. The BI structure of BasilicataTourism.

4.2 Basilicata Tourism Data and Dashboard: Which Data, in Which State, What a Story They Tell

In Basilicata Region, data concerning tourism are spread in different databases and sources. Consequently, one of the first objectives was to collect all the possible suitable data to read and understand Basilicata's tourism. Sometimes these data needed a cleaning process or to rearrange the aggregation level, because of privacy reasons. Moreover, some indicators were extracted from basic information.

All this contents are accessible through the dashboard, designed for data visualization and querying. It is organized as follows: from the homepage it is possible to access two sections: the first one contains the historical data series, the second one is dedicated to spatial data and indicators. The historical data series contains ISTAT datasets and indicators for a period from 2015 to 2021. Instead, all the data and indicators present in the spatial section refers to a period from 2020 to 2022.

In the following paragraphs the information entered into the platform will be introduced, indicating any cleaning process required, and how the data were analyzed to calculate new indicators (dataset and indicators calculated are summarized in Table 1). The description is based on those two dashboard sections, the historical series part and the spatial one and information are arranged also according to their type.

Table 1. Dataset and indicators of BasilicataTourism summarized, grouped for data source (Prov. Stands for Provinces; I/F/T stands for Italian/Foreigners/Total).

Source	Name	Type	Spatial aggregation	Temporal aggregation	Attributes
ISTAT historical series (not spatial)	Arrivals	Acquired	Prov., Region	Monthly	I/F/T
	Presences	Acquired	Prov., Region	Monthly	I/F/T
	Arrivals-to-Resident Population Ratio	Calculated	Prov., Region	Monthly	
	Ratio between international and total arrivals;	Calculated	Prov., Region	Monthly	
	Tourist saturation index	Calculated	Prov., Region	Monthly	
	Average stay ratio	Calculated	Prov., Region	Monthly	
	Gross hotel bed utilization index	Calculated	Region	Monthly	
	Net hotel bed utilization index	Calculated	Region	Monthly	
ISTAT spatial data	Tourist saturation index	Calculated	Municipality	Monthly	I/F/T
	Average stay	Calculated	Municipality	Monthly	I/F/T
	Bed saturation	Calculated	Municipality	Monthly	I/F/T
Mobile cells (Vodafone Italia)	Arrivals	Acquired	Municipality	Monthly	I/F/T
	Overnight stays	Acquired	Municipality	Monthly Daily	Origin country Age Gender
Financial transactions	Charges made by payment card	Acquired	Municipality POI Kilometric grid	Monthly	I/F/T
Internet data	Sentiment	Calculated	Municipality POI Kilometric grid	Monthly	I/F/T

(*continued*)

Table 1. (*continued*)

Source	Name	Type	Spatial aggregation	Temporal aggregation	Attributes
Reviews and ratings	Reviews	Calculated	Municipality POI	Monthly	I/F/T
POI	POI category	Acquired	POI	Monthly	
	Degree of digitalization	Acquired	POI	Monthly	
	Prices	Acquired	POI	Monthly	
	Number of reviews	Acquired	POI	Monthly	

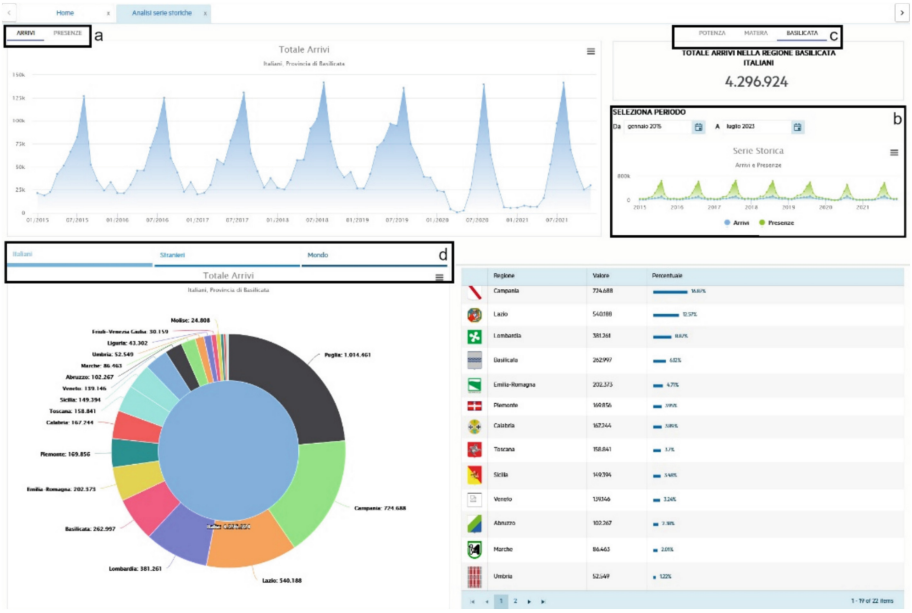


Fig. 2. Dashboard functionalities for arrives and overnight stays in Basilicata and its Provinces.

4.3 Historical Data Series Section: The ISTAT Dataset

The first section of the dashboard contains only numerical data and diagrams. National Institute of Statistics (ISTAT) is the source of data. Tourist movements are aggregated on a monthly basis and spatially related to province (NUTS3) as well as for the entire Region (NUTS2). Specifically, they are:

1. Arrivals in accommodation facilities (ARRIVI in Fig. 2a): the number of customers who checked in at accommodation facilities during the specified period.
2. Presences or tourist overnight stays (PRESENZE in Fig. 2a).

These two features are very important for destination manager because they allow analyzing the trend of tourist demand over time at the regional level. Moreover they enable the calculation of indicators that contribute to a better understanding of the tourism phenomenon, assessing its intensity and allowing producing diachronic comparisons to identify changes that have occurred over the analyzed period. Finally, they facilitate comparisons with other similar territories or simply serve as comparative benchmarks.

These data did not need any cleaning process and are questionable, in the dashboard, by period (Fig. 2b), by territory (Fig. 2c, choices are: POTENZA County, MATERA County and BASILICATA Region) and by composition (Fig. 2d, the choices are Italian, "Italiani", foreigners, "stranieri", and the total, "world"). The dashboard changes interactively according to the selection done.

If one province (NUTS3), is selected, a histogram is represented, containing the Arrivals (or Presences) divided by the Municipality of origin. Finally, there are also three histograms showing the totals for year, classified for provenience (national or international), for month and for year and Italian Region of origin, in order to do diachronic comparison.

From arrival and presences, the following indicators were calculated:

- Arrivals-to-Resident Population Ratio, to understand the impact of tourism not only economically but also socially.
- Ratio between international and total arrivals.
- Tourist saturation index representing the average number of overnight stays per 100 inhabitants. It indicates how many staying tourists are present on average for every 100 residents. It is a crude indicator of the tourism sector's weight in the region's economic activities. The index is calculated by multiplying the annual number of presences by 100 and dividing it by the population count multiplied by 365.
- Average stay ratio, calculated as the ratio of presences to arrivals. This indicator helps to understand the Tourism Stickiness, which refers to how well the destination can retain tourists and differentiate between transient tourism and tourism driven by a desire to explore and discover the hidden gems of a place.

In addition to the already mentioned indicators, only for data referred to the Regions (NUTS2) there are also the two following indicators:

1. Gross hotel bed utilization index, *GUI*: is given by the ratio (Eq. 1) of registered occupancy or presences (P) to the number of potential bed days in hotel establishments (including seasonal, renovation or other temporary closures), where the number of potential bed days, is given by the product of the number of days in the month (d) times the number of beds (b) according to the following expression:

$$GUI = Pd \cdot b \tag{1}$$

2. Net hotel bed utilization index, NUI: this is given by the ratio (Eq. 2) of the recorded occupancy (P) to the number of actual opening bed days of hotel establishments (excluding seasonal, restoration or other temporary closures), where the number of actual opening bed days is given by the product of the number of days the establishment is open (od) times the number of beds (b):

$$NUI = Pod \cdot b \tag{2}$$

4.4 Spatial Section

The spatial section is structured as a web-GIS thanks to GeoServer and the OpenLayers library, while the background map is OpenStreetMap (www.openstreetmap.org).

There are two main layers, useful to manage all the dataset of the section in the bottom right panel, corresponding to the two main types of spatial granularity:

- KPI COMUNALI (Municipal Key Performance Indicators, in Fig. 3a) has a polygonal topology according to Municipality boundaries.
- KPI POI (Point of Interest Key Performance Indicators, in Fig. 3a) has a point topology based on the POI location as explained further.

For what concerns municipal KPI, in the top-left panel (Fig. 3b), it is possible to query the map with a dropdown menu and choosing a dataset/indicator and the tourism origin (Italian, international or the total, called world), while in the top-right panel (Fig. 3c) the first four municipalities with the higher values of the selected element and the legend of the dataset/indicator selected are showed.

It is possible to query each polygon by clicking with the mouse and the related window (Fig. 3d) shows the name of the Municipality, the total of the dataset/indicator, the belonging class and a resuming histogram for the overnights, monthly (Fig. 3d) and daily distributed. Finally, in the lower-left panels (Fig. 3e) it is possible to select the period of interest and visualize its position in diagram of the global regional trend (Fig. 3f).

A similar approach can be followed to view the dataset associated with KPI POI: on the left (Fig. 3g) it is possible to select the desired dataset with a dropdown menu (Fig. 3h) and filtering it, while on the right panel it is possible to look the the ranking of the first five elements (Fig. 3i).

Istat Data. Spatial index calculated from ISTAT data in this section of the dashboard: tourist saturation index, as defined in the previous paragraph, the average stay (the ratio of the number of nights spent to the number of customers who arrived at the accommodation establishment), and the bed saturation (ratio between registered attendances and the number of potential bed days in hotels).

These indicators are aggregated for municipality: this is very useful to understand how tourists are distributed over the Region and to highlight changes in the officially registered hospitality establishments. However, there are lacks in the data, because for 80 Municipalities (out of 131) data are missing, because they have less than three accommodations, so they are not registered from ISTAT. There are also some Municipalities, in the Basilicata Region, that does not have any accommodation.

Mobile Network Cell Data. From the mobile network cell data, tourist arrivals and overnight stays were collected. This is crucial for analyzing temporal trends in numbers of visitors and overnight stays across the Region, as well as for cross-referencing with financial transactions, ratings, and weather data to gain a better understanding of tourist behaviors in Basilicata and develop predictive models.

About the pre-processing phase, this dataset was firstly extracted as daily frequencies, but there are data masking issues due to the small population size in some municipalities (less than 10,000 inhabitants). So, the output in the dashboard was rearranged monthly.

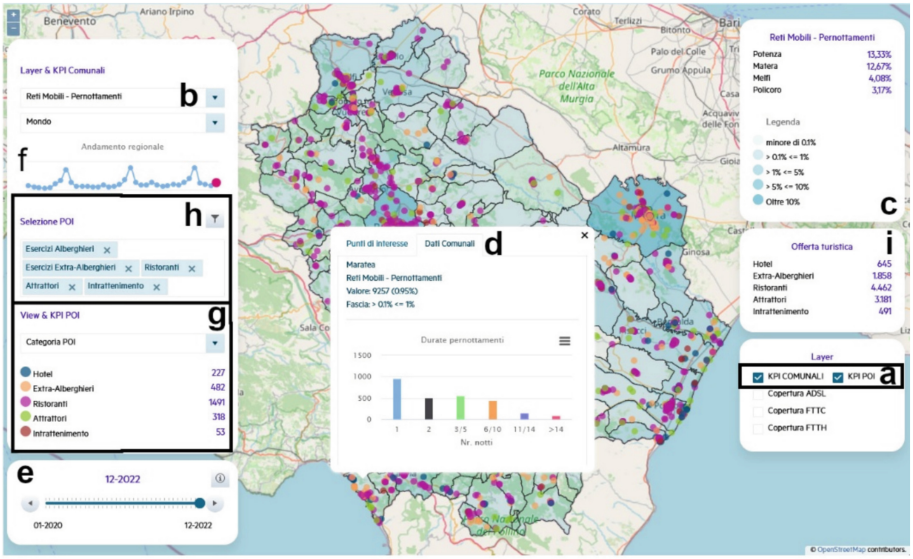


Fig. 3. Spatial section of the dashboard. Main elements: (a) layers, (b) selectors for the polygonal layer (KPI Comunali), (c) top four Municipality and Legend for the polygonal layer, (d) informative window associated to spatial features, (e) temporal selector, (f) temporal trend, (g) selectors for the point layer (KPI POI) and its legend, (h) POI filtering, (i) top five POI layer selected.

The final dataset coming from the mobile network cell is composed by arrivals and overnight stays.

Arrivals and overnight stays, when a specific polygon or point group can be selected on the map and be further filtered by:

- Origin: (1) Domestic: further disaggregated into Domestic-Residents and Domestic-Non-Residents in the area. (2) External Italians: these are all Italian individuals who do not reside within the analysis perimeter, their region and province of origin. (3) Foreigners: all foreigners who come from abroad and do not permanently reside in Italy and their specific nationality.
- Gender: for Italians (both residents and non-residents) male and female.
- Age Group: for Italians, groups 15–25, 26–35, 36–45, 46–65, $>$ 65 years old.

Also for the spatial section, as for the historical series one, some charts are showed under the map, showing the origin of the traffic values and percentages and a demographic pyramid for Italian visitors, classified for gender and for age groups.

Credit-card Transactions. To obtain information about credit card transactions in a place is not an easy task, due to strict bank rules about privacy, but they are useful for depicting how much tourists spend on average, where they make their purchases and which are the favorite asset categories, even if with some limitations. In fact, there is still a strong preference for cash transactions.

Data collected are: value of transaction, number of transaction and average transaction. These are visible in the map, associated to the Municipality layer, but also in a section of the dashboard aimed to select and visualize charts about the financial dataset. They are aggregated weekly and it is possible to see the main countries of origin for international tourists that are: Italy, France, Germany, UK, Spain, Austria, Benelux, Scandinavia, EU + Switzerland, Russia, China, Japan, India, Other Asian Countries, Brazil, USA, other American countries, Africa, Australia and Oceania.

Instead, for what concerns the asset categories, data are furnished already aggregated for privacy reasons in thirteen product classes.

Consequently, there is the need to follow this rule: in the observation period, transactions are visible only if there was five active merchant per merchant category and, at the same time, the first five merchants do not invoice more than 50% of the total turnover of that sector considering all variables included in the query.

At the end of this cleaning operation, the financial transaction dataset covers the 88.1% of the transaction volume of Basilicata between 2018 and 2020.

In the dashboard is also possible to obtain more detailed information can be done by choosing the credit card circuit, the emission country and the category of expenditure. Under this, it is possible to compare transactions values and their numbers. Moreover, in two pie charts and two histograms, it is possible to have information about the category of expenditure selected and the emission country and the trend of category of expenditure and the emission country during the years.

Internet Data. Main sources of Internet data were:

- Social network data. Text data coming from the social network more used at the moment: Facebook, Twitter, Instagram and YouTube. Tik Tok data were not included because it is mostly used form the younger sections of the population so less economically emancipated and so less autonomous in the travel choice.
- Search engine data. Online searches related to Basilicata were considered thanks to Google Trends, in order to estimate tourist arrivals in the Region.

These elements were used as basis to carry out Sentiment Analysis, also known as Opinion Mining. It uses texts extracted from the web and is able to determine sentiment associated to them. In tourism analysis it could be very useful to evaluate people feelings and thoughts about a place or, more in general, a tourist destination and, lastly, to help destination managers and operators to understand the reputation of a place and make informed decisions to enhance visitor experiences.

In BasilicataTourism, the analysis was conducted by introducing inside the software some keywords related to the tourism sector according to their frequencies, such as Tourism, Travelling, Archaeological site, etc. Moreover keywords related to the 131 Basilicata's Municipalities were used in the analysis, both in Italian and in English, aggregated according the will of the Basilicata Territorial Promotion Agency (APT). Then, the results were cleaned from terminological errors. For example, in Italian, some of the Municipality names can be confused with other words, for example: "Bella" can be confused with "beauty". This cleaning phase was supported by Natural Language Processing (NLP) systems, able to aggregate words contained in the posts in topics, which are posts characterized by the use of similar keywords.

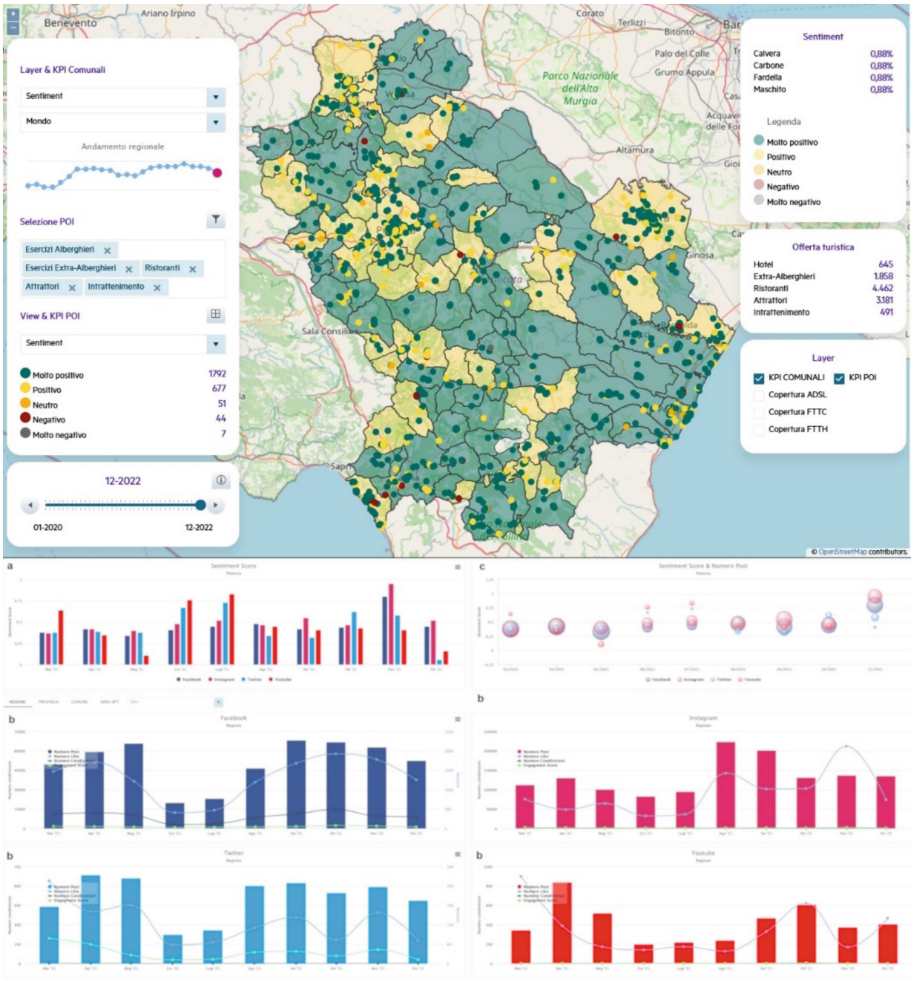


Fig. 4. In the map: sentiment layer calculated for Municipalities (KPI COMUNALI) and POI (KPI POI) and visualised as the classification: very positive, (molto positive), positive (positive), neutral, negative (negative), very negative (molto negativo). Diagrams exploring sentiment analysis by comparing sentiment score between social networks (a), showing the post number, like number, sharing number and the engagement score for each social network (b) and by offering a bubble view comparing the sentiment score trend with the post number (c).

The sentiment layer is calculated and showed in the dashboard both at a municipal and POI level (map in Fig. 4), where the total judgment is classified as very positive, (molto positivo), positive (positivo), neutral (neutrale), negative (negativo), very negative (molto negativo).

Also, they were calculated and visualized in the dashboard (Fig. 5a):

- A sentiment score that measures the level of perceived satisfaction expressed by users which emerges from the semantic analysis of online content, from reviews left by

users on the most popular travel and booking platforms to messaging on the main social medias.
- A bar chart for each social media with the monthly trend of post number, like number, sharing number and the engagement score (number of likes) for each social network (Fig. 5b).
- A bubble view comparing the sentiment score trend with the post number (Fig. 5c).

Reviews and Ratings. Recent studies show that 8 out of 10 people read reviews before choosing a hotel or a restaurant, and an additional star rating can correspond to a revenue increase estimated between 5% and 9% [41]. Therefore, we have gathered all the information regarding the ratings of individual POI.

Furthermore, these data could be cross-referenced with information on tourist arrivals and financial transactions to verify if there is a causal relationship between ratings and reviews on one hand, and visitor numbers and spending on the other.

Point of Interest (POI). Another important source of data is related to POI and their distribution across the territory, associated, as anticipated in paragraph 4.5, to the layer KPI POI. In this phase, the entire regional territory was analysed and the main POI, including attractions, restaurants, and hotels, were identified.

This allows their visualization on a map and their correlation with arrival and accommodation data. In addition to georeferencing, the data have been aggregated at the municipal, provincial, and sub-regional levels, as used by the APT Basilicata. These purely informational data are useful for capturing the current situation of POI at a regional level and observing any changes over time. They will also help understand if a higher concentration of attractions corresponds to greater tourist appeal.

As far as POI is concerned, in the dashboard it is always possible to filter them by services available, languages spoken in the facility and typologies.

Other dataset associated to POI, together with the before mentioned sentiment score, are degree of digitalization, prices, number of reviews.

An Additional Level of Detail. As seen so far, all the different data and indicators are referred to two spatial levels of detail: the first is the municipality scale, the second one concerns the POI. However, there is an additional level of spatial detail that appears only for some layers. This happens for the sentiment and the review number layers contained inside the POI dropdown menu. In fact, when they are selected, a button representing a little grid appears (Fig. 5). By pushing it, a kilometer-long grid appears. Each of its cells is associated with an average value within the area of the selected layer. This helps give a deeper knowledge level on specific areas inside the territory.

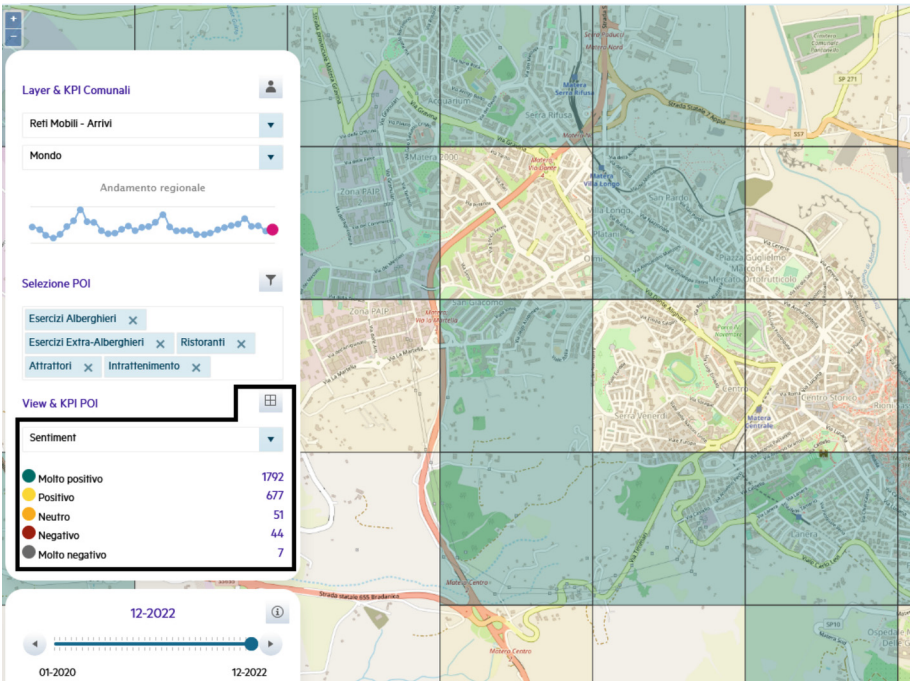


Fig. 5. Kilometre-long grid for the Sentiment layer.

5 Discussion

Tourism, one of the leading sectors of the economy, has seen in recent years an improvement in the acquisition, representation and management of knowledge thanks to the development in the IT sector. Basilicata is a weak context that needs innovative tools that can revitalize its economy by providing support to its key sectors, including tourism. The BasilicataTourism system, developed as part of the BHSL project precisely for this purpose, presents the following advantages:

1. To be one-stop-shop for all data currently existing for Basilicata already cleaned and sorted, ready to be visualized and compared, all in a platform that is easy to use by any type of user, with different levels of IT experience,
2. To have a data visualization tool with great performances, with charts that can be easily and immediately exported.
3. Providing better insights compared with raw data, thanks to various calculated indicators useful in deepening knowledge and assessments of the tourist field.
4. For operators in the field, the platform provides a tool to objectively measure certain variables, such as user flows, their social composition, conversation made, level of liking, and in general its customers, which is often shown to be completely different from objectively measured knowledge.

5. To understand, at the regional level, future trends and be able to quantify their intensity on particular locations, also for forecasting purposes and consequently developing more specific market strategies and then measuring their results derived from financial transaction data. This can help destination managers evaluate the ROI (Return on Investment) of their marketing efforts in attracting specific target groups and determining the total return on euros invested in territorial marketing.
6. To enable comparison of the volumes of traffic present in different territories.
7. To understand where it is most appropriate to allocate resources for the development of the sector.
8. To know objectively the composition of arrivals and stays in the Region and its municipalities;
9. To understand the capacity of a Region to receive tourists and to understand whether the supply and demand are matched or corrective actions are needed to balance the two, with reference to the period analysed, thanks to the specific indicators and the potential of reception compared to the real demand, evaluating possible under- and over-dimensioning of the supply.
10. To understand the ability to retain tourists in a place thanks to the average stay ratio or otherwise assess how tourists' retention varies over time in relation to the undertaken.
11. Understanding the level of appreciation and reputation of regional places and its facilities

However, there are still some limitations in the developed platforms. The first one is easily solvable: at the moment, the data only refer to a very specific time interval, but the platform is structured in such a way that can easily deal with new datasets for new reference periods. The second and the third limitations do not depend directly from the BasilicataTourism instrument, but from the characteristics of the case study and from the nature of data. For what concerns the characteristics of the case study, according to what showed during the data presentation made in the specific paragraphs, in Basilicata there is the problem of data availability at a more disaggregated level. In fact, for small contexts due to privacy regulation we are compelled to aggregate data a lot. Obviously, a reality characterized by larger numbers would not have this problem. About the data characteristics, there is a limitation about the specification that takes into account the gender issue, in that the data are always classified in a binary manner (male/female), which in any case excludes a more complete profiling of tourism that is relevant to today's reality.

Finally, surely a further improvement that can be made in future developments is the implementation of useful methods for synthesizing data and indicators, so as to reduce the multidimensionality of the variables considered and make the platform even more performant.

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References

1. Seddighi, H.R., Theocharous, A.L.: A model of tourism destination choice: a theoretical and empirical analysis. Tour. Manage. **23**, 475–487 (2002)
2. Singh, P., Sharma, D.: Technological innovations in tourism businesses: a study on contemporary trends. In: Tyagi, P.K., Nadda, V., Bharti, V., Kemer, E. (eds.) Embracing Business Sustainability Through Innovation and Creativity in the Service Sector, pp. 141–154. IGI Global, Hershey (2023)
3. Chamboko-Mpotaringa, M., Tichaawa, T.M.: Digital trends and tools driving change in marketing free state tourism destinations: a stakeholder's perspective. Afr. J. Hosp. Tour. Leisure **10**, 1973–1984 (2021)
4. Gutierriz, I., Ferreira, J.J., Fernandes, P.O.: Digital transformation and the new combinations in tourism: a systematic literature review. Tourism Hosp. Res. 14673584231198414 (2023)
5. Abranja, N., Rodrigues, T., Bernardo, E.: Critical essay on emerging, transformative, and disruptive companies influencing consumer behaviour. In: Ramos, C.M.Q., Sousa, C.M.R., Matos, N.M.S., Ashqar, R.I. (eds.) Measuring Consumer Behavior in Hospitality for Enhanced Decision Making, pp. 104–120. IGI Global, Hershey, PA, USA (2023)
6. Munar, A.M., Gyimóthy, S.: Critical Digital Tourism Studies. Tourism Social Media: Transformations in Identity, Community and Culture, vol. 18, pp. 245–262. Emerald Group Publishing Limited (2013)
7. Benyon, D., Quigley, A., O'Keefe, B., Riva, G.: Presence and digital tourism. AI & Soc. **29**, 521–529 (2014)
8. Watkins, M., Ziyadin, S., Imatayeva, A., Kurmangalieva, A., Blembayeva, A.: Digital tourism as a key factor in the development of the economy. Econ. Ann.-XXI **169**, 40–45 (2018)
9. Zambonelli, F., Cabri, G., Leonardi, L.: Developing mobile agent organizations: a case study in digital tourism. In: Proceedings - 3rd International Symposium on Distributed Objects and Applications, DOA 2001, pp. 270–279 (2001)
10. UNWTO. Global Guidelines to Restart Tourism (2020). https://www.hbs.edu/ris/Publication%20Files/12-016_a7e4a5a2-03f9-490d-b093-8f951238dba2.pdf
11. UN. Transforming our world: the 2030 Agenda for Sustainable Development (2015). https://documents-dds-ny.un.org/doc/UNDOC/GEN/N15/291/89/PDF/N1529189.pdf?OpenElement
12. EU. Digital single market for Europe (2020). https://www.consilium.europa.eu/en/policies/digital-single-market/
13. EU. Digital Agenda for Europe (2023).https://www.europarl.europa.eu/factsheets/en/sheet/64/digital-agenda-for-europe
14. EC. European data strategy (2023). https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/europe-fit-digital-age/european-data-strategy_en
15. EU Directive 2007/2/EC of the European Parliament and of the Council estabilishing an Infrastructure for Spatial Information in the European Community (INSPIRE) (2007). https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:02007L0002-20190626
16. Verhun, A., Buntova, N., Boretska, N., Borysova, O., Shevchuk, S.: Digital tools for the development of the hospitality and tourism industry in the context of a digitized economy. Econ. Affairs (New Delhi) **67**, 869–876 (2022)
17. Nyanga, C., Pansiri, J., Chatibura, D.: Enhancing competitiveness in the tourism industry through the use of business intelligence: a literature review. J. Tourism Futures **6**, 139–151 (2020)
18. Höpken, W., Fuchs, M.: Business intelligence in tourism. Handbook of e-Tourism, pp. 497–527 (2022)

19. Ibrahim, N., Handayani, P.W.: A systematic literature review of business intelligence framework for tourism organizations: functions and issues. Interdiscip. J. Inf. Knowl. Manag. **17**, 523–541 (2022)
20. Xiao, H., Smith, S.L.J.: Case studies in tourism research: a state-of-the-art analysis. Tour. Manage. **27**, 738–749 (2006)
21. Fuchs, M., Abadzhiev, A., Svensson, B., Höpken, W., Lexhagen, M.: A knowledge destination framework for tourism sustainability: a business intelligence application from Sweden. Tourism **61**, 121–148 (2013)
22. Hamilton, J., Selen, W.: A multi-agent business intelligence framework for the travel sector. In: Proceedings of the International Conference on Electronic Business (ICEB), pp. 36–42
23. Marine-Roig, E., Anton Clavé, S.: Tourism analytics with massive user-generated content: a case study of Barcelona. J. Destin. Mark. Manag. **4**, 162–172 (2015)
24. Sinha, S., Bhatnagar, V., Bansal, A.: A framework for effective data analytics for tourism sector: big data approach. Int. J. Grid High Perform. Comput. **9**, 92–104 (2017)
25. Stylos, N., Zwiegelaar, J., Buhalis, D.: Big data empowered agility for dynamic, volatile, and time-sensitive service industries: the case of tourism sector. Int. J. Contemp. Hosp. Manag. **33**, 1015–1036 (2021)
26. Li, S., Sasaki, J.: A study on the tourism features extraction from photos in a tourism website by image analysis. In: 2019 IEEE 10th International Conference on Awareness Science and Technology, iCAST 2019 – Proceedings (2019)
27. Önder, I., Koerbitz, W., Hubmann-Haidvogel, A.: Tracing tourists by their digital footprints: the case of Austria. J. Travel Res. **55**, 566–573 (2016)
28. Li, J., Xu, L., Tang, L., Wang, S., Li, L.: Big data in tourism research: a literature review. Tour. Manage. **68**, 301–323 (2018)
29. Li, D., Deng, L., Cai, Z.: Statistical analysis of tourist flow in tourist spots based on big data platform and DA-HKRVM algorithms. Pers. Ubiquit. Comput. **24**, 87–101 (2020)
30. Li, Q., Li, S., Zhang, S., Hu, J., Hu, J.: A review of text corpus-based tourism big data mining. Appl. Sci. (Switzerland) **9**, (2019)
31. Pei, Y., Zhang, Y.: A study on the integrated development of artificial intelligence and tourism from the perspective of smart tourism. J. Phys. Conf. Ser. (Year)
32. Miah, S.J., Vu, H.Q., Gammack, J., McGrath, M.: A big data analytics method for tourist behaviour analysis. Inform. Manag. **54**, 771–785 (2017)
33. Williams, S.: Business Intelligence Strategy and Big Data Analytics: A General Management Perspective (2016)
34. Wöber, K.W.: Information supply in tourism management by marketing decision support systems. Tour. Manage. **24**, 241–255 (2003)
35. Nicoletti, A.: Piano Marketing - Piano delle attività APT (2022)
36. Basilicata, R.: Regione Basilicata. Documento di Economia e Finanza Regionale 2023–2025. Azione C4 "Sistema turistico-culturale" (2023). https://www.regione.basilicata.it/giunta/files/docs/DOCUMENT_FILE_3090764.pdf
37. Ivona, A., Rinella, A., Rinella, F.: Glocal tourism and resilient cities: the case of matera "European Capital of Culture 2019". Sustainability **11** (2019)
38. Cucari, N., Wankowicz, E.: Esposito De Falco, S.: Rural tourism and Albergo Diffuso: a case study for sustainable land-use planning. Land Use Policy **82**, 105–119 (2019)
39. Lugeri, F.R., Farabollini, P.: Discovering the landscape by cycling: a geo-touristic experience through Italian badlands. Geosciences **8** (2018)
40. Rainero, C., Modarelli, G.: The attractive power of rural destinations and a synergistic community cooperative approach: a "Tourismability" Case. Sustainability **12** (2020)
41. Simonetta, B.: False recensioni online fuori controllo, il business vale il 5–9% delle vendite. Il Sole 24 Ore (2015)