June 2026

Activity 2.2.1

REPORT OF ANALYSIS PER AREA

Report per pilot area with predictions of flows for the future high seasons to provide the basis for decision making of tourism operators on how to manage touristic flows.

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Deliverable ID

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1. Executive Summary

This deliverable presents the activities carried out within **Activity 2.2** of the TOURISMO project, focusing on the implementation of **data-driven** methodologies and **digital tools** to support tourism management and future **decision-making** processes. The work performed includes the collection and management of historical and real-time datasets, the development of analytical dashboards, the implementation of forecasting methodologies based on Artificial Intelligence techniques, and the integration of sentiment analysis tools for evaluating visitor perceptions and experiences. Finally, the results of the activities performed are reported.

The proposed framework has been deployed across all TOURISMO pilot areas and is fully integrated into the **Snap4City** platform, providing stakeholders with advanced monitoring, analytical, forecasting, and decision-support capabilities. The resulting system enables the continuous observation of tourism dynamics, the identification of critical conditions, the prediction of future trends, and the assessment of visitors' perceptions, thus supporting more sustainable and evidence-based tourism management strategies. Building upon this integrated information system, the project has developed a set of analytical dashboards capable of supporting both operational monitoring and strategic planning. The dashboards provide stakeholders with real-time access to tourism indicators, environmental conditions, visitor flows, occupancy levels, mobility patterns, and other contextual information through intuitive and interactive interfaces. The availability of harmonized historical data further enables comparative analyses, seasonal evaluations, and the identification of long-term tourism trends.

An important component of the activity concerns the implementation of **forecasting methodologies** based on Artificial Intelligence. Forecasting services allow users to estimate future tourism demand, visitor flows and occupancy levels by exploiting historical observations together with contextual information. These predictive capabilities support proactive decision-making by enabling destination managers to anticipate critical situations, optimize resource allocation, and improve visitor distribution before congestion or capacity issues occur. In parallel, qualitative information has been incorporated into the analytical framework through the integration of sentiment analysis services. **Visitor perceptions** are collected through digital questionnaires distributed via **QR codes** and analysed using Natural Language Processing techniques and Large Language Models integrated within the Snap4City ecosystem. This approach complements quantitative monitoring by providing valuable insights into visitor satisfaction, perceived service quality, and emerging issues that may not be captured by traditional monitoring systems.

Overall, the developed framework has been successfully deployed across all TOURISMO pilot areas and represents an integrated **decision-support system** combining real-time monitoring, historical analysis, predictive analytics, and qualitative assessment of visitor experiences. The resulting platform enables stakeholders to continuously observe tourism dynamics, evaluate operational conditions, forecast future scenarios, and assess public perception through a unified technological environment. The activities presented in this deliverable therefore contribute to the adoption of more sustainable, evidence-based, and resilient tourism management strategies while supporting the broader objectives of the TOURISMO project.

The activities presented in this deliverable should be interpreted within the broader implementation pathway of the TOURISMO project. The analytical framework described here operationalises the methodological approach introduced in Output 1.1 by transforming common indicators, integrated datasets and monitoring concepts into operational dashboards, forecasting services and AI-supported analytical tools. The resulting evidence subsequently supports the implementation actions described in Deliverable D2.3.2, the evaluation activities reported in D2.4.2, and the replication methodology presented in D3.4.1.

2. Introduction and Objectives

The Tourism destinations are increasingly characterized by complex and dynamic interactions among visitors, local communities, mobility systems, environmental conditions, cultural heritage, and public services. The rapid growth of tourism, together with the increasing availability of digital technologies and sensing infrastructures, has generated opportunities for collecting and analysing large amounts of information capable of supporting more effective destination management. At the same time, tourism authorities face significant challenges related to overcrowding, environmental sustainability, resource optimization, visitor satisfaction, and the need to balance tourism development with the preservation of local assets and quality of life. Addressing these challenges requires innovative approaches capable of integrating heterogeneous data sources into a common analytical environment where information can be continuously collected, processed, interpreted, and transformed into actionable knowledge. Modern tourism management therefore increasingly relies on **data-driven decision-support systems** that combine real-time monitoring, historical analysis, predictive modelling, and user feedback to provide a comprehensive understanding of tourism dynamics.

Within this context, **Activity 2.2** of the TOURISMO project aims to support future decision-making processes through the implementation of **forecasting and sentiment analysis** capabilities integrated within the Snap4City platform. The activity builds upon the monitoring infrastructure deployed in all pilot areas and extends its functionalities by introducing advanced analytical services capable of exploiting both historical and real-time information. The resulting framework allows tourism stakeholders to continuously monitor visitor behaviour, evaluate environmental and contextual conditions, analyse patterns, and estimate future tourism demand using Artificial Intelligence methodologies.

A key objective of the activity is the creation of **a common analytical system** capable of integrating data collected from heterogeneous technologies, including people counters, thermal cameras, radar systems, Wi-Fi/Bluetooth sniffers, environmental sensors, weather services, and other contextual open-data sources. Standardized data models and harmonized ingestion procedures ensure interoperability across all pilot areas while preserving the specific characteristics of each monitored destination. Beyond quantitative monitoring, the activity also introduces **qualitative assessment methodologies** based on visitor feedback. Through QR-code-based **questionnaires and AI-supported Natural Language Processing** techniques, the framework enables the automatic evaluation of visitor perceptions, satisfaction levels, and service quality, providing additional information that complements traditional numerical indicators and supports more comprehensive tourism analyses.

The **main objectives** of **Activity 2.2** can therefore be summarized as follows:

- To maintain, validate, and enrich historical datasets collected across all TOURISMO pilot areas;
- To integrate heterogeneous real-time and historical data within a common analytical environment;
- To develop advanced dashboards supporting monitoring, visualization, and exploration of tourism dynamics;
- To implement forecasting methodologies capable of predicting tourism demand, visitor flows, occupancy levels, and other tourism-related indicators;
- To analyse visitor perceptions through sentiment analysis techniques based on Natural Language Processing and Large Language Models;
- To provide destination managers and public authorities with reliable decision-support tools capable of improving operational planning, resource allocation, and sustainable tourism management.

The activities described in this report illustrate how the integration of advanced analytics, Artificial Intelligence, and digital monitoring infrastructures can significantly enhance the ability of stakeholders to interpret tourism phenomena, anticipate future developments, evaluate visitor experiences, and support evidence-based policy making. The proposed framework demonstrates the potential of combining quantitative and qualitative information within a unified digital ecosystem, contributing to more resilient, efficient, and sustainable tourism management practices across the diverse pilot areas involved in the TOURISMO project.

Activity 2.2 represents the analytical core of the TOURISMO implementation phase. While Output 1.1 established the common methodological framework for tourism flow management—including data models, indicators and monitoring principles—Activity 2.2 transforms these concepts into operational analytical services deployed across all pilot areas. The generated analytical outputs subsequently provide the evidence base for the Action Plans (D2.3.2), the assessment of pilot impacts (D2.4.2), and the replication framework developed within WP3 (D3.4.1).

3. Data Collection and Management

The **TOURISMO analytical framework** relies on a comprehensive data collection and integration process implemented through the Snap4City platform. The platform enables the continuous acquisition, harmonization, storage, and management of heterogeneous data streams originating from multiple pilot areas.

Data sources include real-time measurements collected from field devices such as people counters, thermal cameras, radar sensors, environmental sensors, and Sniffers Wi-Fi/Bluetooth detection systems. These datasets are complemented by contextual and open data sources, including weather information, sea conditions, air quality indicators, UV index measurements, parking availability, accommodation statistics, mobility data, and visitor admission records.

A key characteristic of the framework is the continuous data ingestion process. Data are automatically collected at predefined intervals, typically ranging from 5 to 30 minutes depending on the source, and stored within the Snap4City knowledge base to support both real-time monitoring and long-term historical analysis. This approach enables the creation of extensive historical datasets that are essential for trend analysis, behavioural studies, forecasting activities, and cross-seasonal comparisons.

To ensure consistency and comparability across pilot areas, standardized data ingestion procedures and common data models have been adopted. These procedures facilitate interoperability among heterogeneous technologies while preserving the specific characteristics of each monitored site.

Historical data maintenance represents an essential component of the framework. Continuous updating and validation activities guarantee data quality and availability, enabling the generation of reliable indicators and predictive models. The integration of historical and open datasets further enriches the analytical ecosystem by providing contextual information capable of improving the interpretation of tourism dynamics and supporting advanced forecasting activities. In the following, the datasets currently integrated into the TOURISMO platform for each pilot area, including data source typology, monitored parameters, collection frequency, and temporal coverage are summarized.

The harmonised data collection process implemented across the pilot areas follows the common interoperability principles defined during the initial methodological phase of the project. The resulting integrated datasets constitute the common information layer supporting all subsequent TOURISMO activities, including predictive analytics, action planning, pilot evaluation and replication.

3.1. Rhodes City

Data Source	Type	Parameters	Start Date	Frequency
Radar Sensors (8 devices)	Real-time from Installed devices	In/Out people, bikes, Escooters	Dec 2025	5 min
Museums/Sites Visitors	Static data	Admissions	Jan 2020	30 days
Open Weather	Real-time from open-source	Weather parameters	Dec 2024	30 min
Sea Conditions	Real-time from open-source	Sea indicators	Jan 2025	60 min
Air Pollution	Real-time from open-source	Pollution indicators	Jan 2025	30 min
UV Index	Real-time from open-source	UV Index	Mar 2025	24 h

3.2. Florence City

Data Source	Type	Parameters	Start Date	Frequency
Thermal Camera (2 Devices)	Real-time from Installed devices	Total detections, People, Bikes, Strollers	Oct 2025	5 min
Sniffer WI-FI (6 devices)	Real-time from Installed devices	Wi-Fi detections, Bluetooth detections, Total detections	Jul 2025	15 min
Vehicle Traffic Data	Real-time from derived data	Inflow, Outflow	Jan 2017	10 min
SIR Sensors	Real-time from other sources	Humidity, Temperature	Jan 2021	15 min
ARPAT Sensors	Real-time from other sources	CO, NO_2	Jan 2021	24 h
Open Weather	Real-time from open-source	Weather parameters	Dec 2024	30 min
Air Pollution	Real-time from open-source	Pollution indicators	Jan 2025	30 min
Car Parking	Real-time from other sources	Free parking lots, Capacity	May 2022	15 min

3.3. Valencia

Data Source	Type	Parameters	Start Date	Frequency
Camera (Cruise Passengers)	Real-time from Installed devices	Passenger counting	Jun 2025	5 min
Thermal Cameras (3 devices)	Real-time from Installed devices	Counting, Queue management	Apr 2026	1 min
Indoor Pax Counters	Real-time from Installed devices	In/Out people, Occupancy	Jun 2025	10–30 min
Indoor Environmental Sensors	Real-time from Installed devices	Temperature, Humidity	Jun 2025	10–30 min
Indoor Noise Sensors	Real-time from Installed devices	Noise level, Max noise	Jun 2025	10–30 min
Indoor CO_2 Sensors	Real-time from Installed devices	CO_2 levels	Jun 2025	10–30 min
Open Weather	Real-time from open-source	Weather parameters	Dec 2024	30 min
Sea Conditions	Real-time from open-source	Sea indicators	Jan 2025	60 min
Air Pollution	Real-time from open-source	Pollution indicators	Jan 2025	30 min
UV Index	Real-time from open-source	UV Index	Mar 2025	24 h
Car Parking	Static data	Total parking slots	Mar 2025	static

3.4. Limassol Port

Data Source	Type	Parameters	Start Date	Frequency
Thermal Camera (5 devices)	Real-time from Installed devices	Total detections, People, Bikes, Strollers	Jan 2026	5 min
Open Weather	Real-time from open-source	Weather parameters	Dec 2024	30 min
Sea Conditions	Real-time from open-source	Sea indicators	Jan 2025	60 min
Air Pollution	Real-time from open-source	Pollution indicators	Jan 2025	30 min
UV Index	Real-time from open-source	UV Index	Mar 2025	24 h

3.5. Varna City

Data Source	Type	Parameters	Start Date	Frequency
Drone Data	Drone-based data collection	People, Cyclists, Scooter riders	Aug 2024 / Jun 2025 / Aug 2025	Campaign-based (drone deployment)
Open Weather	Real-time from open-source	Weather parameters	Dec 2024	30 min

Data Source	Type	Parameters	Start Date	Frequency
Sea Conditions	Real-time from open-source	Sea indicators	Jan 2025	60 min
Air Pollution	Real-time from open-source	Pollution indicators	Jan 2025	30 min
UV Index	Real-time from open-source	UV Index	Mar 2025	24 h

3.6. Island of Biševo

Data Source	Type	Parameters	Start Date	Frequency
Sniffers WI-FI (2 devices)	Real-time from Installed devices	Wi-Fi detections, Bluetooth detections, Total detections	Jul 2025	15 min
Open Weather	Real-time from open-source	Weather parameters	Dec 2024	30 min
Sea Conditions	Real-time from open-source	Sea indicators	Jan 2025	60 min
Air Pollution	Real-time from open-source	Pollution indicators	Jan 2025	30 min
UV Index	Real-time from open-source	UV Index	Mar 2025	24 h

3.7. Golden Bay

Data Source	Type	Parameters	Start Date	Frequency
Sniffers WI-FI (2 devices)	Real-time from Installed devices	Wi-Fi detections, Bluetooth detections	Mar 2025	15 min
Thermal Camera (3 devices)	Real-time from Installed devices	In/Out humans, cars, buses	Apr 2025	5 min
Open Weather	Real-time from open-source	Weather parameters	Dec 2024	30 min
Sea Conditions	Real-time from open-source	Sea indicators	Jan 2025	60 min
Air Pollution	Real-time from open-source	Pollution indicators	Jan 2025	30 min
UV Index	Real-time from open-source	UV Index	Mar 2025	24 h

4. Data Analysis and Monitoring Framework

The TOURISMO analytical framework provides a comprehensive environment for **monitoring**, **analysing** and **forecasting** tourism-related phenomena through a set of advanced dashboards integrated within the Snap4City platform. The framework combines real-time observations, historical datasets, environmental information, mobility indicators, and user-generated feedback to support evidence-based decision making.

The analytical tools have been designed to support both operational management and strategic planning activities. By integrating heterogeneous data sources into a unified environment, stakeholders can gain a holistic understanding of tourism dynamics, identify critical situations, and evaluate the effectiveness of mitigation and management strategies.

The dashboards presented in this chapter should not be considered as stand-alone visualisation tools. They represent the operational environment through which the methodologies defined in TOURISMO become available to destination managers. The indicators, analytical functions and monitoring capabilities constitute the evidence base supporting the operational measures proposed in D2.3.2 and the impact evaluation performed in D2.4.2.

4.1. Dashboard Architecture and User Interaction

The **dashboards** are organized into three main components. The first component consists of an interactive control panel that allows users to select specific data sources, indicators, temporal ranges, and analytical functionalities. This flexible configuration enables customized analyses tailored to different operational needs. The second component is represented by a geospatial visualization interface where sensors, monitored assets, and points of interest are displayed on interactive maps. Through dedicated pop-up windows, users can access detailed information about each monitored element and navigate to more advanced analytical views. The third component includes dynamic visualization tools for exploring both real-time and historical data. Time-series graphs, statistical summaries, and comparative analyses allow users to investigate temporal trends and evaluate changes occurring across different time horizons.

In Figure 1, the **general design** of TOURISMO dashboard is shown as an example.

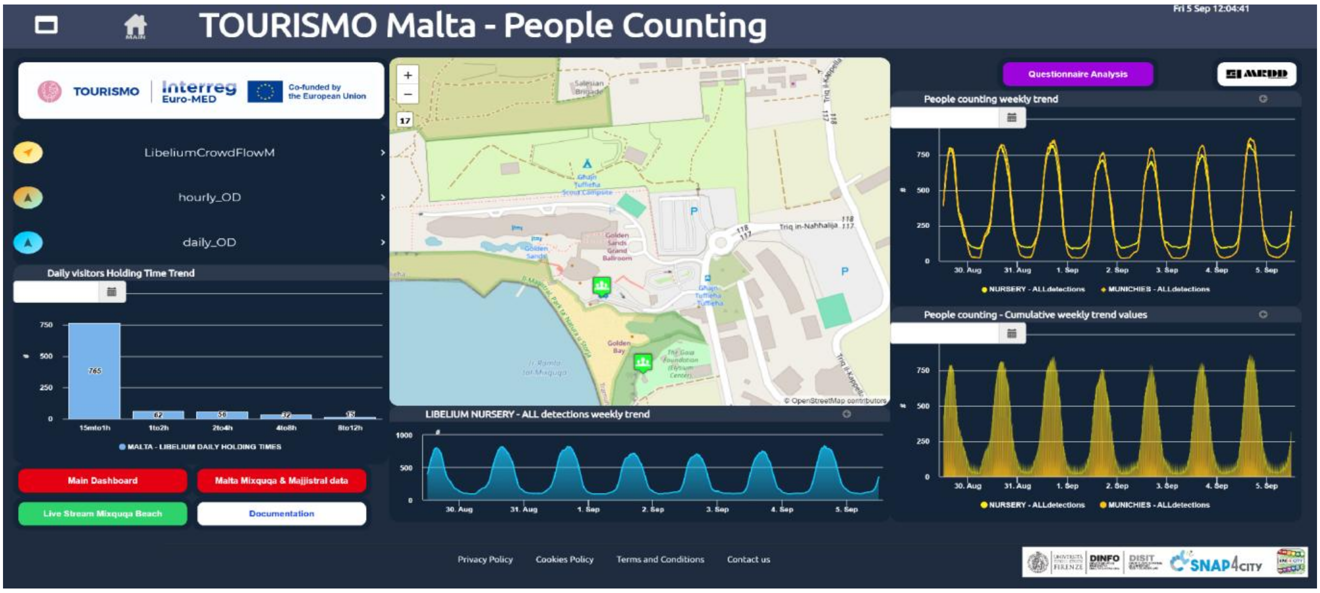

Figure 1: Main components of the Snap4City analytics dashboard: (i) an interactive control panel for selecting data sources, indicators, temporal ranges, and analytical functions; (ii) a geospatial interface for visualizing sensors, monitored assets, and points of interest on interactive maps; and (iii) dynamic analytics tools for exploring real-time and historical data through time-series visualizations, statistical summaries, and comparative analyses.

4.2. Environmental and Contextual Monitoring

Environmental conditions play a fundamental role in influencing visitor behaviour and tourism demand. For this reason, the framework integrates multiple contextual data sources, including weather measures, air quality indicators, sea conditions, and UV radiation levels.

These variables can be analysed at different temporal scales, ranging from hourly observations to seasonal trends. The integration of environmental and tourism data enables stakeholders to investigate correlations between external conditions and visitor behaviour, supporting both operational management and forecasting activities.

4.3. Tourist Flow Monitoring and Behavioural Analysis

Tourist flow analysis constitutes one of the core functionalities of the TOURISMO framework. Visitor presence and movements are monitored through the integration of heterogeneous sensing technologies, including Sniffers Wi-Fi/Bluetooth counters, video analytics systems, radar sensors, and thermal cameras.

The framework supports both real-time monitoring and retrospective analyses, providing information on visitor volumes, movement patterns, peak periods, and temporal variations. Historical data analysis enables the identification of recurring patterns and seasonal trends, while real-time monitoring supports rapid responses to emerging situations.

Behavioural indicators are also computed to better understand visitor interactions with monitored environments. Examples include holding time estimation, occupancy dynamics, flow direction analysis, and movement distribution across monitored areas. To improve the interpretation of raw observations, the framework computes a set of advanced Key Performance Indicators (KPIs), including:

- Total visitor volumes;
- Peak visitor levels;
- Occupancy rates;
- Density indicators;
- Area capacity utilization;
- Human space availability;
- Queue length estimation;
- Infrastructure usage indicators.

These indicators provide a more meaningful representation of crowd conditions and visitor experience than simple counting metrics alone. They support the identification of overcrowding situations, safety risks, and service bottlenecks, enabling proactive management actions. Practical implementations of these indicators have been developed across multiple pilot areas. Examples include, detailed in the sequel of the present paragraph, beach occupancy monitoring in Malta, queue management and room occupancy analysis in Valencia, capacity assessment in the Medieval City of Rhodes, and Origin-Destination flow analysis in Florence.

In Figure 2, the example in Golden Bay (Malta) is shown where the related dashboard displays **key indicators** related to beach attendance, including total visitor counts, vehicles counts, and peak day during the mouth. All metrics are presented for the current month as well as for previous months. Moreover, the dashboard provides two additional indicators: (1) *Occupancy*, representing the number of people present on the beach, calculated as the cumulative difference between incoming and outgoing visitors (pax in – pax out). The recommended occupancy is approximately 1,060 visitors, assuming a beach area of 7,210 m² and the EU average personal space requirement of 6.8 m² per person (or 1,803 visitors when considering 4 m² per person). (2) *Human Space*, representing the amount of available beach area per visitor, expressed in square meters per person and calculated as Human Space = Beach Area / Occupancy.

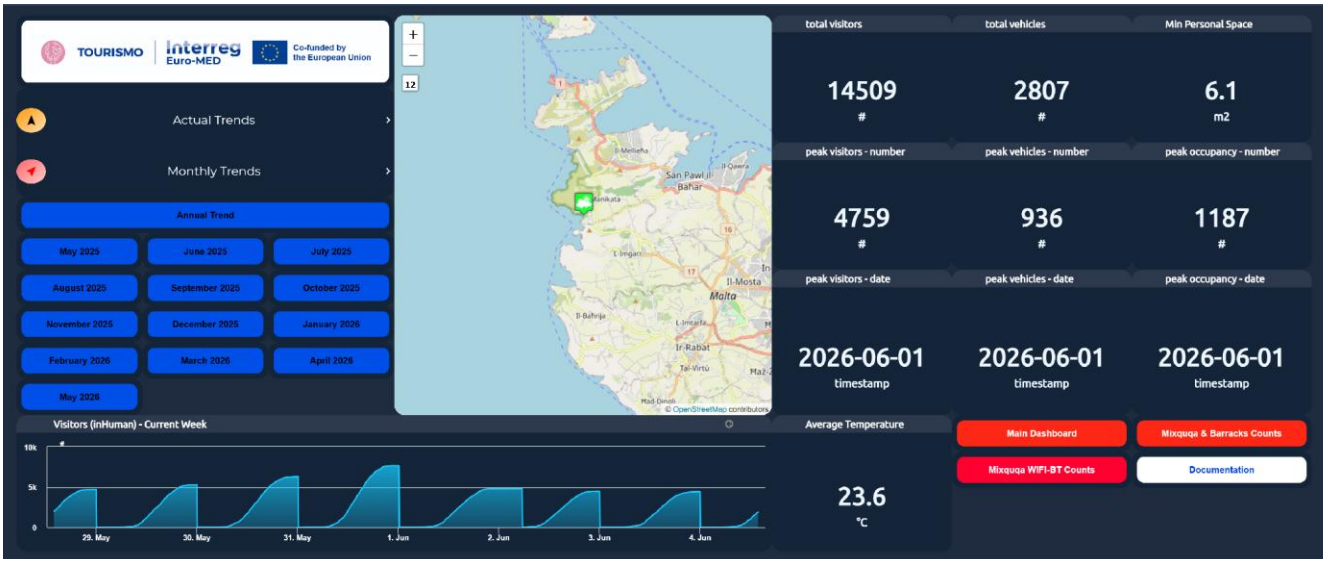

Figure 2: Key indicators in Golden Bay in Malta including total visitor counts, vehicles counts, and peak day during the month.

Another example is provided by Valencia, where the dashboard shown in Figure 3 supports the real-time analysis of visitor flows at major tourist attractions. The dashboard leverages Snap4City's Client-Side Business Logic (CSBL) framework to automatically update indicators and coordinate interactions among widgets. Through CSBL, widgets can exchange events, parameters, and commands, enabling dynamic visualizations. The displayed indicators include the current number of visitors, queue lengths, and attendance peaks observed during the previous day and over the last seven days. Furthermore, occupancy levels are performed within specific rooms of museums and historic buildings, providing detailed insights into visitor distribution and crowding dynamics inside the attractions.

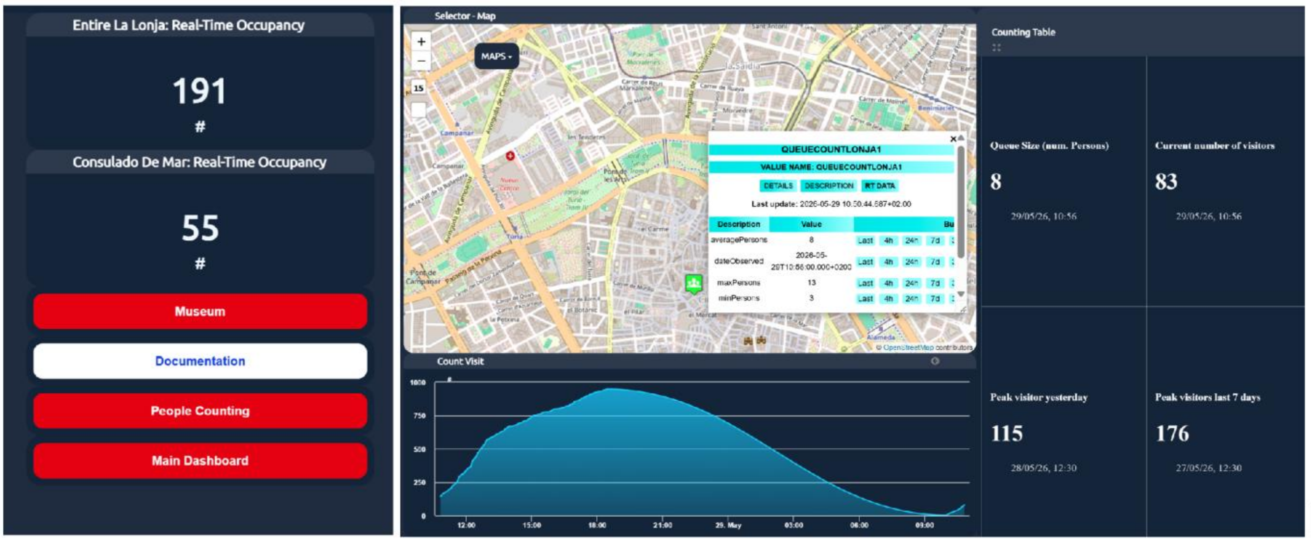

Figure 3: Key indicators in Valencia including the real-time analysis of visitor flows at major tourist attractions.

Occupancy analysis can also be performed in open urban areas, such as the medieval city of Rhodes displayed in Figure 4, where the current number of visitors is estimated in real time by calculating the cumulative difference between incoming and outgoing flows recorded at the eight monitored access gates.

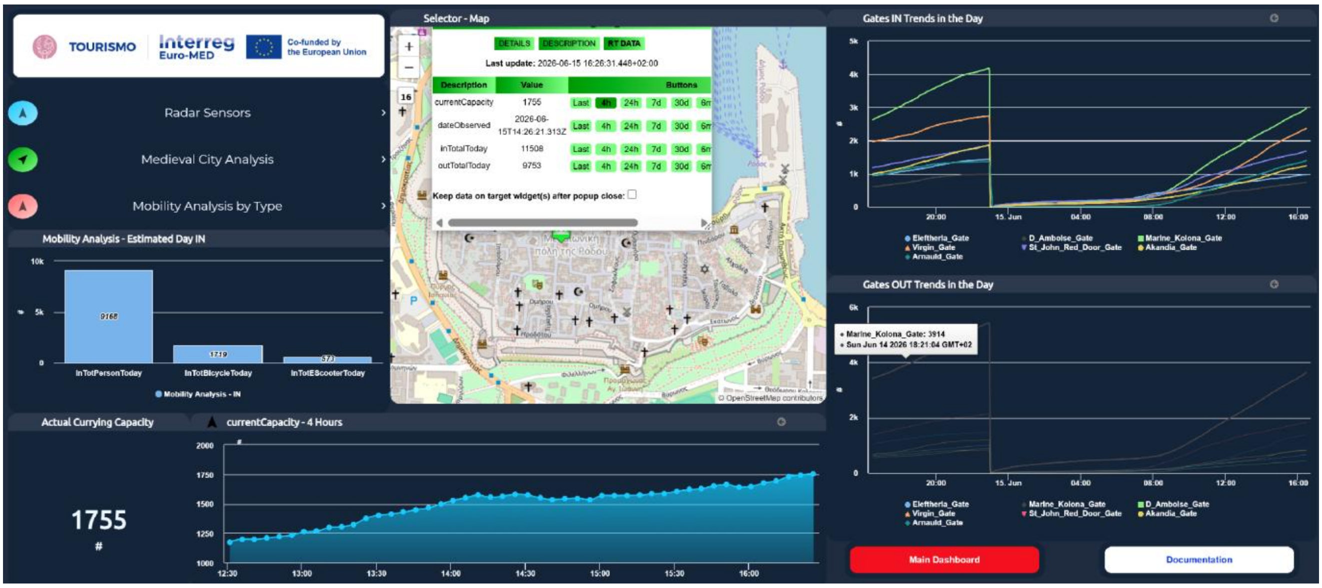

Figure 4: Key indicators in Rhodes including the real-time analysis of the actual currying capacity in the Medieval City.

Advanced mobility analysis is performed through the generation of Origin-Destination (OD) matrices derived from anonymized movement data registered by Sniffers WI-FI. OD matrices enable the identification of visitor flows between monitored locations and support the understanding of spatial interactions within tourism destinations. Analyses can be performed at hourly, daily, or longer aggregation levels, providing valuable insights into mobility patterns, preferred routes, and key attraction corridors. These analyses support destination planning, infrastructure optimization, and the development of sustainable mobility strategies. In Florence, as shown in Figure 5, the illustrated analysis is conducted and supported by the related visual tool.

Figure 5: The analysis by means of Origin-Destination approach in Florence.

5. Forecasting Methodology and AI

Forecasting functionalities have been developed to support proactive tourism management through the prediction of future tourism demand and related indicators. Users can configure forecasting tasks by selecting monitored devices, defining **prediction horizons**, setting temporal aggregation levels, and choosing among alternative forecasting models. Forecasts can be generated for visitor counts, occupancy indicators, environmental variables, and other tourism-related metrics from installed devices. Historical observations and forecasted values are visualized within the same dashboard, facilitating comparison, validation, and interpretation of results. The forecasting environment has been implemented across all pilot areas and supports automated generation, monitoring, and visualization of predictive analyses by means of a dedicated Snap4City tool provided for the aim of the present task. In Figure 6, the design of the related dashboard, which contains the automatic tool approach, is considered.

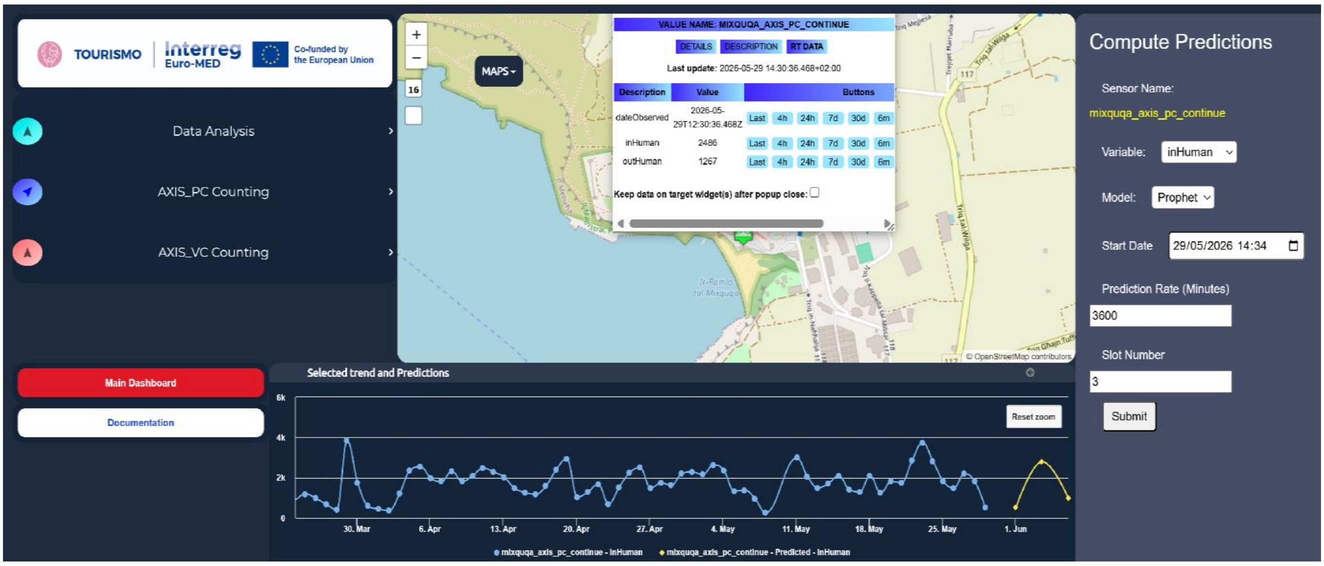

Figure 6: The automatic approach for forecasting performances provided by all the metrics coming from the installed sensors in all pilots.

This section explains the methodologies used to predict future tourism flows. Forecasting is based on the integration of historical data, real-time observations, and (possibly) external variables such as weather or events. Statistical analysis is used to identify correlations and causal relationships among different data sources, forming the basis for predictive modeling. **Advanced Artificial Intelligence** techniques are employed, including **Deep Learning** models such as LSTM (Long Short-Term Memory) and statistical models such as Prophet. LSTM is a Deep Learning architecture specifically designed for time-series forecasting. Unlike traditional neural networks, LSTM models can capture both short-term and long-term temporal dependencies within historical data, making them particularly suitable for predicting tourism flows, occupancy levels, and other dynamic indicators that exhibit seasonal patterns and temporal correlations. Prophet is particularly suitable for sustainability purposes, as it can adapt to trends without requiring continuous retraining. In particular, the operational tools developed to support analysis and decision-making are referenced to the Snap4City forecasting dashboard. This dashboard, displayed in Figure 7, allows users to select specific devices (in the map), configure forecasting parameters (such as start date, prediction rate, and number of time slots), and choose the predictive model (in green). The system provides automated visualization of both historical data (in yellow) and forecasted trends (in red), enabling easy comparison and interpretation.

Figure 7: Example of setting of the forecasting dashboard approach.

Users can generate forecasts at different temporal resolutions (e.g., hourly predictions for a full day) and adapt the configuration to specific needs. In addition, this section highlights the development of business intelligence and visual analytics tools that transform complex data into intuitive insights. Practical use cases from pilot areas are presented, such as beach occupancy monitoring or urban flow management, demonstrating how the system supports real-world applications. Overall, this section emphasizes how data-driven tools can enhance operational efficiency, improve visitor experience, and support sustainable tourism management.

6. LLM and Sentiment Evaluation Approach

This section combines quantitative and qualitative analysis to provide a more complete understanding of tourism dynamics. To facilitate the collection of visitor feedback and support data-driven tourism analysis, a dedicated **QR Code Generation Dashboard** has been developed within the Snap4City platform. The tool allows destination managers and attraction operators to create, geolocate, and manage QR codes associated with digital questionnaires. In Figure 8, an example of the tool provide in Florence is shown.

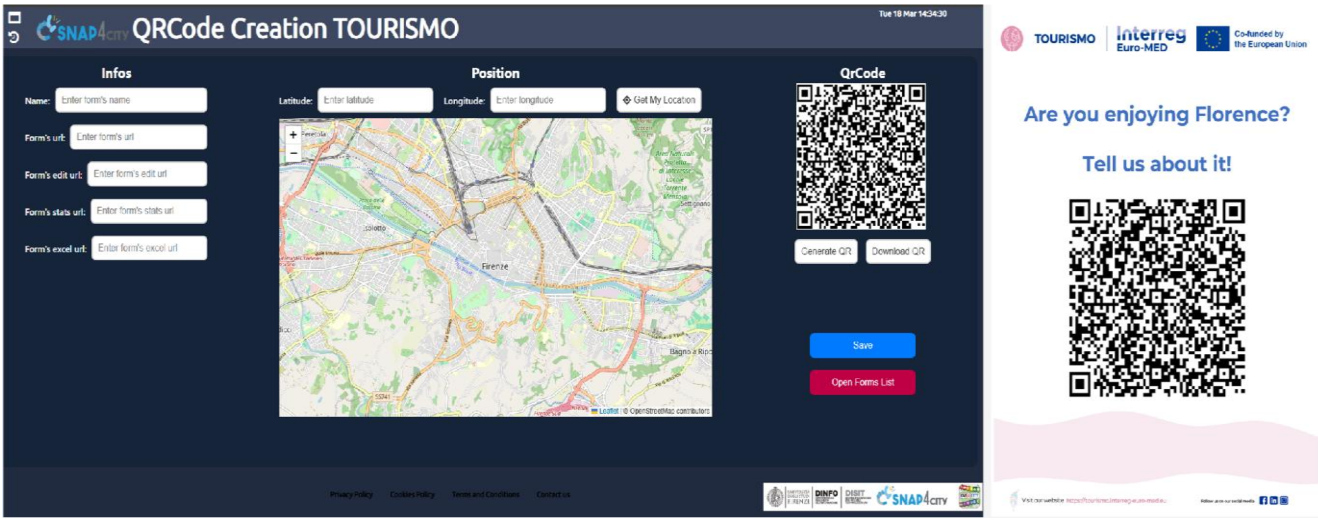

Figure 8: QR code creation tool provided for sentiment analysis evaluation.

By scanning the QR code, visitors can easily access online forms and provide feedback about their experience. The generated responses are automatically linked to the corresponding location and made available for real-time analysis through Snap4City dashboards. This approach significantly simplifies data collection in the field, increases visitor participation, and enables the continuous monitoring of visitor satisfaction, preferences, and perceptions across multiple points of interest.

Quantitative monitoring is complemented by qualitative analyses based on **visitor feedback** collected through digital questionnaires distributed via QR codes. Responses are processed using **Natural Language Processing** (NLP) techniques and **Large Language Models** (LLMs) integrated into the Snap4City environment processed through **SnapAdvisor**, an AI-based analysis service integrated into the Snap4City platform. The system automatically generates summaries of visitor perceptions, identifies recurring themes, and highlights strengths and weaknesses of the monitored destinations.

The sentiment analysis framework enables stakeholders to assess visitor satisfaction, evaluate service quality, identify emerging issues, and complement quantitative indicators with qualitative evidence.

6.1. Sentiment Analysis and User Feedback

In addition to quantitative data, the framework integrates qualitative analysis through sentiment evaluation. User feedback is collected through digital tools, such as QR-code-based questionnaires, and processed using Natural Language Processing (NLP) techniques.

The results are summarized to provide insights into user satisfaction, perceived service quality, and potential critical issues. The integration of Large Language Models (LLMs) by means of SnapAdvisor further enhances the capability to analyze unstructured textual data and generate structured summaries.

This approach complements quantitative analysis by incorporating the perspective of users, enabling a more comprehensive understanding of tourism experiences.

7. Results and Practical Utilization

The **TOURISMO platform** based on Snap4City technology, enabled the collection and analysis of visitor perceptions through georeferenced questionnaires distributed via QR codes at multiple pilot destinations. The collected responses were processed through **SnapAdvisor**, an **AI-based analysis** service integrated into the **Snap4City system**, providing automated summaries of visitor satisfaction, key strengths, critical issues, and emerging trends. The results demonstrate the effectiveness of combining digital feedback collection with AI-supported interpretation to obtain actionable insights for destination managers. Across the analysed pilot sites, visitor perceptions revealed significant differences depending on the characteristics of the destination, tourism intensity, and local management practices. Urban cultural destinations such as Florence, Rhodes, Limassol, Varna and Valencia generally received positive evaluations regarding their cultural heritage, historical identity, and overall attractiveness. However, common challenges emerged, including overcrowding, congestion, noise, accessibility limitations, and the need for improved visitor information services. In Florence and Rhodes, tourism pressure and crowd management were among the most recurrent concerns, while visitors also highlighted the importance of preserving authenticity and improving the quality of public services.

Valencia consistently achieved the highest satisfaction levels among urban destinations. Visitors particularly appreciated its combination of cultural heritage, modern architecture, gastronomy, cleanliness, and urban organization. The main challenges identified were related to localized congestion, thermal discomfort during warmer periods, and public transport efficiency. Limassol presented generally positive evaluations, with visitors appreciating the cultural and historical value of the Old Town. Nevertheless, respondents highlighted the need for improved transport accessibility, parking availability, signage, tourist information services, and environmental comfort measures such as shading and resting areas. In contrast, nature-based destinations showed different visitor priorities. The Biševo Island and Blue Cave Visitor Experience achieved exceptionally high satisfaction scores. Visitors consistently valued the natural environment, authenticity, educational opportunities, and the absence of mass tourism. Suggested improvements focused mainly on enriching the visitor experience through additional activities, workshops, multimedia content, and family-oriented services rather than addressing some deficiencies. Golden Bay Beach in Malta revealed a different pattern. While visitors appreciated the natural beauty and recreational value of the site, feedback consistently identified cleanliness and overcrowding as the main factors negatively affecting visitor satisfaction. Toilet facilities and waste management emerged as the highest priorities for intervention across all analysed periods.

A cross-destination analysis highlights several recurring themes. First, visitors increasingly value authenticity, local identity, and sustainable tourism experiences. Second, tourism pressure and overcrowding continue to represent major challenges in highly visited urban areas. Finally, visitors show growing interest in discovering less crowded attractions, interacting with local communities, and accessing more personalized and experience-oriented tourism services. The collected feedback demonstrates that the **QR-code-based engagement approach**, combined with real-time analytics and AI-supported interpretation, provides destination managers with valuable evidence for supporting data-driven tourism policies. The results can be used to identify critical issues, monitor visitor sentiment over time, evaluate the effectiveness of management actions, and support more sustainable and **visitor-centered tourism strategies**. In addition to real-time monitoring and visitor feedback analysis, the forecasting functionalities developed within the TOURISMO platform demonstrated the potential of predictive analytics to support proactive tourism management.

Tables 1 and 2 summarize the main findings emerging from the sentiment analysis campaigns conducted across the TOURISMO pilot areas. The comparison highlights common strengths and recurring challenges, providing an overview of visitor perceptions and supporting the cross-destination discussion presented in this chapter.

Table 1: Comparative overview of visitor perceptions and main evaluation dimensions across the TOURISMO pilot areas.

Pilot	Satisfaction	Authenticity	Visitor facilities	Overcrowding	Environmental quality	Return intention
Florence	Medium	High	Medium	High issue	Medium	High
Rhodes	High	High	Medium	Medium–High issue	Medium	Very High
Valencia	Very High	High	High	Medium issue	High	Very High
Limassol	High	High	Medium	Low	Medium	High
Varna	High	Medium–High	High	Low	High	Very High
Biševo	Very High	Very High	High	Very Low	Very High	Very High
Golden Bay	Medium	High (natural value)	Low	High issue	Low	Medium

Table 2: All indicators were normalized to a common 0–100 scale to facilitate comparison across pilot areas. Original questionnaires adopted different rating systems (1–5 or −2 to +2). Scores were therefore linearly transformed while preserving their relative meaning. Values marked with "—" indicate that the corresponding aspect was not explicitly assessed in the questionnaire.

Pilot	N. question.	Overall Experience	Destination Attract.	Authenticity	Cleanliness	Accessibility	Visitor Facilities	Main Strengths	Main Improvement Priorities
Florence	41	52.5	87.5	75.0	47.5	55.0	47.5	Cultural heritage, artistic identity, local atmosphere	Visitor flow management, cleanliness, public services
Rhodes	31	67.5	90.0	87.5	53.0	62.5	55.0	Historic heritage, cultural atmosphere	Overcrowding, signage, public facilities
Valencia	26	90.0	95.0	90.0	85.0	85.0	85.0	Heritage, gastronomy, urban quality	Heat mitigation, congestion, public transport
Limassol	4	75.0	80.0	80.0	57.5	62.5	70.0	Historic centre, cultural offer	Parking, signage, accessibility
Varna	28	77.5	80.0	75.0	67.5	67.5	75.0	Welcoming urban environment, visitor experience	Parking, accessibility, green infrastructure
Biševo	21	95.0	97.5	97.5	—	—	80.0	Nature, authenticity, Blue Cave experience	Additional experiential activities, gastronomy
Golden Bay	74	65.8	—	—	42.7	76.5	41.9	Natural landscape, recreational value	Toilets, cleanliness, litter management, overcrowding

The forecasting environment was deployed across all pilot areas, enabling stakeholders to generate predictions for visitor flows, occupancy levels, environmental indicators, and other tourism-related variables through the dedicated Snap4City forecasting tools. The forecasting framework integrates historical observations, real-time data streams, and external factors such as weather conditions and events to estimate future tourism demand. Different forecasting approaches were made available, including statistical models (e.g., Prophet) and Deep Learning techniques (e.g., LSTM), allowing users to select the most appropriate model according to the characteristics of the monitored phenomenon. The deployment of these functionalities across the pilot destinations highlighted several practical benefits. Forecasts enabled destination managers to anticipate periods of high demand, identify potential overcrowding situations, and support the planning of operational measures aimed at improving visitor distribution and resource allocation. In beach environments, predictive occupancy analysis provided early indications of future crowding conditions, supporting visitor guidance and sustainable capacity management. In urban destinations, tourism flow forecasts helped identify expected peaks in visitor presence, supporting mobility planning, crowd management strategies, and the promotion of alternative routes and attractions. The forecasting dashboard proved particularly effective in translating complex predictive analyses into actionable information. Stakeholders were able to evaluate the potential effects of changes in visitor arrivals, weather conditions, or service availability before implementing management actions. This capability supports more informed and evidence-based decision-making processes, reducing uncertainty and improving preparedness for both expected and unexpected tourism dynamics. Overall, the forecasting tools complemented the monitoring and visitor feedback components of the platform, creating an integrated decision-support ecosystem capable of combining real-time situational awareness, visitor perception analysis, and future demand estimation. The results obtained across the pilot areas demonstrate the value of predictive analytics in enhancing operational efficiency, improving visitor experience, and supporting sustainable tourism management strategies.

7.1. Platform Adoption and Stakeholder Usage Assessment

To evaluate the practical adoption of the Snap4City platform and the usefulness of the services developed within the TOURISMO project, a dedicated questionnaire was administered to pilot partners. The objective was to assess how frequently the dashboards are used, which stakeholder profiles access the platform, the purposes for which the information is exploited, and potential areas for future improvement. The results indicate that the platform is actively used by a broad range of stakeholders, including operational personnel, destination managers, public authorities, tourism agencies, facility managers, business operators, technical staff, and decision-makers. In several pilot areas, the dashboards have also been publicly disseminated, extending their potential use to local communities, tourism operators, and the general public. Most partners reported accessing the dashboards on a regular basis, typically between one and three times per week, with some destinations consulting the platform more frequently during peak tourism periods. The dashboards are primarily used to monitor tourism dynamics, analyse visitor flows and occupancy levels, verify trends, compare data across periods, support reporting activities, and facilitate stakeholder engagement. Several partners also highlighted the use of the platform as a decision-support tool for evaluating operational conditions and assessing the impact of management actions.

Overall feedback regarding the platform was highly positive. Partners described the system as robust, flexible, and capable of simplifying access to complex tourism data. The integration of heterogeneous data sources within a single environment was identified as one of the main strengths of the solution, enabling users to access operational, environmental, and tourism-related information through a unified interface. The assessment also identified several opportunities for further enhancement. The most frequently requested improvements included additional automation of analytical processes, enhanced documentation and dashboard guidance, further year-on-year comparison functionalities, integration of event calendars and local activities, support for advanced visitor flow management, and the incorporation of additional environmental monitoring data. Some stakeholders also expressed interest in more advanced visualisation capabilities, including three-dimensional representations and dedicated dashboards tailored to specific user communities such as tourist guides and facility managers. Overall, the survey confirms a high level of stakeholder engagement with the Snap4City platform and demonstrates that the tools developed within TOURISMO are perceived as useful for both operational monitoring and strategic decision-making. The collected feedback also provides a valuable roadmap for future platform evolution, highlighting opportunities to further strengthen usability, automation, predictive capabilities, and collaborative tourism management services.

The widespread adoption of the analytical platform across all pilot areas demonstrates that the proposed decision-support environment is not limited to experimental activities but represents an operational component of the TOURISMO methodology. The practical experience gained by stakeholders during platform usage provides the knowledge base supporting the replication recommendations developed within Deliverable D3.4.1.

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