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Activity 3.4.1

HANDBOOK FOR REPLICATION OF PROJECT SOLUTION

Revision of methodology used, lessons learnt and best practices applied, use case scenaria, adjustments needed for application according to the area etc.

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1. Executive Summary

This **Handbook** provides a concise, non-technical overview of the framework developed under the **TOURISMO project** to support the smart, sustainable, and resilient management of tourist flows within Mediterranean (MED) territories. Leveraging Big, Open, and Smart Data alongside advanced digital platforms like **Snap4City** (https://www.snap4city.org), the project successfully transformed fragmented data into actionable knowledge. This enabled public authorities and Destination Management Organizations (DMOs) to mitigate overtourism, optimize local mobility, and enhance visitor experiences. Validated across eight diverse pilot areas, the solutions presented herein offer a scalable, data-driven methodology tailored to the unique environmental, cultural, and structural challenges of the MED region.

The primary purpose of this Handbook is to facilitate the replication and scaling up of the TOURISMO project solutions in new European and Mediterranean destinations. It serves as a practical, step-by-step guide to help public administrations, technology partners, and tourism operators transition from traditional planning to evidence-based, data-driven governance. By documenting technical architectures, methodologies, and lessons learned, the Handbook aims to reduce implementation complexities and accelerate the adoption of Smart Tourism practices across territories with varying degrees of digital maturity.

The scope of this document encompasses the entire lifecycle of a smart tourism implementation—ranging from initial territorial readiness assessments and co-creation frameworks to data ingestion architecture (Snap4City), use case deployment, and long-term investment planning. The target audience includes:

- **Public Authorities and Municipalities** seeking to align policy objectives with sustainable land-use and infrastructure planning.
- **Destination Management Organizations (DMOs) and Tourism Boards** looking for tools to monitor visitor densities, predict flows, and manage destination reputation.
- **Technology Providers and Research Organizations** requiring scalable, interoperable technical blueprints for AI-driven urban analytics.
- **Tourism Operators and Local SMEs** interested in leveraging data-driven ecosystems for local business creation and hyper-local promotion.

How to Use This Handbook

This Handbook is structured to guide the reader logically from conceptual framework to actual field execution:

1. **Understand the Basics:** Read **Sections 2 & 3** to familiarize yourself with the TOURISMO framework, the co-creation ecosystem, and data-driven principles.
2. **Explore the Technology:** Review **Section 4 & 6** to understand the 5-layer Snap4City architecture and how it applies to practical scenarios like flow management and sentiment analysis.
3. **Execute the Replication Roadmap:** Utilize **Sections 5 & 9** as an operational checklist. Follow the 6-phase chronological roadmap (from Phase 1 Analysis through Phase 6 Investment Planning) to structure your local project timeline, allocate human resources, and track progress against the provided technical and impact KPIs.
4. **Leverage External Resources:** Consult **Section 10** to access the active catalogue of training courses, APIs, and digital twin toolkits required to accelerate your deployment.

The replication approach presented in this Handbook also builds upon the implementation pathways defined in **Deliverable D2.3.2 – Action Plan for Applying Best Practices in Pilot Areas**. While the Action Plan identifies priority actions, stakeholder responsibilities and implementation approaches for the TOURISMO pilot areas, the present Handbook translates these operational experiences into a structured methodology that can be adapted and replicated in other Mediterranean destinations. In this way, replication is supported not only by technological solutions but also by validated governance models, implementation processes and action-oriented practices.

This Handbook builds upon the methodological framework developed in **Output 1.1 – Toolkit for Sustainable Tourism Flow Management**, which established the common approach for tourism flow analysis, indicator selection, data integration and stakeholder engagement across the TOURISMO pilot areas.

It also incorporates the lessons learned from the implementation and evaluation of the pilot actions documented in **Deliverable D2.4.2 – Impact Assessment of Pilot Results**. The replication methodology presented in this document therefore reflects both the conceptual framework developed during WP1 and the operational evidence collected during WP2, translating them into a practical roadmap for other Mediterranean destinations.

2. Introduction to the TOURISMO Framework

The **TOURISMO project**, Smart and Sustainable Tourism in the Mediterranean, is part of the **Interreg Euro-MED 2021–2027 programme**. It aims to improve the management of tourist flows in Mediterranean destinations by leveraging Big, Open, and Smart Data, digital technologies, and innovative methodologies to foster more sustainable, balanced, and resilient tourism.

TOURISMO's mission is to advance towards a tourism model that combines efficient data management with sustainable land-use planning, contributing to the reduction of tourism's negative impacts. To this end, the project promotes the integration of technological solutions, the analysis of visitor behaviour, the redistribution of flows in space and time, and the implementation of measures aimed at reducing pressure on areas with high tourist concentration.

The project builds upon the results of the HERIT-DATA initiative, expanding its scope and tools to support innovative tourism management. Through the use of digital platforms, TOURISMO seeks to optimise the monitoring of tourist flows and assess their impact on cultural heritage, local resources, and the quality of life of residents. The project is implemented across eight pilot areas in seven Mediterranean destinations: Rhodes (Greece), Florence (Italy), Valencia (Port and City) (Spain), Limassol (Cyprus), Varna (Bulgaria), Biševo Island (Croatia), and Ramla tal-Mixquqa (Golden Bay, Malta). These pilot areas enable the testing and validation of technological tools, supporting the development of solutions that can be transferred and replicated in other Mediterranean destinations.

In each pilot area, actions are tailored to address specific challenges related to visitor flow management, cultural heritage protection, tourist mobility, and local sustainability. Overall, TOURISMO contributes to accelerating the transition towards a more responsible and resource-efficient tourism model, with solutions that can be scaled and adapted across different regions.

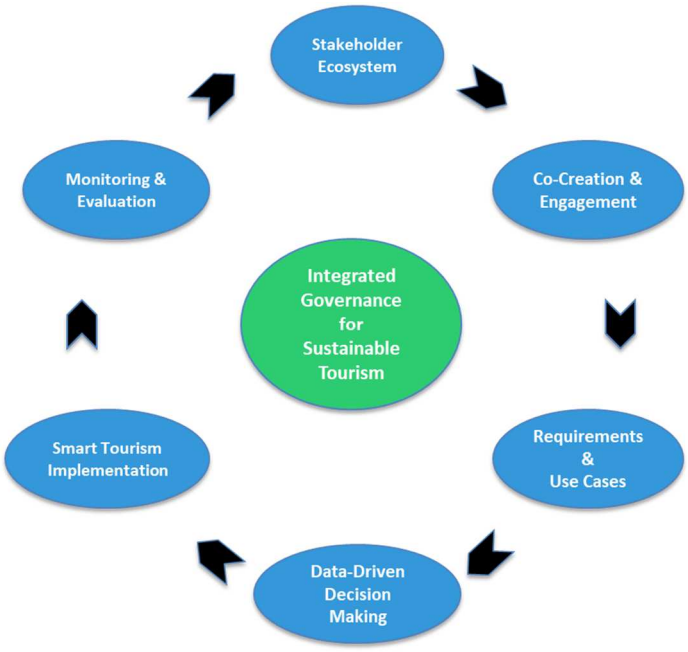
The Handbook therefore represents the operational continuation of previous TOURISMO work. In particular, **Deliverable D2.3.2** identified a portfolio of transferable actions covering governance, socio-economic development, heritage management and environmental sustainability. The present document complements that work by providing the methodological, organisational and technical guidance required to implement those actions in new territorial contexts.

3. Methodological Framework

The **TOURISMO project** adopts a holistic and user-centred methodology for the design, implementation, and replication of digital solutions supporting sustainable tourism management. The adopted approach combines technological innovation, stakeholder participation, and data-driven decision-making to address the complex challenges faced by tourism destinations.

Rather than focusing exclusively on technological deployment, the methodology aims to create an ecosystem in which data, governance processes, and stakeholder collaboration contribute to improving tourism planning, visitor experience, and destination sustainability. The solutions developed within the project are therefore designed to be scalable, interoperable, and adaptable to different territorial contexts, allowing destinations with varying levels of digital maturity to adopt and benefit from the proposed approach.

A key principle of the methodology is the continuous interaction between technological capabilities and local needs. The design process starts from the identification of concrete tourism challenges and operational requirements, which are then translated into data models, monitoring tools, analytics services, and decision-support functionalities. This ensures that technology remains aligned with policy objectives and stakeholder expectations throughout the entire implementation lifecycle.



Regarding the **Stakeholder engagement**, the TOURISMO ecosystem involves a broad range of actors whose collaboration is essential for the successful implementation and long-term

sustainability of the proposed solutions:

- Public authorities play a central role in defining policy objectives, coordinating governance activities, facilitating access to public datasets, and supporting the adoption of evidence-based decision-making processes.
- Municipalities, regional administrations, tourism boards, and destination management organizations contribute to identifying local priorities and ensuring alignment with territorial development strategies.
- Technology providers, tourism operators, transport companies, accommodation providers, and cultural organizations, contribute operational knowledge, sector-specific expertise, and access to relevant datasets.
- Citizens and visitors contribute valuable perspectives regarding tourism impacts, quality of life, and destination sustainability, while visitors provide feedback, behavioural information, and insights into tourism experiences.
- Research organizations provide scientific and methodological support throughout the project lifecycle, by proving contribution for data analysis, indicator definition, impact assessment, development of analytical models, etc.

The methodological framework adopts a **co-creation approach** that actively involves stakeholders throughout all project phases. This process ensures that solutions are developed collaboratively and reflect the needs, expectations, and priorities of the various actors operating within the destination.

Stakeholder engagement activities typically include workshops, focus groups, interviews, consultation meetings, participatory design sessions, and validation exercises. These activities facilitate knowledge exchange among stakeholders and contribute to identifying challenges, defining use cases, prioritizing interventions, and evaluating proposed solutions.

Data-driven decision-making represents one of the fundamental pillars of the TOURISMO methodology. TOURISMO methodology promotes the transformation of fragmented and heterogeneous datasets into actionable knowledge that can support strategic planning, operational management, and policy development.

The adopted approach combines data collection, integration, processing, analysis, and visualization within a common digital environment. Information originating from tourism, mobility, environment, culture, and other relevant domains is harmonized and transformed into indicators, dashboards, and analytical services that support decision-makers.

The data-driven paradigm contributes to increasing transparency and accountability within

governance processes by providing objective evidence to support policy evaluation and strategic decisions.

The methodological framework incorporates the principles of **Smart Tourism** by combining digital technologies, data ecosystems, stakeholder participation, and sustainability objectives within a common operational framework.

The concept of Smart Tourism extends beyond the deployment of technological solutions and emphasizes the capacity of destinations to use information and innovation to improve governance, visitor experiences, resource efficiency, and community well-being. Within TOURISMO, Smart Tourism principles are implemented through the integration of real-time data, interoperability mechanisms, digital services, and advanced analytics. By integrating Smart Tourism concepts into governance practices, destinations can move towards more adaptive, resilient, and evidence-based management models capable of responding to evolving tourism challenges.

Monitoring and evaluation activities are integrated throughout the entire project lifecycle and represent a key component of the methodological framework. Their objective is to assess the effectiveness of implemented solutions, measure progress towards project objectives, and identify opportunities for continuous improvement.

The evaluation process combines quantitative and qualitative approaches. Quantitative assessment relies on the monitoring of Key Performance Indicators (KPIs) related to tourism flows, platform usage, stakeholder engagement, service performance, sustainability objectives, and operational efficiency. Qualitative evaluation complements numerical indicators through stakeholder feedback, user satisfaction assessments, interviews, workshops, and case study analyses.

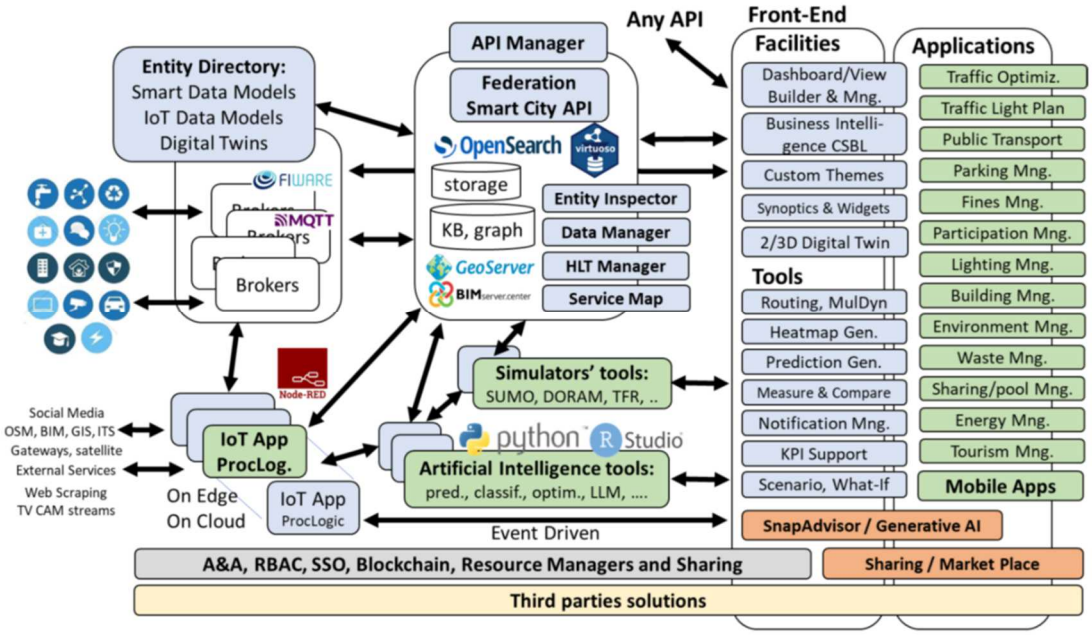
Monitoring activities are supported by dashboards and reporting tools that provide continuous visibility into system performance and tourism dynamics. Regular reviews of collected data allow project partners and local stakeholders to assess results, identify emerging challenges, and adjust implementation strategies when necessary.

The evaluation methodology also supports replication activities by documenting lessons learned, identifying success factors, and generating recommendations that can facilitate the adoption of the TOURISMO approach in new destinations. Through continuous monitoring and iterative improvement, the methodology ensures that the developed solutions remain effective, scalable, and aligned with local governance needs over time.

4. Solution Architecture

Replicating a pilot project based on the **Interreg TOURISMO model through Snap4City technology** relies on a simple principle: transforming a large amount of fragmented city data into clear, useful, and timely information to manage tourism sustainably.

Below is an overview explaining how the solution works, how data is managed, how the system communicates with the outside world, and how maximum security is guaranteed.



Even though the underlying technology is advanced, the logical structure of Snap4City can be visualized as a 5 main layers, where data moves from the bottom up to be transformed into value:

Layer 1 – Data Ingestion, transformation, aggregation and unification: This is the entrance gate of the system. This is where all the information sent by sensors on the ground or from external systems arrives. Processing Logics / IoT Apps could be in some sense used to implement either ETL/ELT scripts. In Snap4City, Processing Logic / IoT App are Node-RED plus Snap4City microservices or Python processes (to push data in Ni-Fi which is the gate to the storage, OpenSearch). Visual programming languages such as Node-RED, Ni-Fi are typically preferred for rapid implementation. These processes can be also allocated on cloud, fog, edge and on premise/field.

Layer 2 – Big Data Storage: At this level, all data is organized, "translated" into a common language, and cataloged. The system connects different pieces of information to give a logical

meaning to the urban context.

Layer 3 – Data Analytics / Artificial Intelligence (Analytics Layer): This is where algorithms analyze the archived data to calculate: predictions, early warning, traffic flow reconstruction, classifications, clustering, trajectories, anomaly detection, KPIs and indicators, Typical Time Trends, typical trajectories, routing and paths, multimodal routing, travel plans, query results, simulations, analysis, calibrated heatmaps, smart parking suggestions, car sharing analysis, what-if analysis, automated ingestion of satellite data, social media processing and sentiment analysis, etc.

Layer 4 – Smart City APIs (**SCAPI**) are the main entry point for accessing data from Big Data Storage (KB and Open Search). They include a large collection of services to: exploit queries and reasoning on the storage and Knowledge Base, access/control IoT Network, exploit Data Analytic results, etc. All the data and services are accessible via the Smart City APIs which are used by front-end tools such as Dashboards, Web and Mobile Apps, and MicroApplications.

Layer 5 – Visualization (Application Layer): This is the human interface. It consists of intuitive digital dashboards filled with colored maps, different charts, and indicators that are easy to read for non-technical users. **Dashboards** can be created by using the Dashboard Builder. The dashboards are used by different kinds of users such as: decision makers, city operators, ICT operators, private users, etc. They can be suitable for implementing

- Smart City Control Rooms with video wall, and Situation Rooms with touch panels
- operation and planning applications for city Operators on Desktop of multiple monitors,
- mobile apps for mobile operators.

5. Implementation Process

This section presents a preliminary methodology for the implementation of a new TOURISMO solution powered by **Snap4City**. The methodology is designed to support public authorities, Destination Management Organizations (DMOs), tourism stakeholders, and technology partners in adopting and replicating the TOURISMO approach in new territories. The replication process follows a sequence of interconnected steps that can be adapted to the specific characteristics, priorities, and maturity level of each destination.

The first step consists of assessing the local readiness of the destination. This phase aims to determine whether the necessary organizational, technical, and data-related conditions are in place to support the implementation of the solution. The assessment includes identifying the key stakeholders and governance structures involved in tourism management, understanding the main tourism challenges and priorities of the destination, evaluating the existing digital infrastructure, mapping available data sources, and analysing any regulatory or operational constraints that may affect deployment.

Once the local context has been assessed, the next step is to define the use cases and objectives that the pilot will address. This activity should be carried out in close collaboration with local stakeholders through workshops and consultation sessions. The objective is to identify the most relevant tourism challenges, prioritize intervention areas, define the expected outcomes and associated **Key Performance Indicators (KPIs)**, and select the use cases that will generate the greatest value for the destination. Typical examples include visitor flow monitoring, tourism demand forecasting, sustainable tourism management, mobility optimization, and enhanced visitor information services. Depending on the needs of the destination, these objectives may include real-time monitoring of visitor congestion, predictive analysis of tourism flows, environmental impact assessment, support for mobility management, or improved communication with tourists and tourism operators. The identified objectives will guide the selection of indicators, dashboards, analytical models, and functionalities to be implemented.

The subsequent phase concerns the instantiation of the platform and the preparation of the technical environment. This involves establishing the infrastructure required for deployment, whether cloud-based or on-premises, configuring networking and security settings, installing and configuring the **Snap4City** platform, defining user roles and access permissions, and establishing the data governance procedures that will regulate data access, ownership, and quality management throughout the project lifecycle.

Once the platform environment is operational, attention shifts to the integration of datasets and analytics services. At this stage, the identified data sources are connected to the platform through

appropriate ingestion pipelines, APIs, and connectors. Real-time data streams can be configured where available, while predictive analytics services and semantic data models are implemented to ensure interoperability and advanced analytical capabilities. Particular attention should be given to data harmonization and quality assurance processes to guarantee reliable and consistent information across different sources.

After data integration, dashboards and visualization interfaces can be designed according to the operational priorities identified during the earlier phases. Effective dashboard design should prioritize simplicity, clarity, and ease of interpretation. Maps and spatial visualizations are particularly valuable for representing tourism flows and visitor movements, while threshold-based alerts and KPI monitoring can support operational decision-making. The combination of real-time and historical data views enables both immediate situational awareness and longer-term trend analysis. Dashboards should also provide flexible filtering options based on time, location, or data categories, allowing users to explore information according to their specific needs.

The next step involves validating the usability and effectiveness of the deployed solution with stakeholders and pilot users. During this phase, dashboards, interfaces, and services are tested under real operational conditions to assess their ease of use, the relevance of the proposed indicators, system responsiveness, reliability of visualizations, and overall usefulness in supporting decision-making processes. Feedback collected from users should be systematically analysed and used to refine the platform, improve functionalities, and optimize the user experience through iterative development cycles.

The final step focuses on preparing the solution for long-term operational deployment and sustainability. Beyond the technical implementation, it is essential to define a governance framework that ensures the continuity of platform operations after the pilot phase. This includes assigning responsibilities for platform maintenance, establishing long-term data governance procedures, organizing user training activities, planning for future scalability, and addressing cybersecurity and privacy requirements. Consideration should also be given to hosting arrangements, operational costs, and potential funding mechanisms to support the continued operation and evolution of the platform. By addressing these aspects from the outset, destinations can ensure that the TOURISMO solution powered by **Snap4City** remains operational, scalable, and valuable over time, supporting data-driven tourism management and sustainable destination development beyond the initial pilot implementation.

6. Use Case Scenarios

The Snap4City platform, at is at the basis of TOURISMO, supports a wide range of tourism-related services that leverage real-time data, historical information, predictive analytics, and interactive dashboards. The implemented use cases can be grouped into three main domains: tourism flow monitoring and management, cultural heritage enhancement, and local experience personalization. These domains reflect the needs of destination managers, tourism operators, public authorities, residents, and visitors, while contributing to the broader objectives of sustainability, digital innovation, and data-driven governance.

6.1. Tourism Flow Monitoring and Management

The aim of this use case is to provide destination managers with real-time and predictive insights into visitor movements and tourism demand. By monitoring tourism flows, authorities can better manage visitor distribution, optimize resource allocation, improve mobility services, and reduce the negative impacts associated with overtourism.

The implementation relies on the integration of multiple data sources within the Snap4City platform, including tourism statistics, accommodation occupancy data, mobility and transport information, parking data, event calendars, environmental monitoring systems, and anonymized visitor flow data where available.

The platform processes these datasets through its knowledge base and analytics services to generate indicators and visualizations that support operational and strategic decision-making. Interactive dashboards display real-time visitor density, mobility patterns, attraction attendance, and demand forecasts. Predictive models can identify potential congestion areas and estimate visitor flows based on historical trends, weather conditions, and scheduled events.

The solution enables public authorities and destination managers to identify overcrowding situations before they occur, implement mitigation measures, and distribute visitors more evenly across the territory. It also supports evidence-based planning, improves coordination among tourism stakeholders, and contributes to more sustainable destination management. Ultimately, visitors benefit from improved accessibility, reduced congestion, and a higher-quality tourism experience.

6.2. Local Experience Enhancement

To provide personalized recommendations and tailored tourism experiences that enhance visitor

satisfaction while supporting local businesses and communities is a must in overcrowded touristic destinations.

The implementation of this use case combines tourism information, event data, mobility services, cultural assets, environmental conditions, and user preferences within the Snap4City ecosystem. Through analytics and recommendation mechanisms, the platform can generate personalized suggestions for attractions, activities, events, restaurants, cultural experiences, and mobility options.

Recommendations may adapt dynamically according to factors such as visitor location, weather conditions, crowd levels, opening hours, thematic interests, and available transportation options. The platform can also promote local products, community initiatives, and sustainable tourism alternatives that align with visitor preferences.

Visitors receive more relevant and engaging tourism experiences, increasing their satisfaction and likelihood of extending their stay or returning to the destination. At the same time, local businesses and smaller attractions benefit from increased visibility and visitor diversification. By encouraging the discovery of less-visited areas and experiences, the platform contributes to a more balanced and sustainable distribution of tourism benefits across the destination.

6.3. Tourist Sentiment Analysis and Destination Perception Monitoring

The objective of this use case is to monitor and analyze tourist sentiment in near real-time in order to understand visitors' perceptions, identify strengths and weaknesses of the destination, detect emerging issues, and support evidence-based tourism management strategies. The solution aims to provide destination managers with actionable insights that can improve visitor satisfaction, enhance destination reputation, and guide investments in tourism services and infrastructure.

The use case is implemented through the Snap4City platform by integrating multiple sources of user-generated content, including online reviews from tourism platforms, visitor feedback collected through surveys, etc.

Natural Language Processing (NLP) and Artificial Intelligence algorithms are employed to automatically process textual content and extract sentiment indicators. The analysis classifies opinions according to positive, neutral, or negative sentiment and identifies the main topics discussed by visitors, such as accommodation quality, cultural attractions, mobility services, cleanliness, safety, accessibility, hospitality, and environmental conditions.

Advanced analytics services can also detect emerging trends and generate alerts when significant changes in visitor perception occur. For example, a sudden increase in negative sentiment related to transportation services or overcrowding can be identified early, allowing operators and public

authorities to implement corrective actions.

The implementation of tourist sentiment analysis provides destination managers with a deeper understanding of visitor expectations and experiences. By continuously monitoring public perception, authorities can identify areas requiring improvement, assess the effectiveness of tourism policies, and measure the impact of interventions on visitor satisfaction

7. Lesson Learned

The implementation of the TOURISMO solutions across different pilot territories has generated valuable insights into the opportunities and challenges associated with the adoption of data-driven approaches for tourism management. Beyond the technological aspects, the project has demonstrated the importance of governance, stakeholder collaboration, data quality, and organizational readiness in ensuring the successful deployment and long-term sustainability of Smart Tourism solutions.

The lessons learned throughout the project provide useful guidance for destinations interested in replicating the TOURISMO approach and adopting similar solutions to support evidence-based tourism governance.

7.1 Key Success Factors

One of the most important success factors observed during the project was the establishment of a strong multi-stakeholder ecosystem from the early stages of implementation. Active collaboration among public authorities, tourism organizations, research institutions, technology providers, and local stakeholders facilitated the identification of relevant use cases, improved access to data sources, and supported the validation of project outcomes.

Another critical factor was the adoption of a clear problem-oriented approach. Rather than focusing on technology deployment alone, the pilots were designed around specific tourism management challenges and operational needs. This ensured that the developed solutions generated practical value and directly supported decision-making processes.

Pilot experience demonstrated that stakeholder engagement should continue throughout the entire replication process. Workshops, information days, surveys and continuous dialogue proved essential not only for validating technical solutions but also for increasing social acceptance, improving transparency and strengthening institutional cooperation.

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The availability and integration of reliable data sources also proved essential. Destinations that were able to combine tourism, mobility, environmental, and contextual datasets obtained a more comprehensive understanding of tourism dynamics and were better positioned to develop

effective monitoring and management strategies.

The use of interoperable and scalable technological architectures, such as the Snap4City platform, further contributed to project success by enabling the integration of heterogeneous datasets, facilitating system expansion, and supporting future replication activities.

Finally, continuous stakeholder involvement throughout the project lifecycle helped maintain alignment between technical developments and user needs. Iterative feedback loops and co-creation activities contributed to the usability, relevance, and acceptance of the developed solutions.

Pilot implementation showed that monitoring technologies alone do not improve destination management. Their effectiveness depends on the existence of governance mechanisms capable of interpreting the generated evidence and translating it into operational actions. Consequently, replication efforts should prioritise governance arrangements alongside technological deployment.

7.2 Challenges Encountered

Despite the positive results achieved, several challenges emerged during the implementation process.

The implementation of innovative digital solutions within public administrations may also be affected by the complexity of public procurement procedures. Regulatory requirements, administrative processes, and procurement timelines can sometimes be misaligned with the pace of technological innovation and pilot implementation activities. This may lead to delays in the acquisition of services, technologies, or equipment necessary for deployment, ultimately affecting project schedules and operational flexibility. The experience gained during the project highlights the importance of anticipating procurement needs, involving procurement offices from the early stages of planning, and adopting procurement strategies that facilitate innovation while ensuring compliance with applicable regulations.

One of the most common difficulties concerned data availability and accessibility. In many cases, relevant datasets were distributed across different organizations, managed under different governance frameworks, or affected by restrictions related to privacy, ownership, or licensing conditions. The process of identifying, accessing, and harmonizing data often required significant coordination efforts.

Data quality and interoperability also represented recurring challenges. Differences in data formats, update frequencies, metadata quality, and semantic structures frequently complicated integration activities and required additional efforts in data cleansing and harmonization.

Organizational challenges were equally significant. Tourism management involves multiple stakeholders with different objectives, responsibilities, and priorities. Establishing effective collaboration mechanisms and promoting data-sharing practices often required time, trust-building activities, and dedicated governance arrangements.

Another challenge concerned the varying levels of digital maturity across pilot territories. Some destinations already possessed advanced digital infrastructures and analytical capabilities, while others were at an earlier stage of digital transformation. This required flexible implementation approaches capable of adapting to different local contexts and capacities.

Finally, maintaining stakeholder engagement over the entire project duration proved challenging in some cases, particularly when stakeholders faced competing priorities or limited resources for active participation.

7.3 Risk Mitigation Strategies

Several mitigation strategies were identified and applied throughout the project to address the challenges encountered.

A key strategy involved adopting a phased implementation approach. By starting with a limited number of high-value use cases and progressively expanding the scope of the solution, project partners were able to reduce complexity, demonstrate early benefits, and build stakeholder confidence.

To mitigate risks associated with public procurement processes, it is important to address procurement requirements from the earliest stages of project planning. The project experience demonstrated that proactive procurement planning is not only an administrative necessity but also a key enabling factor for the successful and timely deployment of innovative Smart Tourism solutions.

The establishment of clear governance structures and responsibilities helped facilitate collaboration among organizations and supported more efficient decision-making processes. Defining data ownership, access policies, and operational responsibilities at an early stage proved particularly beneficial.

To address interoperability challenges, the project relied on standardized data models, APIs, and semantic technologies capable of integrating heterogeneous information sources within a common framework. This reduced integration complexity and improved long-term scalability. Capacity-building activities, including training sessions, workshops, and technical support, were also important mitigation measures. These activities helped increase stakeholder awareness, improve digital skills, and facilitate the adoption of new tools and methodologies.

Regular monitoring and validation activities further contributed to risk reduction by allowing issues to be identified and addressed early in the implementation process. Continuous feedback collection enabled iterative improvements and supported adaptive project management.

The following table summarize the lessons learned from Pilot Implementation:

Lesson learned	**Implication for replication**
Data alone are insufficient	Governance structures are required
Stakeholder engagement must be continuous	Not limited to project start
Data integration is more valuable than isolated monitoring	Combine multiple sources
Visitor redistribution must be carefully planned	Avoid transferring pressure
Transparency increases social acceptance	Explain monitoring technologies
Replication must be adapted locally	Avoid copying pilots identically
Start from governance, not technology	Define institutional roles before deploying the platform
Develop data-sharing agreements	Build integrated information ecosystems
Train stakeholders continuously	Increase operational use of dashboards
Introduce actions progressively	Short, medium and long-term implementation
Adapt solutions to local maturity	Avoid one-size-fits-all replication
Combine monitoring with operational protocols	Transform information into management actions
Start from governance, not technology	Define institutional roles before deploying the platform

8. Business Opportunities and Value Creation

The implementation of the TOURISMO solution, based on the open-source Snap4City platform, transforms sustainable tourism into a dynamic driver of local economic growth by converting fragmented urban data into harmonized and actionable information, enabling destinations to unlock hidden economic potential, stimulate private sector innovation, and build resilient, data-driven ecosystems.

The integration of real-time crowd tracking, environmental metrics, and predictive AI analytics creates a fertile ground for a new generation of smart tourism services. These possibilities, if properly exploited, allow to offer better services for the visitor experience.

- **Dynamic Flow-Management & Crowding Services:** Real-time visibility into hotspot density allows for the creation of smart routing applications. These applications provide tourists with live "comfort indices" for beaches, museums, and historical squares, offering alternative itineraries when thresholds are reached.
- **Proactive Micro-Mobility and Last-Mile Transport Solutions:** By analyzing live congestion and parking data, public and private transport operators can deploy on-demand shuttle services, smart parking reservations, or micro-mobility fleets (e.g., e-bikes) optimized around fluctuating tourist volumes.
- **Predictive Local Event & Experience Scheduling:** Cultural institutions, tour operators, and event planners can utilize 24-to-48-hour crowd forecasts to optimize their opening hours optimize services, adjust ticketing prices dynamically, and schedule smaller-scale decentralized experiences during off-peak times.
- **Real-Time Sentiment & Reputation Management:** Using automated Natural Language Processing (NLP) tools, destination management organizations (DMOs) can instantly detect localized shifts in tourist satisfaction, allowing local businesses to adapt their hospitality services dynamically.

The open, interoperable, and API-driven architecture of the Snap4City platform enables multiple commercial and operational frameworks, ensuring that the system can generate sustainable value beyond the initial public investment and opening Data-Driven Business Models.

- **The "Freemium" Smart City API Model:** commercial entities (e.g., major hotel chains, ride-hailing applications, cruise lines) can pay a subscription fee to exploit service and data analytics results/predictive models directly into their corporate planning software.
- **Data Sharing and B2B Data Co-ops:** A collaborative model where different stakeholders

pool their data into the Snap4City Knowledge Base. In return, participants gain access to advanced multi-domain analytics and services, allowing them to benchmark their performance against city-wide tourism trends.

- **Targeted, Context-Aware Hyper-Local Promotion:** Private operators can sponsor alternative, lesser-known tourist routes generated by the system. When prime hotspots face overcrowding, the platform can push real-time geo-targeted vouchers or promotional discovery packages for peripheral businesses, creating a win-win model for crowd dispersion and local commerce.

By removing technical barriers and opening aggregated data silos, the TOURISMO framework can act as a local business incubator.

Investing in the TOURISMO approach produces measurable positive economic externalities that extend far beyond simple financial returns, balancing tourist satisfaction with community well-being.

Direct Macroeconomic Impacts:

- **Resource and Infrastructure Optimization:** Predictive analytics allow municipalities to deploy public services—such as waste collection, police presence, and public transit frequency—only when and where they are genuinely needed. This drastically reduces operational waste and optimizes municipal expenditures.
- **Geographic and Temporal Diversification of Tourism Revenue:** By actively nudging visitors toward peripheral areas and promoting off-peak activities, the solution spreads tourism expenditures evenly across the territory. This extends the tourism season and revitalizes economic activities in lesser-known neighbourhoods or rural communities.
- **Mitigation of Economic Losses from Overtourism:** Extreme overcrowding damages local infrastructure, degrades cultural assets, harms destination reputation, and alienates residents. Early warnings and active mitigation safeguard the long-term asset value of the destination's cultural and natural heritage.

Evidenced-Based Public and Private Investments: Objective data replaces guesswork. Local authorities can plan and optimize new services like: bike lanes, pedestrian zones, or transit lines using precise historical Origin-Destination Matrices, ensuring that every public euro spent delivers maximum socio-economic utility.

The business opportunities described in this chapter derive from the operational evidence generated during the pilot implementations, where data-driven services demonstrated their potential to improve tourism management, heritage conservation, visitor experience and stakeholder cooperation.

9. Replication Roadmap

In this section, proposed phases, timeline, KPIs, and resources for replication are described. The replication methodology does not propose a new approach, but operationalises the methodology previously developed within the TOURISMO project. The proposed sequence reflects the methodological framework introduced in **Output 1.1** and incorporates the practical lessons emerging from the pilot implementations and their impact assessment **(D2.4.2).**

Phase 1: Analysis (months 1 – 2). The first Phase is a key preparatory step for the transfer and localisation of the TOURISMO approach. The interested new partner need to carry out a structured territorial and governance assessment, (eventually with guidance from the original TOURISMO partners), to identify local tourism challenges, institutional conditions and adaptation priorities for the uptake of the TOURISMO approach.

The activity aim to analyse the tourism dynamics, spatial characteristics and strategic relevance of the selected pilot area(s), together with existing tourism management practices, policy frameworks and digital capacities. Particular attention will be given to tourism flow challenges, including visitor concentration, seasonal pressure, mobility patterns and impacts on local infrastructure and communities. In parallel, it is needed to assess data availability and governance conditions, including existing data sources, management practices, interoperability issues and potential legal or institutional barriers affecting data-driven tourism management.

Phase 2 - Stakeholder Mobilisation and Transfer Environment Activation (months 2 – 4). This phase focuses on the identification, mobilisation, and engagement of key stakeholders in the receiving territory to support the effective transfer and uptake of the TOURISMO Solution. Receiver partner(s) will carry out a structured stakeholder mapping process based on the core target groups of the project: Public Authorities and DMOs, solution and technology providers, and tourism SMEs.

Phase 3 - Adaptation and Transfer of the TOURISMO Solution (months 4 -7). This phase focuses on adapting and transferring the TOURISMO Solution to the receiving territories, ensuring that its methodologies, tools and governance approaches can be effectively applied according to local tourism challenges, data availability and institutional capacities.

The activity will build on the experience of the original TOURISMO pilots and the Snap4City ecosystem, supporting the adaptation of smart tourism management solutions to the receiving territories. The transfer process will assess how technological components and operational approaches can address local tourism challenges, governance structures and data ecosystems, with particular focus on tourism flow monitoring and data-driven destination management.

The activity will assess technologies such as digital twin modeling including contextual descriptions, visitor counting systems, thermal cameras, Wi-Fi/Bluetooth tracking, drones, environmental sensors, mobility and transport data, statistic data, users' participation/engagement data, admin data, towards the integrated data platforms, dashboards and AI-based analysis tools, evaluating their operational feasibility, interoperability and contribution to tourism flow monitoring and management in each territory.

Phase 4: Analytics, Artificial Intelligence & Dashboarding (Months 7–9). Process the ingested data to generate high-value insights and visualize them via interactive, role-based dashboards. Configure Snap4City predictive machine learning models (e.g., forecasting beach/square crowding or traffic in advance). Design TOURISMO-style dashboards displaying geospatial maps, time-series metrics, and combined indices.

Phase 5: Validation, Decision Support & Rollout (Months 10–12). Test the integrated system under real-world conditions, train municipal and technical personnel, and implement automated governance rules. Set up automatic thresholds and alerts (e.g., over-crowding alerts). Validate AI predictive accuracy and activate What-If analysis modules within the Decision Support System (DSS) for local authorities.

Phase 6 - Investment Planning and Sustainability Frameworks. Supports the transition of the TOURISMO Solution from pilot adaptation to future deployment by strengthening investment readiness and defining sustainable implementation frameworks in the receiving territories. It will deliver three deployment-ready investment and implementation plans, tailored to the specific conditions, capacities and priorities of each territory

Executing this roadmap efficiently requires a balanced allocation of human, technological, and data resources:

- Project Manager / Tourism Domain Expert: Coordinates institutional stakeholders and aligns technical deliverables with strategic policy goals.
- Data Engineers / IoT Experts: Manages Business Logic workflows, custom API integrations, and sensor deployments (Pax counters, cameras).
- Data Scientists (AI Experts): Tailors machine learning predictive algorithms and performs advanced Origin-Destination matrix modeling.
- UI/UX Dashboard Designers: Builds human-centric, highly legible dashboards adapted to decision-makers and citizens.
- Snap4City Environment: Cloud-hosted or on-premises (Kubernetes-based) deployment of the open-source Snap4City platform.

- Monitoring Hardware: Physical tracking infrastructure including Wi-Fi/Bluetooth sniffers, AI-edge cameras, and environmental sensors.
- Third-Party Data Assets: Data Streams: Procurement or licensing of critical auxiliary data, such as telecom mobile network insights, open weather services, and public transit schedules (GTFS).

To evaluate the technical effectiveness and regional impact of the replicated TOURISMO pilot, performance is measured against distinct indicator sets, like for example:

- **Technical Implementation** - Data Ingestion Success Rate: Percentage of data packets accurately received and parsed from IoT devices into the platform. (Target ≥ 90.0%)
- **Technical Implementation** - Dashboard Availability: System uptime for administrative and public-facing monitoring applications. (Target ≥ 98%)
- **Technical Implementation - Prediction Accuracy (AI Engines)**: Mean Absolute Percentage Error (MAPE) for 24/48-hour crowd and mobility forecasts. (Target MAPE ≤ 15%)
- **Impact & Sustainability - Crowd Mitigation Effectiveness**: Number of real-time corrective actions (e.g., dynamic re-routing, smart promotions) triggered by automated platform alerts. (Tracked monthly)
- **Impact & Sustainability Stakeholder Engagement**: Active volume of local entities, transit authorities, or businesses consuming the Snap4City DSS insights for operations. (Target: ≥ 5 Entities)
- **Impact & Sustainability User Satisfaction Index**: Qualitative satisfaction score from destination managers regarding platform usability and strategic utility. (Target: ≥ 80% score).

10. Tools and supporting Resources

List tools, templates, APIs, and training materials.

- **Snap4City Training Course**: https://www.snap4city.org/944
- **Snap4City Control and Plan: an Horizontal AI Platform Digital Twin for All Domains**: https://www.snap4city.org/1039
- **Snap4City: City Users' Services, Tourism Management, and Safety, Digital TwinsSnap4City**: https://www.snap4city.org/1043
- **Mobility and Transport, Operation and Plan Digital Twin**: https://www.snap4city.org/1040
- **Snap4City Smart Energy and Buildings Operation and Plan Digital Twin**:

  https://www.snap4city.org/1041
- **Snap4City Environment and Waste Management Digital Twins**:

  https://www.snap4city.org/1042
- **Snap4City 2025 Digital Twin services and tools offering catalogue**:

  https://www.snap4city.org/997
- **TECHNICAL OVERVIEW**:

  https://www.snap4city.org/download/video/Snap4City-PlatformOverview.pdf
- **Development Life Cycle**:

  https://www.snap4city.org/download/video/Snap4Tech-Development-Life-Cycle.pdf
- **MLOps for AI and DA development**:

  https://www.snap4city.org/download/video/Snap4City-MLOps-Manual.pdf
- **Client-Side Business Logic Widget Manual**:

  https://www.snap4city.org/download/video/ClientSideBusinessLogic-WidgetManual.pd f
- **Booklet Data Analytics, Snap4Solutions**:

  https://www.snap4city.org/download/video/DPL_SNAP4SOLU.pdf

- **TOURISMO official webpage**: https://tourismo.interreg-euro-med.eu/
- **TOURISMO: TOURism Innovative and Sustainable Management of flOws** (on Snap4City): https://www.snap4city.org/1001

11. Conclusions and Future Perspectives

The **TOURISMO project** has demonstrated how data-driven approaches, advanced digital platforms, and multi-stakeholder collaboration can significantly improve the management of tourism flows while supporting sustainability objectives across Mediterranean destinations. By combining real-time data integration, analytics, artificial intelligence, and intuitive decision-support tools within the Snap4City ecosystem, the project has provided a practical framework for addressing complex tourism challenges such as overcrowding, mobility management, visitor experience enhancement, and evidence-based policy making.

A key achievement of the project is the development of a replicable and scalable methodology that can be adapted to destinations with different territorial characteristics, governance structures, and levels of digital maturity. The experiences gained throughout the pilot implementations have confirmed that technological innovation alone is not sufficient to achieve sustainable tourism management. Success depends equally on effective governance mechanisms, stakeholder engagement, data availability, interoperability, and the capacity to translate information into actionable knowledge.

Looking ahead, future developments may further enhance the TOURISMO framework through the integration in the Snap4City technological framework of additional data sources, more advanced Artificial Intelligence models, and the expansion of Digital Twin capabilities. The flexibility and scalability offered by the Snap4City platform can support emerging technologies such as generative AI, edge computing, advanced behavioural analytics, and automated decision-support systems with the aim to provide even more accurate forecasting, personalized services, and adaptive management strategies. At the same time, increasing attention should be dedicated to data governance, privacy protection, cybersecurity, and ethical use of AI to ensure trust and long-term sustainability.

The replication of the TOURISMO approach across new Mediterranean and European territories offers a valuable opportunity to create a wider network of smart tourism destinations capable of sharing knowledge, methodologies, and best practices. By fostering cooperation among public authorities, research institutions, technology providers, tourism operators, and local communities, the TOURISMO framework can contribute to building more resilient, inclusive, and sustainable tourism ecosystems that generate long-term benefits for visitors, residents, and local economies alike.

The replication framework presented in this handbook should therefore be interpreted as the culmination of the methodological and operational work carried out throughout the TOURISMO project.

Output 1.1 established the conceptual and technical foundations for sustainable tourism flow management, while Deliverable D2.4.2 demonstrated the practical applicability of this framework through the implementation and assessment of pilot actions across diverse Mediterranean destinations. Building upon these results, this handbook provides a structured methodology that enables other destinations to adapt and replicate the TOURISMO approach according to their own governance structures, territorial characteristics and data ecosystems.

Replication should not be understood as reproducing identical technological solutions, but as adopting the underlying principles of integrated data management, stakeholder collaboration, evidence-based governance and adaptive destination management that emerged from the TOURISMO pilots.

Annexes

List of Abbreviations

- **AI** – Artificial Intelligence
- **API** – Application Programming Interface
- **B2B** – Business-to-Business
- **DMO** – Destination Management Organization
- **DSS** – Decision Support System
- **ELT** – Extract, Load, Transform
- **ETL** – Extract, Transform, Load
- **GTFS** – General Transit Feed Specification
- **ICT** – Information and Communications Technology
- **IoT** – Internet of Things
- **KB** – Knowledge Base
- **KPI** – Key Performance Indicator
- **MAPE** – Mean Absolute Percentage Error
- **MED** – Mediterranean territories
- **MLOps** – Machine Learning Operations
- **NLP** – Natural Language Processing
- **SCAPI** – Smart City API
- **SME** – Small and Medium-sized Enterprise
- **UI/UX** – User Interface / User Experience
- **UNIFI** – Università degli Studi di Firenze
- **WP** – Work Package

Glossary

- **Artificial Intelligence (AI) Engines:** Advanced algorithmic models integrated into the analytics layer to process historical and real-time data. Within the TOURISMO framework, these engines are utilized for predictive analytics, such as forecasting visitor congestion, traffic flow reconstruction, and trajectory clustering.
- **Big, Open, and Smart Data:** The combination of large-scale datasets, publicly accessible data, and high-quality, structured information generated by digital environments and IoT infrastructures, which serve as the foundation for evidence-based decision-making.
- **Co-creation Approach:** A participatory methodological design that actively engages a wide network of multi-sectoral stakeholders—such as public authorities, private businesses, research entities, and citizens—in collaborative workshops and focus groups to define project use cases and validate solutions.
- **Data Ingestion Pipeline:** The initial technical layer (Layer 1) responsible for entering, transforming, aggregating, and unifying heterogeneous datasets coming from field sensors, external systems, or IoT networks into a standardized digital language.
- **Decision Support System (DSS):** An integrated platform configuration that provides public administrations and destination managers with automated insights, threshold-based alerts, and "What-If" analysis modules to test and implement proactive tourism management policies.
- **Destination Management Organization (DMO):** A specialized entity or collaborative network responsible for the strategic planning, marketing, and holistic management of tourism dynamics within a specific geographic territory.

- **Digital Twin:** A virtual, semantic, and interactive representation of a physical destination or urban environment that mirrors real-time operational context, contextual assets, and data dynamics to support simulated planning and management.
- **Interoperability:** The capability of distinct digital platforms, data formats, and software architectures to communicate, exchange data packets smoothly, and interpret shared information via standardized APIs and uniform data models.
- **IoT App / Processing Logic:** Visual programming or scripting workflows (such as Node-RED, Apache Ni-Fi, or Python processes) used within the platform architecture to rapidly implement ETL/ELT rules, route data packages, and control IoT networks.
- **Key Performance Indicators (KPIs):** Quantifiable metrics utilized during the monitoring and evaluation phase to assess platform performance (e.g., data ingestion success rates) and broader socio-environmental destination impacts.
- **Natural Language Processing (NLP):** A subset of Artificial Intelligence specialized in processing, parsing, and classifying textual, user-generated content from online reviews and digital surveys to monitor tourist sentiment and destination perception in near real-time.
- **Overtourism:** A condition characterized by excessive concentration of tourist flows in specific hotspots, causing severe localized spatial pressure, degradation of cultural assets, infrastructural strain, and lower quality of life for local residents.
- **Pilot Area:** A designated territorial site or destination selected to test, deploy, and validate the technical tools and governance methodologies of the project before scaling or wider regional replication.
- **Smart City API (SCAPI):** The primary software interface (Layer 4) enabling secure queries, automated data retrieval, and full exploitation of analytics results from big data storage by front-end applications, dashboards, or external third-party services.
- **Snap4City Platform:** An open-source, horizontal, and multi-domain AI platform utilized as the underlying technical architecture of the TOURISMO solution to capture, store, analyze, and visualize urban and tourism-related datasets.
- **Stakeholder Ecosystem:** The complete web of local actors concerned with or impacted by destination policies, categorized into public authorities, solution/technology providers, tourism operators/SMEs, and citizens/visitors.
- **Sustainable Tourism:** A forward-thinking tourism model designed to optimize data management and resource allocation, aiming to satisfy visitor needs while simultaneously safeguarding environmental heritage, minimizing negative local footprints, and boosting long-term economic resilience.

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