Gaia-X Tourism Ecosystem

White Paper: Data Governance for Tourism Governance

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Table with acronyms

Abbreviation	Explanation
AI	Artificial Intelligence
AR	Augmented reality
BDVA	Big Data Value Association
CMS	Content Management Systems
CSO	Chief Sustainability Officer
DGA	Data Governance Act
DMO	Destination Management Organisation
DSSC	Data Spaces Support Centre
EDIC	European Digital Infrastructure Consortium
ETDS	European Tourism Data Space
EU	European Union
GDPR	General Data Protection Regulation
GXDCH	Gaia-X Digital Clearing houses
IDS	International Data Spaces
IoT	Internet of Things
JRC	Joint Research Centre
NAP	National Access points
SME	Small and Medium size enterprise
VR	Virtual Reality

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1. Introduction

Gaia-X Ecosystems are a gateway to learning about Gaia-X and to communities of businesses and organisations aiming to develop data-driven solutions and interoperable data spaces.

Our Ecosystems bring together diverse stakeholders—ranging from businesses, industries, and researchers to public sector entities—into communities tailored to specific sectors, such as Health or Agriculture, as well as horizonal domains, such as Location and Smart Cities.

Gaia-X Ecosystems go beyond networking—they support knowledge exchange on cutting-edge projects, share funding opportunities and form consortia, and collect cross-country use cases. By bringing together Gaia-X members and non-members, the Ecosystems promote open dialogue on common standards, best practices, and technical deliverables that address the trusted data sharing needs of each sector.

Ecosystems are independently organised by a (co-)lead supported by the Gaia-X Association. Their activities include regular online meetings, producing white papers, and organising webinars. Read more about the goals and activities of each Ecosystem below.

Ecosystems are open for participation to members and non-members of Gaia-X. Member organisations of Gaia-X can find dedicated Ecosystem spaces on the Gaia-X Members Platform.
Are you working on a data space initiative and looking to connect with European stakeholders?
Or simply looking to learn more about Gaia-X?
Then contact Gaia-X Community Manager, Victor de Vries to get onboarded to the Ecosystems.

In today's rapidly evolving world, the European tourism industry stands at a crossroads. With information being pivotal in driving decisions and strategies, based on the access of (high quality) data, the necessity for a robust data governance framework has reached an inflection point. As travel dynamics and consumer behaviours change swiftly, the tourism sector must adapt its governance to benefit everyone involved—from local businesses to international companies, including the public sector.

This white paper explores how effective data management can strengthen tourism across Europe. Starting from the vision offered by the European Data Strategy and drawing insights from the Gaia-X initiative, it explores concepts of digital sovereignty and decentralization in the context of the European tourism data spaces.

In the context of this document, Data Spaces concepts are aligned with the definitions of the Data Spaces Support Centre (DSSC)

1.1. The Importance of Data in Tourism Governance

Data is a vital asset for managing tourism effectively at all levels. It provides insights into travel patterns, preferences, and economic impacts, helping various groups of actors to make smarter decisions.

By leveraging data, tourism actors can predict trends, improve marketing strategies, allocate resources more efficiently, and innovate within the sector. Real-time data analytics also offer a comprehensive view of visitor experiences, enhancing the quality and competitiveness of European tourism. Tourism data spaces break the barrier of data silos. With most tourism organisations being small to medium enterprises, data-based decisions should no longer be dependent on the volume of data collected and controlled by one organisation but rather focus on how to enable such data spaces to emerge.

1.2. Definition and key components

Data governance refers to the systems and processes that ensure data is, among others, high-quality, accessible, and secure. For the tourism industry, key components of effective data governance include rigorous data quality standards, comprehensive data management protocols, adherence to privacy regulations, metadata documentation, and active stakeholder participation. A solid data governance framework builds trust and collaboration, aligning with Gaia-X's focus on joint data and infrastructure governance to enable transparency and control over data.

1.2.1. Objectives it serves

The objectives of data governance in tourism are diverse. These encompass improved data-driven decision-making processes, fostering innovation, enhancing customer experiences, ensuring compliance with evolving regulations, and advocating for accountability and transparency among stakeholders. These objectives resonate with the growing demand for sustainable tourism practices, balancing economic, social, and environmental considerations. Through effective data governance, tourism actors can work together to tackle challenges and achieve sustainability goals.

1.2.2. Challenges

Despite the critical importance of data governance, numerous challenges persist within the tourism sector. Fragmented data landscapes, legal requirements, lack of interoperability, uneven standards of data quality, privacy and cybersecurity concerns, and a lack of cohesive data policies hinder optimal data utilization. Furthermore, the rapid advancement of technology often poses challenges to the established governance frameworks, leading to potential vulnerabilities in data protection. The Gaia-X initiative proposes a Trust Framework for overcoming these challenges. This governance model promotes collaboration over data resources while maintaining a material ability to manage their dependence on third parties by providing transparency over the operational resources supporting the data usage.

1.2.3. Role of data in solving these challenges and governing tourism

Effective data governance is crucial for addressing structural challenges endemic to tourism. The generation of clear rules, data catalogues and collaborative platforms enhance data coherence and accessibility, providing stakeholders with unified insights and knowledge. The application of advanced analytics and artificial intelligence can serve to synthesize disparate data points, enabling stakeholders to glean actionable insights for evidence-based policymaking. Prominently, initiatives like Gaia-X underscore the potential of a shared European data infrastructure to facilitate data interoperability and foster collaborative synergies among tourism entities, ultimately enhancing governance capabilities.

1.3. The connection between data governance and sustainable tourism governance goals

Data governance is intrinsically connected to long-term sustainability objectives within the tourism sector. By establishing responsible data practices that uphold sustainability tenets, stakeholders can ensure that tourism development and operations are aligned with broader environmental and social objectives. Furthermore, effective data governance enhances the capacity to monitor and evaluate the ecological and socio-economic impacts of tourism initiatives, paving the way for informed decisions that promote resilience and equity. Gaia-X's focus on sustainable collaboration provides a pertinent framework, enabling stakeholders to collectively achieve their sustainability aspirations through data-driven governance strategies.

1.4. Inspiration from Gaia-X: Digital Sovereignty and Decentralisation for European Tourism

The Gaia-X initiative offers a transformative paradigm for data governance in European tourism, centred on anchoring data exchange contracts on the supporting infrastructure, enabling the principles of digital sovereignty and decentralisation. By providing a framework for an open, trustworthy, and interoperable European data infrastructure, Gaia-X enables tourism entities to harness data collaboratively while preserving autonomy and agency. This initiative creates opportunities for tourism stakeholders to engage in a more coordinated manner, enhancing competitiveness and innovation while safeguarding Europe's rich cultural and environmental heritage. By providing a clear pathway toward shared governance of data, Gaia-X represents a significant step towards a cohesive and sustainable European tourism data space.

2. Data Governance for Tourism Governance. Guiding principles of data governance: openness, transparency and sovereignty.

Data governance is a fundamental pillar for effective tourism management, integrating sustainability, equity, and resilience into sectoral strategies. The adoption of principles such as openness, transparency, and sovereignty—clearly defined for each actor within the ecosystem—is not merely a technical recommendation but an indispensable condition for building a cohesive and competitive tourism ecosystem.

Effective data governance requires a regulated and ethical framework that ensures equitable and sustainable use of information while addressing the specific challenges of the tourism sector. In this context, the destination is the primary tourism product, functioning as a "virtual enterprise" where producers, operators, public administrations, civil society, and complementary service providers are interconnected, either voluntarily or by necessity.

The fragmented and diverse nature of the sector, encompassing micro family businesses to large transnational corporations, complicates the implementation of uniform frameworks for data governance due to the differing priorities and capabilities of its actors. Additionally, the lack of interoperability among the systems and tools used exacerbates these challenges.

The absence of common technical and semantic standards, along with harmonized regulations, hinders the smooth exchange of information and limits data comparability at regional, national, and international levels. This restricts the development of joint strategies, despite advances made in Europe with regulations such as the Data Governance Act and the Data Act.

Resistance to data sharing, driven by concerns about privacy, intellectual property, and the fact that tourism has traditionally been one of the most regulated sectors, remains a significant obstacle. Many stakeholders perceive data sharing as a threat, particularly in highly competitive markets. Establishing robust legal frameworks to protect intellectual property and shared usage rights continues to be a critical challenge.

The concentration of data in the hands of large global technological platforms poses risks to the sovereignty and equity of the tourism ecosystem. This is compounded by growing concerns about cybersecurity and regulatory compliance, particularly in the protection of personal data.

Finally, while technology offers equal opportunities for businesses, associated costs—which many cannot afford—and the lack of capabilities in emerging, rural, or small destinations represent serious limitations to implementing robust data governance

systems. This creates an unbalanced ecosystem that benefits larger players disproportionately.

2.1. Openness

It is worth noting that, in Europe, the tourism sector comprises approximately 3.2 million businesses, mostly SMEs, according to the European Parliament. While the exact percentage is unknown, these SMEs are responsible for two out of every three jobs in the European tourism sector.

In a sector dominated by SMEs, ensuring equitable access to public and private data under regulated frameworks is imperative. This fosters the creation of shared data platforms that enable destinations, operators, and authorities to analyze tourism patterns in an integrated manner. Openness is key to levelling opportunities, promoting collaboration, stimulating innovation, and encouraging stakeholders to participate in decision-making and the design of competitive strategies.

2.2. Transparency

Transparency ensures clear processes in data collection, storage, and usage, reinforcing trust among stakeholders and guaranteeing traceability of information. This is crucial in a sector where strategic decisions directly impact local communities and natural resources, making it an ethical imperative. It also enhances the regulatory capacity of authorities by enabling effective oversight of the tourism ecosystem.

Obstacles such as the lack of common standards and the opacity in agreements between large tech platforms and public administrations hinder the implementation of this principle. Technologies like blockchain-based smart contracts and standards like International Data Spaces (IDS) emerge as solutions to address these challenges.

Certification of components and operational environments according to the International Data Spaces (IDS) model offers an integrated solution to address issues of fragmentation, mistrust, and lack of interoperability in the tourism sector. This certification does not apply to data itself but ensures that the systems involved in data exchange—such as connectors, brokers, or operational environments—comply with the technical and security standards defined by the IDS protocol. The advancement of this model will depend on capacity building among stakeholders, public and private funding, and the consolidation of complementary global standards that reinforce its principles of sovereignty, interoperability, and trust.

This technological framework enables organizations to share and use data in a reliable, transparent, and controlled manner while respecting privacy and security regulations. While IDS provides a conceptual model to ensure data sovereignty, data security, and ethical usage, the actual operationalization of interoperability—both technical and semantic—is increasingly achieved through SIMPL (Smart Middleware for Interoperability

in Data Spaces). SIMPL incorporates and extends the foundational components developed by IDSA, Gaia-X, and Eclipse, offering a modular infrastructure that supports harmonized data exchange across heterogeneous systems typical of the fragmented tourism sector.

This governance ecosystem not only empowers SMEs but also sets a level playing field for all participants, including large digital platforms. The objective is not to exclude Big Tech, but to ensure that their involvement aligns with European values of digital sovereignty, trust, and openness. By reinforcing these principles through technical certification and regulatory compliance, frameworks like SIMPL offer a collaborative path forward– inviting all stakeholders to participate, while keeping their competitiveness.

Within the Data Spaces Business Alliance work, initiatives like IDSA and Gaia-X are integrating their results, in order to build a coherent view of Data Spaces, that is being analysed by DEPLOYTOUR, the deployment of the European Tourism Data Space. Several European tourism destinations are testing its use for sharing data among administrations, DMOs, and private operators with positive results. However, its global adoption outside Europe is still distant, delaying its consolidation as a pillar of data governance in tourism.

2.3. Sovereignty

Sovereignty allows businesses and destinations to maintain control over their data, defining the conditions for access and use. This principle is particularly relevant in a sector characterized by a diverse array of actors and systems, as it counters data concentration in large global platforms and strengthens collaboration within the ecosystem.

Nevertheless, sovereignty faces technical and regulatory challenges related to the interoperability of diverse systems and the need for frameworks that recognize local particularities without sacrificing global integration. Initiatives like Gaia-X aim to address these challenges by promoting decentralized infrastructures that respect local legislation.

3. Specific challenges associated with data governance in tourism

3.1. Data Fragmentation (related to market)

The tourism sector is considered to be ‘fragmented’ under several aspects. Consequently, a European Data Space must aim to dampen the separating forces and instead build bridges between the distinct ‘fragments’.

The first challenge is the diversity of businesses engaged in tourism. Obviously, there are establishments which take care of mobility, hospitality, gastronomy, entertainment, public administration, medical support, and others, respectively. They all might have different interests and expectations towards a future data ecosystem with respect to data needed and data they can offer. However, at least seen from a tourist’s viewpoint and also from

the viewpoint of public administrations on all levels, they belong closer together as they might believe. Besides the technology that makes the physical connection, a community has to be established that encompasses all subgroups, facilitating mutual understanding and helping their services become more and more integrated, together with the data products that facilitate such integration.

Another obvious aspect of diversity and fragmentation concerns the range of economic sizes of the players in tourism. The vast majority of enterprises consists of SMEs and even micro enterprises like restaurants, souvenir shops, family-run guesthouses, and so on. At the other end of the range are “big players” like international hotel chains, airlines, but also public data providers like Statistic Offices or National Access Points (NAPs) of traffic data. Each SME will contribute only small, elementary amounts of data to the data space and acquire limited data, which might cause an underestimate of their value for the ecosystem. In fact, the totality of SME data will provide a sound overview of the situation in tourism in a region, a country or across Europe than the data of individual, even large companies can provide.

The great number of small and smallest entities leaves the question open if the putative small data traffic associated with them, justifies that each gets its own connector, causing costs and effort. It seems to be favourable to use the data channels which are in many cases well established between local SMEs and their DMOs to bundle data traffic from and to elementary entities.

On the other hand, the big players might try to use the data space to increase their market power, or to dominate standardisation processes. At least they will have the resources to implement the use case of their interest. It will be a challenge for all responsible roles of a data space, to find an equilibrium between such different needs and opportunities, meaning to foster compliance with competition law without impairing competition. Given that each data space governance authority should take a neutral position between its members, it will be beyond the capabilities of data spaces to regulate the competition between different player groups, but it is clearly in scope of the tourism community to raise the awareness for such risks, and encourage players which might find themselves in "weak" positions to defend themselves with appropriate means. The major responsible parties for fostering the equilibration are those who design the use cases. Use cases, essentially addressing the data needs of SMEs. should be actively identified and implemented, probably under strong control of DMOs, EU member states, and the European Commission.

Moreover, the subdivision of Europe in its Member States, which obviously (and somehow legitimately) focus on their own interests in tourism, presents a certain risk to achieving a unified ETDS and the ongoing progress of a genuinely integrated single data market within the European Union. Therefore, it is crucial for the realisation of a truly European TDS, that the member states coordinate their data space initiatives to leverage the benefits of synergies, to contribute to establishing common data and metadata standards, and especially to initiate and fund cross-country projects. The existence of an "interministerial

committee" of several national tourism ministries is already a strong fundament for their sound contribution. It might be a task of the DEPLOYTOUR project, to propose organisational forms and policies to tightly integrate the member state authorities to the emerging tourism data ecosystem.

The desired coexistence of public and private organisations in the European data spaces is often associated with a suspected conflict of interest between the two groups. There seems to be a reservation that freely accessible data products (open data) cannot be offered and exchanged alongside commercial products without further ado. However, there is no real discrepancy between sharing open and proprietary data in the data space, since the principle of data sovereignty allows each data provider to define the conditions of access to its data products in detail, including, of course, any payments to be made. Such determination cannot be overridden by any other player in a data space, in both directions. In the data space infrastructure, it must be ensured that both a price and free access are permissible options in the access conditions for a data product, the connectors, which are compliant with the IDS protocol, allow already for that. Data consumers are free to collect open and proprietary data according to their respective access conditions.

Public-private conflicts of interest, however, might occur in the case of joint use case projects. Whereas public bodies nowadays tend to operate in a transparent manner, in the sense of “open government”, private companies will have the tendency to keep their businesses confidential, to protect it against insight by their competitors. Therefore, a careful contractual basis must be created between the different types for public-private use cases, which defines the respective rights and obligations with regard to publicity and which also sets rules for the monetisation of individual data contributions.

A more serious aspect of public-private interferences might be seen in the fact that, depending on the legal form of the data space organisation, public bodies and private companies could not be equivalent partners in the data space governance authority (e.g. member states will always have the majority of votes in an EDIC, public bodies might have difficulties in becoming shareholders of a company, or members of an association). Careful consideration of the requirements of public and private participants in the ETDS before deciding on the organisational form of this data space and its implementation as a legal entity is therefore an essential task for all those responsible for setting up the ETDS, so that it provides a level playing field for all stakeholder groups.

3.2. Lack of interoperability between platforms and data sources

The fragmentation and diversity of the stakeholders in tourism extends also to processes and technologies applied.

The stakeholders often use different data management systems and tools, which may not be immediately compatible with each other (Content Management Systems (CMS),

relational databases, graph databases, proprietary technologies that do not support open standards), making integration challenging. Moreover, the various existing data silos are not designed to be part of networks. To overcome this latter fact, is the core rationale behind the data space idea and its implementation driven by IDSA, DSSC, SIMPL, GAIA-X and others. Providing standardised components and protocols to be put in front of legacy systems will let all participants appear and interact in a harmonised way, despite the fact that they can have a great diversity in their internal backend technology.

Different stakeholders may use various metadata standards and schemas, leading to difficulties in understanding and integrating data. Without a shared vocabulary and ontology, it becomes hard to ensure that metadata descriptions are interpreted consistently across different systems. In addition to the metadata describing actors in a data space and their products, establishing metadata which describe smart contracts in a way that they will be interoperable across different platforms and systems is a significant challenge. This requires the introduction of standardized protocols and semantic technologies which must ensure that contracts will be as comprehensive as in the analogous legacy world, and that they can be both human-readable and machine-readable.

Data providers and data consumers will frequently use different data formats (e.g., JSON, XML, CSV) for their payload data, which can complicate data exchange and require additional transformation steps. Even when using the same data format, differences in data structure and semantics can lead to misinterpretations and errors in data processing.

In all cases regarding metadata and payload data, AI applications might be powerful tools to map different vocabularies and data models, and provide at least guidelines for implementing a translator app (probably it is already possible that the AI codes the transformer based on the data analysis).

3.3. Resistance of stakeholders to data sharing

Surveys and interviews with potential data space participants have repeatedly shown that there are still numerous reservations about the data space technology, especially regarding trust and security, data sovereignty, and usage control and costs. In the following paragraphs some frequently expressed concern is summarised.

Technology Concerns

Since the technology is quite new and standards are still upcoming, there is little knowledge about the properties, functions and operation of the data pace components among the players which are specialists in their sectoral business but might have limited IT knowledge. The complexity of maintaining and updating the technology infrastructure to ensure seamless interoperability and performance can be daunting. In consequence, the stakeholders also often worry about the unknown security levels, and suppose an elevated potential for data breaches and cyberattacks, which could compromise sensitive

information and personal data. Many of them will be reluctant to take the risk of adopting a new technology. They will need to be carefully informed and possibly, in the beginning, financially supported.

Data Sovereignty and Trust

The concept of data spaces often introduced as 'data sharing' is similarly often misunderstood as an obligation to provide data always as open data. Moreover, participants are concerned about losing control over their data once it is shared within the data space, fearing misuse or unauthorized access. There are often doubts among potential data providers about the purview and efficiency of the trust mechanisms and usage control procedures, on one hand. On the other hand, traceability requirements might raise worries about being obliged to disclose data supply chains or other internal business information.

Legal Risks

The EU data strategy has been enforced with several new regulations in the last years, which are not widely understood by many potential participants. This raises frequently the concern that participating in a data space might come along with additional legal obligations to data providers and data consumers, which go beyond the extent observed in their legacy data sharing situations (e.g. submitting data to a central data lake).

There is a fear of legal repercussions if data is mishandled or if there are breaches of contractual obligations committed by the data consumer. In turn, there are also uncertainties regarding the reverse scenario; data providers are not sure whether they can effectively enforce their contractually agreed claims, such as compensation or usage restrictions for data consumers.

Costs

A critical point for private but also public players are the costs that may be caused by the initial setup of the local connector infrastructure, especially its security assurance, its integration with the backends, and later ongoing maintenance costs (DS membership fees, transaction costs, system updates). A cost element which is rarely mentioned in the literature is the continuous costs related to internal data management, namely the quantitative and qualitative preparation of raw data before they can be offered as data products in the data space. In addition, continuous maintenance of the data products regarding new features, versioning and description in the catalogues are inevitable efforts, which will cause additional costs.

Despite of the launching of SIMPL to ensure interoperability among data spaces, some costs factors still exist:

1. System Upgrades: Existing systems often use different technologies, data formats, and communication protocols, making seamless integration difficult. Upgrading

these systems to ensure compatibility with a standardized data space requires significant investment.
2. New Software and Platforms: Developing or acquiring new software and platforms specifically designed for data sharing within the standardized space adds to the financial burden.
3. Staff Training: Effectively utilizing new technologies necessitates comprehensive training programs for staff, incurring both direct costs and productivity losses during the learning phase.

For many tourism businesses, especially SMEs, these costs can be prohibitive. The financial burden of implementation may lead to a digital divide within the sector, with larger companies able to adapt more quickly while smaller businesses struggle to keep pace. This disparity could potentially exacerbate existing inequalities in the tourism market.

Lack of technical capacities in small SMEs and Destinations

Many small destinations and SMEs in the tourism sector face a significant skills gap when it comes to digital technologies and data management. This shortage of technical expertise poses a substantial barrier to the successful implementation of a standardized data space.

Factors Contributing to Technical Capacity Shortages

1. Limited Financial Resources: Smaller destinations and businesses often lack the financial means to invest in advanced technologies and digital infrastructure.
2. Talent Attraction and Retention: There is often difficulty in attracting and retaining skilled IT professionals, who may prefer larger urban centers or established tech hubs.
3. Limited Exposure: Smaller entities typically have less exposure to cutting-edge technologies and digital trends compared to larger destinations or businesses.
4. Training Opportunities: There are fewer opportunities for staff training and development in technical skills within smaller organizations.
5. Operational Priorities: Digital transformation often takes a lower priority due to more immediate operational concerns in small businesses.
6. Rapid Technological Evolution: Keeping up with rapidly evolving technology and digital marketing landscapes poses a significant challenge for resource-constrained entities.
7. Limited Support Access: Remote or rural areas often have limited access to specialized technical support and services.

Impact on Data Space Participation

Without adequate technical capacities, these smaller players in the tourism industry may struggle to fully participate in and benefit from a common European data space. This could lead to:

- Limited understanding of data analytics and its potential benefits
- Insufficient knowledge of cybersecurity best practices
- Inability to effectively utilize shared data resources
- Reduced competitiveness in an increasingly digital marketplace

Business Value

Given the uncertainties mentioned above, participants are often sceptical about the tangible benefits and return on investment from participating in a data space. Especially smaller participants of a data space might fear that they do not have the resources and the skills to manage data sharing in a data space environment. The effort required to build up resources and expertise or to buy them increases the investment costs and also shifts the profitability threshold.

Sharing data might be seen as a risk to competitive advantage, as proprietary data could be used by competitors. For example, a party that is required to disclose data from its own services under the Data Act, but has the right to withhold business-relevant data, is faced with the problem of analysing exactly what is business-relevant and what is not, because the fact that data users now use AI applications to analyse data has shifted the boundaries of what is feasible.

However, all these worries are very often caused by a widespread lack of detailed information about the philosophy of data spaces and the details behind. Addressing these concerns requires continuous clear communication of all relevant features of data spaces and It is still necessary to point out which features are implemented by the data space building blocks, like those mentioned before, but which obligations will stay with the participants (i.e. legal obligations regarding GDPR, intellectual properties, ownership, competition law). Consequently, it will be part of the value propositions of each data space, to provide support for all technical, data related, legal and commercial issues which its participants might face. Honest considerations of possible costs and ways to reduce costs must be worked out for all parties involved.

Financial Resources

The allocation of financial resources for implementing and maintaining a standardized data space presents a formidable challenge, particularly for certain segments of the tourism sector.

Affected Entities

1. Regions in Economic Recovery: Areas still recovering from economic downturns may struggle to prioritize investment in data infrastructure.
2. Rural or Less-Developed Destinations: These locations often operate with limited budgets and may lack the financial capacity to invest in sophisticated data systems.

3. SMEs with Tight Budgets: Small businesses operating on narrow margins may find it challenging to allocate funds for data space initiatives.

Competing Priorities

Securing adequate funding for data space initiatives often competes with other pressing needs in the tourism sector, requiring careful prioritization and resource allocation. This competition for resources can lead to underinvestment in data infrastructure, potentially limiting the sector's ability to innovate and compete globally

3.4. Lack of unified standards in data management

The absence of standardized data formats and protocols across EU member states presents a significant obstacle to creating a cohesive data space. This lack of uniformity results in numerous challenges that hinder the effective utilization of tourism data.

Challenges arising from Lack of Standardization

1. Data Incompatibility: Different organizations, regions, and countries often use varying formats, definitions, and collection methods for tourism-related information. This leads to incompatible datasets that cannot be easily shared or analyzed across the sector.
2. Cross-Border Complexities: The lack of unified standards increases the complexity of cross-border tourism initiatives, hampering collaboration and data exchange between different EU member states.
3. Performance Benchmarking: Inconsistent data standards make it difficult to compare and benchmark performance across regions, limiting the ability to identify best practices and areas for improvement.
4. Trend Analysis: Inconsistencies in reporting and analysis methodologies can lead to misinterpretation of tourism statistics and trends, potentially resulting in misguided strategic decisions.
5. Integration Obstacles: The absence of standardized formats creates significant obstacles in integrating data from various sources, limiting the potential for comprehensive insights that could drive innovation in the sector.

The Need for Standardization

Establishing and adopting unified standards is crucial for ensuring that data can be seamlessly exchanged and utilized across the entire European tourism ecosystem. This would involve creating common frameworks for collecting, storing, and sharing information about visitors, accommodations, attractions, and other relevant aspects of the tourism industry.

3.5. Legal aspects

Data sharing in Europe is subject to a group of legal regulations, the aim of which is to make data exchange as freely organisable as possible, provided that it complies with European standards. In fact, there are regulations which define standards, like the copyright law, competition law and particularly the GDPR and the AI Act. Other regulations were designed to foster the disclosure of data from either public sources (Data Governance Act, DGA[1]) or from private data holders (Data Act, DA[2]).

The different regulations impose obligations to both the data spaces as a whole, and to particular roles in the context of a data space. Since it is not possible to address any specific legal obligation in this paper, only a few key challenges should be pointed out here.

The DA, in particular, suggests for the first time European data spaces as a preferable technology for data exchange, and obliges data space governance authorities to implement harmonised technical standards (which are currently, in spring 2025, still under work). The DGA is in general less specific, but it introduces the concept of a data intermediation service, which is defined as "a service which aims to establish commercial relationships for the purposes of data sharing between an undetermined number of data subjects and data holders on the one hand and data users on the other, through technical, legal or other means, including for the purpose of exercising the rights of data subjects in relation to personal data, [...]". Since this definition matches the principles of a data space, although it is still under debate to which extent a "data space as a whole" falls under this definition, Article 12 DGA introduces a lot of challenging obligations to a data space governance authority regarding fairness, neutrality, transparency, security and privacy of data exchange, nevertheless. Overcoming these challenges is made easier by the use of now established de facto standards, developed by organisations such as IDSA, DSSC, SIMPL and GAIA-X, which are likely to become parts of the foreseen harmonised EU standards.

As mentioned, other regulations address some other data space participant roles. One relevant player in this context is the data provider. Besides convenient obligations like data quality or the definition of access conditions, which might be negotiable to a certain extent, each data provider has the severe obligation to provide water-proof legal grounds allowing it to disclose data. In the case of non-personal data a data provider must obtain the permission from any data rights holder in its data supply chain prior to sharing data with third parties. In most cases this will be commercial contracts or legal obligations in the case of public entities. It will be the obligation of the data space to provide appropriate means

[1] REGULATION (EU) 2022/868 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL
of 30 May 2022 on European data governance and amending Regulation (EU) 2018/1724 (Data Governance Act)

[2] REGULATION (EU) 2023/2854 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL
of 13 December 2023 on harmonised rules on fair access to and use of data and amending Regulation (EU) 2017/2394 and Directive (EU) 2020/1828 (Data Act)

allowing the data provider to prove these permissions without infringing the confidentiality rights of the data provider (e.g. disclosing contracts).

In the case that personal data is concerned, the consent of the affected data subjects has to be retrieved in addition. Obtaining the consent of data subjects is probably even the biggest problem in connection with data exchange in data spaces. Consent must be given by informed data subjects, i.e. consent cannot be given in advance, before the exact purpose of use has been communicated. This also means that if a data recipient expresses an interest in a data product, the circumstances of the intended data processing must be communicated to all affected data subjects and their (non-)consent must be documented. This bears the risk that not all data subjects will give their consent, reducing the value of a data product, because not all data sets can be shared. It is not clear how consent management tools (which are features of so-called personal data intermediary services), provided by the data space governance authority, might help reduce this risk. It is therefore highly recommended to disclose anonymised data wherever possible, or to apply any privacy enhancing tool which provides appropriate services for a data provider to avoid getting in conflict with GDPR.

In these new ecosystems, that will allow more data to be available, AI is seen as a powerful tool to maximise the benefits of existing data for all participants in the tourism industry. Due to the risks to people and their businesses from inadequately prepared artificial intelligence are very high, the European Union has enacted the AI Act[3], which imposes a number of challenging requirements on the providers and users of artificial intelligence. Thorough selection and preparation of AI training data to prevent erroneous or biased output, controlled by extensive testing and documentation is required from data consumers and use case teams as soon as the intended AI usage reaches a high risk level. Moreover, several AI scenarios which touch fundamental rights of individuals are explicitly forbidden by the AI Act. In the tourism industry, which has people in the centre, scenarios can easily arise that are on the borderline between prohibited applications and those that are permitted in principle. It is therefore of great importance for all AI users to understand the purposes, characteristics and effects of their AI applications so that the right measures can be taken to set up compliant AI in order to avoid harm to the people concerned and severe penalties for the providers.

Another challenge in the context of legal matters deals with the automated closing of smart contracts. Obviously, smart contracting could greatly accelerate and facilitate the process of establishing data sharing agreements. Several proposals of standard contractual clauses exist meanwhile to provide the parties with fundamental prerequisites for contract closing.

[3] REGULATION (EU) 2024/1689 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL
of 13 June 2024 laying down harmonised rules on artificial intelligence and amending Regulations (EC) No 300/2008, (EU) No 167/2013, (EU) No 168/2013, (EU) 2018/858, (EU) 2018/1139 and (EU) 2019/2144 and Directives 2014/90/EU, (EU) 2016/797 and (EU) 2020/1828 (Artificial Intelligence Act)

However, real-life contracts often are composed of specialised legal language and clauses which are difficult to mirror in machine-readable formats. This will need complex algorithms and extensive data annotation to ensure the expected and accustomed accuracy.

4. Roles and responsibilities of key actors in the tourism ecosystem

A clear allocation of roles and responsibilities in data management is essential to avoid imbalances. Issues such as overregulation, the lack of private sector accountability, or conflicts between different levels of government can undermine the efficiency and sustainability of any tourism governance model. This framework must be supported by tools and mechanisms that ensure inclusive participation and foster trust among stakeholders. Unlike other regions, the European Union has established a robust framework for data management and efficient destination governance, rooted in collaboration between authorities, Destination Management Organisations (DMOs), and private actors through inclusive and reliable public-private mechanisms.

4.1. National and Subnational Authorities: Ecosystem Leaders and Enablers

Government authorities are responsible for creating policies and regulatory frameworks that support the collection, interoperability, and responsible use of data. Their key roles include:

- Aligning national standards with European frameworks.
- Promoting the digitalisation of destination governance.
- Financing digital infrastructure projects.
- Ensuring compliance with privacy and cybersecurity regulations.
- Acting as facilitators by fostering collaboration between public and private actors.

However, overregulation can create significant barriers for small tourism businesses, while the absence of robust frameworks results in legal gaps that jeopardise data sovereignty. Furthermore, a lack of coordination between government levels often leads to conflicts and competency gaps, which can hinder the efficiency of projects like Smart Destinations. Without unified data strategies and systems, the effectiveness of sustainability policies and tourism promotion efforts is compromised.

4.2. Destination Management Organisations (DMOs): Knowledge Catalysts

A Destination Management Organisation is an entity tasked with developing, managing, and promoting a tourism destination. Their structure and legal forms may vary depending on local legislation, destination-specific objectives, and public-private collaboration mechanisms.

DMOs are typically responsible for managing tourism information, coordinating stakeholders, and collecting market data to inform decision-making. They often serve as operators of the destination's intelligence platform, fostering collaboration among actors and acting as intermediaries capable of integrating and consolidating data from multiple local sources for aggregation at subnational, national, or regional levels.

Public-private DMOs, where both sectors share responsibilities, funding, and decision-making, have proven to be more agile and efficient. These entities combine the government's strategic vision with the market-oriented efficiency of the private sector, enabling quicker adaptation to evolving market trends.

4.3. Private Actors: Primary Data Generators

Private actors contribute critical data on specific services such as accommodation, transport, and tourism activities. Whether producers or distributors (technological or otherwise), they provide operational and transactional data to the ecosystem. Their responsibilities include:

- Ensuring data quality and accuracy.
- Adhering to privacy regulations and ethical data usage.
- Contributing to the development of industry standards.

Nonetheless, limited private sector involvement in destination management diminishes collaboration on collective challenges such as sustainability, overtourism, and competitiveness. Factors hindering their participation include perceiving shared data usage as a secondary priority, mistrust of data usage, and a lack of resources—human, economic, and technological. Additionally, large platforms often monopolise data access, leaving smaller operators excluded and exacerbating the innovation gap. For instance, more than twenty years after Spain’s DATAHOTEL project, the hotel sector remains reluctant to embrace revenue management at a destination level. Similarly, many operators in emerging destinations rely on international agencies for basic market data, which limits their autonomy.

4.4. Participation and Trust-Building

Promoting a data culture is essential for integrating public and private efforts and ensuring a cohesive data ecosystem. The implementation of collaborative platforms enabling real-time data sharing and real-time data exchange further enhances these strategic alliances.

As noted, mistrust—particularly from the private sector—represents a significant barrier to effective data utilisation. The success of tourism governance initiatives depends on cultural factors. Developing codes of conduct and governance agreements can strengthen confidence in shared data management.

To ensure data management is not only technical but also promotes equity and sustainability, the knowledge generated should directly benefit all stakeholders, enhancing the tourism sector's competitiveness. However, there are few incentives to encourage collaboration in data spaces, perpetuating reliance on external actors.

Collaborative platforms and open data portals can facilitate access and usage for all stakeholders. While advances in real-time and user-friendly data integration have been achieved, the lack of specialists and limited capacity to process and analyse data remain pressing challenges, as highlighted at the Digital Tourist Congress 2023.

5. Opportunities

Effective data governance has emerged as a strategic pillar for tourism governance at all levels – regional, national, and European. Tourism relies on vast amounts of data, from visitor statistics to travel patterns, which can drive smarter decisions and innovation. At local and regional levels, destination management organizations (DMOs) and city authorities use data to monitor tourist flows, manage attractions, and improve services. National tourism boards aggregate data across regions to inform marketing strategies and infrastructure planning. At the European scale, data sharing enables cross-border insights and coordination, which is crucial given tourism's transnational nature. The European Commission explicitly envisions that a Common European Tourism Data Space will allow businesses and public authorities to share a broad range of data to develop innovative services, improve sustainability, and strengthen competitiveness.[4]

The Gaia-X initiative creates opportunities for tourism stakeholders to engage in a more coordinated manner, enhancing competitiveness and innovation while safeguarding

[4] https://single-market-economy.ec.europa.eu/publications/communication-commission-towards-common-european-tourism-data-space_en#:~:text=This%20data%20space%20will%20allow,and%20strengthen%20its%20economic%20competitiveness

Europe's rich cultural and environmental heritage. By providing a clear pathway toward shared governance of data, Gaia-X represents a significant step towards a cohesive and sustainable European tourism data space.

In practice, public authorities across EU Member States stand to benefit from a unified data space that improves interoperability and encourages harmonization of national tourism data initiatives.[5] By establishing solid data governance frameworks, each level of governance can align their efforts. For example, cities can contribute local datasets (e.g. museum visits, mobility data) into national platforms, and national datasets can feed into European-wide analyses of tourism trends. This multi-level approach ensures that policy-making is informed by evidence at the appropriate scale – whether improving a local attraction or shaping EU recovery funds for tourism. Ultimately, robust data governance builds a trusted environment for collaboration, making tourism governance more adaptive and resilient.

5.1. Enhanced sustainable data-driven planning and management

Tourism destinations across Europe can significantly strengthen their sustainability goals by aligning data exchange at local, regional, and national levels. Real-time monitoring of visitor flows, combined with advanced capacity analytics, empowers cities and rural areas alike to anticipate crowding, optimize resource use, and swiftly adapt to changing conditions. Through data-driven planning, officials can redistribute visitors more evenly, thereby reducing negative impacts on both the environment and local residents. In this context, Gaia-X adds considerable value by supplying a secure and interoperable framework—ensuring that stakeholder collaboration is seamless yet respects each partner's data sovereignty.

Importantly, tourism's inherently fragmented and often federal structure spreads economic activity across multiple localities and small enterprises. During crises such as pandemics, severe weather events, or unexpected market fluctuations, these distributed networks of tourism businesses help stabilize the wider economy. If demand drops in one region, another can often compensate—an effect bolstered by standardized, real-time insights that guide resource allocation or marketing efforts. By making tourism data available through open but protected channels (following IDSA-based protocols), destinations become both more resilient to short-term shocks and better aligned with the EU's sustainability agenda. Programs like the European Tourism Indicators System (ETIS)

[5] https://single-market-economy.ec.europa.eu/document/download/dba347be-59e7-4a2e-804b-1594bd9d3b3e_en?filename=C_2023_4787_1_EN_ACT_part1_v4.pdf#:~:text=Public%20authorities%20in%20Member%20States%2C,data%20space%20for%20tourism%2C%20as

and Horizon Europe provide additional support by offering methodological guidelines and funding streams for green and digital innovation.

5.2. Personalisation of tourism experiences through artificial intelligence

The tourism sector stands on the cusp of a new era of personalization, fuelled by Artificial Intelligence (AI) and, increasingly, Generative AI. Through sophisticated recommender systems, travellers gain highly curated itineraries that match their cultural, natural, or culinary interests. At the same time, these AI tools can incorporate real-time data—such as weather conditions, traffic updates, and special events—so that route planning dynamically adjusts. Under Gaia-X, advanced analytics can draw from multiple data sources (hotels, transport providers, cultural institutions) without sacrificing data sovereignty or privacy compliance. This is particularly beneficial to smaller, regional operators who might otherwise lack a vehicle for securely sharing proprietary visitor or operational data.

By tapping into a federated ecosystem governed by Gaia-X principles, start-ups, local DMOs (Destination Management Organizations), and established tourism enterprises can collaborate on AI-driven solutions, reducing the risk of vendor lock-in. In doing so, they cultivate a more diverse range of offerings—whether it involves niche travel categories like rural eco-hospitality or more mainstream interests like city break itineraries. Major EU initiatives, such as the Digital Europe Programme and BDVA (Big Data Value Association) calls for research and innovation, are reinforcing these trends by funding and guiding AI advancements that adhere to European values.

5.3. Generating impact and sustainability indicators

Tourism is multifaceted, producing not only economic outcomes but also social and environmental effects. Gathering robust metrics on job creation, community well-being, energy consumption, and carbon emissions is essential for transparent policy-making and responsible investments. Within a Gaia-X-compliant environment, these various data streams can be aggregated securely, letting policymakers create comprehensive dashboards that highlight environmental footprints and socioeconomic benefits alike. Such a shared, interoperable system enables cross-domain comparisons and supports evidence-based governance.

There is an initiative to develop Sustainable Tourism Indicators that will be globally accepted. The methodology is being led by UN Tourism together with the European Commission, JRC, OECD... and it is being tested in the EU Competence Centre for data management in Smart Destinations (D3HUB), through a pilot programme in which 40 European DMOs are participating with their data.

Critically, having access to automated, regularly updated indicators allows local governments and industry leaders to identify trends, track progress on climate goals, or detect early warning signs of overtourism and resource strain. The sector's fragmented

nature, featuring many small and medium-sized enterprises (SMEs), ensures that data collected is granular, covering a wide spectrum of performance contexts. By systematically analyzing these indicators at regional or national scales, tourism authorities can design more equitable policies, encourage sustainable infrastructures, and communicate genuine progress to the public, investors, and other stakeholders. The European Commission's Data Strategy and BDVA guidelines for sustainability-oriented big data projects offer additional guidance on structuring these initiatives.

5.4. Developing data-driven destination strategies

Shifting from reactive operations to forward-thinking management is a major ambition in the tourism sector. The combination of lodging, transport, cultural events, and hospitality services generates a wealth of information that, when integrated, can form the bedrock for intelligent forecasting and scenario planning. By applying standards for data ingestion, destinations can unify this information into a single analytical landscape without undermining the autonomy of individual data providers. This approach is especially relevant given Europe's patchwork of local authorities, national tourism boards, and EU-level institutions, all of which must coordinate policies around traveller experiences and infrastructure investments.

A data-centric, multi-tier governance model proves indispensable when unforeseen shocks strike, whether a pandemic, geo-political shift, or economic downturn. Observing real-time booking patterns, flight schedules, or road congestion data at once enables agile responses, from regional marketing adjustments to targeted financial support where it is needed most. The EU Tourism Dashboard—managed by the Joint Research Centre (JRC)—, the EU Competence Centre for Data Management in Smart Destinations (D3HUB), and the prospective Common European Tourism Data Space provide valuable blueprints, showcasing how aggregated insights at an EU level can support effective local action. In times of economic uncertainty, such data-driven coordination also helps ensure that tourism's distributed supply chain continues to function as a stabilizing force, propping up local economies and social structures.

5.5. Innovative Applications: Smart destinations and experiential tourism

Next-generation technologies—including the Internet of Things (IoT), augmented reality (AR), and virtual reality (VR)—are transforming visitor interactions with destinations. IoT-enabled visitor management can track foot traffic, e-ticketing adoption, or mobility data, allowing destinations to provide real-time status updates on crowd levels or queue wait times. Under Gaia-X data-sharing standards, these insights remain both secure and interoperable, enabling local governments, heritage sites, and transport authorities to experiment with novel applications and share best practices across regions.

Beyond operational improvements, immersive AR/VR experiences can add new layers of storytelling, from virtual tours of historical landmarks to interactive cultural events. This leap in digital engagement is especially beneficial for SMEs and cultural institutions that might otherwise remain overshadowed by larger, more commercial tourist offerings. Funded and guided through instruments like Horizon Europe innovation calls or domain-specific data spaces supported by IDSA, these projects showcase how tourism can expand beyond "standard" visits and create deeper, more memorable experiences for travellers. The entire sector, united by a Gaia-X-based environment, benefits from collaborative research, continuous feedback loops, and a readiness to scale effective pilots.

5.6. Case example: Monitoring the Green and Digital Transition in European destinations

A notable illustration of the value of a well-structured data ecosystem lies in the EU Tourism Dashboard operated by the European Commission's Joint Research Centre. This platform consolidates information spanning environmental impact, socio-economic conditions, and digitalization levels. By adhering to Gaia-X architectures, aligned with SIMPL, data ingestion can be standardized, while usage restrictions and security measures remain flexible enough to adapt to the distinct legal and cultural frameworks within EU Member States.

As a result, the EU Tourism Dashboard supports evidence-based policy decisions, fosters cross-country benchmarking, and sets the stage for aligning local, national, and EU-wide strategies. Particularly during periods of economic stress—when tourism might be seen as a non-essential sector—transparent, comparable data underscores the sector's actual significance. In many areas, tourism's distributed network of providers acts as a fallback revenue source, ensuring that some degree of economic activity continues and stabilizing local employment. Such a platform also reveals how emerging policies—like those envisaged by the Common European Tourism Data Space—could further advance harmonized data-sharing, helping consolidate Europe's lead in forging a balanced, people-focused tourism industry.

6. Designing a Data-Driven Governance System

6.1. Conceptual Foundations and Strategic Vision

Discussing data governance in the European tourism sector is not merely about managing yet another resource. It is about acknowledging that, in this era of rapid interconnectivity, data is no longer a supporting player—it is the bedrock upon which any meaningful and sustainable tourism policy must be built. This section does not aim to merely sketch theoretical outlines but to challenge how we perceive the use of information: is it a resource we manage, or a mirror reflecting our capacity—or failure—to lead? Now is the

time to place data where it belongs: at the heart of planning, decision-making, and political action.

6.1.1. From Data as a Resource to Data as the Foundation for Strategic Decision-Making

For too long, tourism data has been seen as a disparate set of indicators offering only a fragmented view of sectoral activity. But if we are to design a governance model with genuine transformative potential, we must elevate data from a passive technical input to an active, vital conduit connecting analysis with political action. This reimagining requires us to see data not as a static reflection of reality but as a dynamic nervous system—a mechanism for predicting trends, evaluating policy impacts, and adapting strategies to ever-changing circumstances. Data, in this vision, is no longer an incidental by-product of tourism activities. It becomes the essential platform upon which public and private leaders can bridge interests, deepen collective dialogue, and enhance both the quality and sustainability of destinations.

6.1.2. The European Logic: Aligning Data Governance with the EU's Cultural, Social, and Ethical Values

Data governance cannot be divorced from the European identity. It must reflect the Union's cultural and linguistic diversity and its foundational social and ethical commitments. Privacy protection, respect for territorial diversity, the pursuit of collective well-being, and a careful evaluation of the ethical implications of data use are non-negotiable. The European approach to data governance transcends mere technical efficiency—it prioritizes serving people, recognizing the complexity of local realities, and aligning with overarching goals of sustainability, inclusion, and social cohesion. In this way, tourism data governance becomes a truly European endeavour, committed to the holistic development of destinations, the safeguarding of cultural heritage, and decision-making based on the best available knowledge—all while upholding the inviolable principles of human dignity and responsibility to future generations.

6.2. Regulatory and Policy Anchoring in the European Context

The future of a truly data-driven governance system in tourism does not rest solely on the sophistication of its technological frameworks or the rigor of its operational principles. It depends fundamentally on its capacity to navigate the intricate web of laws and institutions that define the European Union. Every strategic decision, policy initiative, or cross-border project operates within a layered regulatory landscape shaped by norms both longstanding and emergent. The challenge here is profound: to shift from a compliance-focused mindset to a genuinely ethical, forward-thinking approach—one that embraces the transformative

power of data while steadfastly upholding fundamental rights, democratic values, and the rich cultural pluralism that defines Europe.

6.2.1. Regulatory Framework: Harmonizing GDPR, the Data Act, Open Data Directive, and Forthcoming Policies

Europe has charted an ambitious path in data regulation, exemplified by the GDPR, the Data Act, and the Open Data Directive. These frameworks collectively aim to protect individual privacy, ensure fair competition in data markets, and promote open access to non-personal data. Yet in the context of tourism, harmonizing these regulations is far more than a box-ticking exercise. It is about weaving a coherent fabric from principles of privacy, data portability, interoperability, and the public good—creating a shared foundation for destinations, service providers, and policymakers.

True harmonization is not static; it is a dynamic process of constant recalibration. It requires adapting tourism-specific practices to shifting regulatory standards, preparing for new legal instruments, and ensuring that competing priorities—economic growth, environmental stewardship, cultural preservation—are not just balanced but mutually reinforcing. It's about recognizing that regulations are not roadblocks but tools for building a more transparent, sustainable, and equitable tourism sector.

6.2.2. Privacy, Intellectual Property, and User Rights: A Data Ethics Perspective

The GDPR and related policies have raised the bar for privacy protection and fair data use. But let's be clear: compliance alone is a low ceiling. What the tourism sector needs is a commitment to data ethics, where legal obligations evolve into trust-building practices that protect privacy, honour intellectual property, and respect the local context.

For tourism destinations, this means recognizing that their cultural heritage is not just an asset but a shared trust—and ensuring that data policies reflect societal values as much as market dynamics. For entrepreneurs and SMEs, it means safeguarding the balance between innovation and user rights, preventing their data from becoming fodder for exploitation or inequity. As data grows more complex and pervasive, decisions must transcend technical or legal parameters, embracing moral, historical, and social dimensions. A true ethics-driven approach turns the regulatory floor into a springboard for trust, innovation, and resilience.

6.2.3. Inter-Institutional Coordination: European Commission, National Authorities, and Supranational Networks

A cohesive European data governance system for tourism will not emerge by chance. It requires deliberate, structured collaboration across multiple levels—from the strategic guidance of the European Commission to the operational expertise of national tourism boards, local DMOs, private stakeholders, and academic institutions.

Coordination is not just a bureaucratic exercise; it is the lifeblood of a functional governance ecosystem. Expert working groups, thematic forums, and cross-border committees are essential for aligning standards, mediating competing interests, and ensuring efficient allocation of responsibilities. Supranational networks—alliances of forward-thinking destinations and innovation clusters—play a crucial role in disseminating best practices, fostering experimentation, and building a culture of mutual learning.

In this context, the EU's institutional framework is not merely a backdrop—it is an active agent, a catalyst for innovation, and a guardian of democratic principles. By fostering collaboration across geographic and institutional boundaries, Europe can build a tourism data governance model that reflects the collective intelligence of its diverse stakeholders. The result? A system that is not only resilient and future-oriented but fundamentally European in its commitment to inclusion, cultural preservation, and shared prosperity.

The European Commission has already launched a Code of Conduct for data sharing in tourism.[6]

6.3. Capacity Building, Participation, and Cultural Change

The transition to a data-driven governance model for European tourism is not just about technology, regulations, or infrastructure. It is about **people**—the officials, entrepreneurs, cultural leaders, and citizens who must shape and navigate this new reality. Without their skills, engagement, and buy-in, even the most advanced systems will falter. Building capacities, fostering meaningful participation, and cultivating a cultural shift that sees data as a tool for empowerment and collaboration are not optional—they are the **heartbeat** of a governance model that aspires to be democratic, inclusive, and transformative.

6.3.1. Developing Digital and Analytical Skills: Empowering the Actors of Change

No amount of sophisticated technology or visionary policy can compensate for a lack of human capacity. If tourism planners, destination managers, cultural mediators, and small business owners lack the skills to interpret, use, and benefit from data, the system will fail to deliver on its promise.

[6] https://etc-corporate.org/uploads/2023/03/Code-of-Conduct-on-Data-Sharing-in-Tourism_Final.pdf

This requires more than just technical training. It calls for programs that **demystify data** and inspire creative thinking—workshops, online courses, and tailored sessions that equip individuals to read market signals, anticipate visitor needs, and integrate data into decision-making. Imagine local governments using data to design sustainable tourism strategies, or small museums preserving their heritage while reaching new audiences through data insights. By embedding these capacities across all levels, Europe's tourism sector becomes not just reactive but **proactively resilient**, aligning its use of data with the aspirations and values of those it serves.

6.3.2. Engagement Tools: Spaces for Dialogue and Co-Creation

Capacity building alone is insufficient without spaces for collaboration. Governance is strongest when diverse stakeholders—public officials, entrepreneurs, researchers, and citizens—meet as equals to exchange ideas and tackle shared challenges.

Living labs, thematic workshops, and co-creation sessions offer such spaces. Here, prototypes can be tested, feedback loops refined, and mutual understanding deepened. These participatory tools do more than solve problems; they foster a culture of **innovation** that embraces experimentation, tolerates failure, and thrives on open dialogue. Over time, these engagements transform tensions into opportunities, mistrust into collaboration, and isolated efforts into a collective movement toward shared goals.

Building the Foundation for Human-Centered Progress

Capacity building, participation, and cultural change are not just supporting elements—they are the **scaffolding** upon which tourism data governance is built. By equipping people with the tools and skills to thrive in this new environment and ensuring their voices are heard, Europe can craft a model that resonates deeply with its citizens.

This is not merely about making governance functional; it is about making it meaningful. It is about reflecting Europe's democratic traditions, cultural richness, and unwavering commitment to **human-centered innovation**. In this vision, data is not an abstraction but a shared resource—a bridge between knowledge and action, tradition and transformation, individual empowerment and collective progress.

7. Role of Gaia-X enabling the data governance model

7.1 The need for connected data and infrastructure ecosystems

A joint governance approach for data and infrastructure is essential because data does not operate independently, it relies on services for storage, processing, transfer. Effective data governance, understood as control and transparency over data, is a direct result of control and transparency over such infrastructure services where data is stored, processed, and transferred. This means that enforcing access policies occurs through services, rather than directly on the data. Thus, achieving a holistic data governance that enables sovereignty also demands having an oversight on which services are used, where they are located, and who operates them.

In limited data-sharing contexts the need for common data and infrastructure governance may seem less critical. For instance, in the context of a tourism data platform making API calls to request real-time accommodation availability from a cloud-based booking system. The end-user service making the API call (data usage) interacts with a database stored on a cloud server (data infrastructure). In this case, the data exchange participants (the tourism platform integrating the data records received via APIs, and the cloud service provider hosting the booking system) can establish trust through direct agreements.

Scaling up this example, for example for the case of the European Tourism Data Space (ETDS), achieving an effective data governance between all these participants is no longer feasible through direct agreements. The ETDS will likely involve a diversity of interconnected platforms across multiple domains. In such a multi-stakeholder and interoperable data ecosystem, a joint data infrastructure governance becomes an essential foundation for the following reasons:

- **Data governance across multiple participants**: Unlike in a small-scale example where a single platform manages API access, ETDS will involve many stakeholders (e.g. hotels, airlines, platforms, public authorities) who need consistent enforcement of access rights, policies, and compliance. Running rules only on data would be insufficient because different infrastructure providers host, store, and process this data asynchronously and following their own models.

- **Interoperability and standardisation**: ETDS will connect diverse IT systems, cloud providers, and data platforms. Prescribing standards and best practices at an infrastructure level ensures that all services adhere to common models, enabling seamless data exchange and interoperability.

- **Scalability and automation**: Manually enforcing policies at the dataset/ registry level across thousands of participants would be inefficient. However, implementing rules at the infrastructure level allows automated enforcement of policies related to data

access, logging, and security, making large-scale operations manageable yet still being effective at the micro level.

· **Trust and sovereignty enforcement**: Data sovereignty means organisations must control not only who accesses the data, but also where and how it is processed. Running governance rules on infrastructure ensures that data does not move to unauthorised locations and remains compliant with EU regulations (e.g. GDPR, Data Act).

· **Security and compliance**: Infrastructure-level controls help enforce cybersecurity measures, encryption, and identity verification before data even reaches an application. This prevents unauthorised access or misuse in a large, open ecosystem.

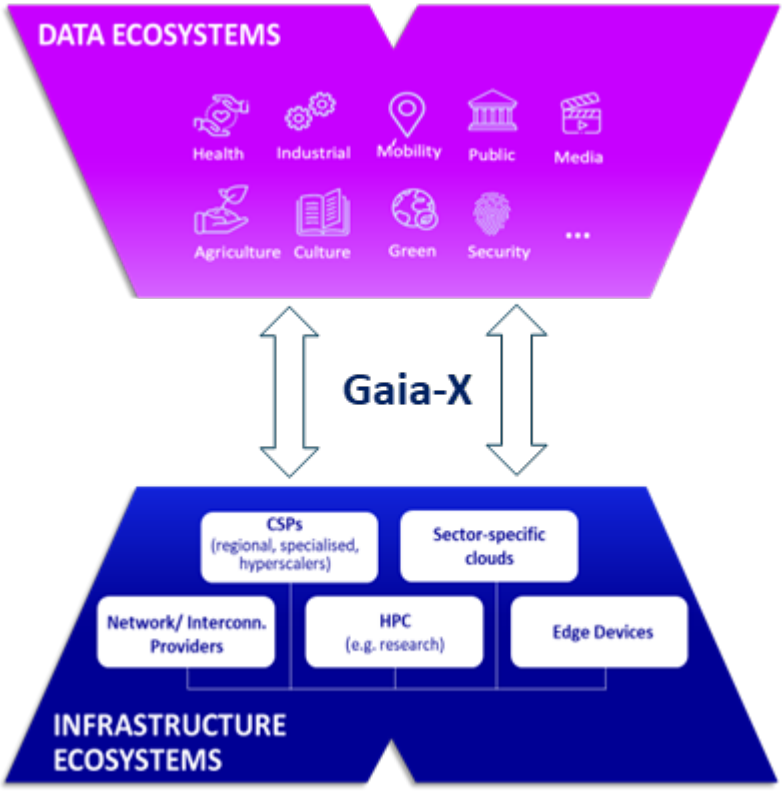

Figure 1. Gaia-X connects the data and infrastructure ecosystems

7.2 How Gaia-X connects data with infrastructure

Establishing the importance of considering both the data records themselves and the infrastructure that processes and stores them is a vital context to explaining the value of Gaia-X in data governance. Together with its members, the Gaia-X AISBL is developing a data governance framework that verifies and enforces consensual trust policies across heterogeneous data ecosystems, as well as on the infrastructure services supporting them. This governance model is operationalised via a Trust Framework providing a measurable and comparable way to assess how digital services, such as cloud storage facilities or data exchange platforms, operate, and how data flows across them.

The Trust Framework consists of two key elements:

- **Gaia-X Technical Compatibility:** The (Web3.0-based) technological basis to perform automated conformity assessments. These are the technological standards, rules and semantic definitions that allow to perform any sort of conformity assessment in a standardised manner. It serves to evaluate operational resources and procedures under the same viewpoint, allowing to relate each of these assessments. It is precisely this that provides the foundation for an interconnected network of data and infrastructure assets, and the backbone for the decentralised and federated model that the European Union strives for, and with which to generate European digital capabilities, and also the reason to having selected preexisting Web3.0 technologies.
- **Gaia-X Compliance:** A set of common policies that all participants understand and can choose to follow. These are agnostic to technology and represent the digital behaviour of the data and infrastructure services under assessment. These policies are usually high-level, with details encoded within the different Permissible Standards. Fulfilling any of said Permissible Standards (there can be several ones, typically across different geographies, even for the same policy) would thus be equivalent to complying with said policies. Gaia-X AISBL does not define its own policy-fulfilling standards, but instead defines the policies and looks for preexisting standards matching each policy. It also ensures the complementarity between the technical specifications (including its ontology) and the semantics of these Permissible Standards. This way, one can interconnect and interpret across each other the different services fulfilling the standards.

This is how it works:

1. **Standardised Descriptions and Policies:** Every participant within the Gaia-X Ecosystem must describe oneself using the same identification scheme. Additionally, providers need to detail their services using standardised formats, as prescribed on the Gaia-X Tech Compatibility, and following the Gaia-X Ontology. This latter is a 'common language' that allows cloud service and ICT infrastructure providers to clearly express their security measures, capabilities, and compliance with agreed policies.

The Gaia-X Ontology aligns the definitions of key stakeholders and resources within a digital ecosystem across different domains, such as what constitutes a dataset, the concept of a data consumer or producer. It is a foundational semantic layer that ensures that all participants, whether in tourism or another sector, refer to the same concept when expressing themselves. For example, this way a tourism data platform and a transportation data service will have a shared understanding of what 'data consumer' means.

2. **Automated Conformity Assessments:** Gaia-X enables automated processes (prescribed as part of the Gaia-X Technical Compatibility) to check if a service meets the predefined standards, certifications, and codes of conduct used to assess Gaia-X Compliance. When a service passes these tests (see next section), it is issued a Gaia-X Label —a publicly-available certification that is a marker of trust of official Gaia-X Compliance.

Beyond the four labels currently governed by the AISBL, organisations and other clusters can also make use of the same automated conformity assessment framework to certify their own policies or best practices. For this, they ought to follow the schemes and scenarios outlined in the White Paper on Geographical and Domain Extensions of the Gaia-X Framework (which only include prescriptions on the governance of these extensions), reserving for themselves the actual content (the 'core') of what to assess against both policies and permissible standards, if any.

3. **Obtaining Conformity with Gaia-X Digital Clearing Houses:** Transparency is achieved by automatically verifying claims about services. For example, a cloud provider's security measures are assessed against Gaia-X-selected Permissible Standards, and upon successful validation or verification (see section below), a Gaia-X Label is issued. This process is operationalised by the Gaia-X Digital Clearing Houses (GXDCH), a common set of tools to manage the conformity assessment automation.

Currently, the GXDCH *Loire* release allows users to identify and compare cloud services via unique IDs. Looking ahead in 2025, the Trust Framework will get extended to also include data-specific attributes (such as restrictions relevant to certain algorithms or data processing methods), suffer updates to accommodate domain-specific rules as well as to regulatory context of different countries/ regions, thus easing application across a generalised federated ecosystem. In this way, Gaia-X will provide a federated framework that supports different cross-industry and sector-specific data governance requirements.

7.3 Readiness of the Gaia-X Standard for data governance in Tourism

As commented, Gaia-X ensures trust, interoperability, and sovereignty in digital ecosystems through a verification framework made up of specifications, code, labels, and a governance system, not as a single platform but as a set of tools and rules that interconnects different data platforms, repositories, databases, applications, participants, use-cases and their infrastructures running underneath. A well-thought governance system (informed by the Gaia-X vision) coded into the specifications and guiding documents held in open repositories, and operationalised in practice by the network of GXDCHs, enforces

these principles, maintaining transparency and alignment with European values. The Gaia-X Standard is made up of:

- A scheme or model to formally assess the compliance of digital entities across participants, resources and service offerings. This scheme encompasses both technical specifications for the digitisation of conformity assessments, as well as the policy rules that eventually go under assessment. The first also enable the inclusion of the assessments' results into a tractable networked system, interrelating those participants, resources and offerings (now validated or verified to any conformity issued) and thus fulfilling the aspiration of a continuum of interconnected data and infrastructure layers. This independently of whether the policies are those prescribed by Gaia-X, or rather by a private organisation, association or consortium.
- A set of technical tools to automate the execution of said compliance assessments. There is code for the various services that compose the GXDCH offerings, available open-source on Gaia-X's technological repositories. Notably, these technical artifacts can also be employed outside of the scope of Gaia-X, within the realms of an individual organisation. However, value delivery within an externally facing context is much higher, following platform network economies[1][7].
- Bundles of the aforementioned policy rules as well as the qualification process to issue certificates of conformity (the so-called Gaia-X Labels).Particularly, a *Gaia-X Label* is a mark of confidence which reflects the completion of different criteria related to transparency, data protection, security, interoperability, portability, sustainability, and also European Control for the highest label levels:
  - Gaia-X Standard Compliance: This label encompasses the basic cloud policies that are pursuant to European values
  - Gaia-X Label Level 1: Additional to Standard Compliance, services fulfilling this label are also compliant with EU data protection rules (GDPR)
  - Gaia-X Label Level 2: Additional to Level 1, there is enhanced cybersecurity and EEA-exclusive data processing
  - Gaia-X Label Level 3: This is the highest level of data protection, additionally ensuring that no external access outside of EEA can occur.

Gaia-X Validation & Verification Process

Gaia-X foresees two different alternatives for instilling trust across any set of data and infrastructure digital services: one relies in *technical validation*, whereby owners of said services self-declare their adherence to specific standards, and the GXDCH validates the integrity and completeness of the information provided. The second alternative is more advanced, where on top of this technical validation, there is also a *formal verification*

[7] [1] Typically modelled as value being the square of its number of users/ participants.

process that sees the involvement of different types of Trust Anchors (also referred to as *Trust Service Providers*) providing extra assurance to the process and the claims therein.

The simpler validation process serves to award 'Standard Compliance', or a Label Level 1. This technically driven process ensures standardisation and credibility, setting the foundation for trust. The more thorough verification process awards a Label Level 2, or Label Level 3, implying higher trust and stricter compliance requirements (including full European geolocation for L3). Its governance is strengthened by enforcing a rigorous oversight of the verification services and their continued accountability.

The How

Gaia-X Standard Compliance & Gaia-X Label Level 1:

1. Characteristics of the services to be assessed: Providers submit a formatted description of their service (e.g. data policies, location), governed by Gaia-X's schema to ensure consistency.
2. Automated Validation: Any of the nodes on the network of GXDCHs checks these self-descriptions (*Verifiable Credentials*, bundled in the form of a *Verifiable Presentation*) against predefined rules for completeness and integrity of the information provided.
3. Credential Issuance: If all validations are successfully completed, the GXDCH issues a *Gaia-X Compliance Credential* for *Gaia-X Standard Compliance,* or for *Label Level 1*.

A service or product offering is certified *Gaia-X Standard Compliance* upon the successful assessment of all the mandatory criteria related to transparency, security, interoperability, portability and sustainability. Thus, this is not specifically bound to a specific jurisdiction or industry domain.
A service or product offering is certified Gaia-X Label level 1 if the offering has reached the Gaia-X Standard Compliance label and —additionally— also fulfils additional European rules related to personal data protection.

Gaia-X Label Level 2 & Label Level 3:

1. Additionally, Level 3 services have an enhanced sovereignty focus, and on top of all they also require independence from non-European laws.
2. Third-Party Assessment: For criteria for which Trust Service Providers capable of issuing credentials (i.e. Conformity Assessment Bodies) can be found, their job is ensuring the veracity of the claims contained within the service credentials (via a review of the evidence, i.e. the work of laboratories, inspection or certification bodies). Their accreditation will be overseen by the AISBL. And for criteria where

these bodies cannot be found, *Trusted Data Sources* will be employed and referenced.

3. Automated Validation: Any of the nodes on the network of GXDCHs can check the credential against the predefined rules for completeness and integrity, but also against the identifier of the CAB (via a cryptographic signature) and the permissible standard for each of the criteria under assessment (that the CAB is validating, typically through a VC).
4. Credential Issuance: The GXDCH verifies CAB findings, issuing a Label Level 2 or Level 3 VC. A solid governance of the model ensures CABs are impartial and criteria are consistent.

A service (product offering) is certified *Gaia-X Label Level 2* if, on top of the criteria for Gaia-X Label Level 1, their verification methods and required attestation mechanisms are stricter for several areas, including cybersecurity and data protection. Also, the service offering should offer the option of processing and transferring the customer's data exclusively within the Europe Economic Area.
A service is certified *Gaia-X Label Level 3* if, on top of satisfying the criteria for Level 2, the headquarters and main establishments of the service provider are in the European Economic Area, also related to enforcing stricter requirements on the treatment of data and the provision of said ICT services (e.g. based exclusively on EEA law, and with immunity to foreign regulations).

The Why

It is the prescription and maintenance of the Gaia-X Standard (for which the AISBL collectively defines the verification framework, ontology, technological and semantic rules, as well as the deployment modes of the GXDCH, to ensure its decentralised network remains trustworthy) that guarantees the process's legitimacy, preventing misuse and maintaining the integrity of the ecosystem's trust. On top of that, the *Gaia-X Standard Compliance* and *Label Level 1* allow to develop an initial version of trust, encouraging broad participation and with policy rules covering foundational concepts needed to operating digital services in a coherent and rational business way.

Gaia-X Labels Level 2 and Level 3, on the other hand, address sensitive use cases (e.g. healthcare, defence, governmental), where high trust and sovereignty are critical vectors. Ones for which purely declaratory means are not deemed sufficient, and organisations requesting these labels need the assurance provided by Trust Service Providers. This is indeed why the definition and governance of the Gaia-X framework ensures the claims supported by these labels are credible, supporting user confidence and provider differentiation while upholding European values.

Value Delivery

Gaia-X Standard & Deliverables weave specifications, code, and labels into a framework aimed at validating and verifying ICT services, fostering the trust basis of a federated digital ecosystem. The validation process offers a low entry barrier rooted on a common trust model, automatable[2][8], meanwhile the verification process delivers on top enhanced trust and sovereignty—both reinforced by a solid overarching system governance. This benefits providers with market access and users with reliable options, all within a fair, community-driven framework.

For Tourism, the Gaia-X Standard enables data spaces where different stakeholders (hotels, travel agencies, local municipalities, and even tourists) can share data securely and in an interoperable way. Specifications guide those common definitions of trust that are key for interoperability across data spaces, meanwhile open-sourced code enables the operationalisation of said common trust model (making it a reality), and labels provide qualification for the providers and operational aspects of services. The governance of the Gaia-X verification framework oversees stakeholder collaboration and provides/ maintains a common consensual model that prevents dominance by any single party, and fosters trust among tourists and businesses.

7.4 Enabling Critical Mass for Generative AI in Tourism Through Joint Governance

In a landscape where data is increasingly hyper-distributed across sectors and stakeholders, achieving critical mass is essential for unlocking the full potential of Generative AI applications in tourism. However, the current fragmentation of data ecosystems, where each industry operates within its own standards, datasets, and regulatory frameworks, limits the ability to develop scalable, high-quality applications and AI models. Joint governance, as enabled by the Gaia-X Trust Framework, and implemented by champion projects and organisations, provides a solution by fostering interoperability, trust, and shared data accessibility, while respecting sector-specific requirements (as encoded in the policies and Permissible Standards whose assessments become operational via the GXDCH).

By establishing a harmonised (and in many cases automatable) governance model, stakeholders across the tourism value chain —hotels, travel platforms, public authorities, and mobility providers— can securely and efficiently share their datasets (and other useful industry digital resources) without compromising their cybersecurity, confidentiality or business advantages. This not only enhances data diversity and quality but also enables cross-sector AI training, essential for developing advanced, context-aware GenAI

[8] When possible, as some criteria may not be easily 'digitisable'.

applications *in vogue* today. For example, AI-powered personalised travel assistants could generate dynamic itineraries by integrating data from multiple sources, while real-time demand forecasting could optimise resource allocation across transportation and hospitality. With a joint data infrastructure governance model ensuring compliance, security, and sovereignty, organisations can confidently participate in these data collaborations, paving the way for a truly interconnected European Tourism Data Spaces that support innovative AI-driven applications and services.

8. Conclusions and Recommendations

8.1. Data governance as a driver of sustainable tourism transformation

Building a European tourism data ecosystem is not a sprint; it is a **marathon of innovation and adaptation**. In the medium term, this journey will focus on consolidating interoperability standards, refining semantic frameworks, and embedding privacy-by-design principles across the sector. These are the **roots**—the foundations of a stable, trusted system.

Looking further ahead, as technologies like artificial intelligence, sensory networks, and decentralized architectures advance, the tourism data ecosystem can become a **laboratory for bold experimentation**. Imagine predictive policy models that anticipate shifts in visitor patterns, cross-sectoral collaborations that integrate tourism with urban planning, or participatory governance models where citizens actively shape tourism's digital future. By envisioning these trajectories, Europe commits to a tourism sector that is not static but **constantly evolving**—expanding its horizons while remaining grounded in social purpose, sustainability and cultural integrity.

No vision, no matter how ambitious, can be realized without trust. In the fragmented landscape of European tourism, trust is not just desirable—it is **indispensable currency**. Achieving this requires forging deliberate partnerships: pacts between destinations to harmonize data policies, alliances among private sector players to develop open standards, and consortia that unite academia, civil society, and public authorities under shared ethical guidelines.

These collaborations are not merely logistical—they are **expressions of Europe's ethos**, recognizing diversity while insisting on common ground. Over time, such networks can crystallize into enduring institutions, platforms for dialogue and experimentation that transform data governance from a transient trend into a **pillar of stability and innovation**. By reducing friction, mitigating duplication, and fostering cooperation, these alliances create a **resilient scaffolding** for a thriving data ecosystem.

8.2. Call to action: A collective commitment to innovation and sustainability in tourism

The European Green Deal charts an ambitious path for tackling climate change, resource depletion, and social inequality. Tourism, as both a beneficiary and steward of Europe's natural and cultural wealth, holds a pivotal role in this transition. Data governance becomes the **engine of actionable sustainability**, providing the insights needed to balance visitor flows in fragile ecosystems, monitor emissions from tourism activities, and optimize resource use in infrastructure.

Through reliable environmental indicators, destinations can move beyond vague commitments to sustainability, adopting **regenerative models** that enhance biodiversity, empower local communities, and respect cultural diversity. In this way, tourism becomes not just a consumer of natural and cultural assets but an **agent of resilience and inclusion**, aligning local actions with global imperatives for planetary well-being.