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Open Government Data-Based Smart Tourism Analytics: A Conceptual Governance Framework

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Abstract. Digital transformation and Open Government Data (OGD) offer opportunities for more transparent, evidence-based, and sustainable tourism governance. However, prior smart tourism and OGD studies remain fragmented, often addressing data publication, analytics, governance, visualization, or sustainability evaluation separately. This study develops an initial conceptual framework for OGD-based Smart Tourism Analytics to support sustainable destination governance. The method combines a structured Scopus-only search, PRISMA-based screening, Biblioshiny mapping, systematic literature synthesis, and layered framework derivation. Of 68 Scopus records published during 2021–2026, 32 documents were selected, comprising 19 core studies and 13 contextual evidence sources. The analysis identifies persistent gaps in OGD integration, analytics readiness, governance control, stakeholder-oriented visualization, and outcome evaluation. The proposed framework includes five layers: OGD integration, smart analytics, decision support and visualization, sustainable destination governance, and tourism outcome evaluation. Pangandaran is used only as an illustrative application context, not as empirical validation. No prototype or live API integration was tested. Accordingly, the framework remains conceptual and requires prototype development, live API integration, and field validation with local governments.

Keywords: Bibliometric Analysis, Conceptual Framework, Open Government Data, Smart Tourism Analytics, Sustainable Destination Governance, Tourism Governance

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1. INTRODUCTION

Digital transformation has reshaped tourism destination management by enabling destinations to collect, process, and transform heterogeneous data into information services for tourists, businesses, and public-sector decision makers [1], [2], [3]. In this context, Open Government Data (OGD) is important because it can increase transparency, reuse, collaboration, and public accountability; however, OGD value is not produced automatically by data publication alone because adoption depends on data quality, interoperability, institutional readiness, user capability, and governance mechanisms [4], [5], [6], [7], [8].

Existing smart tourism studies generally emphasize technology adoption, tourist experience, big data analytics, and destination competitiveness, while OGD studies emphasize publication, reuse, and value creation. These streams are relevant but remain insufficient for sustainable destination governance when they are not connected to an explicit architecture that links data sources, data standards, analytics, decision-support visualization, governance control, and outcome evaluation [7], [9], [10], [11], [12], [13], [14]. Consequently, a smart tourism analytics framework should not only process data, but should also clarify how public data are governed, how analytical outputs are interpreted by decision makers, and how sustainability impacts are monitored.

The Indonesian context strengthens the urgency of this problem. Recent OGD research emphasizes data standardization, interoperability, institutional arrangements, stakeholder capability, data, system, and service quality, public trust, and governance as foundations of effective OGD implementation [15], [16], [17], [18], [19], [20], [21], [22]. In Indonesia, the Satu Data Indonesia initiative provides the institutional basis for standardized and interoperable OGD [18]. More broadly, recent studies show that smart tourism destinations can function as open-data providers [23], while transforming OpenAPI descriptions into RDF-based services can support machine-readable service descriptions, service discovery, and syntactic and semantic interoperability [24]. Nevertheless, practical OGD implementation continues to face legal and privacy constraints, incomplete or inconsistent data, institutional and capability gaps, barriers to use and reuse, and limitations in machine-readable interoperability [15], [16], [17], [18], [24]. In smart tourism contexts, destinations also face specific barriers to publishing and exploiting open data

[23]. Pangandaran is used in this article only as an illustrative application scenario to explain how the conceptual framework may work in a coastal destination context; it is not presented as empirical evidence or validation because no prototype, live API integration, or stakeholder evaluation has been conducted.

A concrete interoperability problem in Indonesian tourism governance arises when visitor statistics, attraction inventories, accommodation data, transport information, and environmental records are maintained by different national and regional institutions using different classifications, spatial units, file formats, metadata completeness, and update cycles. Even when these datasets are publicly accessible, direct integration may require manual reconciliation of identifiers, periods, and definitions before they can support destination-level analysis [15], [16], [17], [18]. Accordingly, the manuscript addresses Indonesia as the broader governance context, while Pangandaran is used only to contextualize the proposed framework as a coastal-destination illustration. No evidence in this study is presented as a test of the framework in Pangandaran.

Based on this background, the study aims to: (1) map the intellectual structure of OGD, smart tourism analytics, and sustainable destination governance research; (2) identify gaps that limit the integration of these domains; and (3) formulate an initial conceptual framework that can guide future prototype development and empirical validation. The practical contribution is a governance-oriented roadmap for local governments and destination managers to move from fragmented tourism data toward accountable analytics-based decision support.

2. METHODS

2.1. PRISMA-Based Selection

This study adopted a hybrid review methodology that combines a PRISMA-guided Systematic Literature Review (SLR) [25], bibliometric science mapping using Biblioshiny [26], and framework-based qualitative synthesis. The term hybrid review methodology is used because the design integrates complementary review approaches: quantitative bibliometric mapping and structured framework-oriented synthesis [27], [28]. Converting coded literature into a conceptual framework follows a qualitative process of identifying, categorizing, integrating, and synthesizing concepts [29]. Layered architecture reasoning was then used to translate the synthesis into separable but connected data, process, output, governance, and evaluation components [30], [31]. The study does not claim to validate an operational system; rather, it proposes an initial framework that should be tested through prototype development and empirical evaluation in future research.

The research process followed the PRISMA 2020 logic to ensure traceability in identification, screening, eligibility assessment, and inclusion [25]. Bibliometric indicators, co-occurrence networks, thematic maps, and trend topics were produced using Biblioshiny/Bibliometrix because this tool supports transparent science-mapping workflows [26]. The hybrid design was selected because bibliometric analysis provides quantitative mapping of the research domain, whereas framework-based review and conceptual framework analysis support qualitative interpretation and integration [27], [28], [29]. The layered architecture perspective was adopted to separate concerns among data integration, analytics, visualization, governance, and outcome evaluation while maintaining traceability from literature gaps to framework components [30], [31].

The secondary data collection procedure was conducted through the Scopus database with a publication timeline from 2021 to 2026. The search was limited to Title-Abstract-Keyword fields using the following Boolean query: TITLE-ABS-KEY ((tourism OR destination* OR hospitality) AND ("open data" OR "government data" OR "public data" OR "official statistics" OR "data governance" OR "data sharing") AND (analytics OR "big data" OR "smart tourism" OR "smart destination*" OR "decision support" OR "data-driven" OR sustainability)). The 2026 data were treated as partial-year records and were not interpreted as a complete annual production count.
The Scopus query was executed and the bibliographic metadata were exported on 1 June 2026. The database scope was limited to Scopus; consequently, the bibliometric indicators and the PRISMA corpus reported in this study should be interpreted as Scopus-based evidence rather than a comprehensive multi-database census.

The search identified 68 initial Scopus records. Records were screened using explicit inclusion and exclusion criteria (Table 1). The final analytical corpus contained 32 documents: 19 core studies directly addressing smart tourism analytics, OGD, data governance, decision support, or sustainability evaluation, and 13 contextual evidence sources used to strengthen adjacent technological, managerial, sustainability, policy-related, standards-related, or Indonesian OGD interpretation. The initial screening was conducted by the first author and cross-checked by the co-authors to reduce selection bias; disagreements were resolved through discussion based on relevance to the research objective.

All 32 included documents were retrieved through the same Scopus search. The 19 core studies were retained because they directly contributed concepts, mechanisms, indicators, or architectural elements to at least one framework layer. The 13 contextual evidence sources were also Scopus-indexed, but were retained primarily to explain adjacent technological, managerial, sustainability, or destination contexts. Policy documents, standards, and official portals cited elsewhere in the manuscript were not counted among the 32 documents.

The complete list of the 32 selected documents, their classification as core studies or contextual evidence sources, and the framework layers supported by each document is provided in Supplementary Table 1. No formal numerical quality score was applied because the corpus contains heterogeneous empirical, conceptual, review, and system-design studies, and the purpose was conceptual framework derivation rather than effect-size estimation. Instead, each document underwent relevance and traceability appraisal based on topical alignment, transferable framework evidence, identifiable authorship and publication venue, metadata completeness, and availability of a DOI or verifiable source record.

Table 1. Inclusion and exclusion criteria for study selection

Criterion	Inclusion Criteria	Exclusion Criteria
Database and document type	Scopus-indexed journal articles, conference papers, or review papers relevant to tourism, OGD, analytics, governance, or sustainability.	Non-scholarly documents, editorials without analytical substance, inaccessible metadata, or sources outside the defined search scope.

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Criterion	Inclusion Criteria	Exclusion Criteria
Time period and language	Publications from 2021-2026 written in English.	Documents outside the time window or not written in English.
Topical relevance	Studies discussing at least one of the following: smart tourism, OGD/public data, big data analytics, decision support, data governance, or sustainable destination management.	Studies mentioning tourism or data only incidentally without conceptual, methodological, or governance relevance.
Framework contribution	Studies providing concepts, variables, architecture elements, governance principles, indicators, or analytics mechanisms that could inform framework layers.	Studies with no transferable concept for framework derivation.
Contextual evidence	Scopus-indexed studies that provide adjacent technological, managerial, sustainability, policy-related, standards-related, or Indonesian OGD context, but do not directly contribute all required mechanisms to the framework.	Policy documents, standards, official portal materials, or other non-Scopus sources counted as part of the 32-document analytical corpus.
Traceability	Documents with verifiable title, authorship, publication venue, year, DOI or official URL when available.	References with synthetic authorship, unverifiable publication details, missing source identity, or doubtful authenticity.

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Table 2. PRISMA screening summary

PRISMA Stage	Count	Description
Records identified from Scopus	68	Initial metadata from Scopus search query execution.
Duplicate records removed	0	No duplicate records found based on DOI verification.
Records screened	68	Title, abstract, and keyword screening stage.
Records excluded	36	Excluded after strict screening of tourism analytics substance.
Reports assessed for eligibility	32	Full-text documents assessed for framework extraction.
Studies included in final review	32	Final dataset: 19 core studies and 13 contextual evidence pieces.

After the screening stage, literature findings were coded into five design categories: data source and interoperability, analytics capability, visualization and decision support, governance and ethics, and sustainability outcome evaluation. Each category was then translated into one framework layer by linking bibliometric evidence, research gaps, system-design problems, and architectural decisions. The Pangandaran scenario was added after framework derivation as an illustrative use case to show potential application logic, not to test performance or claim operational validity.

Table 3. Coding categories and representative evidence used for framework derivation

Coding category	Operational indicators	Representative selected evidence	Assigned layer
OGD and interoperability	Open/public data, repositories, data spaces, metadata, harmonization, APIs	Augmenting Retail Data with Open Data; An Open-data Repository for Sustainable Tourism	Layer 1
Analytics capability	Big data, machine learning, sentiment,	AURORA sentiment-based model;	Layer 2

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Coding category	Operational indicators	Representative selected evidence	Assigned layer
	prediction, explainability, scenarios	TripAdvisor predictive recommendation model	
Decision support and visualization	DSS, geo-dashboard, maps, indicators, recommendations, explanatory notes	Spatial DSS for tourism planning; Tourism Data Space geo-dashboard	Layer 3
Governance control	Ownership, stewardship, privacy, ethics, accountability, barriers, coordination	Digital twins and big-data governance; Smart destinations as open-data providers	Layer 4
Outcome evaluation	Sustainability indicators, service quality, community benefit, environmental pressure	Tourism Sustainability Index; SOSTUR; EU regional sustainability indicator	Layer 5

Coding was conducted in two stages. First, deductive codes were defined from the research objectives and the five intended design concerns: OGD and interoperability, analytics capability, decision support and visualization, governance control, and tourism outcome evaluation. Second, inductive coding was applied to titles, abstracts, keywords, and relevant full-text passages to capture recurring mechanisms such as metadata harmonization, API readiness, explainability, privacy, stakeholder coordination, sustainability indicators, and feedback loops. A document could support more than one layer. The first author performed the initial coding, the co-authors cross-checked the assignments, and disagreements were resolved by consensus against the inclusion criteria and research objectives. Representative coded themes were metadata harmonization and API readiness for Layer 1, prediction and explainability for Layer 2, dashboards and traceable decision notes for Layer 3, privacy and data stewardship for Layer 4, and sustainability indicators and feedback loops for Layer 5, as shown in Table 3.

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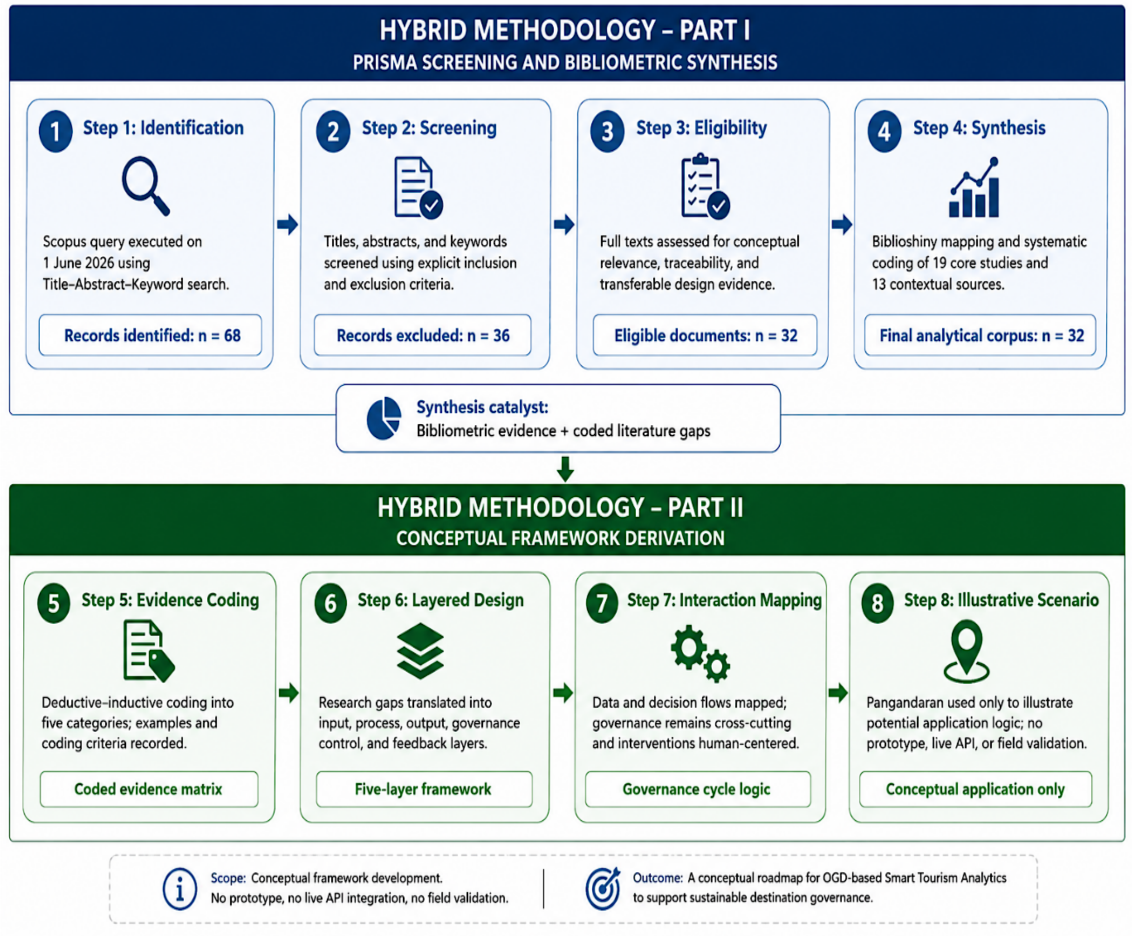

Figure 1. Hybrid review methodology for conceptual framework derivation and illustrative application

2.2. Hybrid Review Methodology

Figure 1 operationalizes the hybrid review methodology through eight sequential steps that connect PRISMA screening, bibliometric mapping, qualitative synthesis, and conceptual framework derivation. Combining bibliometric and framework-based review methods enables quantitative mapping to be integrated with structured conceptual interpretation [27], [28], while the framework-building stage follows the systematic identification, categorization, integration, and synthesis of concepts [29]. The procedure was designed to preserve traceability from the initial database search to the final illustrative scenario. The activity performed and method applied at each step are described as follows.

2.2.1. Identification

A structured Scopus search was executed on 1 June 2026 using the Title-Abstract-Keyword field and the Boolean query reported above. The search covered publications from 2021 to 2026 and produced 68 records. The method used was a structured database identification procedure guided by the identification principles of PRISMA 2020 [25].

2.2.2. Screening

The titles, abstracts, and author keywords of all 68 records were checked against the inclusion and exclusion criteria in Table 1. Duplicate checking was performed using DOI and bibliographic metadata, after which 36 records were excluded because they lacked sufficient relevance to tourism analytics, OGD, governance, decision support, or sustainability. The method used was PRISMA-based title-abstract-keyword screening, conducted by the first author and cross-checked by the co-authors [25].

2.2.3. Eligibility

The full texts of the remaining 32 documents were assessed for conceptual relevance, source traceability, and the transferability of evidence to framework design. Because the corpus combined empirical, conceptual, review, and system-design studies, a relevance and traceability appraisal was used instead of a numerical quality score. The method used was full-text eligibility assessment following PRISMA logic, supported by predefined evidence criteria [25].

2.2.4. Synthesis

The bibliographic metadata of the 32 eligible documents were processed in Biblioshiny/Bibliometrix to calculate corpus indicators, annual production, source distribution, author-keyword frequencies, co-occurrence communities, thematic-map positions, and trend topics. The documents were then classified as 19 core studies and 13 contextual evidence sources. The method used was bibliometric science mapping with Biblioshiny [26], integrated into a hybrid bibliometric and framework-based synthesis [27], [28].

2.2.5. Evidence Coding

The selected literature was coded through a two-stage deductive-inductive procedure. Deductive codes were derived from the research objectives and five design concerns, while inductive codes captured recurring mechanisms such as metadata harmonization, API readiness, explainability, privacy, stakeholder coordination, sustainability indicators, and feedback loops. The method used was qualitative evidence coding and conceptual framework analysis [29]; assignments were cross-checked by the co-authors and resolved by consensus.

2.2.6. Layered Design

The five coded categories were translated into architectural layers by linking each research gap to a system-design problem, a design requirement, and a framework component. Layer 1 represents governed data input, Layer 2 analytical processing, Layer 3 decision-support output, Layer 4 cross-cutting governance control, and Layer 5 outcome evaluation. The method used was layered enterprise-architecture reasoning, which separates concerns while preserving relationships among data, processes, outputs, controls, and evaluation [30], [31].

2.2.7. Interaction Mapping

The relationships among the five layers were mapped as an input-process-output sequence with governance controls operating across the first three layers and verified outcomes feeding back into future data and analytical decisions. Human authorization was retained for all interventions. The method used was conceptual interaction mapping and governance-cycle synthesis, informed by enterprise architecture, destination-governance, and carrying-capacity principles [30], [31], [32], [33].

2.1.8. Illustrative Scenario

After the framework had been derived, Pangandaran was used to demonstrate how the five layers could be applied to a coastal destination through potential data sources, analytics, visualization, governance checks, and outcome indicators. No primary data, prototype, live API, field test, or stakeholder evaluation was used at this step. The method used was a scenario-based conceptual illustration intended to test the internal logic and communicability of the framework, not its empirical effectiveness [32], [33], [34].

3. RESULTS AND DISCUSSION

3.1. Results

This subsection reports the direct outputs of the Scopus screening, Biblioshiny analysis, and evidence-coding process. The reported results include corpus characteristics, annual publication counts, publication sources, keyword frequencies, co-occurrence communities, thematic-map positions, trend topics, and the five coded research gaps.

3.1.1. Characteristics of Bibliometric Dataset

Figure 2 reports the principal metrics of the selected literature corpus. The dataset contains 32 documents from 26 publication sources published between 2021 and 2026. It includes 123 authors, 161 author keywords, and 4,538 cited references. The average document age is 2.06 years, the average citation count is 8.531 per document, the average number of co-authors is 3.94 per document, and the international co-authorship rate is 15.62%.

Figure 2. Main characteristics of the bibliometric dataset

3.1.2. Annual Scientific Production Trends

Figure 3 and Table 4 report annual publication counts of 1 document in 2021, 5 in 2022, 7 in 2023, 6 in 2024, 8 in 2025, and 5 in 2026. The 2025 count is the highest among the complete publication years. The 2026 count represents a partial-year record because the Scopus metadata were exported on 1 June 2026.

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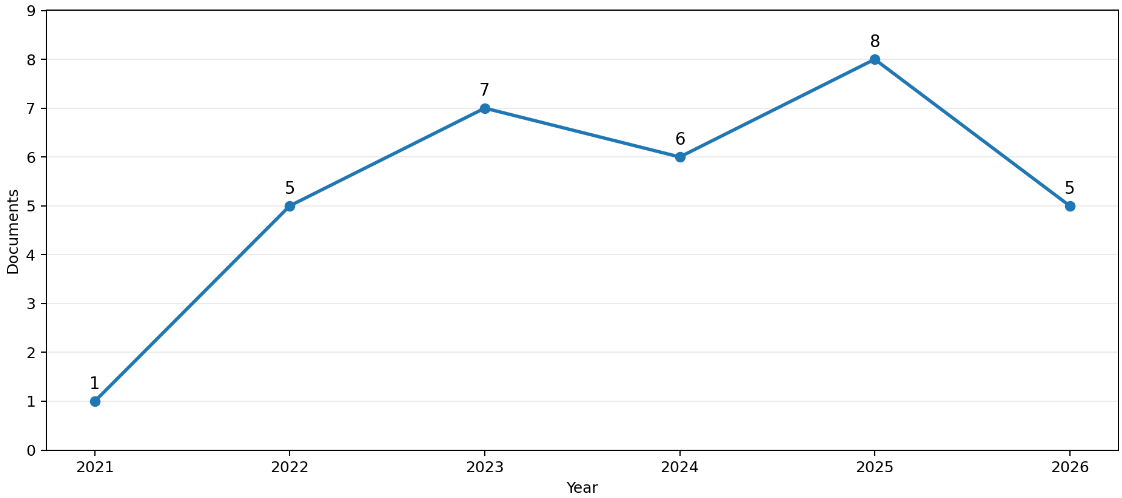

Figure 3. Annual scientific production trends period 2021–2026

Table 4. Annual publication counts in the selected Scopus corpus

Year	Documents	Status
2021	1	Complete year
2022	5	Complete year
2023	7	Complete year
2024	6	Complete year
2025	8	Highest complete-year count
2026	5	Partial-year records as of 1 June 2026
Total	32	Final analytical corpus

3.1.3. Distribution of Relevant Publication Sources

Figure 4 presents the ten most frequent publication sources. The selected documents are distributed across journals and proceedings in sustainability, information systems, smart cities, geography, public-sector data, and tourism management. Sustainability (Switzerland) contributes the largest number of documents in the corpus, while the remaining documents are distributed across several smart-city, information-system, data, and tourism outlets.

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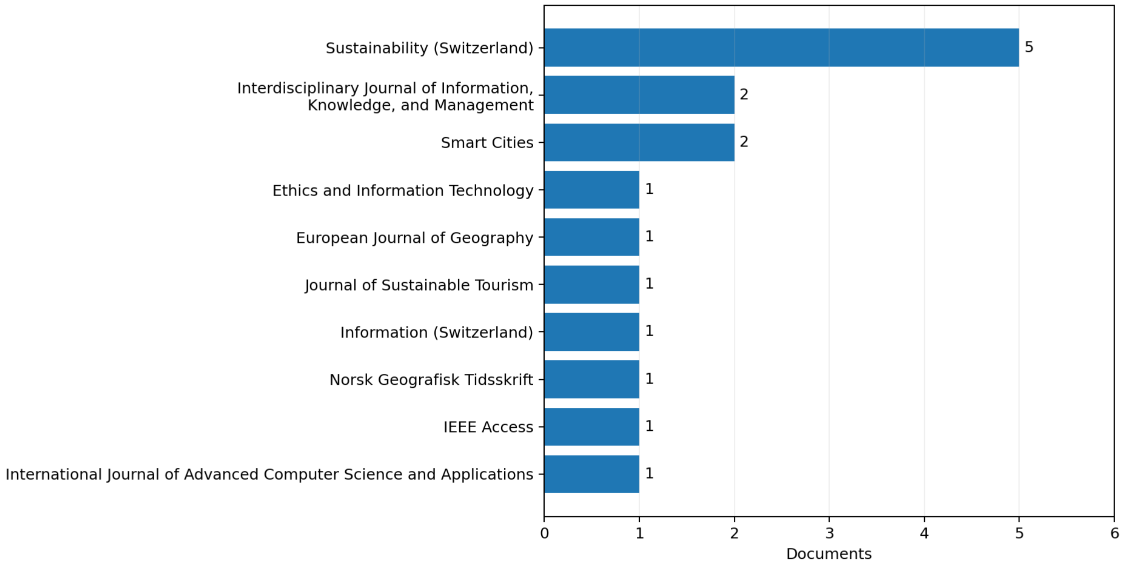

Figure 4. Distribution of the ten most frequent publication sources

3.1.4. Keyword Co-occurrence and Cluster Results

Figure 5 contains the most visible author-keyword nodes: tourism, sustainability, tourism management, smart tourism, open data, big data, machine learning, and decision making. The network contains four color-coded communities: sustainability-tourism development, tourism management and open data, tourism analytics, and smart tourism-sustainable development. The corresponding node counts and dominant terms are reported in Table 5.

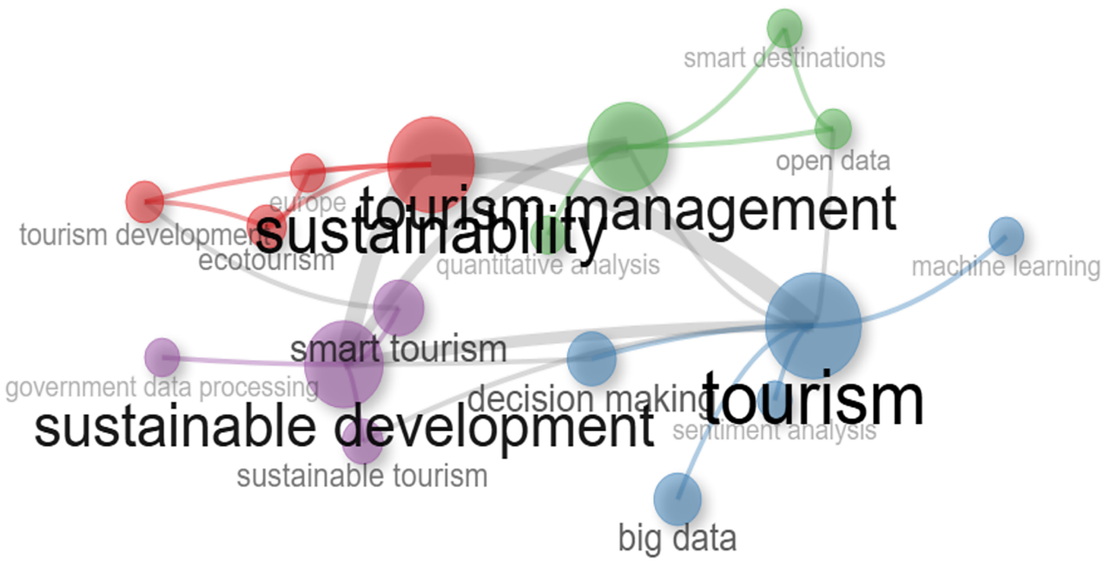

Figure 5. Author keywords co-occurrence network

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The sustainability-tourism-development community contains five nodes, the tourism-management/open-data community contains three nodes, the tourism-analytics community contains five nodes, and the smart-tourism/sustainable-development community contains five nodes. Some low-frequency nodes are displayed without labels in the Biblioshiny export; therefore, Table 5 reports cluster size as node count rather than labeled-term count. Table 6 separately reports the ten most frequent author keywords.

Table 5. Co-occurrence network cluster sizes

Cluster	Node count	Dominant terms
Sustainability-tourism development	5	Sustainability, tourism development, ecotourism, Europe, and a low-frequency quantitative node
Tourism management and open data	3	Tourism management, smart destinations, and open data
Tourism analytics	5	Tourism, machine learning, decision making, sentiment analysis, and big data
Smart tourism and sustainable development	5	Smart tourism, sustainable development, government data processing, sustainable tourism, and one low-frequency node

Table 6. Most frequent author keywords in the 32-document corpus

Author keyword	Frequency
big data	5
smart tourism	5
tourism	4
sustainability	3
open data	3
smart destinations	3
sentiment analysis	3
tourism data space	3
sustainable development	2
sustainable tourism	2

Figure 6 places sustainability, tourism management, and ecotourism in the motor-theme quadrant. Smart tourism, tourism development, open data, machine learning, and government data processing are located closer to the basic-theme quadrant. The remaining themes are distributed across the niche and emerging-or-declining quadrants shown in the Biblioshiny output. The exported Biblioshiny figure provides quadrant positions but does not include the underlying numerical centrality and density values. To avoid unsupported precision, this study reports the qualitative motor-, basic-, niche-, and emerging/declining-theme positions shown in Figure 6; numerical centrality and density should be exported directly from Biblioshiny in a future reproducibility package.

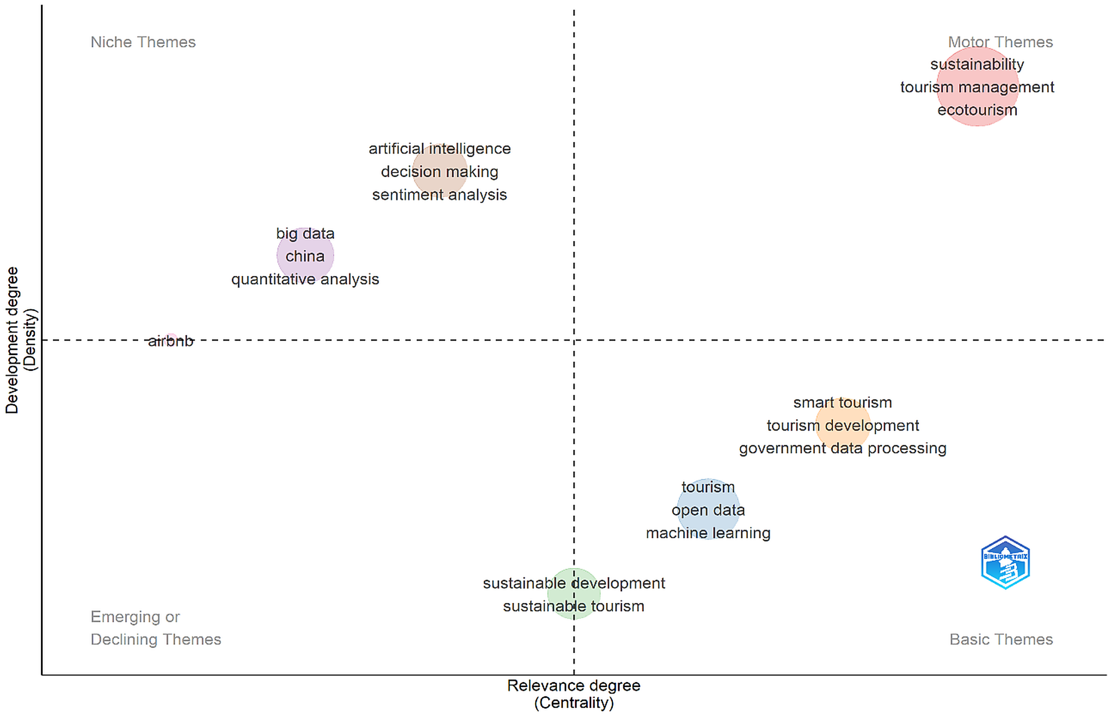

Figure 6. Thematic map of the smart tourism research domain

3.1.5. Thematic Map, Trend Topics, and Synthesized Research Gaps

Figure 7 displays earlier occurrences of big data and sustainable development and later occurrences of tourism management, sustainability, and smart tourism. Bubble size represents the frequency measure generated by the Biblioshiny trend-topic function. Table 6 reports exact frequencies from the Author Keywords field; therefore, the numerical values in Table 6 and the bubble sizes in Figure 7 represent different bibliometric outputs.

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The synthesis of the 32 selected documents identifies five major gaps. First, OGD and tourism analytics are often discussed separately, leaving weak integration between public-data publication and destination decision needs. Second, many analytics studies prioritize prediction or classification but provide limited governance mechanisms for data quality, interoperability, privacy, stewardship, and accountability. Third, decision-support visualization is often presented as a dashboard function without sufficient explanation of stakeholder interpretation, uncertainty, and auditability. Fourth, sustainable-tourism studies emphasize environmental and socio-economic outcomes but are less connected to operational data pipelines and feedback mechanisms. Fifth, OGD implementation in developing-country and tourism contexts continues to face institutional coordination, data-quality, interoperability, API-readiness, and data-use challenges. These gaps are mapped to the framework layers in Table 7.

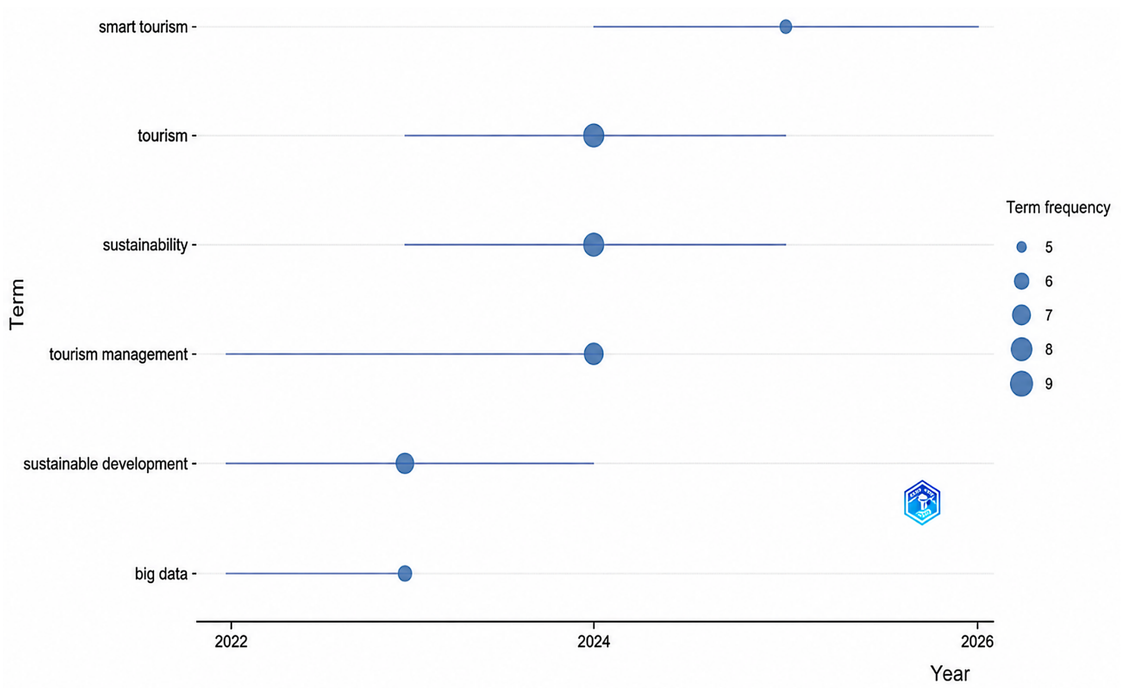

Figure 7. Evolution of trend topics based on publication timeline

3.2. Discussion

The results reveal an expanding but conceptually fragmented research field. The concentration of publications after 2022, the dispersion across 26 sources, and the four keyword communities indicate that tourism analytics, OGD, sustainability, and governance are developing in parallel rather than as a unified design problem. This pattern is

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consistent with smart tourism research that emphasizes data-enabled destination value [1], [2], [3]. OGD ecosystem research that emphasizes reuse and stakeholder capability [4], [5], [6], [7], [8], [9], and destination-governance research that emphasizes coordination and accountability [13], [32], [33].

The keyword and thematic results show that open data is connected to smart destinations and tourism management, but governance-related mechanisms are less visible than technology and analytics terms. This imbalance explains the coded gaps in interoperability, API readiness, privacy, stewardship, and auditability. OGD publication therefore cannot be treated as the endpoint of the data lifecycle: operational value depends on explicit ownership, metadata standards, stable identifiers, quality checks, licensing, privacy assessment, and coordination among data-producing institutions [4], [5], [6], [7], [8], [9], [15], [16], [17], [18], [19], [20], [21], [22], [23], [24]. Without these controls, analytical outputs may combine incompatible or outdated records and remain difficult to audit.

The motor-theme position of sustainability and tourism management, together with the later appearance of governance-oriented trend topics, indicates that analytical performance must be connected to destination outcomes. Government agencies, destination managers, tourism businesses, communities, and environmental stakeholders must interpret evidence against carrying capacity, service quality, community benefit, distributional effects, and accountability requirements [13], [32], [33]. Accordingly, the framework is designed as decision support for authorized human deliberation rather than as an automated intervention mechanism.

3.2.1. Basis for the Proposed Governance Cycle

The use of a governance cycle is supported by three complementary foundations. First, layered enterprise architecture separates data input, analytical processing, decision-support output, control, and evaluation while preserving traceability among them [30], [31]. Second, OGD ecosystem research shows that value creation is iterative: data quality, metadata, interoperability, stewardship, privacy, reuse, and institutional coordination must be checked repeatedly rather than only at publication [4], [5], [6], [7], [8], [9], [15], [16], [17], [18], [19], [20], [21], [22], [23], [24], [35]. Third, sustainable destination governance requires the effects of decisions on carrying capacity, service quality, community benefit, and environmental pressure to be evaluated and returned to subsequent planning [13], [32],

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[33], [34]. These foundations justify a cycle instead of a one-way analytics pipeline. Table 7 shows how the identified evidence and research gaps were translated into the five framework layers.

Table 7. Traceability from selected literature and research gaps to framework layers

Research Gap	Evidence from Synthesis	Design Implication	Framework Layer
Fragmented OGD sources and uneven interoperability.	Selected evidence includes Augmenting Retail Data With Open Data, An Open-data Repository for Sustainable Tourism, and the Tourism Data Space studies. These sources show the need for harmonisation, metadata, provenance, and reusable data infrastructure.	Define data standards, metadata checks, source provenance, and ingestion rules.	Layer 1: OGD Integration
Analytics capability is separated from governance needs.	Selected evidence includes the AURORA sentiment model, the TripAdvisor predictive recommendation model, and the cultural-tourism harmonisation framework. These studies demonstrate analytical potential but also the need for explainability and data-quality controls.	Develop analytics modules only after data quality, legality, and interpretability requirements are specified.	Layer 2: Smart Analytics Engine
Analytical outputs are difficult for stakeholders to interpret.	Selected evidence includes the spatial tourism DSS, the tourism geo-dashboard, and early destination recommendation studies. These sources support maps, indicators, recommendations, and explanatory decision artifacts.	Translate analytics into understandable visual summaries, measurable indicators, and traceable decision notes.	Layer 3: Decision Support and Visualization

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Research Gap	Evidence from Synthesis	Design Implication	Framework Layer
Sustainability and ethics are not always embedded in analytics workflows.	Selected evidence includes Digital Twins, Big Data Governance, and Sustainable Tourism and Smart Tourism Destinations as Open Data Providers. These sources emphasize privacy, stewardship, institutional barriers, accountability, and policy alignment.	Place governance as a cross-cutting control layer for privacy, auditability, data ethics, and policy alignment.	Layer 4: Sustainable Destination Governance
Smart tourism initiatives often lack long-term impact evaluation.	Selected evidence includes the Tourism Sustainability Index, SOSTUR, and the EU regional sustainability indicator. These studies support measurable economic, social, environmental, service-quality, and feedback indicators.	Define outcome indicators and feedback loops for continuous improvement.	Layer 5: Tourism Outcome Evaluation

3.2.2. Governance Cycle Architecture and Layer Interaction

Figure 8 operationalizes the evidence base as a five-layer governance cycle. Layer 1 provides governed inputs through OGD integration, metadata, provenance, and data-quality checks. Layer 2 transforms those inputs into descriptive, diagnostic, predictive, or prescriptive evidence and attaches explainability, uncertainty, and data-quality warnings. Layer 3 communicates the evidence through dashboards, maps, indicators, alerts, recommendations, and explanatory notes. Layer 4 acts across Layers 1-3 to enforce ownership, stewardship, privacy, ethics, interoperability, auditability, institutional coordination, and carrying-capacity alignment. Layer 5 evaluates service, community, environmental, and stakeholder outcomes and feeds verified findings back to Layers 1 and 2. The framework is therefore suitable for uses that require iterative learning, auditable data-to-decision traceability, and human authorization; it is not intended to execute interventions automatically.

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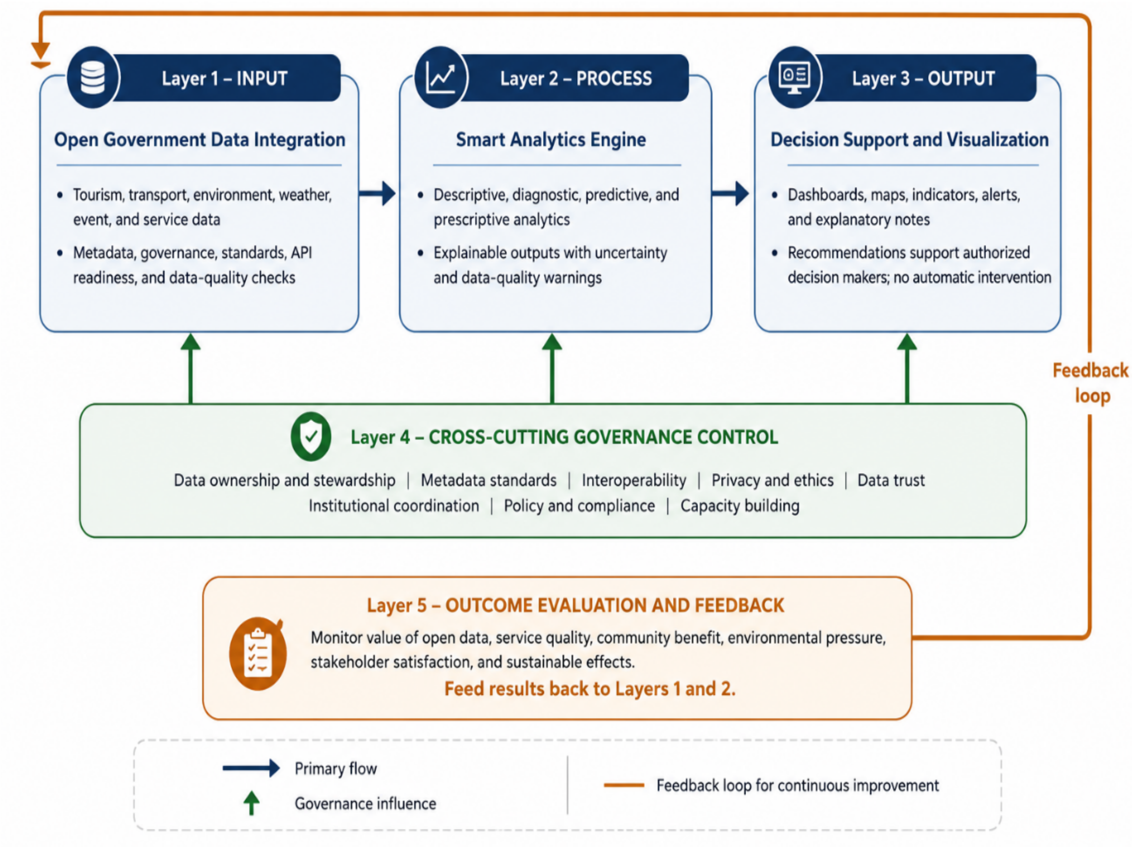

Figure 8. Input-process-output governance cycle with cross-cutting control and outcome feedback

3.2.3. Technical Interaction Scenario and Pangandaran Illustrative Use Case Illustrative technical interaction scenario:

The following scenario demonstrates the internal use logic of the governance cycle if an operational prototype and live data integration were developed. It is a conceptual application derived after the literature synthesis, not an empirical implementation. Consequently, it does not demonstrate technical performance, stakeholder acceptance, or policy effectiveness, and any intervention would remain the responsibility of authorized institutions and stakeholders.

1) Layer 1 (OGD Integration): Public and organizational datasets, such as visitor counts, transport flow, weather, event schedules, facilities, and waste management records, would be standardized and documented using metadata, source provenance, and update-frequency rules before being used by the analytics layer.

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2) Layer 2 (Smart Analytics Engine): The analytics module would process standardized data to identify patterns, estimate destination pressure, detect abnormal visitor-flow signals, and summarize tourist sentiment. The output should be interpreted as decision-support evidence, not as an automatic policy command.
3) Layer 3 (Decision Support and Visualization): Validated outputs would be visualized through maps, indicators, alerts, and explanatory notes. These outputs can recommend options such as visitor-flow redistribution, additional sanitation services, or information campaigns, but actual intervention remains a human governance decision.
4) Layer 4 (Sustainable Destination Governance): Before analytical outputs are communicated to decision makers, this layer would check data legality, privacy risk, carrying-capacity assumptions, policy alignment, and possible bias. This layer prevents the framework from being reduced to a purely technical dashboard.
5) Layer 5 (Tourism Outcome Evaluation): After a decision is implemented by authorized stakeholders, this layer would evaluate changes in visitor distribution, community benefit, service quality, environmental pressure, and stakeholder feedback. The results would be used as a feedback loop for improving future data and analytics design.

3.2.4. Illustrative application scenario: Pangandaran tourism area:

Pangandaran, West Java, is used to contextualize how the proposed framework could be applied in a coastal destination. Potential implementation would need to verify the availability and suitability of relevant official data before any operational use. Coastal destinations commonly face visitor-flow, accessibility, service-quality, and environmental-pressure issues. The following description is a conceptual application scenario only; it does not represent a live system, field experiment, stakeholder evaluation, or empirically validated application.

1) Application of Layer 1 in Pangandaran: For a future implementation, potential data categories may include visitor counts, tourist attraction data, transport accessibility, weather information, event calendars, facilities, and environmental service records. Their actual availability and suitability would need to be verified through relevant official sources before implementation.

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Each available dataset would then be assessed for format, update frequency, metadata completeness, API documentation, interoperability, and data-use limitations [15], [18], [22], [23], [24].

2) Application of Layer 2 in Pangandaran: If data quality and access requirements are met, analytics could estimate visitor concentration, seasonal trends, potential service bottlenecks, and tourist sentiment. These outputs would remain exploratory until validated using real data pipelines and stakeholder feedback.
3) Application of Layer 3 in Pangandaran: The dashboard concept could present destination heatmaps, trend indicators, service-pressure alerts, and explanatory notes for local government, destination managers, MSMEs, and community stakeholders. The dashboard should recommend options rather than automatically execute interventions.
4) Application of Layer 4 in Pangandaran: The governance layer would define privacy safeguards, data-sharing responsibilities, metadata standards, audit trails, and policy-alignment checks. It would also clarify which decisions can be supported by OGD and which decisions require additional field data or stakeholder deliberation.
5) Application of Layer 5 in Pangandaran: The outcome layer would evaluate whether analytics-supported decisions improve visitor distribution, destination service quality, MSME participation, community benefit, and environmental pressure reduction. These indicators should be validated through future field studies.

4. CONCLUSION

This study formulates an initial conceptual governance framework for Smart Tourism Analytics based on Open Government Data. Through PRISMA-based screening and Biblioshiny analysis of 32 Scopus documents - 19 core studies and 13 contextual evidence sources - the study identifies five integration gaps concerning OGD interoperability, analytics readiness, decision-support visualization, governance control, and sustainability outcome evaluation. Its contribution is the integration and synthesis of established ideas into a five-layer roadmap, not the creation of a fully new theory or a validated operational solution. The limitations are explicit: no working prototype was developed;

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no live API was integrated; no field test was conducted; and no stakeholder evaluation was performed. Pangandaran serves only as an illustrative application context and does not constitute empirical validation. The Scopus-only database scope and the absence of numerical thematic-map centrality and density values also constrain the generalizability and reproducibility of the current findings. Future research should develop a Minimum Viable Product, integrate real OGD and API sources, test metadata and interoperability rules, implement privacy and audit controls, evaluate dashboard usability and decision usefulness, and conduct field validation with local governments, destination managers, tourism businesses, MSMEs, and community stakeholders. Claims regarding operational effectiveness or policy impact should be made only after these evaluations are completed.

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REFERENCES

[1] U. Gretzel, M. Sigala, Z. Xiang, and C. Koo, "Smart tourism: foundations and developments," *Electronic Markets*, vol. 25, no. 3, pp. 179–188, 2015, doi: 10.1007/s12525-015-0196-8.

[2] I. Sustacha, J. F. Baños-Pino, and E. Del Valle, "The role of technology in enhancing the tourism experience in smart destinations: A meta-analysis," *Journal of Destination Marketing & Management*, vol. 30, p. 100817, 2023, doi: 10.1016/j.jdmm.2023.100817.

[3] Y. El Archi, B. Benbba, Z. Nizamatdinova, Y. Issakov, G. I. Vargáné, and L. D. Dávid, "Systematic literature review analysing smart tourism destinations in context of sustainable development: Current applications and future directions," *Sustainability*, vol. 15, no. 6, p. 5086, 2023, doi: 10.3390/su15065086.

[4] G. C. Wiedenhöft, R. Matheus, S. Saxena, and C. Alexopoulos, "Barriers towards Open Government Data value co-creation: An empirical investigation," *The Electronic*

Journal of Information Systems in Developing Countries, vol. 89, no. 5, p. e12270, 2023, doi: 10.1002/isd2.12270.

[5] J. Linåker and P. Runeson, "How to enable collaboration in Open Government Data ecosystems: A public platform provider's perspective," *JeDEM: eJournal of eDemocracy and Open Government*, vol. 13, no. 1, pp. 1–30, 2021, doi: 10.29379/jedem.v13i1.634.

[6] M. M. Khurshid, N. H. Zakaria, A. Rashid, M. N. Ahmad, M. I. Arfeen, and H. M. F. Shehzad, "Modeling of Open Government Data for public sector organizations using the potential theories and determinants—A systematic review," *Informatics*, vol. 7, no. 3, p. 24, 2020, doi: 10.3390/informatics7030024.

[7] A. van den Berg, M. Hoekstra, and A. F. van Veenstra, "Government data ecosystems for addressing societal challenges: Lessons from two cases in the Netherlands," *Data Policy*, vol. 7, p. e79, 2025, doi: 10.1017/dap.2025.10018.

[8] A. Shaharudin, B. van Loenen, and M. Janssen, "Exploring the contributions of open data intermediaries for a sustainable open data ecosystem," *Data Policy*, vol. 6, p. e56, 2024, doi: 10.1017/dap.2024.63.

[9] B. W. Wirtz, J. C. Weyerer, M. Becker, and W. M. Müller, "Open government data: A systematic literature review of empirical research," *Electronic Markets*, vol. 32, no. 4, pp. 2381–2404, 2022, doi: 10.1007/s12525-022-00582-8.

[10] Z. Qin and Y. Pan, "Design of a smart tourism management system through multisource data visualization-based knowledge discovery," *Electronics (Basel)*, vol. 12, no. 3, p. 642, 2023, doi: 10.3390/electronics12030642.

[11] R. Agrawal, V. A. Wankhede, A. Kumar, S. Luthra, and D. Huisingh, "Big data analytics and sustainable tourism: A comprehensive review and network based analysis for potential future research," *International Journal of Information Management Data Insights*, vol. 2, no. 2, p. 100122, 2022, doi: 10.1016/j.jjimei.2022.100122.

[12] A. Aguirre Montero and J. A. López-Sánchez, "Intersection of data science and smart destinations: A systematic review," *Front. Psychol.*, vol. 12, p. 712610, 2021, doi: 10.3389/fpsyg.2021.712610.

[13] L. Errichiello and R. Micera, "A process-based perspective of smart tourism destination governance," *European Journal of Tourism Research*, vol. 29, p. 2909, 2021, doi: 10.54055/ejtr.v29i.2436.

[14] B. H. Ye, H. Ye, and R. Law, "Systematic review of smart tourism research," *Sustainability*, vol. 12, no. 8, p. 3401, 2020, doi: 10.3390/su12083401.

[15] Emigawaty and A. Syafrianto, "Data quality analysis on Open Government Data portals: A qualitative study using ISO/IEC 25012:2008 standards," *Journal of Information Systems and Informatics*, vol. 6, no. 2, pp. 1317–1345, 2024, doi: 10.51519/journalisi.v6i2.862.

[16] I. Kawashita, A. A. Baptista, D. Soares, and M. Andrade, "Open government data use: The Brazilian states and federal district cases," *PLoS One*, vol. 19, no. 3, p. e0298157, 2024, doi: 10.1371/journal.pone.0298157.

[17] A. Almuqrin, I. Mutambik, A. Alomran, J. Gauthier, and M. Abusharhah, "Factors influencing public trust in open government data," *Sustainability*, vol. 14, no. 15, p. 9765, 2022, doi: 10.3390/su14159765.

[18] A. Bernot *et al.*, "Institutional dimensions in open government data: A deep dive into Indonesia's Satu Data initiative and its implications for developing countries," *Public Performance & Management Review*, vol. 47, no. 6, pp. 1399–1429, 2024, doi: 10.1080/15309576.2024.2377609.

[19] S. Kempeneer, A. Pirannejad, and J. Wolswinkel, "Open government data from a legal perspective: An AI-driven systematic literature review," *Gov. Inf. Q.*, vol. 40, no. 3, p. 101823, 2023, doi: 10.1016/j.giq.2023.101823.

[20] M. Barati, "Open government data programs and information privacy concerns: A literature review," *eJournal of eDemocracy and Open Government*, vol. 15, no. 1, pp. 73–123, 2023, doi: 10.29379/jedem.v15i1.759.

[21] Z. Zainuddin and E. A. P. Akhir, "Systematic literature review of data quality in open government data: Trend, methods, and applications," *IEEE Access*, vol. 12, pp. 148466–148487, 2024, doi: 10.1109/ACCESS.2024.3475577.

[22] V. Raca, G. Velinov, S. Dzalev, and M. Kon-Popovska, "A framework for evaluation and improvement of open government data quality: Application to the Western Balkans national open data portals," *Sage Open*, vol. 12, no. 2, 2022, doi: 10.1177/21582440221104813.

[23] M. A. Celdrán-Bernabéu, J.-N. Mazón, D. Giner-Sánchez, J. Morales-García, and M. P. Peñarrubia-Zaragoza, "Smart tourism destinations as open data providers: Barriers and opportunities," *Journal of Destination Marketing & Management*, vol. 40, p. 101065, 2026, doi: 10.1016/j.jdmm.2025.101065.

[24] W. Muhamad, Suhardi, and Y. Bandung, "Transforming OpenAPI Specification 3.0 documents into RDF-based semantic web services," *J. Big Data*, vol. 9, p. 55, 2022, doi: 10.1186/s40537-022-00600-8.

ISI Journal of Information Systems and Informatics
Published By Asosiasi Doktor Sistem Informasi Indonesia

[25] M. J. Page *et al.*, "The PRISMA 2020 statement: An updated guideline for reporting systematic reviews," *BMJ*, vol. 372, p. n71, 2021, doi: 10.1136/bmj.n71.

[26] H. Mondal, "A technical note on bibliometric analysis by Biblioshiny and VOSviewer," *Indian Journal of Radiology and Imaging*, vol. 36, no. 2, pp. 167–174, 2026, doi: 10.1055/s-0045-1810060.

[27] Q. Shi and L. Shen, "Advancing firm-level digital technology diffusion: A hybrid bibliometric and framework-based systematic literature review," *Systems*, vol. 13, no. 4, p. 262, 2025, doi: 10.3390/systems13040262.

[28] M. Azarian, H. Yu, A. T. Shiferaw, and T. K. Stevik, "Do we perform systematic literature review right? A scientific mapping and methodological assessment," *Logistics*, vol. 7, no. 4, p. 89, 2023, doi: 10.3390/logistics7040089.

[29] Y. Jabareen, "Building a conceptual framework: Philosophy, definitions, and procedure," *Int. J. Qual. Methods*, vol. 8, no. 4, pp. 49–62, 2009, doi: 10.1177/160940690900800406.

[30] B. Anthony Jnr, "Managing digital transformation of smart cities through enterprise architecture - a review and research agenda," *Enterp. Inf. Syst.*, vol. 15, no. 3, pp. 299–331, 2021, doi: 10.1080/17517575.2020.1812006.

[31] R. Ansyori, N. Qodarsih, and B. Soewito, "A systematic literature review: Critical success factors to implement enterprise architecture," *Procedia Comput. Sci.*, vol. 135, pp. 43–51, 2018, doi: 10.1016/j.procs.2018.08.148.

[32] T. B. Dangi and J. F. Petrick, "Augmenting the role of tourism governance in addressing destination justice, ethics, and equity for sustainable community-based tourism," *Tourism and Hospitality*, vol. 2, no. 1, pp. 15–42, 2021, doi: 10.3390/tourhosp2010002.

[33] X. Dong, S. Gao, A. Xu, Z. Luo, and B. Hu, "Research on tourism carrying capacity and the coupling coordination relationships between its influencing factors: A case study of China," *Sustainability*, vol. 14, no. 22, p. 15124, 2022, doi: 10.3390/su142215124.

[34] M. Hara, T. Nagao, S. Hannoe, and J. Nakamura, "New key performance indicators for a smart sustainable city," *Sustainability*, vol. 8, no. 3, p. 206, 2016, doi: 10.3390/su8030206.

[35] M. D. Wilkinson *et al.*, "The FAIR Guiding Principles for scientific data management and stewardship," *Sci. Data*, vol. 3, p. 160018, 2016, doi: 10.1038/sdata.2016.18.