Architectural Frameworks in Destination Management Systems for Low-Density Regions: A Systematic Review

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Abstract

This systematic review investigates the structures of Destination Management Systems (DMS) in low-density regions. These regions are known for their unique cultural and natural assets but face challenges due to limited infrastructure and accessibility. With the tourism industry embracing digital transformation, DMS are becoming essential tools for leveraging these unique features to attract tourists. They help address challenges such as promoting lesser-known attractions and overcoming marketing limitations. The review emphasizes the significance of advanced technologies such as Big Data, IoT, AI, and machine learning in revolutionizing DMS. These technologies enable real-time data analysis and adaptive responses to the ever-changing tourism landscapes. By analyzing articles, conference papers, and case studies published between 2013 and 2024, the study explores the balance between scalability, trackability, agility, and maintainability in DMS architectures, which is crucial for destinations with limited resources. The review identifies various approaches to DMS design and implementation,

demonstrating their effectiveness in different contexts. The results demonstrate the positive impact of these systems on the competitiveness and appeal of destinations by improving their visibility and accessibility. The analysis stresses the importance of continuous research on the technical aspects of implementing destination management systems and incorporating new technologies. This forward-looking approach is essential for further enhancing destination management and improving the tourist experience in the changing tourism industry, especially in less populated areas where the use of digital tools can greatly influence visibility and engagement.

Keywords: Destination Management Systems (DMS), Low-Density Regions, Destination Management Organizations (DMO), Tourism, Destination

1 Introduction

1.1 Background

The landscape of tourism management has been profoundly transformed by the advent and integration of advanced digital technologies. Destination Management Systems (DMS), at the forefront of this transformation, have emerged as pivotal tools in enhancing the competitiveness and attractiveness of tourist destinations. These systems encompass a broad range of functions, including but not limited to information aggregation, marketing strategies, resource management, and visitor engagement. The advent of DMS has marked a significant shift from traditional destination management approaches, enabling more dynamic, responsive, and data-driven strategies (João Estêvão and Teixeira, 2020).

The importance of DMS becomes particularly pronounced in the context of low-density regions. These regions, often characterized by sparse population, limited infrastructure, and unique cultural and natural assets, present distinct challenges and opportunities for tourism development. The conventional mass tourism models are typically unsuitable for these areas due to their fragile ecosystems, cultural sensitivity, and infrastructural constraints. Therefore, the design and implementation of DMS in such contexts demand careful consideration of sustainability, local community impact, and preservation of natural and cultural heritage.

Technology's role in DMS is multifaceted, ranging from data collection and analytics to visitor experience enhancement. The emergence of Big Data and IoT (Internet of Things) has opened new avenues for capturing real-time data and insights into visitor behavior, preferences, and patterns (Novera et al., 2022). Such data are invaluable for tailoring services, predicting trends, and making informed decisions that align with sustainable tourism goals (OECD, 2023). Moreover, the integration of technologies like AI and machine learning in DMS architectures contributes to the evolution of adaptive and intelligent systems capable of responding to changing scenarios in real-time.

However, the development of effective DMS architectures in low-density regions requires a balance between several critical attributes: scalability, trackability, agility, and maintainability (Martins et al., 2021). Scalability ensures that the system can accommodate varying levels of user demand and data influx without compromising performance. Trackability involves the system's ability to monitor and analyze tourism dynamics effectively, providing stakeholders with actionable insights. Agility refers to the system's capacity to adapt swiftly to changing market trends, technological advancements, and policy shifts. Lastly, maintainability is crucial for ensuring the system's long-term viability, facilitating updates, and addressing potential challenges without significant overhauls.

The development of DMS architectures that encompass these attributes is a complex task, necessitating an understanding of not just technological capabilities but also the socio-economic and environmental context of low-density regions (Toste et al., 2022). This systematic review, therefore, aims to explore the various architectural approaches undertaken in the development of DMS for low-density regions, examining their effectiveness in addressing these unique requirements and challenges (Choe and Fesenmaier, 2021).

1.2 Purpose

The purpose of this systematic review is to delve into the architectures of Destination Management Systems, particularly in low-density regions. It aims to gather and synthesize insights from a diverse range of scholarly articles, conference papers, and case studies. The review primarily focuses on understanding the structural and technological underpinnings of these systems. Special attention is given to their scalability and adaptability, essential for handling varying demands and adapting to changes in the tourism landscape and technological advancements.

A component of this review is understanding how these systems are integrated within the socio-economic and environmental context of low-density areas. It involves a close look at sustainable tourism practices, community impacts, and the preservation of cultural and natural heritage. Practical implementations and real-world case studies of such systems are scrutinized to draw out successful practices, challenges faced, and lessons learned. The review concludes with a discussion on policy implications and recommendations, aiming to guide the future development and implementation of DMS in these unique regions.

By adopting this approach, the review seeks to offer a comprehensive understanding of current architectures of Destination Management Systems in low-density regions, highlighting their capabilities, challenges, and prospects in the realm of sustainable tourism and technology-driven destination management.

2 Methodology

2.1 Research Questions

In guiding this systematic review the following research questions (RQs) were formulated:

- **RQ1:** *What are the prevailing architectural frameworks and technical features in Destination Management Systems that support scalability, trackability, agility, and maintainability in low-density regions?* This question aims to explore the various architectural designs and technical elements that are employed in DMS, specifically in the context of low-density areas. It seeks to understand how these systems are built to handle scalability, ensure effective tracking and reporting, maintain agility in operations, and facilitate ongoing maintenance and upgrades.
- **RQ2:** *How do existing methodologies in developing DMS address the unique challenges and requirements of low-density regions?* This question delves into the methodological approaches used in the creation and implementation of DMS. It focuses on understanding how these methodologies are tailored to meet the specific challenges and needs of low-density regions, such as limited resources, geographical constraints, and distinct user behaviors.

These research questions are designed to direct the review towards a comprehensive understanding of the technical and methodological aspects of DMS development in low-density regions.

2.2 Selection Criteria

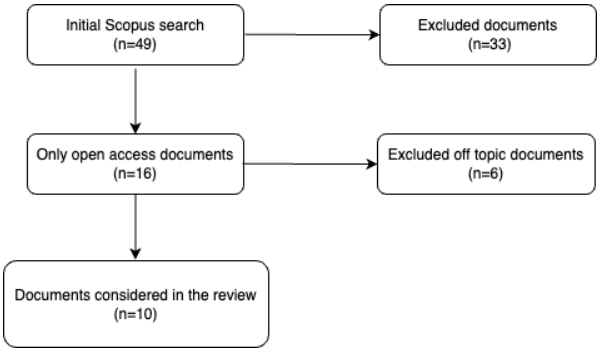

Fig. 1 PRISMA flow diagram

The literature review was meticulously executed using the Scopus database. The specific search string employed was: "destination AND management AND system AND (dms OR dmo)". This string was deliberately constructed to refine the search results, which was a necessary step due to the broad and diverse nature of literature in the fields of destination management and systems. The terms "destination", "management" and "system" on their own are wide-ranging and would yield an overwhelming number of results, many of which may not be directly relevant to the specific focus of this study. Therefore, the inclusion of acronyms "DMS" (Destination Management Systems) and "DMO" (Destination Management Organizations) was a strategic decision to narrow down the search to more pertinent studies. This flow is depicted in Figure 1.

The search spanned from the year 2013 to 2024, encompassing a comprehensive range of contemporary and prospective literature. This timeframe was chosen to ensure that the review includes both recent developments and emerging trends in the field.

The selection criteria for the studies included in this systematic review were defined with the objective of ensuring relevance, quality, and applicability to the research topic. The criteria were as follows:

1. Relevance to Topic: The study must directly address aspects related to Destination Management Systems (DMS) or Destination Management Organizations (DMO), with a particular focus on answering **RQ1** and **RQ2**.
2. Type of Publication: The review included peer-reviewed journal articles, conference papers, and academic publications. This was to ensure the inclusion of high-quality research with rigorous methodologies and well-substantiated findings.
3. Timeframe: Only studies published or scheduled for publication between 2013 and 2024 were considered. This range was chosen to capture both the current state and the evolving nature of the research in this field.
4. Language: Studies published in English were primarily considered, as this allowed for a broader international scope and comparability of findings.

5. Methodological Rigor: Studies that demonstrated clear and sound research methodologies were favored. This included clear articulation of research objectives, methods of data collection and analysis, and well-supported conclusions.
6. Accessibility: Preference was given to studies that were accessible in full-text format, ensuring a thorough review and analysis of their content.

2.3 Data Extraction

In the data extraction phase of this systematic review, a detailed and methodical approach was adopted to ensure comprehensive analysis of the selected studies. The process involved identifying each study that met the selection criteria and recording essential information such as the author(s), publication year, and the source of the publication, which included journals and conferences.

The primary focus and objectives of each study were carefully examined to understand the specific aspects of the DMS being addressed. Particular attention was given to the study context, especially the geographic focus on low-density regions, which is central to this review's theme.

The methodological approach of each study was scrutinized, with key details pertaining to data collection and analysis techniques extracted. This information was critical in assessing the validity and reliability of the findings.

Furthermore, theoretical contributions or practical applications proposed in the studies were noted, as they offer valuable insights for both academic understanding and practical implementation in the field. Finally, suggestions or recommendations for future research mentioned in the studies were also extracted. This helped in identifying gaps in the current literature and potential areas for further investigation.

3 Results

3.1 Excluded Documents

Specific studies were excluded based on their primary focus areas which did not align with the specific requirements of DMS architecture.

Research conducted by (Budimir-Bekan and Pivčević, 2022), (Hristov and Zehrer, 2019), (Weber and Taufer, 2016), and (Luthe and Wyss, 2016) focused on Destination Management Organizations (DMOs). These studies, while pertinent to destination management at a broader level, did not delve into the specific architectural components or technical aspects essential for DMS, particularly in low-density regions.

Furthermore, the works of (Berenguer et al., 2022) and (Aicardi et al., 2015) were oriented towards network applications and analysis. Despite the significance of networks as an important data collection channel to aid in developping information systems, these studies did not contribute directly to the architectural decision-making processes or framework development for DMS.

The exclusion of these studies was thus based on their limited contribution to the specific thematic focus of DMS architecture, as they either addressed broader technological aspects, general functions of DMOs, or applications around networks, rather than providing focused insights into DMS architectural design and implementation.

3.2 Synthesis of Findings

It is worth noting that the papers we have scrutinized vary in how effectively they address our research questions, denoted, once again, as **RQ1** and **RQ2**. This variance reflects the diverse nature of the literature we've engaged with. While some papers provide direct and comprehensive answers to our research inquiries, others contribute in more subtle or tangential ways, offering more nuanced but still usefull insights.

In our quest to identify the most relevant articles, we employed graphical representations, which are visually depicted in Figure 2. Specifically, the plots illustrate the connection between the number of publications considered for analysis in a given year and the subsequent number of citations received by articles published during that same year. Furthermore, our graphical representations reveal an interesting insight.

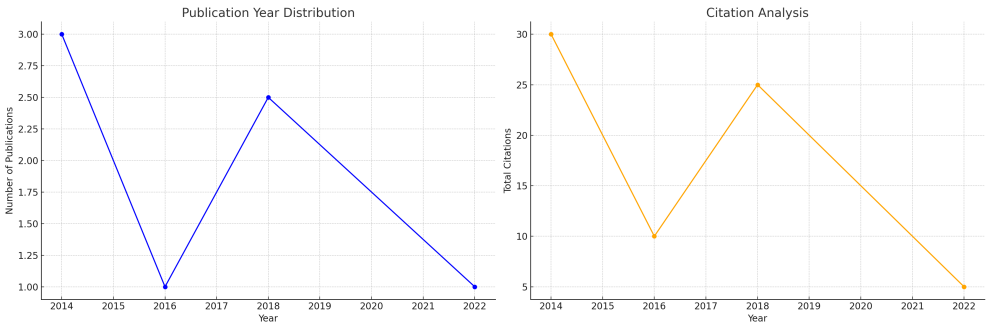

Fig. 2 Absolute Number of Articles by Year and Absolute Number of Citations by Year

They indicate that there isn't a single standout study or article that significantly outshines all others in terms of impact. Instead, our analysis suggests that the influence and relevance of articles in our research field vary considerably.

Broadly speaking, (Sorokina et al., 2022) and (Ammirato et al., 2018) tackle both research questions, (Anh et al., 2022), (Lee, 2023), (Inversini et al., 2014) and (Estêvão et al., 2014) focus on aspects related to **RQ1**, while (Estêvão et al., 2023), (Keil et al., 2017), (Fedyk et al., 2022) and (Borzyszkowski, 2014) can be associated with **RQ2**.

Relative to **RQ1**, (Anh et al., 2022) supports the conclusion that the extent a DMO is aware of the features, costs, benefits and operations mediates the relationship between performance expectancy and the intention to implement a DMS, as well as between social influence and the intention to implement the aforementioned system. In (Inversini et al., 2014), the authors conclude that the a DMS' complexity is not correlated with its success, and implementations therefore should focus on implementing the core use cases (Sorokina et al., 2022) in order to achieve user satisfaction. (Estêvão et al., 2014) cements that these use cases must include the ability to perform transactions and that future implementations must surpass a mere informative role in order to be considered DMSs. Furthermore, they must support specific use cases for DMO agents, serving as a Decision Support System to inform the future direction of the DMO. (Lee, 2023) is focused on developing a model to suggest the best possible

tourist destinations from a set of options. Even thought this does not directly address specific implementation details, it can inform the implementation of such a model in a DMS, based on single-valued neutrosophic triplets.

For **RQ2**, (Estêvão et al., 2023) clarifies that greater resources and a planned vision for the DMS is correlated with positive outcomes, while the existence of alternative web-based competitor systems is implicated with negative outcomes.(Fedyk et al., 2022) does not directly involve DMSs, but shows the vulnerability of DMOs that lack proper tools when faced with a crisis situation, presenting an opportunity for DSM to kick in as a flagship management device. (Borzyszkowski, 2014) asserts that digitalization of DMOs is increasing and the use of DMSs leads to higher efficiency, becoming an evermore necessary tool in order to persuade online customers faced with a plethora of choices. (Keil et al., 2017) analyzes the UX of the Business Intelligence interface of DMSs from the DMO agents' point of view. It concludes, in a similar fashion to what is derived in (Inversini et al., 2014) for the tourist side of the system, that being able to quickly perform core tasks is more important than to provide more fine-tuned, harder to grasp controls.

Concerning both **RQs**, (Sorokina et al., 2022) concludes that DMSs should not only provide information on attractions and utilities as well as allow for transaction to made directly on the platform, but should also have a brand identity, promoting the destination itself as a brand, impacting the tourist's perception of the destination. (Ammirato et al., 2018) supports the notion that mobile devices, sensors, IoT and AI applied to big data extracted from DMSs, have all a positive impact on the success of these systems, contributing independently as well as in tandem for the system and the destination.

4 Discussion

The research papers discussed in the previous section undoubtedly offer valuable insights into the realm of DMSs, shedding light on various aspects related to their functionality and effects. These studies provide essential contributions to our understanding of DMSs, elucidating key considerations that impact their success and effectiveness in the tourism industry. However, it's essential to recognize a notable gap in the existing research, which revolves around the absence of in-depth technological discussions concerning the implementation of DMSs.

The focus of these research papers primarily resides within two pivotal realms: the functionality of DMSs from a high-level perspective and the effects stemming from their implementation. In examining the functional aspects, the studies emphasize the importance of DMSs being informative, capable of handling transactions, and serving as effective platforms for promoting the destination's brand (Estêvão et al., 2014). They underscore the value of simplicity in design and usability, positioning these factors as critical determinants of user satisfaction and adoption (Inversini et al., 2014; Keil et al., 2017). Moreover, the integration of cutting-edge technologies such as mobile devices, Internet of Things (IoT), and Artificial Intelligence (AI) is identified as a means to augment the capabilities of DMSs and enhance user experiences (Ammirato et al., 2018).

On the other hand, when exploring the effects of DMSs, the research highlights their versatility. These systems are recognized for their utility not only during routine operations but also in times of crisis (Fedyk et al., 2022). They are seen as instruments that can significantly enhance the efficiency of DMOs and provide a competitive advantage in the increasingly digital landscape of the tourism industry Borzyszkowski (2014). However, it's crucial to acknowledge that investment in DMSs is resource-intensive, necessitating careful planning, allocation of resources, and diligent management (Estêvão et al., 2023) which can make the implementation of these systems in resource-scarcer environments challenging. Additionally, the presence of web-based competitor systems introduces a competitive challenge that DMOs must address to maximize the impact of their DMS implementations.

While these insights are undoubtedly valuable, they do not extend to the nitty-gritty technical details of DMS implementation, with techincal details being limited to a Machine Learning (ML) model that could be employed in a DMS (Lee, 2023), not an architectural detailing of such a system, and is therefore tangential at best to the proposed Research Questions. The research largely refrains from delving into the intricate technological aspects that underpin the development and deployment of DMSs. This absence of comprehensive technical discussions represents an opportunity for future research to bridge this gap.

Future studies can contribute by delving deeper into the technical aspects of DMS development. This could include thorough examinations of the underlying technologies employed, architectural choices made during implementation, data management strategies employed to handle vast amounts of tourism data, security considerations to safeguard user information, and the integration challenges faced when connecting DMSs with other tourism infrastructure and systems. Detailed technological insights would be invaluable in guiding Destination Management Organizations and stakeholders in the practical implementation of effective DMSs, ensuring that these systems are not only functionally robust but also technologically sound and secure.

Furthermore, future research can benefit from a closer examination of the roles played by emerging technologies like mobile devices, sensors, IoT, and AI in the context of DMS implementation.

5 Conclusion

In conclusion, the research on Destination Management Systems (DMSs) discussed in this analysis highlights several key insights into their functionality and effects. When it comes to functional requirements, DMSs should prioritize being informative, facilitating transactions, and promoting the destination's brand identity. The integration of emerging technologies such as mobile devices, IoT, and AI can enhance their capabilities and user experiences. Simplicity in design and usability remains a crucial aspect to ensure user satisfaction and effective adoption.

On the other hand, when considering the effects of DMSs, their utility extends beyond normal operations, proving invaluable in times of crisis. These systems can significantly improve efficiency within Destination Management Organizations (DMOs)

and provide a competitive edge in the increasingly digital landscape of tourism. However, it is important to note that investment in DMSs is resource-dependent, requiring careful planning and allocation of resources. Moreover, the prevalence of web-based competitor systems introduces a challenge that DMOs must navigate to maximize the impact of their DMSs.

While the papers discussed in this analysis provide valuable insights into the functional requirements and effects of DMSs, they largely refrain from delving into the intricate technological details of DMS implementation. Future research should aim to bridge this gap by offering in-depth explorations of the technical aspects, architecture, security considerations, and integration strategies that underpin effective DMS development. Additionally, a deeper examination of the roles of emerging technologies in DMS implementation can further enhance our understanding of how these systems can evolve to meet the dynamic needs of the tourism industry. Ultimately, a holistic approach that combines both functional and technical perspectives will be crucial in advancing the field of Destination Management Systems and optimizing their impact on the tourism ecosystem.

Appendix A Tally of Relevant Documents

Title	Author / Year	Summary
STAKEHOLDERS' PARTICIPATION INTENTION TOWARDS A SUSTAINABLE DESTINATION MANAGEMENT SYSTEM	Anh, Le Thi Phuong (57680902900); Kunasekaran, Puvaneswaran (55855510300); Ragavan, Neethiahnanthan Ari (56964110800); Subramaniam, Thanam (56884295400); Thomas, Tony K. (57680903000) / 2022	This study examines stakeholder engagement in sustainable Destination Management Systems (DMS), focusing on participation intentions and their impact on system success.
Factors Affecting the Adoption of Destination Management Systems by Stakeholders: Proposal of an Explanatory Model	Estêvão, João (57225986979); Teixeira, Leonor (22434117100); Carneiro, Maria João (36678729600) / 2023	This research proposes an explanatory model to understand the factors influencing stakeholders' adoption of DMS, highlighting key drivers and barriers in system implementation.
Constructing a smart destination framework: A destination marketing organization perspective	Sorokina, Ekaterina (56388420500); Wang, Youcheng (54279519500); Fyall, Alan (6507171922); Lugosi, Peter (13103747300); Torres, Edwin (14016921000); Jung, Timothy (55515556300) / 2022	The study explores the development of a smart destination framework from a marketing perspective, addressing how DMS can enhance destination attractiveness and visitor experiences.
Information technologies in the activities of destination management organizations	Borzyszkowski, Jacek (55273725600) / 2014	This research delves into the role of information technologies in DMS, focusing on how these technologies are utilized by destination management organizations for effective tourism management.
Destination Online Communication: Why Less is Sometimes More. A Study of Online Communications of English Destinations	Inversini, Alessandro (14625267000); Cantoni, Lorenzo (16068131600); De Pietro, Marianna (56273139600) / 2014	Investigating online communication strategies of English destinations, this study assesses the effectiveness of various approaches, suggesting that a concise and targeted online presence may be more impactful.
Destination management systems: Creation of value for visitors of tourism destinations	Estêvão, João Vaz (57225986979); Carneiro, Maria João (36678729600); Teixeira, Leonor (22434117100) / 2014	This study investigates how Destination Management Systems (DMS) create value for tourists, exploring the impact of these systems on visitor experiences and destination appeal.
Changes in DMO's Orientation and Tools to Support Organizations in the Era of the COVID-19 Pandemic	Fedyk, Wojciech (57219801780); Sołtysik, Mariusz (57220272181); Bagińska, Justyna (57364996400); Ziemba, Mateusz (57015195300); Kołodziej, Małgorzata (55858084700); Borzyszkowski, Jacek (55273725600) / 2022	Focusing on the challenges posed by the COVID-19 pandemic, this research examines the shifts in Destination Management Organizations' strategies and the adoption of new tools for resilience and effective management.
Smart Tourism Destinations: Can the Destination Management Organizations Exploit Benefits of the ICTs? Evidences from a Multiple Case Study	Ammirato, Salvatore (16067870500); Felicetti, Alberto Michele (36630289500); Della Gala, Marco (55508587800); Raso, Cinzia (56418328600); Cozza, Marco (57191968411) / 2018	This study explores the potential of Information and Communication Technologies (ICTs) in enhancing the functionality and effectiveness of Destination Management Organizations, assessing their role in developing smart tourism destinations.

Title	Author / Year	Summary
Optimizing User Interface Design and Interaction Paths for a Destination Management Information System	Keil, Dimitri; Höpken, Wolfram; Fuchs, Matthias; Lexhagen, Maria / 2017	The study develops a user-friendly interface for Destination Management Information Systems, aiming to enhance decision support in European tourism due to globalization and digitalization impacts.
An Autocratic Strategy for Multi-attribute Group Decision Making Based on Neutrosophic Triplets: A Case Study in Prioritizing Recreation Areas in the Tourist Industries	Lee, Kuo-Wei / 2023	Research introduces a decision-making strategy using neutrosophic theory for the tourism sector, focusing on selecting optimal tourist destinations based on environmental attributes.

On behalf of all authors, the corresponding author states that there is no conflict of interest.

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