Developing a Destination Management Information System: A Case Study of Ottawa, Canada

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Abstract: Over the last decade, the concept of smart destination management has been gaining momentum (Boes et al, 2016; Buhalis and Amaranggana, 2013, 2015; Del Vecchio et al, 2018a; Gretzel et al, 2015; Ivars-Baidal et al, 2019; Lamsfus and Alzua-Sorzabal, 2013; Xiang et al, 2015). As the tourism industry seeks recovery from the devastations of the COVID-19 pandemic, however, several authors have argued that it is more important than ever for destinations to become "smart" in efforts to build back in a more sustainable and regenerative way (Abbas et al, 2021; Assaf and Scuderi, 2020). Though called on globally to guide destinations through this era of change and adaptation, Destination Marketing Organizations (DMOs) continue to struggle to obtain adequate and reliable data. Specifically, those representing smaller regions often lack the internal capacity to perform the analyses required to become smart destinations (Dodds and Butler, 2019; Dredge, 2016; Gretzel et al, 2006). While the literature has pointed to Destination Management Information Systems (DMISs) as the solution to smart destination management, current applications have been limited and evidence remains primarily anecdotal. Therefore, guided by Höpken et al's (2011) Knowledge Destination Framework Architecture, this study aimed to develop and empirically test a DMIS for Ottawa Tourism in its capacity to support smart destination management. Findings indicated that while it serves as a valid process in the development of a DMIS, a DMIS's capacity to support smart destination management is limited by the quality of its inputs. Opportunities for future knowledge generation and knowledge application in the tourism industry are discussed along with areas for future research.

Keywords: smart destination, destination management, data-driven decision-making, knowledge destination framework architecture, destination management information system, destination marketing organizations

1. Introduction

As technological advancements in Information Communication Technologies (ICTs) have surged in recent years, mass quantities of data, termed Big Data, have been generated across a wide range of industries (Chen, Mao and Liu, 2014). Big Data has most often been characterised in the literature by 6V's: Volume, for its scale in quantity; Velocity, for its rate of generation; Variety, for its diversity in type; Value, for its utility; Veracity, for its accuracy; and Variability, for its inconsistency in generation (Jeble et al, 2017; Kościelniak and Puto, 2015; Laney, 2001; 2012; 2015). Despite the challenges posed by these attributes, organizations with the capacity to gather and harness Big Data are privy to highly detailed insights that can be leveraged to support a competitive and sustainable advantage through better-informed management decisions (Hao, Zhang and Song, 2019; Gajdošík, 2019).

Particularly in the tourism industry, Destination Marketing Organizations (DMOs), responsible for the marketing and increasingly the management of tourism destinations, have been challenged to embrace Big Data in becoming "smart destinations". A smart destination is defined as:

> *"An innovative tourism space, accessible to all, consolidated on state-of-the-art technological infrastructure that supports sustainable development of the territory, facilitates the interaction and integration of the visitor with the environment, elevates the visitor experience at the destination, and enhances the quality of life for the residents" (SEGITTUR, 2015, p.32).*

Destinations that have successfully harnessed Big Data have been found to have increased competitiveness and innovation in areas including visitor mobility management, visitor experience management, and tourism resource management (Boes, Buhalis and Inversini, 2016; Buhalis and Amaranggana, 2013; 2015; Del Vecchino et al, 2018a; 2018b; Enclada et al, 2017; Fuchs, Höpken and Lexhahen, 2014; Fuchs et al, 2013; Gajdošík, 2019; Höpken et al, 2013). Over the last decade, the concept of smart destination management has been gaining momentum (Boes et al, 2016; Buhalis and Amaranggana, 2013, 2015; Del Vecchio et al, 2018a; Gretzel et al, 2015; Ivars-Baidal et al, 2019; Lamsfus and Alzua-Sorzabal, 2013; Xiang et al, 2015); however, as the tourism industry seeks recovery from the damage of the COVID-19 pandemic, several authors have argued that it is more important than ever for destinations to become "smart" in efforts to build back in a more sustainable and

regenerative way (Abbas et al, 2021; Assaf and Scuderi, 2020). Yet, it has been continuously recognized that a great portion of DMOs, specifically those representing smaller destinations, struggle to obtain adequate data and preform the analyses required to become smart destinations (Dodds and Butler, 2019; Dredge, 2016; Gretzel et al, 2006).

In efforts to achieve smart destination management across all levels of DMOs, several studies have supported the need for a destination management information system (DMIS) – an amalgamation of data from internal and external sources into a user-friendly decision support system from which DMOs can make data-driven destination management decisions (Buhalis and Amaranggana, 2013; Fuchs et al, 2013; Fuchs, Höpken and Lexhagen, 2014; Höpken et al, 2011; 2015; Ritchie and Ritchie, 2002; Trunfio and Della Lucia, 2019). To date, however, there have been few applications of DMISs in the literature; specifically, the testing and assessment of DMISs in supporting smart destination management remains primarily anecdotal. Therefore, guided by Höpken et al's (2011) Knowledge Destination Framework Architecture, a four-phased case study of Ottawa Tourism was conducted to both develop and empirically test a DMIS in its capacity to support smart destination management. This project was conducted in collaboration with Ottawa Tourism, Ryerson University, and Klevr Places, a start-up company helping destinations make data-based decisions (https://klevrplaces.com/).

2. Background

This section sets out to review the existing literature in the context of Destination Management Information Systems (DMISs). First, a theoretical framework of DMIS development will be outlined along with its existing applications. Second, the case of Ottawa Tourism will be presented along with the need for the current study.

2.1 The knowledge destination framework architecture

The Knowledge Destination Framework Architecture (Höpken et al, 2011), is one of the most highly referenced in smart destinations and Destination Management Information Systems (DMISs) literature (see figure 1). This framework proposes that smart destinations develop knowledge via a two layered process. In the first layer, knowledge is generated through the identification, extraction, housing, and harnessing of data required for destination management; while in the second layer, knowledge is applied through a DMIS in which the data is visualized and interpreted to support smart destination management decisions (Höpken et al, 2011).

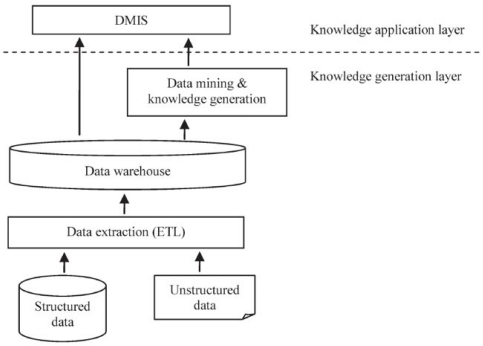

Figure 1: Höpken et al's (2011) knowledge destination framework architecture

While the literature on smart destinations and Destination Management Information Systems (DMISs) is expanding, practical applications of DMISs have been scantly presented in the literature save for a selection of case studies. These studies have not only served as a model for future DMIS development but have also indicated that DMISs hold the capacity to support Destination Marketing Organizations (DMOs) in achieving smart destination management (Fuchs et al, 2013; Fuchs, Höpken and Lexhagen, 2014; Gajdošík, 2019; Höpken et al, 2011; 2013; Ritchie and Ritchie, 2002). While these studies have been primarily focused on recording the DMIS development process, the empirical testing of these DMISs towards supporting smart destination management has been limited; thus, evidence towards the benefits of DMIS applications remains primarily anecdotal. There is, therefore, a need for further research not only towards the development of DMISs but also towards the empirical testing of these DMISs in their capacity to support smart destination management.

2.2 A case study of Ottawa, Canada

This study specifically aims to develop and test a Destination Management Information System (DMIS) for, the metropolitan region of Ottawa, Canada. Ottawa is Canada's capital city, located in the province of Ontario. Situated on the traditional Anishinàbeg Algonquin territory, the City of Ottawa was established in 1855 following settlements and influences of the Irish, French, English, and Scottish as early as the 1600s (Ottawa Tourism, 2021). Ottawa's tourism economy is characterized by its historic and culturally rich lodging, dining, and entertainment options that attract both business and leisure visitors year-round (Ottawa Tourism, 2021). Most notably, Ottawa is home to seven of Canada's nine national museums, the historic ByWard Market, the Ottawa River, the Rideau River and the Rideau Canal, as well as Canada's federal government on Parliament Hill (Ottawa Tourism, 2021).

The tourism industry plays a significant role in Ottawa's economy (Ottawa Tourism, 2020a). Namely, the ongoing total economic impact of Ottawa's tourism industry translates to 43,570 jobs, $1.69 billion in wages and salaries, $2.72 billion in GDP, and $5.49 billion in economic outputs (Ottawa Tourism, 2020a, p. 4). In 2020, however, Ottawa's tourism industry, among many other destinations, was devastated by the COVID-19 pandemic with approximately $1.4 billion lost in visitor spending from 2019 (Ottawa Tourism, 2020b). Taking on a destination management role, the region's Destination Marketing Organization (DMO), Ottawa Tourism (2020b) addressed this challenge by "serving as a conduit of information to its members and to the public, advocating for relief on the industry's behalf, hustling to rebook meetings and conventions, maintaining relationships with suppliers and clients, and working to share the stories of the industry's resilience far and wide" (p. 2). Despite their use of data prior to the pandemic, Ottawa Tourism (2020b) notes that as part of its recovery strategy, "one of [their] priorities…has been to develop into a data-driven organization" (p. 4). Therefore, Ottawa serves as an ideal case study to both develop and test the utility of a DMIS in supporting DMOs with smart destination management.

3. Methodology

This study adopted a single case study approach in the development and testing of a Destination Management Information System (DMIS) for Ottawa Tourism. In doing so, the research was conducted over four-phases: (1) an in-depth interview with Ottawa Tourism stakeholders to perform an assessment of their current practices and needs; (2) development of a DMIS prototype for Ottawa Tourism; (3) presenting and testing the utility of the DMIS through a semi-structured interview with Ottawa Tourism; and (4) addressing the feedback and presenting the final DMIS in a debrief meeting with Ottawa Tourism.

In February 2020, an in-depth, semi-structured interview was conducted with key stakeholders at Ottawa Tourism to assess their current knowledge generation and application practices in accordance with Höpken et al's (2011) Knowledge Destination Framework Architecture as well as identify the existing challenges or gaps in these areas. Questions sought to gather information regarding: (1) existing knowledge generation practices (i.e., data identification, data extraction, data warehousing, data mining); (2) challenges or gaps in knowledge generation; (3) existing knowledge application practices (i.e., data dissemination amongst internal and external stakeholders); and (4) challenges or gaps in knowledge application practices. The transcript was analyzed manually by the researchers.

From March 2020 to February 2021, the findings of the initial interview were applied to the development of a DMIS in accordance with Höpken et al's (2011) Knowledge Destination Framework Architecture. First, existing data sources identified by Ottawa Tourism were individually gathered and assessed on the grounds of the most frequently applied Data Quality Dimensions in the literature including timeliness, consistency, accuracy, and completeness (Sidi et al, 2012). Challenges and gaps identified amongst the data were then attempted to be filled by additional datasets acquired through a thorough online search that was subject to assessment across the same four Data Quality Dimensions. Second, the datasets were extracted, individually transformed, and were then loaded to the data warehouse. Third, the datasets in the warehouse were amalgamated through a mapping process. Fourth, the gathered datasets were manipulated through analytical processes to generate knowledge. Finally, the generated knowledge was visualized through an interactive DMIS. Ottawa Tourism's knowledge manager was engaged and updated throughout each phase of development.

In March 2021, a semi-structured interview was held with Ottawa Tourism stakeholders to present and test the utility of the DMIS. The questions aimed to assess the ability of the DMIS to generate and apply knowledge towards smart destination management. First, knowledge generation was assessed across the Data Quality

Dimensions of timeliness, consistency, accuracy, and completeness (Sidi et al, 2012). Second, knowledge application was assessed based on the DMIS's capacity to support smart destination management across seven domains of destination management adopted from Wang (2011): (1) Build product: inform investment and infrastructure decision making; (2) Build identity: inform, educate, and advise visitors; (3) Build commitment: deliver services to visitors; (4) Build vision: support and develop destination strategy; (5) Build coalition: advise and support stakeholders; (6) Build sustainability: inform destination competitiveness and sustainability; and (7) Build resilience: inform safety and crisis management. The transcript was analyzed manually by the researchers.

In efforts to maximize utility of the DMIS, additional efforts were made between April 2021 and August 2021 in attempt to address the gaps and challenges noted in the interview. Finally, in September 2021, a debrief meeting was held with Ottawa Tourism to review the results of these efforts.

4. Findings

The following will outline the results of the four-phased process of developing and testing a Destination Management Information System (DMIS) for Ottawa Tourism.

4.1 Current practices and needs assessment

Ottawa Tourism's current knowledge generation and application practices were assessed in accordance with Höpken et al's (2011) Knowledge Destination Framework Architecture. First, with regards to data identification, it was found that Ottawa Tourism engaged in both internal and external data collection. External sources derived from a variety of sources and included national, mobile, marketing, accommodation, and visitor sentiment data. In-house data collection, on the other hand, was primarily used to supplement gaps in available external data sources. Internal data collection methods included an airport and attractions visitor survey as well as daily visitation data shared from local stakeholders. Ottawa Tourism noted that their collected sources were extracted and transformed with Business Intelligence (BI) Tools including SPSS, Microsoft's Excel, and Envision. The transformed sources were housed on-premises and minimal aggregation and mapping was performed manually using BI Tools. Analyses were primarily descriptive but included some advanced analytics using SPSS and Microsoft's Excel. Knowledge application practices by Ottawa Tourism included the dissemination of data to both internal and external stakeholders. Internally, knowledge was presented and disseminated via reports, webinars, as well as collective staff and one-on-one meetings. Similarly, knowledge was presented and disseminated to extremal stakeholders (i.e., industry partners) via reports and webinars.

The challenges and gaps experienced throughout this process were then identified to assess the need. Namely, Ottawa Tourism noted four main challenges in generating knowledge. First, budget limitations were noted as a barrier to purchasing datasets as well as data analysis software. Second, inconsistencies in data formats (e.g., structured vs unstructured; static vs live) posed challenges when transforming and aggregating datasets for analysis. Third, gaps in data availability and poor-quality data sources limited the generation of valuable insights. Finally, with a small in-house data team, Ottawa Tourism identified a lack of internal capacity (i.e., time and staff) to effectively gather, transform, amalgamate, and mobilize Big Data towards supporting real-time management decisions. Together, these barriers resulted in gaps in knowledge generation across various categories of key performance indicators (KPIs). Namely, while Ottawa Tourism felt that their existing sources provided sufficient data regarding international arrivals, hotel accommodations, trip purpose, visitor spend, and sentiment; challenges in knowledge generation resulted in inadequate data regarding domestic arrivals, alternative accommodations, tourism employment, sustainability indicators, and their competitive environment. With regards to knowledge application, Ottawa Tourism noted that their primary challenges were upholding confidentiality of stakeholder data, ensuring access to knowledge sharing across all relevant stakeholders, and having a unified platform to house, analyze, and support data-based decision making. It was noted that a dashboard DMIS tool was an existing gap and desired addition to their existing knowledge application practices.

4.2 DMIS development

Following a review and comparison of several popular DMIS platforms, Microsoft's Power BI was selected as the platform for the present study. Once licences were acquired, the development of the DMIS prototype for Ottawa Tourism followed the five phases of Höpken et al's (2011) Knowledge Destination Framework Architecture.

Phase one, taking place from March 2020 through May 2020, included the identification and evaluation of relevant datasets from an array of internal and external sources based on the Data Quality Dimensions of timeliness, consistency, accuracy, and completeness (Sidi et al, 2012). Only a selection of Ottawa Tourism's current datasets were approved through this assessment, thus, additional datasets were further gathered through an online search and were assessed for inclusion in the DMIS. Notably, however, challenges were experienced in identifying datasets that successfully met all criteria; thus, accuracy was prioritized to ensure trusted results at the metropolitan area level. As a result, data related to tourism employment and select sustainability indicators were incomplete; most datasets were only comparable by date due to dataset inconsistencies; and data distribution delays of up to one year, on behalf of the data sources, severely impacted timeliness.

The second phase, which was undertaken between June 2020 and August 2020, included the extraction, transformation, and loading of the various datasets to the data warehouse. All extracted datasets for the purpose of this prototype were static, however, there was a mix of both raw and processed datasets. All datasets were individually loaded into Power BI where transformations were made using the on-board Query Editor. Transformations included deconstructing processed datasets into a raw and usable format, translating coded variable names and responses into readable labels, filtering variables for the required information, converting variable types to align with visual presentation needs, and curating new variables for analysis. Following each individual transformation, the datasets were loaded to the on-premises Power BI data warehouse.

Once transformed and loaded to the data warehouse, the datasets were amalgamated through a mapping process in September 2020. This consisted of establishing relationships between connected datasets with shared variables and linking all datasets by date to a central calendar dataset in Power BI's Model View.

In the fourth phase, taking place from October 2020 to December 2020, the data was analyzed in Power BI through the application of Data Analysis Expressions (DAX) language, on-board processing, and R programming language. Manipulations were applied to generate knowledge across the various categories of key performance indicators recognized by Ottawa Tourism in the initial interview.

Finally, from January 2021 to February 2021, the fifth phase consisted of visualizing the generated knowledge through an interactive Power BI dashboard DMIS. The resulting dashboard consisted of six pages (see figure 2): (1) a destination overview that provides a holistic summary of the destination's most essential key performance indicators; (2) an arrivals report that breaks down visitor statistics, identifies influential factors, and provides internal and competitor benchmarking; (3) a visitor spending report that tracks seasonality, identifies influential factors, and dissects spending across various sectors of the destination's tourism industry; (4) a visitor profiles report that identified visitors demographics, trip purposes, and dispersion and density throughout the destination; (5) an accommodations report that tracks key performance indicators and competitor benchmarking across accommodation types; and (6) a travel trade report that identified behavioural trends in travel package arrivals.

4.3 Presenting and testing the DMIS

In March 2021, a semi-structured interview was held with Ottawa Tourism stakeholders to present and test the utility of the DMIS in generating and applying knowledge. First, the ability of the DMIS to generate knowledge was assessed across the Data Quality Dimensions of timeliness, consistency, accuracy, and completeness (Sidi et al, 2012). While Ottawa Tourism indicated that the DMIS was accurate in terms of the quality of data and granularity for the specific region, challenges were noted across the other dimensions. Namely, although data was collected on most existing and previously inadequate indicators (e.g., domestic arrivals, alternative accommodations, competitive environment, and some sustainability indicators), poor accuracy of sources of tourism employment and select sustainability indicators led to incomplete data in these domains. Next, while all datasets were comparable by date, additional filtering and forecasting capabilities were unable to be realized due to poor consistency across datasets. Finally, the timeliness of the data was hindered by two aspects. First, the quarterly aggregation and release of data by most sources was deemed ineffective within such a dynamic industry that requires monthly, weekly, or even daily insights. Second, the delay in data distribution by most sources hindered the ability to make real-time decisions, specifically in the rapidly changing environment present during a crisis.

Figure 2: DMIS prototype for Ottawa Tourism

Knowledge application was assessed based on the DMIS's capacity to support seven domains of smart destination management including building product, identity, commitment, vision, coalition, sustainability, and resilience (adopted from Wang, 2011). While Ottawa Tourism noted that the extraction, warehousing, harnessing, and visualization of the DMIS would support them in making decisions across these seven domains, the weaknesses in the quality of the data inputs diminished its overall utility, but specifically the capacity to build sustainability and resilience. It was noted that to make decisions to build sustainability and resilience, more complete data is required across sustainability indicators, more consistent datasets are required to make more reliable forecasts, and more timely data is needed due to the dynamic and urgent nature of these decisions.

4.4 Addressing feedback and debrief meeting

After presenting and testing the utility of the DMIS with Ottawa Tourism in March 2021, efforts were made between April 2021 and August 2021 to address the identified gaps and challenges in data timeliness, consistency, and completeness by way of an additional search for supplementary datasets. The search was conducted both online and through contacting industry stakeholders. While additional datasets were identified in the domain of tourism employment and select sustainability indicators, the researchers were only able to obtain them at the provincial level and not at the metropolitan level, thus, the challenges in completeness were unresolved. Additionally, no new datasets were identified towards resolving the challenges in consistency and timeliness.

In September 2021, a debrief meeting was held with Ottawa Tourism to review the results of these efforts. Overall, the DMIS was deemed adequate in supporting management decisions towards building product,

identity, commitment, vision, and coalition, but required more complete, consistent, and timely data inputs in efforts to build sustainability and resilience.

5. Discussion and conclusion

While the COVID-19 recovery is the short-term goal for many, destinations must look to build greater resiliency in the long term. Using smart destination management is now a critical need (Abbas et al, 2021; Assaf and Scuderi, 2020). Through the practical development and testing of a Destination Management Information System (DMIS) for Ottawa Tourism, this study aimed to contribute to the limited applications of DMISs in the literature, specifically, the empirical testing of DMISs towards supporting smart destination management. The results indicated that while Höpken et al's (2011) Knowledge Destination Framework Architecture serves as a valid process in the development of a DMIS, a DMIS's capacity to support smart destination management is limited by the quality of its inputs. Namely, the ability to make decisions, primarily with regards to building sustainability and resiliency, require data inputs that are timely, consistent, accurate, and complete.

The findings of this study point to several opportunities to support future knowledge generation and knowledge application within the tourism industry. First, there is a need for the tourism industry to share data to enhance decision making. Not only is more data needed, but a more unified approach to data collection to ensure comparable and reliable data is required. Second there is a need for more data on sustainability indicators. Currently there is little data about visitor flow, resource use, and community impact apart from ad-hoc data. Third, there is a need for more data interpretation, rather than just visualization of data to ensure that data informed decision making is done. As many DMO's do not even have budgets for data, let alone analysts, tools such as Klevr Place's data interpretation dashboard offers a useful, potentially more affordable tool for destinations.

In addition to serving as a guide for the development and application of future DMISs, the findings of this study support several opportunities for future research. First, while this study prioritized indicators associated with arrivals, spend, visitor profiles, accommodations, and travel trade, there is an opportunity for future applications to further explore the inclusion of additional indicators related to insights in marketing, sentiment, employment, and sustainability. Second, as this study developed a prototype, only static datasets were included in the DMIS; therefore, there is an opportunity to further explore the benefits and challenges of including live datasets in DMIS applications. Third, the reliability and validity of existing DMIS applications have been limited by anecdotal evidence, qualitative data collection, and single case studies; thus, it is recommended that future studies continue to apply theoretical frameworks and utilize more rigorous methods (e.g., experimental procedures) in testing the utility of a DMIS to support smart destination management. Finally, while most DMIS applications to date have focused on a single destination, there is a need for future research to explore the development and testing of a scalable DMIS that can be accessible and transferable across DMO's of all sizes.

References

Abbas, J., Mubeen, R., Iorember, P. T., Raza, S. and Mamirkulova, G. (2021) 'Exploring the impact of COVID-19 on tourism: transformational potential and implications for a sustainable recovery of the travel and leisure industry', Current Research in Behavioral Sciences, 2, 100033.

Assaf, A. and Scuderi, R. (2020) 'COVID-19 and the recovery of the tourism industry', Tourism Economics, 26(5), pp. 731-733.

Boes, K., Buhalis, D. and Inversini, A. (2016) 'Smart tourism destinations: ecosystems for tourism destination competitiveness', International Journal of Tourism Cities, 2(2), pp. 108-124.

Buhalis D. and Amaranggana A. (2013) 'Smart tourism destinations' in Xiang Z. and Tussyadiah I. (eds.) Information and Communication Technologies in Tourism 2014. Springer, Cham: pp. 553-564. https://doi.org/10.1007/978-3-319-03973-2_40

Buhalis, D. and Amaranggana, A. (2015). 'Smart tourism destinations enhancing tourism experience through personalisation of services' in Tussyadiah I. and Inversini A. (eds.) Information and communication technologies in tourism 2015. Springer, Cham: pp. 337-389. https://doi.org/10.1007/978-3-319-14343-9_28

Butler, R. W. (1980) 'The concept of a tourist area cycle of evolution: Implications for management of resources', The Canadian Geographer, 24(1), pp. 5–12.

Chen, M., Mao, S. and Liu, Y. (2014) 'Big data: A survey', Mobile networks and applications, 19(2), pp. 171-209.

Del Vecchio, P., Mele, G., Ndou, V. and Secundo, G. (2018a) 'Creating value from social big data: Implications for smart tourism destinations', Information Processing & Management, 54(5), pp. 847-860.

Del Vecchio, P., Mele, G., Ndou, V. and Secundo, G. (2018b) 'Open innovation and social big data for sustainability: Evidence from the tourism industry', Sustainability, 10(9), 3215.

Dodds, R. and Butler, R. (2019) Overtourism: Issues, realities and solution. Walter de Gruyter GmbH & Co KG.
Dredge, D. (2016) 'Are DMOs on a path to redundancy?', Tourism Recreation Research, 41(3), pp. 348-353.
Encalada, L., Boavida-Portugal, I., Cardoso Ferreira, C. and Rocha, J. (2017) 'Identifying tourist places of interest based on digital imprints: Towards a sustainable smart city', Sustainability, 9(12), 2317.
Fuchs, M., Abadzhiev, A., Svensson, B., Höpken, W. and Lexhagen, M. (2013) 'A knowledge destination framework for tourism sustainability: A business intelligence application from Sweden', Tourism: An International Interdisciplinary Journal, 61(2), pp. 121-148.
Fuchs, M., Höpken, W. and Lexhagen, M. (2014) 'Big data analytics for knowledge generation in tourism destinations–A case from Sweden', Journal of Destination Marketing & Management, 3(4), pp. 198-209.
Gajdošík, T. (2019) 'Big Data Analytics in Smart Tourism Destinations. A New Tool for Destination Management Organizations?' in Katsoni V. and Segarra-Oña M. (eds.) Smart Tourism as a Driver for Culture and Sustainability. Springer, Cham: pp. 15-33. https://doi.org/10.1007/978-3-030-03910-3_2
Gretzel, U., Fesenmaier, D. R., Formica, S. and O'Leary, J. T. (2006) 'Searching for the future: Challenges faced by destination marketing organizations', Journal of Travel Research, 45(2), pp. 116-126.
Hao, S., Zhang, H. and Song, M. (2019) 'Big data, big data analytics capability, and sustainable innovation performance', Sustainability, 11(24), 7145.
Höpken, W., Fuchs, M., Höll, G., Keil, D. and Lexhagen, M. (2013) 'Multi-dimensional data modelling for a tourism destination data warehouse' in Cantoni L. and Xiang Z. (eds.) Information and communication technologies in tourism 2013. Springer, Berlin, Heidelberg: pp. 157-169. https://doi.org/10.1007/978-3-642-36309-2_14
Höpken, W., Fuchs, M., Keil, D. and Lexhagen, M. (2011) 'The knowledge destination—a customer information-based destination management information system' in Law R., Fuchs M. and Ricci F. (eds.) Information and communication technologies in tourism 2011. Springer, Vienna: pp. 417-429. https://doi.org/10.1007/978-3-7091-0503-0_34
Höpken, W., Fuchs, M., Keil, D., & Lexhagen, M. (2015) 'Business intelligence for cross-process knowledge extraction at tourism destinations', Information Technology & Tourism, 15(2), pp. 101-130.
Jeble, S., Kumari, S. and Patil, Y. (2017) 'Role of big data in decision making', Operations and Supply Chain Management: An International Journal, 11(1), pp. 36-44.
Kościelniak, H. and Puto, A. (2015) 'Big data in decision making processes of enterprises', Procedia Computer Science, 65, 1052-1058.
Laney, D. (2001) '3D data management: Controlling data volume, velocity and variety', META group research note, 6(70), p. 1.
Laney, D. (2012) 'The importance of 'big data': A definition', Gartner, Retrieved, 21.
Laney, D. (2015) 'Big Data's 10 Biggest Vision and Strategy Questions', Gartner, Retrieved, 20.
Ottawa Tourism. (2021) About Ottawa. Available at: https://ottawatourism.ca/en/about-ottawa
Ottawa Tourism. (2020a) Economic Impact of Tourism in Ottawa. Available at: https://ottawatourism.ca/sites/default/files/media/documents/2020-06/Economic-Impact-of-Tourism-in-Ottawa-Executive-Summary.pdf
Ottawa Tourism. (2020b) Ottawa Tourism Annual Report. Available at: https://ottawatourism.ca/sites/default/files/media/documents/2021-06/OTTAWATOURISM_ANNUALREPORT_2020.pdf
Ritchie, R. J. and Ritchie, J. B. (2002) 'A framework for an industry supported destination marketing information system', Tourism Management, 23(5), pp. 439-454.
SEGITTUR. (2015) Informe destinos turísticos inteligentes: construyendo el future. Available at: http://www.segittur.es/opencms/export/sites/segitur/.content/galerias/descargas/proyectos/Libro-Blanco-Destinos-Tursticos-Inteligentes-construyendo-el-futuro.pdf
Sidi, F., Panahy, P. H. S., Affendey, L. S., Jabar, M. A., Ibrahim, H., and Mustapha, A. (2012) 'Data quality: A survey of data quality dimensions' in 2012 International Conference on Information Retrieval & Knowledge Management, pp. 300-304. IEEE.
Trunfio, M. and Della Lucia, M. (2019) 'Engaging destination stakeholders in the digital era: The best practice of Italian regional DMOs', Journal of Hospitality & Tourism Research, 43(3), pp. 349-373.
Wang, Y. (2011) 'Destination Marketing and Management: Scope, Definition and Structures' in Y. Wang and A. Pizam's (Eds.) Destination Marketing and Management: Theories and Applications. CABI: Oxfordshire, UK.