Articles – Tourism Management

Dimensions impacting tourists' perception of Smart Tourism Destinations

Dimensões que influenciam a percepção dos turistas sobre Destinos Turísticos Inteligentes

Dimensiones que influyen en la percepción de los turistas sobre los Destinos Turísticos Inteligentes

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Abstract

A Smart Tourism Destination (STD) focuses on improving the tourist experience through the integrated use of Information and Communication Technologies (ICT) in cities. This study investigated how tourists' perception of the "degree of smartness" of a given destination can be influenced by the STD dimensions outlined by the specialized literature, namely Sustainability, Accessibility, Technology, and Innovation. To this end, we conducted a quantitative survey with 303 tourists visiting the cities of Natal, Rio de Janeiro, and São Paulo, Brazil. Multiple Linear Regression analysis revealed that the indicators associated with the Innovation and Sustainability dimensions influenced the STD dependent variable. The indicators with the most significant impact on STD according to tourists' perception were: "New technologies employed by companies in the tourism sector," "Innovation projects for improving tourism products and services," and "Urban planning." Although low, significant correlations were found between the variables associated with Technology and Accessibility and STD. We conclude that the dimensions most perceived by tourists are those with the most significant potential for rapid return and lower risk for destinations, which increase competitiveness and therefore require special attention from public and private managers.

Resumo

Um Destino Turístico Inteligente (DTI) tem como foco melhorar a experiência do turista, facilitada pela integração e utilização das Tecnologias da Informação e Comunicação (TIC) nas cidades. O objetivo desse estudo foi investigar como a percepção dos turistas sobre o "grau de inteligência" de um destino pode ser influenciada pelas dimensões de DTI definidas pela literatura: Sustentabilidade, Acessibilidade, Tecnologia e Inovação. Para isso, realizou-se uma pesquisa quantitativa com 303 turistas em visita às cidades de Natal, Rio de Janeiro e São Paulo. Pela Análise de Regressão Linear Múltipla, verificou-se que indicadores das dimensões Inovação e Sustentabilidade influenciaram a variável dependente DTI. Os indicadores com mais influência sobre DTI na percepção dos turistas foram: "Novas tecnologias utilizadas pelas empresas do setor turístico", "Projetos de inovação para melhoria de produtos e serviços turísticos", e "Planejamento urbanístico da cidade". Houve também correlações significativas, porém, baixas, entre variáveis de Tecnologia e Acessibilidade com DTI. Conclui-se que as dimensões mais percebidas pelos turistas são aquelas com maior potencial de retorno rápido e menos risco para os destinos, aumentando a competitividade, devendo receber atenção especial de gestores públicos e privados.

Resumen

Un Destino Turístico Inteligente (DTI) se enfoca en mejorar la experiencia turística, facilitada por la integración y uso de las Tecnologías de la Información y la Comunicación (TIC) en las ciudades. El

objetivo de este estudio fue investigar cómo la percepción de los turistas sobre el "grado de inteligencia" de un destino puede verse influida por las dimensiones de DTI definidas por la literatura: Sostenibilidad, Accesibilidad, Tecnología e Innovación. Para hacer esto, se realizó una investigación cuantitativa con 303 turistas que visitaban las ciudades de Natal, Río de Janeiro y São Paulo. Mediante el Análisis de Regresión Lineal Múltiple, se encontró que los indicadores de las dimensiones Innovación y Sostenibilidad influyeron en la variable dependiente DTI. Los indicadores con mayor influencia en la percepción de los turistas sobre DTI fueron: "Nuevas tecnologías utilizadas por las empresas del sector turístico", "Proyectos de innovación para mejorar los productos y servicios turísticos" y "Planificación urbana de la ciudad". También hubo correlaciones significativas, pero bajas, entre las variables de Tecnología y Accesibilidad con DTI. Así, las dimensiones más percibidas por los turistas son aquellas con mayor potencial de retorno rápido y menor riesgo a los destinos, aumentando la competitividad, y deben recibir atención por parte de los gestores públicos y privados.

1 INTRODUCTION

Information and Communication Technologies (ICT) have revolutionized tourism by helping to define innovative strategies and increasing the competitiveness of organizations and destinations (Buhalis, 2019). Due to the rapid evolution of ICT, tourism, destinations, and the tourist experience can no longer be addressed as they used to be in the past (Femenia-Serra, Neuhofer, & Ivars-Baidal, 2019). ICT contributes to tourism by generating experiences for tourists, improving the efficiency in process automation for related organizations (Buhalis & Amaranggana, 2015), and inaugurating a new scenario for destination management (Ivars-Baidal, Celdrán-Bernabeu, Mazón, & Perles-Ivars, 2019). For instance, the use of mobile technologies by tourists allows the consumption of personalized information at any time or site at a given destination (Lamsfus, Martín, Alzua-Sorzabal, & Torres-Manzanera, 2015; Jovicic, 2019). Mobile services are able to adapt to the visitors' needs, as they access data such as the tourists' location and movement around a city (geolocation in tourist destinations), and allow the sharing of experiences and the purchase and consumption of tourist services, providing a new view on how a destination can be consumed (Lamsfus, Wang, Alzua-Sorzabal, & Xiang, 2015).

The mobile digital revolution has led to the emergence of Smart Tourism Destinations (STD), which aim at improving the tourism experience, facilitated by the integration and use of ICT in cities (Neuhofer, Buhalis, & Ladkin, 2012). According to Lamsfus et al. (2015), a destination is considered smart when it extensively relies on the technological infrastructure offered by the city in order to (1) improve the travelers' experience by informing them about available tourism services and products, and (2) to empower destination management organizations, local institutions, and tourism businesses to make decisions and take actions supported by data produced, managed, and processed through the technological infrastructure in the scope of a given destination.

Smart tourism and destinations have attracted the attention of members of the tourism production chain, such as professionals, governments (federal, state, and municipal), and researchers (Mehraliyev, Choi, & Köseoglu, 2019). The subject is relevant for public and private professionals and managers due to its high capacity to provide them with meaningful and innovative data by promoting interconnectivity among tourism stakeholders (Johnson & Samakovlis, 2019; Williams, Rodriguez, & Makkonen, 2020). STD is also a promising field of research in terms of models and strategies for the configuration of smart processes at destinations (Vecchio, Mele, Ndou, & Secundo, 2018). Moreover, STD aims to offer customized experiences to tourists by using ICT, which can enable the success and increase the competitiveness of destinations and improve the quality of life of residents in a sustainable way. (Cimbaljević, Stankov, & Pavluković, 2019; Femenia-Serra, Perles-Ribes, & Ivars-Baidal, 2019). Therefore, destinations are redefining business roles and logic by involving tourists as co-creators of their experiences and incorporating new technologies to develop tourism products (Buonincontri & Micera, 2016).

Although the tourist experience has been a central aspect of the discussion on STD in the specialized literature, empirical research on the needs and preferences of tourists from the perspective of smart tourism is scarce. (Femenia-Serra, Neuhofer et al., 2019; Gajdosík, 2019). Nonetheless, tourist-focused STD studies have been

conducted with secondary data and highlighting best practice cases (Femenia-Serra, Neuhofer et al., 2019). Studies from the tourists' perspective can also be found in Brazil, Spain, and Slovakia (Femenia-Serra & Ivars-Baidal, 2018; Femenia-Serra, Perles-Ribes et al., 2019; Gajdosík, 2019; Santos & Gândara, 2019), but no empirical research has been conducted with a broad geographic scope employing advanced statistical techniques or using STD-based theoretical models.

In this context, this study has aimed to investigate how tourists' perception of the "degree of smartness" of a given destination can be influenced by the STD dimensions outlined by the specialized literature while emphasizing the theoretical model developed in Spain by the Sociedad Mercantil Estatal para la Gestión de la Innovación y las Tecnologías *Turísticas* (SEGITTUR, 2016). According to the SEGITTUR model, Sustainability, Accessibility, Technology, and Innovation are dimensions that can be allies to improve competitiveness in tourist destinations. To achieve the objective of this study, three Brazilian tourist destinations with different profiles were selected, namely Natal, Rio de Janeiro, and São Paulo. Data were collected in these cities from June 2019 to March 2020. In addition to their importance for national tourism, São Paulo and Rio de Janeiro rank high on *2020 Connected Smart Cities* (URBAN SYSTEM, 2020). In turn, Natal joined the Brazilian Network of Intelligent and Human Cities, in partnership with the *Instituto Metropole Digital* (IMD), affiliated with the Federal University of Rio Grande do Norte (UFRN) (Mendes Filho, Silva, & da Silva, 2019). Multiple Linear Regression analysis was used to validate the resulting theoretical model.

2 SMART TOURISM DESTINATIONS (STD)

Smart tourism can be defined as an individual tourism support system with ubiquitous information services, integration of tourist information flows, and provision of customized information for tourists (Li, Hu, Huang, & Duan, 2017). Smart tourism provides practical insights for stakeholders involved in co-creating value in the industry's supply chain, including tourists; residents; governments (municipal, state, and federal); urban, regional, and tourist planning authorities; destination management organizations (DMO); travel agencies and tour operators; hospitality, leisure, and cultural heritage organizations; public and private companies and institutions; and universities (Koo, Mendes-Filho, & Buhalis, 2019). According to Gretzel, Sigala et al. (2015), smart tourism has three basic components, namely STD, smart business ecosystems, and smart experiences, all of which are supported by the processing and exchange of data and information among stakeholders.

An STD comprises a system linked to visitors and citizens that is interconnected to all tourist organizations in the destination, allowing to obtain data and services in real-time (Buhalis & Amaranggana, 2014; Boes, Buhalis, & Inversini, 2015). The development of an SDT facilitates direct access to value-added services through advanced ICT, such as, for instance, access to real-time information on the city's public transport network, thus enriching tourist experiences and increasing the destination's competitiveness over their competitors (Buhalis & Amaranggana, 2014; Buonincontri & Micera, 2016; Jeong & Shin, 2019). Enabling STD with data and information intelligence can facilitate the process of integration between the production and consumption of products/services, thus increasing the links between suppliers and consumers in the tourism production chain (Jovicic, 2019).

Moreover, to achieve a competitive edge, an STD needs to offer a tourist experience and ensure its attractiveness compared to neighboring destinations (Cimbaljević et al., 2019). Technologies such as the Internet of Things, Big Data, and mobile devices will allow destinations to achieve a better understanding of tourists' behavior in the data intelligence environment, hence reducing the degree of uncertainty about their consumption habits (Femenia-Serra, Neuhofer et al., 2019; Williams et al., 2020). STD should focus on improving the memorable experience of tourists by employing technologies such as augmented and virtual reality (Jeong & Shin, 2019).

STD primarily focus on smart tourists, a niche that benefits from smart tourism by using the ICT available in STD (Gretzel et al., 2018; Femenia-Serra, Neuhofer et al., 2019). STD can offer personalized experiences to tourists by collecting, accessing, and analyzing personal data, establishing usage patterns, and facilitating the identification of needs and the improvement of services (Buhalis & Amaranggana, 2015). Smart tourists often share data (basic personal information, preferences, social media information, location, and movement tracking, expenses) with other stakeholders, as long as they feel confident about the potential use of such data. Therefore, tourists feel that the derived benefits will be worth it while presuming that their privacy and security will be safeguarded (Femenia-Serra, Neuhofer et al., 2019). Therefore, the ultimate goal of STD is to improve the tourist experience by maximizing the competitiveness of destinations and the degree of visitor satisfaction (Vecchio et al., 2018).

3 ASSESSMENT OF RESEARCH ON STD

There has been a significant increase in articles addressing tourism and smart destinations, so at this point, the progress of scientific knowledge on the subject must be assessed (Johnson & Samakovlis, 2019; Mehraliyev et al., 2019). In the beginning, studies tended to be more theoretical and concentrated on concepts and research frameworks. For instance, Buhalis and Amaranggana (2014, 2015) developed a framework for STD by exploring travel applications in destinations. Other studies proposed smart tourism concepts and laid out the technological and commercial bases for STD (Gretzel, Sigala et al., 2015) and for understanding smart tourism ecosystems (Gretzel, Werthner, Koo, & Lamsfus, 2015).

Then came the studies based on bibliographic and documentary research relying on government, academic, and Internet sources and focusing on relevant European destinations, such as Barcelona, Amsterdam, and Helsinki, to identify STD components (Boes et al., 2015; Boes, Buhalis, & Inversini, 2016). Descriptive surveys in Brazil, China, and South Korea presented STD initiatives and the creation of technological infrastructures for the development of smart tourism (Wang, Li, & Li, 2013; Cacho et al., 2016; Gretzel et al., 2018). Subsequently, case studies were conducted in Spain, in Benidorm and Malaga (Santos Júnior, Mendes Filho, García, & Simões, 2017; Femenia-Serra & Ivars-Baidal, 2018), and in Brazil, in the cities of Curitiba, Florianópolis and Natal (Gomes, Gândara, & Ivars-Baidal, 2017; Mendes Filho et al., 2019; Santos-Júnior, Biz, Almeida-García, & Mendes-Filho, 2019; Freitas & Mendes Filho, 2020).

That is, although the studies on STD are many (Johnson & Samakovlis, 2019; Mehraliyev et al., 2019), there are still gaps to be bridged, especially in empirical terms. For Mehraliyev, Chan, Choi, Koseoglu, and Law (2020), the least researched STD area refers to consumer preference for smart tourism in destinations. For instance, segmentation studies in the context of STD are paramount to answer questions such as which tourists prefer smart tourism, what motivates them, how much they prefer smart tourism, and which aspects of smart tourism they prefer (Mehraliyev et al., 2020).

As for research on STD focusing on tourists and residents, they have been generally based on secondary data and described best practice cases to identify attributes about the types of tourists, their characteristics, and their roles in the context of STD (Femenia-Serra, Neuhofer et al., 2019). As for empirical research, a descriptive study has verified the experience of tourists in São Luís, Maranhão (Santos & Gândara, 2019), along with two other studies conducted in Spain. The first verified that the expectation placed on the STD approach is justified by the technological perception of the tourist demand by Spanish tourism majors (Femenia-Serra, Perles-Ribes et al., 2019), whereas the second found that STD efforts are transforming destination management, marketing processes, and tourist experiences (Femenia-Serra & Ivars-Baidal, 2021). A study in Slovakia examined whether "smart tourists" are indeed a market segment by analyzing the differences in the travel behavior of members of this segment (Gajdosík, 2019). Finally, a theoretical model was proposed, addressing the quality of life of STD dwellers, based on a systematic analysis of the literature, although it has yet to be empirically validated (Santos-Júnior, Almeida-García, Morgado, & Mendes-Filho, 2020).

Approaching STD by focusing on tourists is crucial to improve the travelers' experiences through smarter services interconnecting all stakeholders by integrating production chain data and allowing real-time decision-making (Femenia-Serra, Neuhofer et al., 2019). Tourist experiences in STD can generate greater satisfaction and, consequently, incite the tourists' desire to return to the destination on a later occasion (Jeong & Shin, 2019). Therefore, this study focuses on tourists as the central topic of investigation.
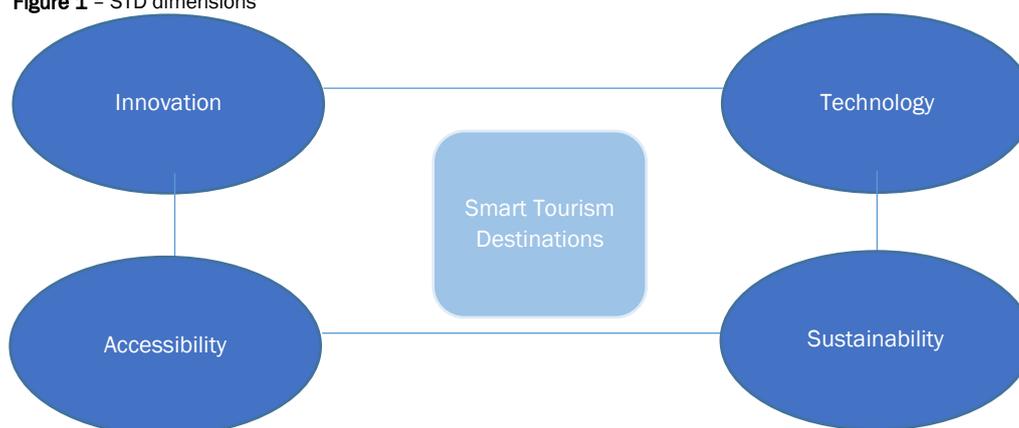
4 METHODOLOGY

This study aims to investigate how tourists' perception of the "degree of smartness" of a given destination can be influenced by the STD dimensions of Sustainability, Accessibility, Technology, and Innovation. This research is exploratory and adopts a quantitative approach to focus on the main results. In addition, the qualitative methodology was employed to define the items of the dimension to be used in the final survey.

During the first step, bibliographic research was carried out combined with a documental survey. This approach allowed identifying the methodologies and dimensions recommended for the evaluation of STD. The literature review was carried out in the following databases: Science Direct, EBSCO, CAPES Journal Portal (Brazilian Ministry of Education), Google Scholar, and the *Publicações de Turismo* database maintained by PPGTUR of EACH-USP (Brazil).

In turn, the documentary survey focused on the rules and bylaws used by the Spanish government through SEGITTUR (2016), such as the standards launched by the *Asociación Española de Normalización y Certificación* (AENOR).

Spain is considered one of the world's references in STD (INVAT.TUR, 2015; SEGITTUR, 2016), and SEGITTUR is a Spanish public company dedicated to innovation management and tourism technologies. Among the standards observed, the UNE 178501 of April 2016 was selected to be the basis of this study, as it objectively deals with the STD Management System. This standard presents a theoretical model for STD to help destinations interested in developing smart tourism practices. STD has gained ground as theoretical models have been applied to understand the impact of new ICT on the relationships between government, business, tourists, and destinations (Femenia-Serra, Neuhofer et al., 2019). Therefore, the UNE 178501 by SEGITTUR (2016) guides this work from the four dimensions recommended to assess an STD, namely Sustainability, Accessibility, Technology, and Innovation (Figure 1).

Figure 1 – STD dimensions

Source: Adapted from SEGITTUR (2016)

Segittur (2016) defines the dimensions as follows:

- Sustainability associates the protection of the economic activity of tourism in the present and future with environmental respect in the short, medium, and long terms, with the preservation of the destination's socio-cultural values, ensuring the quality of life of today and future residents;

- Accessibility encompasses the development of tourism that provides access, use, and enjoyment to all tourists, without exception, granting them the right to equal opportunities to use environments, services, goods, technologies, and products in the safest, most comfortable, and most autonomous way as possible;

- Technology refers to the degree of use and usefulness of technologies by tourists to meet their needs and desires, from the planning to the actual travels;

- Innovation includes the introduction or improvement of new services, processes, organization methods in the destination management practices, and the relationship with residents and tourists to improve the destination's competitiveness.

Documentary research was also carried out in the Operating Manual for the Configuration of Smart Destinations, created by Instituto Valenciano de Tecnologias Turísticas (INVAT.TUR, 2015), which proposes a management model containing items and indicators to transform conventional destinations into STD. The INVAT.TUR indicators are based on the reality of destinations in the Valencian Community and have been outlined by professionals and specialists from different areas related to smart cities and destinations in Spain.

The second step consisted of a qualitative approach through in-depth semi-structured interviews conducted during 2018 and 2019. The objective of the interviews was to verify experiences in STD to consolidate the items and dimensions of SDT identified in the bibliographic and documental research in the first stage. In England, a professor from the School of Tourism at Bournemouth University, a reference in STD research, was interviewed (Boes et al., 2015, 2016; Buhalis & Amaranggana, 2014). In Rio de Janeiro, two public administrators and two UFF researchers studying the tourist activity in the state were interviewed. In São Paulo, two public managers and two USP

researchers studying tourism in the state were interviewed. Finally, in Natal, the interviewees were four managers from the public and private sectors related to the tourism sector in Rio Grande do Norte, in addition to two UFRN researchers. The three Brazilian institutions have researchers with experience in STD studies (Lima, Mendes Filho, Correa, & Mayer, 2021).

From this corpus of information, a questionnaire (Table 1) was designed to identify which dimensions of STD influence the perception of tourists about the degree of smartness of destinations. It was applied through a survey with the participation of tourists in the cities selected. Before applying the survey, a pilot test was carried out to assess the questionnaire patterns, based on participant feedback on the level of understanding of the questions for possible adjustments regarding the dimensions to be tested. The test also aimed to help estimate the average response time. The pilot test was conducted in March 2019 and yielded 20 questionnaires answered by graduate students in Natal. Then, the survey instrument was adjusted before the subsequent and final data collection.

The form consisted of 30 closed-ended questions and was divided into two parts. In the first 20 questions, tourists were asked about their perception of the four STD dimensions: Sustainability, Accessibility, Technology, and Innovation (Table 1). For all items, a five-point Likert scale was used, in which (1) Strongly disagree; (2) Disagree; (3) Neither agree nor disagree; (4) Agree; e (5) Strongly agree. The last question in this section aimed to measure the "degree of smartness" of the destinations, as respondents answered whether or not they perceived the cities as STD. The second section featured nine questions about the profile of respondents, such as gender, age, marital status, monthly family income, among others.

Table 1 – Dimensions and items to evaluate SDTs

Dimensions	Items
Sustainability	**urban planning**
	urban mobility
	electricity supply throughout the city
	trash receptacles throughout the city
	conservation of public buildings
Accessibility	**accessibility** for tourists with physical, hearing, or visual disabilities
	public transportation adapted for tourists with physical, hearing, or visual disabilities
	accessible tourist attractions for tourists with physical, hearing, or visual disabilities
	adapted information services for tourists with physical, hearing, or visual disabilities
	presence of devices/facilities for tourists with physical, hearing, or visual disabilities
Technology	**Wi-fi** availability throughout the city
	fast internet in the city
	travel apps featuring tourist information
	websites featuring tourist information
	social media profiles featuring tourist information
Innovation	innovation in **local tourism organization**
	innovation projects to improve tourism products and services
	adoption of **new technologies** such as QR codes, RFID, NFC, etc., by companies in the tourism sector (hotels, restaurants, bars, etc.)
	last-minute promotions on tourism products and services
	different tourism services compared to other destinations

Source: Prepared by the authors (2019).

The collected data were processed using IBM's Statistical Package for Social Sciences (SPSS) software for Windows, version 26. For data analysis, descriptive statistics were initially used to identify the sociodemographic profile of the participants, as well as their perception of STD dimensions (Sustainability, Accessibility, Technology, and Innovation) per city. Then, Pearson coefficients were calculated to test the degree of correlation between the variables of each dimension with the STD variable. Finally, Multiple Linear Regression was used to test the variance of the items (independent variables) of each dimension on the STD dependent variable, per city.

The study population consisted of tourists visiting Natal, Rio de Janeiro, and São Paulo. The collection points were defined according to the sites with the greatest flow of tourists in each city, and 303 questionnaires were answered. The division by city was organized as follows: 100 questionnaires were collected in June and July 2019 at Ponta Negra beach, in Natal; 103 questionnaires in November and December 2019 in downtown Rio de Janeiro; and 100 questionnaires in February and March 2020 at Guarulhos International Airport, in São Paulo. The sample is non-probabilistic, and the participant tourists were selected randomly or by convenience.

According to Hair Jr., Black, Babin, Anderson, and Tatham (2009), to calculate the sample size in Multiple Linear Regression, each independent variable must have five observations. As this study has 20 independent variables

and the minimum value is five respondents per variable, the minimum number of questionnaires required to analyze the regression results totals 100. Therefore, as at least 100 questionnaires were collected per city (Natal, Rio de Janeiro, and São Paulo), the survey reached the minimum values required for Multiple Linear Regression.

5 ANALYSIS AND RESULTS

This section is divided into five subsections: (1) Sociodemographic profile of the sample; (2) Descriptive analysis of STD dimensions (Sustainability, Accessibility, Technology, and Innovation) and STD ("degree of smartness" perceived in the surveyed destinations); (3) Pearson correlation coefficient, investigating the degree of correlation between the variables of each dimension with the STD; (4) Multiple Linear Regression analysis of the proposed theoretical model; and (5) Discussion of the critical results found through Multiple Linear Regression and Pearson correlation coefficient.

5.1 Sociodemographic profile of the sample

The complete sample (303 respondents) had more female participants (56%), whereas, in São Paulo, the gender variable was more balanced. Most tourists were young adults (60% aged between 25 and 44), married (44%) or single (45%), who completed higher education or a graduate degree (74%). The highest levels of schooling predominated in the samples from São Paulo (78%) and Rio de Janeiro (81%). Half of the respondents declared having a monthly income above R$ 5,001.00, and approximately a third declared having a monthly income ranging from R$ 3,001.00 to R$ 5,000.00. Among all participants, tourists from the city of São Paulo reported the highest income levels, which seems to reflect the local economic context.

As for the actual travel, most respondents (72%) had already visited the cities in question twice or more before. In Natal (78%) and Rio de Janeiro (83%), a significant share of respondents pointed to pleasure as their primary purpose of travel, whereas in São Paulo, business and pleasure were more balanced (48% and 52%, respectively). However, as the three cities are analyzed together, the number of tourists who traveled for pleasure totaled 71%. Finally, most respondents (77%) stayed in the city for more than three nights. Therefore, the sample consists of individuals with previous experience in those destinations, which indicates an excellent ability to assess them according to the requirements of this research (Table 2).

Table 2 – Sample Profile

Variable	Category	Total
Sex	Female	56%
	Male	44%
Age Group	18-24	15%
	25-34	36%
	35-44	24%
	45-54	15%
	55-64	7%
	65 or older	3%
Marital Status	Single	44%
	Married	45%
	Separated	5%
	Widowed	4%
	Other	2%
Income	Up to R$ 1.000,00	3%
	R$ 1.001,00 to R$ 3.000,00	14%
	R$ 3.001 to R$ 5.000,00	33%
	R$ 9.370,01 to R$ 9.000,00	36%
	R$ 9.001,00 or more.	14%
Level of education	Primary School	3%
	High School	22%
	College Graduate	54%
	Graduate Degree	20%
Visits to the city	Once	28%
	Twice or more	72%
Primary purpose	Business and the like	29%
	Pleasure Length of stay	71%
	One or two nights	23%
	Three nights or more	77%

Source: Prepared by the authors (2020).

5.2 Descriptive analysis of STD dimensions

Based on the results of Sustainability, according to the perception of tourists visiting Natal, Rio de Janeiro, and São Paulo, the cities provided tourists with "Electricity supply," as proved by the highest absolute mean values of all three destinations surveyed (4.31, 4.17 and 4.19, respectively). Other Sustainability items with a good degree of agreement according to the tourists' perception were the "Availability of trash receptacles" in Natal (4.0) and "Urban mobility" in Rio de Janeiro (3.80).

As for the Accessibility dimension, no substantial agreement was found regarding the fact that cities have "Adapted public transport for tourists with physical, hearing or visual disabilities." The mean values for the cities are as follows: Rio de Janeiro (3.19), São Paulo (2.97), and Natal (2.89). Other Accessibility items stood out for achieving moderate agreement according to the participants' perception, namely "Accessible tourist attractions for tourists with disabilities" in Rio de Janeiro and São Paulo (3.21 and 2.98), "Services of information adapted for tourists with disabilities" in Rio de Janeiro (3.18), and the Presence of devices/facilities for tourists with disabilities" in Natal (2.98).

The results of the Technology dimension revealed that the tourists visiting São Paulo, Rio de Janeiro, and Natal agree that the cities provided "Fast internet connection," as shown by that item's high mean values (4.50, 4.11, and 3.83, respectively). Other technologies with substantial agreement according to tourists were "Websites featuring tourist information" about Rio de Janeiro and Natal (3.75 and 3.50), "Social network profiles featuring tourist information" about Rio de Janeiro and São Paulo (3.74 and 3.21), and "Travel applications" in Rio de Janeiro (3.58).

As for Innovation, the tourists visiting São Paulo agreed that "Adoption of new technologies (QR codes, RFID, NFC, etc.) by companies in the tourism sector" is a form of Innovation offered by the destination, with the highest mean value (3.85). In turn, the highest mean value for Innovation in Rio de Janeiro, according to the participants' perception, was reached by the item "Different tourist services compared to other destinations" (3.84). As for Natal, the highest mean value was the item "Last-minute promotions on tourist services" (3.70).

After evaluating the four dimensions, tourists were asked to indicate the "degree of smartness" of the destination in question. The results show that on a 1-5 scale, São Paulo was the best-evaluated destination as an STD, according to the tourists' perception (Mean = 3.68; Standard Deviation = 1.15), followed by Rio de Janeiro, which showed a substantial rating (Mean = 3.05; Standard Deviation = 0.65) and, finally, Natal, which showed the lowest rating in terms of its performance as an STD (Mean = 2.55; Standard Deviation = 1.14). In this sense, the data reinforce the positions of the ranking called *2020 Connected Smart Cities*, which characterizes the tourism leadership of São Paulo and Rio de Janeiro at the national level (URBAN SYSTEM, 2020). It also adds to the fact that tourists have noticed the STD strategies implemented by São Paulo, for instance.

5.3 Pearson correlation coefficient

The Pearson correlation coefficients (r) were calculated to test the degree of correlation between the variables of each dimension (Sustainability, Accessibility, Technology, and Innovation) and the STD variable. For Corrar, Paulo, and Dias Filho (2007), two variables are strongly correlated if changes in one variable are strongly related to changes in the other variable. Therefore, the correlation coefficient measures the strength of the association between two variables. The linear correlation between the variables analyzed is strong when the positive or negative Pearson coefficients range between 0.60 and 0.99; moderate when values range between 0.30 and 0.59; and low when values range between 0.10 and 0.29 (Corrar et al., 2007). In turn, to analyze the level of significance of the relationship between the variables, the correlation is considered significant if the p-value is less than 0.05 (Corrar et al., 2007).

Based on Pearson coefficients for the Sustainability dimension, a significant positive correlation was found between "Urban planning" and STD in the three cities examined, ranging from moderate to low (0.458; 0.291; 0.229). The city of São Paulo stood out since its Pearson coefficient showed a moderately positive correlation of 0.458 and a strong correlation between "Urban planning" and STD; that is, the highest degree of correlation in the Sustainability dimension among the three cities surveyed. Another interesting fact is that significant values were found for Pearson coefficients for all correlations of the five Sustainability variables with STD in São Paulo, with emphasis on "Urban planning" and "Conservation of public buildings" (0.333).

As for Accessibility, Pearson coefficients with moderate and significant correlation were found between the variables "Accessible tourist attractions for tourists with disabilities" and STD in the cities of Natal and Rio de Janeiro (0.396 and 0.300), while in São Paulo, the correlation was also significantly positive, albeit low (0.233). Low positive correlation values were found for the variables "Adapted public transport" and "Accessibility for tourists with disabilities variables" with STD in all three cities surveyed (0.162 to 0.264). It should be noted that all correlations between the Accessibility variables and STD in Natal showed significant Pearson coefficients, particularly the item "Accessible tourist attractions for tourists with disabilities."

As for Technology, Pearson coefficients showed small and significant correlations for the variables "Travel apps featuring tourist information" and "Wi-fi available throughout the city" in Natal and Rio de Janeiro, with values ranging from 0.182 to 0.265. Natal stood out with a slight positive correlation of 0.299, and significant between "Social network profiles featuring tourist information" and STD (highest correlation coefficient in the Technology dimension among all three cities analyzed). Likewise, a small positive correlation of 0.251 was found between the item "Websites featuring tourist information" and STD. On the other hand, no significant correlation was observed between Technology and STD variables in the city of São Paulo.

Regarding the Innovation Pearson coefficients, a moderate and significant correlation was identified between "Adoption of new technologies (QR codes, RFID, NFC, etc.) by companies in the tourism sector" and STD in all three cities surveyed (0.654, 0.300, and 0.466). Moreover, other Innovation variables showed significant Pearson coefficients (medium or small) in all three cities, such as "Innovation projects to improve tourist services" (0.530, 0.313, and 0.214) and "Innovations in local tourism organization" (0.523, 0.245, and 0.210). Finally, we emphasize that the correlations of the five variables of Innovation with SDT in Natal showed moderate and significant Pearson coefficients, with values ranging from 0.430 to 0.654.

5.4 Multiple Linear Regression Analysis

Multiple Linear Regression analysis was performed to verify how tourists' perception of the "degree of smartness" of a given destination (the STD dependent variable) can be influenced by Sustainability, Accessibility, Technology, and Innovation. It is essential to mention that the absence of multicollinearity was verified by a variance inflation factor (VIF) and data tolerance value. According to Hair Jr. et al. (2009), the tolerance value should ideally be higher than 0.10, and the VIF value should be lower than 10. The minimum tolerance value for Natal, Rio de Janeiro, and São Paulo was 0.74, and the maximum was 0.98, whereas the minimum VIF values for the cities were 1.01 and the maximum value was 1.34. Therefore, no multicollinearity was found between the independent variables.

The Stepwise method was used for Multiple Linear Regression Analysis, as it has a high number of independent variables (20 in total), in addition to avoiding multicollinearity between the variables in the research model. According to this method, "independent variables are added as long as their partial correlation coefficients are statistically significant" (Hair Jr. et al., 2009, p. 151). As a parameter for adding variables, the Stepwise method checks whether p values are equal to or less than 0.05; in turn, for excluding variables, the values must be equal to or greater than 0.10.

The results of the regression coefficients (Table 3) for the 20 independent variables tested revealed that five of these variables showed a significant relationship with the STD dependent variable. Of the five significant independent variables, three variables are associated with Innovation, namely "Adoption of new technologies by companies in the tourism sector", "Innovation projects to improve tourist services", and "Different tourist services compared to other destinations"; in turn, two variables are associated with Sustainability, namely "Urban planning" and "Electricity supply throughout the city."

It is worth noting that the "Adoption of new Technologies (QR codes, RFID, NFC, etc.) by companies in the tourism sector" was the most significant factor influencing the perception of destinations as STD both in Natal (β = 0.439; t = 5.623; p < 0.001) and São Paulo (β = 0.360; t = 4.110; p < 0.001). "Urban planning" ranked second as the most significant factor influencing the perception of a destination as an STD, both in São Paulo (β = 0.348; t = 3.973; p < 0.001) and in Rio de Janeiro (β = 0.345; t = 3.578; p < 0.001). Two other variables had a positive impact, namely "Innovation projects to improve tourist services" in Natal (β = 0.293; t = 3.966; p < 0.001) and Rio de Janeiro (β = 0.282; t = 3.141; p < 0.002), and "Different tourist services compared to other destinations" only in Natal (β = 0.246; t = 3.323; p < 0.002). It is worth highlighting the item "Electricity supply throughout the city," which showed

a lower relative weight compared to other variables that influence the perception of a destination as an STD in Rio de Janeiro. In addition, this variable showed an inverse relationship, as both β = -0.238 and t = -2.490 were negative, despite a significant relationship with a p value < 0.014.

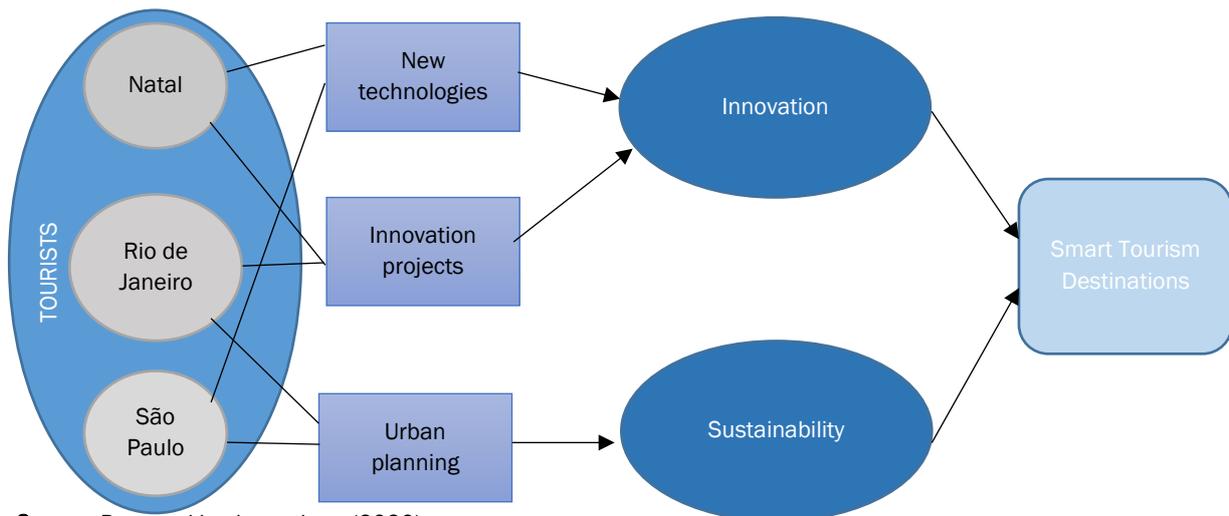**Table 3** – Regression and Coefficients of Determination (R^2)

	NATAL			RIO DE JANEIRO			SÃO PAULO	
	Innovation			Innovation	Sustainability		Innovation	Sustainability
	New technologies	Innovation Projects	Different tourism services	Innovation Projects	Urban planning	Electricity Supply	New technologies	Urban planning
Unstandardized coeficiente (B)	0.492	0.355	0.251	0.176	0.246	-0.149	0.367	0.302
Standardized coeficiente (β)	**0.439**	**0.293**	0.246	**0.282**	**0.345**	-0.238	**0.360**	**0.348**
t	5.623	3.966	3.323	3.141	3.578	-2.490	4.110	3.973
Sig	0.000	0.000	0.001	0.002	0.001	0.014	0.000	0.000
R	0.752			0.461			0.571	
R^2	**0.565**			**0.213**			**0.327**	
Adjusted R^2	0.551			0.189			0.313	
Standard error of estimate	0.76384			0.58317			0.95643	

Source: Prepared by the authors (2020).

The evaluation of the coefficient of determination (R^2) indicates the explanatory power of the regression; that is, it shows how much of the variation in the dependent variable can be explained by the variations in the independent variables studied in the model (Corrar et al., 2007). In social and behavioral sciences, R^2 = 26% can be classified as large effect size, R^2 = 13% can be classified as medium effect size, and R^2 = 2% as small effect size (Cohen, 1988). The results found through Regression Analysis (Table 3) showed a strong relationship for Natal (R^2 = 56.5%) and São Paulo (R^2 = 32.7%), whereas the relationship was considered moderate for Rio de Janeiro (R^2 = 21.3%).

When evaluating the R^2 values per city, the variance of the set of three independent variables of the Innovation in Natal dimension ("New technologies", "Innovation projects", and "Different tourist services") showed the strong explanatory power of the STD dependent variable. In Rio de Janeiro, an independent variable from the Innovation dimension ("Innovation projects", the same as Natal) and two independent variables associated with the Sustainability dimension ("Urban planning" and "Electricity supply") showed the moderate explanatory power of the STD dependent variable. Finally, in São Paulo, an independent variable associated with the Innovation dimension ("New technologies", the same as Natal) and an independent variable associated with Sustainability ("Urban Planning", the same as Rio de Janeiro) showed the strong explanatory power of the STD dependent variable. When the three cities were analyzed in combination, the indicators associated with Innovation and Sustainability showed the power to influence the STD, especially the variables "New technologies", "Innovation projects", and "Urban planning", which were present in two of the three cities investigated (Figure 2).

Figure 2 – Indicators and dimensions influencing tourists' perception of STD

Source: Prepared by the authors (2020).

Therefore, to synthesize the main results, Figure 2 presents a model with the indicators "New technologies", "Innovation projects", and "Urban planning", and their respective dimensions Innovation and Sustainability, which influenced tourists' perception most in at least two of the cities surveyed.

5.5 Discussion

According to the results obtained through Multiple Linear Regression analysis, the indicators associated with Innovation and Sustainability influenced the STD dependent variable. Of these two dimensions, the variables "New technologies" (Innovation), "Innovation projects" (Innovation), and "Urban planning" (Sustainability) significantly influenced the perception of STD in at least two of the three cities investigated. On the other hand, the specific variables of Accessibility and Technology did not show significant relationships with STD, although the variable "New technologies", associated with Innovation, proved significant. Therefore, it is necessary to discuss the Innovation and Sustainability dimensions (and their respective indicators) as the ones that influenced the perception of STD among tourists most.

These results can be related to studies on Innovation and STD, such as Boes et al. (2016), in which the authors found that for a given tourist destination to become an STD, it must focus on innovation, as this will facilitate the development of an ecosystem. Therefore, the implementation of an STD strategy will favor innovation to consolidate a destination, especially if it has been able to act upon management and decision-making (Femenia-Serra & Ivars-Baidal, 2018; Femenia-Serra, Perles-Ribes et al., 2019), and the cooperation between stakeholders (Ivars-Baidal et al., 2019). Innovation adds a comprehensive perspective that allows us to understand the ongoing development and management of an STD. Therefore, the focus should be on treating smart destinations as innovative destinations (Williams et al., 2020). To facilitate innovation, destinations must have access to new technologies and cutting-edge knowledge (Pierre, 2019). Technological innovations bring together stakeholders interested in the tourism activities ecosystems in destinations (Buhalis, 2019).

In this study, the "Adoption of new technologies (QR codes, RFID, NFC, etc.) by companies in the tourism sector" (hotels, restaurants, bars, etc.) proved to be paramount for the cities to be perceived as STD, according to the perception of tourists who visited Natal and São Paulo. For Femenia-Serra, Neuhofer et al. (2019), the use of new technologies is vital for STD. Tourism has increasingly incorporated new technologies, such as QR codes, Radio Frequency Identification (RFID), Near Field Communication (NFC), the Internet of Things, 5G, wearables, 3D printing, Blockchain and cryptocurrencies, wireless sensor networks and smart beacons, gamification, cloud computing, ubiquitous computing, artificial intelligence, machine learning (Boes et al., 2015; Paska, 2018; Buhalis, 2020). Smart tourism focuses on taking advantage of these technologies because, when combined, they form the STD ecosystem to strengthen innovation and create new tourism business models (Gretzel, 2018).

Technology companies can support the integration and use of new tools, in addition to facilitating collaboration to promote innovation and the dissemination of ICT in destinations (Öberg, Ribe, Glaumann, Gjelstrup, & Berntsson, 2017). After all, technologies are paramount in the context of STD, as they encourage tourists to communicate directly and interact with tourism stakeholders more efficiently (Jeong & Shin, 2019). Therefore, STD are a rapidly developing field, which will only grow in importance as new technologies advance (Gretzel et al., 2018).

The variable "Innovation projects to improve tourism products and services" had a significant influence on the perception of a destination as an STD for tourists visiting Rio de Janeiro and Natal. Indeed, a study by Strömdahl et al. (2014) conducted in Sweden identified a relationship between innovation projects and STD, as evidenced by the projects (a) Perfect Traveler, which aims to bridge the gap between public and private transport through a brokerage service focused on travel solutions daily; (b) Virtual traveler, which focuses on how visualization and simulation can support the involvement of travelers in the design process of new transport solutions; and (c) Living Lab, which developed a travel service implemented in a laboratory test environment. According to the United Nations (United Nations, 2016), governments have allocated resources to research projects on innovation in STD and encouraged the use of innovative infrastructures, such as science parks, business incubators, innovation hubs, and Living Labs to help develop ideas for smart cities. Indeed, these Living Labs exemplify the culture of innovation that permeates STD (Gretzel & Scarpino Johns, 2018).

The results of this study establish a dialog with research on Sustainability and STD. Gomis-López and González-Reverté (2020) have highlighted the importance of the connection between Sustainability and STD through the implementation of technologies such as the strategy of a given destination to achieve more efficient environmental management. STD have equipped themselves with technological infrastructures to better deal with the environment (overcrowding, weather, traffic, and power consumption) (Gretzel & Scarpino Johns, 2018). By efficiently applying smart technologies, STD can focus on sustainable destination management (Mehraliyev et al., 2019). At a systemic

level, environmental sustainability is a crucial priority to enable the ecosystem of a given STD (Gretzel, Sigala et al., 2015; Gretzel, Werthner et al., 2015).

In São Paulo and Rio de Janeiro, "Urban planning" influenced the tourists' perception of STD, corroborating the ideas of Gretzel (2018), who stated that destinations where smart tourism concepts have been implemented, have focused on urban planning. STD have employed technologies in urban planning, which has facilitated the use of public spaces, as well as parking and security issues (SmartCitiesWorld, 2018). The Internet of Things, 5G, and artificial intelligence will enable access to real-time data in cities and will be efficient tools to assist urban planning and management in sustainable destinations in the future (Paska, 2018).

Smart tourism is a crucial component of urban planning in tourist destinations, providing local renewal strategies and technological solutions that can address urban demands such as tourist mobility and overtourism (Gomis-López & González-Reverté, 2020). For instance, incorporating technologies into urban traffic infrastructure such as cameras generates more mobility options for tourists in large cities where traffic jams are frequent (Gretzel, 2018). As highlighted by Santos and Gândara (2019), sustainability is fundamental for sustainable tourism development and the competitiveness of STD.

Although various studies have attested that the presence of technology directly impacts tourists' perception of STD (Sigala et al., 2015; Buhalis & Amaranggana, 2015; Boes et al., 2016; Gretzel & Scarpino Johns, 2018; Gretzel; Ivars-Baidal et al., 2019), the results of the regression analysis did not show that the variables associated with this dimension influenced the participants in this study. On the other hand, it is noteworthy that the variable "Adoption of new technologies" (QR codes, RFID, NFC, etc.), associated with Innovation, significantly impacted the perception of Natal and São Paulo as STD. In addition, Pearson coefficients showed a low and significant correlation between the variables "Wi-fi availability" and "Travel apps featuring tourist information" and STD in Natal and Rio de Janeiro. Similarly, significant low correlations with STD were found when considering the technological variables "Websites" and "Social networks profiles featuring tourist information" only in Natal. This proves the relevance of Technology in the context of STD, this reaffirming the use and usefulness of technologies by tourists in STD while aiming to meet their needs before and during travels (SEGITTUR, 2016; Buhalis, 2020).

Unlike other research on Accessibility and STD that addressed the importance of the relationship between these areas (Buhalis & Amaranggana, 2014; Boes et al., 2016; Santos, Souza Neto, Pereira, Gândara, & Silva, 2016), the Accessibility dimension did not show a strong relationship with STD in this study. A possible explanation is that the respondents probably did not have any type of physical, hearing, or visual disability. Even so, moderate or low significant correlations were identified between Accessibility and STD in the three cities examined, considering the variables "Accessibility on the streets for tourists", "Adapted public transport", and "Accessible tourist attractions". Therefore, Accessibility is a critical factor for STD, providing a positive experience for tourists by ensuring equal opportunity rights for all, through the inclusion of people with special needs, in addition to promoting the competitiveness of the destination and quality of life for residents (Santos et al., 2016; SEGITTUR, 2016).

6 CONCLUSIONS

In the context of the implementation of strategies aimed at the development of tourism and the adoption of technologies to transform destinations into STD, there are complex decisions and a set of high public and private investments that should not be neglected by tourism managers since the goal is to attract more tourists and increase competitiveness compared to other destinations.

In view of the difficulties inherent in deciding which dimensions should be prioritized in the scope of the STD management process, and the fact that the literature on the topic is scarce (Gajdosík, 2019), we propose that the planning of actions considers the perception of tourists and their decision-making process in choosing to visit a smart destination. Tourists have become increasingly adept at technology, not only to improve their tourist experience but also to interact in real-time and participate in co-creation processes with other STD stakeholders (Femenia-Serra, Neuhofer et al., 2019).

Therefore, we recommend a set of priority dimensions for the implementation of STD, which can be effectively perceived by tourists as an added value. This, in turn, would allow a quicker and less risky return on investments made by public and private managers. Furthermore, redirecting the process that can turn a destination into an STD can contribute to attracting new resources that support complementary and fundamental actions for consolidating the STD in question.

This study aimed to investigate the dimensions impacting tourists' perception of STD in three destinations with different profiles (Natal, Rio de Janeiro, and São Paulo), based on the dimensions proposed by STD-based theoretical models developed in Spain (INVAT.TUR, 2015; SEGITTUR, 2016), and an initial qualitative study that outlined the items of the dimensions adopted in the survey. The analysis of the results revealed that the perception of the Innovation and Sustainability dimensions stood out in terms of their influence on the perception of destinations as STD among tourists visiting the three destinations. To a lesser extent, significant albeit low correlations were identified between Technology and Accessibility and STD.

It is noteworthy that the understanding of STD should not be limited to the adoption and implementation of advanced technologies to be used by stakeholders (Gretzel & Scarpino Johns, 2018; Johnson & Samakovlis, 2019; Jovicic, 2019); instead, it should be perceived as the relationship of interdependence with other aspects such as Sustainability, Innovation, and Accessibility, as the results of this research have pointed out. In addition to technologies, destinations need to be guided by tourism development and management strategies, which, in turn, have implications for the destination's governance and strategy (Gretzel, 2018). Therefore, the "degree of smartness" of destinations will not be conditioned to the use of technologies but will encompass a strategy shared by tourism stakeholders, with solutions tailored to each destination (Ivars-Baidal et al., 2019).

6.1 Theoretical and managerial contributions

Studies focusing on STD have been conducted in various contexts (Femenia-Serra & Neuhofer, 2018; Johnson & Samakovlis, 2019; Mehraliyev et al., 2019, 2020). However, studies focusing on tourists are scarce (Femenia-Serra, Neuhofer et al., 2019; Femenia-Serra, Perles-Ribes et al., 2019; Gajdosík, 2019), and most of them relied on secondary data, addressed best practice cases, or consisted of descriptive empirical studies. This study is one of the first to conceptualize and statistically test an STD model based on the perception of tourists about three destinations with different profiles.

The primary contribution of this article is to propose an STD model developed from the Innovation and Sustainability dimensions since the indicator that influenced tourists' perception of STD the most was "Adoption of new technologies (QR codes, RFID, NFC, etc.) by companies in the tourism sector", "Innovation projects to improve tourism products and services", and "Urban planning".

As for managerial contributions, we hope that this model can help destinations to prioritize specific dimensions in the process of implementing new STD initiatives. In this way, the tourist activity shall benefit from having a model on STD dimensions based on the preferences of the main stakeholders, that is, tourists themselves (Mehraliyev et al., 2020). Also, it shall serve as a tool to foster innovation and competitiveness in tourist destinations. The information provided by the theoretical model can guide policies and practices that encourage smart, sustainable, and integrative growth, led by municipal and state tourism secretariats, aiming to engender innovation in the sector.

It is important to note that the STD dimensions and indicators may vary according to the destination (Freitas & Mendes Filho, 2020). Therefore, the dimensions and indicators to be adopted by a destination must adapt to the needs and resources available in the city and region, to favor those with more agile organizational structures and that are prone to public-private collaboration, in addition to being well-equipped in terms of economic and human resources (Ivars-Baidal et al., 2019).

6.2 Limitations and suggestions for future research

This study has some limitations that are briefly described below. Data were collected in three Brazilian cities, totaling 303 respondents. We suggest that future research on STD frame destinations in other Brazilian regions or countries in order to verify whether the dimensions and indicators covered in this research will be perceived by tourists visiting these places. We also suggest the conduction of qualitative research to be compared with the quantitative results found in this study.

7 ACKNOWLEDGEMENTS

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