

# OPEN DATA AND SMART TOURISM DEVELOPMENT

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**Abstract:** *Smart tourism destinations are created with the implementation of the Smart City concept. This concept is getting stronger because projections show that about 66% of the world population will live in an urban environment by 2050. The Smart Cities around the globe have already implemented strategies for the development of smart tourism or their implementations are in progress. The goal of this paper is to study key factors of the successful smart city technologies with a primary focus on Open data to the development of smart tourism destinations through the analysis of more than 10 smart cities that represent leaders in the smart tourism.*

**Keywords:** *Smart City, tourism, sustainable development, Open Data, BigData.*

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## 1. INTRODUCTION

Smart cities represent urban environments that attempt to use modern ICT (Information Communication technologies) such as Open Data, Internet of Things - IoT, Blockchain technologies, augmented reality, BigData and another state of the art ICT technologies in order to optimize and increase the efficiency of resources and urban environmental management. Application of these technologies aims for the increase of the competitive advantage of the cities that are using them in order to attract investments, an increase of the quality of life for the inhabitants and optimization of the resource allocation. The Smart Cities development consecutive lead to the development of the smart tourism destinations. The definition of „Smart Tourism“ is first established in the first meeting of the „Tourism Resilience Committee of the UN World Tourism Organization” in the year 2009th as a concept that should „address the important questions such as ethics, sustainability and the quality of the service chain and to provide short-term response to the economic crisis as well as to provide long-term sustainable economic development“.

Smart tourism is tourism based on the application of modern ICT. It is important to note that there is no clear definition and agreement on the term smart tourism destination“ in the scientific literature. Because of the lack of the definition and established methodology frameworks, it is hard to subject to scientific analysis and critique. The majority of the scientific papers on this subject are in the form of case studies (Bakici et al. 2013; Wang et al. 2013.) or in the form of the isolated technology achievements and applications (e.g. Huang and Chen 2015; Boes et al. 2015) [1]. With the further development of the Smart cities and expansion of the cities that are the leaders in the smart tourism which are renowned as the „smart tourism destination“ a possibility for the analysis of the contemporary smart tourism leaders arises. With the careful and scientific study of the cities that are highly ranked in the smart city indexes and the cities that are perceived as leaders in the smart tourism destinations, a correlation between their strategies and operative actions and the sustainable smart tourism development can be established. The scientific analysis can be used to establish a pattern of actions/policies that contribute to the

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smart tourism development in order to establish a methodology and a framework for the development of the smart tourism. The analysis of the cities that represent leaders in the development of smart tourism has to be holistic because it is hard or even impossible to isolate a single area of the effect from others. Further study should include multicriteria analysis in order to establish the strength and the impact of the individual factors. This study is deemed as justified because it should join the isolated case studies and individual technology application study into an attempt to establish a framework and the methodology for the sustainable development of smart tourism. The authors of this paper think that it is justified to create a methodology framework for comparison of the smart city achievements in the field of smart tourism development. The narrower focus of the paper within such a broad context is the analysis of the data gathering, storing and public disclosure of the data in the form of the open data in order to provide the foundation for the development of the tourism and tourism-related web applications. The systematic analysis of the number and the nature of the smart tourism web applications created in/for the cities that are perceived as the leaders in the smart tourism this paper attempts to show the correlation of the technology used in/by the smart cities and the development of the smart tourism. The clear conceptualization of this practice could lead to the further establishment of the decision support systems, indices of destination success, and destination strategy simulation models for both smart cities and countries and regions alike.

## 2. THE SUSTAINABLE TOURISM DEVELOPMENT

The predominant view of the scientific community is that the tourism industry has a long way to go in order to achieve sustainable development. There is a various interpretation of the reasons for the slow progress toward the sustainability, however, it may be concluded that the actors in the tourism sector pursue sustainability only to meet the regulatory demands and not because of the market reasons. Further development of the sustainable tourism should include the role of tourism in the expansion of protected areas; improvement in environmental accounting techniques; and the effects of individual perceptions of responsibility in addressing climate change. There are over 7000 relevant publications on the subject of sustainable tourism development but rare, very few attempt to evaluate the entire global tourism sector in terms which reflect global research in sustainable development.

A study reviewed the mainstream tourism sector worldwide, in five categories: population, peace, prosperity, pollution and protection and concluded that: “The industry is not yet close to sustainability. The main driver for improvement is regulation rather than market measures. Some tourism advocates still use political approaches to avoid environmental restrictions, and to gain access to public natural resources” [2].

A number of articles are so-called “green tourism” or ecotourism which is only to some uncertain degree synonym with sustainable tourism. Sustainable tourism and ecotourism are similar concepts and share many of the same principles, but sustainable tourism is broader; it covers wide variety types of travel and destinations, from luxury hotels to backpacking and bustling cities to remote rainforests. **Ecotourism** is defined by the International Ecotourism Society as: “responsible travel to natural areas that conserves the environment and improves the welfare of local people.” The key principles of ecotourism include minimizing impact, protecting biodiversity, building environmental awareness, and respecting local culture. Typically, the primary attractions for ecotourists are flora, fauna, and cultural heritage. **Sustainable tourism** businesses support environmental conservation, social development, and local economies. Examples

of sustainable business practices include conserving water and energy, supporting community conservation projects, recycling and treating wastes, hiring staff from the local community, paying them just wages and providing training, and sourcing locally-produced products for restaurants and gift shops. Sustainable tourism businesses take concrete actions to enhance the well-being of local communities and make positive contributions to the conservation of natural and cultural heritage. In doing so, they often cut down on their own costs and preserve the longevity of their businesses in addition to attracting responsible travelers. In order for sustainable tourism to thrive, it has to be profitable for business owners [3]. Some papers argue that sustainable tourism development pay more attention to the ecological and economic aspects than the socio-cultural aspect and that true sustainability achievement can be accomplished through the community involvement rather than the application of the technology. “Sustainable tourism has traditionally given more focus to aspects related to the environment and economic development and that more focus should be given to community involvement“ [4].

## 2.1. Smart city technologies relevant to sustainable tourism development

Through the literature 6 key technologies called the pillars of Smart City development are agreed upon. They are summarized as:

1. Smart energy - Both residential and commercial buildings in smart cities are more efficient, using less energy, and the energy used is analyzed and data collected.
2. Smart transportation - A smart city supports multi-modal transportation, smart traffic lights, and smart parking.
3. Smart data - The massive amounts of data collected by a smart city must be analyzed quickly in order to make it useful. Open data portals are one option that some cities have chosen in order to publish city data online so that anyone can access it and use predictive analytics to assess future patterns.
4. Smart infrastructure - Cities will be able to plan better with a smart city’s ability to analyze large amounts of data. This will allow for pro-active maintenance and better planning for future demand. Having a smart infrastructure means that a city can move forward with other technologies and use the data collected to make meaningful changes in future city plans.
5. Smart mobility - Mobility refers to both the technology and the data which travels across the technology. The ability to seamlessly move in and out of many different municipal and private systems is essential if we are to realize the promise of smart cities. Building the smart city will never be a project that is „finished.“ Technology needs to be interoperable and perform to expectations regardless of who made it or when it was made.
6. Smart IoT devices - In a smart city, information will increasingly be obtained directly from purposefully deployed sensors or indirectly from sensors deployed for another purpose but which gather and share useful information. With this information, freely exchanged, complex city systems can be managed in real-time and, with sufficient integration, to minimize unintended consequences.

These pillars or leading directions of smart city development are predominantly achieved by heavy utilization of the newest state of the art ICT. The way these pillars are achieved starts with the application of the Internet of Things IoT devices to gather a large amount of data in real time. This data is stored and analyzed by the application of the BigData technologies and other AI (Artificial intelligence) and BI (Business intelligence) tools in order to obtain information to be used by the city managers and the inhabitants of the city. This data is represented and publicly displayed in the form of the OpenData or used for nonpublic use by the city management. The

information can be transmitted in the form of the web application or even with the application of augmented reality. For the development of smart tourism, both augmented reality and various tourism web applications are used to feed the visitors/tourists with the additional content and information.

### ***2.1.1. Internet of things (iot)***

Internet of things is defined as the „self-configuring and adapting system that consists of a network of sensors and smart objects that are used to interconnect things including industrial and everyday objects in a way that makes them intelligent, programmable and to make their interaction with humans easier” [3]. This sensory network is used to gather real-time data about anything. These vast amounts of data are using a technology known as BigData in order to house and process this data in real time, and in order to provide real-time information. These smart sensors can be found on the roads, power lines, in the buildings, in smart apartment units, on the bracelets, cars, planes, bikes, etc. IoT is one of the key technologies that lead to the development of Smart Cities. It enables the gathering of previously unimaginable amounts of data in the real time. Even harder and more fantastic is the fact that IoT can be used to manage nonliving entity such s environment in an intelligent manner without the human presence. This may sound befuddling but It has very simple and easy to use real-life applications – manage a smart street lights system and make it work only when someone is passing through the street, energy saving, optimize garbage collection, separate recyclable materials, enhance parking management, optimize vehicle traffic, etc. [6].

### ***2.1.2. Big data***

IoT sensors gather huge amounts of data that are useless by itself if they cannot be processed in order to derive the usable information suitable for the decision support system and adequate management decision making. There are 3 levels of analysis: (1) knowledge that something happened, (2) programming of the future events based on the data, (3) finding the best decision/answer to the perceived situation” [7]. The Big Data represents technology for storing and analysis of the large amounts of data. However, this technology is not sufficient, it has to be combined with other data sources and processing engines in order to support the development of smart cities [5].

### ***2.1.3. Open data***

The OpenData concept is a growing trend of enabling public availability for predefined databases in the form of data sets. Selected database parts are publicly shown on the Internet, optimized for automatic processing and machine learning. The owners of these data sets show them and enable machine reading, storing and reproduction of the data. OpenData has especially developed in the government initiatives because this sector has a legislative obligation to show selected data sets that are in public interest. Because of the nature of OpenData, these data sets are suitable for use by 3rd parties for the development of the web-based applications. These 3rd parties use these data to derive usable information and distribute them to the end users.

### ***2.1.4. Augmented reality (ar)***

Augmented reality (AR) is defined as ”live view on the real-world environment with the elements of the enhanced/augmented computer-generated sensory contents such as sound, graph-

ics, or GPS data”. In the most cases, these contents are presented with help of smart devices that are equipped with multiple sensory devices such as camera, microphones, speakers, high-resolution touchscreens, 3D screens, holographic screens, pico-projection technologies, etc. These technologies enable manufacturers and programmers to pack information in a clear and effective manner without the loss of visibility. Modern AR applications e.g. “iPhone World Lens” and “Google goggles” attracted the great attention of the public. The development of these applications is facilitated by the development of other technologies such as low-cost processor manufacturing, thin screens, the wide availability of computing hardware such as smartphones and tablets. Also, this technology can now be evaluated as mature, and there are no standards for the use of this technology. The use of this technology is not legally regulated. This technology possesses great possibilities in the enhancement of human possibilities, but there is a significant danger of health, safety, and other security threats [8]. The interest of this paper is only AR technologies that are related to tourism. AR technology went far away from the pilot and research projects. It now in commercial use with smartphone applications, and with augmented reality smart googles (on a smaller scale). It is vital to stress the technical qualities of the AR development with a focus on the technologies that enable the creation of augmented reality contents that represent the augmented experience in the essence. Various technological limitation still slows down the adoption of AR technology such as high-speed internet and smartphones availability. The elimination of these limitations will lead to the full tourism application of these technologies across the globe [9].

#### ***2.1.5. Tourism web applications***

There are two segments of application use. The first is for the planning of the trip itself. People planning a trip often start investigations by looking for materials on the Internet. The user can find a large amount of information about the city and its popular tourism objects, but it takes a long time to select the most interesting objects and create a good plan for a visit [10]. The second use of tourism applications is during the stay/visit. During the stay in the Smart City, tourist can download applications to their smart devices that can provide additional information and content to enhance and facilitate their experience.

#### ***2.1.6. Tourism and augmented reality (ar)***

Current frameworks for augmented reality resulted in the creation of a substantial number of applications. Many of these begin as a research project but are now commercially widely available and used by numerous users. These applications and their use is highly heterogenic which is a good signal for their further development. On the first look, these applications are heterogenic but there is a common set of properties – they are based on AR and they are built for the requirements of the tourism. The scientific paper that analyzed use cases for some European widely adopted AR tourism applications made a short review which will be shown [9].

Tuscany+, the first AR application, developed specifically for the Tuscany region by Fondazione Sistema Toscana, operates as a digital tourist guide. Drawing information from Internet sources, such as Wikipedia, Google Places and the region’s official portal, Tuscany+, delivers tourist information in Italian and English regarding accommodation, dining, the city’s nightlife and of course sightseeing [11].

Basel is another city with its own AR tourist guide. Having started as part of the project “Augmented Reality for Basel”, it is now accessible through the Layar AR browser discussed previ-

ously, as one of the browser's available layers. Therefore, the application is available for iOS, Android OS, Symbian OS, and BlackBerry OS. It is available in English, German, French, and Spanish, and the content is drawn from the city of Basel's dedicated database. The users can retrieve valuable information for the city of Basel and its outskirts, and more specifically regarding its sites, museums, restaurants, and hotels, while information for events and shopping centers are also available [12].

The StreetMuseum application, developed by Thumbspark Limited specifically for the needs of the Museum of London, offers users the chance to visualize the city of London at various points in history. Tourists can point the camera of their mobile phones at present-day street views and have historical pictures, drawn from the Museum's vast collection, superimposed on top of their real view, while additional information is also available through information buttons. StreetMuseum offers also a trail functionality in which tourists can design their route beforehand and discover the city's history or identify altered landscapes and important landmarks [13].

A different approach to AR term applications can be found in the example of „Urban Sleuth“ application. Developed by Urban Interactive, Urban Sleuth is designed as a real-life city ‘adventure’ in which users participate with the aim to solve mysteries and carry out missions while traveling around the city, competing against each other or in teams. Through the application, the real world blends with the virtual, and the offered ‘missions’ can be designed so that participants can discover neighborhoods and historical monuments, among other interesting locations [14].

## **2.2. Sustainable development of tourism**

Tourism sustainable development should be achieved with the application of the modern ICT and with the improvement of existing business practices. One of the proven ways of sustainable tourism development is the gathering and processing data obtained from the application usage by the tourists.

According to Katie Briscoe, EVP of client services with MMGY Global, 35 percent of travelers downloaded booking applications in 2015, and 45 percent of them made a booking. In addition, consumer engagement on social media channels continues to climb on all fronts aside from LinkedIn, which is retracting. Briscoe's research also shows that 90 percent of travelers share information about their trip through photos, and 75 percent of travelers share their travel experiences post-trip on social media. Hotels need to get used to this idea, Briscoe said, because the generation coming after millennials are going to be even more difficult to nail down. Known as “Generation Z,” and comprising those currently aged five to 20, this generation will comprise 40 percent of the population in five years and will be attracted to entrepreneurial endeavors. And while it didn't go into the myriad possible causes, this Generation Z is expected to have an attention span for marketing of roughly eight seconds, down from the theorized 12 seconds possessed by millennials, presenting even more challenges. The data from this research show that only 10 percent of apps that are downloaded are ever used more than once, suggesting hotels should think twice before considering the development of another app. Even more interesting, a survey from MMGY found that 93 percent of travelers found human touch to be irreplaceable, and 90 percent of respondents desire meaningful human interaction from hotel brands [15].

The final conclusion of this research was that hotel operators take more notice to booking offers and lower prices in order to obtain competitive advantage compared to the nourishing quality service and human interaction as a factor of competitive advantage.

Smart city technologies such as BigData, Open Data, and Augmented Reality can be used to gather data in order to derive meaningful information that can have a significant impact to the overall satisfaction of the services provided to the visitors/guests. The use of these applications can facilitate sustainable development of the tourism sector. Augmented reality-based applications can join people and places in new and exciting ways with the use of smartphones or VR goggles and provide them with additional content based on user location. These applications represent a segment that must not be neglected because they can provide significant improvement to the over experience delivered to the end user. They can provide vital information about the e.g. museum, gallery, square, monument, hotel, commercial object, etc. A large number of cities across the world offer download of the smart applications that help tourists orient, aid their stay and provide them with additional information. This practice improves the experience and safety of the tourists. Local shop owners also benefit from these applications because they help them to reach potential customers in an easier way and increase their earnings. These applications are sustainable in the same way because conserver resources should be used to get the same effect by using the conventional methods.

### 2.3. Smart tourism destination

“Vital ICT components are required for the creation of the smart tourism destination: (1) Cloud computing, (2) IoT and (3) high-speed Internet“ [16]. Cloud computing provides availability to web services and information as well as data storing simultaneously. Cloud computing transforms variable IT infrastructure costs into fixed costs. IoT gathers information, analysis, automatization, and control. Tracking of the tourist can show location availability, parking availability, tourist attention and spent time on certain locations can be determined, etc. The term Availability is used to mark the ability to download applications from the Internet to their tablets, smartphones, laptop or some other devices. These technologies provide the foundation for the development of the various tourist applications and other digital contents that fulfill the over tourist experience. The use of these applications transforms the tourist destination into the smart tourism destination [4].

## 3. SMART TOURISM DESTINATION AND THE SMART CITY

„Smart tourism destinations and smart cities have the same goal by the definition, both aim for the quality of life improvement as well as competitive increase“ [17]. „During the last decade that marked proliferation of internet cafes, WIFI technologies, social networks, photo sharing sites, etc. ICT enabled sharing of content and created first interactive travelers“ [18].

„From the tourism perspective ICT can contribute to the creation of the added value with simultaneous efficiency improvement and automatization and networking“ [19]. „Smart tourism destination is special case of the smart cities: they apply smart city principles to rural and urban areas and pay attention to tourists and residents by providing them mobility, improve resource allocation, sustainability, and quality of life/visits“ [20].

For example, Smart City (SC) is a semantic recommender and route composer system for tourists. A tourist can specify his location, time of the visit and his preferences about different types of objects and events. Based on the created profile, the suggestion engine finds interesting objects for the given user. For each found object a score of „interestingness“ is found. The objects that the user probably likes have a higher score and vice versa. The objects and events are organized into a timetable based on their location and time. Finally, the schedule and the trip route

will be presented to the user. The tourist has an option to modify the suggested objects and to create a more suitable timetable [10].

In the case of the smart city, the focus in the case of a smart tourism destination is on the visitor. Smart cities, by themselves, manage the factors that make city system develop smart tourism and transformation of the smart city into a smart tourism destination. This destination will have large competitive advantages compared to other non-smart destinations. These benefits are dual: quiet of service delivered to the end user and competitive advantages gained by operating business within the smart city itself [21].

### 3.1. The application of smart city technologies in the development of smart tourism

The cities in the focus of this initial research are chosen from the internet page <https://easypark-group.com/smart-cities-index/> [22] that shows the ranking of the smart cities by 19 different factors based on the methodology that was developed to facilitate comparison between the smart cities. Every ranking is arbitrary in its nature and despite how good the methodology was, it is important to stress that this is arbitrary ranking, so the goal of this paper is to show a correlation between the strategy of the sustainable development in the smart cities and the strategy of sustainable smart tourism developments.

The cities were chosen because they are ranked as top 10 most ranked cities by the overall score – the cities that had the most index points on the list. The number of tourism-related projects and developed web applications was researched and analyzed in these top 10 ranked cities.

Rank	City	Projects	Applications
1.	Copenhagen, Denmark	>5	>9
2.	Singapore	>2	>10
3.	Stockholm, Sweden	> 4	>14
4.	Zurich, Switzerland	>2	>20
5.	Boston, United States	>7	>30
6.	Tokyo, Japan	>2	>8
7.	San Francisco, United States	>7	> 50
8.	Amsterdam, Netherlands	>100!	>20
9.	Geneva, Switzerland	>3	>7
10.	Melbourne, Australia	>3	>20

Table 1: Top 10 ranked cities

The values are in the form „more than“ because the numbers are found by the researchers and this paper does not claim that it has found all projects and apps; however, if we generalize that research has similar skills to the tourist a conclusion that average tourist will be able to find a similar number of applications. The number of applications was found by searching the web services and application download services. The number of projects represents the number of projects that can be related to the smart tourism that is currently being implemented in the city.

The authors of this paper find important to stress the number of ongoing projects in the city of Amsterdam – it is currently implementing more than 100 tourism-related projects out of 150 total smart city projects. Also, the cities from North America show a slight lead in the number of developed mobile applications. When the number of developed applications is shown by the continent the following graphic representation can be made:

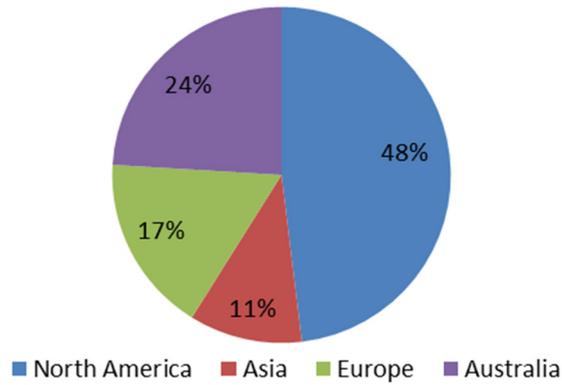


Figure 1: Number of Smart Cities and applications by the continent in the top 10 ranked smart cities

The graphic representation of the application distribution shows that North American cities lead in the number of developed applications, followed by European cities. However, Europe has 5 cities that contribute to a total number of applications so if we look at the average number of application per city per continent we see that North America cities are far superior compared to the European cities.

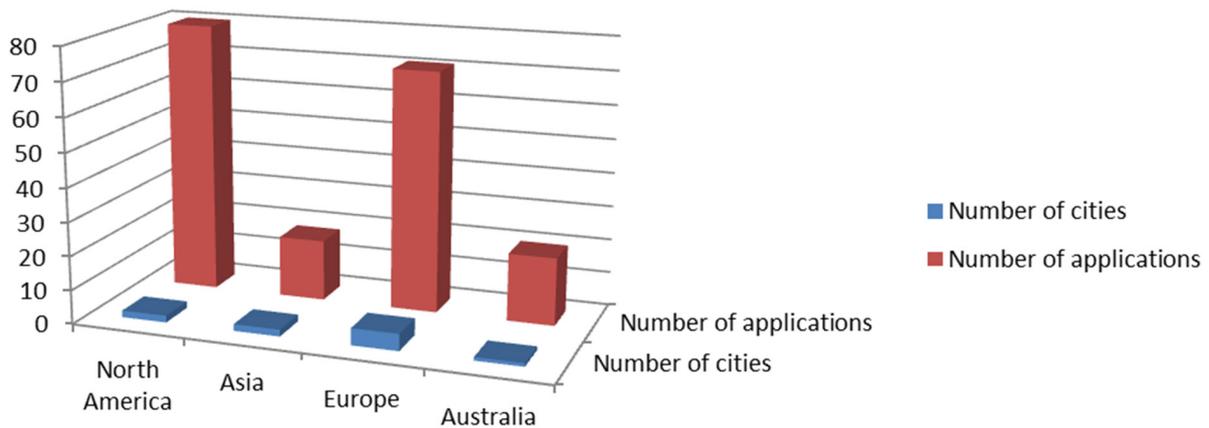


Figure 2: The number of avg. applications per city per continent

It is important to note that by average number of applications per city Australian cities perform better than European and Asian cities.

#### 4. CONCLUSION AND FURTHER STUDY

This paper attempts to review available sources related to the smart cities that consist of relevant scientific literature, internet sources, official strategies, and other available materials., in order to assess the impact of smart cities on the development of smart tourism destinations. Trough application of existing smart city technology cities that are ranked as leaders in the smart city niche encourage the development of smart tourism by applying the state of the art ICT. They gather the data by using BigData technologies and later use them to create smart tourism applications and augmented reality content in order to improve overall visitor experience and safety.

Available literature has shown the correlation of the smart cities and smart tourism destinations, but this paper attempts to show one of the individual factors that consist that correlation. Careful study and determination of all major factors and a research can be created to study the impact of each factor in order to develop a clear methodology that can easily be transferred to strategy and action plan to create a smart tourism destination. Further study has to discover all the major factors that contribute to this correlation and relation between smart cities and smart tourism. Limitations of this study are that only top 10 cities were analyzed due to the amount of the effort required to gather the data about the single city. Therefore, a study for first 100 cities on the list should be conducted in order to obtain a more objective result. During the course of research, another thing drew the attention of the authors – the fact that the cities that are so-called „City-States“: Dubai, Malta, and Singapore rank very high as the smart tourism destinations; also, only Singapore is ranked high on the 2nd place in the list that was analyzed. Dubai is in 37th position while the Malta or Valletta as its capital city is not even on the chart. *The study of smart tourism in these city-states requires a separate study that can provide scientific conclusions in a more sharp manner due to the elimination of many factors that contribute to the overall smart tourism output.*

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